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Comprehensive Emergency Management System Guide

[This Guide describes suggested non-mandatory approaches for meeting requirements. Guides are not requirements documents and are not to be construed as requirements in any audit or appraisal for compliance with the parent Policy, Order, Notice, or Manual.]

U.S. Department of Energy
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1.1.1. Introduction

The United States Department of Energy (DOE), including the National Nuclear Security Administration (NNSA), manages a wide variety of sites, facilities, and activities throughout the country. These include:

- National Laboratories;
- Nuclear weapons complex;
- Legacies of the Manhattan project and the early days of the Nation's atomic energy program;
- Transportation of hazardous materials:
  - Office of Secure Transportation
  - Hazardous waste shipments
- Power Marketing Administrations (PMAs); and
- Strategic Petroleum Reserve (SPR).

The National Laboratories conduct basic and applied research, ranging from high energy particle physics to the human genome, alternative sources of energy, and applications of technology to homeland security. Activities at other sites include development, stockpiling, and dismantling of nuclear weapons, production of nuclear power sources for space vehicles, environmental cleanup at legacy sites, transportation of waste materials generated by Departmental operations, and storage and isolation of radioactive waste.

The Department also manages the national SPR, which stores reserves of petroleum product in case of a national emergency that impacts normal supplies, and is the home of the PMAs, which function both as distributors of electric power and brokers of regional energy supplies. Finally, the DOE/NNSA is involved in energy restoration activities following major disruptions of supply or distribution.

The diversity of these activities indicates DOE/NNSA sites and facilities store, use, produce, and dispose of many different hazardous substances, including radioactive materials, toxic chemicals, and biological agents and toxins. In managing these hazards, DOE holds the safety of workers and the public to be paramount. By maintaining high standards of facility design, conduct of operations, safety oversight, and personnel training, DOE activities consistently achieve accident and injury rates that compare very favorably with those of similar operations in the private sector. In addition to the systems of workplace hazard controls that prevent incidents and ensure worker safety, the DOE *Comprehensive Emergency Management System* superimposes additional protections over all operations involving dispersible hazardous materials in quantities that could harm people outside the immediate workplace.

The overall mission of DOE/NNSA emergency management is to be ready to respond promptly, efficiently, and effectively to *any emergency* involving or affecting DOE/NNSA sites, facilities, or activities (SFAs) by applying the necessary resources to mitigate the consequences and protect workers, the public, the environment, and national security. It is important to note that not all DOE/NNSA activities occur within DOE/NNSA site boundaries. DOE is also the coordinating agency for Emergency Support Function #12 - Energy, under the National Response Framework and the Sector Specific Agency for the energy sector under Presidential Policy Directive (PPD) 21, PPD-41, and the Fixing America's Surface Transportation Act.

The DOE *Comprehensive Emergency Management System* provides a framework within which to address all hazards, from natural, technological, and human caused, and all the components of an effective emergency management program. The standard components of a DOE emergency management program are *planning*, *preparedness*, *response*, and *readiness assurance*. DOE/NNSA will directly and indirectly employ unique technical expertise and resources that are specific to a radiological incident occurring locally, nationally, or internationally.

- *Planning* involves determining, in advance, what will be done in response to specific emergencies.

- *Preparedness* is putting in place procedures, equipment, and personnel capabilities that will be needed to respond.

- *Response* is the actual mobilization of personnel including people, equipment, and resources to take action during an emergency, emergency termination, and when initiating recovery to return the site/facility/activity operations to normal.

- *Readiness Assurance* is the ongoing process of validating and demonstrating readiness to respond.

The current DOE emergency management requirements are the result of the evolution that began after the Three Mile Island reactor accident in 1979. At that time, the Department was still operating several reactors and producing materials for nuclear weapons. Accordingly, throughout the early- and mid-1980's, DOE emergency management requirements focused heavily on nuclear and radiological hazards. The Department expanded its emergency management requirements in 1991 to include toxic chemicals after the 1984 tragedy involving a methyl isocyanate gas leak in Bhopal, India, that resulted in numerous deaths and injuries, and other accidents that turned the world's attention to chemical release hazards. After the Occupational Safety and Health Administration (OSHA) enhanced its worker protection regulations and included hazardous waste operations, DOE expanded its emergency management requirements to stipulate a level of basic emergency planning for all sites/facilities/activities (SFAs), with more specific and detailed requirements for activities using radioactive materials and toxic chemicals. Current emergency management requirements also address biological toxins and infectious agents, since research is ongoing at some DOE/NNSA laboratories using these materials to develop detectors and support other homeland security-related programs.

The DOE *comprehensive*, all-hazards approach to emergency management became firmly established with the issuance of DOE O 151.1 in 1995. The Order was subsequently updated several times, culminating in DOE O 151.1D, which incorporated emergency management lessons learned from international events such as Hurricane Katrina (2005), and Japan's Fukushima Daiichi disaster (2011), and direction from DOE. The Order established DOE policy that provides a general structure and framework for response to any emergency at a DOE site, facility, or activity, and specific requirements to address protection of the workers, the public, and the environment from the release of hazardous materials.

Note: This guide uses the term site/facility/activity (SFA) similarly to DOE O 151.1D. The use of this term is meant to encompass all labs/plants/sites/Program Secretarial Offices (PSO) involved throughout the DOE/NNSA Complex. The purpose for this is to limit the ambiguity that could be construed through the constant use of different terms.

1.1.1.1. Cancellation

This guide was updated to reflect the changes in DOE O 151.1D. It cancels and supersedes the following:

DOE G 151.1-1A, *Emergency Management Fundamentals and the Operational Emergency Base Program*, dated 7-11-07

DOE G 151.1-2, *Technical Planning Basis Emergency Management Guide*, dated 7-11-07

DOE G 151.1-3, *Programmatic Elements Emergency Management Guide*, dated 7-11-07

DOE G 151.1-4, *Response Elements Emergency Management Guide*, dated 7-11-07

DOE G 151.1-5, *Biosafety Facilities Emergency Management Guide*, dated 7-11-07

1.1.2. Requirements and Guidance

DOE O 151.1D, *Comprehensive Emergency Management System*, current version (the Order) establishes policy, assigns roles and responsibilities, and provides the framework for the development, coordination, control, and direction of the DOE Emergency Management System. This Guide does not provide requirements; instead, the Order establishes requirements for emergency planning, preparedness, readiness assurance, and response, and describes the approach for effectively integrating these activities under a comprehensive, all-hazards emergency concept. DOE SFAs, Field Elements, and DOE (HQ) offices are required to develop emergency management programs as components of an integrated and comprehensive emergency management system.

Together, these elements ensure that DOE emergency management is prepared to respond promptly, efficiently, and effectively to any emergency involving DOE SFAs to protect workers, the public, the environment, and national security.

The Order requires that SFA emergency management programs be developed *commensurate with the hazards* at that particular SFA. To assist SFAs in implementing the Order requirements, DOE/NNSA has developed this comprehensive guidance applicable to all DOE/NNSA SFAs and generally applicable at DOE/NNSA organizational levels, including Field Elements and Headquarters (HQ) offices.

If official interpretation of the requirements in DOE O 151.1D or guidance in the associated Emergency Management Guide is needed, the NNSA Associate Administrator for Emergency Operations serves as DOE's primary point of contact for all emergency management activities. Questions or requests should be submitted directly to the Office of Emergency Management, Office of Policy. Questions and accompanying interpretations will be posted as Frequently Asked Questions (FAQs) on the Enterprise Data Management System (EDMS) by the Office of Emergency Management Policy.

1.1.3. Application of Guidance

The Emergency Management Guide (EMG) provides acceptable approaches to emergency planning, preparedness, readiness assurance, and response activities at DOE/NNSA SFAs, including DOE transportation activities, Field Elements, and HQ offices. This EMG provides preferred, non-mandatory, supplemental information about acceptable methods for implementing requirements of the DOE Comprehensive Emergency Management System. This EMG "does not impose requirements but may quote requirements as long as the sources are adequately cited." (DOE O 251.1D) Thus, the DOE/NNSA guide is ***not*** a requirements document and may not be construed as establishing requirements in any audit or assessment of compliance with the associated Order. Further, the guide provides needed clarification regarding the intent of DOE O 151.1D requirements.

Guidance contained in this EMG is generic in nature because detailed guidance on every conceivable type of emergency for every SFA cannot be provided. Other equivalent approaches for meeting the Order requirements may be acceptable to accommodate the wide range and diversity of DOE operations and activities, facility types and missions, hazards, and site characteristics. Features such as local and state political structures, geography, and local demography may also contribute to unique SFA-specific solutions for developing and maintaining an acceptable emergency management program that complies with the Order requirements. Using phrases such as "must" or "shall," throughout this guide that seem to establish new requirements actually reiterate requirements from DOE O 151.1 current version, emphasize steps in a required process, or promote steps as part of previously identified best practices. *Must* or *shall*, within the context of this guide, when choosing to implement a best practice methodology contained within this document, is deliberately intended to represent those specific actions that when executed deliver best practice and compliance with established requirements in DOE O 151.1. For a best practice to prove reliable, the identified specific actions, procedures, and deliverables for the specified best practice must or shall be performed.

Using either the guidance contained in this EMG or another acceptable approach to implement the Order requirements, the resulting emergency management program should be integrated and coordinated with regulations and plans developed by other Federal agencies, states, local authorities, and other DOE offices. These regulations and plans may establish requirements similar to those required within the Emergency Management Core Program and Emergency Management Hazardous Materials Program, and should be integrated, where applicable, to ensure a standard approach and continuity of effort.

Newly issued or revised DOE Orders, regulations, or plans should be incorporated in accordance with corresponding implementation requirements at least by their implementation deadline, or otherwise**,** as soon as reasonably achievable (e.g., during the performance of the all-hazards survey(AHS) and EPHA reviews/updates).

1.1.4. Conceptual Foundation of DOE Emergency Management

The DOE approach to emergency management is built upon three guiding principles or conceptual *foundation stones* of emergency management. These key concepts are:

- **Effective response is the *last line of defense* against adverse consequences**. Regardless of how sound the fundamental safety programs and controls may be, incidents will sometimes happen that have adverse health effects on people or the environment. This principle expresses the DOE position that if controls should fail, the SFA must be prepared to take actions to limit or prevent adverse health and safety impacts to workers and the public. The application of this principle requires some level of emergency response planning even for those incidents whose severity exceeds the design basis for safety controls.

- **Planning, preparedness, response, and recovery must be *specific to* and *commensurate with the hazards*.** The Department is responsible for a large number of different hazards that could threaten the health and safety of workers or the public if not controlled. These hazards are varied in the nature of the potential impacts on people, their behavior in the environment, and the distance at which adverse impacts may be experienced. While the basic emergency management framework is the same for all DOE SFAs, the specific planning and response measures for each hazard are to be tailored to the hazard, such that they are specific (technically appropriate) to the hazard and commensurate with (in size, scope, or scale) the magnitude of the hazard and its potential impacts.

- ***Early recognition* is vital to timely, effective, and commensurate response**. In many cases, warning potentially affected workers and the public and directing them to take actions to prevent or limit their exposure is the only way of mitigating the adverse health effects. Hence, the early recognition of an incident is essential if warnings are to be delivered in time to be executed effectively. By developing a full understanding of possible scenarios and the indications that would point to an actual or impending incident, emergency management will increase the likelihood of successful warning and intervention to prevent or limit health impacts. This analysis of scenarios and development of recognition indicators provides the basis for *tailoring* the response to the actual or potential hazard (commensurate response).

1.1.5. Emergency Management Programs

The DOE Comprehensive Emergency Management System is based on a three-tiered management structure consisting of SFA, Field Element, and HQ, with each tier having specific roles and responsibilities during an emergency. Each organizational tier provides management, direction, and support of emergency response activities. The SFA develops an emergency management program, which manages the tactical response to the emergency by directing the mitigative actions necessary to resolve the problem, protect the workers, the public, and the environment, and return the SFA to a safe condition. The Field Element Manager oversees the SFA response, provides local assistance, guidance, operational direction to the SFA management, and coordinates the tactical response to the incident with Tribal, State, and local governments. DOE HQ provides strategic direction to the response, provides assistance and guidance to the Field Element Managers, and evaluates the broad impacts of the emergency on the DOE complex. DOE HQ also coordinates with other Federal agencies on a national level, provides information to representatives of the executive and legislative branches of the Federal Government, and responds to inquiries from the national media.

DOE O 151.1D requires that emergency management programs are established and maintained at each organizational level to implement requirements pertaining to the comprehensive emergency management system. Because DOE/NNSA and its contractors are involved in a variety of operations and activities incorporating a broad range of hazards to be considered in effective emergency management, the Order requires that the emergency management program for a specific SFA be commensurate with the hazards present at that SFA (a tailored approach.)

Each DOE SFA is required by DOE O 151.1D to have an Emergency Management Core Program, which provides the framework for evaluating hazards that pose serious threats, or conditions that involve the health and safety of workers and the public, the environment, and safeguards and security. Although DOE O 151.1D establishes several DOE-unique requirements and a minimum set of generic requirements for the Core Program, the framework for response results mainly from the implementation of the requirements of DOE regulations, other DOE orders, and applicable non-DOE Federal, Tribal, State, and local laws/regulations/ordinances. The specific requirements that constitute the Emergency Management Core Program are the emergency planning and preparedness aspects of these Orders and laws/regulations/ordinances. Examples of emergency response features addressed in other DOE Orders and laws/regulations/ordinances include medical support, worker evacuation plans, fire drills, worker notification systems, hazardous material communication, contingency planning for oil spills, environmental spill drills and exercises, and DOE security and safeguards requirements. The objective of the Core Program is to achieve an effective integration of emergency planning and preparedness requirements into an emergency management program that provides capabilities for All-Hazards emergency response, through communication, coordination, and an efficient and effective use of resources.

DOE O 151.1D requires an SFA-specific EPHA be conducted for each DOE SFA where identified hazardous materials are present in quantities exceeding the amounts that can be “easily and safely manipulated by one person” and whose potential release would cause the impacts and require response activities characteristic of an Operational Emergency (OE). An EPHA is a quantitative analysis that includes the identification and characterization of hazardous materials specific to an SFA, analyses of potential accidents or incidents, and evaluation of potential consequences. The results of the EPHA determine whether an Emergency Management Hazardous Materials Program is required. If the analysis results indicate that no potential incidents and conditions would be classified as an Alert or higher (as defined in DOE O 151.1D), then the Core Program (including 29 Code of Federal Regulations (CFR) 1910.120 requirements) constitutes the appropriate emergency management program for the SFA. If the analysis results associated with an SFA indicate the potential for an Alert, Site Area Emergency, or General Emergency (GE) as defined in DOE O 151.1D, an Emergency Management Hazardous Materials Program is required; the analysis results will also provide the technical planning basis for the program.

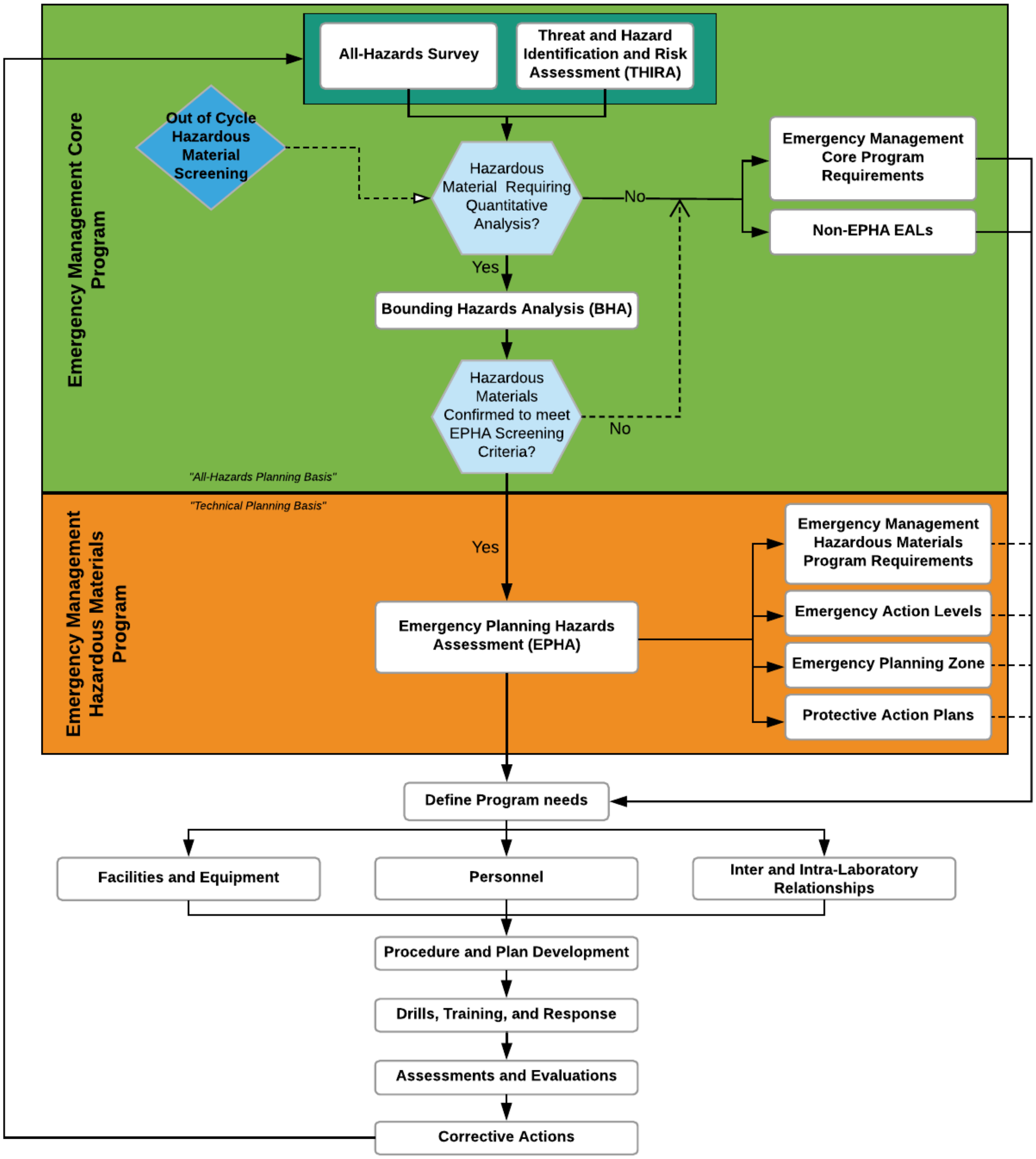

Figure 1-1. Emergency Management Program Overview[1]

[1] BHA Bounding Hazards Analysis (BHA) is an LBNL-specific term for what is more commonly referred to as the "PAC-30 Analysis" at other DOE sites. This is an example of an Emergency Management Program Overview and is not meant to be universal across the DOE/NNSA complex.

1.1.6. Emergency Management Program Elements

The DOE/NNSA emergency management system consists of four standard components:

- Emergency *planning* including the identification of hazards and threats, hazard mitigation, development and preparation of emergency management plans and procedures, and identification of personnel and resources needed for an effective response

- Emergency *preparedness* including the acquisition and maintenance of resources and training and drills

- Emergency *response* including the application of resources to mitigate consequences to workers, the public, the environment, and national security, and the initiation of recovery from an emergency

- *Readiness assurance* including evaluations, exercises, improvements, and documentation to assure that stated emergency capabilities are sufficient to implement emergency plans

In order to more clearly indicate the roles that the fifteen (15) Program Elements of the emergency management program perform, they are separated into the following three groups: Technical Planning Basis (Planning), Programmatic Activities (Planning, Preparedness, Readiness Assurance), and Response Activities.

Within each of the program elements, specific activities, tasks, products, etc., and their related plans, procedures, and tools contribute to the successful accomplishment of the intended product(s) in each specific area. Examples of individual products can include: incident classification, press briefings, source term estimates, Protective Action Recommendations (PARs), consequence versus distance calculations, exercise programs for the site, training plans, effectively trained ERO personnel, detection equipment requirements, meetings with public or offsite response organizations, EPZ, etc.

The intended objective from each function or activity is evaluated in terms of the desired qualitative or quantitative performance characteristics of each of the products. These performance characteristics are determined by the role that the goal plays in meeting the overall emergency management performance objective. The resulting evaluations will be referred to as *performance-based evaluations* where the focus of the evaluation methodology is not on specific prescriptive details of plans, procedures, calculation techniques, administrative structure, etc., but on the desired performance characteristics of the resulting output.

The collective performance associated with the program elements supports the overall performance goal of emergency management programs. In order to provide a logical structure for evaluating the overall emergency management program, an individual performance objective has been developed for each program element. These goals were derived from the requirements of DOE O 151.1D, *Comprehensive Emergency*

Management System, augmented with additional guidance from this EMG (Chapter 2 *All Hazards Planning/Technical Planning Basis*), other DOE-directives, and other Federal, Tribal, State, and local regulations.

As indicated above, these groups represent the core emergency management activities and encompass the fifteen (15) Program Elements of the DOE/NNSA emergency management program:

- ALL-HAZARDS PLANNING/TECHNICAL PLANNING BASIS
  - All-Hazards Survey/Emergency Planning Hazards Assessment
- PROGRAMMATIC - activities that sustain the program
  - Program Administration and Management
  - Training and Drills
  - Readiness Assurance
- RESPONSE - elements that respond or contribute to response as needed in an emergency
  - Emergency Response Organization (ERO)
  - Emergency Operations System
  - Offsite Response Interfaces
  - Emergency Facilities and Equipment/Systems
  - Emergency Categorization and Classification
  - Notifications and Communications
  - Consequence Assessment
  - Protective Actions
  - Emergency Medical Support
  - Emergency Public Information
  - Termination and Recovery

Comprehensive Emergency Management Program (CEMP) Elements

All-Hazards Planning/Technical Planning Basis

1. All-Hazards Survey. An examination of the features and characteristics of the SFA that identifies the generic emergency incidents and conditions, and the potential effects of such emergencies is to be addressed by the DOE Comprehensive Emergency Management System. The All-Hazards Survey identifies key components of the Emergency Management Core Program that provide a foundation of basic emergency management requirements and an integrated framework for response to serious incidents involving health and safety, the environment, safeguards, and security. For SFAs involved in producing, processing, handling, storing, or transporting hazardous materials that have the potential to pose a serious threat to workers, the public, or the environment, the All-Hazards Survey provides a hazards screening process for determining whether further analysis of the hazardous materials in an EPHA is required.

2. Emergency Planning Hazards Assessment (EPHA). Performed for each SFA involving at least one qualifying hazardous material, as identified through the hazardous material screening process and indicated in the All-Hazards Survey. EPHAs involve the application of rigorous hazards analysis techniques that provide sufficient detail to assess a broad spectrum of postulated incidents or conditions involving the potential onsite release of (or loss of control over) hazardous materials and analyzing the resulting potential consequences. Each EPHA reflects both the magnitude and the diversity of the hazards and the complexity of the processes and systems associated with the hazards, and provides the technical planning basis for determining the necessary plans/procedures, personnel, resources, equipment, and analyses (determination of an EPZ) for the Emergency Management Hazardous Materials Program.

Programmatic Elements

1. Program Administration and Management. Effective organizational management and administrative control of the SFA emergency management program is provided by establishing and maintaining authorities and necessary resources commensurate with the responsibility to plan, develop, implement, and maintain a viable, integrated, and coordinated comprehensive emergency management program.

2. Training and Drills. A comprehensive, coordinated, and documented program of training and drills is an integral part of the emergency management program to ensure that preparedness activities for developing and maintaining program-specific emergency response capabilities are accomplished.

3. Readiness Assurance. A Readiness Assurance program provides a framework and associated mechanisms to assure that emergency plans, implementing procedures, and resources are adequate and sufficiently maintained, exercised, and evaluated

(including evaluations and assessments), and that appropriate and timely improvements are made in response to needs identified through coordinated comprehensive emergency planning, resource allocation, exercises, and evaluations.

4. Exercises. All elements of an emergency management program are validated over a multi-year period through a formal exercise program. The exercise program validates SFA-level emergency management program elements by initiating response to simulated, realistic emergency incidents/conditions in a manner that replicates an integrated emergency response to an actual incident as nearly as possible. Planning and preparation use an effective, structured approach that includes documentation of specific objectives, scope, timelines, injects, controller instructions, and evaluation criteria for realistic scenarios. Each exercise is conducted, controlled, evaluated, and critiqued effectively and reliably. Lessons learned are developed, resulting in corrective actions and improvements.

Response Elements

1. Emergency Response Organization. An ERO, a structured organization with overall responsibility for initial and ongoing emergency response and mitigation, is established and maintained. The ERO establishes effective control at the event/incident scene and integrates local agencies and organizations providing onsite response services. An adequate number of experienced and trained primary and alternate response personnel are available on demand for timely and effective performance of ERO functions.

2. Emergency Operations System. All the systems and logistical support needed to provide an effective emergency response by Emergency Operations Center (EOC) staff, Incident Command, first responders, site managers, and building emergency organizations including all the necessary facilities, systems, and equipment.

3. Offsite Response Interfaces. Effective interfaces are established and maintained to ensure that emergency response activities are integrated and coordinated with the Federal, Tribal, State, and local agencies and organizations responsible for emergency response and protection of workers, the public, and the environment.

4. Emergency Facilities and Equipment/Systems. Facilities and equipment adequate to support emergency response are available, operable, and maintained. Specifically, an adequate and viable command center and personal protective equipment (PPE) are available and operable to meet the needs of the responders.

5. Emergency Classification & Categorization. Major unplanned or non-routine events or conditions involving or affecting DOE or NNSA SFA by causing, or having the potential to cause, serious health and safety impacts onsite or offsite to workers or the public, serious detrimental effects on the environment, direct harm to people or the environment as a result of degradation of security or safeguard conditions, or release of (or loss of control over) hazardous materials, are recognized promptly, categorized,

and declared as Operational Emergencies (OE). In addition to being categorized as OE, incidents involving the actual or potential airborne release of (or loss of control over) hazardous materials from an SFA also require prompt and accurate classification based on health effect thresholds (for initiating protective actions) measured or estimated at specific receptor locations (i.e., site and facility boundaries, etc.). Predetermined conservative onsite and offsite protective action recommendations are associated with the classification of OE.

6. Notifications and Communications. Prompt, accurate, and effective initial emergency notifications are made to workers and emergency response personnel/organizations, including appropriate DOE or NNSA elements, and other Federal, Tribal, State, and local organizations and authorities. Accurate and timely follow-up notifications are made when conditions change or when the classification is upgraded, or the emergency is terminated. Continuous, effective, and accurate communications among response components or organizations are reliably maintained throughout an OE.

7. Consequence Assessment. Estimates of onsite and offsite consequences of actual or potential releases of hazardous materials are correctly computed and assessed in a timely manner throughout the emergency. Consequence assessments are integrated with incident classification and protective action decision-making, incorporate facility and field indications and measurements, and are coordinated with offsite agencies.

8. Protective Actions. Protective actions are promptly and effectively implemented or recommended for implementation, as needed, to minimize the consequences of emergencies and to protect the health and safety of workers and the public. Protective actions can be implemented individually, or in combination, to reduce exposures from a wide range of hazardous material types and include evacuation, sheltering, decontamination of people, medical care, ad hoc respiratory protection, control of access, shielding, radioprotective prophylaxis administration of stable iodine, chelating agents, or diuretics), control of foodstuffs and water, relocation, decontamination of land and equipment, and changes in livestock and agricultural practices. Protective actions are reassessed throughout an emergency and modified as conditions change. Reentry activities are planned, coordinated, and accomplished properly and safely.

9. Emergency Medical Support. Medical support is provided for workers contaminated by hazardous materials. Arrangements with offsite medical facilities to transport, accept, and treat contaminated, injured personnel are documented.

10. Emergency Public Information. Accurate, candid, and timely information must be provided to workers, the news media, and the public during an emergency to establish facts and avoid speculation. Emergency public information efforts must be coordinated with State, Tribal, and local governments, and be part of Federal emergency response plans as appropriate. Workers and the public are informed of emergency management plans and planned protective actions before emergencies.

11. Termination and Recovery. An OE is terminated only after a predetermined set of criteria has been met and termination has been coordinated with offsite agencies. Recovery from a terminated OE involves communication and coordination with Tribal, State, local, and other Federal agencies; planning, management, and organization of the associated recovery activities; and ensuring the health and safety of workers and the public.

1.1.7. DOE/NNSA Emergency Management and Integrated Safety Management (ISM)

As the last line of defense in protecting workers, the public, and the environment, the comprehensive emergency management program at each DOE/NNSA SFA is a key element of work planning and execution in accordance with ISM. Emergency management (like quality assurance, maintenance, personnel training, conduct of operations, fire protection, and waste management) should be a specific function addressed by the safety management program necessary to ensure the safe operation of an SFA. The DOE emergency management system ensures consistency across the complex through a common understanding of emergencies and expected DOE response at all organizational levels, including the local worker and SFA level, which are the primary focus of ISM.

The approach begins with identifying the type and nature of the emergencies that could affect DOE SFAs followed by analyses of the resultant hazards to workers, the public, the environment, and national security. Based on the hazards analyses, the requirements in the Order are tailored to develop an emergency management program that addresses the unique hazards and operating environment of each SFA. The All-Hazards Survey and Emergency Planning Hazards Assessment (EPHA), which are integral parts of the *commensurate with hazards* or *tailoring* approach, provide the recognition tools and define the appropriate response to potential releases of hazardous materials. Such hazard controls are essential components in the last line of defense in protecting workers, the public, and the environment.

Continuous Improvement is a fundamental concept embedded in ISM and the DOE emergency management system. In DOE emergency management, continuous improvement is provided through the readiness assurance program required of all DOE/NNSA SFA emergency management programs. Readiness assurance provides the framework and associated mechanisms to assure that planning and resources are adequate and sufficiently maintained, exercised, and evaluated, and that appropriate, timely improvements are made in response to needs identified. A structured and focused program of evaluations (Criteria Review and Approach Document (CRAD) and exercise evaluations) and reliable lessons learned via process ensure that an effective program of continuous improvement maintains DOE/NNSA emergency management programs.

Thus, the fundamental concepts that characterize DOE emergency management and the requirements contained in DOE O 151.1D set forth DOE/NNSA expectations for emergency management and provide effective mechanisms for integrating emergency management objectives effectively and seamlessly with ISM fundamental concepts and core safety management functions.

1.1.8. DOE/NNSA Emergency Management and National Incident Management System

1.1.8.1. National Response Framework

The National Response Framework (NRF) provides a single, comprehensive approach to domestic incident management. It is an all-hazards plan built on the template of the National Incident Management System (NIMS). The NRF, using NIMS, provides the structure and mechanisms for national-level policy and operational direction for incident management. The NRF can be partially or fully implemented in response to an incident requiring a coordinated Federal response.

The NRF is based on the premise that incidents are typically handled at the lowest jurisdictional level, with first responders using existing authorities. Consequently, when an Operational Emergency occurs at a DOE/NNSA SFA, the initial response is conducted by the site/facility/activity using plans and procedures developed commensurate with the hazards at the SFA and according to the requirements of the DOE Comprehensive Emergency Management System. These plans could include use of response capabilities from the surrounding jurisdictions. Most OE should be resolved using these plans and capabilities.

There may be situations where the DOE/NNSA Nuclear Emergency Support Team (NEST) are needed to augment the local response. Requested NEST teams are generally directed through the appropriate DOE Regional Coordinating Office to the DOE HQ EOC. All other requests for the NEST go directly to the DOE HQ EOC. When other agencies receive requests for Federal radiological monitoring and assessment assistance, they notify the DOE HQ EOC.

The DOE serves as the coordinating agency for the Federal response to radiological incidents involving DOE/NNSA SFAs, or material otherwise under its jurisdiction (transportation of material shipped by or for DOE/NNSA). The National Oil and Hazardous Substances Pollution Contingency Plan (NCP), found in 40 CFR Part 300, provides similar planning guidance and operational concepts for Federal response to other hazardous material incidents, including incidents involving source, by-product, or special nuclear material, or other ionizing radiation sources requiring Federal coordination.

DOE O 151.1D contains requirements for the Field Element Managers to pre-designate personnel to oversee the SFA response and assign tasks to those Federal assets that are deployed to support the SFA, under the authority of the full NRF, the Nuclear/Radiological Annex to the Response and Recover Federal Interagency Operations Plans, or the NCP. As part of the DOE O 151.1D planning process, DOE/NNSA SFAs and Field Elements should identify the scenarios where response capabilities may be exceeded and broader assistance from the Federal Government would be needed. The scenarios requiring these response capabilities are likely to be limited to the high-consequence end of the spectrum of potential incidents. It is possible that, commensurate with the hazards at the DOE/NNSA SFAs, Federal response capabilities or assistance may not be needed.

Implementation of the NRF reveals concepts that are not directly addressed within the DOE Comprehensive Emergency Management Program. As part of the change to an all-hazards approach at the Federal level, the NRF broadened concepts related to incident management and began the process of establishing a common terminology related to emergency management. The National Preparedness System describes a framework that includes: Prevention, Protection, Mitigation, Response, and Recovery. Where the DOE emergency management program names the standard components as *planning, preparedness, response*, and *readiness assurance*, the NRF includes two other concepts, *prevention* and *mitigation*. These are defined in the NRF as follows:

Prevention includes capabilities necessary to avoid, prevent, or stop a threatened or actual act of terrorism. Within the context of national preparedness, the term *prevention* refers to dealing with imminent threats.

Mitigation is the effort to reduce loss of life and property by lessening the impact of incidents. Mitigation includes any activities that prevent an emergency, reduce the chance of an emergency incident occurring, or reduce the damaging effects of unavoidable incidents.

Prevention involves the use of information and data to avoid an incident or to intervene to stop an incident from occurring. The primary focus of activity in incident management involves the use of intelligence data or other types of surveillance activities to anticipate and stop/avoid the incident.

Prevention activities are more closely related to activities undertaken in the security, safety, or health programs, before the incident rises to the seriousness of an emergency.

On the other hand, DOE activities, representing the standard components of a DOE emergency management program, explicitly incorporate the NRF concept of *mitigation*. Examples include:

- The planning analysis associated with a hazards assessment can identify opportunities to reduce the consequences of a potential hazardous material release incident using hazard mitigation activities such as inventory reduction or inventory dispersal.

- Response activities include the execution of incident mitigation activities designed to limit the loss of life, personal injury, property damage, and other unfavorable outcomes.

- Readiness assurance activities include incorporating lessons learned from evaluations and actual emergencies to improve the response and, perhaps, identifying vulnerabilities in hazardous materials safety procedures and systems.

These and other NRF concepts and terminology will be more fully integrated into the DOE emergency management system in future versions of the Order and this guidance.

1.1.8.2. National Incident Management System

For years, DOE requirements and guidance have discussed the need to have an incident command system at the SFA level that could seamlessly integrate response assets from the surrounding jurisdictions. NIMS is designed to achieve the same integration at all levels of government. The Department of Homeland Security (DHS) promulgated NIMS, 3rd Edition, in October 2017, under the authority of Homeland Security Presidential Directive 5. NIMS is the nationwide template enabling Federal, State, local, and Tribal governments and private-sector and nongovernmental organizations to work together effectively and efficiently to prevent, prepare for, respond to, and recover from emergencies.

1.2. Core Program Facilities

1.2.1. Introduction

Emergency management programs for each DOE/NNSA SFA are documented in an emergency management plan. The plan describes provisions for response to OEs and activities for maintaining the emergency management program. The recommended emergency management plan content for Core Program Facilities is provided in this section. A Departmental SFA with no additional requirements for an Emergency Management Hazardous Materials Program must develop and implement an emergency management plan for a Core Program.

1.2.2. Program Elements

1. **All-Hazards Planning Basis**

   List all hazards that are applicable to the operation of a given entity and establish the planning basis for an emergency management program. This list can cover single facilities, multiple facilities and activities, or an entire site. Conduct a Threat and Hazard Identification and Risk Assessment (THIRA) as described by Comprehensive Preparedness Guide (CPG) 201.

2. **Program Administration and Management**

   State the overall function and mission of the facility or site. Broadly describe the facility or site; for a site, this includes the buildings and facilities within the site. State the name, position, mailing address, and telephone number of the emergency management program administrator at the facility or site level. (This information should also be in the appendix that lists Emergency Management Personnel.)

3. **Training and Drills**

List drills and training programs that are provided to employees. Indicate refresher training for employees who are certified operators or supervisors and those workers who are likely to witness a hazardous material release.

4. Readiness Assurance

Ensure that the procedure for annual self-assessments is listed in this section. The formal improvement program consisting of lessons learned from evaluations and drills/exercises should be described. Describe the process for identifying and implementing relevant lessons learned from external sources. Exercises—Describe the exercise program. Describe how exercises will be controlled and evaluated and how lessons learned from exercises, improvements, or corrective actions are incorporated into emergency planning. List all offsite agencies involved in the exercise program (i.e., HQ, other Federal agencies, and local agencies). List annual testing of all emergency notification equipment.

5. Emergency Response Organization

List the individual who has been assigned to manage and control all aspects of the SFA response. Indicate how the individual will fit into the responding Incident Command System (ICS).

6. Emergency Operations Systems

List the process for centralized collection, validation, analysis, and coordination of information relating to an emergency supporting on scene responses.

7. Offsite Response Interfaces

Outline all coordination with Tribal, State, and local agencies and organizations responsible for emergency response or protection of the health and safety of the public. If there is no offsite coordination, provide a brief justification statement.

8. Emergency Facilities and Equipment/Systems

Identify the SFA capabilities and specific equipment in place that is used to support an emergency response, including systems and equipment used to notify and evacuate employees.

9. Emergency Categorization

This section should provide criteria for determining quickly if an incident is an Operational Emergency (OE) and how categorization is accomplished within 15 minutes.

10. Notifications and Communications

Discuss the required and documented notification process for onsite and offsite notifications for all OEs. Identify positions responsible for both initiating and receiving notifications. Discuss the method of notification. Discuss notification procedures for termination of an incident. Include copies of all notification forms, particularly those used in response to DOE O 231.1B Admin Chg. 1, *Environment, Safety and Health Reporting*, and its successors. Describe the communications systems and equipment that would be employed by emergency personnel at the site or any specific facility for any notifications, sirens, or warnings to the public, including a description of primary and alternate systems. Discuss communications interface with onsite and offsite organizations. Identify what portions of the system are dedicated to emergency management. Describe the equipment, back-up equipment, quality assurance, and testing procedures.

11. Consequence Assessment

Since there are no minimum requirements specified for this area, this section would contain only references to types of consequence assessment functional areas required by other Departmental Orders or Federal regulations.

12. Protective Actions

Describe the procedures to determine personnel accountability and evacuation. Discuss the method and procedures for accountability of onsite personnel and visitors, locations of shelters, and other conditions. Describe access control procedures for evacuated areas. Describe the system to ensure safe shutdown of operations following the declaration of an emergency. Describe the plan and criteria for reentry at each facility and, where applicable, for the entire site; identify all reentry plans.

13. Emergency Medical Support

Identify onsite medical support, if applicable, as well as offsite medical response agencies and facilities responsible for providing support in normal and mass casualty situations.

14. Emergency Public Information

List all onsite organizations and personnel (by position) responsible for providing information to the media during an emergency incident. Additionally, maintain lists of the offsite organizations' Public Information Officers (PIOs) for rapid coordination in event of an emergency.

15. Termination and Recovery

Detail notifications associated with termination of an OE and the criteria for resumption of normal operations.

1.3. Hazardous Materials Program Facilities

1.3.1. Introduction

Emergency management programs for each DOE/NNSA SFA are documented in an emergency management plan. The plan describes provisions for response to OEs and activities for maintaining the emergency management program. The recommended emergency management plan content for Emergency Management Hazardous Materials Programs is provided in this section. The requirements for Core Programs and Emergency Management Hazardous Materials Programs should be seamlessly integrated into one emergency management plan for the facility or site with hazardous materials that require a more substantial level of planning and response capabilities.

1.3.2. Program Elements

1. Technical Planning Basis

An All-Hazards Survey shall be used by the site, facility, or activity Emergency Manager to identify the planning requirements addressed in the Emergency Management Core Program. A Departmental site, facility, or activity may then be required to establish and maintain a quantitative Emergency Planning Hazards Assessment (EPHA). The quantitative EPHA analyzes hazards significant enough to warrant consideration in an SFA or activity Emergency Management Hazardous Materials Program.

Include or summarize the results of the All-Hazards Survey. Describe known hazards originating outside the Departmental facility that could impact the health and safety of onsite personnel or other Departmental interests.

List or summarize the significant radiological and non-radiological hazards present. Describe the system for updating the EPHA. Identify technical supporting documents that describe the methodology and information of EPHAs used as the basis for emergency planning.

2. Program Administration and Management (Same as Core)

Hazardous Material Facilities will follow the same format for this as previously mentioned in the Core Program requirements.

3. Training and Drills

Describe the goals and objectives of the facility or site training and drills program. Describe the overall approach to the design of the training and drill program, including training analysis methodology, overall curriculum design, and qualifications.

(a) Defense Nuclear Facilities

Describe the goals and objectives of the facility using a graded approach and incorporate all aspects of emergency staff as mentioned in DOE O 151.1D.

4. Readiness Assurance

Describe the procedures for developing a structured readiness assessment program, including program and exercise evaluations.

Describe the emergency management exercise program and how it conforms to the requirements of DOE O 151.1D and any other applicable Federal, State, and local regulations. Describe how exercises will be controlled and evaluated and how lessons learned from exercises (improvements or corrective actions) are incorporated into emergency planning.

(a) Defense Nuclear Facilities

Describe how the site exercise program meets additional requirements provided by DOE O 151.1D (involvement of staff, involving Department Radiological Emergency Response Assets no less than once every 3 years, causal analysis for corrective actions, etc.).

5. Emergency Response Organization (Same as Core)

Hazardous Material Facilities will follow the same format for this as previously mentioned in the Core Program requirements.

6. Emergency Operations Systems (Same as Core)

Hazardous Material Facilities will follow the same format for this as previously mentioned in the Core Program requirements.

7. Offsite Response Interfaces

Provide an overview of relationships, both formal and informal, with offsite organizations, including other Departmental elements and other Federal government, Tribal, State, and local organizations with emergency management or emergency planning responsibilities. Mutual Aid Agreements (MAAs), Memoranda of Agreements (MOAs), and Memoranda of Understanding (MOUs) should be described in this section.

8. Emergency Facilities and Equipment/Systems

List and provide a brief description of all emergency-related facilities EOC, Alternate EOC, Joint Information Center (JIC). Distinguish between dedicated and non-dedicated facilities. Maps and floor plans of facilities should be included when a complete description of the facility will be useful in a response.

List and describe the equipment likely to be used for responding to emergencies. Include in the list equipment capability and limitations, quantity of equipment, locations (both fixed and portable equipment), consumables, maintenance requirements, certification requirements, expiration dates, and computer/communications compatibilities.

(a) Defense Nuclear Facilities

List shutdown or walkaway strategies for equipment and facilities during emergencies and provide a description for a transition of responsibilities and required actions between normal work activities, incident activities, and recovery operations.

9. Emergency Classification

State the definitions of OEs and emergency classes per DOE O 151.1D. In the interest of consistency, the definitions as provided in the Departmental Orders can be repeated.

10. Notifications and Communications

Discuss the required and documented notification process for onsite and offsite notifications for all OEs. Identify personnel (positions) responsible for both initiating and receiving notifications. Discuss the method of notification. Discuss the notification procedure for termination of an incident. Discuss the procedure variance for classified notifications. Include copies of all notification record forms, particularly those forms used in response to DOE O 231.1B Admin Chg. 1, and its successors.

Describe the communications systems and equipment employed by emergency personnel at the site or any specific facility for any notifications, sirens, or warnings to the public, including a description of primary and alternate systems. Discuss communications interface with offsite organizations; describe the integration of the site's communications with offsite response resources, such as the police, fire, and offsite EROs.

Identify what portions of the system are dedicated to the Emergency Management System. Describe the equipment, back-up equipment, readiness assurance, and testing procedures. Describe the troubleshooting system for ensuring that problems noted during tests and drills are identified, tracked, and resolved. Reference to any listing of communication equipment in the Emergency Equipment chapter is acceptable. Describe the procedures and plans for communicating classified information.

11. Consequence Assessment

Describe the procedures used to determine the potential consequences based on the results of emergency planning hazards assessments and input from all other pertinent areas, such as intelligence and meteorological information. Describe the methodologies used for consequence assessment and reference technical supporting documentation.

Describe the expected utilization of the National Atmospheric Release Advisory Center capabilities during a response. Describe the procedures for continually (and in real time, where appropriate) monitoring an emergency or a continuing situation to update the consequence assessment. Describe the processes for initiating and performing field monitoring for both radiological and chemical releases. When appropriate, include a discussion of any special circumstances associated with coordination and execution of offsite field monitoring.

Describe the procedure to coordinate with other Federal, Tribal, State, and local organizations information necessary to make accurate and timely consequence determinations.

12. Protective Actions

Identify the purpose and intended use of protective actions. Describe protective actions used at the SFA and under what circumstances they are implemented.

13. Emergency Medical Support (Same as Core)

Hazardous Material Facilities will follow the same format for this as previously mentioned in the Core Program requirements.

14. Emergency Public Information

Maintain information on hazardous materials facilities, programs, and personnel by position who can provide information to the media and general public as related to the emergency. The PIO will maintain documented procedures for release of information, personnel by position who may clear information for release, and timelines for release of information (i.e., first tweet, first press release, press conference).

15. Termination and Recovery

Describe the plan and criteria for declaring the emergency condition terminated and transitioning to recovery at each facility, where applicable, and for the entire site. Provide references to technical supporting documentation if applicable.

1.4. Leased Facilities

1.4.1. Introduction

Leasing facilities within DOE/NNSA sites for non-DOE/NNSA work presents some unique difficulties for those responsible for implementing site-wide emergency management programs. In accordance with the *Guidance on Protection of Workers*

Utilizing DOE Leased Facilities, issued through the Department's Safety Council on August 6, 1999, each Field Element Manager, in consultation with the Lead PSO, should:

- Develop evaluation criteria that result in leasing conditions that provide protection to workers at leased facilities from radioactive, chemical, and biological hazardous materials; and,
- Determine the appropriate level of protection by grading facilities being leased by hazard to worker safety and health. Prior to leasing a facility for private use, each Field Element Manager is required to make a determination that the facility is suitable for reuse and that worker safety and health will be protected.

To ensure protection of worker health and safety in the event of an emergency involving or affecting the leased facility, arrangements with lessees should effectively integrate the activities of the leased facilities into the DOE/NNSA site-wide emergency management program. These arrangements should ensure consistent interfaces with offsite EROs and establish and sustain an effective working partnership for emergency planning, preparedness, readiness assurance, and response activities.

Arrangements with lessees should include:

- Integration of each of the lessee's emergency management program elements into the site-wide program;
- Annual reporting of the tenant's hazardous materials inventories to the site emergency management organization; and
- Means for reporting significant changes to the facility or to hazardous materials inventories to the site emergency management organization prior to implementing the changes.

Incorporating leased facilities into site-wide emergency management programs should be addressed consistently across the DOE/NNSA complex. To promote this consistency, emergency management factors that should be considered by DOE/NNSA elements with responsibility for leasing facilities at DOE/NNSA sites for non-DOE or non-NNSA work are presented in Section 1.4.2.

1.4.2. Application of Emergency Management Guidance

Leased facilities at DOE/NNSA sites should be included in site-wide emergency management programs using criteria from DOE O 151.1D, whether the leased facility uses significant quantities of hazardous materials or not. DOE/NNSA should share information standards with lessee, or consider document procedures to carry out their own assessment. Specifically, the following factors should be considered for selected elements of the emergency management program.

1.4.2.1. All-Hazards Planning/Technical Planning Basis

- DOE/NNSA ensures:
  - Security vulnerability assessments (VAs) are changed as appropriate to reflect leased facility conditions;
  - Emergency responders and medical treatment providers have appropriate information to plan and respond to an emergency incident involving or affecting the leased facility.
- DOE/NNSA provides:
  - An assessment of potential hazards to the leased facility from DOE/NNSA facilities and activities, and from DOE/NNSA onsite transportation activities, with periodic updates;
  - Information on hazards and medical concerns that DOE/NNSA, other emergency responders, or medical treatment providers may encounter.
- The lessee provides:
  - Information on hazards and activities that could affect DOE/NNSA facilities and activities, with periodic updates.

1.4.2.2. Programmatic Elements Training, Drills, and Readiness Assurance

- DOE/NNSA provides:
  - Initial and refresher training on the site emergency management plan for personnel at the leased facility;
  - Opportunity for personnel at the leased facility to participate as appropriate in site drills and exercises for postulated emergency incidents affecting the leased facility;
  - Opportunity for personnel at the leased facility to participate as appropriate in the planning and critique processes for emergency response exercises involving incidents that affect the leased facility.
- DOE/NNSA ensures:
  - Site responders and decision-makers receive training on all hazards associated with the leased facility and all facets of emergency response associated with incidents involving or affecting the leased facility, and that these factors are practiced during drills and tested during exercises;

- Leased facilities and personnel are incorporated in site emergency response drills and exercises as appropriate;
- DOE/NNSA travels to lessee facilities and conducts periodic tests and assessments that lessee staff and facilities are complying with sites/DOE/NNSA emergency management plans.

- The lessee ensures:
  - Personnel at the leased facility attend initial and refresher training on the site emergency management plan;
  - Personnel at the leased facility participate as appropriate in site drills and exercises for postulated emergency incidents involving or affecting the leased facility.

1.4.2.3. Response Elements ERO

- DOE/NNSA ensures:
  - Designated Incident Commanders (ICs) have access to hazards related to leased facilities;
  - Lessee emergency response resources are effectively integrated through plans, procedures, drills, and exercises with site and other emergency response resources;
  - The emergency management plan and implementing procedures contain provisions for personnel from the leased facility to be integrated into the site ERO as appropriate during emergency incidents involving or affecting the leased facility.
- The lessee ensures:
  - The scope of emergency services provided through the site-wide emergency management program and associated incident command is fully understood and effectively integrated in the emergency response plan and implementing procedures, practiced during drills, and tested through exercises for the leased facility;
  - The emergency management plan and implementing procedures contain provisions for a representative to interact with site emergency management personnel during emergency incidents involving or affecting the leased facility.

<u>Offsite Response Interfaces</u>

- DOE/NNSA ensures:

- Local agencies, law enforcement officials, and offsite mutual aid and support organizations are aware of the relationship and the respective emergency management roles and responsibilities between the site and the leased facility for response and notifications to hazardous material and security incidents. This includes information on hazards and medical concerns that offsite emergency responders or medical treatment providers may encounter.

- The lessee ensures:

  - Information concerning unique facility-specific hazards is made available to offsite emergency responders and emergency medical personnel.

Communication/Notifications

- DOE/NNSA ensures:

  - Site-wide plans and procedures contain provisions and assignment of responsibilities to contact representatives of the lessee in event of a site emergency affecting the leased facility, and that these provisions are practiced during drills and tested during exercises;

  - Site-wide plans and procedures, and those of potentially affected DOE/NNSA facilities, contain provisions for receipt of notification of an emergency at the leased facility;

  - Coordination with the lessee on communication equipment and protocols and messages for timely and effective notifications of emergency incidents.

- The lessee ensures:

  - Plans and procedures contain provisions to notify and protect personnel in accordance with OSHA requirements for hazards at the leased facility.

Consequence Assessment

- DOE/NNSA ensures:

  - Site-wide consequence assessment models include the leased facility locations for emergency management decision makers;

  - Site-wide consequence assessment models include appropriate hazards information specific to the leased facility;

  - Site-wide field monitoring (radiological, chemical, and biological) plans, personnel, equipment, and resources appropriately consider leased facility hazards and site hazard impacts on the leased facility.

- The lessee ensures:

- Facility-specific consequence assessment models and field monitoring plans, personnel, equipment, and resources are available to DOE/NNSA for integration into the site-wide consequence assessment capability.

Protective Actions

- DOE/NNSA ensures:
  - Pre-determined protective actions are identified for the leased facility based on site hazards that could impact the leased facility, and that these actions are coordinated with the lessee;
  - Pre-determined protective actions are identified for site facilities that could be affected by hazards at the leased facility;
  - Provisions for protection (appropriate protective equipment, monitoring equipment, hazard information, potential exposure information, safe routes of entry/egress) of site and other emergency responders and security personnel are incorporated into plans and procedures, practiced during drills, and tested during exercises involving leased facility hazards;
  - Site evacuation planning includes consideration of personnel at the leased facility;
  - Plans and procedures for site medical facilities appropriately consider hazards and personnel at the leased facility;
  - Lessee plans for personnel accountability in the event of an emergency involving or affecting the leased facility are understood and integrated into site plans and procedures, practiced during drills, and tested during exercises involving the leased facility;
  - Potential responders have access to leased facility hazard information and building layout for safe search and rescue and emergency mitigation.
- The lessee ensures:
  - Pre-determined protective actions are identified for the leased facility based on site hazards that could affect the leased facility, and that these actions are coordinated with the lessee;
  - Protective actions are identified in accordance with OSHA requirements for hazards at the leased facility.
- The lessee provides:
  - Hazard information and building layout to permit safe search and rescue and emergency mitigation;

- Plans for personnel accountability in the event of an emergency involving or affecting the leased facility.

Emergency Public Information

- DOE/NNSA provides:
  - Access to the JIC for emergencies at the leased facility.
- DOE/NNSA ensures:
  - Ongoing and coordinated planning between PIOs of the site and leased facilities;
  - Emergency information released through news releases and statements to the press is coordinated with leased facility representatives when the emergency directly impacts the lessee;
  - Site PIOs are aware of designated lessee emergency contacts as well as hazards specific to leased facilities.
- The lessee ensures:
  - News releases and statements to the press regarding an emergency incident at the leased facility are coordinated with the site PIO;
  - Complete and accurate information concerning emergencies at the leased facility is made available in a timely manner to support DOE/NNSA response to public inquiries.

1.5. Closure Activities

1.5.1. Introduction

Closure activities and conditions can pose significant challenges to emergency planners. Often, the changes inherent in SFA closure affect the planning basis for emergency response as well as the response itself. The critical problem is to ensure that inevitable reductions in response capabilities do not overtake the decrease in hazards posed by the SFA processes and materials, resulting in an inadequate emergency response capability. The planner should recognize that the resolution of issues included in this chapter should be in total concert with a basic tenet of the DOE emergency management systems, namely: planning, preparedness, and response must be specific to and commensurate with the hazards.

The purpose of this chapter is to address important issues that should be considered when planning changes to an emergency management program based on the projected closure of the SFA. The approach for addressing a closure's impact on emergency management is to provide precautionary statements that give emergency planners thought-provoking considerations that may apply to specific elements of emergency management at their closure facilities/sites. The following sections present a number of these important reminders related to the impact of closure activities on DOE emergency management program elements.

Note that there is a different effect on the emergency management program when there is a closure of an entire site versus the closure of a single facility or group of facilities on a site that will continue to operate. The closure of an entire site will affect both site-level and facility-level programs and assets, whereas the closure of a facility on a site may leave site-level programs intact, since these would likely support Emergency Management Hazardous Materials Programs at other facilities on the site. When necessary, this distinction will be specifically addressed in the following sections.

1.5.2. All-Hazards Planning/Technical Planning Basis

All-Hazards Surveys and EPHAs. Frequent and often dramatic physical changes at closure SFAs challenge the efforts of emergency planners to keep all-hazards surveys information current. It is imperative, therefore, that emergency planning be a priority consideration for managing change at a closure SFA. Examples of physical changes that may affect emergency planning and preparedness include:

- Dismantling any item that will alter process unit safety, facilities, or information;
- Change in a critical instrumentation device or alarm;
- Dismantling that may reopen closed/sealed systems or components containing contamination;
- Addition or deletion of piping connections, drains;
- Change in firefighting equipment or capacity; and
- Temporary use of equipment not covered by existing procedures.

The introduction of short-term hazards during the Decontamination and Decommissioning (D&D) process can add to the planning basis for the program, requiring temporary response measures. Site/facility changes can result in the introduction of common usage hazardous materials that pose a new threat as an initiator for a hazardous material release.

Since changing inventories of toxic chemicals may occur frequently at closure facilities/sites, administrative systems should be in place to ensure that emergency managers are informed of these changes in a timely manner. The importance of reliable and comprehensive methods of hazardous material identification during closure activities cannot be overemphasized. Past methods or systems may not be reliable for identifying changes in hazardous material inventories when an SFA is involved in D&D.

Communication of changes in hazards to emergency response personnel is critical and can only be ensured if a reliable system is in place to communicate change to those responsible for the technical planning basis for the program. One method for tracking progress is to have an emergency planner attend the periodic production planning meetings, which address the hazards that will be encountered with the next dismantling activities.

Changes may be subtle or can occur quickly at a closure SFA. Barriers to release of hazardous materials, storage locations and mixes, engineering controls, administrative controls, and safeguards and inventory systems may change. A production facility may be closed, and process equipment removed, but hazards may still reside as holdup in ductwork or piping. The release of those hazards becomes a potential emergency when piping is cut during final dismantlement. The EPHA that applies for a production facility does not apply when the same building is empty. If hazards still exist, based on a revised All-Hazards Survey, then a new EPHA may be needed. Similarly, the EPHA that applies when the building is empty would likely not apply after it is demolished. During the dynamic progression of D&D activities, a facility should not be expected to update the EPHA document constantly. However, the emergency management program must remain prepared to respond to whatever emergency current hazards present. Hence, as hazards are removed during closure, facilities/sites should develop and implement a timely, efficient, and effective process that facilitates the modification of the emergency management program using associated criteria for initiating changes.

A possible approach for tracking changes associated with the closure activities is to ensure that emergency management is integrated with the safety hazards analysis and work order processes used by facility management (ISM systems). Before closure begins at an SFA, a generic hazards analysis is required to identify potential hazards to be encountered. Additionally, at each step in the process of D&D, there should be a work order that includes a specific safety hazard analysis for the work to be performed. For example, safety analyses of many DOE/NNSA sites/facilities, which use or store radioactive materials, will include criticality analyses to address accumulation and movement of nuclear materials in piping. If emergency planners at the closure SFA are involved in review of these work orders and hazards analyses and are prepared to use this information to ensure readiness to respond to emergencies, then it is reasonable that they take credit for the safety management processes used during D&D.

1.5.3. Programmatic Elements

Program Administration and Management. An emergency management administrator at a closure SFA needs to ensure that changes taking place will not adversely impact the ability of the program to respond effectively to an emergency. Emergency administrators need to have access to the appropriate level of management to make decision makers aware, on an ongoing basis, of facility, equipment, materials, personnel, and resource issues that may impact SFA ability to respond to an emergency.

Also, emergency management administrators at closure facilities/sites may be tasked with collateral duties that could interfere with and affect responsibilities to ensure that the emergency management program readiness is maintained. Efficient planning by the program administrator becomes critically important. Administrators should ensure that provisions are in place for rapid development, approval, and issuance of changes to response procedures, and timely scheduling of training to ensure these changes are implemented. Maintaining plans and procedures can become a significant task when frequent change is occurring involving people, facilities, materials, and expertise at an SFA.

Training and Drills. Emergency response training programs should be reviewed and updated periodically, based on the frequent change characteristic of such facilities/sites. Emergency management administrators should have frequent input to General Employee Training programs for changes in basic emergency response. Drill programs should be dynamic to address the needs of the SFA and issues identified in real incidents, exercises, and reinforce training. This should include both operational and closure facilities. For example, aggressive milestones may not allow time for a regular drill schedule. As a result, shorter drills that are focused on changes to areas and materials may provide a solution for some facilities/sites.

Facility and organizational experience and knowledge may be lost when an SFA transitions from production to closure. Facilities/sites may need to put in place a means to capture critical knowledge before the transition is made and to incorporate some of this knowledge in training for emergency managers and responders.

Training of offsite emergency responders may become more critical as site resources for emergency response are reduced. Offsite responders may be expected to have an increased role in response to SFA OEs.

Readiness Assurance. Maintaining, updating, and testing/validating plans and procedures can become a virtually continuous task at a closure SFA because the nature of closure activities may mean frequent changes in hazards, physical facilities, organizational expertise, management, number of personnel at the site, and ERO resources available to support response. Evaluation and improvement programs at closure SFAs need to be vigilant in adjusting to change and its impact on the readiness of the SFA to respond to emergencies, as well as on new vulnerabilities that require adjustments in resources. These programs will by necessity be driven by short-term objectives to ensure readiness through careful attention to focused evaluations of the modified aspects of the planned response. Improvements and lessons learned would be implemented on a schedule that should coincide with the schedule of changes caused by the closure activities.

As a site undergoes changes from an operational site to a site focused on demolition and closure processes, the exercise requirements and community expectations will change. However, exercises do help reassure the community that the site can still respond and mitigate the hazards in an emergency. Hence, participation in the annual site-level exercise should be maintained at an acceptable level to provide assurances that response will be adequate in the event of an emergency. This level of participation might be ensured by tracking a performance measure or as an explicit inclusion as part of contractual agreements.

The demolition and closure of an individual or group of facilities on an operating site should have no effect on the site-wide programs. However, closure facilities will, at some point, be excluded from being the source of the hazards, but should still participate in the exercise as a collocated facility responding to an OE incident elsewhere on the site.

1.5.4. Response Elements

Emergency Response Organization. Ensuring that an adequate number of primary and alternate response personnel are available, prepared, and qualified becomes a challenge for closure facilities/sites emergency management programs. Responsive and creative programs are needed in the ERO organizational structure when a site transitions from production to closure. For example, some programs may need to consider moving to a dedicated and specialized emergency response brigade when organizational changes create conditions in which the usual volunteer ERO is not available or reliable.

Reduction in hazards may drive an SFA to tailor its cadre of emergency responders. These types of changes should be considered as part of the site Closure Plan, and emergency management professionals should have an active role in site closure planning.

Responsibility for control of operations, monitoring, and repair teams should be vested with a single individual; however, at a closure SFA, it is possible that personnel who would staff these teams will be subcontractors. In this case, organizational changes or provisions would need to be made to ensure resource availability and adequate organizational controls in an emergency.

The dynamic nature of closure facilities/sites may also create conditions in which tools, parts, and even PPE needed by repair and maintenance teams are not readily available for mitigating an emergency. There should be ongoing dialog with operations and maintenance managers on these types of issues. Emergency planners should be particularly cognizant of possible changes in the effectiveness of emergency fire response on closure sites. Changes in SFA hazards due to closure activities should be communicated to the Fire Department. Physical facility and site changes may affect timely fire response as well as security. SFA changes could also impact the usability and reliability of pre-arranged fire preplans for facilities undergoing D&D.

Emergency Operations Systems. Sites that are transitioning toward closure should maintain the function of the emergency operations system such that it is scalable to the emergency.

Offsite Response Interfaces. Sites that are transitioning toward closure generally experience changes in the contracting process, budgeting for emergency management, management priorities, and the nature of site hazards. These changes can result in significant changes in the relationship with local and state offsite EROs. If resources for emergency management are reduced overall, there may be an impact on agreements for mutual assistance and a site's ability to supplement offsite emergency response programs. However, during closure, MOU for offsite resources, such as emergency medical support, often become even more critical as onsite resources diminish. These impacts may not result from the closure of a single facility or a group of facilities, since offsite interfaces may be implemented and maintained at the site-level.

In any closure situation, if SFA hazards change significantly, there may be a need to inform offsite agencies. Similarly, the ultimate impact of closure on offsite communities may be significant and affect offsite relations that are important to emergency preparedness. Discussing these issues with offsite agency contacts early during the closure planning process will help preserve relationships that must be maintained for effective response.

Emergency Facilities and Equipment/Systems. Within the D&D environment of a closure SFA, there is still the need to maintain operational capability, staffing and support systems for communications, protection, and utilities at emergency operations facilities. Facility reference materials at the EOC, such as site maps and facility drawings, must be kept current and available to responders. The operability of public address systems and alarm systems needs to be maintained and not allowed to become vulnerable in a deconstruction environment. Similarly, storage locations for response equipment may change. Emergency management staff must stay aware of such changes. Surveillance of emergency response facilities, communication systems, and equipment may be needed more frequently. Ultimately, as the site-wide hazards on a closure site are significantly reduced, the need to maintain a state-of-the-art EOC may not be warranted, and a simple command center location may be adequate.

Emergency Categorization and Classification. At a closure SFA, the readily available indications or observable conditions that provide decision-makers' criteria for categorization of OEs may change. The SFA-specific criteria must be kept up to date and responsible persons kept informed and trained on the changes. Site-/facility-specific EALs may also require updating and decision-makers must be knowledgeable of these changes.. As initiating conditions and emergency scenarios may change, emergency planners may need to intensify programs for reviewing and testing criteria to categorize OEs and EALs for classification of closure of SFAs.

Notifications and Communications. Impacts on communication and notification systems can result from a D&D modified environment. This could involve changes to the effectiveness of an SFA's public address systems, facility alarm systems, or offsite communications. Lines of communication and notification are essential for timely notifications. On a site where selected facilities are undergoing D&D, it is essential that workers at a closure facility are not isolated from the rest of the site, even if the closure facility emergency management program is no longer required for its own hazards. A release at a nearby operating facility can still affect the closure facility.

Consequence Assessment. Because of the potential dynamic conditions at closure facilities/sites, indicators necessary to assess emergency consequences may continually change, or at least the ability of responders to monitor the indicators may be affected.

Emergency planners should also be alert to the need for changes to input data requirements for the consequence assessment process (source term estimates) when hazards change. Emergency planners should ensure that the Consequence Assessment Team has access to the most current planning basis documents. A process should be developed and implemented to ensure that consequence assessment tools reflect changes in an SFA's hazards due to closure activities in a timely manner.

Protective Actions. Changes to SFA physical characteristics may affect worker and responder access and egress procedures. The D&D conditions may force changes in evacuation routes. Emergency planners should look for SFA changes that may pose new hazards or impediments along established evacuation routes. Any changes to these logistical aspects of protective actions need to be communicated to the workforce. Similarly, receptor locations for predicted hazardous material consequences may change when physical SFA changes occur. The potential for changes in the pre-planned initial protective actions for onsite areas and protective action recommendations for offsite areas should also be recognized.

Emergency Medical Support. Emergency planners should be cognizant of SFA changes on emergency medical response capabilities. Changes in facility hazards should be communicated to the site medical director. Physical SFA changes may affect timely medical response; for example, location for landing a life-flight helicopter at a closure site could change. The SFA changes could also affect the usability and location of pre-arranged decontamination facilities. Agreements with offsite medical providers may still be needed during the closure process and those offsite providers should be made aware of the impact of SFA changes on possible medical emergency needs.

Emergency Public Information (EPI). Emergency planners should ensure the EPI staff (both onsite and offsite) are informed of any significant changes in SFA hazards, emergency response capabilities, and plans/procedures, and be prepared to address these in the event of an emergency. A PIO should be part of the closure planning team. As facilities/sites downsize during closure, adequate emergency public information resources may still be needed to provide a public information response should an emergency occur. A media center should be designated and available for use in the event of an emergency, even when a closure site emergency management program is reduced to a Core Program.

Termination and Recovery. The termination of an Operational Emergency on a closure site will be based on many of the same general criteria that an operational site will use. However, the criteria, and subsequent recovery, will not have as their ultimate goal to return a facility undergoing D&D to operating status, but to restart and continue the closure processes. Senior management will need to determine the level of termination criteria that is consistent with protecting the workers, the public, and the environment, and performing the D&D activities safely. The termination criteria will likely be similar to criteria for planning, scheduling, and accomplishing D&D work on a daily basis. Recovery planning may only include the determination of the cause of the incident to prevent reoccurrence in future closure operations.

1.6. Biosafety Facilities

1.6.1. Introduction

The primary requirements specific to DOE/NNSA biosafety facilities using or storing select agents or toxins are contained in 10 CFR Part 851, Appendix A, Section 7, *Biological Safety*, and the regulations from the U.S. Department of Health and Human Services (HHS) and the U.S. Department of Agriculture (USDA) regarding certain hazardous biological agents and toxins and their possession and use in the United States (U.S.), receipt from outside the U.S., and transfer within the U.S. of certain hazardous biological agents and toxins. For purposes of this guidance, the rules that address the HHS and USDA requirements will be referred to collectively as the *Select Agent Rules*. At a minimum, an entity registering under these requirements needs to develop and implement an incident response plan. For DOE/NNSA sites, the biosafety facility incident response plan needs to be coordinated and integrated with the implemented site-wide emergency management plan.

The required contents of an incident response plan are described in brief statements related to various emergency management issues. Emergency management personnel at sites with planned, or currently operating biosafety labs, will recognize that a DOE/NNSA emergency management program addresses many of the same issues in the Program Elements defined in DOE O 151.1D and the other guidance chapter in this EMG. Although the major focus of the current DOE emergency management Order and EMG is on radioactive and chemical hazardous materials, requirements and guidance are generally valid for biosafety facilities through modifications to account for the unique properties and issues related to biological hazards.

1.6.2. General Approach

Integration of hazardous biological materials into the emergency management program is directed by 10 CFR Part 851, *Worker Safety and Health Program*, Appendix A, *7. Biological Safety*. According to this rule, contractors must establish and implement a biological safety program that establishes an Institutional Biosafety Committee (IBC) or equivalent. The IBC must review the site's security, safeguards, and emergency management plans and procedures to ensure they adequately consider work involving biological etiologic (i.e., disease causing) agents. In addition, the biological safety program confirms that the site safeguards, security plans, and emergency management programs address biological etiologic agents, with emphasis on biological select agents. Other Federal regulations that govern the use and storage of select agents and toxins (to be introduced in subsequent chapters) require that mandated incident response planning be "integrated with any site-wide emergency response plans."

For purposes of DOE O 151.1D and this Guide, a biosafety facility can include a standalone building with a single research activity, a floor in a building, or simply a laboratory consisting of a single room or several rooms on a floor in a building where storage is maintained, or work/research is performed involving biological etiologic agents or hazardous biological toxins. A biosafety facility will have an assigned containment level consistent with applicable guidelines provided in *Biosafety in Microbiological and*

Biomedical Laboratories (BMBL), U.S. Department of Health and Human Services (HHS), Public Health Service (PHS), Centers for Disease Control and Prevention (CDC) and National Institutes of Health (NIH), Fifth Edition, Revised 2009. The primary focus in this guidance is on biosafety facilities that store or support activities involving biological select agents or toxins, although the approach can also be applied to other etiologic agents and hazardous toxins.

Other activities in a building containing a biosafety facility may be using or storing radioactive or toxic chemical hazardous materials. The Emergency Management Hazardous Materials Program for the building/facility should represent an integration of planning, preparedness, and response activities for all hazardous materials. For example, a single EPHA should be produced for the facility covering analyses of all hazardous materials identified in the All-Hazards Survey.

As indicated above, complications influencing application of the traditional DOE hazardous materials approach to biological releases dictates that each agent be analyzed and researched to examine variations in agent characteristics that may not be bounded by a standard hazardous materials planning and response approach. Hence, emergency management planners need to familiarize themselves with the specifics of each agent in use in the biosafety facility to augment the standard planning and response template, as necessary.

The guidance contained here is aimed at both biosafety and emergency management professionals responsible for implementing the Select Agent Rules and DOE O 151.1D. To satisfy the needs of both disciplines, the general subject of biosafety is covered in the *Biosafety Facilities*, Chapter 5. Biosafety concepts of containment and barriers, biosafety levels (BSLs), and biosafety controls are introduced in the context of the Select Agent Rules and are taken directly from the BMBL. Note that descriptions of facility operations or biosafety programs are provided to support examples and concepts discussed in Chapter 5. However, these descriptions should not be interpreted as necessarily representing actual DOE/NNSA biosafety facility operations and programs.

According to 10 CFR Part 851 Appendix A, 7. *Biological safety*, DOE/NNSA biosafety facilities are required to establish an IBC to review any work with biological etiologic agents for compliance with appropriate CDC (i.e., BMBL), NIH, World Health Organization (WHO), and other international, Federal, Tribal, State, and local guidelines and the site security, safeguards, and emergency management plans and procedures. Understanding the basic biosafety concepts contained in these guidelines are essential for interpreting and implementing the guidance to be presented in this guidance document.

In addition, because of the impact that agent characteristics and diverse transport/transmission mechanisms have on specific emergency management planning issues (threshold quantities, measures of severity, protective actions), a brief discussion of these issues are provided in Chapter 5 to support the approach contained in DOE O 151.1D. Agents and their relevant general characteristics are discussed with special emphasis on potential transport/transmission mechanisms. OEs related to the release of biological agents to the environment, the characterization of biological release scenarios, and tools for their recognition are also discussed.

This analysis and the Emergency Management Hazardous Materials Program, which are required for any DOE/NNSA facility subject to the Select Agent Rule(s), address the actual or potential release of biological agents outside of the secondary barriers of biocontainment. Results of the EPHA will form the basis for the emergency management program that will be commensurate with the biological hazards in the facility. Planning, preparedness, and response activities will reflect the characteristics and release transport/transmission mechanisms of the potential hazards.

Biological select agents are emphasized in the guidance contained in Chapter 5; biological toxins are essentially extremely toxic chemicals generally covered by guidance contained throughout this guide. However, clarifications and discussions in this Guide will specifically address the release of toxins when necessary. In addition, further discussion in Chapter 5 will focus on planning for human or overlap select agents. Future guidance will include toxins and agents that are solely animal and plant pathogens.

Chapter 2. All Hazards Planning/Technical Planning Basis

2.1. All-Hazards Planning Basis

2.1.1. Introduction

The purpose of this chapter is to assist Department of Energy (DOE) and National Nuclear Security Administration (NNSA) field elements in complying with the DOE O 151.1D requirement that an All-Hazards Survey be prepared, maintained, and used for emergency planning purposes. The Order requires that emergency management efforts begin with the identification and qualitative assessment of the site/facility/activity (SFA) specific hazards and the associated emergency conditions that may require a response, and that the scope and extent of emergency planning and preparedness at a DOE facility reflect these facility-specific hazards. The first step in the implementation of this *commensurate with hazards* approach to emergency management is an All-Hazards Survey.

Based on an examination of the features and characteristics of the facility, the All-Hazards Survey identifies the generic types of emergency incidents and conditions (including natural phenomena such as earthquakes and tornadoes, wildland fires, and other serious incidents involving or affecting health and safety, the environment, and safeguards and security at the facility) and the potential impacts of such emergencies to be addressed by the DOE Comprehensive Emergency Management System. The All-Hazards Survey also identifies key components of the Emergency Management Core Program that provide a foundation of basic emergency management requirements and an integrated framework for response to serious emergency incidents or conditions. For facilities involved in producing, processing, handling, storing, or transporting hazardous materials that may pose a serious threat to workers, the public, or the environment, the All-Hazards Survey provides a screening process to determine if further analysis of the hazardous materials in an Emergency Planning Hazards Assessment (EPHA) is required.

This guidance is directed at operations and emergency management staff responsible for DOE and NNSA facilities at field offices, service centers, and operating contractor organizations. It is expected that emergency management staff will obtain support from site and facility management in addition to a variety of scientific and technical disciplines within their respective organizations. Appendix A provides recommended screening approaches for radioactive and chemical hazardous materials.

2.1.2. General Approach — All-Hazards Planning Basis

Every facility and activity on a DOE/NNSA site should be included in a documented All-Hazards Survey. Much of the information necessary to generate an All-Hazards Survey will already have been developed and documented in the course of meeting other DOE and Federal agency requirements relating to facility safety, occupational safety, environmental and effluent controls, and hazardous materials management. However, the intent of the Order will not be met by simply defining existing documents or analyses as the All-Hazards Survey document.

The All-Hazards Survey process involves the review of facility programs already in place to meet Federal, State, and local requirements related to worker health and safety, environmental protection, and hazardous materials reporting. It is not suggested that emergency management departments assume increased responsibility and authority for ensuring compliance with the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation, and Liability Act, the National Pollutant Discharge Elimination System (NPDES), and the Occupational Health and Safety Requirements (OSHA) requirements. The SFA management may find it useful to incorporate the All-Hazards Survey process into its program of internal oversight and compliance monitoring for hazardous materials, environmental protection, and worker safety regulations (See DOE-STD-3009-2014).

The All-Hazards Survey should be a distinct document that contains or references the information specified in this chapter.

Recommended Steps:

Step 1 Briefly describe each facility and identify their hazards.

Step 2 Screen hazardous materials to determine the need for further analyses in a facility-specific quantitative Emergency Planning Hazards Analysis (EPHA).

Step 3 Identify the generic types of emergency incidents and conditions for each facility.

Step 4 Qualitatively describe the potential effects of applicable emergencies to health, safety, environmental, or national security.

Step 5 Document the applicable Core Program planning and preparedness requirements.

An All-Hazards Survey may address a single facility, multiple facilities, or may even cover an entire site. A tabular/matrix presentation can be used to efficiently summarize and document the survey information.

2.1.3. Step 1: Describe the Facility and Identify its Hazards

Each facility or activity covered by the All-Hazards Survey should be identified and a brief description of its operations provided. Detailed descriptive information should be included by reference. A general understanding of the facility and its associated hazards can be adequately presented in a table or matrix. That information should include:

- A general characterization of the facility and its operations;
- The number of workers normally assigned;

- Special designations, such as nuclear facility; radiological facility; hazardous waste site; Treatment, Storage, or Disposal facility; etc.; and

- Whether hazardous materials other than standard office products and cleaning supplies are used or stored in the facility.

The use or storage of radioactive, chemical hazardous materials, or hazardous biological agents or toxins in the facility should be noted and described. Sources of information on hazardous materials include documents such as Basis for Interim Operations (BIO), Safety Analysis Reports (SARs), Safety Assessment Documents (SADs), Documented Safety Analyses (DSAs), Design Basis Threats (DBTs), process safety management/risk management analyses documentation, and databases including chemical and radioactive material inventories. Facility walk-downs enable emergency management staff and hazards analysts to familiarize themselves first-hand with actual facility systems, processes, practices, equipment and, especially, material inventories. Periodic walk-downs can provide checks on the accuracy of documentation and material inventory databases and may identify additional hazards from by-products of chemical processes or potential accidental mixing interactions.

If hazardous materials other than office products/cleaning supplies are identified, further screening should be done in accordance with Section 2.1.4 below to determine if a facility specific quantitative EPHA is required.

2.1.4. Step 2: Screen Hazardous Materials to Determine Need for an Emergency Planning Hazards Assessment (EPHA)

Due to the myriad forms and quantities of hazardous materials in use throughout DOE/NNSA facilities and activities, the Comprehensive Emergency Management System provides a screening process to reduce the number of hazardous materials quantitatively analyzed for emergency planning purposes. Use of the screening process described here is not intended to avoid analyses of hazardous materials, but to allow emergency management resources to be focused on analyzing materials that, because of their quantity, toxicity, and dispersibility, have the potential to harm people who are outside the immediate workplace where the materials are used or stored. The hazardous material screening process identifies inventories of specific materials in an SFA that, if released, could cause a hazard significant enough to warrant specific consideration in an Emergency Management Hazardous Materials Program.

To determine whether a facility requires a quantitative analysis of its hazardous materials in an EPHA, the screening process must identify at least one hazardous material that requires further analysis. The results of the EPHA will then determine if the release of each identified material could cause a hazard significant enough to be included as part of the Emergency Management Hazardous Materials Program planning basis.

DOE O 151.1D requires a quantitative emergency planning hazards assessment if the all-hazards survey screening process identifies specific hazardous materials and quantities that could produce impacts consistent with the definition of an Operational Emergency (OE). In general, an OE involving an uncontrolled release of a hazardous material must immediately threaten or endanger those in close proximity of the incident; have the potential for dispersal beyond the immediate vicinity of the release in a quantity that threatens the health of onsite personnel or the public in co-located facilities, activities, on or offsite; and have a potential rate of dispersal sufficient to require a time-urgent response to implement protective actions for workers and the public. (For guidance on co-located workers and facilities see DOE-STD-3009-2014.)

All radioactive materials and chemicals with known or suspected toxic properties should be subjected to a hazardous material screening process that identifies all hazardous materials in an SFA that are to be considered for further analysis in an EPHA. Some materials may be excluded from analysis in an EPHA based on use, form, dispersibility, or toxicity. Radioactive materials requiring further analysis include those listed in DOE-STD-1027-2018 Chg. Notice 1, in quantities greater than Category 3 values. Chemicals assigned Health Hazard Ratings 0, 1, or 2 based on the handbook of the National Fire Protection Association (NFPA) 704, *Standard System for the Identification of Hazardous Materials for Emergency Response,* may be excluded from further EPHA analysis. With some exceptions for extraordinarily high toxicity, chemicals in quantities less than those that can be easily and safely manipulated by one person, also referred to as *laboratory scale* quantities, may be excluded from further analysis. Appendix A provides a discussion of the hazardous material screening process and describes a recommended screening approach. If the screening process identifies at least one hazardous material requiring further quantitative analysis, the All-Hazards Survey should indicate that an EPHA is needed for that SFA. A description of the screening process and the results of its application should be provided in the All-Hazards Survey or supporting documents.

2.1.5. Step 3: Identify Applicable Types of Emergency Incidents and Conditions

The generic types of emergency incidents and conditions that may occur at each facility for which some planning and preparedness may be required should be identified and documented. The word *incident* is used by sites and facilities for an unexpected occurrence, natural or manmade, that requires a response to protect life or property that affect a site. For planning purposes, SFAs should always plan for events as they would normally happen (weather events, change in normal operations, severe incidents, demonstrations, etc.) Hazardous materials not specifically addressed in a quantitative EPHA should also be considered when identifying the emergency conditions. At a minimum, the following types of emergency conditions should be considered:

- Structure fires and explosions;
- Natural phenomena impacts;
- Environmental releases (of oil or other pollutants that degrade the environment);
- Hazardous material (HAZMAT) releases;

- National Security impacts (see definition in DOE O 460.1D);
- Multiple facility/building incidents;
- Malevolent acts (see DOE O 470.3C for applicable scenarios);
- Workplace accidents/mass casualty incidents (explosion, release of toxic fumes, high energy system failure);
- Hazards external to the SFA; and
- Accidental criticality.

The DOE/NNSA Comprehensive Emergency Management System emphasizes emergencies involving the release of hazardous materials. The inventories of materials in facilities will be subject to the screening process discussed above. If a potential release may cause a classified OE, then an EPHA is required. If, on the other hand, the facility contains an aggregation of small quantities (i.e., less than screening thresholds) that may be released during large-scale destructive incidents, such as a fire or explosion in a laboratory, an aircraft crashing into a building, or an earthquake that collapses a structure, this should also be indicated in the All-Hazards Survey. A site may consider defining such incidents as categorized, but not classified OEs if it appears the condition would meet all the aspects of an OE. The potential HAZMAT aspect of these destructive incidents may be used as a *qualitative factor* or *criterion* (without the support of detailed quantitative calculations of consequences) in defining specific OEs related to these incidents. However, even without the inclusion of this category, a site may be required to categorize such an incident as an OE under one of the existing definitions contained in the Order.

Some types of emergency conditions will apply to nearly every facility, while others will only apply to facilities that exceed a threshold inventory of some hazardous material or environmental pollutant or are located near other hazards. Site-specific risks/hazards, such as flooding from a nearby dam failure, should be included in the list of potential emergencies to identify the facilities that are potentially threatened.

Facility and site hazards can be identified by using subject matter experts (SMEs), BIO reports, SARs, SADs, DSAs, DBTs, Vulnerability Assessments (VAs), chemical and radioactive material inventory databases, and even Federal Emergency Management Agency (FEMA), National Weather Service, and insurance industry documents.

Hazards originating outside the DOE facility or site that could affect the health and safety of onsite personnel or other DOE interests should be identified and examined. At a minimum, the Local Emergency Planning Committee should be consulted to identify nearby facilities containing hazardous material inventories that could affect the DOE site.

Railroads, highways, and other transportation arteries that pass through or near a DOE facility or site should be considered possible locations of hazardous material transportation accidents. If the transportation artery is a known corridor for particular hazardous substances, identify the substance, quantities, approximate shipment frequencies, and Protective Action Zone distance specified in the Department of Transportation (DOT) Emergency Response Guidebook (ERG). Protective Action Zone distances may need to be calculated for hazardous substances not specified in the ERG. Once this information is collected, determine whether specific arrangements should be made for protection of onsite personnel. If no specific information can be obtained, the transportation arteries should be identified as potential sources of hazards to onsite personnel.

2.1.6. Step 4: Qualitatively Describe Potential Impacts

Qualitatively describe the potential impacts of the emergency conditions identified in Step 3. These descriptions should relate the potential impacts to the different types of OEs identified in the Order. Consideration should be given to cascade effects, where the emergency condition can result in plausible disruption of response capabilities, such as when an earthquake could result in fires from downed power lines while rupturing fire mains.

Examples of potential impacts of several emergency conditions include:

Facility Type	Emergency	Qualitative Description of Impact Condition
Office Building	Structure Fire	Workers killed/injured by smoke inhalation and burns.
Waste Incinerator	Earthquake	Workers killed/injured/ trapped by building collapse; release of hazardous materials; contamination of facility and surroundings; spill of fuel oil into streams/wetlands.
Onsite Transportation Activity	Collision	Actual or potential release of hazardous materials; exposures exceeding Protective Action Criteria (PAC).

2.1.7. Step 5: Identify Applicable Planning and Preparedness Requirements

Various Federal, State, and local regulations include requirements that pertain to planning and preparedness for emergencies. The Order recognizes these as Core Program requirements and directs that they be incorporated into the site emergency management programs. Emergency planners should correlate All-Hazards Survey results with the relevant planning and preparedness requirements from other Federal, State, or local regulations that apply to a specific facility, and provide a summary of the required scope of emergency planning and preparedness at the site. Examples of possible Core Program planning and preparedness requirements are listed in the Order. The All-Hazards Survey should serve as a guide for assessing site compliance with a variety of DOE and non-DOE emergency planning and preparedness requirements that are integral parts of the Comprehensive Emergency Management System.

2.1.8. All-Hazards Survey Documentation

As noted in Section 1.2, a single All-Hazards Survey document may address multiple facilities with the results presented in several ways. The tabular/matrix presentation format is an efficient method of summarizing and documenting survey information for many facilities. Using this approach, the All-Hazards Survey document can consist of brief descriptions of the facilities, types of hazards that apply, potential impacts of hazards, applicable regulations, and other common information, followed by a table or matrix indicating which items apply to each facility. If the number of facilities is small, separate text section(s) can be devoted for each. For facilities with hazardous materials, the All-Hazards Survey document should identify the sources of inventory information and summarize the hazardous material screening methods and results.

Sites are not expected to reproduce extensive texts from original sources to incorporate in the All-Hazards Surveys. Instead, existing site documents or record systems such as facility descriptions, building pre-incident plans, and hazardous material inventories may be included in a table or matrix in the All-Hazards Survey. Hazardous material inventory information for an SFA or activity should be documented to support the results of the hazardous material screening process. The inventory information need only be documented in the All-Hazards Survey to the extent necessary to indicate whether a quantitative EPHA is required. If an EPHA is required, the results of the screening process for all materials in an SFA should be included in the EPHA. Otherwise, the screening results can be included as part of the supporting documentation for the All-Hazards Survey.

Sites must ensure EPHA documentation is reviewed for classified or CUI prior to release, when required, with particular emphasis on the quantity and location of hazardous materials (especially nuclear materials) and malevolent acts scenarios associated with these materials.

2.1.9. Threat and Hazard Identification and Risk Assessment (THIRA)

2.1.9.1. Introduction

The purpose of the THIRA is to provide a strategic-level view of identified threats and hazards impacting the area, and anticipated capabilities necessary to address these threats and hazards. Requirements for performing an All-Hazards Survey, including conducting a THIRA, are described in Attachment 3, Section 2 of DOE O 151.1D.

Information provided through the THIRA will serve as the baseline for NA-41 (HQ) development of the Department's comprehensive, enterprise-wide threat and risk assessment that supports Presidential Policy Directive 8 (PPD-8) and the National Preparedness System in accordance with its guiding principles of a risk-informed culture and risk-informed decision making. The DOE Enterprise THIRA will create a common operating picture for DOE leadership for strategic planning purposes such as formulation of level direction and priorities.

The DHS Comprehensive Preparedness Guide (CPG) 201 provides guidance for developing a THIRA that is flexible and scalable. The intent of the Order requirement is to allow flexibility in how the guidance in CPG 201 is applied to each SFA, while maintaining a common framework and a consistent approach for identifying and assessing risks and impacts.

For information on an over-pressurization hazard and on how it is presented in DOE O 151.1D, and how to account for it in a THIRA, SFAs should refer to the analysis in DOE-STD-1212-2012.

2.1.9.2. Step 1: Identify Threats and Hazards of Concern

For the purposes of the THIRA, the CPG 201 organizes threats and hazards into three categories.

- Natural hazards: acts of nature
- Technological hazards: accidents or the failures of systems and structures
- Human-caused incidents: the intentional actions of an adversary

SFAs can use scenarios previously derived from SAR/SAD/DSA/DBT development to fit into these categories to help meet the requirements of the THIRA.

Table 2-1 provides examples of the types of threats and hazards that an SFA may encounter (the list is not all-inclusive).

Table 2-1 Example Threats and Hazards by Category

Natural	Technological	Human-caused
• Avalanche • Drought • Earthquake • Epidemic • Flood • Hurricane • Landslide • Pandemic • Tornado • Tsunami • Volcanic eruption • Wildland fire • Winter storm	• Airplane • Dam failure • Levee failure • Mine accident • Hazardous materials release • Power failure • Radiological release • Train derailment • Urban conflagration • UAS-Incursions	• Active shooter / threat • Biological attack • Chemical attack • Cyber incident • Explosives attack • Radiological attack • Sabotage

Likelihood of a Threat or Hazard Affecting a Site/Facility Activity (SFA)

For the purposes of the THIRA, likelihood is defined as “the chance of a given threat or hazard affecting an SFA.” Considering likelihood is critical because SFAs must allocate limited resources strategically.

Likelihood of occurrence should be the determining factor in allocating resources for threats and hazards. Through the THIRA, SFAs identify threats and hazards that are challenging enough to expose capability gaps, and likely enough to justify investing in the capabilities necessary to manage them.

The ability to predict the likelihood of a specific incident varies. Some hazards have mature prediction models that allow SFAs to calculate the probability of a specific incident with a moderate degree of accuracy. Other hazards, such as terrorism, are more difficult to predict and may be most easily expressed either on a logarithmic or ordinal scale. Regardless of how SFAs express the probability of a specific incident, understanding the likelihood of threats and hazards can help understand capability requirements and prioritizations of investments.

Including estimates of probability in the THIRA is not necessary but may be included if deemed appropriate. SFA staff may consider additional sources for useful likelihood and consequence information to inform threat and hazard selections, such as hazard mitigation plans. Regardless of whether probability is included in the THIRA process, SFA staff should only consider the threats and hazards that could realistically occur.

The Impacts of a Threat or Hazard

The projected impacts of threats and hazards determine the level of capability an SFA will need to address impacts. To understand risks effectively, the staff at the SFA should identify and select threats and hazards that most challenge their capabilities. Different incidents present different challenges. In some cases, the sheer magnitude of the incident may be substantial; in other cases, there may be operational or coordination complexities or economic and social challenges. When assessing potential impacts, SFA staff may include as many threats or hazards in the THIRA as they desire but include as many as necessary to challenge each of the 32 core capabilities.

2.1.9.3. Step 2: Give Threats and Hazards Context

Context Descriptions

Threats and hazards were identified in Step 1. In Step 2 of the THIRA, create context descriptions and estimate the impacts of the threats and hazards.

If an element of the scenario is essential to understanding the effect of an incident and the capabilities required to manage it, the element should be included in the context description.

For example: How would the location of an incident affect the SFA's ability to manage it? Which locations would be most likely to have the greatest impacts (populated areas, isolated areas, or areas with large amounts of hazardous materials)?

Estimate Impacts

SFA staff write impacts in the language of common emergency management metrics, for example, the affected population, the number of people requiring shelter, or the number of people requiring screening. The standardized impact language communicates metrics estimated and, in most cases, across multiple threats and hazards.

SFA staff will develop capability targets in Step 3 based on estimated impacts. As such, they will identify a specific number for the standardized impact when estimating impacts before proceeding to Step 3. Ideally, SFA staff estimate all standardized impacts for each threat or hazard scenario. However, at a minimum, to develop capability targets in THIRA Step 3, they will develop an estimate for each standardized impact at least once across all included threats and hazards.

In addition to impacts for which standardized language exists, other impacts may be included in the THIRA as deemed appropriate. Non-standardized language may be used to describe impacts when not included in the standardized impact language. If SFA staff choose to estimate an impact using data from a single scenario, they should choose the scenario that could create the most challenging impact.

2.1.9.4. Step 3: Establish Capability Targets

Capability targets are not a reflection of current capabilities, but represent a long-term desired proficiency level. Capability targets are established to describe the level of competence to work toward to achieve core capabilities. When developing capability targets SFA staff should consider what is required to address the impacts of threats and hazards.

Impacts, Objectives, and Timeframe Metrics

Each capability target describes a critical task that, when completed, helps successfully manage a threat or hazard. These critical tasks:

(1) Are based on the activities that emergency managers plan for; and

(2) Define activities that must be performed for a wide variety of threats and hazards, not only the ones identified in the THIRA.

Additionally, SFAs estimate which threat or hazard most challenges their ability to achieve the critical task described in each capability target. This adds more utility to the THIRA during real-world incidents. Capability targets are specific and measurable, and can be built by combining impacts, which represent the size of the capability requirement, and timeframe metrics, which represent the timeframe in which the action must be performed.

Impacts and Objectives

For each capability target, SFAs should identify the level of capability they want to work toward. To determine this desired level of capability, consider the impacts of threats and hazards, estimated resource requirements, expected available resources, and other relevant factors. The impact that is selected as a target does not need to match the impacts previously identified. However, SFAs should ensure they understand the risk posed by their threats and hazards and use that knowledge to inform the impacts they include in their capability targets. If an impact is selected that is different from the one previously identified, describe how it was chosen and the sources used. THIRA capability targets should reflect the SFAs' unique planning and investment strategies.

In addition to capability targets, SFAs may also set an additional target called a *maximum requirement* target. The maximum requirement reflects the highest level of a potential capability requirement. This maximum requirement reflects the impacts of the threat or hazard that most challenge the critical task described in the capability target.

It is important to note that not all capability targets are impact-based. While most targets use post-incident quantitative impacts as explained above, some capabilities focus on preventing an occurrence, or lessening the vulnerabilities that affect the scale of a threat or hazard. Instead of a traditional standardized impact, these targets include a measurable objective that represents a goal that has been set for that core capability.

Timeframe Metrics

Timeframe metrics describe the timeframe or level of effort needed to successfully deliver core capabilities. When constructing targets, it is not enough to know how much of an objective you plan to accomplish, you may also need to know how quickly you must be able to activate that capability, and how long you need to be able to sustain it. The answers to these questions will be unique to the capability target in question. When considering timeframes, SFAs should not be constrained by their current ability to meet timeframes or other conditions of success; rather, they should identify the timeframe that they desire to achieve. The SFA should use the type of metric that is most appropriate for the given capability. For the core capability Mass Search and Rescue Operations, that might be "search (#) structures within # hours," while for Threats and Hazards Identification, a more appropriate timeframe might be "model (#) scenarios every # years." The SFA should work with SMEs and stakeholders to determine time-based metrics that are most appropriate for each capability.

Developing Capability Targets

In the THIRA, SFAs create capability targets for the core capabilities listed in the National Preparedness Goal. The SFA should use standardized language and their own specific metrics to construct these targets.

In addition to setting capability targets using the standardized target language for each of the 32 core capabilities, certain SFAs may also want to develop additional targets. These additional targets can capture goals to achieve additional capabilities or critical tasks that are specific to the SFA's needs.

2.1.9.5. Conclusion

An SFA THIRA is intended to be a separate, stand-alone document, conducted on a site-wide basis, which characterizes a limited set of events that would stress the internal capabilities of the site, (i.e., most likely, worst-case incidents). The All-Hazards Survey is intended to provide a comprehensive evaluation of hazards applicable to individual facilities/activities and includes hazardous material screening. The goal of the THIRA is to provide a common operating picture to local authorities for emergency management and emergency scenarios.

The THIRA may reveal scenario hazard gaps in the existing EPHA. If, based on the professional judgement of Field Element Manager (FEM), scenario hazard gaps are revealed, then they are to be added to an existing EPHA or detailed in a new EPHA. If no scenario hazard gaps are revealed, then there is no further action required by the FEM than the conduct of the THIRA.

Specific guidance on how to conduct a THIRA for DOE SFAs is provided through templates located on the Enterprise Data Management System SharePoint site.

2.2. Technical Planning Basis

2.2.1. Introduction

The purpose of this chapter is to assist DOE and NNSA field elements in complying with DOE O 151.1D whenever a facility-specific quantitative assessment of the potential release of hazardous materials is required. An EPHA must be performed for an SFA when at least one hazardous material requiring quantitative analysis is identified through the hazardous material screening process conducted as part of the All-Hazards Survey. The Order requires special planning and preparedness for DOE emergency management programs that need to respond to emergency incidents or conditions involving the unplanned release of hazardous materials. The scope and extent of these programs will be based on facility-specific hazards through a *commensurate with hazards* approach. The first step in the implementation of this approach for hazardous materials is the quantitative analysis of potential emergencies in an EPHA.

EPHAs involve the application of rigorous hazards analysis techniques that provide sufficient detail to assess a broad spectrum of postulated incidents or conditions involving the potential release of hazardous materials and to analyze the resulting consequences. The screening process and the analysis of identified hazardous materials in an SFA determine the potential for producing an OE classified as an Alert, Site Area Emergency (SAE), or General Emergency (GE). If the hazardous material does not screen out, is not covered by the exclusions in Attachment 3 of DOE Order 151.1D, and a potential classifiable OE associated with an SFA or onsite activity is identified, an Emergency Management Hazardous Materials Program needs to be developed and maintained that establishes additional, more detailed emergency management program requirements than those imposed by the Emergency Management Core Program.

The EPHA performs three roles in a DOE emergency management program.

1. By summarizing the processes and systems associated with the hazardous materials, together with the nature and magnitude of the hazards, the EPHA provides the technical planning basis for establishing a graded approach that will determine the necessary plans/procedures, personnel, resources, equipment, and analyses that comprise the Emergency Management Hazardous Materials Program.

2. The documented EPHA provides an archival record of the data, assumptions, and methods used in developing the technical planning basis for the program; it also reflects the reasoning used to modify the program in response to changes in operations and hazards. The documented EPHA should enable an emergency management program to survive the inevitable turnover of hazards assessment personnel without the loss of continuity that can result from uncertainty about past analyses and decisions.

3. The EPHA performs a key readiness assurance role by providing clear evidence that facility-specific hazards are well understood by the responsible emergency management planners, and that, if used correctly, the EPHA represents a valid technical foundation for developing an emergency management program that is commensurate with hazards.

Of particular importance in performing hazards assessments, especially for sites with multiple facilities, is consistency in the selection and application of analysis techniques, hazardous material release scenarios, and the assumptions and input data used in consequence calculations. A recommended approach for ensuring consistency is to standardize and document ground rules and criteria prior to performing the hazards assessment analyses. The selection and subsequent documentation of EPHA release criteria and analysis techniques, beforehand, ensures both consistency between EPHAs for common scenarios and analyses and consensus among diverse site functions.

An effective method for accomplishing consistency and for ensuring consensus among diverse disciplines involved with the EPHAs is through interaction and coordination with a broad scope of interested facility or site functions, including operations, programs, Safeguards and Security (S&S), safety, fire protection, and authorization basis and emergency management analysts. Most sites, especially those with multiple facilities, can benefit from the issuance of a formal site-wide procedure for performing hazards assessments. Such a procedure should specify standard analysis methods, inputs, and criteria for performing the hazards assessment analyses, as well as a step-by-step hazards assessment approach and documentation standard that will ensure consistency among the site’s EPHAs. This documented procedure can also streamline the required DOE review and approval process for revised and updated EPHAs, which should significantly decrease the time required to implement approved changes in emergency management plans and procedures and emergency response tools such as Emergency Action Levels (EALs).

To the maximum extent possible, the hazards assessment process should make use of facility description and accident scenarios from SARs/SADs/DSAs/DBTs, consequence assessment methods used during emergency response, and existing hazardous materials inventories maintained for other purposes. Information available from sources such as SARs/SADs/DSAs/DBTs, BIO documents, Probabilistic Risk Assessments (PRAs), VAs, Fire Hazard Analyses (FHAs), Environmental Impact Statements (EISs), and other documents that address SFA hazards or potential consequences may be used to ensure consistency of basic input data. The analyses contained in these sources should be used with caution, however, because the assumptions and methodology applicable to their intended purposes may not be fully compatible with emergency management planning needs.

When scheduling EPHA preparation, the schedules for the preparation, review, and update of other safety and regulatory compliance documents should be considered. Integrating the EPHA effort with these schedules can increase preparation efficiency and reduce cost. Where possible, the same release parameters and analysis techniques may be used to minimize the differences between the EPHAs and safety/authorization-basis analyses.

In order to advance the level of understanding and the capability of performing integrated hazards analysis, a handbook was developed by DOE to emphasize the efficiencies and advantages associated with integrating the numerous hazard analysis methodologies performed under various requirements. This handbook, DOE-HDBK-1163-2003, *Integration of Multiple Hazard Analysis Requirements and Activities*, focuses on data exchange among the various analysis methodologies under multiple standards and requirements, where applicable. It is the intention of the handbook to promote further discussion and hands-on experience in encouraging the concept of the integration of hazards analysis. The hazards assessment process for emergency management discussed in this guide promotes this concept of analysis integration.

The guidance in this section is directed at operations and emergency management staff responsible for DOE and NNSA facilities at field offices, service centers, and operating contractor organizations. It is expected that emergency management staff will obtain support from site and facility management and from a variety of scientific and technical disciplines within their respective organizations as they conduct and document the analyses described herein.

2.2.2. General Approach – Technical Planning Basis

DOE Emergency Management System policy and Order 151.1 (current version) require that hazardous material emergency management programs are responsive to the full range (spectrum) of potential hazardous material release scenarios, including applicable hazardous material types, release magnitudes, and initiating incidents. The term *release* is used here to mean, primarily, an airborne release. The airborne release pathway typically represents the most time-urgent situation and requires a rapid, coordinated emergency response on the part of the facility, co-located facilities, and surrounding jurisdictions to protect workers, the public, and the environment. Releases to aquatic and ground pathways, although a matter of serious concern in terms of potential environmental and long-term public health consequences, in most instances do not have the same time urgency as the airborne release. When a release to an aquatic or ground pathway could have a near-term effect on the workers or the public, then it should be considered in the hazards assessment.

For a single facility, there may be hundreds of different possible hazardous material release scenarios. To address this range of possibilities, facilities should develop and document a technical planning basis for the facility-specific emergency management program consisting of a manageable number of systematically selected and realistically analyzed release scenarios to represent a spectrum of severity and initiators. The purpose of this chapter of the EMG is to provide guidance that will address the process for conducting and documenting the selection and quantitative analysis of potential release scenarios associated with the hazardous materials identified by the All-Hazards Survey screening process.

The recommended steps in the EPHA process are the following:

Step 1 Define and describe the facility and operations

Step 2 Characterize the hazardous materials

Step 3 Select scenarios for analysis

Step 4 Analyze Scenarios

- Estimate Source term
- Calculate consequences
- Identify recognition factors
- Finalize technical planning basis scenarios

Step 5 Document the results of the analysis

Although the basic steps of the process should be accomplished and documented in the order presented, within any given step of the process, there is substantial leeway within which the unique features of the facility, operations, and site can be accommodated.

The EPHA should address factors such as:

- Initiating incidents (e.g., security incidents, natural phenomena, technological hazards, etc.)
- Contributing events
- Accident mechanisms
- Equipment, system failures, or engineered safety system failure
- Source terms
- Material release chemistry and characteristics
- Environmental transport and diffusion
- Emergency incident or condition observable indicators
- Exposure considerations
- Health effects

Conservative consequence calculations should be performed for the purposes of incident classification, initial protective action determinations, response decision-making, and special planning (co-located facilities, special offsite populations, EPZ determination). The results of the hazards assessment are to be used to determine the EPZs for each facility and site, as well as the emergency classification and initial protective actions for each analyzed incident. The observable indicators, or recognition factors, of each analyzed incident or condition are identified for use as incident classification criteria (EALs).

The EPHA should be prepared and documented in a manner that permits critical review of the analyses and results and, if necessary, reconstruction by independent analysts. However, detailed descriptions of the methods, assumptions, and models need not be included if they are documented elsewhere and referenced.

2.2.3. Step 1: Define and Describe Facility and Operations

A clear, accurate, and unambiguous written and schematic description of the facility, activity, or operation that represents the scope of the EPHA should be provided. This description should provide sufficient detail to support the identification, location, and characterization of all hazards (radiological, biological agent/toxin, chemical and explosive) and their potential consequences. For many facilities, the descriptions of the facility and its operations from current SAR/SAD/DSA/DBT or environmental reports should serve this purpose and may be briefly summarized and incorporated by reference.

In some cases, the boundaries of the facility and operations in question will have been previously defined. Facility definitions used for SAR/SAD/DSA/DBT purposes may be applicable. However, the boundaries should be reexamined with the objectives of the EPHA in mind.

Sites may group their facilities, activities, and hazards in any of several ways for hazards assessment purposes. Several structures or component units with a common or related purpose may be defined as single facility, such as a waste tank farm consisting of a number of units of approximately the same nature and purpose under common management and operational control. On the other hand, a group of dissimilar buildings, operations, and equipment, such as a research reactor with its associated cooling tower, fuel handling and waste storage buildings, laboratory, and hot machine shop may also be considered as one facility for purposes of the hazards assessment. Finally, all the hazards within a single building or structure containing several tenant activities or units, such as process lines, hot cells, or hazardous material storage may be analyzed and documented as one facility, even though the tenant activities have little in common, technically or organizationally.

The written facility description should include general information related to the site mission, operations, and physical characteristics, including an assessment of the site exposure to external and natural phenomena hazards. It should include the location of the facility relative to other facilities on the same site, the site boundaries, the nearest public access locations, and transportation networks, such as highways, railroads, and rivers.

Particular attention should be paid to including facility-specific information critical to understanding and reconstructing the consequence calculations and to information necessary to aid emergency planners in using the analysis results to develop other emergency management program elements. This information should include:

- Descriptions and physical parameters for facility containment/confinement systems
- Potential leak paths and release points
- Protective/mitigative systems or features
- Technical, physical, or administrative limits on use/storage of hazardous materials
- Installed process monitors, alarms, or detection systems.

2.2.4. Step 2: Characterize the Hazardous Materials

After the facility hazards have been screened, using the hazardous material screening process outlined in Attachment 3 of DOE O 151.1D, the characterization of both radioactive and chemical hazardous materials should include the following information:

- The maximum quantity of the material in appropriate units (pounds or kilograms, curies or becquerels) and its storage or process locations.

- A description of the conditions under which the material is stored or used, including process systems or containers that hold the material, and barriers that may impact its release or dispersion, such as shipping containers, buildings, berms, sumps, or catch basins. Where applicable, security and access controls for the storage and use locations should be identified.

- The properties of the material that are needed for determination of source term and consequence analysis, such as the physical form and chemical characteristics of the material (e.g., solid, liquid, gaseous, particle size, flammability, chemical reactivity, density, combustion and explosion byproducts, vapor pressure, boiling point, freezing point), radiological characteristics, and the temperature and pressure conditions under which it is stored, processed, used, or transported.

- A description of engineered controls, safeguards, or safety systems designed to prevent or mitigate a hazardous material release. These may include both automatic and manually activated mitigative systems, as well as passive mitigative features and engineered geometry or configuration controls for fissionable materials. Instruments and systems that would detect actual or potential emergency conditions should be identified.

- A description of administrative controls that would prevent or mitigate the initiation of a hazardous material release, such as limits on the total quantity of a material in a single place or container, or restrictions on where certain materials can be used or stored.

For criticality accidents, the inventory of interest is the total yield of gaseous and volatile fission products from the postulated criticality incident(s). Analyses of these postulated criticality incidents would generally be available in the facility SAR, SAD, or DSA.

Where the material consists of a reactor core or irradiated fuel containing mixed fission products, the relevant factors that define the radiotoxicity of the mixture should be analyzed and the case that produces the largest impact selected. The actual isotopic composition of the mixture used for consequence calculations can then be included as an appendix and referenced.

For those facilities having a documented vulnerability analysis, the identified targets may include both hazardous materials and essential parts of the system of barriers, controls, and protection features that keep them in a safe condition. The target list is a potential source of information regarding both the quantity of certain hazards and the conditions under which they are stored, handled, and used.

Other materials and hazard sources, such as flammable or explosive materials, energy sources, processes containing oil, and non-toxic hazardous materials (i.e., NFPA health hazard rating ≤ 2 in quantities greater than a quantity that can be easily and safely manipulated by one person), should also be included in the characterization. The potential for these materials/hazards initiating releases of radioactive or chemically toxic materials contributing to the dispersal of those materials, degrading the effectiveness of safety systems, incapacitating workers causing a process upset, or posing an asphyxiation hazard to collocated workers, should be considered. Available information concerning the reactive properties of the hazardous materials should be assessed and the possibility of interactions between substances considered.

2.2.5. Step 3: Select Scenarios for Analysis

The objective of this step in the hazards assessment process is to select potential release scenarios associated with the hazardous materials characterized in Step 2. These analysis cases will ultimately represent a spectrum of possible scenarios that will serve as the technical planning basis for the SFA emergency management program.

The specific scenarios/cases to be analyzed in the EPHA should be chosen through a systematic examination of:

- All the hazardous materials in the facility;
- Primary barrier(s) that maintain each material in a safe condition;
- Modes by which each primary barrier could fail;
- Initiating incidents or conditions that could cause barrier failure modes; and
- Release conditions associated with the failure mode or the initiating incident, including pathways and mitigation devices through which the substance could be released to the environment.

Applicable combinations of the hazardous materials in the facility and potential scenario characteristics will define a set of analysis cases, where each release scenario will be represented by combinations of the following four terms:

- Hazardous material [Material-At-Risk (MAR)]
- Failure mode
- Initiating incident or condition
- Release condition(s)

This process of developing potential scenarios by constructing combinations of these four parameters will ultimately lead to a complete listing of the applicable cases.

2.2.5.1. Types of Incidents and Conditions to Be Considered

A set of incidents and conditions should be postulated and analyzed that represents the full spectrum of possible initiators and severity levels involving releases of hazardous materials that could affect workers, the public, or the environment. A spectrum of potential incidents ranging from low-consequence, high-probability incidents to high consequence, low-probability incidents, including those considered to be beyond-design basis, should be postulated and realistically analyzed. The spectrum of incidents and conditions analyzed should include those exclusively affecting onsite personnel, as well as those also affecting the offsite public. Analysis of a spectrum of incidents does not mean analysis of every imaginable incident. The goal is to create a comprehensive picture of the types of incidents and a range of associated consequences that could occur at a facility. This comprehensive picture of incidents and consequences will then serve as the basis for emergency response planning.

The All-Hazards Survey described in Section 1 of this Chapter, identifies the types of emergency incidents and conditions and the potential impacts of such emergencies to be addressed by the DOE emergency management program for the facility. If facilities have sufficient quantities of hazardous materials, some of those types of emergencies will have the potential to cause the airborne release of hazardous materials with significant health and safety consequences outside the facility. Thus, the All-Hazards Survey for a facility provides an initial set of potential release incidents and initiators to be considered for analysis.

Initiating incidents and failure mechanisms considered in the hazard assessment should include traditionally defined accidents, as well as incidents arising from external causes and malevolent acts. Scenarios should be included that represent both the success and the failure of control measures and engineered safety systems. A minimum set of incidents is recommended for analyzing hazardous material releases identified as candidates for a hazard assessment. The incidents that are appropriate to the specific facility should be selected from the following groups:

1. **Incidents**:

    - Fire
    - Explosion
    - Loss of confinement or containment
    - Process upsets
    - Criticality
    - Onsite transportation accidents

    Accident event initiators include failure causes such as corrosion, manufacturing defects, malfunctioning equipment or control systems, interaction of reactive materials, external impact, incapacitation of workers, and procedural or human error. (The analysis of onsite transportation accidents is addressed in Appendix B.)

2. **Events**:

- Earthquakes
- Tornadoes
- Lightning and Hail
- Floods
- Wildland Fires
- Winter Storms

Most natural phenomena events to be analyzed can be selected from the SAR/SAD/DSA/DBT (if available) for the facility. Typically, two events are defined for each type of natural phenomenon — DBE used to determine safety control systems, as well as an extreme, beyond-DBE, considered incredible in SAR/SAD/DSA/DBT analysis. Both events are derived from historical data. If no SAR/SAD/DSA/DBT is available, the event(s) can be obtained directly from historical data for the region.

3. **External Events**:

- Aircraft crash
- Offsite transportation accidents
- Offsite commercial facility or utility accidents

External events have the potential to be the initiating incident for the onsite release or loss of control of hazardous material, either directly or by disruption of operations or processes onsite. Historical data can provide information on the susceptibility of the area to wildland fires and potential aircraft sizes can be determined from experience with aircraft operating in the vicinity. A review of road, river, and railway transportation networks near the site boundary (or through the site) provides indications of potential hazardous material transport accidents. In addition, nearby commercial facilities or utilities (chemical plants, pipelines, water treatment plants) may contain hazardous materials that pose a threat to facilities onsite.

Incidents originating offsite that affect the site may not meet the requirement to have an EPHA. The ERG may be used by emergency responders to analyze offsite releases of hazardous materials that impact the site. Offsite transportation accidents may involve nuclear weapons, their components, or special nuclear weapons, and require assistance from the Office of Secure Transportation (OST). Refer to DOE O 151.1D Attachment 5 for requirements regarding the OST EPHA.

4. **Malevolent Acts**:

Malevolent acts, including the use of explosives or flammable material, are possible hazardous material release initiators within the scope of the emergency planning and the EPHA. More examples of potentially malevolent scenarios can be found in the current version of DOE O 470.3C, *Design Basis Threat (DBT) Order*. The Office of Emergency Management Policy defines the term *extreme malevolent acts* within the context of catastrophic incidents that can be further categorized as man-made deliberate criminal acts.

Severe Incident Scenarios

Low-probability, high-consequence incidents should be addressed in facility emergency management plans (and in EPHAs) because of their potential effects on workers in the affected facility and those nearby. Both malevolent acts, which are seldom analyzed in SARs/SADs/DSAs, and beyond-DBEs should also be included in the EPHA. Extreme malevolent acts and beyond-DBEs typically represent the upper end of the consequence spectrum for which prompt recognition and response may be essential to the mitigation of both the incident and its health and safety consequences. By adding these scenarios to an EPHA, planners can:

- Gain perspective of the residual risk associated with the operation of the facility.
- Gain additional perspectives for accident mitigation.

These analyses provide valuable insights and can serve as bases for cost-benefit evaluation of improvements, modifications, or enhanced emergency management response capabilities.

2.2.5.2. Selection of a Spectrum of Scenarios

A process consisting of the following sequence of steps is an acceptable method for selecting a spectrum of scenarios related to the hazardous materials in the facility:

1. Identify MAR(s) in the facility;
2. Identify primary barrier(s);
3. Select failure mode(s);
4. Identify initiating incident(s); and
5. Identify release condition(s).

This selection process is described in detail below.

A. Identify Material-at-Risk (MARs) in Facility

The selection process begins by identifying the hazardous substances at each location within the facility. Each quantity or unit of a hazardous substance is the MAR, as that term is used in DOE-HDBK-3010-94 (and discussed in Section 2.6, below), for one or more possible release scenarios. Examples of MARs include:

- Nitric acid in an outdoor storage tank
- Radioactive liquid in a processing system
- Chlorine in a cylinder attached to a gas manifold

A facility can contain one or multiple MARs. In some instances, the MAR for an incident affecting the entire facility might include all the material located in the facility. This will be addressed in the discussion of the source terms in Section 2.6.

B. Identify Primary Barriers

The physical or administrative features that maintain the hazardous substance in a safe condition should be identified for each MAR. The primary barrier is generally the one physically nearest to the material. In the case of gaseous or liquid materials, the tank, cylinder, process piping, or other container is usually the primary barrier. For materials that are prevented from being released by their own structure or physical form, that form or structure can be regarded as the primary barrier.

C. Select Failure Modes

Failure modes are the ways in which the primary barrier might lose its integrity or its ability to perform the function of controlling or confining the hazardous material. Failure modes should be selected that are applicable to the primary barrier for the MAR being addressed. The following are examples of failure modes of the primary barrier that might apply to the MAR examples given above and the types of release that might be produced:

- Puncture (of the nitric acid tank, causing spill of liquid)
- Fatigue crack (in the pipe carrying pressurized radioactive liquid, causing spray leak)
- Impact fracture (of the chlorine cylinder stop valve, venting a pressurized gas)
- Combustion (of solid radioactive waste material, releasing contaminants)

For radioactive materials, identification of the failure modes is necessary to make use of the source term information from DOE-HDBK-3010-94. It also helps align the EPHA consequence calculations with authorization basis safety analyses, a key element in the integration of facility hazards analyses. See DOE-HDBK-1163-2003, *Integration of Multiple Hazard Analysis Requirements and Activities*, for guidance on this subject. Selecting failure modes and their size/degree is also an initial step in modeling chemical releases using calculation methods such as those described in Environmental Protection Agency (EPA) 550-B-99-009, *Risk Management Program Guidance for Offsite Consequence Analysis.*

The first and most important failure mode to be identified for each MAR is the one that produces the bounding (largest possible) source term, either in terms of total amount of material released or the rate of release to the environment. For facilities covered by authorization basis safety analyses, this case is likely to correspond to an analyzed bounding event (DBE or Beyond-DBE). Using the earlier MAR and failure mode examples, reasonable bounding source terms might correspond to the following cases:

- Spill of the entire contents of the nitric acid on a flat surface at the highest average daily temperature, producing the largest expected evaporative (airborne vapor) source;
- Spray from a pipe crack of the size that will produce the maximum mass release rate of respirable-size aerosol droplets, continuing for a time corresponding to the expected duration of the liquid transfer operation;
- Release of the entire contents of a chlorine cylinder over a period of 15 minutes (the averaging time used for comparison with the applicable exposure criterion); and
- Burning of the entire contents of a waste accumulation area, with release of the bounding fraction (from DOE-HDBK-3010-94) of the largest amount of radioactive material expected to be in the waste material.

Once the bounding release is identified, one or more additional cases may be needed to adequately represent the range of possibilities. If the consequences of the bounding case are below the threshold for classification at the Alert level, there is little reason to analyze additional cases, because any smaller releases will also fall below the threshold for classification. However, this may only become evident when final consequence calculations are performed.

The following represents a set of failure modes that might apply to a nitric acid tank:

- Puncture (or crack) low on the tank, which would produce an evaporative source limited by the area of the confinement curb/berm
- Puncture/crack at a higher level, which would produce splash/spray source of aerosols, in addition to the evaporative source
- Overturning/toppling, such that all or most of the tank contents end up outside the curb, producing a larger evaporation surface and source

The choice of the spectrum of sizes or degrees of failure (modes) that will apply to the MAR under consideration is the key to the selection approach. If this initial selection of the spectrum of failure modes is done carefully and methodically, based on a clear understanding of the features/characteristics of the primary barrier and the MAR, then the spectrum of selected scenarios that is the final product of the process will provide a solid foundation/basis for emergency planning.

The results of this step include combinations of MAR and failure modes for each MAR and its associated failure modes identified in the facility.

D. Identify Initiating Incident(s)

The next step in the process is to identify initiating incidents/conditions that could apply to each failure mode (i.e., cause the failure). The analyst should postulate a range of initiators applicable to the specific SFA, starting with the guidance presented in Section 2.5.1 and identifying those that could produce the failure mode under consideration. In addition, the analysis should indicate whether a specific failure mode would be exclusively or most likely associated with a particular initiating incident or condition, OR, conversely, if that particular release could NOT result from a certain incident/condition.

Examples of initiating incidents that might be considered include:

- Fire;
- Explosion *Accidental or Intentional (VBIED, IED)*;
- Loss of electrical power;
- Material/manufacturing defect;
- Operator error; and
- Natural phenomena impacts.

For example, a puncture failure of the nitric acid tank might result from impact by a truck or forklift, which, in turn, might be attributed to human error. The puncture might also be caused by a natural phenomenon (wind-driven missile) or an external incident (gas explosion in a nearby facility).

This step results in a set of failure modes (for a particular MAR), each associated with one or more initiating incident(s) or condition(s), that is, combinations of MAR, failure mode, and initiating incident. The next step identifies the last parameter(s), which represents factors that influence the release of the material to the environment (i.e., outside the facility/building).

E. Identify Release Condition(s)

Incidents or conditions that could influence the progression of the scenarios identified above, or alter the magnitude or nature of the associated consequences, should be identified in this step. These events or conditions, referred to as *release conditions*, represent the status or functional condition of structures and mitigation systems consistent with the impact/influence of the chosen initiating event. These release conditions can affect the magnitude, rate, or location (elevated vs. ground level) of the release to the environment. For example, failure of fire suppression systems to activate following initiation of a fire would change the event progression. Likewise, different levels of combustible loading in a given area might increase or decrease the magnitude of the fire. Either or both release conditions might affect the degree of damage to the facility or quantity of hazardous material released.

In the nitric acid tank example, an installed curb or berm may limit the size of the spill and hence the evaporative source. The release rate will depend on whether, for the particular initiating event under consideration, the curb/berm can be expected to limit the pool surface area. Whereas puncture of the tank by one event (missile) might reasonably be expected to spill the contents within the curb/berm, thereby limiting the pool surface area and evaporative source, a seismic event might overturn (topple) the tank, causing all or part of the liquid to spill outside the curb where it could spread out and evaporate from a larger surface area.

If the operation of an engineered feature can be determined at the time of an event, then the performance of the mitigation feature (and the resulting source term mitigation) is known. If the ultimate release to the environment accounting for the mitigation is sufficiently different from any other analyzed case, then separate analysis cases should be identified that represent the performance and the non-performance of the mitigation function. For bounding events that correspond to a safety basis DBE, the performance of the design features that were credited in that analysis can often be determined from the SAR/SAD/DSA/DBT, and additional analysis cases can be constructed that take into account different degrees of mitigation. To develop useful bounding incidents in the event there is a lack of detailed information during an incident that resulted in a release, additional scenarios should be performed that identify the minimum quantity of a hazardous material that, when released, results in an Alert, SAE, or a GE.

For example, a filtered ventilation exhaust via an elevated release point will reduce consequences from a release inside a building by removing part of the airborne aerosol and allowing greater dispersion of the plume before it encounters a ground level receptor. If the spray leak discussed above occurs inside a building and the ventilation exhaust function is maintained, one source term (and release point) would apply. If the exhaust system does not operate and the structure is damaged, a second case would have to be identified in which the release occurs at ground level and is unfiltered. If the exhaust system does not operate, but the structure remains intact, a third case may even be needed to represent attenuation of the source term by static confinement.

The identification of release conditions is the final step in the selection of a spectrum of scenarios for analysis. The set of release scenarios (or cases) selected for detailed analysis will consist of combinations of MAR, failure mode(s), identified initiating event(s), and, finally, identified release condition(s) that may influence the location or magnitude of the release. The next step (Step 4) involves the analysis of each release scenario/case [i.e., MAR-failure mode-initiating event-release condition(s) combination] to characterize the release to the environment by producing an estimate of the source term, calculating the consequences, and identifying recognition factors (if available) for each scenario.

Additional consideration for sites with underground facilities include atmospheric release data: postulated radionuclides, release amounts, release rates (constant or variable); release assumptions: longitude and latitude of the release locations, vent release heights (above ground level), radii of the release stacks, exhaust air temperatures, estimated particle sizes, particle deposition velocities; onsite meteorological data and consequence model information: real time site weather data, site consequence model name, assumptions used, distances to which results are expected to be accurate and how the site model compares and differs from the National Atmospheric Release Advisory Center atmospheric model. Those factors that could invalidate the results are directly linked to the dispersion model used and the assumptions built into the model. It is the recommendation of the Office of Emergency Management that, prior to using any site dispersion model, that it be submitted for peer review to the Consequence Assessment Modeling Working Group under the Subcommittee for Technical Analysis and Response Support (STARS).

2.2.6. Step 4: Analyze Scenarios

Once the full range of possible releases has been identified and representative cases selected in accordance with the preceding sections, each case should be analyzed and the potential consequences should be calculated to determine the areas potentially affected and the need for personnel protective actions. In addition, the analysis includes the identification of recognition factors for each scenario and the development of a final set of technical planning basis scenarios using the previous analyses of consequences and recognition factors.

This step in the hazards assessment process consists of the following analysis components:

- Estimate source term
- Calculate consequences
- Identify recognition factors
- Finalize technical planning basis scenarios

Methods and models used to calculate consequences should be documented such that the analyses and their results can be critically reviewed and, if necessary, reconstructed by independent analysts. Detailed descriptions of the methods, assumptions, and models (e.g., dispersion models, dose codes, or other complex calculation methodologies) need not be included in the EPHA if they are documented elsewhere and appropriately referenced.

When operating an Emergency Management Hazardous Materials Program, the dominant hazards on the site, and severity of the consequences for the emergency classification (GE, SAE or Alert) must be listed in a table of potential Operational Emergencies within the EPHA. This table must contain the majority of the most severe potential hazardous material releases. For more information concerning concurrent or multiple releases see Section 2.6.2.

2.2.6.1. Estimates of Source Terms

The source term associated with MAR primary barrier failure modes, initiating events, and release conditions should be calculated. For each possible failure mode of the primary barrier, the release fraction or release rate values from the DOE source term handbook, DOE-HDBK-3010-94, can be used to estimate the amount of radioactive material that would become airborne. Selection of failure mode and size are implicit in the modeling choices that need to be made to calculate chemical releases using methods such as those described in EPA 550-B-99-009, *Risk Management Program Guidance for Offsite Consequence Analysis.*

Radiological Source Terms. After failure modes have been identified for the primary barrier or containment system associated with each hazardous material, a quantitative estimate of the source term, the amount ultimately released (or rate of release) to the environment, can be developed using the method described in DOE-HDBK-3010-94. The source term is defined as follows:

ST = MAR x DR x ARF x RF x LPF
Or
ST = MAR x DR x (ARR x t) x RF x LPF

Where:

ST	=	Source Term (Ci or Bq)
MAR	=	Material-at-Risk (Ci or Bq)
DR	=	Damage Ratio (fraction)
ARF	=	Airborne Release Fraction
ARR	=	Airborne Release Rate (fraction/hour)
t	=	Release Duration (hours)
RF	=	Respirable Fraction
LPF	=	Leak Path Factor (fraction)

Material-at-Risk (MAR). For each initiating event, develop a quantitative estimate of the Material-at-Risk (MAR), the amount of material available to be acted on by a given physical stress. The maximum inventory that may be affected by the initiating event is typically used to represent the MAR. For a given analysis, the MAR will be based on factors such as the type and magnitude of the initiating event, the spatial distribution (separation) of the inventory, and administrative controls. For example, consider a facility with a process line producing items that are placed in shipping containers and then transferred to a shipping/receiving area. The MAR for an event affecting the entire facility (for example, a catastrophic earthquake) might include all the material in the process line, all the product in shipping containers still within the process area, and all the product material stored in the shipping/receiving area. The MAR for an explosion in the process line might be the maximum quantity allowed by administrative controls for that process. The MAR for a handling mishap involving a single shipping container might be either the physical capacity or the licensed maximum contents for that type of container.

Damage Ratio (DR). The Damage Ratio is the fraction of the MAR impacted by the actual conditions under evaluation. The DR is usually estimated based on engineering analysis of the response of the materials involved to stresses of the type and level generated by the event. The DR value will depend on the specific initiating event and the definition of MAR for that event/condition. In the example above, if the MAR for a handling mishap involving a single shipping container were defined as the contents of one container, the DR for a puncture of that single container would be one (1). On the other hand, if the MAR is defined to include all the material in *n* shipping containers subject to handling mishaps, the DR for an event that punctures a single container is 1/n. DOE-HDBK-3010-94 provides information on DRs for various phenomena.

Airborne Release Fraction (ARF). The ARF is the fraction of material suspended in air following physical stress from a specific event. For events of short duration, the ARF is a fraction of the material affected (i.e., of the MAR times DR). For processes that act continuously over a period of time to suspend aerosols (such as aerodynamic entrainment or resuspension) a release rate is required to estimate the consequences. Airborne Release Rates (ARRs) are based on measurements over an extended period of time from a particular mechanism. Recommended ARF and ARR values are published in DOE-HDBK-3010-94 for a variety of release phenomena.

Respirable Fraction (RF). The Respirable Fraction is the fraction of the airborne material that can be inhaled and thereby contribute to the radiation dose to an exposed person. The RF is commonly defined as the mass fraction of the airborne material that is in the form of particles of 10 micron Aerodynamic Equivalent Diameter (AED) and smaller. However, applying the source term equation to materials such as radioactive noble gases that do not produce their effect by the inhalation pathway requires that a somewhat more general definition of the RF be used. For such materials, DOE-HDBK-3010-94 recommends the ARF value of 1.0 for condensable and non-condensable gases. All materials in the gaseous state can be transported and inhaled; therefore, an RF value of 1.0 is assumed for analysis purposes.

Leak Path Factor (LPF). The Leak Path Factor quantifies the combined effects of any secondary barriers and other mitigating features. In the case of material aerosolized or vaporized inside a glovebox within a building, the LPF represents the fraction of the total aerosol or vapor that is ultimately released to the environment through exhaust filters, door seals, and other leakage paths.

Realistic values should be used in developing the LPF for the particular event. To determine the overall LPF, the effectiveness of individual barriers and mitigating features should be estimated. For example, exhaust filters may have a rated or tested efficiency of 99.95 percent for the first stage and 99 percent efficiency for subsequent stages. The building walls may be assumed to be intact in some scenarios with all the release through the filters, while other scenarios may involve damage to the walls, resulting in part of the release being unfiltered. The methods described in EPA 550-B-99-009, *Risk Management Program Guidance for Offsite Consequence Analysis,* Appendix B, may be used to represent the effect of building confinement.

DOE-HDBK-3010-94 provides Airborne Release Fractions (ARFs), Respirable Fractions (RFs), and Airborne Release Rates (ARRs) applicable to many types of releases. The bounding ARF, RFs, and ARRs listed in the DOE-HDBK-3010-94 are normally most appropriate for use in hazards assessments. Accident-specific ARF, RF, and ARR values derived in other safety documents can also be used in the hazards assessment. If no specifically applicable values can be found, the final release fraction values for Hazard Category 2 cited in DOE-STD-1027-2018 Chg. Notice 1, Attachment 1, may be used to represent the ARFxRF.

<u>Chemical Source Terms</u>. The conceptual approach embodied in the source term equations presented above for radioactive materials can also be applied to chemicals. EPA 550-B-99-009, *Risk Management Program Guidance for Offsite Consequence Analysis*, contains useful information on modeling a number of different toxic gas and liquid release phenomena. Alternatively, any of several computer codes can be used to determine chemical source terms and to model their transport and dispersion. DOE Office of Environment, Health, Safety and Security also provides a useful toolbox of models available under Safety Software Quality Assurance — Central Registry (ALOHA, CFAST, EPIcode, GENII, Hotspot, IMBA, MACCS2, MELCOR).

Note: Use of the Central Registry toolbox codes is not mandatory. However, using the codes offers several advantages to the DOE and its contractors. Some of these advantages include: 1) the gap analysis evaluation performed provides valuable information on the code regarding application of Safety Software Quality Assurance (SSQA) requirements, 2) the evaluation extends beyond the DOE SSQA criteria to the review of the code's capability to produce verifiable and acceptable results, and 3) due to the established pedigree, further evaluation of the toolbox code by DOE and site contractors may be reduced in scope.

Chemical source terms for reaction product formation are normally determined by manual calculation using conservative assumptions regarding the rate and completeness of the reaction. Models or analysis techniques used to develop chemical source terms should be documented and the justification for their use provided.

2.2.6.2. Consequence Calculations

After all identified combinations of MAR, failure mode(s), initiator(s), and release condition(s) have been considered, and the associated source terms recorded, the consequences of each release scenario/case, for which a source term has been estimated, should then be calculated and recorded.

Methods and Models for Consequence Calculations. The consequences of hazardous material releases should be estimated using models and calculation methods that are most appropriate to the material released and to the physical characteristics of the site and its atmospheric dispersion conditions and, if applicable, hydrologic dispersion conditions. Generally, the consequence assessment models used for emergency planning and response purposes at the facility should be used to conduct this hazards assessment. The selection of dispersion and consequence models should be justified in the EPHA for each facility. Specifically, the applicability of the model to the release mode, the site geographic features, and atmospheric conditions typically experienced at the site should be described. The results of any experimental verification or validation of the models should be cited as well as any known limitations or sources of inaccuracy. The model capabilities with regard to factors such as plume buoyancy, dense gas effects, building wake, surface roughness, gravitational settling, and dry deposition should be described. As previously indicated, a listing of available codes is provided in the Central Registry or the STARS modeling toolbox. The following modeling recommendations are provided as guidance to consequence analysts:

- Use of a straight line Gaussian model as the atmospheric dispersion portion of the code is acceptable in most cases for emergency planning.

- Dose Conversion Factors (DCFs) and exposure parameters embedded in radiological computer codes should be verified to ensure that they are consistent with the desired results (e.g., total effective dose (TED) or committed effective dose (CED)). DCFs from current International Commission on Radiological Protection (ICRP) publications should be used for consequence calculations. The same DCFs should be used to calculate onsite (worker) and offsite (public) doses for the EPHA (see Appendix C).

- If computer codes are used to calculate chemical consequences, inputs and model choices representing the release (source term) should be selected to ensure that the output (predicted concentration) values are consistent with the criteria against which they will be compared (15 minute time-weighted average concentration). See Appendix C for additional guidance on selecting consequence criteria and computing time-weighted average concentrations.

- For chemical mixtures and concurrent releases of different substances, the consequences should be assessed using the STARS default methodology for analysis of airborne exposures to mixtures. Concurrent releases should only be analyzed if a plausible scenario exists by which quantities of different substances, each exceeding a laboratory scale threshold discussed in Appendix A, could be released from the same location at the same time.

- If a significant waterborne pathway exists (i.e., potential for a spill into a waterway with a downstream public water supply intake), site-specific calculation of downstream concentrations over a range of spill volumes should be performed.

The accuracy of a dispersion model is highly dependent on the transport model and coded assumptions. For the purpose of the EPHA, if results go beyond 25 miles, identify the corresponding model used for the analysis. If critical distances are at or beyond the 25 miles, report the true distances and assure that the transport model used is validated and peer reviewed for accuracy at those distances. Results generated with a simple, straight-line plume model should not be suitable to report distances at or beyond 25 miles due to inaccuracies resulting in over-conservatism that will be compounded by the increasing distance. Distances at or beyond 25 miles may require more sophisticated dispersion models.

The accuracy or uncertainty of dispersion models should not be quantified by a single value to be applied to all models and all modeling situations. Dispersion models vary in their capabilities and inherent uncertainties and the scenarios they simulate vary over a range of hazardous situations and atmospheric conditions; therefore, it is misleading to use a single downwind distance to reflect model confidence or uncertainty.

As an example of the range of dispersion model capabilities, the Gaussian class of models is intended for limited downwind distances and time periods due to its use of steady-state conditions. Accurate determination of when these Gaussian models become uncertain depends on whether scenario characteristics invalidate the steady-state assumption; variable weather conditions, in space or time, and the presence of varying terrain. More complex models, such as 3-D models, are suitable for changing conditions associated with either longer downwind distances and time periods and normally account for terrain variability. While both Gaussian-based and 3-D models have an inherent uncertainty that increases with downwind distance, their respective uncertainties are specific to their differing methodologies leading to the validity of using 3-D models over larger distances and longer time scales.

Estimates based on the assumptions from Gaussian dispersion models are overly conservative. As you increase the distance from the source, the accuracy of the model decreases, but should be sufficient in bounding the health and safety impacts for a site as required by an EPHA. The distance of 25 miles is believed to be arbitrary and could easily be stated as 10, 30, or 50 miles, etc.

Chemical Mixtures

Chemical mixtures and concurrent releases from multiple facilities for plausible site scenarios may be examined using the STARS Chemical Mixture Methodology Workbook, which provides step-by-step instructions for use. The sites are responsible for identifying and preparing to respond to the worst case scenarios listed in their EPHA for a single facility or multiple facilities that could be relevant during a cascading event.

Concurrent releases should be analyzed if a plausible scenario exists by which quantities of different substances, each exceeding the laboratory scale threshold discussed in Appendix A, could be released from the same location at the same time. Due to their physical separation, simultaneous releases of different chemicals that would result only from severe accidents don't need further analysis.

Dispersion Conditions for EPHA Calculations. At least two sets of dispersion conditions should be considered in computing consequence versus distance for each source term:

- Conservative Conditions. The first case of an assumed ground level release should correspond to the 95 percent worst case relative concentration (X/Q) based on an appropriate wind speed and stability combination for the particular site. If such a determination has not been made for the site, default to a wind speed of 1.5 m/sec (measured at a height of 10 meters) and Stability Class F to approximate the 95th percentile X/Q.

For an elevated release, the conservative condition may need to be determined by trial. In general, the conservative condition should be the combination of stability class and wind speed that results in the ground level consequence exceeding the Protective Action Criterion (PAC) at the greatest distance from the source. However, if the PAC is not exceeded at ground level, the conservative condition should be that which produces the highest consequence to a ground level receptor. If the dispersion condition meeting the above criterion occurs significantly less than 5 percent of the time at the source location, a less severe combination of wind speed and stability, that might be expected approximately 5 percent of the hours in a year, may be selected for the conservative case.

- Average Conditions. The second case should approximate a typical set of conditions for the site, such as the average wind speed and most prevalent Stability class averaged over the compass sectors. If such information is not available, D stability and 3 m/sec wind speed are acceptable assumptions.

Consequences calculated using the selected conservative dispersion condition should be used to develop EALs and default (i.e., pre-planned) initial protective actions and to determine the size of the EPZ. Use of direction-specific atmospheric dispersion factors for these purposes is strongly discouraged. Consequences calculated using average dispersion conditions are for general reference and response planning purposes only. The *typical* or *average* results are used in conjunction with the conservative case results to provide perspective on the risk associated with each scenario. These results may be useful in offsite planning discussions with local authorities and as a resource for emergency response personnel.

In general, the use of real-time meteorological conditions as a factor in determining incident classification and initial protective actions is not encouraged. Doing so requires a sophisticated understanding of the local atmospheric transport/dispersion environment, as well as accurate information on current meteorological conditions and a high degree of confidence in the forecast. It also complicates, and potentially lengthens, the decision processes. The need for reliable real-time weather information and on-call meteorological expertise, together with the added complexity of the decision process, make such an approach unsuitable for reaching timely, conservative, and anticipatory classification and protective action decisions as required by DOE emergency management policy.

Consequence Calculations for EPHAs. Consequences of each radiological and chemical release should be calculated and summarized in the form of a graph or table that gives the dose (TED) or concentration (the highest 15-minute time-weighted average concentration) versus distance, extending out to a distance beyond which PAC [i.e., (Protective Action Guides (PAGs) for radioactive materials; and AEGLs, ERPGs, or TEELs for chemicals] are exceeded (Cf. Appendix C). These summarized results can then be used to estimate consequences at receptor locations relevant to each facility, including the facility boundary and nearest site boundary. This data can be used during a response to estimate (interpolate) consequence values at other locations rapidly.

Consequences at the facility boundary and nearest site boundary are used for determining the emergency classification and developing EALs corresponding to each analyzed incident. In addition to calculating consequences at specific receptors, the maximum distances at which consequences exceed the applicable PAC are used to develop default (i.e., preplanned) initial protective actions. Maximum distances at which consequences exceed the PAC and Thresholds for Early (acute) Lethality (TELs) (Cf. Appendix C) are both considered in developing EPZs. The distances at which PAC and TELs might be exceeded under the most severe credible accident conditions are important considerations in defining the EPZ.

All emergency response facilities and receptor locations within the site EPZ should be identified and outlined in the site EPHA. The maximum distance for the site EPZ is a 10-mile radius. If the nearest distances to offsite receptors, such as emergency buildings, schools, and hospitals are beyond the 10 mile EPZ, they should still be included in the site emergency management plan to provide protective action recommendations to State and local decision makers to protect members of the public. The site emergency management plan should include these critical offsite receptor locations so that field teams may be deployed to confirm or modify the protective action recommendations that were provided to the offsite designated responsible authorities.

Consequences at Receptors Locations of Interest. Calculation of consequences at key receptors provides the emergency planner with essential parameters that affect classification decisions and protective action determinations.

Other Onsite Receptors. Other onsite receptor locations of interest should be identified for each facility, including:

- Adjacent facilities with significant occupancy;

- Protected area boundaries;
- Any locations accessible to the general public, such as roads, visitor centers, parking lots; commercial (non-DOE/NNSA) facilities and operating areas on the site; and
- Emergency response facilities, such as Emergency Operations Centers (EOCs), evacuation staging areas, medical aid stations, or fire stations.

For purposes of emergency planning and classification, the maximum consequences to a hypothetical individual at ground level outside a structure are to be calculated. The hypothetical individual will be standing at a distance of 30 m from the point of any ground-level release to the environment, or at the point of maximum ground-level impact (in terms of radiation dose or concentration) for any elevated release.

As used in the Order, the term *facility boundary* denotes a line of separation between the facility (and its immediate environs) and the remainder of the site. The facility boundary discussed in this guidance is intended only for use in hazardous material emergency planning and analysis. It is not intended to correspond to the exclusion zone normally established by the on-scene IC for a fire response.

Implicit in the DOE Order emergency class definitions and discussion is the assumption that DOE facilities are located within larger tracts (sites) over which DOE has access control authority. There is a logical progression in severity from incidents that affect the facility, but not the larger site (Alert), to those that affect the site outside the facility, but not offsite areas (SAE), to those that affect offsite areas (GE). This progression reflects the assumption that a buffer of DOE-controlled land exists between each DOE facility and the site boundary. Some DOE facilities may not have this buffer, and the relationship between facility boundary, site boundary, and the emergency classes should be carefully considered when defining facility boundaries and determining the emergency classes that best describe facility events.

Selection of Facility Boundary Distance

For emergency planning purposes, several structures or component units with a common or related purpose may constitute a single facility. On the other hand, a complex of dissimilar buildings, processes, and equipment may be considered as a single facility if they are physically adjacent, under common management, and contribute to a common programmatic mission.

To promote consistency of incident classification, a standard analysis radius of 100 m should be used to represent the facility boundary receptor for all facilities. Using the same facility boundary analysis radius for all facilities ensures that the relationship between emergency class and consequences is consistent throughout the DOE/NNSA complex.

In a few cases, it may be useful to define a facility to include the entire fenced security area that surrounds the structures or activities of interest. If the facility boundary is defined in this way, the minimum distance to the facility boundary from the likely release point(s) should be used as the analysis radius for all consequence calculations. This approach is reasonable if it leads to selection of an analysis radius of at least 100m, but less than about 200m, and the security area is small with respect to the size of the site (i.e., distance to the facility boundary is short with respect to the site boundary distance).

Definition of Site Boundaries

In general, the perimeter enclosing the area where DOE has the responsibility for implementing protective actions will be the site boundary. DOE facilities occupied by vendors or contractors with which agreements have been reached regarding emergency notification and protective action responsibilities should be considered onsite for purposes of analysis and incident classification. However, there are several possible situations that could require adjustments to achieve overall consistency with the intent of DOE Orders and with sound emergency management principles.

- If the general public can gain unescorted access to areas of the DOE site, such as public highways or visitor centers, those areas should be considered as offsite for purposes of emergency class definition, unless it is ensured that those areas can be evacuated, and access control established within about one (1) hour of any emergency declaration.

- Any non-DOE facility or activity located within a DOE site may be considered as offsite for purposes of emergency class definition. The potential effect on the non-DOE facility of a hazardous material emergency originating at a DOE facility may necessitate the type of coordinated response characteristic of a General Emergency.

Other Offsite Receptors. These include locations or facilities that represent specific emergency planning/response problems or issues, such as schools, hospitals, nursing homes, prisons, industrial complexes, evacuation routes, major transportation facilities, EOCs, and concentrations of population. Offsite receptors relevant to the ingestion exposure pathway should include dairy farms, orchards, truck farms, and public water supply intakes.

2.2.6.3. Identify Recognition Factors

While identifying and analyzing potential release scenarios and their consequences, any means or *recognition factors* (observable indicators) by which an analyzed scenario or a distinct variation of it might be detected and recognized should be recorded. These recognition factors may include such things as direct human observation of the initiating incident or the barrier failure, effluent monitoring instrument readings, physiological effects experienced by persons exposed to the hazardous material, or building (structure) damage expected to cause failure of the barrier (such as roof collapse on a building with contaminated ventilation ducts and filters). To the degree possible, the analyst should record the level or value for each indication that would be associated with the analyzed scenario (such as the specific reading on a pressure gage or observed liquid level in a tank). Many hazardous material releases will be first identified and recognized by outward indications of the initiating incident.

Although the analysis and documentation of recognition factors is completed only after the source term estimate and consequence calculations are done for the final set of scenarios, the validity of the observables (as indicators for specific scenarios) will have been examined to some degree during the process of scenario selection. Recording the results of that examination as it is being done can eliminate the need to repeat the effort during the final phase of the scenario analysis.

For each analyzed scenario (i.e., for each combination of MAR, failure mode, initiating incident, and release condition), recognition factors should be identified, if available. Chapter 4, Section 5, provides further guidance on the nature of the recognition factors and how they are used in developing EALs.

2.2.6.4. Finalize Technical Planning Basis Scenarios

The final step in the analysis involves the exclusion of scenarios that represent nearly duplicate consequences or no unique observable indicators that allow them to be distinguished from another case. This review process causes each possible combination of MAR, barrier failure mode, initiating incident and release condition(s), including the consequences and recognition factors, to be actively considered and then either retained as part of the technical planning basis or discounted. In general, a case would be retained if:

1. The consequences are sufficiently different from other case(s) that it would be classified at a different level and,
2. The recognition factors are sufficiently different that the case could be reliably classified at a level different from other case(s) (i.e., the case could be distinguished from other analyzed cases within a short time after occurrence).

In other words, all of the scenarios might not be unique in terms of the key emergency management characteristics, namely, the consequences and the recognition factors. If two scenarios were not distinguishable using observable indicators, then the one with the most severe consequences would be selected. On the other hand, if two cases have nearly the same consequences, then only one need be included in the planning basis. The general or specific reasons for discounting cases (or groups of cases) should be recorded for future reference.

If the selection of analysis cases is done by applying the above tests to each possible combination of MAR, failure mode, initiator, and release condition(s) at the time the case is conceived in the logical sequence of steps of the methodology, then it may not be necessary to describe and tabulate the entire set of combinations. Many combinations could conceivably be eliminated as the step-by-step process is accomplished using the criteria described above. The approach described in this section lends itself to this modification for the experienced analyst, or as the analyst becomes more experienced with the process and analysis results. Using either approach, however, the analyst should arrive at the same final set of analyzed scenarios.

2.2.7. Step 5: Document the Results of the Analysis

In documenting EPHA results, it is necessary to consider the different uses of the information developed by the hazards assessment process. The emergency planning and preparedness staff will use the information to create emergency management plans and response procedures that are commensurate with the analyzed hazards. As the facilities and hazards evolve over time, future planners (and future hazards assessment analysts) will need to maintain and update the EPHA, plans, and preparedness elements. The emergency management staff may be called upon to explain and defend the hazards assessment process and results to their own management or to evaluators, both internal and external. The documented EPHA should provide solid and convincing evidence that the emergency management program is based on a thorough understanding of the facility-specific hazards.

2.2.7.1. General Scenario Documentation Guidelines

Each analyzed scenario should be documented in enough detail that, if necessary, the consequence calculations can be modified or recreated later by someone who does not have access to the original analyst or the supporting non-report documentation. Scenario information needed to explain, reconstruct, and revise the analysis should include:

- A brief narrative containing key facts that define each scenario, such as the location, the hazardous material, initiating incident (including size or magnitude) and any contributing or mitigating factors. If applicable, the origin of the scenario (SAR/SAD/DSA/DBT section, hazards analysis, etc.) should be identified;

- Any assumptions (explicit or implicit) that enable or support the analysis;

- The source terms, including the SAR/SAD/DSA/DBT scenarios (if any) to which they correspond. If applicable, values for the MAR, DR, LPF, ARF/ARR, and RF should be recorded, along with the bases for their selection;

- Release characteristics (such as effective height, duration, building wake effects, stack exit velocity, plume buoyancy) and reasons for making the necessary modeling choices;

- Atmospheric transport and exposure model inputs (such as wind speed, measurement height, surface roughness, sampling time, exposure pathways, dose conversion factors) and the bases for their selection;

- The consequences of the release at distances and locations of interest.

2.2.7.2. Documented Basis for Emergency Action Levels (EALs)

Background. Frequently, the emergency planning staffs develop facility EALs, in concert with facility personnel. Because the analyst(s) responsible for producing the EPHA may not be available to contribute to EAL development, the documented hazards assessment should include all the information needed by the planning staff to construct an integrated set (system) of EALs covering the full range of possible facility emergencies. In addition to factual information and descriptions (from the facility description and hazard characterization sections) and the calculated consequences of postulated incidents, analysts should document their reasoning and insights. Of particular importance to EAL development are analyst insights and conclusions regarding similarities and differences between the analyzed scenarios, the features or elements that comprise each scenario, the outward indications, and the consequences associated with those scenarios. For example, the analyst might note that the same incident occurring in two different locations (and thus, involving different MAR or different degrees of mitigation) will have very different consequences. If the analyst further determines that there are indications by which one variation of the scenario might be promptly distinguished from the other at the time of occurrence, the two incidents can be placed in different emergency classes for planning purposes. However, if the analyst determines that there would be no timely, reliable means of distinguishing between two scenario variations, that conclusion should be documented as part of a rationale for conservatively applying the higher classification to both incidents.

All relevant facts and analysis results, including the analysts' insights, interpretations, and conclusions, should be summarized in an EAL logic section that provides essential information needed by the planning staff to develop and maintain facility EALs. The EAL logic should be a concise presentation of the rationale by which the results of the representative analysis cases can be used to create EALs to classify the full range of possible emergency conditions. The EAL logic is the documented link (or *bridge*) between the EPHA results and the EAL statements.

Information Requirements. Much of the information needed to support development of EALs is not directly used or produced in the process of selecting scenarios and calculating consequences. Therefore, it will not necessarily be completely captured and documented during those steps of the hazards assessment effort. In order for analysts to recognize and preserve key information, they should understand how the products of their efforts would ultimately be used to develop EALs and other elements of the emergency management program. Following are specific types of information that analysts should recognize and preserve for later use in constructing the EAL logic.

- Any means (indications) by which an analyzed scenario or a distinct variation of it might be detected and recognized. Examples include noise, direct visual observation, instrument readings, alarms, and physiological effects on exposed people. To the degree possible, the analyst should record the level or value for each indication that would be associated with the analyzed scenario (such as the specific reading on a pressure gage or observed liquid level in a tank).

- The timeliness and certainty with which each indication would/could be recognized at the time of, or shortly following, onset of the scenario. The analyst should record whether a particular indication would or might (and under what conditions) be associated with the analyzed scenario. Indications that would not be available within minutes of an occurrence (such as results of laboratory analysis of samples) should be noted. The analyst should understand that while any indications of the analyzed incident/condition may be useful to the planners developing EALs, indications that are prompt, unambiguous, and reliably associated with the incident/condition will be most useful.

- Any other incidents or conditions that would have the same consequences, or for which the consequences can be inferred or extrapolated from the results of an analyzed scenario. Consider, for example, an earthquake-induced building collapse scenario, the source term for which is largely attributable to the crushing of contaminated ventilation ducts and filters. The analyst should recognize that any other incident causing major damage to the structure would affect the same MAR (material in ducts and filters), produce the same failure mode (shaking/crushing) and the same status/functional condition of mitigative features (direct release to atmosphere). The analyst might reasonably conclude that any incident involving building collapse or major structure damage would be modeled using about the same parameter values and assumptions used for the earthquake case, thereby yielding the same consequences. Accordingly, the analyst should conclude that the consequences of building/roof collapse due to high wind or snow/ice buildup would be about the same as for the earthquake, and that the earthquake consequence calculation adequately represents that type of initiator and portion of the severity spectrum. By identifying different incidents/conditions expected to produce source terms that are similar or proportional to those from an analyzed scenario, a small number of carefully chosen representative analyses can provide suitable bases for classifying incidents across the full spectrum of possible initiating incidents and severity.

Documentation Approach. The EAL logic should be arranged according to incident types sometimes termed *recognition categories* that are used to organize EALs in the facility classification procedure. The incident type/recognition category is a short descriptive title or name (such as fire/explosion, process upsets, or natural phenomena) that leads the user of the classification procedure directly to the most applicable EALs, based on the most obvious characteristics of the incident/condition. See Chapter 4, Section 5, for suggested EAL groupings.

For each incident type the analyst should briefly describe the kinds of incidents and conditions that make up the incident type/recognition category. For example, the process upsets incident type is usually defined to include incidents caused by equipment failures, material defect, personnel error, control system failure, loss of power, and so forth. The analyst should then list the scenarios of that type that were analyzed in the hazards assessment and the classification that is indicated by the calculated consequences.

Beginning with the highest classification indicated for any analyzed scenario, the analyst should discuss briefly each of the analyzed scenarios that yielded that classification. Compare and contrast the scenarios with respect to factors such as:

- MAR
- Type and magnitude of the initiating incident(s)
- Values of the other parameters that comprise the source term (DR, ARF/ARR, RF, LPF)
- Release pathway and mitigation features
- Time progression of incidents leading to a release
- Indications by which the incident, as well as similar incidents with higher or lower consequences, could be detected and recognized, including any limitations on the usefulness of those indications as EALs

Because this discussion is the heart of the documented EAL logic, it should describe the features of each analyzed scenario and what portion of the incident spectrum it represents. Incidents of higher or lower classification involving the same material (MAR) or type of initiating incident should be noted. After the EAL basis statement is developed (as described below), the discussion should be reviewed and modified as necessary to make sure that the basis statement follows logically from information presented in the discussion.

The analyst should describe the incidents/conditions of each particular type that require declaration of this emergency class. These descriptions may take several different forms. They may be very specific to a particular analyzed incident (such as, spill of more than X gallons of acid), they may broadly specify an entire group of incidents that should be classified at the same level (any fire in X Building that is not declared controlled within 10 minutes of initial recognition) or they may be expressed in terms of an indication that warrants the emergency declaration without reference to the cause (release to the environment equal to or greater than X becquerels per second).

For each such description, the analyst should provide a succinct basis statement that summarizes the information, insights, and inferences that support the recommended classification. The basis statement should refer to the facts and insights presented in the discussion. The basis statements and discussion should provide the planning staff with a clear and logical argument for selecting EALs to classify emergencies at each level.

2.2.7.3. Basis for Planned Protective Actions

As detailed in Chapter 4, Section 8, planned (or default) initial onsite Protective Actions (PAs) and offsite PARs associated with each EAL should be based on several factors, including:

1. The type of hazardous material involved (radioactive, chemical)

2. The affected area and population characteristics (onsite, offsite, time needed for warning and evacuation)

3. Available options for protective actions (practicality of evacuation, suitability of structures for sheltering, effectiveness of ad hoc measures)

4. The nature of the release implied by the EAL (in progress or imminent, short or long duration, ground level or elevated)

Beyond the documentation suggested earlier in this chapter, little additional information from the hazards assessment process is needed to specifically support development of planned protective actions. The type of hazardous material that would be involved in a particular incident should be obvious from the facility description, hazard characterization, and incident scenarios. The affected area and population characteristics will come from the results of the consequence calculations, specifically, the distance at which the PAC will be exceeded under adverse dispersion conditions. The available options for protective actions will be determined by the planning staff based on their knowledge of the affected area and population and the locations and types of structures available for sheltering.

In item 4 above, much of the information implied will also be obvious to the planners based on facility descriptions and hazards assessment scenarios. However, the hazards assessment analyst should take care to document any scenario-specific information that will help correlate potential EALs (i.e., the indications by which an actual or potential release would be recognized) with scenario factors that should be considered when selecting planned protective actions. The use of scenario information to develop optimum EAL-specific pre-planned protective actions is discussed in the Chapter 4, Section 8, *Protective Actions.*

2.2.7.4. EPHA Document as a Response Reference

In the early phases of response to a real incident, emergency personnel will often use the EPHA document in an attempt to understand the incident and possible consequences. With scenario information and consequences summarized, the document should serve as a useful tool for initial consequence assessment efforts. Features and information that are particularly useful in this regard include:

- The analyzed scenarios identified using short, descriptive names

- Tabulated consequences of each scenario at key receptor locations under conservative (adverse) and average (typical) dispersion conditions, including the distances at which PAC and TEL would be excluded

When developing an EPHA it is important to list identified, analyzed scenarios using short descriptive names in the form of a table in the EPHA so the information is located and referenced in one location in the event of an emergency. The simplest and most acceptable way to meet the standalone requirement is to provide the information in a table in the EPHA. There is no prohibition on information in the EPHA being repeated in other sections of the same document or listed in several other documents; however, incorrectly referencing documents where emergency management information required by the EPHA can be found would result in an instance of non-compliance for each incorrectly referenced document.

2.2.7.5. EPHA Document Format

The EPHA document should either stand alone as the technical planning basis, or incorporate by reference other documented analyses, descriptions, explanations, or justifications. If the latter format is used, the EPHA document should contain all results necessary for directly meeting the emergency management program planning requirements, as would be presented in a standalone version.

If the results of a facility EPHA are included in a site-wide EPHA document, the same documentation of the facility EPHA should be totally included in the site-wide version or fully referenced. A site-wide EPHA document should contain all results necessary for directly meeting the emergency management program planning requirements for each facility covered.

2.2.8. Special Topics

2.2.8.1. Smoke from Ordinary Structure Fires

Any structure fires will produce toxic products of incomplete combustion, or by-products from the burning of structural materials, preservatives, refrigerants, paint, and so forth. Although fires in office buildings or industrial facilities that do not contain large inventories of hazardous materials may be categorized as OEs, if they result in significant structural damage with suspected personnel injuries or death, they should not be classified on the basis of the incidental hazardous material release. Appendix D, Combustion Products and Toxicity in Hazards Assessment, provides additional guidance regarding this topic.

2.2.8.2. Exceptions for Facilities needing an EPHA

According to DOE O 151.1 D, hazardous materials that do not screen out are subject to further examination in an EPHA; however, this requirement may not always be used to directly identify the planning inventory for chemical facilities that do not track their inventory by individual chemical or product. For facilities whose operations resemble transportation operations (i.e., chemicals are transported to the facility, packaged in accordance with DOT regulations) and conduct shipments that satisfy DOT regulations and specifications, it may be more suitable to use the ERG to determine protective actions for potential hazardous material incidents. See DOE Order 151.1D Attachment 4, Section 2.s. for more details.

2.2.8.3. Explosions/Explosives

Although generally outside the scope of the Hazardous Material emergency management program specified in DOE O 151.1D, any analysis of hazards from conventional explosives should focus on blast, missile, and burn hazards, not the potential airborne release of toxic chemicals. Analysis and planning for those hazards should be done in the context of the SFA Fire Protection program or other safety programs. Fires involving or threatening conventional explosives should be regarded as imminent blast/missile hazards. The potential airborne release of toxic chemicals from a malevolent act should be considered per DOE O 470.3C C1, *Design Basis Threat*.

To account for hazards posed from Explosives, Boiling Liquid Expanding Vapor Explosions (BLEVEs) and Vapor Cloud explosions, refer to guidance provided in EPA 550-B-99-009.

Results of research by the National Institute of Standards and Technology (NIST) and the U.S. military, as well as Department of Defense standards and DOT emergency response guidance, clearly indicate that the toxicity hazards from burning explosives are no greater than for many common materials used in structures and furniture, and that hazards associated with blast and fragments should dominate the emergency planning concerns for explosives.

Based on the above information, conventional (chemical) explosives should be addressed in the following manner:

1. In general, safety/emergency planning for any conventional explosives should be based on the blast and missile hazards and not on the potential for airborne release of toxic chemicals. Any fire involving an explosive should be treated as an imminent blast/missile hazard and the necessary safety measures for the blast/missile hazard implemented.

2. An explosive should be analyzed as a dispersible toxic chemical hazard in an EPHA only if it is used or stored in a form (such as a powder or liquid) that represents a plausible air-dispersible source of the substance.

If an explosion has occurred and there is no potential for another, the most significant safety impacts (blast, shock, missiles) will already have ended and, therefore, will not be mitigated by the same kinds of protective actions and response measures that are usually applied to hazardous material emergencies (evacuation, sheltering).

2.2.8.4. Aggregations of Small Quantities of Hazardous Materials

The release of inventories of multiple small quantities of like or unlike hazardous materials (all below the laboratory scale threshold) poses an analysis problem in hazards assessments for some DOE/NNSA facilities. A simultaneous release of these quantities of hazardous materials from the same facility or location requires a destructive or energetic incident. Although such destructive incidents have the potential to breach multiple containers, the assessment of the impacts resulting from a simultaneous release producing additive effects beyond the local incident scene is particularly difficult to quantify because of spatial and temporal separation of individual unit releases, inhibition of the release by structure or rubble, reduction through various release conditions (scrubbing by fire sprinklers), and other factors.

The uncertainties associated with consequence estimates for these incidents will be very large, and analyses using conventional models and assumptions add little to understanding the hazard. In addition, quantitative analyses are not needed for development of incident recognition criteria (EALs) because destructive incidents necessary to release multiple small quantities are readily recognized by persons most likely to be affected by those releases (i.e., workers in the immediate area and first responders). Conservative, worst-case analyses for simultaneous releases of multiple small quantities cause expenditure of resources on hazards and scenarios of minimal significance and provide little or no useful information to improve planning or response.

The following steps represent a reasonable approach for addressing aggregations of small quantities of like or unlike hazardous materials, each of which is below the laboratory scale threshold, in DOE/NNSA emergency management programs. The approach may also be applied to fires that are judged by the local fire protection establishment to have the potential for *extraordinary* emissions of toxic combustion products (see Section 2.8.1).

1. In the All-Hazards Survey, recognize and document the HAZMAT aspect of possible destructive incidents involving multiple small quantities of hazardous materials. Building emergency management plans and pre-fire plans are the appropriate vehicles for identifying and planning responses to destructive incidents that would have major, direct human health and safety impacts (blast, burns, entrapment, etc.) and for which hazardous materials in modest quantities would be of secondary concern. Throughout the non-DOE emergency management community such incidents are routinely managed using standard fire and HAZMAT response methods.

2. Define certain destructive incidents (large fire, structure collapse, etc.) to be OEs if it appears that the condition would meet all aspects of the OE definition. The potential HAZMAT aspect of a destructive incident may be used as a qualitative factor (i.e., without resorting to quantitative calculations of impact) in defining certain incidents as OEs.

Quantitative analyses of concurrent releases of small quantities (all below the laboratory scale threshold) are typically not warranted because of the high variation involved in accurately modeling accident phenomenology on a small scale, and the limited geographic area that could be affected do not add value to the planning and response process.

2.2.9. Using Safety Analysis Results in EPHAs

To the extent practicable and available, the hazards and accident analysis results from current facility SARs/SADs/DSAs/DBTs should be used to ensure consistency of the emergency technical planning basis with the facility authorization basis. Careful consideration to use of safety analysis information can both enhance the quality of the EPHA and greatly reduce the effort required for its preparation.

Facility/Process Description. The written description of the facility, processes, hazardous materials, and controls can generally be incorporated, in full or in abbreviated form, to provide the most credible and technically sound basis for the EPHA.

Hazards Identification and Analysis. The Hazards Analysis that forms the basis for SAR/SAD/DSA/DBT accident selection should be a primary reference for facility hazards identification. The rigorous analysis techniques used for facility/process hazards identification, such as Failure Modes and Effects Analysis (FMEA) or Hazards and Operability Studies (HAZOPs), will often yield a lengthy and detailed list of potential hazards and accidents, along with a qualitative assessment of their consequences. From that list, a few (discussed above) are selected for analysis in the SAR/SAD/DSA/DBT to provide the technical justification for engineered or administrative controls to prevent or mitigate the hazard. Many of the hazards and accidents identified in the Hazards Analysis will therefore not be addressed in the SAR/SAD/DSA/DBT accident analysis section. Incidents having only non-radiological consequences, those that do not have significant consequences outside the facility, and incidents that are similar to, but with lower consequences than the bounding incident of a given type, are among those unlikely to receive detailed analysis in the SAR/SAD/DSA/DBT. In order for the EPHA to represent the full spectrum of hazards and incident severity, hazards identified by the SAR/SAD/DSA/DBT Hazards Analysis process (but not addressed in the accident analysis) should be selected for inclusion in the EPHA as needed to fill out the range of potential hazards, consequence/severity levels, and incident types.

Accident Analysis. The scenarios and corresponding source terms analyzed in current facility safety analysis documents should be incorporated into the EPHA if consistent with emergency planning requirements and needs. DCFs and exposure parameters embedded in radiological computer codes should be verified to ensure consistency between emergency management and SAR/SAD/DSA/DBT results. The SAR/SAD/DSA/DBT scenarios will typically represent the maximum or bounding incident of a given type. If possible, information from the SAR/SAD/DSA/DBT discussion or supporting documents can be used to develop variations of the bounding scenario that have different consequences, indications, or initiating incidents. Results of existing analysis may be incorporated by reference or, under some circumstances, the consequences of newly postulated scenarios may be derived from the results of existing analyses (adjusting for different source terms).

The following examples demonstrate variations in SAR/SAD/DSA/DBT scenarios that can provide additional EPHA scenarios without further extensive analysis.

Example 1: The SAR/SAD/DSA/DBT calculates the source term for a release to the environment that is mitigated by an isolation system. A second (unmitigated release) case can be inferred from the credited performance characteristics of the isolation system. The unmitigated case would provide a second point on the severity spectrum. The second case will provide information that is most useful for incident recognition and classification if response personnel would be able to determine the isolation status at the time of an incident.

Example 2: The SAR/SAD/DSA/DBT calculates the design-basis fire source term by using the largest of the MAR values associated with several different process areas that are separated by rated fire barriers. Additional cases representing fires in other process areas holding less MAR may be inferred by scaling the source terms for the different MAR values. A catastrophic fire scenario, such as could be attributed to an aircraft crash or malevolent act, might be represented by a source term based on the MAR total for the structure.

2.2.10. Using Security Risk Assessment in EPHAs

To the extent practicable and available, the asset categorization and Security Risk Assessment (SRA) results from current SFA SRAs should be used to ensure consistency of the emergency technical planning basis with the security risk assessment basis. See DOE-STD-1192-2018, *Security Risk Management*, for how to develop an SRA. Careful consideration to use of security assessment information can both enhance the quality of the EPHA and greatly reduce the effort required for its preparation. DOE O 470.3C, *Design Basis Threat (DBT) Order*, requires evaluation for sabotage for all hazardous materials, including those excluded by DOE O 151.1D. Therefore, Safeguards and Security (S&S) analysts are required to consider a broad yet detailed set of conditions under which malevolent acts could occur and the consequences of a successful malicious act.

Because this is a new process, a facility SRA may not be completed in time for the initial or next update for an EPHA. In the event that an SRA has not been completed, the EPHA analyst should meet with the responsible SRA security analyst and determine the appropriate scenarios, materials, release conditions, and parameters for one or more malevolent acts for an SFA. This will help ensure that the EPHA is consistent with the SRA when approved.

Depending on the assets at an SFA, there are two different types of security analyses, VAs and SRAs. An SFA may have one or the other or both, but whichever analyses an SFA uses to evaluate hazards from a security perspective should support the EPHA and vice versa.

Asset Categorization

The asset categorization (AC) provides a designation for an SFA based on the types and quantity of hazardous materials stored or used in the SFA. The AC drives the characteristics of the malevolent act and actors for an SFA based on the protection level

(PL) assigned to the SFA. These are specified in DOE O 470.3C for hazardous materials depending on the PL defined for the SFA's assets.

If the SRA has not been completed for an SFA, the EPHA analyst can obtain the characteristics for the malevolent act and actors directly from DOE O 470.3C. As stated, the analyst should meet with the responsible SRA security analyst to ensure consistent use of the characteristics between the organizations.

Security Risk Assessment

A completed SRA will provide the EPHA analyst with the malevolent act scenarios that are determined to be appropriate, plausible, and bounding for an SFA. In many cases, malevolent act scenarios will produce releases and consequences similar to those that could be caused by accidental, natural phenomena, or other external initiating incidents. Therefore, information in the SRA and consequence information may be sufficient to determine that malevolent acts are bounded by the scenarios already evaluated and the developed EALs are adequate. Additional consequence modeling or calculations are not required. In the early stages of an incident the cause of the initiating incident may not be known, therefore, separate EALs for malevolent acts as causes for initiating incidents are not needed.

The EPHA analyst may determine that additional scenarios are needed, or a modified scenario is needed to adequately address an SRA malevolent act within the EPHA. For example, the meteorological parameters used for SRA malevolent act scenarios are equivalent to the typical meteorological conditions in DOE O 151.1D (i.e., 3 m/s wind speed and D stability). This is acceptable for use as a malevolent act scenario for DOE O 151.1D and an additional conservative scenario is not required. However, an EPHA analyst may determine that the model output from a conservative scenario is needed to ensure that the EALs and protective actions are appropriately bounded. To ensure consistency with the SRA, the variables needed for the consequence calculations, with the exception of the meteorological conditions, should be obtained from the SRA analyst.

One area where additional consequence analysis of a scenario is likely to be necessary is one that involves dispersion or a release of radiological materials. The EPHA analyst needs to be aware that the consequences developed under DOE O 470.3C requirements may use different target organs and an acute exposure methodology instead of the early phase approach recommended in Appendix C. In these cases, the initiating conditions are the same, but the method for arriving at the consequences will need to be reevaluated, considering the guidance herein, to determine the consequence thresholds consistent with DOE O 151.1D.

Materials Excluded from the EPHA

There may be situations where a material excluded from further analysis in an EPHA is a significant concern in the SRA. For example, a highly toxic material in less than laboratory scale quantities that could result in harm to personnel, including death, if released as an aerosol to a confined area may be a situation of concern in the SRA. It may be appropriate to state that additional scenarios involving excluded materials are discussed in the SRA. Materials or hazards (sealed radiological sources) are evaluated in an SRA and should be included in the overall evaluation of hazards for an SFA. DOE O 470.3C and DOE O 151.1D, while having common elements and approaches to analysis, have different mission endpoints.

2.3. Emergency Planning Zones

2.3.1. Background

The DOE Comprehensive Emergency Management System requires the integration of emergency management programs for both radioactive and non-radioactive hazardous materials. Consistent with this approach, an EPZ surrounding at-risk facilities is established to integrate protective action planning related to all potential hazardous material releases. An EPZ is defined by DOE O 151.1D, as a zone identified to facilitate a pre-planned strategy for protective actions during a defined emergency. The EPZ is an area within which the SFA should support the local, state, or tribal authorities in planning and preparedness activities to protect people living and working there. Among these activities are:

- Identification of response organizations;
- Establishment of effective communications to notify the public and the responsible authorities within the EPZ;
- Development of public information and education materials;
- Training and provision of equipment for offsite emergency workers;
- Identification of predetermined response actions
- Development and testing of response procedures.

DOE facilities are subject to EPA emergency management requirements for nonradioactive hazards. It is DOE policy that emergency management for DOE/NNSA nuclear facilities should be consistent with the requirements of the Nuclear Regulatory Commission (NRC) related to radioactive hazards to the extent practicable. Basic planning and response principles, as well as the NRC and EPA requirements and their bases, are considered as background for the guidance provided in this chapter.

The NRC has established EPZs for commercial power reactors. The basis for the establishment of radioactive plume exposure and ingestion pathway planning zones EPZs for power reactors is documented in NUREG-0396/EPA 520/1-78-016. The report concluded that a 10-mile (16 km) plume exposure (airborne) pathway EPZ was adequate because:

1. Projected doses from the traditional design-basis accidents would not exceed PAG levels outside the EPZ;

2. Projected doses from most core melt sequences would not exceed PAG levels outside the EPZ;

3. For the worst case core melt sequences, early severe health effects would generally not occur outside the EPZ; and

4. Detailed planning within the EPZ would provide a substantial basis for expansion of response efforts in the event that this proved necessary.

The distances were determined using the higher PAG levels then in effect (5-rem [50 mSv] whole body, 25-rem [250 mSv] thyroid dose) and are also satisfied relative to the current lower PAG values (1-rem [10 mSv] whole body, 5-rem [50 mSv] thyroid).

The ingestion pathway EPZ distance was largely based on a judgment that the likelihood of exceeding ingestion pathway PAG (infant milk dose) levels at 50 miles (80 km) was comparable to the likelihood of exceeding plume exposure pathway PAG (whole body and thyroid) levels at 10 miles (16 km).

The EPA has published guidance that leads to the determination of a *vulnerable zone* for non-radioactive hazards. This zone is described by the EPA as the area that may be subject to concentrations of an airborne, Extremely Hazardous Substance (EHS), following an accidental release, at levels that could cause irreversible acute health effects or death to human populations within the area. The EPA guidance defines the vulnerable zone in terms of the distance at which a *level of concern (LOC)* would be exceeded because of a release of the hazardous material under severe (conservative) dispersion conditions. An LOC is defined as the concentration of an EHS in air above which there may be serious irreversible health effects or death because of a single exposure for a relatively short time. LOCs are identified in the EPA guidance for the EHSs listed in 40 CFR Part 355, Appendix A. The vulnerable zone was developed for use by community emergency planners in evaluating the risk of, and planning for, response to hazardous material releases. Because of differences in both the impact (concentration) criteria and the methods used, the vulnerable zone does not directly correspond to the EPZ concepts developed for DOE facilities.

In the following sections, an EPZ methodology is recommended for DOE facilities that uses the underlying NRC/FEMA/EPA bases for the radioactive plume exposure (airborne) pathway *EPZ* and incorporates planning for both radioactive and nonradioactive hazardous material releases.

2.3.2. General EPZ Concepts

The designation of an EPZ and the related detailed planning and preparedness activities are not intended to ensure complete protection of all persons who might be affected by the largest conceivable hazardous material release under the most severe meteorological conditions. The EPA PAG Manual, *Protective Action Guides and Planning Guidance for*

Radiological Incidents, EPA 400-R-17-001, January 2017, states, "Although the size of the EPZ is based on the maximum distance at which a PAG might be exceeded, the actual boundary of an EPZ should be demarcated by features readily identifiable by people within that area."

Establishing the EPZ is meant to provide a planning area for the implementation of prompt, protective actions to reduce the health effects from accidental uncontrolled releases of radionuclides to the environment.

In addition, those responsible for establishing the geographic extent of any facility EPZ should note that a larger EPZ does not necessarily provide better protection of the population than a smaller one:

- For a given wind speed, the elapsed time between initiation of a hazardous material release and the onset of consequences at a receptor location is directly proportional to the distance between the source and receptor. Hence, the greater the distance from the source, the more time will be available to carry out protective actions.

- If distance (and available time) is great enough, ad hoc protective actions will be approximately as effective in reducing health impacts as those actions that have been planned and prepared for in detail. As the effectiveness of a preplanned protective action approaches that of an ad hoc action, the efficiency of planning/preparedness efforts (expressed in terms of reduced health impacts per unit investment in planning/preparedness) approaches zero.

- Because resources available for protective action planning and preparedness are always limited, use of those resources should be concentrated in the geographic areas where the greatest reduction in health impact per unit expenditure can be achieved.

In some cases, specifically the most severe release conditions, protective actions may be needed in areas outside the EPZ. Therefore, the EPZ should be sufficiently large that the planning and preparedness for actions within the defined EPZ provide authorities with a reasonable basis for extending their preplanned response activities to areas outside the EPZ, if warranted by the actual conditions.

2.3.3. Developing Facility EPZs

An EPZ associated with a particular DOE facility or site is an area within which government and facility managers determine that special planning and preparedness efforts are warranted as a means of apportioning preparedness resources to the areas where they are most needed. Developing EPZ boundaries and applicable protective actions should be developed in coordination with local, State, and Tribal authorities since each has a statutory or constitutional responsibility to protect its citizens.

Facility EPZs may be based on risk criteria agreed upon by State and local authorities. Risk-based methods of prioritizing emergency planning and preparedness efforts provide assurance that resources are dedicated to the proper areas and issues. However, such methods require a major investment in a comprehensive Probabilistic Risk Assessment (PRA) for the facility. See DOE STD-1628-2013, *Development of Probabilistic Risk Assessments for Nuclear Safety Applications,* for how to develop a PRA. Facilities for which a PRA has already been prepared, or is in progress, may choose to use the results to establish their EPZs in cooperation with local and State authorities.

For those facilities that do not choose the risk-based approach, the EPZ should include as a minimum the area where people would be at risk of death or significant health effects from the releases under severe meteorological conditions. It may also include part of the area where protective actions would be warranted for the same release and normal meteorological conditions. Hence, the EPZ for each facility should be based on objective analyses of a spectrum of hazards associated with that facility, *not* on arbitrary factors such as historical precedent or distance to the site boundary. The results of the consequence calculations described in Section 2.6, geographical and jurisdictional factors, as well as other factors detailed in this guidance can be used to define the facility EPZ.

Following the underlying rationale for establishing the EPZ for commercial nuclear reactors, the integrated EPZ for DOE facilities, which is based on the spectrum of potential radioactive and chemical hazardous material releases, should be of sufficient size that:

1. Protective actions are not likely to be required beyond the EPZ for most analyzed incidents (i.e., consequences from most analyzed incidents are not likely to exceed PACs outside the EPZ);

2. Measures taken within the EPZ would provide for substantial reduction in early or significant health effects for all analyzed incidents (i.e., consequences from all analyzed incidents would not exceed TELs outside the EPZ); and

3. Planning efforts within the EPZ provide a substantial basis for expansion of response efforts beyond the EPZ, if necessary.

4. The maximum EPZ for any DOE or NNSA SFA should not exceed a nominal radius of 10 miles (16 kilometers), modified to account for geographic and political conditions.

The following steps provide a methodology for developing a candidate, technically defensible plume exposure pathway EPZ for DOE/NNSA facilities that implements the basic characteristics of the integrated EPZ as given above.

1. If the results of consequence calculations, done in accordance with Section 2.6, indicate no OE higher than an Alert classification, then an EPZ need not be defined for the facility.

2. From the results of consequence calculations, done in accordance with Section 2.6, determine the maximum distance at which a TEL would be exceeded for the most severe analyzed potential release under severe meteorological conditions.

This distance, the smallest EPZ radius that should be considered, is denoted EPZ_{MIN}.

3. Next, determine the maximum distance at which a PAC would be exceeded for the most severe analyzed potential release (excluding those that are beyond-design-basis natural phenomena events or outside the scenario of likelihood in the DBT) under severe meteorological conditions. This distance, the *maximum EPZ radius* that should be considered, is denoted EPZ_{MAX}. Additionally, it must be noted that while the DBT focuses on identifying threats for planning purposes via their security risk assessments (SRAs), these calculations are for planning purposes and it is not expected for these calculations to be included in the technical planning basis for determining EPZs.

4. If EPZ_{MAX} is greater than 10 miles (16 kilometers), then the EPZ_{MAX} is set equal to 10 miles (16 kilometers). The value for the EPZ is within the limits EPZ_{MIN} to EPZ_{MAX}.

5. Within the limits of the largest and smallest EPZ radii, EPZ_{MIN} to EPZ_{MAX}, consider other factors and adjust size and shape in accordance with the following principles:

   - The full spectrum of emergencies that contribute to SFA offsite risk should be considered. Even if a comprehensive PRA has not been done, local knowledge of the probability or risk contribution of the most severe analyzed incident relative to the other events that comprise the balance of the SFA risk may be used in a semi-quantitative way to determine whether the EPZ size should be closer to the maximum or minimum values as determined in Steps 1-4, described above:

     – If the most severe analyzed release would result from a single failure incident, or is believed to have a relatively high probability of occurrence, an EPZ radius closer to the maximum than the minimum value should be selected.

     – If the probability of the most severe analyzed release is judged to be extremely low, or if it contributes a minor fraction of the total offsite risk from site emergencies, an EPZ radius closer to the minimum value is indicated.

   - The hazards judged to contribute most heavily to the offsite risk should be considered, as follows:

     – If the hazard is radiological, an EPZ radius closer to the minimum value should be selected because of the wide margin (a factor of greater than 100) between the thresholds for protective action and early lethality.

     – If the hazard is non-radiological, an EPZ radius closer to the maximum value should be selected because of the narrower margin (typically a factor of 3 to 10) between the concentration thresholds for protective action and lethality (as defined in Appendix C), and the potential for severe irreversible effects resulting from exposure to concentrations between the protective action and lethality thresholds.

- The definition of an EPZ is meaningful only if significant planning and preparedness measures are implemented within it. This commitment and the responsibility to expend resources planning and preparing for the protection of people should be factored into EPZ size. The planning and preparedness activities that the SFA should expect to support on behalf of the population within the EPZ include the following:
  - Identification of responsible onsite and offsite EROs and the method for activating their services;
  - Establishment of effective communication networks to alert and notify the public within the EPZ and the responsible authorities promptly;
  - Development and delivery of public information and education materials to ensure timely and correct response to warnings;
  - Implementation of training programs and provision of equipment for offsite emergency workers;
  - Identification of predetermined response actions by authorities, and protective actions for the public;
  - Development, testing, training, and exercising of response procedures.
- The cost of implementing an EPZ is usually directly related to the geographic size of the EPZ. If creating a larger EPZ means that scarce resources are allocated to the protection of people who are at minimal risk, a larger EPZ may actually be less effective at mitigating overall risk to the population than a smaller one.
- If distance from the source and the time available to respond are great enough, protective actions carried out on an ad hoc basis will be approximately as effective in reducing risk as those actions that have been planned and prepared in detail. Also, planning and preparedness for the EPZ will provide a basis for more effective response activities outside the EPZ if conditions should warrant.
- The EPZ should conform to the physical and jurisdictional realities of the site and surrounding area.
- The EPZ size should give confidence that planning and preparedness will be sufficiently flexible and detailed to deal with a wide range of types and magnitudes of emergency conditions. Four significant considerations that

cannot be readily stated as quantitative guidance are presented below in the form of questions to be used as *tests of reasonableness* for the proposed EPZ size.

– Is the EPZ large enough to provide a credible basis for extending response activities outside the EPZ if conditions warrant?

– Is the EPZ large enough to support an effective response at and near the scene of the emergency (i.e., to preclude interference from uninvolved people and activity, to facilitate onsite protective actions, to optimize on-scene command, control, and mitigation efforts)?

– Is the EPZ likely to meet the expectations and needs of offsite agencies?

– What enhancement of the facility and site preparedness stature would be achieved by increasing the size of the EPZ? What resources, costs, and liabilities might a larger EPZ engender? Would a larger EPZ result in a large increase in preparedness without correspondingly large increases in cost or other detriment?

As a last consideration, ensure that the underlying rationale for establishing the integrated EPZ for DOE facilities (a. through d.) is generally satisfied for the EPZ determined from Steps 1-5. Document the consideration of each of the tests and any adjustments made to the EPZ. The resulting EPZ and its bases provide the beginning point for discussions with Tribal, State, and local authorities.

Where several facilities are located close to one another and the nature of the hazards is the same at each, the largest impact from an incident at any of the facilities may be used to define the EPZ for the entire area. Though it is possible that under certain conditions releases from several facilities might occur at the same time with consequences that are additive, the EPZ size should not be based on concurrent incidents at separate facilities.

Where a number of individual facilities and activities are located in close proximity to one another, a composite EPZ for the group of facilities or the entire site should be defined to simplify communications and offsite interactions. Also, the EPZ for a site should not be extended beyond the site boundary solely on the basis of potential consequences of a transportation accident, if the transportation activity is comparable (in terms of materials, quantities, and mode of shipment) to that normally conducted on public routes.

Finally, the planning process should recognize and provide for the need to refine the initial default protective actions and carry out protective actions in limited portions of the EPZ for specific incidents or conditions. Dividing the EPZ into sectors by direction and radial distance, and using natural or jurisdictional boundaries to define protective action zones, are suggested ways to assist offsite authorities by providing a finer planning and response structure.

2.4 Maintaining All-Hazards Surveys and EPHAs

All-Hazards Surveys and Emergency Planning Hazards Assessments (EPHAs) should be maintained so that they accurately reflect changes in the SFA design, operations, safety features, inventories of hazardous materials, and features of the surrounding area. In the absence of other overriding requirements on the mechanics of this maintenance process, the following guidelines should be applied.

- All-Hazards Surveys and EPHAs should be reviewed and, as necessary, updated at least every 3 years, and prior to significant changes to the SFA or to hazardous material inventories. For example, significant changes are those changes which would result in an unreviewed safety question (USQ) for nuclear facilities, as defined in 10 CFR Part 830, *Nuclear Safety Management*, or in an unreviewed safety issue for accelerator facilities, as defined in DOE O 420.2C, *Safety of Accelerator Facilities*. If the change reduces hazards with no adverse effect on safety or emergency preparedness and response, the modifications may be performed at the next scheduled review and update.

- For all other SFAs that would not generate a USQ, including chemical and non-EPHA SFAs, an All-Hazards Survey (AHS) may follow the provisions of the 3-year review cycle when significant changes at a facility or project do not alter the conclusion of the AHS, such as increasing the quantity of an already identified hazardous material listed in the AHS when an EPHA is already in place to address the hazardous material; and decreasing the quantity or eliminating the quantity of a listed hazardous material from a facility or project, but other hazardous materials remain that would still require an existing EPHA to be maintained.

- A significant modification that changes the conclusion requires immediate update of the existing AHS, such as adding new hazardous materials to inventory that exceed the screening threshold quantity that were not identified in the existing AHS; using existing hazardous materials identified in the AHS that exceed the screening threshold quantity in a new operation, or at locations where an EPHA is not already in place.

- If the change reduces hazards with no adverse effect on safety or emergency preparedness and response, the modifications may be performed at the next scheduled review and update.

- Maintenance of the All-Hazards Surveys and EPHAs should be monitored through existing administrative processes and commitment tracking systems. A reliable, efficient, and timely method for tracking changes in SFA operations or processes that involve hazardous materials (introduction of new materials, new uses, changes in inventories, modification of material environments) should be established and maintained for each facility/activity.

- The method for tracking changes in SFA operations or processes that involve hazardous materials should allow sufficient transition time for emergency management personnel to review the EPHA and modify plans or procedures, as necessary, to account for changes in the hazardous material situation.

- Methods for tracking changes in SFA operations may include regular access to current site-wide inventory records, special notification procedures for operation or process changes, or active involvement of emergency management personnel in the SFA or activity Integrated Safety Management systems. The method can also be linked to the USQ process, which identifies changes in the safety basis of the SFA.

- Changes in the SFA safety analysis reports, probabilistic risk assessments, VAs, fire hazard analyses, environmental impact statements, and other documents that address SFA hazards or potential consequences should be integrated with maintenance of the EPHA.

- The review schedule should be specified in the Emergency Readiness Assurance Plan (ERAP). Reviews should be coordinated and planned to take maximum advantage of other required periodic safety reviews, such as the annual Superfund Amendments and Reauthorization Act hazardous material inventory, nuclear facility safety reviews, required by 10 CFR Part 830.202 and 830.204, and reviews required by 40 CFR Part 122, (NPDES), or other permit processes. Reviews should be done whenever significant changes to facility, process, or materials inventory occur.

- Transitory hazards, such as short-duration storage of large quantities of hazardous materials or the short-term assembly and testing of nuclear explosive devices, may be covered in several ways. If an EPHA exists for the facility, the EPHA and associated emergency planning documents can be updated. For ease of maintenance and to avoid duplication of effort, the test plans or other controlling safety documents for such transitory hazards may be configured to serve as temporary addenda to the site or facility emergency plans. Another option is to issue a special abbreviated assessment that contains a description of the activity or operation and its expected duration, discussion, and results of the hazards screening and characterization, scenario descriptions, consequence calculations, and EALs.

- Major changes in offsite or onsite population, or in transportation features of the site and environs, such as the construction of major facilities or new highways, should also cause the EPHA to be reviewed.

- The hazardous material emergency potential associated with facilities undergoing decommissioning or remediation will decline and become static as the process nears completion. The review and maintenance effort may then be substantially reduced without detriment to the emergency management program by creating a single documented hazards assessment covering a number of facilities of the same general hazard profile and inactive (non-operational) status.

- The results of each review should be documented and reported to the management responsible for facility operations and emergency preparedness. If a review identifies no significant changes in facility, process, or potential emergency consequences, a finding to that effect should be documented.

If the review identifies significant changes, they should be documented and reported. The report should address (1) the possible effects on the adequacy of facility and site emergency plans, (2) any temporary compensatory measures that are being considered or implemented, and (3) a schedule for updating the analysis, reporting the results, and proposing any needed changes to the site's emergency planning or response program.

Although most generic types of emergency conditions identified in an All-Hazards Survey will remain unchanged throughout the useful life of a facility, the status of hazardous material inventories within a facility may be the most variable and critical. The hazardous material screening process provides the mechanism that examines facility hazardous material inventories to determine the need for an EPHA, both on a periodic basis and, as required, when notified of changes in operations or inventories.

Other uses of the EPHA results include:

- Verification and monitoring of facility hazardous material inventories;
- Confirmation of, or input to, the authorization basis safety analysis;
- Recommendations for minimizing or segmenting hazardous materials inventories;
- Inputs to the fire pre-planning and hazardous material spill prevention/cleanup plans. Assessing the capability of instruments and effluent monitors to quantify emergency releases;
- Identification of facility or procedure changes that would help prevent or mitigate the incidents analyzed.

Chapter 3. Programmatic Elements

3.1. Program Administration and Management

3.1.1. Introduction

The purpose of this chapter is to assist Department of Energy (DOE) and National Nuclear Security Administration (NNSA) field elements in complying with the DOE O 151.1D (the Order) requirement to provide effective organizational management and administrative control of an emergency management program by establishing and maintaining authorities and resources necessary to plan, develop, implement, and maintain a viable, integrated, and coordinated program. Each manager or administrator of a DOE, NNSA, or DOE/NNSA contractor-operated sites, facilities, agencies (SFA) subject to this Order designates an individual to administer the emergency management program. This individual develops and maintains the emergency plan, develops the Emergency Readiness Assurance Plan(ERAP) and its annual updates, develops and conducts training and exercise programs, coordinates assessment activities, develops related documentation, develops a system to track and verify correction of findings or lessons learned, and coordinates emergency resources. Responsible administrators of emergency management programs should use the guidance in this chapter to define responsibilities and implement functions to ensure and maintain effective emergency planning, preparedness, readiness assurance, and response activities.

3.1.2. General Approach – Program Administration and Management

Management and Operating (M&O) contractor managers/administrators at each DOE/NNSA facility and site retain overall authority and responsibility for emergency management at their respective levels. However, responsibility for, and authority over, the development and day-to-day operation and maintenance of the program is specifically designated to an emergency management program administrator with responsibility and authority to ensure:

- Development and maintenance of the All-Hazards survey and Emergency Planning Hazards Assessment (EPHA), emergency management plans and procedures, and related and supporting documentation;

- Development and conduct of training and exercise programs, and development, conduct, and coordination of the readiness assurance program and activities;

- Coordination of emergency resources by identifying resource needs and ensuring the availability of adequate resources;

- Development and submittal of the annual ERAP; and

- Interface with State and local emergency response elements, other Federal agencies, and private institutions providing emergency medical and other emergency support to the site.

The designated administrator has authority and resources in accordance with assigned responsibilities and has access to top-level management. The administrator is responsible for implementing an SFA-specific comprehensive emergency management program based upon a graded approach that is commensurate with hazards.

The administration of programmatic activities is established and maintained through rigorous adherence to a formal process. Review and approval processes are established and documented to ensure that the planning and development of components of the emergency management program receive sufficient oversight by staff, management, and DOE/NNSA elements. To ensure that programmatic activities are initiated, completed, and periodically repeated in a timely and efficient manner, reasonable schedules are established for planning (document submission, reviews, approvals), preparedness (training), readiness assurance (self-assessments), and programmatic response element (maintaining Emergency Response Organization (ERO) assignment roster) functions. *Timely* means suitable for response activities to be effective in protecting worker and public health and safety. Other time-sensitive terms such as *prompt*, *initial*, and *immediate*, are not specific requirements; however, they are descriptive terms meant to describe the imminent nature of completion of a given activity.

Adequate resources are identified and obtained to ensure that the program is ready to respond. Financial resource requirements are identified and budgeted. Response facility needs are identified, and locations established. Equipment requirements are identified; supplies of required equipment are monitored and acquired as needed. Personnel requirements are identified and addressed.

An emergency management document control system that meets industry standards for document review, approval, distribution, and change control is established, or emergency management documents are controlled, under an existing site-wide document control system. An auditable administrative program for ensuring the availability of essential records (i.e., essential to the continued functioning or reconstitution of an organization during or after an emergency), regardless of media, is established and reliably maintained (DOE O 243.1C). If classified or controlled unclassified information or materials are being used or generated, effective security procedures and controls are implemented and reviews required under applicable DOE orders are conducted.

Administration of an emergency management program can vary considerably from site to site depending on characteristics of the site and program, including size, geographical layout, hazards, administrative structure of the M&O contractor, and structure and constituents of the ERO.

A small site with few facilities and hazards and a simple response structure may have one program administrator responsible for management and control of the program, who may have direct responsibility for various aspects of the detailed planning, implementation, and maintenance functions and activities. At a larger site with many facilities, more extensive hazards, and a more complicated ERO, the program administrator may delegate detailed programmatic responsibilities to site-level and facility-level administrators, retaining overall responsibility for site-wide program administration and control.

Information and data that the designated site administrator can track and oversee depends primarily on the size of the site and scope of the emergency management program. With only a few facilities, the program administrator at a small site is familiar with details of the site-wide program, as well as each individual facility program. The administrator at a large site may only be personally cognizant of the larger aspects of each facility program.

On a multiple-facility site, the site emergency management program administrator is responsible for tasks similar to those of the facility program administrator (or for all tasks, if the sole administrator). In addition, the site program administrator is responsible for review and oversight of emergency management activities of facility emergency management program administration. The site program administrator must prepare guidance for facility emergency planners to ensure an effective, integrated site program is achieved when the facility capabilities are activated for a coordinated response.

The program administrator's job is to ensure the emergency management program is developed and maintained─not necessarily to perform all these tasks or track/monitor all activities personally. Emergency management authority may be delegated to subordinate administrators responsible for various aspects of the program. The designated emergency management program administrator has ultimate responsibility for ensuring that requirements of the Departmental emergency management-related policies and Orders are met. The program administrator coordinates with other site groups responsible for implementing various aspects of emergency preparedness and response (Health Physicists, Industrial Hygienists, Medical, Public Affairs, Security, Operations, and Engineering).

Federal Managers, when mentioned in DOE O 151.1D, refers to circumstances in which the site/facility does not have a federal line-manager designated specifically as a *Field Element Manager (FEM)* and the site/facility reports directly to the Program Secretarial Office (PSO), which takes on the responsibilities of the FEM. Specifically, *Federal Manager* as used in DOE Order 151.1D, is the lowest-level federal line-manager position, within the line-management chain for the specific site/facility that has the delegated authority to exercise the action.

In the following sections, general responsibilities of program administration and management are discussed in the context of the key activities of an emergency management program: *planning, preparedness, readiness assurance*, and *response*.

3.1.3. Planning Responsibilities

Emergency planning includes "the identification of hazards and threats, hazard mitigation, the development and preparation of emergency management plans and procedures, and the identification of personnel and resources needed for an effective response." Documents that can assist in the planning process include a Baseline Needs Assessment, Site Security Plan, Cybersecurity Plan, Continuity of Operations Plan, Documented Safety Analysis, and the Threat and Hazard Identification and Risk Assessment guide. In the following sections, the responsibilities of program administration and management with respect to emergency management planning activities are divided according to the following topics: technical planning basis, program implementation, documentation, resource management, and policy issues.

3.1.3.1. All Hazards Planning/Technical Planning Basis

The primary responsibility of the emergency management program administrator is the establishment and implementation of the Comprehensive Emergency Management System. This involves the establishment of an Emergency Management Core Program that coordinates and integrates the emergency planning and preparedness requirements of applicable Federal, Tribal, State, and local laws, regulations, and ordinances, and other Orders and standards of performance. As warranted, the Core Program is expanded to implement additional emergency management requirements of an Emergency Management Hazardous Material Program, if hazardous materials pose a major threat to the health and safety of workers and the public. The program administrator(s) ensures that the proper technical staff are assigned to the efforts (health physicists when radioactive materials are involved, industrial hygienists to address toxic chemicals, meteorologists, subject matter experts (SMEs) in the transport and dispersion of hazardous materials, operations personnel, security specialists).

3.1.3.2. Program Implementation

Using the results and conclusions of the technical planning basis, the program administrator coordinates the development of the emergency plan and the implementing procedures for the Core Program and, as required, the Emergency Management Hazardous Materials Program and ensures that they are commensurate with the hazards on the SFA. As with the All-Hazards Survey and EPHA efforts, this activity may require involvement of personnel from a variety of technical areas and SFA organizations.

The program administrator ensures that emergency management plans and implementing procedures are coordinated with all involved site and facility response elements, integrated for site-wide consistency, and in accordance with Departmental policies. Emergency management plans are developed for Core Program Facilities, which addresses the minimum Core Program requirements, and for facilities requiring an Emergency Hazardous Materials Program, whose requirements are seamlessly integrated with Core Program requirements. Coordination and cooperation of tenant facilities (if any) with the site organization in programmatic and response activities should be described in the emergency plans.

The FEM, or applicable Federal Manager, is responsible for ensuring the contractor's basis documents, plans, and analyses, which the contractor then uses to develop implementation processes and procedures, are in compliance with requirements. This is an essential part of the federal oversight continuum and mitigates the potential of an error or omission carried forward from basis documents into procedures that could adversely affect health and safety.

The following table identifies documents requiring submittal to, or approval by, the FEM or applicable Federal Manager.

Table 3-1 Documents for FEM/Federal Manager

Documents	Approval/Submittal	Frequency	DOE O 151.1D Reference
After Action Reports (AARs) for Annual Exercises	Submit to FEM	Annual	Attachment 3, 14.a(2)(f)
After Action Reports for Actual Incident Operational Emergencies	Submit to FEM	As Applicable	Attachment 3, 13.c(2)
All-Hazards Surveys	Submit for Approval to FEM	When Performed (updated at least every 3 years)	Attachment 3, 2.c
EPHA	Submit for Approval to FEM	When Prepared, Triennial Review	Attachment 4, 2.n
Letters to Document Triennial EPHA Reviews if Determined No Changes Needed	Submit to FEM	Triennial Review	Attachment 4, 2.p
Exercise Plans (EXPLAN) for Annual Site-Level Exercises	Submit for Approval to FEM	Annual	Attachment 3, 14.a.(2)(e)
Emergency Management Plan	Submit for Approval to FEM	When Updated (no less than every 3 years)	Attachment 3, 1.c.(1), (3)
ERAP	Submit for Approval to FEM	Annual	Attachment 3, 14.c(1)(f)
Emergency Planning Zone (EPZ)	Submit for Approval to FEM	When Prepared	Attachment 4, 2.i
Corrective Action Plans (CAPs) for Findings from Federally Directed or External Assessments	Submit for Approval to FEM	When Identified	Attachment 3, 14.b.(1)(d)
CAPs for Findings Identified as a Result of Noncompliance for Life Safety at Defense Nuclear Facilities	Submit for Approval to FEM	When Identified	Attachment 4, 15.j.(1), (2)
Annual Exercise Schedule	Submit to FEM	Annual	Attachment 3, 14.a.(2)(c)

The program administrator(s) ensures that emergency management plans and procedures have the following characteristics:

- Document the emergency management program, including provisions for response to an Operational Emergency and procedures to describe how the emergency management plan will be implemented;
- Clearly state roles, responsibilities, and requirements associated with program administration and management, EROs, individual positions, operations, and interfaces;
- Describe the integration and coordination of the emergency management program with the DOE/NNSA Integrated Safety Management (ISM) systems;
- Are compliant with applicable requirements of the National Response Framework (NRF) and the National Incident Management System (NIMS).

3.1.3.3. Documentation

Documentation of the technical planning basis (All-Hazards Surveys and EPHAs) is an essential component of an emergency management program. It represents the technical information related to hazards on the SFA, methods and assumptions that form the foundation of the program, and documented evidence that responsible emergency management planners understand the SFA-specific hazards. Existing hazardous material databases and safety documentation are monitored to ensure that All-Hazards Surveys and EPHAs represent the status of hazards and operations at the SFA.

The program administrator is responsible for ensuring that emergency management plans and procedures are developed, verified, validated, reviewed periodically, updated as necessary, and that the program receives an appropriate level of oversight. This includes providing direction and guidance for conducting and documenting reviews, assessments, and approvals to ensure they are consistent, correct, up-to-date, and complete. Program administrators ensure that reasonable schedules are established, and SMEs are made available to provide competent reviews and evaluations.

3.1.3.4. Resource Management

Emergency management programs require resources to function effectively. Emergency management programs are developed based on the technical planning basis, three programmatic and eleven response program elements. Each program element requires financial, material, and human resources to develop and maintain the program.

- Financial resources. The program administrator tracks the financial resources allocated for their emergency management programs, including costs of facilities, equipment needed to respond to emergencies, training programs, drills and exercises, and all related personnel costs. Annual budgets are prepared, based on program needs identified through the readiness assurance process. The program administrator provides justification for budget requests and acts as an advocate for needed resources. See DOE Order 226.1B, *Implementation of Department of Energy Oversight Polic*y, for possible additional sources of information regarding the identification of program needs.

- Emergency facilities and equipment requirements. Changes in All-Hazards Surveys and EPHAs and the results of program and exercise evaluations and self-assessments may identify needed modifications and improvements that necessitate revising or updating facilities or equipment.

- Personnel requirements. Program and exercise evaluations, as well as the self-assessment process, may identify additional personnel needs. These requirements should also be documented so that additional resources can be allocated.

In summary, the program administrator ensures that adequate resources are identified and obtained to ensure that the program is ready to respond; financial resource requirements are identified and budgeted; facilities and equipment requirements are identified, monitored, and acquired; and personnel requirements are identified and addressed. Resource needs (including personnel, facilities, equipment, and financial) are identified and justified in the annual ERAP.

3.1.3.5. Policy Issues

This document provides guidance for implementing the Order requirements and represents a source for interpreting the intent of the requirements in the Order. Any additional questions regarding interpretation of Order requirements should be submitted to Frequently Asked Questions through the FEM. The program administrator is responsible for ensuring that all the emergency management program elements are consistent with Order requirements, including both prescriptive requirements as well as broadly stated and general performance goals found in this Emergency Management Guide (EMG).

Examples of policy issues that should be monitored include:

- This EMG provides sufficient guidance for developing an EPHA that satisfies the intent of the Order.

- The emergency management plans and associated procedures for consequence assessments and protective actions are consistent with the Order requirements in terms of the components (and phases) of the assessment process and Protective Action Criteria (PAC) selected for triggering protective actions.

- Times for emergency notifications are given in the Order and must be followed in the SFA procedures.

- The ERO training requirements (initial and refresher training) are given in the Order.

3.1.4. Preparedness Responsibilities

Emergency *preparedness* includes the acquisition and maintenance of resources, and the conduct of training, drills, and exercises. In the next four sections, the responsibilities of program administration and management with respect to emergency preparedness activities are divided according to program plans, program implementation, documentation, and policy issues.

3.1.4.1. Program Planning

Training and Drills. The DOE/NNSA emergency management training and drill programs ensure that personnel are prepared to respond to, manage, mitigate, and recover from emergencies associated with DOE/NNSA SFAs. Training programs can include a variety of instruction methods, such as classroom instruction, computer-based or web-based coursework, and hands-on training and drill activities.

General training for employee response, required as part of the Core Program, may be included as part of an employer's General Employee Training (GET) program. This program may include emergency awareness, warnings and alarms, evacuation and accountability, and first aid. Emergency Management Hazardous Materials Programs have additional training requirements for developing and maintaining specific emergency response capabilities for all personnel identified as members of their EROs. The training program should be commensurate with the hazards identified in the EPHA.

The program administrator must ensure the development and coordination of training program activities to prevent conflict with other activities and to ensure that resources are available. In larger SFA programs, there may be an individual assigned as the training program manager. In smaller programs, the designated site emergency management program administrator may be responsible for all aspects of the training program. The program administrator should also ensure a formal training plan is developed that describes program goals and objectives, organizational responsibilities, resources, and planned activities.

The administration of training and drill programs should include functions to meet the recommendations that will be mentioned below in section 2, *Training and Drills*.

Exercises. Emergency management exercises are formal, evaluated demonstrations of the integrated response capabilities of an emergency management program. Exercises are conducted to validate the response program elements of an emergency management program. Exercises should be realistic simulations of potential SFA emergencies. They may vary significantly in size and complexity to achieve their respective purposes. The DHS exercise methodology refers to these evaluated demonstrations as discussion-based or operations-based exercises.

Exercise-specific objectives are used to establish the exercise scope, specify the emergency response functions to be demonstrated, identify the extent of organizations/ personnel participating, and identify the breadth and depth of exercise activities to be accomplished or simulated. Typically, not all emergency management program elements are demonstrated in each exercise. The program administrator ensures that a systematic approach is used, with emphasis on participation and coordination among the members of the EROs, to develop an exercise plan to ensure that all elements of SFA programs are exercised and validated over a multi-year period. Coordination of exercises is particularly important at sites with multiple, integrated facility emergency management programs, where response resources are shared, and efficiency in scheduling and conducting exercises is paramount.

The administration of exercise programs should include functions to meet all exercise recommendations listed below in section 3, *Readiness Assurance*.

3.1.4.2. Program Implementation

Training and Drills. The emergency management program administrator has the responsibility for the conduct of the training program, including the scheduling of drills, based on the plans and procedures developed for the specific program. Administration of the training and drills program implementation should include functions to:

- Ensure training and periodic drills are scheduled, conducted, monitored, and documented;
- Ensure coordination of training and drills at sites with multiple facilities;
- Ensure auditable training and drill records are developed, maintained, and updated;
- Ensure a system is in place to track the development and implementation of lessons learned from exercises, and actual incidents to promote program improvements.
- Conduct periodic self-assessments, including evaluating instruction and reviewing training materials;
- Ensure drills provide supervised, hands-on training for members of EROs;
- Ensure emergency preparedness training is provided to all workers who may be required to take protective actions;
- Ensure emergency-related training on SFA conditions and hazards is made available/offered to offsite response organizations that may need to respond onsite; and
- Maintain access to a qualified training staff.

Exercises. For effective conduct of the exercise program, the administrator must ensure that:

- Each site exercises its site-level ERO elements and resources, as well as its integrated emergency response capability, at least annually in a site operations-based exercise. For multiple-facility sites, this site-wide exercise will be rotated among the facilities;
- For sites/facilities with an Emergency Management Hazardous Materials Program, offsite response organizations are invited to participate in the annual site-wide exercise once every three years. Site-wide exercises that include offsite participation are referred to as full-participation exercises (FPE). The annual site-wide exercise is an FPE at least every third year if offsite response organizations agree to participate;
- The evaluation of exercises conducted by the sites and facilities is accomplished by a knowledgeable, independent organization whose staff displays familiarity with responder organizations, functions, and procedures;
- Auditable exercise records are developed, maintained, and updated;
- Corrective actions items, identified as a result of the evaluation and critique process, are incorporated into the emergency management program;
- A system is in place to track the development and implementation of lessons learned from exercises and to promote program improvements.

3.1.4.3. Documentation

Training and Drills. The training program plan should be documented, and training materials archived. Drill parameters (through drill guides/plans) should also be documented with performance scoring/rating records to be archived. Training and drill records enable the emergency management program administrator to determine the types of training to be scheduled, the number of people to be trained, the specific individuals to be trained, and the type and quantity of resources that are needed to conduct the training and drills. Scores on training validation tests and performance during drills should also be measured and recorded. The training records and drill participation records provide a means for verifying minimum qualification requirements and hands-on practice for ERO participation.

Lessons learned from training and drill sessions are recorded and correlated with exercise evaluations, and other readiness assurance activities to determine additional training program needs.

Exercises. A complete Exercise Plan (EXPLAN), as described in Chapter 3, Section 3, should be produced for each annual site-level exercise. Facility-level exercises can be accomplished with an EXPLAN that contains only the essential elements that are required to conduct the exercise. Exercise participation records enable the emergency management administrator(s) to ensure that individual members of the ERO are given the opportunity to demonstrate their proficiency annually. An exercise AAR should be produced following the exercise that provides an account of exercise control, player performance, and self-assessment evaluation findings.

3.1.4.4. Policy Issues

Training and Drills. Policy issues related to training and drills will focus on the adequacy of the training to prepare ERO members for their respective response tasks. The Order requires a coordinated program of training and drills for developing and maintaining ERO position skills, including initial and refresher training. The administrator is responsible for ensuring that the training matches the skills required for the specific ERO positions.

Exercises. In addition to frequency requirements for conducting the exercises, the administrator must ensure that the scopes of facility- and site-level operations-based exercises match the intent of the Order. Also, the exercise program should include facilities participating in the site-level exercise on a rotating basis and all the emergency management program elements validated over a multi-year basis.

3.1.5. Readiness Assurance Responsibilities

As indicated in the Order, emergency *readiness assurance* includes "…establishing a framework and associated mechanisms for assuring that emergency management plans and procedures and resources are adequate by ensuring that they are sufficiently maintained, exercised, and evaluated, and that appropriate and timely improvements are made when identified." In the next three sections, the responsibilities of the program administrator with respect to emergency readiness assurance activities will be divided according to the following topics: program plan, program implementation, and documentation.

A formal emergency management evaluation is no longer required every three years. However, the associated requirements throughout DOE O 151.1D, taken together, ensure that adequate readiness assurance is maintained. This is accomplished primarily through the SFA emergency management plan, which must be approved every three years. Overall, the FEM is responsible for ensuring that adequate readiness assurance is maintained at their SFAs, in much the same way as the previous order. The DOE O 151.1D requirements depend on emergency management evaluations, improvements, and ERAPs to assure emergency management plans and procedures are adequate. Further information on the role of FEMs can be found in DOE O 151.1D, Appendix A.

3.1.5.1. Program Plan

Readiness assurance provides a framework and associated tools to assure emergency plans, implementing procedures and resources are sufficiently maintained, exercised, and evaluated; as appropriate, timely improvements are made in response to identified needs. The framework consists of evaluations, improvements, and documentation. Emergency management administrators should develop a readiness assurance plan that consists of evaluations (internal and external program evaluations, exercise evaluations, tabletop tests of decision-making) and a real-time improvement system to ensure that findings from all evaluations (including self-assessments) result in corrective actions that are implemented in the program and are verified and validated. In addition, the administrator should institute a lessons-learned program to take advantage of lessons, not only from DOE/NNSA, but also from other Federal and commercial activities performing similar tasks.

3.1.5.2. Program Implementation

To assure a quality emergency management program, persons with knowledge of the program or response activity being assessed should conduct an internal assessment of all aspects of a facility or site emergency management program annually. These assessments will be the basis for improvements which should be integrated into the emergency management program. The site emergency management program administrator should coordinate the scheduling of evaluations and assessments by external organizations to minimize impacts and maximize benefits. Evaluation schedules shall be forwarded to the Program Office and Headquarters (HQ) Associate Administrator of Emergency Operations to ensure maximum coordination. The emergency management program administrator should coordinate the response to emergency management evaluation findings.

The emergency management program administrator should maintain a root cause investigation and corrective action program that establishes and documents an integrated site program for corrective actions, including tracking corrective actions, and validating the adequacy of corrective actions resulting from the annual assessments. The program should also include specific findings and lessons learned from training, drills, exercises, and particularly those from actual responses and self-assessments, even though such findings may not have the same visibility and urgency as those associated with external oversight. Site emergency management program administrators should maintain an open-door policy for employee concerns regarding emergency management. A combination of programmatic self-assessments and performance-based validation through exercises does meet the intent of DOE O 151.1D to conduct annual self-assessments for all program elements.

3.1.5.3. Documentation

The emergency management program administrator ensures the timely preparation of facility ERAP elements for inclusion in the site ERAP. The contributions to the site ERAP are made on an annual basis and reflect current and projected facility emergency management program capabilities, resources, and requirements (personnel, facilities, equipment, emergency planning and preparedness activities).

Lessons learned from evaluations of exercises should be included with such records to enable facility emergency management program administrators to identify areas requiring additional training or that could require changes to the facility emergency management plan and implementing procedures.

3.1.6. Response Responsibilities

The responsibilities of the program administrator related to plans and procedures associated with emergency response was covered in Section 1.4. However, associated with several of the response emergency management program elements are functions/activities that must be maintained on a regular or periodic basis to be ready in the event of an OE. The program administrator must ensure that these functions are performed regularly. Chapter 4 contains guidance related to all the response program elements.

3.1.6.1. Programmatic Activities

Emergency Response Organization. An adequate number of fully trained personnel, with periodic participation in an exercise, a drill, or an actual response, are assigned to facility- and site-level ERO positions to ensure adequate staffing for emergency response. The standby staffing of ERO emergency facility positions and response teams is effectively accomplished. ERO rosters are periodically reviewed for accuracy (current qualifications, correct phone number, correct response time). Communication systems used to activate both on-shift and off-shift emergency response personnel are periodically tested.

Emergency Operations System. All of the systems and logistical support needed to support an effective emergency response such as the Emergency Operations Center (EOC) staff, Incident Command, first responders, site managers, and building emergency organizations, to include all the necessary facilities, systems, and equipment.

Offsite Interfaces. The emergency management program administrator(s) should meet with local emergency planning officials at least annually and upon significant program change to ensure their collective understanding of the site emergency management plan and emergency management plan implementing procedures. This review should occur as the documents affecting their roles, responsibilities, and activities change or require greater emphasis or attention, particularly in emergency categories, classifications, notifications, and protective action recommendations.

The program administrator is also responsible for the development, review, and update of site/facility MAAs/MOAs/MOUs relevant to a comprehensive and effective emergency management program. These MAAs/MOAs/MOUs routinely involve support provided to or from offsite organizations or, on a multiple-facility site, support provided to or from other facilities, contractors, or offsite organizations. On a multiple-facility site, MAAs/MOAs/MOUs with offsite organizations should be developed, maintained, and updated by the site emergency management program administrator, and are typically maintained as a part of the site emergency management plan. There are DOE/NNSA locations where DOE/NNSA retains full responsibility for development and maintenance of agreements with offsite organizations.

Organizations that may be needed in a supporting role, or needed for long-term support, have been identified with pre-designated offsite points of contact, including organization, names, and telephones numbers, which are documented, maintained, and available to the response organization. Planned response functions to be provided by offsite organizations are periodically tested and verified.

Emergency Facilities and Equipment. Designated response facilities, especially multiuse facilities, are adequately maintained. Inventories of all emergency equipment and supplies are maintained in identified locations. Periodic inspections, operational checks, calibration, preventive maintenance, and testing of equipment and supplies are carried out as required.

Emergency Categorization and Classification. The EAL sets are reviewed and tested regularly against a range of initiating conditions and emergency incident/condition scenarios.

Consequence Assessment. A formal Quality Assurance Program is implemented and maintained for control of the tools used in consequence assessment.

Emergency Medical Support. Arrangements with offsite medical facilities to transport, accept, and treat contaminated, injured personnel are established, documented, and periodically reviewed. Onsite and offsite medical personnel are periodically offered information and training on SFA hazardous materials, and opportunities for participation in drills and exercises.

Emergency Public Information (EPI). Workers and site personnel are informed of emergency response plans, response capabilities, and planned protective actions. Information is disseminated periodically to the public regarding facility hazards, how they will be alerted and notified of an emergency, what their actions should be in the event of an emergency, and points of contact for additional information. Continuing education is provided to the area news media for the purpose of acquainting the media with the facility, management personnel, facility hazards, emergency plans, and points of contact. A list of 24-hour media points-of-contact is available and maintained current.

3.1.6.2. Documentation

Written MAAs/MOAs/MOUs should be developed to ensure that the provision of support during an exercise and an actual emergency is not dependent on the presence of specific individuals. MAAs/MOAs/MOUs may be mutual aid or support agreements between onsite and offsite response organizations or may require Departmental elements or contractor organizations to provide specific capabilities, training, or information in exchange for assistance from offsite organizations.

Copies of supporting MAAs/MOAs/MOUs between Departmental entities and Tribal, State, and local governments or response organizations should be maintained as an appendix to the emergency management plan. If the potential release of phone numbers and radio call information is of concern, a table listing just the MOAs/MAAs/MOUs with renewal dates can be included in the emergency management plan.

3.1.7. Document Control Systems

Note: This section is provided to increase the sensitivity of the emergency management program administrators to document control aptitudes. Emergency management staff and responders should follow established processes and policies relating to information security, records management, protection of personally identifiable information, and so on.

The volume of information and documents that support and define an emergency management program, together with supporting technical information and reports, represents a significant challenge to emergency management program administration and management. A reliable document control system for document review, approval, distribution, and change control should be established, where none exists, or emergency management documents should be controlled under an existing site-wide document control system. The following list represents some of the documents that should be managed under a document control system:

- <u>Technical Supporting Information</u>. Diagrams, illustrations, maps, reference documents, and technical documents, such as risk assessments and Material Safety Data Sheets (MSDS)
- <u>Emergency Management Documents</u>. SFA All-Hazards Surveys or EPHAs, Plans and Procedures, EPZ documentation, all MOU, MOA, MAA, and all other documents required by Orders or other applicable laws or regulations
- <u>Auditable Program Records</u>. Complete training and drill records; exercise records, including participation and evaluation reports; program assessment and evaluation reports; and records resulting from actual emergencies; corrective actions and associated closure verification/validation records

The program administrator determines the appropriate controls to be placed on each document for its review, approval, distribution, and change control. No specific document control system is required, but the system should meet industry standards. Document accessibility includes ensuring the availability of documents essential for the continued functioning, operation, or reconstitution of a site organization/activity during or after an emergency.

The program administrator ensures adequate documentation of all technical data that supports the emergency management program by ensuring copies are maintained and up-to-date, information is properly distributed or made available or accessible, documents are updated when needed or required, and required supporting information is maintained. Both hard copy and electronic media (where possible) are used to keep documentation current. Documentation is shared with those who require access to it consistent with security requirements for access and established need-to-know.

The DOE/NNSA encourages program administrators to make maximal use of technological and information sharing tools (SharePoint sites, Electronic Document Management Systems) to increase document and information availability. Copies of documents maintained on electronic media should be read-only and access-controlled. The specific procedures used to address access to these electronic media files should be determined by the respective facility or site.

The emergency management program administrator must ensure that sharing information and documents complies with Federal and Departmental security regulations and guidance.

Any system of records that contains information on individuals, and is retrieved by a personal identifier, such as a person's name, or other unique identifier, needs to be compliant with the Privacy Act of 1974.

The system for document control also needs to ensure that Departmental requirements are met, such as security protections for information that is classified or controlled unclassified (to include Need-to-Know, privacy, and export control considerations) as well as ensuring requirements for records management are met (to include the availability of records essential for the continued functioning, operation, or reconstitution of a site organization/activity during or after an emergency).

3.1.8. Classified/Controlled Unclassified Information

If emergency management documents containing information that is classified or controlled unclassified are used at or have the potential to be generated at an SFA, the emergency manager program administrator is responsible for ensuring security protocols are incorporated per NNSA/DOE security directives, to include documents that could be exploited by malevolent interests (EPHAs, SFA diagrams, and maps). The emergency management program administrator also ensures that a properly authorized Derivative Classifier and a Unclassified Controlled Nuclear Information (UCNI) Reviewing Official reviews emergency management documents and supporting information. The emergency management official also ensures required reviews for other types of CUI such as privacy information or export controlled information.

3.2. Training and Drills

3.2.1. Introduction

The purpose of this chapter is to assist DOE and NNSA field elements in complying with the DOE O 151.1D requirement to ensure that a coordinated program of training and drills for developing or maintaining specific emergency response capabilities is an integral part of the emergency management program. The program must apply to emergency response personnel and organizations that the SFA expects to respond to onsite emergencies. The Order further requires that emergency-related information must be available to offsite response organizations. The Training and Drills program, ranging from general employee training to ERO training should be customized around All-Hazards Surveys, EPHAs, and associated emergency management program elements.

3.2.2. General Approach- Training and Drills

The DOE/NNSA emergency management training programs must ensure that personnel are prepared to respond to, manage, mitigate, and recover from emergencies involving hazards associated with facilities and onsite activities.

Training documentation and records should be formally managed and controlled to ensure that training programs support current emergency management plans and requirements and that training records are maintained for instructors and for all personnel assigned ERO positions. Drill and exercise participation and performance should be documented for each member of the ERO.

Requirements for initial and periodic refresher training should be identified for all ERO personnel. This should include special team training for functional groups with technical and management assignments, and training for decision makers to ensure they can perform duties promptly and accurately. Training needs should also be addressed for offsite emergency response personnel and organizations that are expected to support onsite response to emergencies. This includes training on SFA-specific hazards and emergency management plans and participation in training and drills to ensure integration of onsite and offsite response resources.

Emergency drills should be developed, scheduled, and conducted to provide supervised hands-on training and validation of classroom training for emergency responders and to provide practical training on interfaces between site groups that support emergency response. Drills should be developed based upon feedback from actual incidents and exercise experience, to validate corrective actions from program evaluations, and to validate new or revised procedures and equipment or facility changes.

The DHS employs a broad definition of *exercise* that focuses on many of the general functions attributed to the training and drills programs of the Homeland Security Exercise and Evaluation Program (HSEEP), as described in this EMG. The broad range of purposes attributed to exercise activities described in the HSEEP series emphasizes the design of exercises to familiarize personnel with plans and procedures, achieve teambuilding, build consensus, examine contingencies, solve problems, evaluate functions, measure resources, and examine interfaces. The training aspects of drills are emphasized in DOE guidance.

This chapter provides a system-based approach to emergency management training and is organized into the following sections:

- Training program management
- Training needs assessment for onsite and offsite personnel
- Training requirements
- Training development
- Training delivery
- Training drills/practical applications

3.2.3. Training Program Management

Effective management of a training program requires a formal training plan be developed that describes program goals and objectives, organizational responsibilities, resources, and planned activities. To accomplish the elements of the program plan, a schedule of development, delivery, and evaluation activities should be developed and updated as needed. Annual internal assessments of training development and implementation identify needed improvements in the program. Trainer/instructor qualifications should be established and updated to reflect changes in instructional techniques as well as relevant technical disciplines. Evaluation of the training staff ensures their appropriate skill levels and knowledgebase. Documentation of training requirements and lesson plan reviews ensure that the course materials meet expectations for the subject positions. Finally, a system for managing emergency responder training records ensures that staff personnel on ERO rosters are trained for the positions assigned.

3.2.3.1. Program Plan

A comprehensive and systematic training program plan includes the following:

- A full description of training program goals and objectives, compliance with requirements and administrative policies and procedures
- Identification of current training needs for all emergency responder positions
- Identification of training resources, staff, facilities, and reference material to support training activities
- Schedule for training activities, including development, delivery, and evaluation of training programs and courses
- Description of the process for identifying and documenting training needs for emergency responders
- Requirements for ERO qualification and re-qualification, including retraining and remedial training

The program plan should also identify administrative processes that support the systematic approach to training. Such processes should be identified for the following elements of training management:

- Identifying training program approval and signature authority
- Establishing a matrix of training requirements for ERO positions
- Identifying methods for selecting qualified instructors and establishing a list of training staff qualified to teach each course or program
- Describing how training records are maintained in a manner that can be audited
- Describing how refresher training addresses the details of program changes and lessons learned from actual incidents, exercises, and program evaluations
- Describing how the emergency management training program is integrated and coordinated effectively with related training provided by other organizations

The training program plan should address training for all primary and alternate personnel assigned to the facility- and site-level ERO. A training program plan typically distinguishes the following levels of training requirements:

- Initial training to qualify for a position on the ERO
- Refresher training to maintain competency and receive information on changes related to required knowledge and skills, as well as:
  - Lessons learned
  - Best practices
  - Identified gaps or deficiencies on individual training
- Remedial training to correct deficiencies in performance or testing related to ERO positions
- Annual participation in performance-based training or evaluation methods such as drills, simulations, and exercises in order to maintain ongoing proficiency and skills

An effective way to illustrate the emergency management organization’s training plan is to use a matrix to list ERO positions and the specific training required for each position. The matrix is both an internal tool for tracking positions and training as well as a tool for satisfying external evaluators of the completeness of the program.

3.2.3.2. Schedule

A schedule for developing, delivering, and evaluating training activities should be developed and updated as needed. The schedule should provide a current and structured view of program-specific training requirements, including a detailed list of courses provided by the emergency management department, as well as dates for scheduled implementation. An annual forecast of drills should be established to support the training plan and the site/facility exercise schedules. Internal program assessments should also be indicated.

3.2.3.3. Training Program Evaluations

Internal assessments of training development and implementation should be performed once a year as part of the required annual assessment of the overall emergency management program. A process should be identified to ensure that recommendations from training assessments and lessons learned from previous training drills are incorporated into future training development and implementation efforts. Internal assessments should aim to improve training programs, including administration, development, and delivery. The site internal corrective actions tracking system provides a convenient tool for ensuring that identified corrections are made to the program. The site should also ensure all members of the ERO understand the corrective action system and how it operates.

3.2.3.4. Trainer/Instructor Qualifications and Evaluations

<u>Qualifications</u>. Each training program should develop a list of requirements for qualifying instructors/trainers. These requirements should be reviewed and updated periodically to keep pace with changes in instructional techniques as well as relevant technical disciplines. Two primary qualification areas to be addressed in instructor requirements are as follows:

- *Instructional skills* — These are skills related to the imparting of knowledge, regardless of the subject. Examples include adult learning methodologies, presentation skills, and training in the use of various instructional media, such as video and on-line computer instruction.

- *Technical knowledge and experience* — Adequate understanding of theory, practical knowledge, and experience in the content area are needed. Technical competency is based on instructor credentials, job references, and demonstration of technical expertise. Proficiency in instructing the subject areas should also be evaluated as part of instructor qualification. Examples of areas where technical or subject-specific expertise are necessary include dose assessment, emergency medical and EPI.

A schedule should be established to ensure continuing education and professional development of emergency management trainers/instructors in their areas of expertise.

Evaluations. Evaluation of objectives and responder's performance during a drill should consist of a measurement or demonstration that indicates completion of training objectives and achievement of qualification standards. Evaluations in drills differs from evaluations carried out in exercises in that evaluations in an exercise are an assessment of the organization or individual's overall readiness and demonstration of expected proficiency, whereas evaluations in drills focus on developing or maintaining proficiency through training. Management should also conduct internal reviews of the training staff as part of the annual assessment of the training program. These evaluations should demonstrate the following:

- The instructor methods are consistent with the site training program standards and are appropriate to the course objectives
- Instruction adheres to the documented lesson plan and evaluation
- Subject-matter knowledge and experience are appropriate for course content
- Instructional presentation styles are appropriate and support course methodology
- Instructor-related feedback/ratings from course evaluation forms are analyzed and documented
- Post-training evaluations of instructors are analyzed and documented

Instructor deficiencies identified during the evaluation should be corrected and documented within a specified period. Input from the evaluation should also be used to improve knowledge, skills, and abilities of the staff.

Documentation supporting the staff qualifications should be maintained in a manner that may be audited. Documentation should include the following:

- A matrix of staff positions, including requisite education and experience, cross referenced with each training staff member;
- Qualification records; and
- Feedback and post-training evaluations.

3.2.3.5. Course Documentation

All documentation for a particular training program should be kept in either hard copy or electronic format. Files should be organized by date, iteration, or topic. Course history files should include rosters/attendance sheets, evaluations of knowledge and performance, and lesson plans and tests.

- *Training Requirements* — Training requirements for each emergency response position should be documented, reviewed, and updated on an annual basis. This update ensures training requirements are relevant to the position and provides an opportunity to add any new requirements assigned to the position. For example, should hazards change or regulatory requirements for select training change, the organization may need to revise training requirements for some emergency response positions.

- *Lesson Plan Reviews* — Each site is responsible for maintaining current, documented lesson plans for all site-specific training developed by that site. Lesson plans include course documentation of classroom training, on-the-job training programs, and computer-based training. Lesson plans should be reviewed prior to their use. This process includes a review by an SME to ensure that information contained in lesson plans continues to be consistent with current procedures and practices and remains applicable to DOE emergency management. Lesson plans should be updated prior to use if there have been changes to the emergency management plan and related procedures since the last annual review. Updates should include the dated signature of the SME.

3.2.3.6. Emergency Responder Training Records

A system for managing emergency responder training records should include a means for tracking the following:

- Course attendance and completion
- Status of individual emergency responder qualifications
- Scheduled training, including a system for reminding employees and program administrators when training is needed
- In-house and external training
- Training dates, location, length, and name of the instructor
- Participation in emergency drills and exercises

Training records should also include all documentation supporting the implementation of training developed by a DOE/NNSA SFA. Such documents include the following:

- Memos relating to scheduled and canceled training or training exemptions
- Certificates for training conducted outside of DOE
- Course and program evaluations

There have been situations in which training received by an individual emergency responder has become an issue during litigation after an accident or emergency. Facilities should seek advice from General Counsel to determine whether to include additional information in the training records. Examples of additional records to maintain may include lesson plans by course iteration, participant evaluations, and any memoranda or documentation regarding remedial training received by an individual.

3.2.4. Training Needs Assessment

3.2.4.1. Training for Onsite Emergency Responders

Training needs are based on tasks to be performed by an emergency responder, hazards that may be encountered by response personnel, and established requirements and standards for emergency responder training. A systematic process should be used to identify and document performance-based training requirements for emergency responder positions. Training needs are identified initially by reviewing regulatory requirements and existing training programs, and then conducting a needs analysis.

In the case of training requirements originating from a regulatory source (Occupational Safety and Health Administration (OSHA), National Fire Protection Agency (NFPA), DOE Order), a needs analysis may have already been accomplished and included in the regulation. Further in-depth analysis need not be conducted once applicable requirements have been determined. These requirements should be included and addressed in the design and development phases of the training program. Examples of Federal requirements that specify training for emergency responders are included in Section 2.5.

A needs analysis should ensure that training for individual emergency response positions provides knowledge and skills associated with assigned tasks to be performed. The needs analysis should document the training that the emergency responder receives related to their normal position in the work force that is applicable to their ERO responsibilities. Training topics should reflect specific function, position, and responsibilities consistent with activities associated with the Program Elements of the emergency management program. Training should incorporate lessons learned in emergency planning and response based on site experience, as well as experience from throughout the DOE/NNSA complex, other government agencies, and private industry. Appropriate topics to be considered for inclusion in emergency management training programs are listed in Section 2.5.

Analysis of emergency response training needs should be ongoing. Additional analysis is appropriate when a discrepancy or problem is identified in the performance of an emergency response task and whenever program changes occur. Responsible managers should receive and use information from a variety of sources to ensure that training continues to reflect changes and to address lessons learned. Training requirements may be modified based on changes in hazards, response facilities or equipment, communication systems, site or facility mission or layout, reorganization of the ERO, or revision of procedures or requirements. Training needs may also change based on drill or exercise evaluations, results of independent evaluations, occurrence reports, and industry lessons learned.

Tabletop analysis is a recommended method for identifying site-specific training needs. This method uses a facilitator to guide a group of SMEs through a process of job analysis and selection of tasks to be addressed in training.

For personnel who have transferred from another DOE site, or for contractor or personnel with experience in a closely related industry, a streamlined and standardized qualification process can be established. The feasibility of streamlining qualifications must be evaluated on a case-by-case basis and documented by proof of experience. Some additional training will usually be required to become familiar with facility-specific hazards and procedures.

3.2.4.2. Training for Offsite Emergency Responders

Training needs should also be identified for offsite emergency responders who may be involved in response to site emergencies. The applicable agreements (MAA/MOA/MOU) should identify the type of training needed.

A systematic process should be used to determine which offsite organizations have emergency responders that may require site-specific training. For example:

- Facility-specific orientation training on hazards and emergency response procedures, as well as emergency notification and communications should be offered annually to State, Tribal and local EROs.

- Private hospitals, medical, and ambulance services expected to support onsite response efforts, or receive contaminated, injured personnel from the site, should also receive training on site hazards and protection from those hazards as well as interface and communications with site responders.

- Offers of annual training for all parties in mutual aid agreements should be considered. These same parties should be offered the opportunity to participate in training drills and exercises. Refer to the DHS HSEEP program website for specific information on requirements pertaining to emergency exercises for local and state agencies and integration with offsite responders.

Training, drills, and exercises should aim to achieve team building, consensus building, contingencies examination, problem solving, resources measurement, and interface examination.

3.2.5. Specific Training Requirements

Each site must determine the specific emergency response training requirements that apply to the ERO positions based on specific site hazards, conditions, resources, and emergency plans. Applicable requirements will differ from site to site. For example, for sites that involve mining operations, the Mine Safety and Health Administration (MSHA) regulations for mine rescue training may apply. Differences would result from the situation where a site must maintain an onsite fire brigade vs. a site that depends solely upon offsite agency fire response. The following sections describe specific training requirements derived from applicable regulations, position-specific functions, site characteristics and operations, and details of the emergency management program.

Each site must develop ERO training to include ICS 100 and ICS 700, *Introduction to ICS*, and *NIMS, An Introduction*. The goal for both of these courses is to help introduce the concepts of the Incident Command System (ICS) and NIMS to emergency responders, so in the event of an emergency there is common terminology in use. To meet this requirement, sites need to focus on ensuring that ERO members will have adequate knowledge of ICS and NIMS for interaction with potential offsite responders.

3.2.5.1. Regulatory Requirements

Training personnel should monitor applicable regulations promulgated by OSHA, MSHA, Nuclear Regulatory Commission, Environmental Protection Agency, NFPA, and DHS. The impact of regulatory changes on training needs can be evaluated using the following questions:

- What conditions do the changes address?
- Do those conditions exist at this SFA?
- Will changes influence the way our personnel perform their tasks?
- What specific effects will this change have on training?
- Does the condition require an immediate response?

This list is not intended to be exhaustive and provides a set of examples of non-DOE Federal and national requirements that specify training for emergency responders:

- 29 CFR Part 1910.156 specifies fire fighter training
- 40 CFR Part 265.37 specifies training for EROs Granted Facility Access and Training for Hospitals Receiving Facility Patients
- 40 CFR Part 112.7 specifies training for Spill Prevention, Control and Countermeasures
- 29 CFR Part 1910.120 specifies training for Hazardous Materials Emergency Response
- 29 CFR Part 1910.38 specifies training for Emergency Action Plan/Evacuation of Employees
- 29 CFR Part 1910.157 specifies Fire Extinguisher Education

- 29 CFR Part 1910.146 specifies Confined Space Rescue Training
- NFPA 472 specifies training for Professional Competence of Responders
- NFPA 473 specifies training for Professional Competence of Emergency Medical Service (EMS) Personnel
- NFPA 1500 specifies training for fire department Occupational Safety and Health Programs
- NRF and NIMS

The DHS HSEEP and other Federal or State training requirements may apply for some DOE/NNSA sites.

3.2.5.2. Site-Specific Training

General training for employee response, including training on protective actions in an emergency is required as part of the Emergency Management Core Program. This may be included as part of an employer's GET Program. Emergency-related information in this training should include emergency awareness, overview of the organization’s emergency response plan, warning systems and alarms, protective action, accountability for site workers in the event of an emergency, and first aid. Employees assigned to specific responsibilities for onsite emergency response should receive additional training to address those responsibilities. At a minimum, this includes emergency managers, building wardens who support personnel accountability and protective action procedures (personnel assigned to close doors and windows and shutdown ventilation systems), personnel assigned to perform first aid/cardiopulmonary resuscitation or use fire extinguishers, emergency spokespersons, and personnel responsible for interface with offsite response organizations that may support onsite emergency response.

3.2.5.3. First Responder Training

Initial and annual refresher training should be provided to workers who are likely to witness emergency conditions involving hazardous materials and who are expected to notify the proper authorities. These workers are expected to attain the applicable training level according to the requirements specified in 29 CFR Part 1910.120.

3.2.5.4. Offsite Responder Training

As discussed in Section 3.2.4, emergency-related information, instruction concerning notification procedures, and training on site-specific conditions and hazards should be made available to offsite personnel who might be requested to respond to an emergency at the DOE SFA, as well as hospitals that have agreed to receive patients from facility emergencies. Offsite responders should also have the opportunity to participate in drills conducted to validate procedures and test integration of resources with the facility response organizations.

3.2.5.5. Training on Change

When changes occur involving facilities or sites (change in mission, facility decommissioning, organization reengineering) or when hazards change, employees and responders should receive training on how these changes apply to them and their responsibilities for emergency response. Annual re-training should address changes; however, training on changes may need to occur prior to scheduled re-training to ensure safe and effective response.

3.2.5.6. Coordinated Training Programs

The training and drills program described in DOE O 151.1D (Core and Hazardous Material) requires a coordinated training program consisting of formal training and drills. The program develops or maintains specific emergency response capabilities for all personnel and organizations expected to respond to onsite emergencies. This training program should consist of a combination of self-study, formal classroom training, field training focusing on skills, and drills. All personnel (including both the primary and alternates) who constitute the ERO should receive both initial and annual refresher training. Emergency-related training should also be made available to offsite response organizations.

Training should emphasize the need for prompt, accurate, and practical judgments involving incident categorization and classification, protective actions, and the urgency of notifications of Operational Emergencies. Training should address decision-making when information is incomplete or uncertain and when incidents and conditions are not covered explicitly by EAL procedures.

The training program should be commensurate with the hazards identified in All-Hazards Surveys and EPHAs. Individual training programs should be commensurate with assigned emergency-response responsibilities. Training topics should reflect the trainee’s functional position and responsibilities. Appropriate topics to consider in the training program include:

- All-Hazards surveys
- Emergency Planning Hazards assessments
- Emergency Management Program Administration and Management
- Emergency Operations System
- ERO
  - Incident command
  - Activation and coordination of response resources

  - Hazardous materials emergency response
  - Firefighting
  - Security Incidents
- Offsite interfaces
  - Coordination and liaison with offsite response and support organizations
- Emergency facilities and equipment operation
- Emergency categorization and classification
- Notification and communications
- Consequence assessment
  - Dose projection
  - Field monitoring
  - Decision-making
- Protective Actions
  - Protective actions/protective action recommendations decision-making
  - Reentry planning – Rescue
  - Decontamination
- Emergency medical support
- EPI
  - Emergency spokesperson skills
- Recovery Planning

3.2.5.7. Defense Nuclear Facility (DNF) Training

In addition to having a training program that incorporates factors from Emergency Management Hazardous Materials Program, sites that qualify as DNFs should be able to meet additional training criteria. DNFs should:

- Incorporate EOC staff in OE training

- Use scenarios in training that are realistic and represent the hazard and threats of the site
- Integrate training with ERO training and conduct of drills and operations
- Use evaluation that incorporates continuous improvement for drill design and content
- Consider rotation of shifts in drill scenarios
- Conduct unannounced drills, and drills with low staffing levels

3.2.6. Training Development

In this section, development of individual training courses is discussed. The initial step in training course development is establishment of goals and objectives. The method for delivery of the training will depend on the target audience and the goals and objectives of the training. Course materials will be designed to facilitate the learning process and will be consistent with the delivery method selected. A key element of the course development is identification of the method for testing whether students have successfully achieved the specified level of competency in the material presented. Once all aspects of the course have been developed, the training should be evaluated to determine whether it meets expectations. Finally, the special subject of remedial training development is briefly discussed in this section.

3.2.6.1. Training Goals and Objectives

The training or instructional goals for a specific course state the anticipated outcome of instruction. The instructional goal provides a broad statement of what will be accomplished at the conclusion of the lesson or course. Training objectives are measurable statements of intent that specify expected outcomes of each stage of training. They should state clearly what participants would know or be able to demonstrate after training. Course results will be measured against the original goals and objectives set at the beginning of course development.

3.2.6.2. Training Delivery

Methods of training delivery are an important consideration in the design of each course. Appropriate methods for delivering the specific training depend on the target audience's composition, location, need, and job complexity. The type of delivery for emergency management training should also be based on learning objectives, learning tasks, and group size. Class size may need to be controlled to maximize instructor/student interaction. Classroom-style delivery of training may effectively use live classroom, video presentations, computer-based instruction, or self-paced instruction. Most training should combine instructor presentation with student participation and hands-on demonstration and experience. Training demonstrations, roleplaying, and practical skills training should be realistic, but with due consideration for student and facility safety. The ISM system should be fully implemented when bringing realism into practical training or drills.

To maximize student involvement, classroom training may be augmented with tabletop simulations, hands-on drills, role-playing exercises, group tasks, facilitated group discussions, and assigned reading/reporting. Practical exercises that put knowledge into practice are very effective to help ensure student ability to apply knowledge in the context of realistic hypothetical situations.

3.2.6.3. Developing Course Materials

Course materials are the materials used by instructor and participants to facilitate training. When preparing to develop course materials, first review any existing training materials, regulations, manuals, and industry guidelines for usability. Existing materials should be reviewed against instructional objectives to determine whether they partially or fully meet training requirements. Course materials can include lesson plans/course documentation, training support materials, and participant materials.

Lesson Plans/Course Documentation. An instructor uses a lesson plan as the primary training tool for guiding the learning process. Standard lesson plans for classroom instruction promote consistent, effective instructor presentation and may include the following:

- Administrative information (name of course, time allotted, target population, instructional method, and approval)
- Training goal and objectives
- Details about training methodology
- Lesson content based on learning objectives
- Lesson content sufficiently detailed to ensure consistent and repeatable training
- Safety information, as relevant
- Training support requirements

Training Support Requirements. Training support materials should be selected or developed to support and reinforce the learning objectives. For each course documented identify, develop, and maintain a list of the resources including trainers, technology, equipment, and facilities required to support training activities. Training support materials or aids to consider include computers, software, video, models, demonstration equipment, scenarios, and classroom exercises.

Participant Materials. The purpose of participant materials is to enhance learning and to provide reference materials for participants. Materials might include any of the following:

- Student workbook

- Job aids such as procedures or equipment operating instructions
- Glossary of terms
- Checklists used to document action steps
- References discussed during training session
- Lesson plan outline

Participant materials should be marked *For Training Use Only* to ensure that trainees do not confuse them with procedures.

3.2.6.4. Test Methodology

Training should include some form of measurement or demonstration that indicates completion of training objectives and achievement of qualification standards. Tests document the knowledge and skills a participant has gained from training. Written examinations and performance evaluations measure achievement of each instructional objective. Each evaluation item should reference a specific training objective.

Emergency drills in particular provide an excellent opportunity to incorporate tracking of individual emergency responder and response group proficiencies. Instructors who evaluate practical exams during drills must have the technical experience and expertise to provide a valid assessment of performance.

When constructing a test, the following characteristics and constraints should be considered:

- Test length should reasonably reflect the length and complexity of the lesson plan that is delivered
- Multiple test items for each learning objective may more accurately verify that learning has taken place
- Vary test materials or use randomly selected test banks to ensure long-term validity of tests and ensure that test information is not shared and compromised between students
- Development of pre-tests and post-tests, and the comparison of results, can help validate that learning has taken place and help verify the effectiveness of the specific training course
- Intermediate evaluation (i.e., measuring progress during the course) can help instructors verify learning before the training course is complete and may prevent the need for remedial training at the end

- Evaluation of course objectives measures what the participants know or can perform at the end of training

3.2.6.5. Course Evaluation

Training programs should be evaluated by the training organization for the adequacy of the following: program and lesson content, examinations, presentation, documentation, and post-training performance. Participants should be encouraged to provide evaluation of course materials and delivery as part of the overall program evaluation process. This evaluation process determines strengths and weaknesses, improves content and delivery, and ensures that revisions are made as appropriate. Development of new courses should include evaluation and validation of the effectiveness of course materials using pilot presentations, peer reviews, or review by SMEs.

3.2.6.6. Remedial Training

Remedial training is additional training provided to a participant who did not correctly answer the required number of test questions or who was unable to successfully complete a formal training session in the previous iteration. Because remedial training requirements are lesson-specific, they should be prescribed in each lesson plan so they are ready for use in case they are needed. Remedial training focuses on the specific knowledge or skills challenging the participant. Remedial training might consist of additional instruction or training directly related to the training objectives for the portion of the course in which the participant had difficulty. The remedial training is intended to raise the individual's competency to a level that allows attainment of the knowledge and skills required to successfully complete the lesson or demonstrate the skill proficiency required to perform the job.

3.2.7. Training Delivery

The previous section briefly discussed methods for delivery of training and how the delivery method should be part of the training plan. This section provides specific guidance to training organizations, including instructors responsible for actually delivering training. In preparation for delivery of training, training personnel should confirm that the necessary items are ready for the training session, including the following:

- Equipment — instructional equipment such as projectors, computer hardware, computer software, and television monitors

- Facilities — classrooms and setup of the classroom, exercise sites, ranges, computer labs, etc.

- Course administration — materials, supplies, documentation, such as attendance sheets, certificates, and participant notebooks or handouts

- Instructor Qualifications/Skills — knowledge of lesson plan content and knowledge of target population's needs; preparation of lesson plan and participant learning activities

The following is practical guidance for instructors to help ensure successful delivery of training:

- Adhere to the lesson plan content and presentation method defined in the training design document
- Adhere to all safety measures listed in the lesson plan
- Create an instructional atmosphere that enhances the learning process
- Use effective communication skills to keep students engaged in discussions and activities
- Dress appropriately for the environment and training activities. For example, if the normal dress is business casual or if training will be conducted outside, dress accordingly
- Provide and monitor feedback from participants to ensure active learning
- Ensure that participants accomplish all the objectives during training
- Ensure involvement of all students in training activities, group tasks, discussions, and hands-on learning experiences
- Evaluate participant performance during, and at completion of, the training session
- Ensure that all required materials are made available to the participant for self-paced training
- Use standardized materials for on-the-job and technology-based training programs

3.2.8. Drills

Drills are training methods that allow an individual to put knowledge into practice in the context of a scenario-based simulation. The drill provides practical training to enhance preparedness for emergency response personnel and organizations that are expected to respond to onsite emergencies. Qualification requirements for each emergency response position should include annual participation in at least one training drill (or an exercise) during which practical knowledge and skills are demonstrated.

Drills are supervised hands-on instruction and application sessions for individuals or teams. These sessions provide an opportunity to demonstrate and maintain individual and organizational proficiency. During drills, the desired skills or actions may or may not be first demonstrated by the instructor. These training activities are documented by a plan, which includes evaluation criteria used by the instructor or evaluator. The checklist has two purposes: to provide feedback during the training and to summarize overall performance. Because the focus is training, it is often appropriate for the instructor to stop and correct participant actions during the activity rather than wait until the end.

Drills should be of sufficient scope, duration, and frequency to ensure adequate training for all emergency response functions applicable to the facility. The size and complexity of any drill will depend on the objectives. Many drills will be functional, focusing on training responders involved in a specific response function. Drills can range from hands-on instruction involving one procedure to a multi-organizational, scenario-driven incident. Drills should be as realistic as possible, using realistic scenarios based on All-Hazards Surveys and EPHAs as well as actual facility conditions. Conduct of drills requires a skilled and experienced instructor who can present the scenario, control activities of responders, and provide feedback that enhances learning.

Within the DOE/NNSA emergency management system, the distinction between a drill and an exercise is reflected in their primary purpose; namely, a drill is oriented toward training and is not a graded evaluation of the response activity. Because the focus of a drill is training, some aspects of drill conduct can be made more flexible than in an exercise. Some emergency response roles may be combined, and the instructor/controller may be free to stop and correct the responder actions during the drill. In a small drill, one instructor may plan, conduct, and evaluate the performance.

Consideration should always be given to the need for safety and security plans when drills are conducted. Any drill that has the potential to affect or might be observed by an offsite population (field monitoring team activities, smoke from a fire drill) should be planned to avoid public concern or inconvenience.

The following represent typical functions/activities for the focus of drills:

- Emergency medical team response
- Hazardous Materials (HAZMAT) response
- Joint Information Center (JIC) activation
- Dose assessment drill
- Field monitoring drill
- Emergency notifications/communications with offsite agencies
- Protective Force interface with Fire Department

Successful implementation of drills involves systematic planning, conduct, and assessment.

- Planning for drills should involve the following components:

  – Performance objectives. Identify the performance, including conditions and standards of performance. The objectives should reference a specific policy, procedure, or training requirement.

  – Evaluation Criteria. Develop criteria based on the performance objectives, conditions, and standards of performance. Also, identify how the drill will be conducted in the context of the criteria specific to the drill.

  – Scenario description. Describe the elements or system being trained through use of the specific scenario. Scenarios may be restricted to specific, limited aspects of the emergency management system. Scenarios should be based on site hazards identified in the All-Hazards Survey or EPHA. The scenario description should include a detailed description of incidents and conditions that emergency responders need to deal with, and a timeline of events and actions that are expected to take place.

  – Controls. Describe the controls imposed to ensure the integrity of the drill (safety plans, security notifications, use of trusted agents, equipment controls, time limitations, and coordination with other operational elements).

  – Resource requirements. Description of resources needed to conduct the drill (facilities, personnel, and equipment).

  – Compensatory measures. Describe the measures to be taken to compensate for any degradation of capabilities (security, safety, and medical) during the training to ensure safe and secure operations are continued.

  – Documentation and approval process. Identify the approval process for drill plans.

  – References. Included are lesson plans, DOE HQ and site orders/manuals, and site policy documents containing requirements for objectives being tested.

- Conduct of a drill requires that the instructor adhere to the emergency management plan. This ensures that the training provides an accurate and valid representation of the emergency management program. Feedback from the instructor during the training is essential.

  Guidelines for conduct of a drill include:

  – Explain the purpose and objectives of the training drill/practical application

  – Maintain a calm and professional attitude

  – Question to verify the knowledge gained by participants

  - When there is a deficiency, stop the drill/application and provide immediate corrective action

  - Provide fact-based feedback

  - Respect participants' experience and expertise

- Drill Assessments are an effective review of a drill performance that requires the members of the control organization to document the actions taken in the drill when compared to the objectives and expected response actions. Not all drills are significant enough to require a formal report. If a formal report is prepared, consider including the following elements:

  - Description of the drill. Describe the conditions under which the test was performed and specifics of who participated.

  - Summary of performance. Describe what was observed during the training drill. Include not only positives, but also opportunities for performance improvement.

  - Results. Analyze data to describe observed performance against the performance standards from the objectives.

  - Remediation/corrective actions. Optimally, use an established issues management system to address observed areas during the drill performance that did not meet requirements, or could have been improved upon, in the event that coaching during the drill was not sufficient to correct the issue.

<u>Tabletop Activities</u>. Tabletop activities represent a cost-effective type of training drill experience during which emergency responders have an opportunity to interact with other response positions and learn their individual responsibilities, decision-making functions, and communication requirements in the context of these interactions. Tabletops may range from lecture and guided discussion to a detailed verbal simulation of response to a particular scenario. The instructor or students verbally walk-down response to a facility-specific scenario to illustrate the overall direction the response is taking and to clarify participant perceptions of their roles.

Learning objectives for a tabletop will determine the focus of the activity (overall coordination versus detailed problem-solving). Because of the inherent flexibility of this approach, trainers are free to structure the training experience creatively, controlling scenario time and trainee activity. However, a tabletop requires significant preparation to ensure that objectives are satisfied. The instructor must be skilled to facilitate and record the training session. A co-instructor or recorder can also be used to note questions and problems to be addressed later through procedure revisions, additional training, or agreements between response groups. If a tabletop involves multiple response groups or a detailed or highly technical scenario, then representatives of the involved groups/ agencies or technical specialists should be involved in the planning of the activity to ensure that scenario details, procedures, and expected response actions are correct.

Typical topics for the focus of tabletop training activities may include:

- Coordination and interfaces between the site and offsite agencies
- EOC management decision-making
- Interfaces within the JIC
- Interfaces between site response groups (e.g., health physics, security, fire department)
- Hostage negotiations
- Emergency categorization/classification

3.3. Readiness Assurance

3.3.1. Introduction

The purpose of this chapter is to assist DOE and NNSA field elements in complying with the DOE O 151.1D requirement that a Readiness Assurance program be in place to assure that emergency plans, implementing procedures, and resources are adequate and sufficiently maintained, exercised, and evaluated and that improvements are made in response to identified needs. As part of building a Readiness Assurance Program, sites need to establish a formal exercise program that validates all elements of an SFA emergency management program. The exercise program should validate both facility- and site-level emergency management program elements by initiating a response to simulated, realistic emergency incidents or conditions in a manner that, as nearly as possible, replicates an integrated emergency response to an actual incident.

Readiness assurance programs provide assurances that the key activities of emergency management (planning, preparedness, and response) are effective in maintaining an adequate and reliable response. Readiness assurance performs an essential role in the development, management, and improvement of emergency management programs. Its structured process of evaluations followed by a rigorous implementation and tracking of program improvement ensures an efficient and timely progression toward a high-quality emergency management program.

The readiness assurance requirements in DOE O 151.1D and the guidance contained in this chapter are consistent with DOE O 226.1B, *Implementation of Department of Energy Oversight*. DOE O 151.1D requires all levels of the Comprehensive Emergency Management System, SFA (contractor), Field Element Manager, and Program Secretarial Officer (PSO) to conduct an annual self-assessment of their programs. This chapter of the guidance concentrates on acceptable methods of implementing those requirements at the SFA level, with Section 3.6 specifically addressing self-assessments.

In addition, DOE O 151.1D follows the DOE Oversight Model (DOE O 226.1B) with readiness assurance requirements for the Field Element Manager and PSO to ensure the continuous improvement of the Comprehensive Emergency Management System at all levels of the Department. Teams from the Field Element Manager or PSO levels most often employ the structured approach to emergency management evaluations discussed in Section 3.4. The Office of Enterprise Assessments; and Office of Environment, Safety, and Health Assessments; Office of Emergency Management Assessments (EA-33) conduct independent oversight of emergency management programs.

Planning and preparation for exercise conduct should use an effective, structured approach that includes documentation of specific objectives, scope, timelines, injects, controller instructions, and evaluation criteria. Each exercise should be based on a realistic scenario derived from the SFA All-Hazards survey or EPHA and must be conducted, controlled, evaluated, and critiqued effectively and reliably. Lessons learned from the exercise evaluation should be developed to ensure that corrective actions are implemented, and improvements are made to the program.

Requirements, development, and implementation of an exercise program, including program planning and management, are addressed in this chapter. Guidance is provided on the design and development of an exercise, including scheduling, work planning, determining objectives, and production of an exercise plan. Exercise conduct, control, and evaluation processes are also described.

The DHS HSEEP is a Federal-level exercise program developed for State, county, and local emergency management programs. The DHS approach addresses not only Homeland Security-sponsored exercises, but also those exercises where Federal level agencies may interact with State, county and local emergency management programs. Therefore, to ensure consistency with the DHS approach to exercise development, conduct, and evaluation, common exercise concepts and processes of the HSEEP are incorporated in the guidance presented in this chapter using DHS terminology where applicable.

An easy-to-use computer-based tool for developing DOE emergency exercises, the Exercise Builder, has been developed by participants in the Emergency Management Issues Special Interest Group (EMI SIG) Emergency Readiness Assurance Subcommittee, under the sponsorship of the DOE/HQ Office of Emergency Management. It makes available generic exercise components such as scenarios, objectives and criteria, and provides a PC-based application that can be used to develop exercise plans. End products include exercise scopes, objectives, scenario materials, and evaluator modules. Once exercise plans have been developed, they can be modified for future use.

Training is also available for using Exercise Builder. Web-based tutorials are available to prepare emergency management staff to plan and develop exercise/drill objectives and scenario materials.

3.3.2. General Approach – Readiness Assurance

DOE O 151.1D defines the framework of a readiness assurance program consisting of evaluations, improvement, and documentation. The Order specifies the responsibilities of the SFA in performing internal evaluations (self-assessments) to monitor their own programs, in addition to their responsibilities to respond to the external oversight evaluation activities of DOE/NNSA HQ and Field elements. The SFA must ensure that appropriate and timely improvements are made in response to needs identified through these evaluations, and through other activities such as training and drills. A formal tracking system monitors the implementation, verification, and validation of improvements made through corrective actions developed for findings from all sources. A formal program must be implemented that takes advantage of lessons learned from DOE/NNSA programs, as well as other similar government and private activities. Finally, SFAs are required to develop or contribute to an ERAP that documents the readiness of the emergency management program based on emergency planning and preparedness activities and the results of the readiness assurance program, including evaluations and improvements. Thus, the key elements of a readiness assurance program to be discussed in this guide are the evaluation program, the improvement program, and documentation of readiness assurance results, and forecast of activities in the ERAP.

Managing a readiness assurance program requires that the emergency management organization take a systematic and structured approach to carrying out or integrating the results of program evaluations, program improvement, and the program planning reflected in the ERAP. Readiness assurance evaluation programs must be managed intentionally to test and evaluate all emergency management functions and activities. In addition, the evaluation program should be based on identified needs each year, focusing on areas where the organization has shown that it needs improved performance. The improvement program must ensure that corrective actions are rigorously developed and implemented, verified and validated to correct identified problems, pursue lessons learned, and acquire relevant experience from other sites and industries. Annually, the organization should assess its overall readiness and identify resources needed to address improvements, as necessary.

As will become evident in subsequent discussions, no single evaluation tool provides the complete readiness evaluation required for *readiness assurance*. Also, the evaluation tools by themselves are not sufficient without an effective improvement process. Finally, management commitment and support is essential for committing resources necessary to meet requirements, conduct evaluations, correct deficiencies and findings, and institute an effective lessons learned program. The elements of the readiness assurance program give the emergency management organization a framework to determine what is needed to ensure a viable emergency management, supported by convincing evidence. Hence, the readiness assurance program should be a comprehensive system, a *collage* of redundant and complementary evaluations, which provide both general and focused program validation, combined with a reliable, continuous improvement process.

With the establishment of DOE O 151.1D, exercises now fall under Readiness Assurance programs. Emergency management exercises are formal, evaluated tests and demonstrations of the integrated capabilities of SFA emergency response resources (i.e., personnel, facilities, and equipment), conducted for the purpose of testing/validating multiple elements of an emergency management program. Exercises include realistic simulations of emergencies and tests of response capabilities, such as command, control, and communication functions and incident-scene activities. Exercises can vary significantly in scope, size, and complexity to achieve their respective objectives.

A valid test of response capabilities requires a formal and structured approach for planning, developing, and conducting each exercise. Exercise-specific objectives are used to specify the emergency response functions to be tested. Exercise objectives must be well defined and achievable. The set of objectives should effectively define the predetermined extent of organization/personnel participation and scope (i.e., breadth and depth) of exercise activities to be accomplished or simulated. The scenario must be based on the specific hazards associated with the SFA that is the focus of the emergency. The scenario must provide the opportunity for participating organizations/personnel to demonstrate each objective in order to evaluate the function or activity. The flow of the scenario timeline and events must be effectively controlled, and the response of the participants must be realistic and professional. An effective evaluation and critique process, based on specific evaluation criteria, ensures clear and useful findings are accurately developed and ultimately will lead to lessons learned and corrective actions resulting in an improved emergency management program.

General guidance in this chapter is primarily applicable to *operations-based* exercises throughout the DOE/NNSA complex at all levels of the ERO: facility, site, Field Elements, and HQ levels for DOE/NNSA Federal and contractor organizations, including the response activities of the Radiological Emergency Response Assets and Transportation Emergency Preparedness Program. This guidance follows the DOE/NNSA commensurate with hazards approach to emergency management. Guidance is provided for SFAs with varying types and levels of hazards and with differing organizational structures and complexity.

Functional aspects of planning, development, and conduct of exercises are addressed, but not roles and responsibilities of specific organizations or individuals. Requirements, development, and implementation of an emergency management exercise program, including program planning and management, are presented. Guidance is provided on design and development of an exercise including scheduling, work planning, determining objectives, and production of an exercise plan. Conduct, control, and the evaluation process for exercises are also described.

3.3.3. Readiness Assurance Program

The DOE/NNSA emergency management Order requires that each SFA implement a readiness assurance program consisting of the following three components: evaluations, improvements, and documentation. The discussion in this section will address this framework as follows:

- Evaluation Program: Provides guidance on what to evaluate and methods of evaluation
- Improvement Program: Provides guidance on the concepts of corrective actions, and lessons learned, and the importance of management support
- Documentation: Provides guidance on development and submittal of ERAP

In the sections that follow, each component of the readiness assurance program will be addressed, providing guidance for developing and maintaining a rigorous continuous improvement process.

3.3.3.1. Evaluation Program

The first component of readiness assurance is the evaluation program. The purpose of evaluations are to identify problems in the emergency management program, usually focused on the DOE/NNSA emergency management Program Elements and their associated activities and functions. If problems are found, then improvements can be accomplished. This process is repeated periodically, so that continuous improvement becomes a constant component of the emergency management program.
Evaluations of an emergency management program are focused on three general areas:

- All Hazards Planning/Technical planning basis, plans, procedures and supporting analyses
- Preparedness activities
- Response performance

The first area focuses on the All Hazards Planning/Technical planning basis for the emergency management program and emergency plans, procedures, and supporting analyses developed to implement the program. The second area includes the planning and preparedness activities, which support and maintain the program. Finally, the response performance involves the implementation of the emergency management plan and procedures in applying the response capabilities to mitigate consequences and protect people and the environment. Evaluations in the first two areas involve an assessment of projected response, based on observations resulting from document and analyses reviews, training data analysis and validation tests, the exercise program, corrective action tracking, etc. The response performance involves direct observations of actual integrated response to a simulated emergency situation.

Evaluations of projected response based on plans, procedures, supporting analyses, and preparedness activities can be comprehensive, since the documented response planning and the preparedness activities are intended to apply to the full planning basis of the program. However, evaluators are limited in their ability to assess, and hence, predict actual responder performance since they do not observe a demonstration of trained responders. They must rely on their assessment of the training responders have received and the plans/procedures they are to follow. In contrast, given the necessary resources, evaluations of demonstrated response are unlimited in reviewing and assessing all aspects of the responder performance. However, they are not comprehensive since the response evaluated is focused only on one scenario from the All Hazards Planning/Technical planning basis. The value of these two evaluation techniques (i.e., *projected* and *actual* response) lies in their complimentary aspects, one compensating for the weaknesses in the other. Both techniques should be conducted as part of an effective readiness assurance program.

Tools or processes for performing formal evaluations can differ for each of the program components discussed above, as follows:

- Plans, procedures, supporting analyses, and preparedness activities are evaluated using the following evaluation tools:
  - Program Evaluations
  - Performance Indicators
- Response performance is evaluated using:
  - Exercise Evaluations (including functional/limited scope)
  - Performance Indicators

<u>Program Evaluations</u>. Program evaluations involve a comprehensive examination and assessment of the *readiness* of an emergency management program, based on data collected from the following sources: documents, response tools, interviews, preparedness observations, and data/records analyses. None of these sources or associated collection methods provides the evaluator with a complete picture of the emergency management program, as indicated below:

- Document reviews – Expected/projected performance only
- Operation/utilization of response tools – Demonstrates that tools are in place, but not their correct use in a response
- Interviews with responders – Less stressful environment than a response
- Observations of training and drills – Lack of realism; less stressful environment
- Analysis of training and participation records – Verification of training and participation but not a validation of training effectiveness

Performance Indicators. Performance indicators also represent an evaluation tool for monitoring, tracking, and analyzing specific parameters that reflect the characteristics of a program's preparedness activities. They can provide a timely indication of problems developing in program readiness if key parameters have been identified that might predict performance degradation. Performance indicators which reflect response performance obtained directly from observations during exercises can also be used to track and identify unacceptable trends associated with responder activities. Section 3.7 addresses performance indicators in more detail.

Exercise Evaluations. Exercise evaluations involve the evaluated observations of an integrated response to a simulated emergency situation, where multiple organizations or activities must function together to mitigate the emergency. Exercise objectives ensure that the opportunity for evaluation exists by focusing on specific activities or functions. Specific objectives provide the basis for evaluating/validating the performance of response capabilities. Exercise objectives clearly state what is to be demonstrated; they are specific, attainable, and measurable. Hence, the response capabilities to be evaluated are limited in that only one specific scenario is simulated.

There are several variations of the exercise that differ in scope and focus. A brief discussion of the application of these exercises is included below:

- Tabletop Exercise — Tabletops can be applied to any working group(s) or team(s) whose successful performance depends on the timely and appropriate interaction of all of the participating individuals or teams involved in an emergency response. The scope is usually limited to the participants present and the focus is on the decision-making activities of those interacting. Control cells are used to simulate nonparticipants.

- Facility & Site Exercises — A formal exercise program is established at a DOE/NNSA site to validate all elements of the emergency management program over a 5-year period. Each exercise should have specific objectives and be fully documented. Each individual facility exercises its *facility-level* emergency response capability annually, including at least a facility-level evaluation and critique. *Site-level* ERO elements and resources participate in at least one exercise annually. This annual site-level exercise is designed to test and demonstrate the site's integrated emergency response capability. For multiple-facility sites, the basis for the annual site-level exercise must be rotated among facilities. At least once every 3 years, offsite response organizations are invited to participate in a site-level full participation exercise.

The requirement in Attachment 4, para. 15.e addresses the requirement of the SFA's EROs to effectively demonstrate their ability to respond to the hazards that have been identified in their respective EPHAs.

While the requirement in DOE O 151.1D Attachment 4 section 15 para. e, states "EPHA facilities with facility-level EROs must evaluate facility-level emergency response capability and proficiency annually by initiating response to simulated, realistic emergency situations/conditions in a manner that, as nearly as possible, replicates an integrated emergency response to an actual incident," sites are not required to have an exercise for each facility within a site unless multiple EROs have been identified and designated for a particular activity or area based on inherent authorities or PSO direction. In essence, if multiple level EROs *reside* within a site, each ERO must be exercised annually to ensure proficiency in executing emergency response. A single site-level ERO, is NOT required to conduct an annual exercise for each designated EPHA facility. ERO's that respond to more than one facility are required to demonstrate proficiency by rotating exercise scenarios among hazardous material facilities over a 5-year period (DOE O 151.1D Attachment 4, para.15.a Readiness Assurance).

In order to meet the intent of the Order, a non-DNF would need to conduct an annual exercise; a DNF would need to conduct an annual exercise per DOE O 151.1D attachment 4, paragraph 15.h, and a triennial exercise with the Department's Radiological Emergency Response Assets per paragraph 15.i; the annual exercise may be rotated among the facilities. However, notice there is no time requirement associated with completing a full rotation among the various facilities onsite, so imposing a 5-year requirement would meet the intent of the order and guidance, but may not be necessary.

The evaluations of these exercises represent essential contributions to the readiness estimate for the emergency management program. As a readiness assurance technique, the evaluation of a well-controlled and designed exercise (especially a full participation exercise) most nearly estimates the readiness of the program to accomplish the goals of emergency response — to mitigate consequences and protect people and the environment.

The evaluation program should focus the available evaluation tools discussed above on the specific issues/problems identified through previous evaluations, tracking performance indicators, or other preparedness activities such as training and drills. Each tool has advantages and a scope that is appropriate for specific aspects of the emergency management program; each also has limitations that should be considered when applying each to an issue. **Table 3-2** provides some indication of the focus and limitations of these tools.

According to DOE O 151.1D, DOE/NNSA SFAs are expected to implement an emergency management self-assessment program to identify problem areas (Cf. Section 3.6). An effective self-assessment can include more than a single annual program or exercise evaluation. A broader interpretation includes the usual internal evaluations together with data collected from various observations, reviews, and monitoring activities over the course of the year. This involves a systematic selection of the areas and program elements for emphasis. A robust self-assessment program, in addition to likely becoming the major component of the readiness assurance program in the future, will assist in ensuring that problems are self-identified and corrected, without requiring the influence of external evaluators.

Table 3-2. Focus and Limitations of Evaluation Tools

Method	***Focus***	***Limitation***
Tabletops	Integrated decision-making	Focused on decision-making, not on resulting performance
Facility & Site Exercises	Onsite integrated response	Interactions with offsite responders not observed
Full Participation Exercise	Integrated offsite and onsite response	Response to only one scenario
Program Evaluation	Comprehensive response planning	No performance observed
Self-Assessment	Detailed, comprehensive review	Limited evaluation by owners of program

3.3.3.2. Improvement Program

A strategic objective of an emergency management readiness assurance program should be continuous improvement. A strong, reliable readiness assurance program will help an organization ensure that appropriate and timely improvements are made in response to needs identified and will provide the organization with a direction and path forward to achieve an effective and efficient emergency management program. The two key elements of a readiness assurance improvement program include:

- Corrective Action Program
- Lessons Learned Program

Corrective Action Program. A corrective action program is a readiness assurance process for continuously improving an emergency management program. This continuous improvement results from reliable implementation of corrective actions for findings in all types of evaluations, including both internal self-assessments and external evaluations.

A Corrective Action Plan (CAP) is the formal documented response to findings that have been identified in program and exercise evaluations or through observations in other preparedness activities, such as training and drills. The corrective action itself consists of the means, measures, and methods proposed by the emergency management organization for addressing and fixing the identified problem area.

In preparing/writing a CAP, the conditions, circumstances, situation, and causal factors that led to the finding should be described. A description of the specific corrective action(s) that will be taken to remove the cause of the problem and to resolve the finding must be addressed. The extent and prevalence of the same or similar problem area should also be indicated in the write up. Completion of corrective actions must include a verification and validation process, independent of those who performed the corrective action, that verifies the corrective action has been put in place and validates the corrective action has been effective in resolving the original finding. A general description of the conduct of an independent corrective action effectiveness review for verification and validation should be included with the CAP.

Corrective actions that address revision of procedures or training of personnel are particularly urgent and should be assigned a high priority and completed before the next evaluation of the program element. In contrast, a corrective action may require some time before it is finally in place. As necessary, non-permanent interim measures should provide control over a deficient situation or condition to limit the hazard or the possibility of emergency response failure. Any interim measures or compensatory actions should be described in the CAP.

The recommended content of a CAP is summarized below:

- Conditions, circumstances, situation, or causal factors that led to the finding
- Extent and prevalence of similar or the same/repeat problem area
- Specific corrective action(s) that will be taken to remove the cause of the problem and to resolve the finding
- Interim measures or compensatory actions taken
- General description of the conduct of an independent corrective action effectiveness review for verification and validation

These recommendations can be used for self-assessment corrective actions and for corrective actions where the required content of the formal corrective action is unspecified. Detailed requirements associated with the management of specific Departmental corrective actions are contained in DOE O 414.1D Chg 2, *Quality Assurance*.

Program responsibilities for acting on corrective actions are stated in DOE O 227.1A, *Independent Oversight Program*, Attachment 1, *Contractor Requirements Document*.

Lessons Learned Programs. Decision-making, planning, and execution of work should be founded on the best professional and industrial practices available. DOE/NNSA management has placed significant emphasis on the concept of lessons learned across multiple health and safety disciplines, to ensure that knowledge and experience is shared among individuals and organizations in order to benefit from the experiences of others. Broad application of the lessons learned concept is important to the Department's commitment to maintain effective Integrated Safety Management (ISM) Systems. Outside the DOE, corporations, government agencies and departments, and the military are actively using lessons learned information to help them achieve their varied goals and missions.

The emergency management community is committed to benefiting from the experiences, good and bad, of our peers, both from within and outside the DOE/NNSA complex. A lesson learned may be a good practice or innovative approach that is captured and shared to promote repeat application. A lesson learned may also be an adverse practice or experience that is captured and shared to avoid recurrence. A lessons learned program is a principal component of emergency management organizations whose culture is committed to continuous improvement. As such, an emergency management lessons learned program should strive to:

- Reduce the number of problems encountered by sharing information
- Improve program efficiencies and effectiveness by exchanging information and experience with others in emergency management

The following are important functions of an effective emergency management lessons learned program:

1. Identify: Mechanisms should be in place to identify lessons learned;
2. Document: A process for documenting lessons and success stories;
3. Validate: Validate the lessons learned to ensure each is meaningful and not repetitious;
4. Store: A database for capturing and storing lessons learned information;
5. Share: Forum for sharing information between organizations, both within the site organization and within the broader DOE community. The EMI SIG provides such a forum for the DOE complex;
6. Evaluate: Establish a formal method or process to evaluate the applicability of lessons learned to the site or its facilities;
7. Incorporate and utilize: Incorporate the actions to address applicable lessons learned into the SFA corrective action tracking system. Use lessons learned to improve the program;
8. Follow-up: Follow-up process is implemented to ensure actions are taken.

In summary, an effective readiness assurance program includes a system for incorporating and tracking lessons learned from training, drills, exercises, actual responses, and a site-wide lessons learned program. DOE–STD–7501–99, *The DOE Corporate Lessons Learned Program*, provides guidance on use of the system.

3.3.3.3. Documentation of Readiness Assurance

ERAPs are documented assessments of the development, implementation, and maintenance of Emergency Management Programs. The ERAP is also a planning tool to identify and develop needed resources and improvements. An ERAP highlights significant changes in emergency management programs (i.e., planning basis, organizations, and exemptions) and compares actual achievements to goals, milestones and objectives. The information reported in the ERAP should provide assurances to the organization’s management as well as DOE/NNSA HQ that emergency management programs are *ready to respond*. The ERAP is designed to be an emergency preparedness management tool for all levels of management.

While the provisions of the SFA readiness assurance program are documented in the emergency plan, the ERAP documents the annual assessment of readiness assurance activities. The ERAP provides detailed information on an annual basis about how continuous improvement in the emergency management program is being achieved and how the complimentary tools of program and exercise evaluations are being used to ensure that the emergency management program is ready to respond.

Following the direction of the Government Performance and Results Act (GPRA – 31 U.S.C. 1115 and 1116), the time period for ERAP coverage was reduced to the immediate past fiscal year and the new fiscal year in DOE O 151.1D. The ERAP includes the goals for the immediate past fiscal year and compares those with what was accomplished during the past year, and identifies the goals established for the new fiscal year. For example, a site ERAP submitted on 9-30-18 would compare the progress made during FY18 (10-1-17 to 9-30-18) against the goals that had been set for FY18, as well as identify the goals that were set for FY19 (10-1-18 to 9-30-19).

In addition, the ERAP should contain the results of emergency preparedness activities, external evaluations/assessments, self-assessment activities, exercise after-action reports, corresponding corrective action plans, improvements based on the lessons learned program, summary of a Threat and Hazard Identification and Risk Assessment (THIRA), and summary information about the SFA or activity emergency management program in sufficient detail to be understood by managers that are not in direct contact with the program. The following general guidance regarding content should also be applied:

- The SFA contractor is responsible for preparing the ERAP;
- The level of detail should not be voluminous;
- Include information that will help support the improvements needed for the program;
- Details about daily processes are not relevant;
- Ensure that information included is complete and accurate; and
- The most detailed information should be from the past year.

DOE O 151.1D contains specific requirements addressing submittal and review, and the general requirements for the ERAP, summarized as follows:

- An ERAP may require review for classified or controlled unclassified information prior to submittal;

- It must be submitted to the Field Element Manager for approval;
- The Field Element Manager should review the ERAP; comments should be addressed to the contractor representative;
- ERAPs should be consolidated for SFAs under the supervision of the Field Element Manager;
- The consolidated ERAP should also contain the same type of discussion regarding the emergency management program at the field element level as is contained in the site ERAP; and
- The consolidated ERAP should be submitted to the Associate Administrator for Emergency Operations and the responsible PSO each year;

The Associate Administrator for Emergency Operations will prepare, in coordination with the responsible PSO, an annual report summarizing the status of the DOE Emergency Management System.

3.3.3.4. Management Commitment

Management leadership, commitment, and active involvement are essential for emergency management program improvement. Management should be made aware of the requirements and performance expectations in order to integrate these with the strategic plans of the organization. Site and facility managers should be kept informed and involved in the emergency management program.

Management should review the emergency management program at planned intervals to ensure its continuing suitability, adequacy, and effectiveness. This review should include assessing opportunities for improvement and the need for changes. Records from management reviews should be maintained. Input to management reviews should be provided by personnel responsible for emergency management and should include information related to:

- Exercise performance
- Results of internal and external evaluations
- Findings involving the emergency management program
- Complaints or significant communications with offsite agencies
- Status of corrective actions
- Emergency management performance measures and progress in meeting targets

- Changes in regulatory and statutory requirements that may impact resource needs of the emergency management program
- Changes at the SFA that may impact preparedness or response
- Recommendations for improvement
- An annual ERAP report

Site and facility management should ensure that necessary interface and cooperation is maintained between emergency management and the various departments at the SFA. The nature of emergency management requires effective ongoing coordination and cooperative interfaces with organizational groups such as medical, fire/HAZMAT, training, environmental health and safety, health physics, engineering, information systems, security, public affairs/media relations, etc.

Line management participation is critical to ensuring that corrective actions are handled efficiently and effectively and that applicable lessons learned information is distributed and implemented throughout the organization. Expectations of upper management must be communicated to line management. Performance measures established for the emergency management program should be linked with performance expectations of senior management and their commitment to the program.

Sufficient resources must be budgeted to maintain and improve the program. In considering resource needs to maintain emergency management and meet expectations for performance improvement, the following should be factored into requests to management:

- Current resources
- Changes at the SFA that may impact preparedness or response. These may include physical, information systems, communication systems, organizational, and financial changes
- Changes in regulatory or statutory requirements
- Changes in response capabilities of external EROs
- Program effectiveness and achievement of performance goals over the past year
- Lessons learned (facility-specific, DOE/NNSA Complex and industry)
- New performance goals
- Corrective action commitments

Continued improvement and success of an emergency management program can only be ensured through management commitment to maintain a response capability that is ready to respond promptly, effectively, and efficiently to emergencies at DOE/NNSA SFAs.

3.3.4. Evaluations

An emergency management program consists of diverse functions and activities whose collective objective is to ensure that response capabilities will be ready when needed and will be applied promptly, effectively, and efficiently. The successful accomplishment of this objective involves groups of emergency management functions and activities. These groups are included in the Program Elements of the DOE emergency management system. The evaluation of emergency management programs will focus on these elements as a convenient means for organizing the evaluation methodology and processes to be discussed.

One possible method for tracking and measuring program evaluations and exercise evaluations is using the DOE/NNSA baseline CRAD. The CRAD covers the requirements of DOE O 151.1D, while breaking down all of the program elements in Emergency Management Programs with individual objectives and compliance-based lines of inquiry. Sites/facilities/activities can use the CRAD to build their program assessments by selecting which program elements to assess, which objectives they are intending to meet, lines of inquiry to demonstrate proficiency, and any best practices lines of inquiry to improve program element functions. SFAs can use the CRAD to select which program elements will be evaluated on an annual basis to help meet the requirements of DOE O 151.1D.

The general, overall performance goal (or mission) of DOE/NNSA emergency management programs can be summarized as follows:

> *DOE emergency management programs will be ready at all times to promptly, effectively, and efficiently apply the necessary resources to mitigate consequences and protect its workers, the public, the environment, and national security in the event of an Operational Emergency involving DOE/NNSA SFAs.*

3.3.4.1. Program and Exercise Evaluations

Two methods are recommended for obtaining complementary estimates of the readiness of an emergency management program to respond: program and exercise evaluations:

- A *program evaluation* involves an assessment of an emergency management program based on a comprehensive examination and evaluation of response plans and procedures, administrative control mechanisms, planning basis and supporting analyses, response tools, resource availability, training activities and results, training validation, overall exercise program, and organizational factors.

- An *exercise evaluation* involves an assessment of an emergency management program based on the observation and evaluation of the demonstrated integrated performance of response capabilities during simulated emergency incidents or conditions. The exercise evaluation is usually combined with an evaluation of the validity of the specific exercise as a viable test of the readiness of the program to respond.

The all hazards planning/technical planning basis and programmatic activities are generally evaluated during a program evaluation. Response activities are also evaluated during program evaluations. However, since there is no observation of response to an emergency incident (as in exercises), the evaluation must depend on expert extrapolation from the response planning, procedures, and available tools to an anticipated or projected response. The evaluation consists of a judgment of the anticipated or projected performance based solely on reviews and analyses of the planning and preparedness activities.

Evaluation of response activities during an exercise involves an assessment of the demonstrated performance of integrated response capabilities, based on observation and evaluation results from each program element. Exercise evaluation will determine whether and how well response functions and activities are performed based on observations during a specific (simulated) emergency scenario. (Note that some programmatic activities are evaluated during an exercise to determine the reliability of the planning and conduct of the exercise. This assessment (i.e., Conduct of Exercise) provides an indication of the value of the observed performance during a specific exercise in estimating the expected response during an actual emergency.)

The ERO personnel perform response functions and participate in activities during an exercise; actual failures in performance can be observed. Similarly, during an assessment of a *programmatic* element in a program evaluation, inadequate or ineffective training of response personnel might be discovered through a record search or individual testing. This will also be an actual failure, where accomplishments of the training program do not meet emergency management program expectations. In contrast, during a program evaluation of a response element, the plans, procedures, and tools for a specific activity are evaluated to determine whether they are accurate, clear, unambiguous, effective, timely, etc. If they were found to meet expectations by an evaluator, then, based on the materials evaluated or interviews with the ERO personnel, the desired result of the activity during a response would be satisfactory. In other words, no projected failure would be suggested by the program evaluation. On the other hand, if the procedures were incorrectly written or the expected result not appropriate, then a failure might be projected (considered likely) during an emergency response.

It is common practice during program evaluations to validate their proficiency in performing certain response tasks for which they would be responsible during an emergency response. These evaluations validate the effectiveness of the training received and are essential for evaluating the performance of the Training and Drills, a programmatic element. However, they should be interpreted as one indicator of projected performance, but not sufficient to characterize expected performance as a well-planned and conducted, quality exercise, or during an actual response to an emergency.

As stated in the beginning of this section, two methods are recommended for obtaining complementary estimates of the readiness of the response capabilities of an emergency management program: program and exercise evaluations. Neither type of evaluation (technical planning or programmatic) is sufficient by itself to provide a complete measure of the readiness of the emergency management program.

Program evaluation is comprehensive in terms of hazards and activities. It provides a measure of the applicability of the planning associated with the program, as well as an evaluation of the adequacy of programmatic activities that ensure the maintainability of the program in sustaining a high level of proficiency over time. Program evaluation, however, lacks a true evaluation of actual, integrated performance of response capabilities as observed in a real or simulated emergency incident.

Exercise evaluation, on the other hand, provides such an evaluation of response performance during a simulated emergency scenario. However, since the scenario involves only selected response capabilities and personnel appropriate to the emergency incident, the evaluation of the exercise is insufficient to generalize the overall capabilities of the response. The exercise is a snapshot in time that captures and evaluates performance in response to the specific event. Each scenario demands a unique, detailed response from emergency management functions and activities (the specific EAL, the associated protective actions, the consequence assessment calculations, the procedures used, the medical situation encountered, the specific content of news releases). Although the processes for some general response functions/activities are accomplished similarly for each type of emergency (though the detailed results are unique), the exercise evaluation does not provide a comprehensive, overall assessment of the adequacy of the emergency management program in responding to a spectrum of emergency incidents or in maintaining the readiness of the program over time.

Finally, the readiness of an emergency management program is best estimated by an assessment of the combination of complementary results from program and exercise evaluations and, when available, post-emergency evaluations. However, in order to perform these evaluations, performance-based criteria must be developed to provide a means for consistently judging the critical aspects of emergency management program element performance. In the next section, performance-based criteria for evaluating emergency management program elements are introduced.

Exercise evaluators should use program-specific expectations, and characteristics should be developed for each emergency management program, based on SFA-specific hazards and associated program capabilities. From these attributes, generic criteria can be restated in the context of the specific program. This facilitates the evaluator’s task by bounding the general intent and scope of the function or activity, as expressed in the generic criteria, and focusing on the key program-specific attributes incorporated in the revised criteria. In contrast, during a program evaluation, the generic criteria for programmatic and response elements are used as the standard against which the plans/procedures and preparedness activities are judged in the context of the SFA-specific hazards, associated program capabilities, and the commensurate with hazards concept.

3.3.4.2. Program and Exercise Evaluations Findings

Program and exercise evaluations consist of numerous individual judgments related to the adequacy of projected or demonstrated performance in specific emergency management functional areas. These judgments are expressed in terms of meeting or failing to meet expectations expressed by a specific evaluation criterion. The necessary information for making such judgments is obtained from numerous data sources, including document and record reviews, direct observations, personnel interviews, selected testing of personnel performance, and critiques. Inadequate or failed actual or projected performance identified during an evaluation is referred to as a *finding*. A finding describes a failure related to a criterion.

Upon completion of an assessment an appraiser or evaluator must identify the overall effectiveness of a given program.

Findings are deficiencies that warrant a high level of attention on the part of management. If left uncorrected, findings could adversely affect the DOE mission, the environment, worker safety or health, the public, or national security. Findings define the specific nature of the deficiency, whether it is localized or indicative of a systemic problem, and identify which organization is responsible for corrective actions.

Another type of finding includes deficiencies that are an inadequacy in the implementation of an applicable requirement or performance standard that is found during an evaluation, thereby directly impacting the associated basic emergency management activity, such as planning, preparedness, readiness assurance, or response.

A direct impact on an emergency management activity resulting from a failure to meet a single evaluation criterion will, by itself, adversely affect the associated performance-based result of the program element. The adverse effect of the failure should be significant and readily apparent. For example, in Consequence Assessment (a response element), failure to conduct a Timely Initial Assessment (TIA) of the consequences of an emergency has a direct impact on the response activity, since consequence assessment results serve as a basis for the initial timely decision-making following pre-planned (default) conservative decisions. Failure of the All-Hazards Survey/EPHA to analyze potential emergency incidents or conditions representing a spectrum of severity has a direct impact on the planning activity, because the All-Hazards Survey/EPHA serves as the comprehensive planning basis for the emergency management program.

A failure that contributes to a direct impact on, or indirectly affects, an emergency management activity results from a failure to meet a single evaluation criterion that adversely affects a supporting or auxiliary role in the accomplishment of the emergency management activity. For example, failure to maintain a controlled document system as part of Program Administration and Management (a programmatic element) contributes to a direct impact on the planning activity, because the latest procedures or hazards information might not be available during a response. Failure to plan for extended operations of the ERO (a response element) has an indirect impact on the response activity, since members of the ERO need respite from their assigned activities; fresh personnel are more likely to make better decisions than tired personnel.

When determining direct, contributing to direct, or indirect impacts on emergency management activities, the following should be considered. The impact in a specific functional area is on the result of the activity. The impact cannot be judged on the actual or projected outcome of the emergency management program's response, since there are no measures to realistically judge the outcome during either a program or exercise evaluation. A direct impact cannot be judged on an unsupported evaluator's prediction of an adverse direct impact. A finding that represents an indirect impact based on its intended function cannot become a direct impact simply because the evaluator can conceive of a scenario that explains how the failure could ultimately combine with other failures to produce a direct adverse impact. Such extrapolations simply cannot be supported by evidence gathered during the evaluations.

Finally, the recommended approach (Cf. Chapter 3, Section 3) for developing exercises that test emergency response capabilities identifies a specific set of exercise objectives to be achieved. The finding definitions should be used only to address failure of a specific evaluation criterion. However, although some exercise objectives may correspond to just one evaluation criterion, a more likely situation would have multiple criteria associated with an exercise objective. In that case, the definition of Deficiency should **not** be applied to the failure of the exercise objective, but to each of the evaluation criteria. When multiple evaluation criteria are reflected in an exercise objective, then the failure of the objective should be judged by the combined (rolled up) assessment of the total results for the objective; namely, those criteria that were achieved versus those that were not.

Finally, findings will be directly associated with a specific emergency management program element and hence will point to problems specific to the element through the characterization of the evaluation criterion. However, to identify problems that are systemic across elements, it is useful to determine the general characteristics of the failure. In the following section, the format for labeling or binning findings is presented in terms of generic faults. Such a system can facilitate analyses of a collection(s) of findings by emphasizing the generic (observed) fault that may have caused the failure of diverse criteria across program elements.

3.3.4.3. Program Readiness

An emergency management program consists of diverse activities, functions, and tools that operate either in a periodic, ongoing mode to ensure the readiness of the program to respond, or in a standby mode to respond to an emergency when called upon. A comprehensive estimate of overall program readiness to respond to an emergency cannot be obtained from a simple combination of evaluation results related to the individual program elements. A true determination of the readiness of the overall emergency management program must account for the relationships between the all hazards planning/technical planning basis, programmatic and response elements, and on the relative contribution of each type to the estimate. Only by combining applicable *programmatic* element evaluations with *response* element evaluations can an estimate be obtained from program evaluations complementary to observed performance during an exercise. It is the method for combining/integrating programmatic and response element evaluation results that will determine the structure and methodology for obtaining overall readiness estimates.

3.3.5. Evaluation Process

Evaluations of DOE/NNSA emergency management programs can be characterized by the organization that sponsors the evaluation and the relationship of the evaluators to the development and maintenance of the program. Evaluators who are neither responsible for the development or maintenance of the program nor associated with the managing organization conduct an external evaluation. An internal evaluation, or self-assessment, is an evaluation sponsored by an organization to review and evaluate its own emergency program.

The process of evaluating emergency management in a program evaluation, either external evaluation or self-assessment, can involve examination, analysis, and evaluation in the following areas:

- Plans and procedures
- Administrative control mechanisms
- Planning basis and supporting analyses
- Response tools, such as computer models, monitoring equipment, communication systems
- Resources and resource availability
- Organizations and organizational interfaces
- Training and training validation
- Exercise program

Data sources include plans and procedures, EPHAs, MOUs, databases and records, limited scope tests/drills, and interviews. The more thoroughly these data sources are examined and analyzed, the more comprehensive is the evaluation.

An exercise evaluation, on the other hand, involves observation, analysis, and evaluation of the demonstrated performance of integrated response capabilities during a simulated emergency incident. Observations of activities included involve the ERO staff, usage of facilities, equipment, and procedures. The scope of the evaluation, including the selection of the emergency management program elements to be observed, is determined by specific objectives developed for the exercise. Exercise evaluation also addresses the overall conduct and control of the exercise. This evaluation is based on exercise documentation, including the scenario and objectives, and the actual conduct of the exercise. Also included in the evaluation are the conduct of ancillary activities, such as controller and evaluator training, responder training, and the exercise critique. The validity of the exercise as a viable test of readiness should be a conclusion of this evaluation.

The process for conducting internal and external evaluations can differ substantially in areas such as scheduling, preparation, and interactions with the evaluated organization both during and after the evaluation. Since the process used for both types of evaluations will be determined by the evaluating organizations, this guide does not address details related to organization-specific logistics and coordination issues. However, some common features of evaluations are discussed in the following sections, namely, data/ information sources and the expected output from evaluations.

3.3.5.1. Data Sources

Successful evaluations depend on the availability of diverse sources of information. Choosing the appropriate sources will vary depending on whether the team is conducting a program or exercise evaluation. These sources can include document and records reviews, interviews, and observation of performance. See Section 3.10 for additional information.

1. Document Reviews. Document reviews for program evaluations include analyses such as All-Hazards Surveys, EPHAs, Safety Analysis Reports/SADs/DSAs, DBTs, and Environmental Impact Statements (EISs); plans such as emergency plans, building plans, spill prevention plans, Resource Conservation and Recovery Act (RCRA) plans, and training plans; procedures such as administrative procedures for emergency management and Emergency Plan Implementing Procedures; agreements, such as MOU and MOA; and contracts. Additionally, evaluators should be knowledgeable of organizational structure, functional responsibilities, and previous evaluations.

2. An exercise evaluation requires a more limited SFA document review to provide the team with sufficient familiarity with the SFA layout, activities, emergency management program plans and procedures, response capabilities, and hazards. A more extensive review effort is involved in an evaluation of the planning documentation associated with the exercise. The exercise plan should contain sufficient information for the conduct, control, and evaluation of the exercise, including exercise objectives, scope, participants, simulations, time lines, injects, technical data, safety/security provisions, controller instructions, and evaluation criteria.

3. Records Reviews. Records reviews during program evaluations could include the following:

- Training records
- Drill and exercise reports
- Hazardous materials inventories
- Corrective action tracking
- Facility and equipment inventories
- Systems tests such as notification, alerting, monitoring, and communications tests
- Incident and event reports

Data and records review following exercise evaluations can also provide supplementary supporting information necessary to address exercise findings, so that an implicit recommendation can be included in the write-up.

4. Interviews. Interviews during program evaluations should be conducted after the initial document review, when the program functions have been identified. Interviewees should include the managers of the emergency management staff, the emergency management staff itself, the ERO (including back-shift personnel), support organizations such as training, industrial hygiene, health physics, operations and maintenance, and offsite interface organization representatives.

Evaluators should conduct interviews with a variety of individuals with different backgrounds and at different levels in the organization. Team members should talk to operators, mechanics, and all levels of supervision as necessary to get a thorough picture.

Interviews can elicit meaningful information concerning:

- Personnel qualifications, training, and drill participation
- Familiarity with procedures and equipment
- ERO activation
- Problems encountered during response
- Adequacy of procedures and resources

Careful planning and conduct of the following steps in advance of each interview will enhance their effectiveness:

- Delineate the topics to be discussed

- Identify the types of questions to be asked
- Determine what reference materials should be available for the interview
- Identify the best location to hold the interview; if possible, perform the interview in the interviewee's workplace so that the resources needed will be readily available
- Anticipate the interviewees' perspective, possible concerns, and expectations
- Know the procedures and hazards that the interviewee should know and understand
- Determine how to establish a climate of trust and collaboration and, hence, how to avoid an adversarial encounter
- Facilitate the interview process to ensure that information needed is obtained and that the dialogue continues after the interview, as required
- Plan to follow through if information is promised for a later time
- Thank people for their time

The following techniques may facilitate the interview process:

- Set up the interview by introducing yourself, stating the purpose and context of the interview, outlining the topics to be covered, assuring confidentiality, and establishing your credibility
- Ask open-ended questions — why, when, how, who, where, and what
- Ask hypothetical questions
- Observe and listen closely to the person being interviewed
- Show interest and respect and don't be critical
- Restate the question and answer to ensure understanding
- Inform interviewees that notes will be taken of topics discussed
- Verify and evaluate all information by requesting demonstrations of procedures or equipment, soliciting identical information from more than one person, and checking records to verify claims
- Separate levels of supervision when interviewing; do not have the interviewee's supervisor present during the interview
- Do not make recommendations initially; determine the facts first to ensure a clear understanding of the problem

- Ask for copies of documents shown or referenced by the interviewee

- Do not respond positively or negatively to answers given, through either comments or facial expressions; instead use clues to develop further questions

- Hold your opinion during the course of the interview and avoid arguing

For exercise evaluations, interviews are limited to before or after the exercise, for logistic information or follow-up questions. During exercises, team members should refrain from interfacing with responders, since interrupting or prompting the responders can prevent their decisions or actions. Prior to exercises, team members may interview personnel to gain further knowledge or clarification of responder duties, procedures, and equipment capabilities. After the exercise, responders may need to be interviewed by evaluators to clarify their response activities and observed performance.

5. Observations. When possible, observations should be made during both program and exercise evaluations. Program evaluations may include observations during the following:

- Individual skill/knowledge tests

- Training sessions

- Facility walk-downs

- Scheduled drills

Exercise evaluations may include observations of the following:

- Responder briefings

- Controller, evaluator, or specialized training

- Application of response capabilities

- Control of the exercise

- Exercise hotwash

- Exercise critiques

To maximize the effectiveness of data collection from observation of performance during an exercise, use the following practices:

- Review the applicable procedures to guide observations of the planned performance required of the personnel.

- Before the action begins, find a location where key actions and communications can be seen and heard.

- Record the time of each observation.

- Observe whether exercise players have been pre-positioned.

- Note any impediments encountered by the players while they are accomplishing their tasks.

- Note significant deviations from the exercise timeline.

- Note controller/evaluator effectiveness.

- Observe and take note of key response activities, including: ERO notification and mobilization, procedure usage, facility and equipment availability and usage, instrument calibrations, communications, decision-making, notifications, record keeping, staffing of functions, support requests, briefings, and key scenario times. Additional opportunities for observation may include:

  - Observations of backshift operations to ascertain staffing and resource availability, training and responsibilities of backshift personnel, and general capabilities when management is not generally available.

  - Facility walk-downs to ascertain emergency response facility characteristics (communications equipment, power supplies, workspace, references, computer systems, ingress-egress, and habitability monitoring, etc. Walk-downs of hazard facilities are also useful to review and validate information on inventory, storage, and barriers in relation to EPHAs and EAL procedures.

  - Demonstration drills may be requested in advance by evaluators to observe team performance and validate what actions are depicted in emergency response procedures.

  - Scheduled training may be observed to review the actual content of training and instructor capability.

  - Equipment demonstrations can provide evaluators observations of equipment storage, security, availability, operability, maintenance/calibration, operational procedures, personnel knowledge and skills. Equipment observations may include field monitoring equipment readiness and use, communications systems, hazardous release plume modeling and tracking systems, notification systems, meteorological equipment, decontamination equipment, medical emergency response equipment.

6. Data Selection Techniques. A common problem associated with evaluations is the normally limited time available for collecting, reviewing, and evaluating information. Several data selection techniques can be employed to perform a reasonably

comprehensive evaluation within the available time constraint. These selection techniques include sampling and horizontal-to-vertical review.

- Sampling. The technique of data sampling is essential to maximizing the evaluation effectiveness within the time constraints and available resources. During a program evaluation, team members cannot examine all activities, operations, processes, documents, and records for assigned functional areas. A selected number of activities, processes, or operations should be chosen to represent the whole. The selected examples should be chosen at random to avoid concentration on a particular group or time. Since accuracy increases with sample size, multiple examples for sampling should be examined, keeping within the time allotted, resources, and reasonableness. Random sampling may be used in any of the information collection activities mentioned earlier, for example:

  – Training records

  – Procedures for review

  – ERO members to interview

  – Weekly communications checks

  – Exercise scenarios to review

  – Equipment maintenance records

- Horizontal-to-Vertical Review. The horizontal-to-vertical information review methodology provides a means for investigating a specific emergency management component or element in a logical and efficient manner, without delving into details unnecessarily.

The technique applies primarily to program evaluations and involves a step-by step general review of materials related to an area or activity to be evaluated. It may begin with a general top-level review of an emergency management element. If a potential problem is discovered during the general review (horizontal), then the evaluator can refocus the review effort on the supporting details (vertical) in an attempt to arrive at the underlying problem. The technique is a way to cover major aspects of a program and, on a selected basis, examine supporting details to uncover potential problems or to verify the status of an activity.

7. Field Notes. Field notes are a critical component of the evaluation process that provide the mechanism for documenting an observation or issue as soon as possible after it is made or identified. Documentation should contain sufficient detail to support later development of findings and verification of issues or concerns. These field observations should be recorded in an informal notebook.

Names and titles of DOE and contractor personnel interviewed, with times, dates, and topics discussed should be included in the notes, as well as the observations made during a walk-down. Team member entries should organize information collected, formulate tentative findings, and reveal the nature of missing information needed to resolve outstanding issues. These serve as an excellent source of thoughts in the preparation of the draft report. Under normal conditions, field notes should not be released to facility personnel being evaluated. These notes are for the use of team members only, unless otherwise stipulated by the team leader. Additionally, during exercises, evaluators should keep a timeline record, drill and exercise observations, and critique information.

3.3.5.2. Evaluation Results

Based on the analysis and evaluation of the information collected from the data sources reviewed, an evaluation should yield at least findings and corrective actions, as required by the observed or projected performance. Other judgments such as Improvement Items, Superior Performance, and Noteworthy Practices are optional. An After-Action Report (AAR) should be produced for all evaluations to provide supporting documentation for the evaluation activity and the resulting findings and program improvements.

Findings. An evaluation consists of a judgment of the adequacy of demonstrated or projected performance in specific functional areas and activities, developing specific response or programmatic products, and using the appropriate equipment, facilities, and tools. This performance is compared with a single evaluation criterion or a selected subset of criteria to determine its adequacy. Findings are then used to express these judgments resulting from either program or exercise evaluations by identifying the inadequacies in demonstrated or projected performance and characterizing their significance. Based on findings, evaluations can be categorized via rating (e.g., Effective Performance, Needs Improvement, and Significant Weakness) per DOE O 227.1A.

An essential aspect of evaluation results is a concise, clear, and complete description of each particular finding. This description must detail explicitly the situation, circumstances, and special considerations and constraints that are needed to characterize the finding and identify the specific underlying fault. In addition, the finding description should be sufficiently explicit so that a recommended solution, if determined by the evaluator, is clearly expressed and readily apparent in the finding text.

Corrective Actions. Evaluations and the resulting findings would be of no benefit to an emergency management program if identified problems were not addressed through corrective actions. The corrective action responding to each finding is developed by the evaluated organization. To ensure that the problems identified will be corrected in an effective and timely manner, the evaluated organization should produce the following:

- Clear statement of the finding
- Statement of the cause of the identified problem area

- Details of the actions needed to eliminate the cause
- Responsibility for corrective action
- Schedule for completion of corrective action

To ensure that the evaluation findings are accurate and consistent with the observations and perceptions of multiple evaluation teams, draft findings should be reviewed and validated by all team members in an open discussion in order to achieve consensus. Such a validation process should resolve any identified discrepancies. This process is an essential step in an evaluation process to be accomplished prior to the preparation of the report. Other results of an evaluation can include:

Opportunities for Improvement: Opportunities for improvement are suggestions offered in Independent Oversight reports that may assist managers in improving programs and operations. While they may identify potential solutions to findings and deficiencies identified in appraisal reports, they may also address other conditions observed during the appraisal process. Opportunities for improvement are provided only as recommendations for line management consideration; they do not require formal resolution by management through a corrective action process.

Recommendations: Recommendations are suggestions for senior line management's consideration for improving program or management effectiveness. Recommendations transcend the specifics associated with findings, deficiencies, or opportunities for improvement and are derived from the aggregate consideration of the results of the appraisal.

Best Practice: A safety or security-related practice, technique, process, or program attribute observed during an appraisal that may merit consideration by other DOE and contractor organizations for implementation because it: (1) has been demonstrated to substantially improve safety or security performance of a DOE operation; (2) represents or contributes to superior performance (beyond compliance); (3) solves a problem or reduces the risk of a condition or practice that affects multiple DOE sites or programs; or (4) provides an innovative approach or method to improve effectiveness or efficiency.

3.3.6. Self-Assessments

A *self-assessment* can be viewed as an evaluation (program or exercise) of an emergency management program performed or sponsored by the organization itself or by some level of the management of the organization responsible for evaluating the emergency management program. Any level of the DOE organizational structure can perform a self-assessment, including personnel who are:

- Involved in the emergency management program and *directly* responsible for activities or program components that they are assigned to evaluate

- Involved in the emergency management program, but *not directly* responsible for activities or program components that they are assigned to evaluate

- Within the sponsoring organization, but without a direct relationship to the emergency management activities

- With no direct connection or relationship to the program or the sponsoring organization

Personnel performing self-assessments should be qualified and trained in audits or evaluations and, if possible, should be, at most, indirectly associated with the specific activities or emergency management program components they evaluate. This is particularly important for an evaluation of analyses related to the program bases and analytical tools. While the author of such analyses can certainly verify the required contents and end results, an objective view by another analyst is the most efficient way to evaluate their validity. The author may be too close to the analysis to judge it objectively. This discussion is not intended to preclude an author evaluating his own work, but merely to point out possible limitations associated with that approach. In areas other than technical analyses, the evaluations conducted by directly involved personnel are more likely to yield objective evaluation results consistent with evaluations conducted by the other groups mentioned above.

Self-assessments may also include compliance with external non-DOE codes and regulations and, similarly, with internal organizational requirements and commitments. The methodology associated with self-assessments is very similar to that applied for other forms of evaluations. The data- and information-gathering and evaluation techniques will be substantially the same.

Self-assessments can contribute significantly to enhancing a program's effectiveness through:

- Verifying program status on a periodic basis, for the benefit of emergency management staff and management

- Identifying program and performance weaknesses and negative trends

- Providing program-specific budgetary/staffing planning basis

- Preparing for an evaluation by an external sponsor

Secondary benefits of self-assessments, especially those performed by members of the emergency management program themselves, include:

- Reinforcing confidence of staff/management in the ability of the emergency management program to respond

- Providing emergency management staff with the opportunity to view the integrated program

The internal program evaluation can be the primary focus, but not the only part of a self-assessment program. It provides the opportunity to examine the results of other assessment activities throughout the year. Internal evaluations should be planned and organized to include and focus on those areas that the organization most critically needs to test and evaluate each year. Emergency managers should consider the following in determining the scope and focus of self-assessments:

- Results of evaluations from the previous year
- Results of response to actual incidents
- The scope of evaluations from the previous years, ensuring that areas that were not evaluated thoroughly receive greater scrutiny
- Progress in making corrective actions previously identified
- Weaknesses identified from other self-assessment activities
- Achievement of performance measures set for the organization's emergency management program
- Improvements that the organization is committed to making

As resources for external evaluation activities decrease, more emphasis will be placed on the use of self-assessments for assuring that the readiness of the emergency response capabilities is maintained at a satisfactory level. A reasonable and consistent approach for conducting these internal evaluations is to follow the guidance suggested for external evaluations using consistent evaluation criteria and the same definitions for severity of findings. This simplifies the process of combining the results of internal program evaluations with exercise results and combining self-assessments with external evaluations.

3.3.7. Performance Indicators

As emphasized previously, neither a program evaluation nor an exercise evaluation provides a single, standalone measure of emergency management program readiness. A reliable and comprehensive estimate of the *readiness* of an emergency management program must be based on an integrated assessment of both quantitative programmatic data and subjective evaluations of the various functions, activities, products, analyses, tools, etc., that contribute to the implementation, maintenance, improvement, and execution of emergency response capabilities. For the estimate to be meaningful, the contributions must be reasonably comprehensive and reflect the emergency management program within a somewhat narrow time frame.

Realistically, however, the contributions to such a comprehensive assessment may take several years to accumulate and, as a result, could reflect data and evaluations from different stages of a program. This would be especially true for large sites with extensive programs, where substantial resources, planning effort, and time would be involved in acquiring the necessary data, resulting in a significant interval between valid estimates of readiness for the full program. To avoid such potential inconsistencies and delays in assessing and tracking program readiness, an approach using specific programmatic data or evaluation results in selected functional areas can provide timely performance indicators to reflect discrete aspects of program readiness over the broad scope of the program.

Performance indicators for emergency management will consist of a set of critical indicators or *vital signs* derived from programmatic data or evaluation results to track the readiness of the program. Similar to physiological vital signs, such as temperature, blood pressure, heart rate, glucose level, cholesterol levels, etc., used by physicians to track patient health, critical performance indicators can be developed to focus on specific aspects of selected emergency management activities to measure the health of the program. In the case of the physiological vital signs, each by itself provides only a single indication of a potential health threatening condition, which leads the physician to order further tests and procedures. Similarly, emergency management indicators only tell a part of the story and further investigation is required in order to determine if a problem actually exists and, if it does, to provide further diagnosis.

The discussions that follow address two performance indicators: performance metrics and performance measures. A performance metric is a single parameter that reflects performance in terms of its absolute value (percent ERO personnel trained). A performance measure reflects performance in terms of the value of a metric relative to a pre-assigned goal (percent ERO personnel trained relative to a goal of 90%). The performance metric is used to follow or trend a value that characterizes a given activity or function. A performance metric can be used when a performance goal is unavailable or not meaningful for use as the baseline for a performance measure. A practical means for selecting an acceptable and achievable goal for the performance measure is by tracking the values of a performance metric over time, and selecting a candidate value that approximates an acceptable goal. The goal can be modified as more performance data is collected over time.

Performance indicators are usually discussed in terms of deterministic processes that produce products or services with identifiable characteristics that meet the needs of the customer. Whether the product meets the specific requirements is either directly apparent or becomes apparent through deterministic testing. In contrast, the products of emergency management are not necessarily objects that can be directly observed and whose characteristics are readily apparent and well defined. Actual tests (emergencies, exercises) are not comprehensive, involve a snapshot of performance in response to a single incident scenario, test only selected functions, and usually involve only one cadre of the ERO. Hence, the ongoing activities that maintain the program (programmatic activities) must also be evaluated to provide assurances that the program satisfies the comprehensive objectives associated with the range of hazards on the SFA or associated with an activity and is maintained at a level of readiness to protect workers, the public, and the environment.

The remainder of this section focuses on the types and general characteristics of performance indicators and how they relate to emergency management. This is followed by a more detailed discussion of performance indicators specific to emergency management programs.

3.3.7.1. DOE/NNSA Framework and Performance Indicators

Performance indicators for emergency management provide the means for each tier of the DOE/NNSA management system and the Office of Emergency Management to track areas of critical importance to the mission of emergency management throughout the DOE/NNSA complex. At each tier of the DOE/NNSA system, indicators can be defined that measure performance in establishing and maintaining emergency management capabilities commensurate with their responsibilities for planning, preparedness, readiness assurance, and response.

Responsibilities of the levels of management in the DOE/NNSA hierarchy that have not been addressed are the oversight responsibilities with respect to SFAs or field elements below them in the organizational structure. Performance indicators can provide a mechanism for tracking emergency management programs at multiple SFAs within the responsibility of each DOE/NNSA Field Element or HQ organization. Most critical performance indicators can be rolled-up or aggregated to express a summary of performance for all applicable SFAs. For example, a performance measure, such as percentage of ERO trained, has a goal for a specific SFA of XX%. At the next level up in the DOE hierarchy, the performance indicator could be expressed as percentage of SFAs that have met or exceeded their specific ERO training goals. Similarly, performance indicators that reflect performance of the DOE/NNSA field elements can also be rolled-up for tracking at the HQ level.

3.3.8. Exercise Program

The program should provide a continuing series of periodically conducted exercises to evaluate emergency response capabilities and to provide assurances that members of the ERO are prepared to respond promptly, efficiently, and effectively to an actual emergency affecting an SFA. The program includes a plan for validating all elements of each program by incorporating specific objectives in exercises over the planning period. The exercise program includes provisions for incorporating specific exercise objectives in each exercise designed to:

- Periodically test specific aspects of emergency response
- Validate plans/procedures

- Validate implemented corrective actions
- Test program improvements
- Evaluate notifications and communications

A formal exercise program should be established and maintained for each DOE/NNSA SFA to address the following:

- Long-range planning and scheduling for future exercises, and short-range planning for the current year's exercises
- Overall planning, preparation, conduct, control, and evaluation of exercises
- Development of comprehensive exercise objectives based upon Core Program and Emergency Management Hazardous Materials Program requirements from DOE O 151.1D and program-specific EPHAs
- Development of exercises commensurate with, and based upon, the SFA hazards and types of scenarios identified in Hazard Surveys and EPHAs
- Application of sufficient resources to the exercise program
- Roles and responsibilities of all aspects of the exercise development, conduct, and evaluation process are assigned

Long- and short-range program planning should include:

- A long-range plan, for Emergency Management Hazardous Materials Programs, to be prepared and maintained as part of the ERAP. The long-range plan should be developed in concert with the various organizations affected by its provisions. The plan should include the general schedule, scope, and objectives of the exercise over a 5-year period and provide for demonstrating all aspects of the emergency program in a systematic and comprehensive manner.
- A short-range plan to address fiscal year planning. It should include the scope, exercise objectives, participants, and schedule for the major tasks and activities associated with the current year's exercise(s). Planning and scheduling for a specific exercise includes confirming or modifying the planned scope, developing detailed objectives, committing the participants and resources, and identifying and scheduling the various activities.
- Each organization should identify a single individual who is responsible for the exercise program. Depending on the organization's size and the scope/complexity of the exercise program, these responsibilities may be the primary or collateral duties of the individual. Responsibilities include the authority or capability to commit and coordinate the resources necessary for an effective exercise program. Exercise

program functions to be performed by the designated individual should include the following:

- Resolving conflicts identified during the exercise scheduling process;
- Concurring on the scope and objectives of each exercise;
- Coordinating organizational resources for development, conduct, response, and critique of an exercise;
- Monitoring potential programmatic impacts from the exercise development process, as well as resolving any specific exercise development difficulties or conflicts;
- Coordinating with the training and drill program to ensure that all participants have completed their required fundamental emergency management training (not specific to an exercise) prior to a scheduled exercise.

3.3.9. Types of Exercises

Various types of exercises can be used to test and validate DOE/NNSA SFA emergency response capabilities. The type used will be based on DOE/NNSA requirements and the identified goals of the exercise and can include *discussion-based* and *operations-based* exercises.

3.3.9.1. Discussion-Based Exercises

Discussion-based exercises are used as a starting point in the building block approach to the cycle, mix, and range of exercises. Discussion-based exercises include seminars, workshops, tabletop exercises (TTXs), and games. These types of exercises highlight existing plans, policies, mutual aid agreements, and procedures. Discussion-based exercises typically focus on strategic, policy-oriented issues and are ideal tools for familiarizing agencies and personnel with current or expected jurisdictional capabilities. Facilitators or presenters usually lead the discussion, keeping participants on track while meeting the objectives of the exercise.

A. Seminars

Seminars generally orient participants to or provide an overview of authorities, strategies, plans, policies, procedures, protocols, resources, concepts, and ideas. As a discussion-based exercise, seminars can be valuable for entities that are developing or making major changes to existing plans or procedures. Seminars can be similarly helpful when attempting to assess or gain awareness of the capabilities of interagency or inter-jurisdictional operations. Seminars offer the following attributes:

- Low-stress environment employing a number of instruction techniques such as lectures, multimedia presentations, panel discussions, case study discussions, expert testimony, and decision support tools

- Informal discussions led by a seminar leader
- Lack of time constraints caused by real-time portrayal of incidents
- Effective with both small and large groups

B. Workshops

Workshops, while similar to seminars, differ in two important aspects: player interaction is increased, and the focus is on achieving or building a product (such as a plan or a policy). Effective workshops entail the broadest attendance by relevant stakeholders. Workshops provide an ideal forum for:

- Collecting or sharing information
- Obtaining new or different perspectives
- Testing new ideas, processes, or procedures
- Training groups in coordinated activities
- Problem solving of complex issues
- Obtaining consensus
- Team building

Workshops, used in conjunction with operations-based exercise development, are useful in achieving specific aspects of exercise design.

A workshop may be used to produce new emergency operating procedures, mutual aid agreements, Multiyear Exercise Plans, and Improvement Plans (IPs). Workshops share the following common attributes:

- Low-stress environment
- No-fault forum
- Employ different instructional techniques to convey information
- Facilitated, working breakout sessions
- Discussions led by a workshop leader
- Goals oriented toward an identifiable product
- Lack of time constraint from real-time portrayal of incidents

- Effective with both small and large groups

C. Tabletop Exercise (TTX)

A TTX generally involves senior staff, elected or appointed officials, or other key personnel in an informal setting in which situations are discussed that arise during simulated scenarios. The TTX can be used to assess response plans, policies, and procedures, or types of systems needed to mitigate and respond to the specific emergency incident. It is aimed at facilitating understanding of concepts, identifying strengths and weaknesses, or achieving a change in attitude. The TTX format focuses on slow-paced problem solving rather than the rapid, spontaneous decision-making that occurs during actual emergencies or operations-based exercises.

TTX methods can be divided into two categories: basic and complex. In a basic TTX, the scene set by the scenario remains constant. The emergency incident is described and brings discussion participants up to the simulated present time. The leader is then presented with a set of problems to be discussed by participants, resolved by the group, and summarized by the leader. In an advanced TTX, play advances as players receive pre-scripted messages that alter the original scenario. A facilitator usually introduces problems one at a time in the form of a written message, simulated telephone call, videotape, or other means. Players discuss the issues raised by each problem, referencing established authorities, plans, and procedures for guidance. Player decisions are incorporated as the scenario continues to unfold.

The TTX can have the following attributes:

- Practicing group problem solving
- Familiarizing senior officials with a situation
- Conducting a specific case study
- Examining personnel contingencies
- Testing group message interpretation
- Participating in information sharing
- Assessing coordination among participants
- Achieving limited or specific objectives

D. Games

A game is a simulation of operations that often involves two or more teams, usually in a competitive environment, using rules, data, and procedures designed to depict an actual or hypothetical situation. Games explore the consequences of player decisions and actions. They are useful tools for validating plans and procedures or evaluating resource requirements.

During game play, decision-making may be either slow and deliberate or rapid and more stressful, depending on the exercise design and objectives. The open, decision-based format of a game can incorporate *what if* questions that expand exercise benefits. Depending on the game's design, the consequences of player actions can be either pre-scripted or decided dynamically. Identifying critical decision-making points is a major factor in the success of evaluating a game. Large-scale games can be multi-jurisdictional and include active participation from Federal, Tribal, State, and local governments.

Games are excellent vehicles for the following:

- Gaining policy or process consensus
- Conducting what-if analyses of existing plans
- Developing new plans

3.3.9.2. Operations-Based Exercises

Operations-based exercises include functional exercises (FEs), and full-scale exercises (FSEs). These exercises can be used to validate plans, policies, agreements, and procedures; clarify roles and responsibilities; and identify resource gaps. Operations-based exercises are characterized by actual reaction to an exercise scenario, such as initiating communications or mobilizing personnel and resources. Operations-based exercises play the primary role in the readiness assurance program for an SFA and will be the focus of much of the guidance in this chapter.

A. Functional Exercise (FE)

An FE is designed to validate and evaluate individual capabilities, multiple functions or sub-functions, or interdependent groups of functions. They are typically focused on exercising plans, policies, procedures, and staff members involved in management, direction, command, and control functions. In FEs, incidents are projected through an exercise scenario with incident updates that drive activity, typically at the management level. An FE is conducted in a realistic, real-time environment; however, movement of personnel and equipment is usually simulated. The FE controllers typically use a Master Scenario Events List (MSEL) to ensure participant activity remains within predefined boundaries and ensure exercise objectives are accomplished. Simulators in a Simulation Cell (SimCell) can inject scenario elements to simulate real events. Attributes of an FE include:

- Evaluating functions
- Evaluating EOCs, HQ, and staff

- Reinforcing established policies and procedures
- Measuring resource adequacy
- Examining facility or site internal relationships

B. Full-Scale Exercise (FSE)

An FSE is typically the most complex and resource-intensive type of exercise. It involves multiple agencies, organizations, and jurisdictions and validates many facets of preparedness. An FSE often includes many players operating under cooperative systems such as the ICS or Unified Command. In an FSE, events are projected through an exercise scenario with event updates that drive activity at the operational level and are usually conducted in a real-time, stressful environment that is intended to mirror a real incident. Personnel and resources may be mobilized and deployed to the scene, where actions are performed as if a real incident had occurred. The FSE simulates reality by presenting complex and realistic problems that require critical thinking, rapid problem solving, and effective responses by trained personnel. The level of support needed to conduct an FSE is greater than that needed for other types of exercises. The exercise site for an FSE is usually large, and site logistics require close monitoring. Safety issues, particularly regarding the use of props and special effects, must be monitored. Throughout the duration of the exercise, many activities occur simultaneously. Typical FSE attributes include:

- Assessing organizational and individual performance
- Demonstrating interagency cooperation
- Allocating resources and personnel
- Assessing equipment capabilities
- Activating personnel and equipment
- Assessing inter-agency cooperation
- Exercising public information systems
- Testing communications systems and procedures
- Analyzing MOUs, standard operating procedures, plans, policies, and procedures

The level of support needed to conduct an FSE is greater than that needed during other types of exercises. The exercise site is usually extensive with complex site logistics. Food and water must sometimes be supplied to participants and volunteers. Safety issues, including those surrounding the use of props and special effects, must be closely monitored.

C. Full Participation Exercise (FPE)

These exercises are similar to a Full-Scale Exercise except that offsite elements have agreed to participate in the full-scale exercise. Participation may include:

- Local and State response agencies
- Local and State operations centers,
- DOE HQ
- Local or regional hospitals
- Department of Defense partners
- Other offsite responding agencies

The FPE is designed to test the interface with offsite mutual-aid partners and other organizations that supplement or support response efforts.

3.3.10. Exercise Planning

This section addresses generic aspects of exercise planning. Planning for an exercise is fully documented by an exercise plan that includes specific exercise objectives, scope, scenario, participants, simulations, timelines, injects, technical data, safety and security provisions, controller instructions, and evaluation criteria. Planning should be coordinated among onsite ERO components and offsite organizations or groups regarding their respective participation and exercise objectives.

3.3.10.1. Exercise Planning Team

The exercise planning team is responsible for designing, developing, conducting, and evaluating all aspects of an exercise. The structure and functions of the exercise planning team should follow a similar structure to that mentioned in HSEEP. The planning team determines exercise design objectives, tailors the scenario to the needs of the participating organizations, and develops documentation used in exercise evaluation, control, and simulation. Planning team members also help with developing and distributing pre-exercise materials and conducting exercise briefings and training sessions. Due to this high level of involvement, planning team members are ideal selections for controller and evaluator positions during the exercise itself.

An Exercise Director manages the exercise planning team. The team should be a manageable size and include a representative from each major participating onsite and offsite ERO/agency, with team membership modified to fit the type or scope of an exercise. Depending on the individual exercise, planning team members can be drawn from a variety of response disciplines within a DOE/NNSA SFA. The planning team may expand or contract in size according to the scope of a given exercise, causing a member or group leader to assume additional roles.

Note: The guidance in this document is not authoritative with respect to other disciplines and how those elements are planned and conducted within the Emergency Management

Exercises. Those disciplines should use their own disciplines' guidance, standards, policies, procedures, and so on to safely perform those roles within the Emergency Management Exercise. References within this document to those documents are current at the time of publishing and are provided as a courtesy to those disciplines' requests for inclusion. The references should not be considered exhaustive.

Exercise planning teams should follow a combination of common considerations and principles, including:

- Exercise planning teams can be efficient and effective when they adhere to an ICS-based structure.

- Planning teams should be formed in advance of the exercise to ensure adequate time for effective planning, preparation, and review of the exercise plan.

- Members assigned to these teams should be familiar with emergency management plans and procedures in their areas of technical expertise and be experienced in exercise development.

- Team members may work independently or meet in subgroups to develop their respective parts of the scenario; members can participate on more than one team, if necessary.

- Effective project management ensures identification, development, and management of critical and supportive tasks; frequent communication about project status; and use of management plans and timelines.

- Exercise planning team members should be aware of both their individual responsibilities and team responsibilities. Tasks should be identified and assigned to an appropriate planning team member, and clear deadlines should be established.

- A SME should be used in the planning process to ensure that a realistic and challenging scenario is chosen. For example, in a biological terrorism scenario, public health departments and hospitals will have larger roles than special weapons and tactics teams or the bomb squad.

- Certain exercise objectives may require detailed technical or specialty areas of expertise for the development of scenarios, injects, and data. In these situations, a special team can be formed. Typically, this expertise is in specific areas or disciplines such as process operations, health physics, medical, chemistry, safety engineering, or plume modeling.

- Team members should demonstrate appropriate leadership principles, including mentoring, motivation, discipline, personnel management, and time management. Team leaders and members should delegate tasks as necessary. Planning team members should strive toward group and common goals, using all available expertise while fostering creativity.

- Team members should implement standardized processes (such as incorporating task, time, and project management) into exercise design and development. Exercise planning meetings/conferences should be scheduled to develop and review tasks and outputs.

- Both DOE/NNSA and contractor senior management representatives should be briefed to gain their support.

- Coordination with the emergency management training program manager (if designated as a trusted agent) should occur in the exercise planning stage. This allows sufficient time before an exercise is conducted to satisfy any new management training or qualification requirements.

Exercise planners are to consider themselves as trusted agents and understand that, in most cases, they will act as facilitators or SMEs, rather than participants. Planning team members, as a general rule, are not exercise players except at smaller, less populated DOE/NNSA facilities with limited emergency response/management capabilities. In those cases, exercise planning team members who act as both planners and players should be especially careful not to divulge exercise information in advance.

3.3.10.2. Exercise Planning Functions

Development and conduct of a DOE/NNSA exercise requires a structured and coordinated planning process. For each exercise, the following list includes several key functions or activities that should be accomplished at some level, depending on the type and scale of the exercise.

- Develop, document, and schedule:

  – Scope – Who, what, where, how, and why of the exercise;

  – Objectives – Specific objectives provide the basis for evaluating/validating the performance of response capabilities by each participating organization. Each exercise objective should clearly state what is to be demonstrated and be specific, attainable, and measurable;

  – Participants – Who will plan the exercise and who will respond, control, and evaluate. Any limitations or simulations regarding their participation are identified and documented;

  – Safety – Safety is an integral part of each exercise. The exercise should be conducted in a manner that protects workers and other personnel and does not cause harm to the environment;

  – Security – Instructions on facility access, use of firearms, and instructions for any potential classification or controlled unclassified information issues or reviews;

- Scenario – Technically accurate mechanism developed to provide responders with the opportunity to meet objectives. The scenario is consistent with the set of exercise objectives and explicitly supports an evaluation/validation of each objective;

- Budget – What the exercise will cost to plan, conduct, and evaluate, and the financial obligations of participating organizations;

- Logistical Support – Specific responsibilities for support activities;

- Administrative Activities – Procurement, documentation, and reproduction responsibilities;

- Public Affairs Plan – A public information/education plan should be developed, especially for full-participation site-level operations-based exercises, to coordinate activities with appropriate offsite State, Tribal, and local authorities, the media, and the public. This plan should be developed early in the planning process to ensure coordination with interested offsite authorities/officials;

- Oversight of the exercise development process;

- Exercise control;

- Exercise evaluation and critiques;

- Exercise AAR;

- Implementation of corrective actions.

These key functions or activities should be reflected in the Exercise Planning Team structure presented next.

3.3.10.3. Exercise Planning Team Position Descriptions

Providing exercise planning team members with clearly stated roles and responsibilities, along with assigned specific tasks and completion timelines, will facilitate the exercise planning process by ensuring that tasks are not overlooked, forgotten, or identified only at the last minute. Regardless of the size of an exercise planning team, certain core groups must be formed as described below:

Exercise Director

- Oversees all exercise functions during conduct of the exercise

Lead Exercise Planner

- Coordinates all exercise planning functions

Planning Group

- Schedules exercise activities
- Determines exercise scope, objectives, participants, and planning schedule
- Develops scenario guidelines
- Coordinates administrative, logistics, safety, and security activities
- Maintains fiscal responsibility

Scenario Development Group

- Includes members from all participating organizations
- Coordinates development, assembly, and production of exercise plan
- Develops scenario component, including, for example, scenario narrative, MSEL, timeline, injects and messages, and the exercise technical data

Control Group

- Responsible for the safe and effective conduct of the exercise
- Exercise control
- Safety

Evaluation Group

- Responsible for observing, evaluating, and critiquing the exercise

Other planning groups (tasks may be separated from above main teams)

- Administration/Logistics
- Communications
- Technical data preparation
- Security/safety
- Public information
- Visitor and observer management

If an ICS management model is used for organizing the Exercise Planning Team, then the groups described above will be formed under the headings of core ICS groups: Command

Group, Operations Group, Planning Group, Logistics Group, and a Finance/ Administration Group.

During the planning process, as tasks increase in frequency and complexity, the planning team grows. It may be necessary to expand positions to include several functional experts or SMEs and additional logistical support or service staff. Many large, complex exercises may start with a planning team that fills most, if not all, of the organizational structure represented by the groups indicated above.

3.3.10.4. Exercise Planning Meetings/Conferences

The Lead Exercise Planner and the exercise planning team should decide on the number of meetings needed to successfully conduct a given exercise. To effectively host planning meetings, the Lead Exercise Planner needs access to information on the program, its objectives, and its flexibilities and limitations. Listed below are basic descriptions of primary objectives for each type of planning meeting along with information on tools (agendas, draft documents, checklists, and presentations) used to assist the exercise planning team in designing, developing, and conducting an exercise.

Providing advance information to the planning team members significantly enhances the efficiency of a planning meeting. These materials may be provided to team members in a read-ahead packet, which may include proposed agenda items, any relevant background information, and expected meeting outcomes. In addition to making the attendees better informed, a read-ahead packet also allows them to understand the relevancy and importance of the meeting.

The scope, type (operations- or discussion-based), and complexity of an exercise should determine the number of meetings necessary to successfully conduct an exercise. Planning meetings are listed in typical chronological order:

1. Concept and Objectives Meeting

2. Initial Planning Meeting

3. Mid-Term Planning Meeting The time between the MPM and the FPM should be used to finalize the exercise plan, scenario timeline, and remaining exercise documentation (determined at the IPM)

4. MSEL Meeting

5. Final Planning Meeting

3.3.10.5. Exercise Planning Schedule

Planning and scheduling an exercise require the involvement and cooperation of all participating organizations. A well-planned, executed, and documented exercise requires the coordination and cooperation of senior management, facility- and site-level EROs and, when applicable, offsite response organizations. Participating offsite response organizations must be included in the initial planning stages of the exercise. Their participation may range from the limited staffing of a control cell for the purpose of receiving notifications to the complete staffing and activation of all applicable response facilities and assets. In planning the exercise, adequate time should be allowed for effective preparation and review of the exercise plan.

Table 3-3 contains a sample schedule applicable to a DOE/NNSA complex site-level exercise; planning times should be adjusted down for smaller scale exercises.

Table 3-3. Sample Planning Schedule for a Site-level Annual Exercise

Calendar Days Prior To the Exercise	*Planning Activity*
365	Establish or confirm exercise date. Establish exercise scope.
270	Establish planning organization. Confirm scope and level of participation by all organizations. Develop initial exercise objectives.
180	Verify plans and procedures to be used. Begin scenario development.
150	Finalize exercise objectives.
90	Submit scenario narrative, scope, MSEL (draft), objectives, and participant list to contact Field Element Manager, PSO, and Associate Administrator, Office of Emergency Management (NA-40) as applicable.
60	Complete planning group review/revision of draft EXPLAN.
30	Submit EXPLAN to DOE/NNSA Field Element Manager for approval.*
15	Complete generic controller/evaluator training.
1-5	Conduct exercise-specific controller/evaluator training. Conduct responder and observer briefings.
1-2	Finalize exercise preparations.
Post Exercise	Conduct critiques.
Post Exercise 15	Complete draft AAR.
Post Exercise 45	Finalize AAR and submit a copy to FEM, PSO, and Associate Administrator, Office of Emergency Management (NA-40).
Post Exercise 90	Develop/prepare corrective and improvement actions and submit a copy to Field Element Manager, PSO, and Associate Administrator, Office of Emergency Management (NA-40).

*Required per DOE O 151.1D

3.3.11. Exercise Documentation

Typical exercise documents resulting from the efforts of the Exercise Planning Team are addressed in the following sections. They provide essential components for preparing, conducting, and evaluating exercises.

3.3.11.1. Situation Manual (SITMAN)

The SITMAN is a participant handbook for discussion-based exercises, particularly TTXs. It provides background information on the exercise scope, schedule, and objectives. Also included is the scenario narrative that will drive the participant discussions during the exercise. The SITMAN should mirror the multimedia briefing and supporting narrative allowing participants to read along while watching events unfold.

3.3.11.2. Exercise Plan (EXPLAN)

An EXPLAN, typically used for operations-based exercises, is published and distributed prior to the start of an exercise. The EXPLAN provides a synopsis of the exercise and addresses the exercise objectives and scope. The EXPLAN assigns tasks and responsibilities for successful exercise execution and provides documented components essential for preparation, conduct, and evaluation of the exercise. The EXPLAN contains all the documentation necessary to control and evaluate the exercise; however, the extent and detail of the information will vary with the scope and complexity of the particular exercise.

The EXPLAN contains an explanation of the exercise and provides the documented components essential for preparation, conduct, and evaluation of the exercise.

Development of an EXPLAN by an exercise planning team involves an iterative process consisting of several steps:

- Address issues of exercise scope and duration, participants, objectives, administrative and logistical considerations, and operational or technical constraints
- Develop a scenario timeline, a listing of the sequence and timing of key operational, technical, and logistical events comprising the scenario
- Refine the timeline, develop detailed scenario information, prepare message injects (instructions to controllers) and data, and prepare control, evaluation, and other supporting documentation

This iterative development and refinement process are followed by a final review. Final review of the EXPLAN is conducted to ensure overall completeness and technical accuracy and that players/responders are provided the opportunity to meet the exercise objectives. The EXPLAN should be completed in sufficient time to allow DOE or NNSA line management and the DOE Associate Administrator of Emergency Operations to review and comment before the conduct of the exercise. However, some elements of the

EXPLAN, such as telephone directories or lists containing names of controller/ evaluators, will be subject to change up to the conduct of the exercise. To ensure that classified and controlled unclassified information are identified and protected during all stages of EXPLAN development, consult appropriate review officials throughout the process. If there is no intent to establish a Federal advisory committee, any consultation conducted with non-federal entities for the purpose of obtaining advice and/or recommendations may raise concerns under the Federal Advisory Committee Act (FACA) that should be raised to GC-21.

The scenario reflects current SFA-specific hazards, correlates technically with the All-Hazards Survey/EPHA, and is technically accurate in terms of operations and radiological, chemical, and meteorological data. A unique scenario should be developed for each exercise to prevent responder anticipation of events and to ensure a valid test of integrated response capabilities. The final approved EXPLAN provides documentation to conduct and evaluate the exercise.

The EXPLAN contains all documentation necessary to control and evaluate the exercise; however, the extent and detail of information will vary with the scope and complexity of the exercise. The format can be tailored by individual organizations, but a typical DOE/NNSA EXPLAN includes the following components:

1. Scope and Purpose. All participating organizations, the extent of their participation, and the organizations being simulated are identified. States the purpose of the exercise. Contains the type of exercise, the location of the event scene, SFA background information, and the date and expected duration.

2. Exercise Objectives. The objectives are the key to the exercise. Each exercise objective should clearly state what is to be demonstrated and should be specific, attainable, and measurable. They should contain specific conditions, performance/action, and standard of performance to define how the objective is to be evaluated. Exercise objectives are discussed further in Section 3.8.

   Use of an exercise objective matrix is recommended as a tool to facilitate administration of the exercise program. The matrix should identify all programmatic exercise objectives and correlate with SFA-specific hazards and the specific objectives to be demonstrated in individual exercises. It should support/document validation of emergency management Program Elements over the 5-year period. To test the interfaces between site security and SFA emergency response capability, the exercise program at a DOE/NNSA SFA should include security scenario events.

3. Exercise Organization. The exercise organization is comprised of all participants in the actual conduct of the exercise and includes the following:

- **Exercise Director** ensures exercise conducted according to the EXPLAN

- **Players** include actual responders and onsite and offsite organizations

- **Evaluators** are SMEs who observe, monitor, and evaluate player performance; they are responsible for critiques and the final AAR

- **Controllers** ensure that the exercise proceeds on schedule; monitor the sequence of events, and input contingency injects to keep the exercise on time; monitor safety; input technical data at appropriate times in the scenario; and assist with critiques and the final AAR

- **Observers/visitors** should have no interaction with players/responders

4. Scenario Narrative. A scenario is an outline or model of the simulated sequence of events for the exercise. It can be written as a narrative or depicted by an event timeline. For discussion-based exercises, a scenario provides the backdrop that drives participant discussion, and is contained in a SITMAN. For operations-based exercises, a scenario provides background information about the incident catalyst(s) of the exercise. The overall scenario is provided in the C/E Handbook, and specific scenario events are contained in the MSEL.

5. The scenario reflects current SFA-specific hazards, correlates technically with the All-Hazards Survey/EPHA, and is technically accurate in terms of operations, radiological, chemical, and meteorological data. A unique scenario should be developed for each exercise to prevent player/responder anticipation of events and to ensure a valid test of integrated response capabilities.

6. Rules of Conduct. Design and development guidelines are established for each exercise and include:

- Limitations are management policies and guidelines of concern to the exercise developers and scenario designers; include issues such as conducting exercises on weekends, overtime restrictions or authorizations, and financial constraints.

- Protocols (ground rules or rules of conduct) remind players/responders of drillsmanship and safety issues.

- Pre-approved simulations list the major simulations applicable to the exercise; may include pre-determined meteorological data, response vehicle red lights, simulating roadblocks without interfering or disrupting public traffic patterns, use of water to simulate a chemical liquid hazardous materials spill, use of a smoke generator to simulate fire/smoke, use of protective equipment, simulated operation of systems/equipment, and photographs to simulate equipment damage.

7. Safety Issues. Safety of personnel and the facility is paramount during exercises. A major concept of DOE ISM is the integration of safety awareness and good practices into all aspects of work conducted at DOE. Simply stated, exercises should be conducted in such a manner that protects workers and other people and does not cause harm to the environment. Safety is an integral part of each exercise; it is not a stand-alone program.

The planning process and management of exercises must ensure that sufficient precautions and limitations are established and followed for safe conduct of the exercise. A person with the sole responsibility for ensuring safety during the exercise, such as an exercise safety director, should be appointed to the exercise planning team.

During an exercise, all participants must comply with established safety rules and practices. Participants must understand that safety of exercise participants, nonparticipants, the public, and the environment is the highest priority. An exercise safety plan is an effective method of documenting safety concerns and solutions. The plan should address generic and specific safety concerns, solutions for mitigating the problem, and required actions or notifications if a safety concern or emergency occurs during an exercise.

8. Security and Access Planning. Adherence to security requirements by all participants in all phases of an exercise is a necessity. Planning and management of exercises should include provisions for the participation of appropriate security personnel and should establish parameters for exercise design, development, and conduct in view of identified security issues. Controllers are responsible for conducting the exercise within security limitations.

Persons involved in exercise planning must be sensitive to information or activities that may have security implications. An exercise security plan is an effective method of documenting security concerns and solutions. This plan should address generic and specific security concerns, mitigative solutions, and required actions/notifications if a security problem or emergency occurs during the exercise. Special provisions should be made for visitors and observers since they may not be familiar with DOE or site security requirements.

9. Public Information Planning. Scheduled exercises, especially large-scale operations-based exercises, should be coordinated with the media and announced to the public. Interfaces with the public and offsite Tribal, State, and local authorities require management awareness and sensitivity.

The public typically does not have involvement or participation in an exercise. However, all exercises conducted at an SFA that have the potential to affect the offsite population, either directly or indirectly, should include adequate provisions to prevent public concern, rumor, or inconvenience. The planning process and the management of exercises should provide for the development of a public information/education plan to coordinate activities with appropriate offsite Tribal, State, and local authorities, the media, and the public. This plan should be developed early in the planning process to ensure coordination with interested offsite authorities/officials.

10. Timeline of Key Scenario Events. The exercise timeline should include key scenario events and expected responder actions and, where possible, the events and player/responder actions should be tied to exercise objectives.

11. Message Injects. Message injects include instructions to controllers to begin simulations, insert information, provide earned information, and acting instructions. Message injects should contain accurate, unambiguous, and non-prompting information and technical data for the players/responders and provide proper direction for the exercise. They should be formatted/presented in a manner as to reflect the actual data that would be observed by players/responders in a real event (strip charts, alarm printer output, use of accident mock-ups).

12. Exercise Data. Exercise data varies greatly depending on the type and scope of the exercise. For example, the data requirements for a TTX are limited by design in order to minimize the resources needed to conduct this type of exercise. The technical data that supports the scenario should be technically accurate and clearly presented:

- General facility information is especially important when non-facility personnel participate in the exercise; includes a facility description, (area, site, and facility maps), mission description, emergency management program information, and a description of offsite interfaces.

- Specific facility information provides operational data at the time of the event; may include diagrams, schematics, and data tables that will augment the scenario.

- Meteorological data provides weather conditions and forecasts, both real and simulated, as required.

- Hazardous material data may include radiation or chemical plume plots and tables, decontamination levels, and exposure levels; technical basis and assumptions used to develop this data should be provided.

- Medical information includes a description of medical conditions and moulage procedures, actor behavior instructions, and vital signs.

13. Exercise Control. The control organization is responsible for controlling the exercise and is usually depicted on an organizational chart showing the categories of controllers and lines of communication. The categories of controllers include the lead controller, timeline coordinator, area controllers, on-scene controllers, the control or simulation cells and their associated actors. Controllers are assigned by name to each position listed in the control organization. The controller assignments should include alternates.

Detailed controller instructions include a schedule of events for all controllers, basic controller instructions, and requirements for each controller assignment. These should include the message injects that the controller is responsible for inserting in the exercise, contingency message injects and the authorization process for their use, and special equipment required for the position. A special type of controller instructions, called profiles, can be used to define actor roles. Profiles are normally used for media actors in either a control cell or for interviewing in person or for control cell actors representing political figures (profiles are generally used only with experienced controllers).

14. Exercise Evaluation. Exercise evaluation is conducted by the evaluator organization. The evaluator organization is usually depicted by a chart and description of the categories of evaluators and lines of communication. The categories of evaluators include the lead evaluator, lead area evaluators, and evaluators. Evaluators and alternates are assigned by name and listed in the evaluator organization.

Evaluation criteria provide the standards and activity- or function-specific criteria used to evaluate an exercise. Evaluator modules or checklists display the expected response in a time-sequenced format used to monitor player/responder progress. They are based on the exercise objectives, the evaluation criteria, and the participating organization's plans and procedures.

15. Logistics. A logistics plan is prepared to specify tasks to be accomplished in support of exercise preparation, conduct, and evaluation. This includes notification of controllers, obtaining meeting rooms and classrooms, identifying and setting up the control cell, communications requirements, meals, transportation, facility security badging/access, and acquiring/staging props (moulage dummies, smoke generators, damaged equipment, simulated material).

A method to identify exercise participants and, if necessary, various non-participants should be documented in this section. Vests, hats, or armbands of various colors can identify participants. Ensure that the type of participant is printed on the identification method to assist those with color-impaired vision.

16. Schedule of Events. A master schedule should be developed that addresses all preparation activities, conduct of the exercise, the critique process, and the evaluation AAR.

17. Communications Plan. This plan documents radio and telephone requirements. It provides radio frequencies, protocol, telephone numbers, and directories. Additionally, it contains information concerning controller communications, training, and systems testing. Normally the following exercise telephone (communications) directories are prepared:

- Control Cell Directory is provided to responders and lists the telephone numbers of controllers simulating individuals or organizations
- Controller/Evaluator Directory which includes telephone and radio channels/frequencies used for communication within the control and evaluation organizations
- Responder Directory is provided to control cell controllers and lists the telephone numbers of responders who may need to be contacted by the control cell

18. Glossary of Acronyms. This section contains SFA-specific acronyms and definitions for the benefit of personnel who are not familiar with the ERO, operations, and SFA organization.

3.3.11.3. Controller and Evaluator Documentation

The Controller and Evaluator (C/E) Handbook supplements the EXPLAN by presenting more detailed information about the exercise scenario and describing exercise controller and evaluator roles and responsibilities. The C/E Handbook should only be distributed to individuals specifically designated as controllers or evaluators. Larger, more complex exercises may use the Control Staff Instructions (COSIN) and an Evaluation Plan (EVALPLAN) in place of, or to supplement, the C/E Handbook.

Controllers ensure that player/responder behavior remains within predefined boundaries. Simulation Cell (SIMCELL) or Control Cell controllers continuously inject scenario elements to simulate real events. Evaluators observe behaviors and compare them against established plans, policies, procedures, and standard practices. Safety controllers ensure all activity is executed within a safe environment.

In addition to containing the same information as the EXPLAN, the C/E Handbook usually contains the following sections:

- Detailed scenario information (including agent fact sheets)
- Assignment of personnel to specific controller/evaluator positions
- Roles and responsibilities of functional area or individual controllers and evaluators
- Controller communications plan
- Exercise Evaluation Guides (EEGs)

The C/E handbook may also be combined with the EXPLAN.

The COSIN is typically developed for large-scale, complex exercises that require more coordination among control staff. The purpose of a COSIN is to:

- Provide scenario details
- Develop guidelines for control and simulation support
- Explain the exercise concept as it relates to controllers and simulators
- Establish management structure for these activities
- Establish and define the control structure’s communication, logistics, and administration

The MSEL is a chronological timeline of expected actions and scripted events to be injected into exercise play by controllers to generate or prompt player activity. The MSEL ensures that necessary events happen so that all players can effectively demonstrate their objectives. The MSEL links simulation to action, enhances exercise experience for players, and reflects an incident or activity that will prompt players to implement the policy or procedure being tested. Larger, more complex exercises may employ a Procedural Flow, which differs from the MSEL in that it only contains expected player actions or events.

Each MSEL record contains:

- Designated scenario time
- Event synopsis
- Controller responsible for delivering inject, with controller/evaluator special instructions (if applicable)
- Expected action (player response expected after an MSEL inject is delivered)
- Intended player (agency or individual player for whom the MSEL inject is intended)
- Objective to be demonstrated (if applicable)
- Notes section (for controllers and evaluators to track actual events against those listed in the MSEL, with special instructions for individual controllers and evaluators)

Times listed in an MSEL should reflect the times that injects should occur. These times should be as realistic as possible and should be based on input from functional area representatives. For example, to determine when triage and treatment should be established during the exercise, solicit input from EMS or a hospital representative. If the activity occurs sooner than anticipated, the time should be noted, but play should not be interrupted.

There are three types of injects:

- Contextual injects are introduced to a player by a controller to help build the contemporary operating environment. For example, if the exercise objectives include information sharing, a MSEL inject can be developed to direct a controller to select an actor to portray a suspect. The inject message would then instruct the controller to prompt another actor to approach a security officer and inform him/her that this person was behaving suspiciously.
- Earned information injects contain data to be provided to a responder when the function being performed would yield specific information. For example, when an EMS technician begins to treat a patient, vital signs are provided through these injects

when the proper actions to earn them have been achieved. If the EMS does not perform the appropriate actions, no inject information is provided.

- Contingency injects are events that should be verbally provided to a player by a controller if they do not take place. Use of contingency injects during the exercise should be documented. For example, if a simulated secondary explosive device is placed at an incident scene, but is not discovered, a controller may want to prompt an actor to approach a player/first responder and say that he/she witnessed suspicious activity close to the device location. This should prompt the discovery of the device by the responder and result in subsequent notification of protective force (specifically, the bomb squad).

The MSEL is typically produced in two formats: short and long. Short MSELs include injects, the time, a short description, the responsible controller, and a player. These can be used as a quick reference guide during exercise play. Long MSELs are used when greater detail is necessary; they include more detailed descriptions, exact quotes for SIMCELL injects, and descriptions of expected actions.

Message injects are typically used in exercises that involve multiple simulated activities. These messages are typically delivered via a SIMCELL and are used to simulate the actions, activities, and conversations of an individual, agency, or organization that is not participating in the exercise, but that would likely be actively involved during a real incident. For example, in an exercise with limited scope, the State Governor’s office may not be playing. To simulate the activities of the Governor’s office during an emergency incident, a message can be scripted to simulate notification of the mayor. That message can be delivered by phone through the SIMCELL. This script or message inject should be read by a simulator acting on behalf of the Governor’s office.

Evaluation Plans (EVALPLANs) provide evaluation staff with guidance and instructions on the evaluation or observation methodology to be used as well as essential materials required to execute their specific functions. During larger, more complex exercises, planners may develop an EVALPLAN in lieu of, or in addition to, a C/E Handbook. The EVALPLAN is a limited distribution document that evaluators use in conjunction with the EXPLAN and the MSEL. Level of detail varies and can include the following:

- Exercise overview
- Evaluation control organization
- Evaluation methodology and observation techniques
- Evaluator roles and responsibilities
- Evaluation communications plan

The EEGs are developed to assist in exercise evaluation and incorporate the critical tasks that should be completed in an exercise. The EEGs are intended for use by both experienced evaluators and SMEs who may have little or no exercise evaluation experience.

Controller and Evaluator Packets are provided to controllers and evaluators prior to an exercise. The packets contain materials that they need to carry out their responsibilities. These materials can be extracted from the more detailed information found in the C/E Handbook or the COSIN.

A controller packet should contain:

- C/E Handbook or COSIN information (scenario and threat/hazard information, communications, safety, exercise staff organization)
- MSEL (including injects for each responsible controller)
- Maps/directions

These materials should be placed in a packet for use during the exercise.

3.3.12. Post-Emergency Evaluation

A Post-Emergency Evaluation is a critique of response to an actual emergency incident or condition at any DOE SFA. In addition to being required by DOE O 151.1D, it is required by DOE O 422.1 Chg. 2 and 29 CFR Part 1910.120. Emergency management specialists should accompany the team assigned to critique the response to the event (a team conducting an accident investigation required by DOE O 225.1B; Type A or B Investigation). It is important to emphasize that, as a member of an accident investigation team, the team leader has the responsibility to determine the procedures and protocols involved in the conduct of the investigation. Hence, as a member of the team, an emergency management specialist must follow the direction of the team leader.

This section is intended to give emergency management personnel some preliminary guidance on a general approach to the emergency management investigation related to a response. The evaluation of the emergency response to an actual event should include the following steps:

Step 1. <u>Collect and Review Data</u>.

- Collect and review shift logs;
- List personnel on shift;
- Review emergency communications in logbooks;
- Review ERO notification and activation times;
- Review sequence of response to emergency;

- Review press releases; and
- Review recorded operating parameters of equipment.

Step 2. Reconstruct Sequence of Events From Data.

Step 3. Conduct Interviews to Exchange Facts and Information.

- Have two to three persons on the interview team representing operations and the safety organization;
- Compare the interview sequence of events with logs to verify the sequence and clarify discrepancies;
- Involve emergency response personnel as appropriate. Include offsite response personnel involved with the response.

Step 4. Several After-Action, or Follow-Up, Steps Should be Accomplished as Follows to Exchange Facts or Information:

- Draft a report on the reconstructed sequence of events. Identify report items by source of information (i.e., log, interview, work request, work permit, and inspection team observations). Have emergency response personnel review the draft;
- Conduct a tabletop response. Conduct a team tabletop response to the event using site procedures and recording the actions that should have been performed were the procedures followed. Compare against the reconstructed sequence of events;
- Analyze events, decisions, and response actions;
- Identify areas needing corrective action or improvement (i.e., findings). Emergency response findings and corrective actions should be identified. Implementing the corrective actions is the responsibility of the organization.

More detailed guidance for structuring an evaluation of an actual response to an accident is available elsewhere. This limited description is intended to support the assertion that such a post-emergency evaluation is like an exercise evaluation. Hence, the evaluation of exercises and, likewise, the response during an actual emergency should be based on the same evaluation criteria. However, during an actual emergency objectives selected for evaluation will correspond to the response needs of the specific emergency, while for an exercise, objectives will be selected to focus the exercise performance on specific aspects of the program to be tested.

3.3.13. Exercise Objectives

Based on direction from associated stakeholders, the exercise planning team selects one or more exercise program priorities on which to focus an individual exercise. These priorities drive the development of exercise objectives, which are distinct outcomes that an organization wishes to achieve during an exercise. Exercise objectives should incorporate elected and appointed officials' intent and guidance, and exercise participants' plans and procedures, operating environment, and desired outcomes. Generally, planners should select a reasonable number of specific, measurable, achievable, relevant, and time-bound (SMART) exercise objectives to facilitate effective scenario design, exercise conduct, and evaluation.

3.3.13.1. Developing Exercise Objectives

Considerations in developing exercise objectives include the following:

- Primary sources of exercise objectives are the participating organization's emergency management plans and procedures. Other sources may include lessons learned from past exercises, the specific plans/procedures being exercised, and job-task analyses used to develop the organizational response structure, requirements, or training.

- Exercise objectives need to be fully developed for all organizations prior to the preparation of the scenario script. If offsite organizations are participating in the exercise, they should develop their own objectives for evaluation during the exercises and these objectives should be included in the exercise plan. These objectives are not evaluated by the DOE/NNSA evaluators, but should be reviewed to ensure that the objectives that rely on site input are attainable and measurable. The DOE/NNSA should evaluate the interfaces between DOE/NNSA and the offsite agencies, if this is part of an exercise objective.

  Each exercise objective should clearly state what is to be demonstrated by the responders:

  – Is the objective clearly stated? It should be specific, focus on the performance to be demonstrated, and be interpreted in the same manner by all participants.

  – Is the objective attainable? The performance required in the objective must be attainable (achievable). The function or activity specified must be within the capabilities of the responders to accomplish.

  – Is the objective measurable? The performance addressed by the objective should have observable and measurable indicators. Specific evaluation criteria should be developed for measuring performance using a procedure or checklist.

- Exercise objectives should contain a condition, an action, and a measurable standard. For example, given an OE (*condition*), activate the EOC (*action*), in accordance with the Site EOC Emergency Management Plan Implementing Procedure (*measurable standard*). The condition provides the evaluator an understanding of the conditions that have to occur prior to the responders taking the action. This allows the evaluator to position him/herself to observe the action. The action should be clearly stated and attainable. This is the function that the evaluator will observe and analyze to report performance. The standard is the plan, procedure, or regulatory requirement listing the steps to be taken by responders to meet the exercise objective.

- For purposes of identifying responsibilities, it is useful to categorize or group objectives. Typically, objectives may be grouped by geographical area (event scene, command center, collocated facility), function (notification, consequence assessment, protective actions), by organization (Operating Contractor, operations/field office/service center/HQ, State, local organizations), or by relationship to the DOE SFA. For example, a grouping by relationship to the DOE/NNSA SFA could result in a categorization of objectives, as follows:

  – SFA objectives – involve only site and facility organizational units

  – Offsite objectives – involve only offsite units

  – Shared objectives – involve coordinated site and offsite units

  – Special purpose objectives – designed to accomplish a specific purpose and may involve site or offsite units

Using the categories in the example listed above and grouping by organization will assist in identifying the entity responsible for determining the extent of exercise play and, therefore, the organizational unit responsible for preparation of its objectives. Joint objectives will require the collaboration of more than one entity. Special purpose objectives may be prepared to test, for example, a new capability, such as a mutual aid agreement, that would dispatch a medic response unit within a specified time.

Once established, the objectives should clearly define the extent of play (including offsite organizations in the exercise), identify types of events to be included in the scenario, and provide the entire framework on which the exercise will be designed.

3.3.14. Exercise Preparation

Pre-exercise activities include configuring props or staging equipment, establishing controller and evaluator communications, specifying safety and security precautions, making arrangements to feed participants, and making arrangements for minimizing the impact on non-participants and ongoing operations.

Coordination among participants prior to the exercise should include provisions for exercise initiation, interruption, and termination. All participants (players, controllers, and evaluators) should be reminded of their responsibility to prevent unsafe acts and to stop the exercise, if necessary, to ensure that they do not occur.

3.3.14.1. Controller and Evaluator Training

Generic Training. Generic training should be developed and conducted for individuals participating as controllers and evaluators in an exercise. This training should include both initial training and a periodic refresher prior to each exercise.

- Individuals with experience in the control and evaluation of exercises should provide the initial training. It should include a classroom-type presentation and discussions of correct controller/evaluator performance in various exercise circumstances.

- Classroom-type presentation should address all aspects of an exercise and include such topics as objectives, safety, participants, realism, simulation, free play, contingency messages, earned information, prompting, and the evaluator and controller-responder interface. Discussions should provide examples of circumstances that may occur during an exercise with proper controller actions. Emphasis should be placed on the criteria for controllers to intercede in responder actions and the criteria for suspending or terminating the exercise.

Exercise-Specific Training. Just prior to any exercise, all controllers and evaluators must receive a briefing on the scenario package and the specific duties they are to perform. This briefing may include a presentation on the various plans and procedures that the responders are expected to use. Controller briefings should cover the entire scenario and anticipated responder actions, the location and assignments of each controller (including actors), communication plans, administrative and logistical details, an in-depth presentation of safety and security issues, and an in-depth discussion of each controller's specific assignments. Details for controlling complex or sensitive parts of the exercise should be presented in the briefing. A tour of locations and associated equipment involved in the exercise may be performed as part of the briefing; this may not occur if a tour will result in compromise of the exercise.

3.3.14.2. Exercise Player and Observer Briefings

Exercise Player Briefing. Should not include information related to the scenario.

Exercise Players shall be briefed regarding rules of conduct; scope of the exercise; safety and security precautions; approved simulations; methods for identifying various exercise participants; and any special administrative, logistical, or communications arrangements in effect during the exercise. Briefing pre-approved simulations must be carefully considered, since some may be very scenario-specific and may divulge too much advance information.

Observer Briefing. Should occur prior to the exercise to ensure compliance with safety and security precautions and other rules of conduct. Observers may attend the controller briefing or may be provided separate briefings.

3.3.14.3. Exercise Setup

Exercise setup should be documented in the logistics plan and includes setting up simulations, preparation of scenes and visual areas (smoke generators, simulated spills, actor moulage), performing controller communications checks, positioning controllers/evaluators, conducting responder initial conditions briefings, synchronizing clocks, initializing computer simulation data, and other scenario-specific activities. Exercise setup should be carefully planned to ensure that all logistics necessary to conduct the exercise are checked before the exercise begins. Security of the exercise scenario must be properly managed; pre-staging of players or prior knowledge of scenario material by players must be effectively prevented.

3.3.15. Conduct of the Exercise

Control of the exercise ensures that the scenario unfolds according to the exercise plan. Controllers are responsible for staffing and positioning themselves for effective control. They must ensure there is no interference or prompting by non-responders. Players/responders must perform their respective functions, initially and throughout the exercise, in a professional manner as if the situation were an actual emergency. Simulation of activities during the exercise must be sufficiently realistic to provide confidence that the activity could have been performed during a real emergency.

3.3.15.1. Roles of Participants

Exercise Director. During the exercise, the exercise director is responsible for the following:

- Safe conduct
- Coordination and continuity
- Providing the opportunity to meet exercise objectives
- Commencing, suspending, and terminating the exercise

Controllers. Controllers provide overall direction and control of the exercise. They are primarily responsible for ensuring continuity of the scenario and maintaining safety and security precautions. Controllers should do the following:

- Review appropriate emergency response plans, procedures, and checklists prior to the exercise
- Review safety, security, communications, and logistical plans included in the exercise plan
- Attend required training and briefing sessions

- Allow freedom of responder decisions and actions (free play) to demonstrate exercise objectives and response capabilities
- Preclude responder decisions or control actions that would result in loss of opportunity for a participating organization to meet its objectives
- Inject approved contingency messages or provide instructions, as needed, to keep the exercise on track with the scenario
- Preclude responder decisions and control actions that may compromise safety or security of the facility, personnel, or equipment
- Refrain from prompting, in any fashion, decisions or actions of responders
- Keep the lead controller informed of significant unplanned activities
- Be prepared to suspend exercise activities in the immediate area and to use prearranged protocols to terminate an exercise

Evaluators. In general, the only function performed by an evaluator during the exercise is to observe and document the responder actions; however, due to personnel limitations, evaluators may perform a dual role as an evaluator/controller. Formal evaluation is performed after the exercise is terminated. Evaluators should be assigned specific locations or specific exercise functions. Evaluators should do the following:

- Review appropriate emergency response plans, procedures, and checklists prior to the exercise
- Review safety, security, communications, and logistical plans developed for conduct of the exercise
- Attend required training and briefing sessions
- Observe performance of responders during the exercise and document their actions using their evaluator modules or checklists
- Refrain from interfacing with responders to prevent interrupting or prompting
- Evaluate responder performance (not the person) and adequacy of procedures, facilities, and equipment based on exercise-specific evaluation criteria and evaluator checklists
- Document errors and problem areas in the scenario or conduct of the exercise
- Maintain a timeline of the events as they unfold
- Present their evaluations and recommendations in a formal critique

Observers. Observers should not interfere with or become involved in any exercise activity, nor should they contribute information or opinions to responders in any fashion.

Exercise Player. Exercise Players represent the majority of participants in an exercise. In addition to site DOE/NNSA and contractor emergency response personnel, responders may include personnel from DOE/NNSA HQ, DOE/NNSA Operations/Field Elements and service centers, and various other DOE/NNSA elements; federal agencies; State, Tribal, local, and private organizations; and the media.

Non-Participants. Non-participants are individuals outside the scope of play who will continue to perform their normal, routine duties as though the exercise were not in progress. Such routine duties include activities necessary for continued safe and secure operation of the facility. Efforts should be made to minimize the impact of the exercise on nonparticipants and to avoid interface between responders and those individuals.

3.3.15.2. Conduct

This section discusses various aspects of exercise conduct that ensure that the exercise represents a valid test of performance of the response capabilities in achieving the exercise objectives.

Confidentiality. Scenario information should be closely guarded and not discussed with potential responders. Guidelines for maintaining exercise confidentiality include the following:

- A C/E should be careful of what they say and to whom they speak about the exercise because they may be overheard; this includes conversations over radio net communications.
- A C/E should be careful when positioning themselves to observe an activity to ensure they do not give away information by their actions.
- The C/E should take care that no one can see their scenario notebooks or comments. They should never lay their scenarios, notes, or messages in a location where responders can read them.

Simulation and Realism. Realism should be emphasized throughout any exercise.

- Exercises should be managed to be as realistic as possible. Exercises should attempt to duplicate the sense of stress inherent in a real emergency while, at the same time, ensuring safety of personnel and security of the facility.
- Exercise responders should receive scenario information only when it is earned via demonstration of the particular role and its response to the event.
- Simulation should be kept to a minimum. During responder briefings, responders should be briefed on which functions/activities are simulated.

- A control cell should be used whenever it is necessary for responders to interact with entities not participating in the exercise. The control cell is located away from responders and is staffed by experienced professionals who simulate or role-play nonparticipating organizations. This method of simulation enables realistic interactions to occur between the exercise responders and those they would expect to interact with during an actual response.

- Actors/role-players (controllers) should be used to simulate personnel who would be encountered by responders if the scenario were real. Actors may come in face-to-face contact with the responders or may be members of a control cell.

- Responders should implement their appropriate plans, procedures, and training to respond as if the scenario information is real. Responders should rely upon the controllers or exercise simulation tools to supply scenario information.

<u>Presentation of Scenario Information</u>. Data and evidence should be presented to the responders as it would be found, measured, or indicated, with a maximum degree of realism.

- Information should be provided to responders only when it is earned through their observations, correct use of procedures, and correct reading and use of instrumentation. For authenticity, data sheets, recorder charts, and instrument output information should be provided wherever possible in the scenario.

- Time-related parameters should be provided to responders at the time identified on messages to ensure progress of the scenario timeline.

- If responders require clarification about a particular message or visual cue, the controller should provide such data/information as accurately as possible considering simulated time and scenario conditions, then advise the Lead Controller/Evaluator of their inject.

- If controllers need to create additional information (the message was incomplete) or do not know the information required, they should use pre-arranged protocols (obtain area controller or lead controller permission) to formulate a response.

<u>Free Play</u>. Free play allows responders to make decisions and take actions they consider appropriate to the response. Realism is enhanced and responder motivation is improved when responders are provided the latitude to make decisions and take actions that may differ from those anticipated during the scenario development.

- The key management aspect of free play is to allow such actions to occur, but to preclude actions by responders that would do the following:

  – Jeopardize personnel safety

  – Jeopardize SFA safety

- Compromise security
- Interfere with the scenario
- Exceed established exercise scope or limitations
- Preclude exercise objectives from being demonstrated

- During exercises, responders may interject innovative, unexpected response solutions or actions that can be accommodated by the scenario. In such situations, the controllers should allow the responders to proceed with their actions and notify the exercise lead controller that a deviation is occurring. If the responder actions compromise safety or security, or limit demonstration of stated exercise objectives, the controller should note the intended action, but preclude that intended action from occurring. This information should be reported to the evaluator.

- Actual equipment and procedural problems that are identified during the exercise interject a form of free play. Solutions to actual equipment or procedural problems on a real-time basis afford a valuable evaluation of the conduct of operation, training, and safety culture of the responders. Controllers should allow responders to solve such actual problems unless safety, security, or demonstration of exercise objectives may be compromised.

Prompting. Explicit instructions should be given to all participants to avoid prompting during an exercise. Prompting occurs when responders are provided advance scenario related information or guidance regarding appropriate response actions. Prompting may result from either unintentional or intentional action by controllers, evaluators, or observers.

Communications. All written and verbal communications among participants should be clearly identified as exercise information and all message transmissions should begin and end with the statement:

THIS IS AN EXERCISE

Because offsite parties can monitor radio and cellular telephone transmissions, personal information such as the names or phone numbers of individuals should never be transmitted. All communications should be in compliance with security practices.

3.3.16. Exercise Evaluation

Evaluation and critique of the exercise provide feedback to resolve deficiencies and incorporate improvements in the emergency management program. A well-planned, structured evaluation is essential for performing a valid test of the emergency response capabilities of the program. In this section, the planning and organization of an evaluation of an operations-based exercise will be described. This will be followed by a discussion of the evaluation process.

3.3.16.1. Planning and Organization of the Evaluation

The following steps should be implemented to effectively plan for an operations-based exercise evaluation:

- Define evaluation requirements. Determine what will be evaluated and where the observations will occur.
- Prepare the EVALPLAN. Prepare the complete package of information on the evaluation process.
- Develop evaluation tools. Develop the forms evaluators will use to capture information for evaluation during the exercise observation.
- Recruit, assign, and train evaluators. Determine the necessary qualifications of evaluators, identify appropriate individuals, obtain commitments from those individuals, and train them.
- Finalize the evaluation plan. Undertake the activities necessary to organize the evaluation just before the exercise.

Define Evaluation Requirements. While the exercise is being designed, the evaluation planning team will be provided, via the EXPLAN, the MSEL, and other exercise documents, with information on:

- Exercise goals and objectives
- Exercise flow
- Critical actions
- Exercise participants
- Functions and activities to be evaluated

The evaluation planning team will use this information to plan the evaluation, as follows:

Step 1: The evaluation planning team will first use the exercise goals and objectives to determine what performance outcomes should be evaluated.

Step 2: Once the outcomes to be evaluated are determined, the team identifies what activities should be evaluated.

Step 3: Based on these activities, the team identifies which functions (individuals, teams, disciplines, and organizations) should be evaluated.

Step 4: From the functions, the evaluation planning team can identify where the observations should take place (what locations) and which specific tasks should be evaluated.

Step 5: From the tasks to be evaluated, the planning team should develop the guidelines within the objectives and criteria for meeting an objective when criteria are only partially met.

Step 6: Once these steps have been completed, the evaluation planning team can identify or develop the appropriate evaluation tools for the evaluators to use.

Prepare the EVALPLAN. The planning for an evaluation is incorporated in an EVALPLAN, which consists of the following:

- Exercise-specific information: The EVALPLAN should include the scenario, the map of the play site (including evaluation locations), and the exercise schedule (including the evaluation schedule).

- Evaluator team organization, assignments, and location: The EVALPLAN should identify how many evaluators are needed, where they will be located, and how they are organized. Evaluators cannot see everything that occurs at any one location during a response. Yet, during the exercise, evaluators must be able to capture information that provides insight into how effective each group is as well as how well they operate with each other. Thus, location and number of evaluators are crucial to the data collection process.

- Evaluator instructions: Evaluators should be given instructions on what to do before they arrive (review exercise materials, jurisdictional plans and procedures, and the EVALPLAN) as well as how to proceed upon arrival.

- Evaluation tools: The EVALPLAN should include the data collection instruments and guides as discussed below.

Develop Evaluation Tools. Once the evaluation planning team has determined what will be evaluated and where the observations will occur, specific evaluation tools are developed for use in the data collection and analysis. The EEGs are developed to assist in exercise evaluation. The SFA-specific plans and procedures are used to describe the expected response to be evaluated for each exercise objective. The EEG should provide the evaluator with the important parameters and actions to look for in observing the activities. Guidance is provided for determining whether the objective is met. Space in the EEG should be provided to record observations; a checklist format might be useful to link observations with the parameters and actions required in plans/procedures. Questions to address after the exercise can also be recorded in the EEG.

Recruit, Assign, and Train Evaluators. Selection, recruitment, and assignment of evaluators are crucial components of exercise design. The individual responsible for these tasks is the Lead Evaluator. Other members of the evaluation planning team may assist the Lead Evaluator in this task.

The EXPLAN, which is developed by the exercise planning team, serves as the basis for determining the number and expertise of evaluators needed for the exercise. This document defines the scope and concept of play for the exercise. It describes the response tasks that will be demonstrated by exercise players and indicates whether simulations will be used for nonparticipating organizations. It also identifies exercise locations such as EOCs, medical facilities, decontamination sites, and field locations.

The Lead Evaluator plays a critical role in operations-based exercises and should be identified early in the process to fully participate as a member of the exercise planning team. The Lead Evaluator should be a senior-level person who understands command and decision-making processes and interagency coordination, as well as specific response functions. Exercises with play in multiple sites will need an Evaluation Team Leader for each site.

A number of evaluators will also be needed to observe and record player performance during the exercise. Evaluators should be chosen for their knowledge and understanding of the specific functional area they will be assigned to observe. Evaluators should be assigned to monitor all participating organizations and player locations. The following guidelines will help participants determine the number of evaluators that are needed:

- Field response. A minimum of one evaluator for each function evaluated (incident command, decontamination, and emergency medical services); additional evaluators are needed for functions that involve multiple activities that take place simultaneously, or activities that take place in multiple locations.

- Hospitals/Medical Facilities. A minimum of three to five evaluators at each participating medical facility, depending on size and expected patient/victim flow; additional evaluators are needed for functions that involve multiple activities taking place simultaneously or activities taking place in multiple locations.

- EOC. A minimum of three to five evaluators at each participating facility, depending on the size and organizational structure of the EOC.

- JIC. Depending on the expected number of participants at the JIC, one or two evaluators may be sufficient.

Additional evaluators would be needed for a large exercise with many players performing a function in a single location, or for each location when the function is performed at multiple sites.

Generally, exercise evaluators will be peer reviewers identified by reaching out to other facilities on a site, to other DOE/NNSA sites, or to DOE/NNSA HQ offices. Independent evaluators who can assist in monitoring compliance may also supplement this peer review approach. Potential evaluators may be identified from multiple sources, including the following:

- Members of the Exercise Design Team who are fully versed in the scenario, players, and expected actions are a good source for evaluators (if they are not already committed to other duties during the exercises).

- Experienced members of participating organizations and the ERO who are not involved in the play are a good choice for evaluators because they are familiar with the organizations, plans, and procedures.

- Professionals in similar agencies in adjacent or nearby jurisdictions can be a source for evaluators, especially when all of the participating jurisdiction's members of a specialized function, such as a HAZMAT team, are involved in the exercise.

- DOE/NNSA and contractor employees from other DOE/NNSA facilities or sites might be available with sufficient notice.

Although service as an evaluator requires a considerable commitment of time, evaluators and their agencies can expect to gain significant benefit from the peer evaluation process. For example, observing other locations exercising their emergency response plans may help evaluators gain insight into best practices or other ways to provide emergency response, which could benefit their own communities.

Evaluators are expected to be available for the pre-exercise training and briefing/site visit, the exercise itself, the post-exercise hot wash, and the data analysis and contribution to the AAR. This time commitment is usually equivalent to one day before the exercise, the exercise day(s), and one day after the exercise. One or more of the evaluators may devote additional time to drafting the AAR and briefing participant organizations and their management on findings and recommendations.

3.3.16.2. Evaluation Process

Information is gathered and documented by the evaluators. Evaluators assess the performance of the ERO and adequacy of equipment, facilities, and resource documents used by the responders. The assessment consists of a comparison of performance against predetermined and documented SFA-specific evaluation criteria based on program-specific plans/procedures. Information from the evaluation and critique processes provides feedback for use in identifying corrective actions and improvements to the emergency management program.

The evaluator organization must be sufficiently staffed to evaluate the performance and key decision-making of the responders in satisfying the exercise objectives. Evaluators should be familiar with responder organizations, functions, procedures, and anticipated responder decisions and response activities in order to accurately monitor activities and functions performed by the players.

Responders/players are evaluated with respect to their demonstrated proficiency in their respective responsibilities and functions, communication and coordination with other responders, familiarity and use of applicable procedures and equipment, and overall professional response. Facilities and equipment are evaluated with respect to adequacy of functions/operability. Procedures are evaluated with respect to their use by responders, specifically, their adequacy of content for the tasks performed. Notifications and communications are evaluated during every exercise. When offsite agencies participate, interfaces with offsite agencies are evaluated.

The following overview describes the steps in the exercise evaluation process for operations-based exercises, not including auxiliary activities such as development of the evaluation tools or training for evaluators.

Step 1: Plan and organize the evaluation. As part of the exercise planning and development process, the exercise planning team will determine what information should be collected, who will collect it, and how it will be collected.

Step 2: Observe the exercise and collect data. Expert (peer) evaluators collect data by recording their observations during exercise play and collecting additional data from records and logs. Evaluators of tabletop exercises record discussions and review documents such as plans, procedures, and interagency agreements.

Step 3: Analyze data. The analysis phase should answer the following questions about the exercise play:

- What happened?
- What was supposed to happen?
- If there is a difference, why is there a difference?
- What is the effect of that difference?
- What should be learned from this?
- What improvement should be made, or exemplary practices adopted?

The first step in the analysis process is a player hotwash immediately following the exercise to get player feedback.

Analysis of exercises is conducted using data collected to reconstruct the timeline of events as they occurred, an approach like reconstruction of events that most agencies do following an accident or other type of incident. This information is then used to identify and explore the differences between what happened and what was supposed to happen to ascertain the root causes for the differences.

Step 4: Develop the draft AAR. As part of the analysis phase, the evaluation team drafts the AAR, which provides a description of what happened, exemplary practices, issues that need to be addressed, and recommendations for improvements.

The evaluators share the assessment information with management and, if appropriate, facilitate identification of improvements that can be made. This phase of the Exercise Evaluation and Improvement Process generally consists of the following steps.

Step 5: Conduct Exercise Debrief meeting. The exercise planners or evaluation team will present their analysis findings and recommendations in an Exercise Debrief meeting with management from the sites, facilities, departments, agencies, and jurisdictions that participated in the exercise. They will also solicit feedback and validation from the attendees on their observations and recommendations.

Step 6: Identify improvements to be implemented. Much of the Exercise Debrief meeting will be devoted to discussing specific actions that the exercise participants will take to address the opportunities for improvement contained in the recommendations in the draft AAR. This list of actions, referred to as the Improvement Plan (IP), identifies what will be done, who (person, department, or agency) is responsible, and the timeframe for implementation. Although the IP is a written document, it should be viewed not as a static document, but as a dynamic program that is updated and modified regularly in a constant cycle of improvement.

Step 7: Finalize the AAR. Following the Exercise Debrief meeting, the evaluation team should finalize the AAR by incorporating any corrections or clarifications related to the observations or recommendations as well as the improvement steps that will be taken. Some of the actions may include only the preliminary step of a multi-step activity.

3.3.16.3. Critiques

Formal critiques are conducted after the exercise to provide a forum in which the exercise results can be addressed and discussed among the participants. This can result in the identification of lessons learned for improving the response to an emergency. For large-scope exercises, it may be necessary to conduct several critiques to ensure that all participants are given the opportunity to take part.

Responder hotwash critiques are conducted immediately following the exercise to provide an opportunity for players/responders to discuss their own perspectives on the activities and events. These critiques are typically conducted in place by the area lead responder or controller.

A formal comment and feedback period is conducted following each exercise and should include participation by all controllers and evaluators. This critique should provide the forum for discussion and correlation of individual observations, formulation of exercise findings, determination of objectives demonstrated, and determination of overall exercise performance. Recommendations for corrective and improvement actions should be addressed.

Critiques should accomplish the following:

- Be conducted in a questioning, objective manner to maximize the benefit and learning experience from each exercise.
- Include a review of scenario events, identification of shortcomings in the scenario or exercise conduct, and analysis of expected and actual responder actions.
- Discuss responder performance, the adequacy of procedures and other documentation, and the adequacy of facilities and equipment.
- Provide the basis for documentation of findings to facilitate identification of corrective actions and improvement items for upgrading the emergency management program.

3.3.17. Follow-up Activities

3.3.17.1. Corrective Actions and Improvement Items

Findings resulting from the exercise should be subject to an in-depth review. For recurring problems, a root cause analysis should be performed. A plan should be developed to implement corrective actions and improvement items. Management should budget, schedule, and implement the actions to upgrade the emergency management program. Activities should be coordinated with affected organizations. Corrective actions such as procedural modifications necessitate timely feedback to the participants. Such timely feedback demonstrates management attention and concern for upgrading the emergency response capability and demonstrates management support for involvement of participants in exercises.

3.3.17.2. Maintaining Records

Auditable records should be prepared and maintained for each exercise. Long-range planning information such as exercise objectives, schedules, and the exercise AAR are considered auditable records. Records that may be maintained include the following:

- Training records
- Participant rosters
- Exercise participant packages
- Critique minutes or summaries
- Completed evaluator modules or checklists
- Final report
- Accounting summary

Chapter 4. Response Elements

4.1. Emergency Operations Systems

4.1.1. Introduction

The purpose of this chapter is to assist Department of Energy (DOE) and National Nuclear Security Administration (NNSA) field elements in complying with the DOE O 151.1D requirement to establish and maintain an Emergency Operation System (EOS) within DOE sites. The EOS includes the sites, facilities, agencies (SFAs) organizations collaborating to respond to all types of emergencies to save lives, stabilize the incident, and protect the environment and property. This should include documenting how each organization is integrated to meet their requirements, e.g.,. 10 CFR Parts 835 and 851, DOE O 420.1C (flows down OSHA 1910.120, NFPA 1710, NFPA 472, 473 Baseline Needs Assessment (BNA)). To implement an Emergency Operation System each SFA should follow National Incident Management System (NIMS).

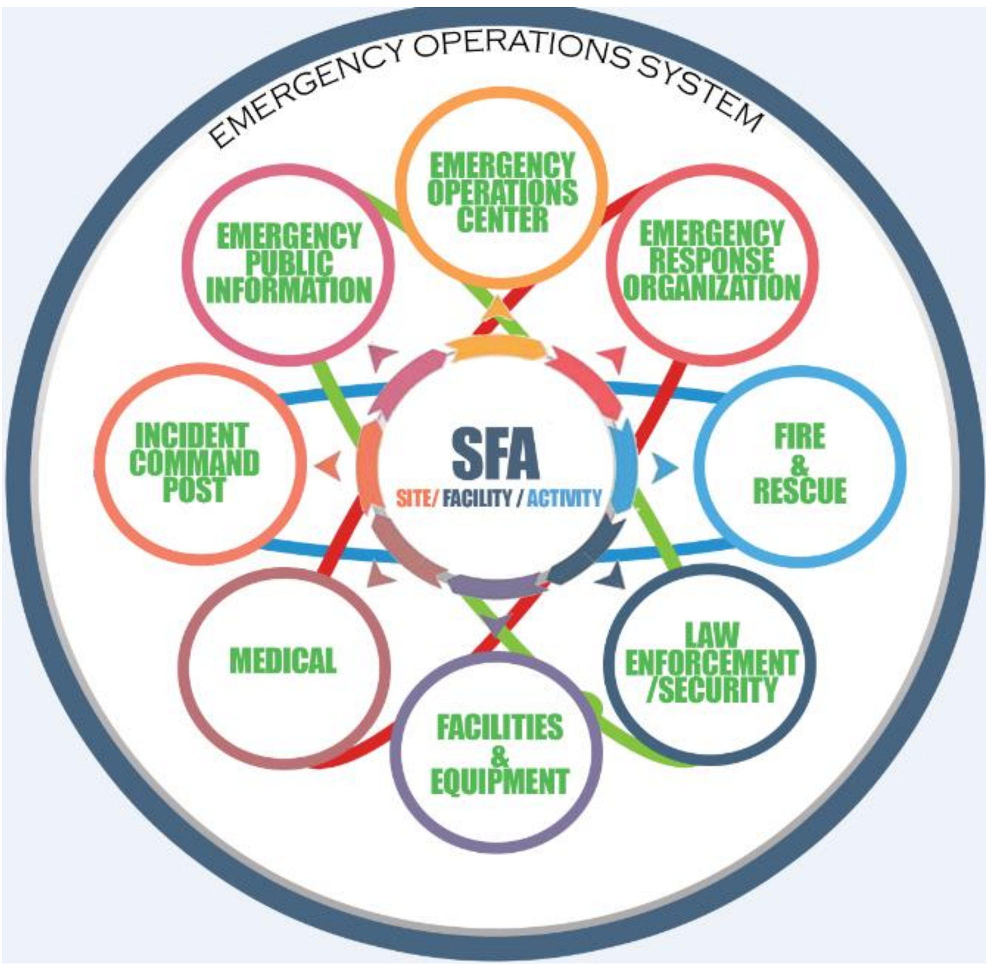

Figure 4-1 Emergency Operations System Structure

4.1.2. General Approach – Emergency Operations System

The Emergency Operations System (EOS) has all of the systems and logistical support needed to support an effective emergency response such as the Emergency Operations Center (EOC) staff, Incident Command, first responders, site managers, building emergency organizations to include all the necessary facilities, systems, and equipment. The EOS:

- Establishes and operates within the lines of authority, responsibilities, and organizational relationships needed for effective emergency response.
- Provides coordination among the responsible SFA contractors, local and Federal governments, nongovernmental organizations, the private sector, and other applicable stakeholders.
- From a personnel standpoint, the EOS includes the emergency response organization (ERO) staff, first responders at the incident scene and across the site, the IC and others supporting incident command post activities, and personnel responding to the EOC and their backups.
- Subject matter experts (SMEs) called in to provide technical support during an emergency include personnel supporting the JIC, building safety personnel who provide emergency direction and guidance to staff members, field monitoring personnel, onsite medical personnel, people who provide infrastructure support for emergency response facilities and systems, emergency response trainers, and others.

4.2. Emergency Response Organization

4.2.1. Introduction

The purpose of this chapter is to assist DOE and NNSA field elements in complying with the DOE O 151.1D requirement to establish and maintain an ERO for each SFA and to ensure that DOE/NNSA EROs are compliant with the NIMS. Within each facility, the ERO is a structured organization with overall responsibility for initial and ongoing emergency response to an Operational Emergency (OE) and for mitigation of the consequences. The ERO establishes effective control of response capabilities at the scene of an event/incident and integrates ERO activities with those of local agencies and organizations that support onsite and provide response services. An adequate number of experienced and trained personnel, including designated alternates, should be available on demand for timely and effective performance of ERO functions.

4.2.2. General Approach – Emergency Response Organization

Emergency response in the DOE/NNSA Comprehensive Emergency Management System consists of a three-tiered, bottom-up organizational structure. While not the case at all DOE/NNSA SFAs the primary capability for responding to an OE typically resides with site prime Management and Operating (M&O) contractors because of their responsibility for directing appropriate emergency response actions within the area under their control and at the scene of the emergency. The SFA emergency response capability is based on comprehensive and integrated plans and procedures. Field elements, the second tier, oversee and support emergency management activities for responding to an OE at SFAs under their cognizance. The third tier, DOE/NNSA Headquarters (HQs) organizations, oversee and support the emergency management activities of the field element by monitoring the field and contractor response; providing support as needed; assisting with issue resolution; and coordinating interagency, congressional, and public information activities at the national level. Headquarters provides strategic direction to the DOE/NNSA field response and evaluates the impact of the emergency on DOE/NNSA operations, missions, and functions. At each tier the DOE/NNSA Comprehensive Emergency Management System requires a structured organization, an ERO, to ensure a prompt, effective, and efficient response to a wide variety of emergency incidents and conditions so that appropriate response measures are taken to protect workers, the public, the environment, and national security. The guidance in this chapter addresses the establishment and maintenance of an ERO at the site level, facility level, or activity level on an ongoing basis during normal operations and the on-demand staffing of the ERO in response to an OE. Each facility on a multi-facility site should have a facility-level ERO that may interface with and join the site-level ERO during emergency incidents. The functional response needs to be consistent with the results of the All-Hazards Survey and Emergency Planning Hazards Assessment (EPHA); the availability and location of individual emergency response facilities may also affect the configuration and allocation of ERO personnel and response capabilities.

This guidance focuses on the structure and functions to be implemented by SFAs and will assist in defining an ERO that is capable of responding to the spectrum of potential emergencies affecting a site, including definition of authorities, responsibilities, and duties of individuals assigned to the organization. A description of a typical onsite emergency organization, including a method for determining functions to be performed and its interfaces with offsite services and agencies, is provided. The ongoing activities that are required to maintain the readiness of the ERO during normal operations are addressed. Finally, the activation of the ERO organization and subsequent operational aspects during a response are discussed.

The remainder of this section closely reflects the Incident Command System (ICS), which manages response operations at the incident scene, and is developed and implemented to conform with the ICS developed by the Federal Emergency Management Agency (FEMA) as detailed in the National Response Framework (NRF) and required by the NIMS.

4.2.3. ERO Structure

The organizational structure of the ERO should be based on the results of the SFA All-Hazards Surveys and EPHA, the relationships between the site and facility response capabilities, and the relationships between the onsite and offsite EROs. Characteristics of the spectrum of scenarios that constitute the all-hazards planning/technical planning basis for a facility determine the functions that will be required to respond to emergency incidents. Specific functions, personnel, and resources activated in a response will depend on the requirements of the emergency. The distribution of the emergency functions among facility and site levels will be determined primarily by the locations of response facilities and organizations that provide response assets. For a specific site or facility, some emergency response functions can best be organized and performed at the facility level, while others may be better served by a site-wide organization. Facility level functions may include control of process operations and implementation of local protective actions. Functions that are more likely to be common for a site include firefighting, medical response, security, and environmental monitoring. In contrast, some response functions, such as firefighting or hazardous material (HAZMAT) response, may be performed using offsite support services.

The terms *ERO* and *UCS* (Unified Coordination System) are not synonymous. All personnel who may be needed to perform duties, beyond those specified by 29 CFR Part 1910.120 for the first responder awareness level, during a response to any of a broad range of emergencies defined in the All-Hazards Survey or EPHA, are members of the ERO. In general, the ERO component formed to manage the response actions during emergencies is the UCS. At each response tier (facility, Field element, Headquarters), the UCS provides for overall management, direction, and control of the emergency response and normally operates from a command center or EOC. For more information on the UCS see the NRF.

4.2.3.1. Emergency Director (ED)

The SFA M&O contractor Emergency Director (ED), or similar title, should have unilateral authority and responsibility to implement the SFA emergency management plan and employ overall emergency management responsibility during response to an OE. Full authority and responsibility implies that this individual should either initially perform, or oversee, the following minimum functions: detect or assess, categorize and classify (as necessary) the emergency incident or conditions; carry out initial notifications; implement initial protective actions onsite; issue offsite protective action recommendations; and initiate response by appropriate emergency resources.

4.2.3.2. ERO Functions

The ERO should provide emergency response capabilities, as necessary, to meet site needs as established by the BNA, safety basis requirements, and applicable regulations, codes, and standards. The ERO configuration should be contingent on the severity of the emergency and the required functions determined by analysis. The All-Hazards Survey and EPHA should be used as the basis document for determining required functions. Identified emergency conditions from the All-Hazards Survey and analyzed scenarios of the EPHA are particularly useful in determining what response resources are needed and, ultimately, what response tasks need to be performed. The ERO staffing should be documented based upon an analysis performed of potential emergency conditions.

Although the functional response needs and results of the All-Hazards Survey and EPHA should be the predominant factors affecting the ERO structure, the availability and location of existing emergency response facilities may affect the allocation of ERO personnel. The structure of the site ERO should take into account locations of emergency facilities and how these locations may influence the effectiveness of emergency response functions. For example, damage control and repair teams are best dispatched from an area close to maintenance shops, tool cribs, and storage areas for personnel protection equipment. Additional information is presented in Chapter 4, Section 4.

The emergency management plan should address the scope and responsibility of the support functions and the equipment and facilities required for performance of the function. Implementing procedures should assign personnel to the various functions required and provide directives and checklists for the performance of those duties. The extent to which support functions are implemented is dependent upon the nature and severity of potential emergencies at an SFA. A scaled approach should be considered; some support functions may not be required at all, while some may be required dependent on the type or classification of emergency. While most generally conform to the NIMS management structure, several functions are unique to DOE/NNSA emergency management programs and are not explicitly encompassed within the NIMS functions.

The following representative support functions should be considered during analysis to ensure the ERO is capable of successfully responding to any potential emergency:

- Operations Support. Operational support in the form of a coordinated workforce and equipment for performance of assessment or damage control, maintenance/repair, or implementation of mitigative actions should be considered for most operational events.

- Technical Support. Technical personnel are available to advise emergency and operations management on the present status of the SFA and to forecast future operational impacts. Technical personnel should advise management on actions to bring the facility to a stable condition or safe shutdown.

- Notifications. Notification methods should be established to support emergency management. Equipment, personnel, and procedures should be made available to ensure the SFA fulfills all responsibilities of notifying workers, response organizations, and other agencies. The SFA personnel and organizations and offsite authorities and response organizations should be notified in a timely manner of initial or emergency condition and changes in incident status.

- Consequence Assessment. This support function should assist emergency assessment teams and protective actions personnel in estimating and measuring onsite and offsite consequences. This function may include directing environmental sampling and analysis teams, and meteorological data monitors.

- Communications. Communications support should be provided to all ERO functions to maintain control of the emergency organization and provide effective communications, both among key ERO members and with offsite agencies. This support includes assurance of compatible communications equipment. Support may be required to maintain continuous communications within elements of the ERO (technical support for communication equipment/systems, and maintenance of status boards and logs).

- Health and Safety Support. Radiological, chemical, biological, and occupational safety support may be required for exposure and dose control, or environmental contamination assessments. Health and safety support (health physics, industrial hygiene, microbiology) may be required to understand specifics about the hazards resulting from emergency incidents, such as exposure implications, contamination levels, and appropriate mitigative controls. These SMEs are also important for supporting briefings and other communications (including those to responders, personnel impacted by the emergency incidents, and those providing public information).

- Logistics. Logistics personnel conduct logistical planning to ensure there are sufficient resources available or acquired during an emergency incident for mitigation and support (food for the ERO, Personal Protective Equipment (PPE), heavy equipment).

- Administration, Data Distribution, Documentation. The SFA data and status should be promptly distributed to all functional groups to permit overall management of the response effort. Documentation of key events, including actions taken, decisions made, etc., necessary to reconstruct the incident should be maintained.

- Public and Media Information. Public and media information support should be available to perform such tasks as interfacing with the media, including social media; updating the public, including SFA personnel not directly involved with the response; providing rumor control, etc., in partnership with offsite public information personnel as appropriate to the emergency.

- Medical. Medical support should be provided for all injured or potentially contaminated or infected personnel, including emergency responders. Medical advice should also be provided to emergency management when there is a potential for significant injuries or casualties from an incident. Interfaces with offsite medical support organizations are within the responsibilities of the site medical staff.

- Field Teams. The HAZMAT Survey, Sampling, and Sample Analysis Teams should be designated to evaluate the occupational, radiological, and environmental health hazard at or near an accident scene. These teams should be equipped with adequate monitoring equipment and personnel. Teams should possess knowledge on the use of protective gear, monitoring equipment, and communication equipment and should be equipped and trained to accomplish field monitoring and plume tracking, when appropriate, within and beyond the EPZ.

- Security. Security support will be required to interface with emergency management personnel in several different response activities (control of an incident scene; direction of evacuation efforts; control of classified matter; protection of nuclear, hazardous, or sensitive materials; and preservation of the accident/incident scene) and, in the event of a potential security or criminal incident, provide response assets. Organizational and operational interfaces between these traditional emergency response functions and security organizations should be clearly defined in emergency management plans and procedures to ensure timely decision making, coordination of actions, field communications, HQ communications, and recovery. Expected interfaces with offsite security and law enforcement organizations should be defined and covered in emergency plans.

- Fire and Rescue. Fire and rescue support should be capable of responding to the scene of the emergency safely. Response units should possess the proper amount and type of specialized equipment. Search and rescue operations should be capable of being conducted in an efficient and effective manner. Depending on the situation, Fire and Rescue operations should include monitoring for PPE acceptability by industrial hygiene and Health Physics personnel. Fire and Rescue support is determined by the baseline needs assessment performed in accordance with DOE O 420.1C Chg 1, using the All-Hazards Survey and EPHA. The facility/site ERO shall provide onsite fire and rescue personnel and equipment based on potential emergency conditions 24 hours a day/7 days a week. The onsite ERO shall use site-specific trained personnel to assess, manage, and mitigate emergency incidents based on site familiarity and knowledge of area-specific hazards. The rapid response onsite personnel will provide for greater outcomes in saving lives, protecting property and the environment, as well as our National interests.

- Repair and Maintenance. Repair and maintenance support should be available for carrying out repair and maintenance activities during an emergency in a timely and efficient manner. Repair and maintenance teams should possess the proper resources and capabilities to promptly procure replacement parts if needed during an emergency. Repair and maintenance activities should extend to equipment needed for personnel protection and monitoring as well as coordination with other support groups, such as health physics and industrial hygiene SMEs.

The above functions are not intended to represent an all-inclusive list. A needs analysis can be used to identify ERO functions to be performed in implementing an effective emergency response based on the results of the All-Hazards Survey and EPHA, ultimately developing a list of functions similar to those indicated above. Organizations and personnel who are not part of the normal site operations, but are a part of the ERO, may perform some facility/site ERO functions. It may be more cost effective to rely on offsite providers of specialized services, such as medical support or explosive disposal, than to develop those capabilities onsite. These offsite capabilities should be clearly defined in a current Memoranda of Agreement (MOA), Memoranda of Understanding (MOU), or Mutual Aid Agreements (MAAs), and the emergency management plan.

Several of the functional areas mentioned above may include various tasks. For example, in the case of a high hazard facility, a review or analysis of the EPHA and applicable guidance documents will be required to identify all tasks that could be necessary in response to the spectrum of emergencies analyzed. When tasks have been identified, the staffing of the ERO can be determined, and assignment of specific staff members to given positions may be accomplished by aligning normal operating organization to the ERO. Personnel whose day-to-day duties most closely align with required emergency functions and tasks should be assigned to the equivalent ERO position in order to maximize organizational effectiveness and minimize training and additional qualification requirements.

Once functional areas have been determined and individual tasks within each area are identified, it will be apparent that many functions have direct counterparts in offsite organizations. One task not uniformly described in each of the above functions involves working level interfaces with offsite organizations. An example is the liaison function necessary between the consequence assessment team (CAT) and the applicable state agency for incidents with offsite consequences.

The needs analysis concept described above is also applicable to determining where elements of the ERO are located and what equipment is required to support staff efforts. Utilization of the All-Hazards Survey and EPHA for deriving required facilities and equipment is presented in Chapter 4, Section 4, as well as chapters devoted to specific response functions, such as consequence assessment.

4.2.3.3. ERO Positions

A one-for-one correspondence between ERO positions and emergency response functions is not always necessary. For example, small, low-hazard facilities might have one position serve several functions, whereas other facilities might need several persons to carry out a single function (such as a high hazard facility consequence assessment function for several different potential emergency scenarios).

The following is a list of positions of specific responsibilities or authorities for a generic ERO structure:

- Duty officer is the individual assigned initial decision-making responsibility with the requisite authority to categorize the OE, make initial classification and protective action determination, and activate the ERO. A separate Duty Officer position is not necessary; for example, the Duty Officer may be the Fire or Security Officer who becomes the Incident Commander (IC) in the event of an emergency.

- The IC maintains operational control of the response at the incident scene, transmits information to the command center or EOC, and may request additional resources.

- The ED maintains overall command and control of the emergency response and performs functions as listed above in Section 1.3.1.

- Environmental, Safety, and Health manager oversees and monitors the operations of the occupational safety organization, CAT, and the activities of health physicists and industrials hygienists. This manager supports incident scene response, EOC staff, and field team activities.

- The EOC manager oversees, monitors, and directs the EOC response operations, offsite communications, notification process, and administrative operations of the EOC.

- Operations manager ensures communications with incident command; manages overall impact of the incident on operations; provides needed information about facilities, systems, processes; and monitors personnel status and accountability.

- Logistics manager ensures logistical requests are met for response support equipment, supplies, and communications.

- Public affairs manager ensures emergency public information is communicated effectively and accurately.

- Security manager ensures safeguards and security response efforts and needed liaison. The security manager coordinates security operations with offsite security liaisons such as the Federal Bureau of Investigation (FBI), local law enforcement agencies, DOE Office of Inspector General.

Provisions should exist for interface between other agency response personnel and the facility/site and Field Element EROs, with clearly defined positions or points-of-contact. Interfaces that require coordination, liaison exchange, or integration, that will also influence the structure of the ERO during an emergency, may include:

- Tenant and visiting national laboratories (for special projects)

- Potential Department of Defense (DOD), Defense Threat Reduction Agency Department of State, Environmental Protection Agency (EPA)

- Department of Homeland Security, and Department of Justice (DOJ)/FBI presence

- Offsite organizations include local law enforcement; fire, medical, American Red Cross, local, State, Tribal, and regional federal agencies; and joint public information groups

- Nuclear Emergency Support Team (NEST)

- Radiation Emergency Assistance Center/Training Site (REAC/TS), and Radiological Assistance Program (RAP)

- Organizations under the NRF, such as the Joint Field Office or the NCP organizations

- Organizations under National Interagency Fire Center for wildland fires

These interfaces should be preplanned and described in the emergency management plan where applicable. Additional information concerning the interface with offsite EROs is provided in Chapter 4, Section 3.

4.2.4. Staffing the ERO

4.2.4.1. Initial Staffing

Upon declaration of an OE, on-shift personnel should initially fill key ERO positions and perform time-urgent emergency functions until designated ERO personnel arrive and assume their assigned positions. Wherever possible, functions of the ERO should be performed by shift personnel until full staffing has been achieved.

Assigned ERO personnel will eventually staff the ERO positions associated with the specific OE conditions. If normal site operations are managed by a site prime M&O contractor, then that contractor should staff the primary positions in the ERO. The ERO may consist of personnel from several different contractors or subcontractors that provide specific services or expertise to the site (such as fire protection or security). Personnel needed to perform emergency-related duties and activities during a response to any of a broad range of OEs are considered members of the ERO. Authorities, responsibilities, and duties should be developed for each position in the ERO, documented in the emergency plan, and implemented by Emergency Plan Implementing Procedures (EPIPs). Minimum qualifications and training requirements for each position should be well defined and implemented. Control of operations, monitoring, and repair teams should be clearly defined and associated with a single ERO position, or the teams should each be associated with a separate position.

The system used for performing the initial activation of the ERO should ensure that the ERO positions are functionally staffed and activated in a timely manner. The following aspects of an initial activation should be considered in developing the call-out system:

- Response time objectives for primary and alternate responders and the minimum staffing levels necessary to achieve different levels of emergency response capability

- Provision of appropriate communications devices such as tested, maintained, and controlled pagers or cell phones

- Provisions of multiple communication means (phone calls, texts, emails)

- Authentication of responder notification, such as use of code words, call-backs, or restricted access communication networks

- Effects of seasonal weather, concurrent emergencies at more than one facility on a site, and local equipment/phone exchange limitations

- Security clearances and credentials that may be needed for onsite and offsite responders to gain entry to facilities and participate in response, especially in response to security driven incidents.

A person trained and qualified to fill the Emergency Director (ED) position should always be onsite. For facilities where there is no operating shift outside of the normal work day, there should be either an individual qualified to fill the ED position on the back-shift, or arrangements made to fill the position with a qualified person from an adjacent facility, the site organization, or with an IC from an organization such as the fire department. When an individual from outside the specific facility fills the position of ED, a qualified person from the facility staff should be on-call to assume the ED position as soon as possible.

Fully trained and qualified personnel should be available at all times to perform each of the emergency response functions. Primary and backup personnel may be assigned to each position in the ERO (both facility and site level) to enhance planning and response. Availability of staff to perform these ERO functions may be achieved by having three or more persons qualified to fill each position, with at least three of them being on call at all times. An adequate number of experienced and trained personnel should be assigned to each functional area for initial and ongoing response. For some operations or processes and locations, offsite personnel may also staff ERO positions. All persons assigned to ERO positions should demonstrate their proficiency in their assigned position through periodic participation in an exercise, a drill, or an actual response; all primary and alternate personnel can accomplish this participation on a rotating basis.

4.2.4.2. Staff Augmentation

The emergency management plan should provide for a modular organization, which enables the ERO to expand or contract to meet the needs of the incident. The ERO evolves as a top-down organizational structure for any incident. As the incident warrants, the ED activates other functional areas, as needed. Thus, the ERO can consist of several layers with additional resources (personnel and equipment) to ensure performance of required basic and support functions. Procedures should include specific methods and information (rosters of qualified ERO personnel, telephone numbers, email, and paging procedures) necessary for timely activation of response personnel. The following additional items should be considered during development and review of the ERO activation procedures to facilitate staff augmentation:

- Rapid contacting of alternates to replace or augment ERO positions that have been filled

- Activation procedures should be easily implemented by on-shift personnel and not adversely affected by an incident occurring during normal working hours, off-hours, or holidays

- Round-the-clock staffing of the ERO for long-duration emergencies

- Site and facility access by ERO staff responders during an OE
- Potential interference by non-essential personnel being evacuated while ERO staff are being activated

The lines of succession for key emergency response positions should be established and documented. For example, positions authorized to assume ED duties should be specified, including positions in the normal operating organization (normally the senior on-shift position at a facility) and the non-shift management positions in the corporate structure. While certain positions automatically qualify for the ERO ED position by virtue of their function (Emergency Management Manager), other positions require a specific qualification process.

Procedures and checklists should be available to provide for orderly assumption and transfer of emergency management and coordination functions during shift roll-overs.

4.2.5. Operational Aspects of the ERO

All ERO operations, both activation and ongoing response activities, will depend on the actual or potential emergency conditions. Procedures and the management structure of the ERO should provide for the efficient collection and dissemination of accurate data, setting priorities, assigning work to functional groups, and keeping key emergency response staff abreast of emergency conditions and response status. In this section, the activation of the ERO is discussed and features of the operation of an ERO during a response are presented.

4.2.5.1. Activation

ERO operations should take priority over normal job functions immediately after an OE is declared. The defined authorities, responsibilities, tasks, and lines of communication of the ERO should supersede those of the normal operating organization for the duration of the emergency. On-shift operations staff should perform initial response functions (categorization/classification of the incident or condition, notifications and activation of the ERO, Timely Initial Assessment (TIA)) including notification of appropriate initial protective actions. The ERO should incorporate the capabilities of the normal operating organization, augmenting them as needed to meet the functional and operational requirements of the emergency response facilities, defined for the specific OE, *normally within an hour* after the declaration of the emergency. Once activated, the SFA ERO should remain operational until a formal decision is made to terminate the emergency and enter recovery.

The staffing of ERO positions in emergency response facilities should be orderly, controlled, and verifiable. Personnel who are assigned to ERO positions should gain access to the facility and their respective stations without impediment. In contrast, non-ERO personnel should be deliberately excluded from emergency response work areas. Sign-in procedures at access points will accomplish both. In addition, ERO staff should readily identify personnel who assume key response positions/functions (using status boards or badges).

4.2.5.2. Operations

In general, all members of the ERO should perform in their roles, functions, and interfaces and in their use of emergency equipment, facilities, and resources in a timely, effective, and efficient manner; clearly acknowledge and understand authorities and responsibilities in functional areas; and identify and access available response resources (personnel, equipment, consumables, and replacement parts). The following represent specific activities that should characterize the efficient and effective operation of the ERO staff within an emergency facility:

- Transfer of a command and control function to another emergency facility, within an emergency facility, or to a command external to the ERO or ICS (another Federal agency, such as DOJ/FBI) in an orderly and formal manner and ERO personnel are informed of the transfer.
- A fully staffed ERO establishes effective internal and external interfaces with other agencies and organizations such as Federal, Tribal, State, and local agencies, and non-governmental groups such as concerned citizens and the media.
- Responsible ERO operations and technical support staff are clearly identifiable and will determine and implement a reasonable, well-planned course of action based on their current knowledge of the situation.
- Specialty groups (consequence assessment, maintenance, operations, technical staff) provide timely information to the decision-making process.
- When priority actions are identified, tasking is clearly made to emergency response staff, and the actions are followed through to completion.
- Adequate data on the emergency situation are obtained and analyzed by the ERO to support the operations staff in assessing and mitigating the emergency incidents.
- Information is documented and transmitted accurately and efficiently in an orderly manner throughout the chain of command and between/within emergency facilities.
- To ensure that the ERO staff is kept up to date on the emergency situation, periodic briefings are provided on the status of the emergency and significant current response priorities and activities.
- Communications between the site ERO and the DOE HQ UCS are maintained, and information about the emergency situation is provided to the UCS on a regular basis.
- ERO management effectively coordinates State and DOE site requests for use of assets, such as the RAP.

An essential aspect of effective communication is the requirement that the use of acronyms, code words, jargon, convention or technical terminology causes no misunderstandings related to the response and associated data. In routine performance of their duties, security and ERO teams/groups may use differing terminology. This could affect the effectiveness of communications and decision making in an emergency. It is important that these response groups have an advanced understanding of terminology differences and, to the degree possible, resolve these differences in advance. This requirement provides just one example for the need of integrated emergency response exercises involving these varied organizations.

Several ERO activities require specific attention and assigned responsibilities:

- Liaison responsibilities for coordinating with offsite agencies to ensure that effective communications are initiated and maintained during an emergency.
- Liaison responsibilities with personnel representing DOE or NNSA assets involved in the response, to coordinate logistics, ensure that effective communications are initiated and maintained, and ensure that data is effectively exchanged using consistent units of measure.
- Individual(s) trained to recognize, categorize, and classify incidents and to conduct appropriate notifications is available 24 hours a day, 7 days a week. This individual's authority is unambiguous and clearly communicated throughout the ERO.

The activities of reentry and rescue teams should follow specific protocols:

- ERO teams should be provided with adequate briefings concerning safety, operations, communications, and hazards before being deployed.
- ERO teams should be debriefed upon return from their assigned missions.
- The accomplishments, failures, exposures, and status information of ERO teams should be recorded and made available to the other ERO teams.
- If necessary, the responsible ERO individual authorizes ERO personnel to receive exposures in excess of site administrative limits (or other federal criteria) for carrying out lifesaving or other emergency activities.

4.2.6. Maintenance of the ERO

To ensure that ERO personnel are available on demand for timely and effective performance of ERO functions, the ongoing, maintenance, or standby staffing of ERO emergency facility positions and response teams is effectively accomplished by:

- Using a technique, such as duty-cycle or static roster, to ensure that qualified personnel are accessible and available on demand and properly assigned;

- Ensuring that sufficient trained personnel for initial and ongoing response, including designated alternates, are candidates for call-up in each functional area;

- Periodically reviewing ERO rosters to verify individual qualifications for specified positions, current qualification dates, required numbers of primary and alternate personnel for all positions, correct work and home phone numbers, pager numbers, addresses, commute time from home to assigned response facility, and other contact information;

- Periodically reviewing and updating ERO personnel qualifications.

In addition to maintaining ERO staffing, the communication systems used to activate both on shift and off shift emergency response personnel should be periodically tested to ensure their adequacy and reliability.

4.2.7. Special Response Function/Positions

Several special response functions or positions are addressed in this section in the context of both their interactions within the ERO structure and the specific accommodations that are required of each function because of the potential hazardous environment within which they need to perform.

4.2.7.1. Incident Commander

An IC should be designated to manage and control all response activity at the incident scene. The IC typically coordinates the activities of multiple response elements at the scene (fire, rescue, medical, spill containment, mutual aid) and makes on-the-spot decisions. The IC will use the ICS to manage response operations at the incident scene, in accordance with the NRF and the NIMS/ICS. The NIMS/ICS is ideally tailored to deal with command, control, and coordination issues in advance. Some of these issues are command on-scene, transfer of command, authority to request offsite mutual aid, authority to declare the situation under control, integration of field response functions, and assignment of response activities. The facility/site ICS should be compatible and integrated with offsite agency ICS systems. This is important to the inter-relationship of the site ERO and offsite agencies when using the NIMS/ICS structure.

The basic attributes of a NIMS/ICS are:

- Common terminology

- Modular organization

- Management by objectives

- Reliance on Incident Action Plan (IAP)

- Manageable span-of-control

- Pre-designated incident locations and facilities
- Comprehensive resource management
- Integrated communications
- Establishment and transfer of command
- Chain of command and unity of command
- Single command IC or Unified Command (UC)
- Accountability
- Deployment
- Information and intelligence management

When both the UCS and ICS are used, close cooperation and coordination between the facility/site UCS and the ICS are required, along with pre-arranged division of responsibility and authority. This division should be specified in the emergency management plan and associated implementing procedures. The emergency management plan and implementing procedures should clearly state whether the ICS or UCS is able to invoke any or all-mutual aid agreements with State, Tribal, and local emergency response agencies or the conditions for shifting such responsibilities. An IC may lead the UCS until an on-call senior manager is available to assume that role. When an IC is used in the site ERO, the UCS in the EOC should focus on broader issues such as offsite notifications, communications with offsite entities, protective action issues, and marshaling additional resources (personnel and equipment).

When an incident involves more than one agency with incident jurisdiction, or when incidents crossover political jurisdictions, an application of the ICS, known as UC, should be used. The UC provides guidelines to enable agencies with different legal, geographic, and functional responsibilities to coordinate, plan, and interact effectively. Agencies work as a team to establish a common set of objectives and strategies, as well as a single IAP.

An Area Command (AC) is established to oversee management of multiple incidents that are each being handled by a separate ICS organization, or to oversee the management of a very large or complex incident that engages multiple incident management teams. An AC is generally used when there are a number of incidents in the same area and of the same type, which tend to compete for the same resources, such as public health emergencies. If the incidents under the authority of the AC span multiple jurisdictions, a Unified AC should be established.

For DOE/NNSA SFAs, there should be a predictable, coordinated, effective, and acceptable response to OEs of all types. The UC allows the varied response organizations to join in a seamless response effort. However, the concept can be complicated during security events, especially if there are competing priorities between security, rescue, medical, and operations teams. It is critical that there be ongoing discussions between all response organizations, to achieve agreement on the concepts and procedures for UC. Additionally, this needs to be studied and exercised repeatedly until all concerns are addressed and resolved by all organizations involved. Procedures for UC should be in place to support transition from security command to traditional emergency response (i.e., fire department) command. Additionally, the ICS and procedures used for security emergencies should mirror the system and procedures used for other OEs.

An ICS response to an OE on a DOE/NNSA site is characterized by the basic generic attributes of an ICS, which are generally reflected in specific response activities, including:

- The incident is assessed, and response priorities are established; in the order of highest to lowest, the priorities are lifesaving, safety, incident stabilization, and property conservation.
- The IC sets clear strategic goals and tactical objectives and a flexible IAP is implemented.
- Incident command staff continually assesses the situation, develops a mitigation strategy, and requests additional assets, as needed.
- Incident command staff coordinates internal and external response assets in an efficient and effective manner.
- An incident command post (ICP) is established in a safe area away from the incident scene, in order for the command and control functions to be performed safely and effectively.
- The habitability of the ICP is periodically assessed, and the command post is moved, as necessary, when a hazardous environment challenges the safety of the staff.
- Incident command staff ensures that the response personnel take necessary precautions for personal safety and contamination control, as follows:
    - Incident command staff establishes a staging area where arriving asset personnel are briefed, communications are checked, special equipment is issued, and the assets are deployed upon request.
    - Asset personnel being released are debriefed, personnel are accounted for, personnel and equipment are surveyed for contamination and decontaminated as necessary, and issued equipment is returned.

4.2.7.2. Hazardous Material Survey, Sampling, and Sample Analysis Teams

Teams implement survey and sampling procedures in a timely manner. Adequate monitoring equipment and personal protective equipment should be available to the field teams in order to accomplish field monitoring and plume tracking within and beyond the EPZ. The teams should receive sufficient training to correctly use protective equipment, such as protective clothing and respirators, filter masks, and dosimetry. Required equipment for their tasks should be adequate, accessible, functional, and calibrated. In carrying out the required surveys or sampling activities, the teams should be capable of making effective use of maps or general arrangement drawings showing pre-determined and potential monitoring points.

Emergency response management is expected to control field teams effectively. This can be accomplished by establishing a position of survey team coordinator. Prior to deployment, the survey team coordinator develops a Survey Plan and obtains management approval of the plan. The survey team coordinator ensures that the teams are briefed on facility and meteorological conditions, and exposure control procedures; teams should be notified when changes occur. During survey operations, the survey team coordinator:

- Provides directions to survey-specific areas;
- Provides directions to minimize hazardous material exposure by exiting high airborne and whole body dose areas, or high concentration areas, when not actively engaged in sample and survey activities;
- Sets exposure limits for survey and tracking teams, and solicits and records survey results; and
- Allows the teams the time necessary to complete the surveys.

Effective communications with their coordinator should be established to ensure that transmissions of readings and results are accurate and received in a timely manner. The survey teams should use proper survey equipment and keep accurate logs of results.

Responsibilities of sampling teams include:

- Collecting samples, bagging and marking them, and logging the results accurately and efficiently;
- Receiving and properly packaging and labeling with information such as sample time and date, sample location, volumetric data, sample media, and sample or survey collection person's name, to assure maintenance of chain-of-custody;
- Using analysis procedures and equipment to support processing of samples received, and either analyzing the samples in the field or transporting them to a laboratory; and

- Communicating analysis results promptly and accurately to emergency response facilities, in particular, the CAT.

4.2.7.3. Security Staff

The security staff and other components of the ERO should develop a mutual understanding of authorities and responsibilities, response plans, utilization of command and control facilities, and terminology that enables site security to effectively coordinate and correlate response activities during an OE. The responsibilities and procedures of the site protective forces should be efficiently and effectively implemented during response and be characterized by effective command and control. Many of the responsibilities of the protective forces involve the protection of onsite personnel, which requires that they be performed promptly and safely, to include:

- Timely and proper maintenance of access and egress control for the SFA, impacted areas (safe perimeters), and emergency response facilities;

- Implementation of effective security practices that facilitate timely movement and access of SFA operating and response personnel (including offsite personnel) to required areas during emergencies.

The protective forces implement the NIMS/ICS for security emergencies. Under emergency conditions, material accountability and protection for Special Nuclear Material (SNM) and other critical DOE assets are handled in a timely and effective manner.

When local law enforcement provides backup to the onsite security force, common, preplanned protocols are used (use of deadly force, weapons employment, tactics, code words, radio frequencies).

4.2.7.4. Fire and Rescue

Fire/rescue personnel and equipment are assembled and deployed to the scene of the emergency in a safe and timely manner. Personnel take necessary precautions for contamination, exposure, heat, and personal safety. Both onsite and offsite fire personnel are outfitted with the appropriate specialized equipment and supplies specific to the onsite hazards. When fire/rescue teams carry out search and rescue operations, their efforts should be coordinated with medical, industrial hygiene, and health physics personnel. Injured personnel should be properly extricated, immobilized, and moved during search and rescue operations.

4.2.7.5. Repair and Maintenance

When facility and field repair and maintenance teams are dispatched, it is essential that their activities be carried out in a timely and efficient manner. They should have access to the proper tools for repair and maintenance activities and the procurement of replacement parts is expedited. Their activities include personnel protection equipment and monitoring as well as coordination with support groups (health physicists, industrial hygienists, and biosafety professionals). Emergency work order procedures are used and emergency tagging (lockout/tag out or clearance) is implemented.

4.3. Offsite Response Interfaces

4.3.1. Introduction

The purpose of this chapter is to assist DOE and NNSA field elements in complying with the DOE O 151.1D requirement that effective interfaces be established and maintained to ensure that emergency response activities are integrated and coordinated with the Federal, Tribal, State, and local agencies and organizations responsible for emergency response and protection of the workers, public, and environment. Interfaces with offsite response entities should be in accordance with the requirements of the NRF and NIMS.

4.3.2. General Approach – Offsite Response Interfaces

Interfaces with offsite response authorities and organizations are an integral part of the DOE and NNSA Comprehensive Emergency Management Program. In the context of the DOE/NNSA emergency management system, interfaces represent interactions with offsite response authorities and organizations, both during an emergency in supporting onsite response, and on a continuing basis by engaging in frequent dialog and interactions to establish and discuss emergency response roles, responsibilities, capabilities, notification procedures, and information needs. Interfaces can be effectively maintained through a designated point of contact within organizations.

DOE and NNSA have committed to comply with applicable Federal, Tribal, State and local regulations that focus on protecting workers and the public in the event of an emergency. Many of these regulations have provisions that require the establishment of interfaces between organizations having responsibility for emergency response. Results of All-Hazards Surveys and EPHAs are used to help identify agencies and organizations necessary to support a comprehensive and integrated response. Appropriate interfaces should be established, documented, and tested with each agency and organization.

Under federal environmental regulations, each state is required to establish a State Emergency Response Commission (SERC). The SERC is charged with designating emergency planning districts, appointing Local Emergency Planning Committees (LEPCs) for each district, and coordinating their activities. The LEPCs are charged specifically with integrating and coordinating community emergency planning. These requirements are further defined in 40 CFR Part 300, Subparts B and C. Superfund Amendments and Reauthorization Act (SARA) of 1986 Title III, Emergency Planning and Community-Right-to-Know Act, provide regulations on offsite interface regarding hazardous materials.

To establish and maintain offsite interfaces, regular SFA meetings with offsite officials should be held to discuss areas of concern and changes to emergency response plans and procedures. These meetings can also be used to develop emergency public information and outreach programs. The SERC/LEPC meetings could be used as a forum for these discussions.

The guidance in this chapter focuses on the establishment of interfaces through documented arrangements with offsite response agencies and organizations that may augment site resources in response to an onsite emergency, and also Tribal, State, and local agencies and organizations responsible for protecting the public and environment within the vicinity of the SFA; these arrangements are discussed in terms of the types of agreements and their generic content. The second part of the guidance addresses information and issues that should be addressed by DOE/NNSA sites and offsite agencies and support organizations in order to ensure that notifications, communications, information exchange, and operational integration necessary to establish effective response interfaces during an emergency onsite are accomplished. Activities and functions necessary for activating and maintaining effective interfaces during an emergency are presented in the last section.

4.3.3. Offsite Agencies and Organizations

All-Hazards Survey and EPHA results should be used to develop a list of emergency services, which may be needed to respond to potential accident conditions. Examples of required services include hospitals, fire departments, law enforcement, explosive/ordinance investigation and disposal, accident investigation, analytical laboratory services, ambulance services, coroners, materials suppliers, contractors, specialists, and others. Offsite response agencies and organizations responsible for augmenting site response resources and State, local, and Tribal agencies responsible for protecting the public and environment within the vicinity of the SFA should be identified. These agencies and organizations should be contacted to determine or establish authorities, responsibilities, resources, notification procedures, and information necessary in the event of an emergency at a DOE/NNSA SFA. Sites with potential for offsite consequences with radiological assets should plan and address potential support requirements per DOE O 153.1.

Candidate offsite organizations can include:

- Local Emergency Responders. Local municipal and county fire departments, law enforcement personnel, HAZMAT teams, and emergency medical and ambulance services will be among the first to respond to a request for support. For incidents involving public transportation near or on an SFA, workers and officials from these transportation organizations may be among the first responders. In the event of fatalities, the county coroner could also be a responder.

- State Emergency Responders. State Emergency Management Agencies are responsible for coordinating activities necessary to protect communities from natural and technological disasters and other emergencies. They coordinate the response of state agencies ensuring the most appropriate resources are dispatched to the affected area and work with local governments, volunteer organizations, and the private sector. In many states, State Police play a key leadership role in response and may have a significant planning role as well.

- State and Local Public Health Authorities. State laws grant state and local public health authorities emergency powers to combat communicable diseases. Emergency powers available and the procedures for enforcement vary from state to state. Typical powers include the isolation or quarantine of persons and places and obligatory vaccinations and other preventive measures, such as wearing masks. In some states, these measures may be taken whenever there is a threat of a communicable disease; in other states, the powers apply only to one or more specific, named diseases. State health departments often have the responsibility for decision making associated with public protection in the event of emergencies involving radiological material release.

- Medical Service Providers. Hospitals generally perform emergency planning both to protect their own facilities and patients and to respond to disasters in the community. State licensing and accreditation standards require hospitals to meet certain criteria for emergency preparedness, which often includes participation in local or regional medical planning for disasters. Hospitals accredited by the Joint Commission on Accreditation of Healthcare Organizations should be prepared for a variety of disaster scenarios, including facilities for biological, radioactive, or chemical isolation and decontamination, where appropriate.

- The LEPCs, SERCs, and Tribal Emergency Response Commissions (TERCs). These entities are established under SARA Title III, and the implementing regulations of the EPA. The LEPCs develop and maintain local hazardous material emergency management plans and receive notifications of releases of hazardous substances. SERCs and TERCs supervise the operation of the LEPCs and administer the community right-to-know provisions of SARA Title III, including collection and distribution of information about facility inventories of hazardous substances, chemicals, and toxins. LEPCs will have detailed information about industrial chemicals and emergency response capabilities within the community.

- Federal Emergency Responders. Depending on the emergency scenario, the Federal Government may respond to provide assistance. These departments and agencies may include the following: DOE Office of Inspector General, DHS, DOJ, FBI, DOD, EPA, U.S. Department of Agriculture (USDA), Nuclear Regulatory Commission (NRC), Department of Veterans Affairs, and the Department of Health and Human Services, which includes the Centers for Disease Control and Prevention (CDC).

The NEST is available to support offsite officials in the event of a radiological incident. Sites/facilities should coordinate with offsite officials to provide information on the availability and capabilities of DOE/NNSA Nuclear Emergency Support Team and how to access and use these federal assets.

One or more of the following organizations not usually included in emergency planning should be considered and liaison established, as appropriate, depending on the particular emergency scenario:

- Local Business Community. Local business might have resources to help support recovery from an emergency.

- Colleges and Universities. Colleges and Universities may provide temporary large facilities such as field houses, gyms, etc. Faculty members may have expertise (civil engineering, health physics, public health, agriculture, chemical weapons, infectious diseases) that can be used to assist with the emergency response or even as an independent expert to support public understanding of hazards.

- American Red Cross. This service organization provides disaster relief services for emergency workers and victims.

- Federal Executive Board (FEB). The FEB is a network of councils located in 28 cities across the country. The councils comprise top managers from agencies having offices in those cities. The FEB plays a role in notifying agencies in the field when there is a major attack or threat of attack anywhere in the country. Local Boards have emergency management plans for their respective areas and are the first point of contact for emergencies that affect large municipalities.

4.3.4. Support Agreements

An interface should be established with each entity from which support will be needed and appropriate agreements prepared. For multiple-facility sites, the contractor and Field Element Manager with site-wide responsibility should provide a centralized point of coordination. Arrangements with State and local governments should be documented. All agreements (MOUs, MOAs, MAAs, Agreements in Principle, and State Oversight Agreements) with emergency management/response provisions should be consistent and contain provisions for periodic review to ensure continued applicability. These agreements should be accessible in the SFA emergency plans.

Generally, an agreement should contain, at a minimum, the following information:

- The specific service or resources to be provided

- The agency, organization, or jurisdiction to which it applies

- Onsite individuals authorized to request aid from the offsite agency, organization, or jurisdiction

- Offsite individuals authorized to implement the arrangement, points of contact, and information required for implementation, such as names and telephone numbers

- Specific responsibilities, authorities, and command structure

- Any constraints/conditions that might preclude the agency, organization, or jurisdiction from meeting its obligation or support its refusal

- Public information release protocols

- Financial arrangements, including commitments by the facility or site to provide training, equipment, and facilities to the entity providing the service, and indemnification for injury to persons for loss and damage to property

- Specified periodic reexamination of the provisions and a renewal or termination date

- Signature of authorized individuals representing the site organizations and the offsite agency, organization, or jurisdiction

If an SFA is to provide support to an offsite agency under the *good neighbor* policy or through MAAs, those support interfaces should be documented.

All SFA plans should describe integrated support from offsite response organizations responding to emergencies. The organizations may include groups from outside the SFA EPZ that respond under provisions of the NRF, Nuclear/Radiological Incident annex, for nuclear/radiological emergencies; the NCP, for oil and non-radiological hazardous material emergencies; or the NRF, if the situation is declared an emergency or major disaster by the President.

4.3.5. Interface Information and Issues to Address

Individuals with the appropriate authority, knowledge, and training should be responsible for establishing and maintaining ongoing and effective interfaces with offsite political, technical, law enforcement, and emergency services officials. Such interfaces will ensure that necessary information and issues are addressed prior to an emergency, to facilitate the activation and establishment of effective interfaces during an emergency. Areas that should be addressed and resolved in agreements include:

- Identification and responsibilities of all parties and participants, including the method for coordination and control of an emergency, in accordance with the requirements of the NIMS/ICS procedures. Clarify details of incident command, including communication points and methods, facilities designated for command posts, and terminology.

- Identification of emergency points of contact, a description of information in notifications and follow-on activities, and a method to validate emergency notification messages (cf. Chapter 4, Section 5).

- Offsite Receptor Locations at which Protective Action Criteria (PAC)-2 levels would be exceeded as mentioned in Chapter 2 Section 2.6.2.2.

- Descriptions of actions by the parties for each type of OE, both classified (Alert, Site Area Emergency (SAE), and General Emergency (GE)) and not classified. The EPZs and EALs for Emergency Management Hazardous Material Programs should be described and include criteria for protective action recommendations to permit a clear and full understanding among parties.

- Agreement for liaisons and corresponding allocation of space in the EOCs and Joint Information Center (JIC) of site and offsite parties.

- Communication interfaces/protocols for notification points and ongoing communications between EOCs, responders, monitoring teams, and other entities involved in the emergency response. Personnel to resolve offsite agency inquiries and concerns should also be designated.

- Methods of communication between the site and offsite responders and agencies should be described, along with agreed-upon procedures for periodic testing of the communication system. These methods of communication may include commercial telephone, Internet, radios, or dedicated lines. Details should address assurances of compatibility between the communication systems used by different agencies and organizations.

- Public warning methods should be described.

- Descriptions of public information activities, including SFA press release protocols and the name or position of personnel authorized to speak for each organization during an emergency. Agreement should be reached with offsite agencies on the location and management of the JIC. Also, the information on emergency management plans and protective actions to be provided to the public prior to an emergency should be addressed with key offsite agencies.

- Description of operational interfaces between EOCs, including an organization chart depicting points-of-interface among parties.

- Descriptions of training activities, including beyond-the-basic emergency response training required for response to site-specific layout, conditions, and hazards. Additional training needs should be identified and arranged. For example, training for hospital emergency room personnel in handling radiological contaminated and injured individuals (cf. Chapter 4, Section 9) and training in JIC operations.

- Each DOE/NNSA SFA is required to offer offsite response organizations the opportunity to participate in an exercise every three years. This section of the site emergency management plan or procedures should discuss formulation of exercise objectives and exercise scenarios to accommodate these objectives. Agreed-upon schedules for development of exercise milestones should also be addressed.

- In accordance with 2 CFR Part 910.126(c)(3) or 2 CFR Part 910.126(c)(6), program official(s) should discuss MOUs, MOAs, or MAAs with a Contracting Officer for consideration as the basis to establish a non-competitive financial assistance award (grant or cooperative agreement) to State, local, and Tribal governments) for offsite response interfaces such as fire services, hospitals, ambulance services, life flight helicopter service, and other offsite agencies and organizations supporting the DOE/NNSA SFA emergency management plan, and the public.

- Access/entry protocols by emergency responders to facility access to minimize delays.

- Monitoring and consequence assessment plans and methods of the site and offsite response agencies should be clearly identified. This may include description of units used and methods to coordinate activities and data of onsite and offsite monitoring teams, including/reconciling understanding differences in results from different modeling methods.

- Assumptions made by the facility as a basis for public protection planning should be clearly identified. Actions anticipated by each interface agency should be stated and information required to respond effectively identified. Potential protective action recommendations (sheltering, evacuation, relocation, food control) should be described, including evacuation routes for site personnel and offsite public. Geographic areas for protective action, special needs populations, and other locations of significance with regard to hazardous material releases should be clearly identified.

In some cases, primary responsibility for establishing and maintaining emergency management interfaces for the site may reside in other organizations, such as site security, who may facilitate coordination of emergency management activities with local, State, Tribal, and Federal law enforcement organizations. Onsite fire department representatives may provide interfaces with the local fire response assets.

4.3.6. Interfaces during Response

The identification of offsite response assets, the documentation of agreements, and the resolution of issues prior to an emergency are intended to ensure that SFA response activities are integrated and coordinated with offsite supporting capabilities during an emergency. In addition, the following are essential for ensuring effective interfaces during an emergency:

- Organizations which may be needed in a supporting role or for long-term support have been identified and pre-designated offsite points of contact, including organization, names, and telephone numbers are readily available to the ERO

- Methods of communications and communication protocols are in place, identified, and operable

- Offsite officials are briefed upon activation of their facilities

- Offsite agencies and organizations are provided initial and ongoing information sufficient to perform their respective functions
- Timely, clear, accurate, and effective information exchange occurs between the ERO and offsite personnel
- Incoming offsite agency/organization inquiries and concerns are directed to the appropriate site personnel for resolution
- Effective working relationships exist between the offsite officials and their ERO counterparts
- Coordination and integration of response activities with offsite agencies and organizations follow established, pre-arranged, and documented plans and protocols, including responsibilities and authorities, coordination of response, notifications, facility activations, communications, EOC interfaces, public information activities, and logistic protocols (working space and site access).

4.3.7. Offsite Response during Severe Incidents

Each site, having conducted an All-Hazards Survey, must document in the site's emergency management plan which emergency services they rely on, including offsite agencies and organizations that could potentially augment onsite response efforts during a severe incident. The potential reliance on offsite responders during a severe incident is limited to those outlined in the Emergency Management Plan. Each site must maintain current written agreements detailing the extent of offsite assistance and practice during a site exercise.

Because a severe incident could potentially isolate a facility or site, preventing offsite response assistance and infrastructure support, DOE sites and facilities must be capable of maintaining emergency operations during a severe incident at existing facilities for 72 hours without reliance on offsite responders. Existing DOE site and facilities must be capable of maintaining auxiliary power in the event of electrical transmission interruption for 72 full hours at maximum load. Both FEMA and the NRC recommend all newly constructed EOCs be capable of maintaining operations for a minimum of 72 hours during severe incidents, and this requirement has been adopted as an industry best practice. For more information on EOC requirements see Chapter 4, Section 4.4.1.

Each DOE SFA should plan their reliance of offsite responder assistance according to their site-specific emergency response plan. DOE sites should take into consideration how to incorporate offsite responders beyond local/regional responders into their emergency management plan as part of preparing for the possibility of severe incidents. In the case of a severe incident that is likely to affect the surrounding communities equally by the initiating event, sites must prepare for their local/regional offsite responders to be unavailable. In situations where local/regional offsite responders are overwhelmed and not readily available, sites must be able to supplement their normal response resources with other available Tribal, State, or Federal organizations that can provide emergency response assistance.

4.4. Emergency Facilities and Equipment/Systems

4.4.1. Introduction

The purpose of this chapter is to assist DOE and NNSA field elements in complying with the DOE O 151.1D requirement that emergency facilities and equipment, adequate to support emergency response, are available, operable, and maintained. At a minimum, facilities should include an adequate and viable command center. Emergency equipment includes, but is not limited to, PPE, Communications Equipment, and an Emergency Operations System that includes systems or facilities to support emergency response operations.

4.4.2. General Approach – Emergency Facilities and Equipment/Systems

The nature of the hazardous material releases analyzed in All-Hazards survey findings, or the EPHA, should dictate many of the specifications for facilities and equipment. The diversity, complexity, and magnitude of potential hazardous releases at the SFA will help define general response needs, such as communications equipment and command center capability. The specific hazards will indicate whether there is a need for specialized equipment or capabilities, such as protective clothing, portable monitoring instruments, decontamination supplies, consequence assessment models, response vehicles and supplies, and facility data acquisition systems.

For all DOE/NNSA SFAs, DOE O 151.1D requires that emergency facilities and equipment, including supplies, be available and maintained for use in an emergency response. These requirements mandate the ability of an SFA to provide proper notifications (both onsite and offsite), implement protective actions (evacuate or shelter), and perform accountability for affected onsite personnel in the event of an emergency. Specific equipment that may be needed during a response to an OE includes: current reference materials (maps, facility drawings); decisional aids (including computers and, as appropriate, handheld tablets or smartphones); area and process monitors; sitewide or public address system; PPE; portable monitoring instruments; personnel monitoring devices; siren and alarm systems; decontamination equipment; and communications equipment. The actual functions and operating characteristics of the specific equipment should function as intended to provide adequate support during a response.

Additional DOE O 151.1D requirements for an Emergency Management Hazardous Materials Programs include: an onsite facility to serve as an EOC; a facility to serve as an alternate EOC in the event the primary is not available; and, the availability of adequate emergency equipment and supplies to meet the needs determined by the results of the EPHA. Depending upon these results, additional emergency facilities and capabilities may be necessary, such as technical support, security, personnel assembly/control, media centers; decontamination, supplies, medical services, process control, and chemical/biological/radiological analytic laboratories.

Emergency equipment and response facilities located throughout each site may be under different administrative or programmatic organizations, but should be integrated to provide an overall, site-wide response capability.

This chapter provides guidance in determining emergency facility and equipment needs based on the All-Hazards Survey and EPHA results. General design and siting considerations are provided for each type of response facility and suggestions are given for identifying equipment to support response functions.

4.4.3. Role of the All-Hazards Survey/EPHA

The results of the All-Hazards Survey or EPHA are used to identify emergency facilities and equipment that may be needed during the response to a hazardous material release from a DOE/NNSA SFA. The specific technical information useful in making this determination includes the following:

- Hazardous material types, forms, quantities, and locations
- Release modes and postulated incidents/scenarios
- Severity of estimated consequences at various receptors (concentration, dose)
- Emergency Categorizations (Health and Safety, Environment, Offsite Transportation, Hazardous Biological Agents or Toxins, and Safeguards and Security)
- Emergency Classifications of postulated analyzed incidents
- Time to receptors for a selection of wind speeds
- Persistence of released material in the environment
- Initial protective actions and protective action recommendations
- EPZs
- Demographics of potentially affected areas, onsite and offsite
- Onsite and offsite entities and environments potentially affected by materials released
- Impact of hazardous material releases on positions in facilities or associated with activities that require occupancy for safe operation, security, or monitoring

Additional EPHA results that may influence the acquisition and tailoring of emergency facility and equipment needs to include the following:

- Estimated duration of hazardous material releases**.** Determine emergency facility and equipment features such as automated and sophisticated notification systems; Heating, Ventilation, and Air Conditioning (HVAC) system filtration capability; vehicles and equipment for field monitoring teams; and plans and resources for extended occupancy of emergency facilities.

- Potential for successful mitigation. Determine the emergency facility and equipment features needed for successful mitigation, such as facilities, equipment, technical support, and operations support; coordination capabilities of onsite and offsite firefighting and medical assets; and the degree to which emergency facilities are equipped with analytical tools (drawings, computers, and workspace for problem-solving teams).

- Field measurement or consequence assessment methods that are applicable for the material and release types. Determine emergency facility and equipment features, such as use of manual-versus-computerized consequence assessment methods; need for specialized dispersion modeling (such as heavier than air models, codes that address chemical conversions such as uranium hexafluoride when it reacts with atmospheric moisture), adequacy of installed monitoring and detection instrumentation; specific field team instruments; sophistication of meteorological instruments and ability to access forecast information.

- Hazardous material incidents involving security considerations. Determine emergency facility and equipment features, such as secure communications between security personnel and emergency facilities; processing, storing, and need for discussing classified information within emergency facilities. This will support establishing the level of physical security to be provided at these emergency facilities; respiratory protection equipment for security personnel; and hazardous materials monitoring equipment for security personnel and vehicles.

The EPHA results can be used to help identify potential locations and habitability requirements for both primary and alternate emergency facilities (EOC/Alternate EOC). Consequence estimates will identify areas potentially affected by hazardous materials releases. The analysis of EPHA consequence calculations determines the habitability requirements for a command center/EOC located within a potentially affected area for a new or existing structure, and also determines a suitable location for the alternate. Staging facilities/areas could also be identified for such diverse emergency needs as personnel evacuation and accountability, decontamination sites, and casualty management locations through this process.

Comparison of emergency facility and equipment needs identified using the results of the EPHA with existing facilities and equipment can help eliminate duplication and redundancy. Selected equipment, such as radiation or hazardous material detection instruments, Self-Contained Breathing Apparatus (SCBA), and emergency repair materials may be used for emergencies, as necessary. Existing facilities and equipment should be used to meet these needs whenever possible.

The need for additional types of emergency facilities and equipment should be determined based on the extent they can help to lessen the onsite and offsite consequences of an incident or accident. For example, establishing sophisticated emergency facilities and equipment (technical support center, operations support center) to support mitigation activities may not be appropriate, if the likely duration of hazardous material releases is shorter than the time needed to activate and bring emergency response resources online. Mitigation-oriented facilities may not be necessary if the majority of the more severe analyzed accidents are massive puff releases. In contrast, if some portions of the postulated severe accidents involve prolonged releases, complex process systems, or conditions that deteriorate over time (a fire spreading throughout a facility containing multiple hazard sources), then mitigation-oriented facilities and equipment may be warranted.

Examples of enhanced mitigation activities include augmenting firefighting capabilities; improving the ability to rapidly modify or create impromptu operations and maintenance procedures; increasing the number of staging areas for tools, supplies, and personnel; and arranging for the equipping of command and control infrastructures necessary to carry out mitigation activities.

Assessment of the potential magnitude and duration of consequences will help develop logistical contingencies to support all response activities through emergency termination and into recovery. These include adequate housing, vehicles, food services, and general services, and consumables (office supplies and equipment, construction materials, and minor repairs to computer equipment).

Additionally, for Defense Nuclear Facility (DNF) sites it is required by DOE O 151.1D Chg 1 to have walkaway or shutdown strategies for equipment and facilities during emergencies and ensure a transition of responsibilities and required actions between normal work activities, incident activities, and recovery operations. These will vary site by site; however, it is recommended that sites use DOE-STD-1226-2019, *Conduct of Operations Implementation*, or the most current iteration in reference to DOE O 422.1, *Conduct of Operation*, to meet this requirement.

4.4.4. Emergency Facilities

In this section, characteristics of emergency facilities will be discussed. Specifically, attributes of an emergency command center and its alternate are described in terms of general functional requirements and those imposed by the SFA-specific hazards. The special case of a *habitable* command center, the EOC, is also introduced. Finally, the JIC and other possible emergency facilities are discussed.

4.4.4.1. Emergency Operations Center (EOC)

The EOC is a primary onsite emergency response operations center designed to allow the UCS component of the ERO to fulfill its emergency response functions and responsibilities with consideration given to habitability and human interface requirements.

During emergency response, a dedicated facility should be available for use as an EOC. The EOC is the primary onsite emergency facility designed to allow the UCS to fulfill its emergency response functions and responsibilities, based on an analysis of emergency response needs. Characteristics of this EOC should reliably support the designated response functions and assignments. Facility systems and installed equipment (HVAC, sanitation, lighting, radiation monitors, computer systems, communications, and visual displays) should be adequate to support the functions and expected level of staffing. The EOC should have the capability to access alternate power supplies in the event of a loss of power. If the primary EOC becomes unavailable, then provisions should be in place to use an alternative location considering habitability, accessibility, and security, as well as access to power and communications.

Controlled access procedures should maintain security and accountability within the EOC. Sufficient space and equipment should be provided to permit the UCS to perform its functions effectively and efficiently using its operations procedures, especially round-the-clock command, control, and communications.

A resource area with current electronic and hard-copy reference materials, such as operating procedures, technical safety requirements, emergency management plans and procedures, safety analyses, offsite demographic data, evacuation plans, and environmental monitoring records, should be designated and maintained to allow for ready accessibility and use by the UCS. Many of these materials may be maintained electronically on shared drives for ready access, and updating, by members of the EOC staff. Similarly, the EOC should have the capability of maintaining an electronic log of key response events, accessible to all staff.

If the EOC is a dual-use facility, then plans and procedures should be in place and tested regularly to ensure that the facility can be rapidly converted into an EOC, staff are knowledgeable in carrying out this transition, and facility resources and equipment are adequately maintained to ensure timely conversion, activation, and availability to support an emergency response.

At a minimum, an EOC should have the capability to effectively integrate the following five functional elements:

- Command
- Operations
- Planning
- Logistics
- Finance/Administration

This configuration meets the intent of the NIMS and describes the basic functional make-up of a NIMS/ICS. However, depending upon the actual emergency, these elements and their sub-elements should be tailored to needs dictated by the incident, not by an automatic, one-size-fits-all configuration. An EOC needs to flexibly support management of the SFA emergency response while coordinating and meeting its Federal, Tribal, State, and local obligations.

To be considered habitable, the EOC should be capable of remaining operational and life supporting for an extended period of time under accident conditions and maintaining its structural integrity under various design basis accidents, including natural phenomena (DOE O 420.1C Chg. 2), *Facility Safety*. A habitable EOC should satisfy the following criteria:

- Breathable atmosphere. The HVAC system should be designed to maintain safe oxygen levels, provide for air contaminant removal and filtration to prevent intake of contaminated outside air (including smoke), and establish a positive pressure to prevent the infiltration of radiologically, chemically, or biologically contaminated air. Equipment should be available to confirm that the atmosphere in the EOC remains uncontaminated.

- Shielding/Protection. Sufficient shielding and protection from radioactive and other hazardous materials should be provided to permit continued occupancy of the EOC by the UCS for its maximum expected activation time without exceeding recommended exposure levels.

- Back-up emergency power. Loss of normal electrical power should not preclude the EOC from performing its functions.

The design of the EOC should also follow human-factor principles for sleeping, food preparation comfort, noise reduction, lighting, and work-group interfaces.

New EOCs at DNFs have additional requirements to be deemed habitable per DOE O 151.1D; they must provide auxiliary power for sufficient lighting, ventilation, communication, and occupancy for a minimum of 72 hours following a severe incident that interrupts commercial power allowing response organization personnel to conduct emergency operations. This requirement is applicable only for newly built EOCs at defense nuclear facilities. Power, communication, and lighting must be sufficient to complete the assigned tasks in the EOC. Ventilation must be sufficient to filter radiological or chemical particulates from indoor air supplying the EOC. Occupancy standards as established by the local fire codes must be adhered to in the new EOC.

There must be sufficient fuel to provide auxiliary power to generators in new EOCs at defense nuclear facilities for 72 hours when commercial power has been interrupted.

4.4.4.2. Alternate Emergency Operations Center (EOC)

An Alternate EOC needs to be available if the primary EOC becomes uninhabitable. The alternate does not have to duplicate every design feature and piece of equipment found in the primary EOC, as long as it allows the UCS to perform its necessary functions effectively. The requirements for a new EOC cannot be met by *backfilling* or using resources from another nearby or alternate EOC facility. The following points should be considered in the design of a new, or the designation of an existing, facility to operate as an alternate command center:

- The alternate EOC should be located outside of the EPZ or in a markedly different atmospheric transport sector than the EOC so that it is highly unlikely that the primary and alternate EOCs would be affected by the same incident. Monitoring equipment should be available to confirm the habitability of the alternate. Accessibility, security, and the ability to provide controlled access and secure communications should be considered in selecting the alternate location.

- Communications and information processing systems for the alternate command center should meet the same capability and interoperability specifications as for the primary. Back-up communications, such as cellular or satellite phones and radios, should be made available to maintain command and control.

- Reference material, including up-to-date plans, procedures, EPHAs, and maps, should be available in the alternate command center or provisions made to obtain them from other emergency facilities as needed.

- Transfer and activation procedures should be prepared, training conducted, and the process validated during exercises and drills for shifting responsibilities from the primary command center to the alternate during an emergency.

- Where appropriate, and within resource limitations, a mobile or virtual EOC may be an appropriate alternative.

4.4.4.3. Joint Information Center

DOE O 151.1D requires that each SFA provide accurate, candid, and timely information about emergencies to workers and the public. Emergency Management Hazardous Materials Program facilities/sites/activities are expected to, and Core Program facilities/sites/activities should ensure that an adequate public information program is established and maintained, commensurate with site hazards, where an adequate emergency public information program includes a JIC to provide resources to comply with the integrated, comprehensive Emergency Management System, commensurate with hazards, during an emergency. This program should provide support in media services, public inquiry, media inquiry, JIC management and administrative activities, and media monitoring.

To accomplish this, a facility should be designated as a JIC and located where controlled access by the media and public is facilitated. When an onsite incident has offsite consequences, a consolidated JIC, with local, State, Tribal, and other Federal officials, is encouraged to present a coordinated response to the public. Chapter 4, Section 10, details further considerations for JIC facilities and equipment requirements.

4.4.4.4. Other Emergency Facilities

In addition to the EOC, Alternate EOC, and the JIC, a variety of other emergency facilities may be necessary to accommodate the response activities as determined by the All-Hazards Survey and EPHA. Variations in the physical arrangement of other augmenting emergency facilities depend on size, nature, and organization of the facility/site ERO. These other facilities may include the following:

- Staffed operations area. Facility operations and processes are controlled or monitored. An emergency could possibly be detected and reported, and initial mitigative actions implemented from this area.
- Technical support center. Detailed technical support and assistance is provided to the ERO. Activities such as technical assessments and engineering support could be coordinated from this center.
- Operations support center. Activities involving maintenance, health physics, industrial hygiene, and operations resource personnel could be coordinated and directed from this location. This center is typically the dispatching point for field monitoring teams, search and rescue teams, damage control and equipment repair teams, and emergency equipment operators.

Other facilities, used on a routine basis to support SFA response activities during an OE, should also be considered emergency facilities during an emergency incident. Examples include fire stations, security patrol HQ, notification centers, medical stations, decontamination stations, assembly points, and central alarm stations.

An analysis of the functional requirements of the command center may suggest that similar functions be combined in a single emergency facility. Examples of potential emergency facility arrangements include the following:

- Combining all emergency response control and coordination functions in a command center, with separate specialty functions in rooms or partitioned areas;
- Combining the technical support center and command center;
- Combining the technical support center and operations support center;
- Establishing individual facility technical support centers and operational support centers, along with a common command center for the entire site;

- Dividing operations support center functions among multiple emergency facilities (repair, monitoring, and operations staff staged in separate locations).

4.4.5. Emergency Equipment

The purpose of this section is to introduce emergency equipment by first discussing how specific equipment supports essential aspects of the emergency response. This is followed by a more detailed characterization of several categories of emergency equipment, such as communication, field monitoring instruments, protective action supplies, medical, public information, and miscellaneous equipment (computers, printers).

4.4.5.1. Equipment Support for Response Functions

Response functions that are supported by specific, specialized emergency equipment include the following:

- Notifications and Communications. This notification/communication capability is usually made by a public address system or through alarm sirens, horn blasts, etc. Other systems may use mass e-mails or text messages disseminated through cell phones. Notifications to emergency responders are usually made over a radio/telephone, hard line/battery-type redundant system to reasonably ensure that communication is maintained regardless of the nature of the emergency and its impacts on SFA systems. This same system can also serve to notify other appropriate Federal, Tribal, State, and local organizations, including mutual-aid fire departments, as well as additional offsite Departmental entities. Many Departmental facilities and sites have designated radio frequencies and dedicated telephone lines to be used only for emergency notification and communication purposes. Provisions are also established to ensure operational compatibility between facility response capabilities and DOE or NNSA assets.

  If the resources of offsite response organizations are to be integrated into the overall SFA response, their communications capabilities need to be compatible and procedures/terminology consistent with onsite communications. The MOUs with appropriate agencies should provide communication protocols and a workable integration process. Individual facilities or the site may need to provide mobile, compatible links to these organizations or establish other means of communications, such as exchanging liaisons.

- Protective Actions. Depending on type and duration of emergencies that could occur at or affect an SFA, effective sheltering or transporting of onsite personnel for evacuation purposes may be desirable or even necessary. Pre-designation of the locations for these potential shelters and assembly points for evacuation is critical in order to support onsite direction and coordination actions (temporary billeting, transportation) and for obtaining accurate accountability of all potentially affected personnel. Understanding the peak, onsite number of personnel that could potentially be affected by the emergency will help determine the size/type of sheltering facility, numbers/types of vehicles needed to support their evacuation, and the optimum personnel accountability system to be used. Selected shelters should include a communications capability to and from the EOC, and appropriate materials and supplies for enhancing shelter in place effectiveness. (See Chapter 4, Section 8 for other protective actions that might be taken.)

- Accountability Processing. The capability to determine the whereabouts and status of onsite personnel, including visitors and subcontractors, during an emergency requires that the facility/site maintain a personnel accountability system. Some method of communication (except radio) is necessary to communicate the names of personnel unaccounted for or missing to the command center. The complexity of the system might be no more than a roll call, if it serves to determine accountability after evacuation. Whatever system is used, from simple roll calls to fully automated badge-reader systems, consideration needs to be given to the variety of personnel that may be on the facility/site, optimum placement of accountability systems, system usage capabilities/limitations/needs, and mobility requirements. For emergencies that could force the evacuation of most of a site and even the surrounding populations, some method for recalling onsite personnel who may not be accessible at their normal/permanent residences should be identified. The capability to determine the whereabouts and status of onsite personnel, including visitors and subcontractors, is essential.

4.4.5.2. Command, Control, and Communications Equipment

Command, control, and communications are the most important functions of the ERO. Primary and back-up emergency equipment, supplies, and alternative emergency response functions (to include redundant manual systems) need to be considered to ensure the continuous functioning of command, control, and communication capabilities. Recording capability of all radio and phone line communications is highly desirable.

Decision aids and information displays to support the command and control functions of the ERO in their emergency facility, and to provide a common operating picture, should be available and regularly tested during drills and exercises. Equipment to be considered includes the following:

- Equipment should be available to provide a common operating picture of the emergency and the response. Key information should be accessible, including facility and system parameters; effluent releases; environmental monitoring and measurements results; consequence assessments results; onsite and offsite protective actions; initial and follow-up notifications; key individuals in command and contact info; accountability; status of injured or exposed personnel; and search and rescue status. Information should be available to the ERO at a glance, confirming reports that response actions have been taken and that future actions have been identified.

- Data from installed instrumentation (meteorological and source term) critical to command and control (e.g., protective actions, classification) should be available to appropriate ERO personnel.

- Site or facility maps should be used and kept updated in EOCs as visual aids illustrating potential release points, controlled areas, safe routes of travel, safe zones or distances, command center location(s), incident scene wind direction, plume direction, etc.

- Primary and back-up communications systems should be provided to ensure effective communications critical to command and control of emergency response activities.

- Consideration should also be given to compatible communications systems to pass notification and activation reports to both on-shift and off-shift emergency response personnel, and to communicate such reports and other information to Departmental entities offsite and to other Federal, Tribal, State, and local government agencies. The systems designed to perform these functions should be tested and maintained regularly. Standard procedures and forms also should be developed to ensure that information can be passed quickly and accurately during an emergency.

- Secure communications for transmitting classified and controlled unclassified information should be considered and be available during an emergency response if needed.

Additional guidance impacting the design and employment of communications systems used for notifications and reports can be found in Chapter 4, Section 3.5.

Primary and back-up communication links for mobile personnel, such as field teams and ICs, should be provided, tested, and maintained. If offsite response forces will be integrated into the overall facility or site response, communications should be compatible. The facility or site may be required to provide mobile, compatible communications links to these offsite organizations.

Communications networks used to support daily operations at a facility or site should be compatible with the networks established to exercise command and control of emergency response. For example, fire departments and brigades, security patrols, and craft departments often have established radio networks to communicate with central dispatch facilities. Equipment within the command center may be needed to ensure that the direction provided by the ED or the IC is accurately and quickly transmitted to all emergency response elements.

4.4.5.3. Consequence Assessment Equipment

The level of sophistication required for consequence assessment capabilities, such as meteorological data acquisition, calculation and dispersion models, and monitoring capabilities, should be determined based on the results of the EPHA. Chapter 4, Section 7 of this guide provides recommended methods based on maximum incident classification at the facility.

Adequate equipment should be staged and adequate modeling capability readily available to facilitate an estimation of consequence assessment to permit prompt protective action implementation and recommendations. This equipment/capability should be inventoried regularly, and their locations identified. In accordance with manufacturer's instructions or industry standards, all such equipment, capabilities, and supplies should also be periodically inspected, calibrated, operationally checked, tested, and maintained. Installed monitoring systems needed for accident characterization should have back-up power to ensure continued operability in an accident.

Monitoring equipment should be capable of measuring applicable chemical concentrations or radiological dose or count rates during the emergency response. If plans include provisions for the deployment of joint DOE/State/local monitoring teams, then standardized or compatible monitoring and communication equipment should be used. Instruments suitable for determining occupational exposures during normal operations may not be capable of recording incident concentrations/levels. (Regardless of the choice of instrument types, consequence assessment data/results should be compatible in terms of units, conversion factors.) Remote monitoring capabilities should be considered for situations where worker hazard controls are needed (e.g., buildings/areas are unsafe to enter; elevated dose rates, derived air concentrations, or chemical concentrations).

4.4.5.4. Protective Equipment

All-Hazards survey and EPHA results concerning the nature of potential hazards and affected areas, the types of consequences, and the population affected are useful for determining requirements for emergency equipment, materials, and facilities needed for protective action implementation. Detailed guidance is provided in Chapter 4, Section 8.

Respiratory protection and protective clothing may be necessary to protect workers in a contaminated environment, to allow for their escape, and to protect emergency workers during emergency response or reentry to a contaminated facility. The type of respiratory protection and protective clothing should be based on the EPHA and consequence calculations. The possibility of inhalation and absorption through the skin should be considered in determining the type and quantity of protective clothing available. Additional discussion of requirements for maintaining PPE can be found in Hazardous Waste Operations and Emergency Responses (HAZWOPER) standards; Appendix B, 29 CFR Part 1910.120; 29 CFR Part 1910.132 through 1910.140; and NFPA Standards 1991, 1992, and 1999. Some type of decontamination facility, either mobile or fixed, is suggested to provide for the decontamination for emergency responders and possibly victims. Specific locations within the facility, such as security posts or operations control rooms, are critical and may have to be continuously manned. The EPHA should be used to determine requirements for protective equipment that should be available at these locations.

Consideration should be given to standardization and interoperability of emergency equipment needed for implementing protective actions across an SFA. This would enable routine operating supplies maintained by organizations, such as the fire department and the hazardous materials response group, to be pooled with any dedicated emergency equipment inventory and periodic inspections/calibrations/operational checks/testing conducted. Standardization of equipment allows for increased interoperability by response organizations, ease of maintenance, and greater flexibility during response.

Transportation equipment should be provided or identified as readily and rapidly available by means of an MOA, for use in evacuating nonessential personnel onsite to a safe location following an evacuation order. Determination of suitable modes of transportation should consider disabled workers. Transportation equipment could include automobiles, buses, vans, ambulances, and cargo vehicles. This equipment can be either owned and maintained by the SFA or available from Tribal, State, local, or private organizations via a contract or MOA.

4.4.5.5. Medical Equipment and Supplies

Sufficient medical equipment should be available to treat both workers and responders who may be injured during an emergency. Emergency planners should coordinate closely with medical professionals to ensure that appropriate treatment is available for the range of possible accident scenarios, the types and nature of injuries that may need to be treated, the kinds of contamination possible, the number of personnel that could become casualties, and the timeframes during which treatment needs to be provided to be effective. Planning and evaluation should include types and amounts of medical equipment needed to respond to a mass casualty event, including ambulances or other means of transportation to offsite medical facilities. This should include medical supplies to treat exposure to toxic chemicals or biological agents, and radioactive material uptakes.

10 CFR Part 851, 29 CFR Part 1910, and DOE O 440.1B Chg. 2 and its supporting guidance document provide additional information on requirements for onsite and offsite medical equipment. In addition, Chapter 4, Section 9 should be consulted.

4.4.5.6. Public Information Equipment

Audio-visual and data processing equipment dedicated to communications with the media and the public should be available. While some equipment may be dedicated to public information activities as part of normal operations, these assets may need to be upgraded to accommodate the substantially greater demands for public information dissemination and inquiries during an emergency. Equipment needs may include TV monitors for monitoring local news broadcasts regarding the incident, equipment for recording media briefings, audio-visual display equipment, capabilities to monitor social media, podiums and other briefing equipment. Members of the media are generally self-supporting with their own cameras, recording equipment, and communications. Detailed guidance is provided in Chapter 4, Section 10.

4.4.5.7. Additional Support Equipment

Access control equipment and procedures for the command center and any other emergency facility are essential to ensure that the ERO functions without interruption or disruption for the duration of the response. Equipment may be necessary to ensure that access to temporarily sensitive security areas or potentially contaminated areas is restricted. If an atmospheric release may affect areas beyond facility and site boundaries, coordination should occur with offsite authorities regarding the equipment and procedures necessary to extend a perimeter beyond the traditional facility or site boundary for access control purposes. The security force is usually tasked to carry out access control activities onsite, while offsite access is usually the responsibility of local law enforcement.

Fire departments normally make up a substantial portion of the emergency response force at a facility/site. DOE O 420.1C Chg. 1 requires that a BNA establish the minimum required capabilities of site firefighting, emergency medical, rescue, and HAZMAT response.

Once determined, these capabilities are to be reflected in the site emergency management plan. Emergency planners should coordinate with counterparts in the fire protection organization to ensure that all hazards noted in the EPHA are considered in the BNA.

Spill containment equipment and supplies should be available for immediate use following declaration of an emergency, if necessary. This includes containment equipment (e.g., booms and berm-making equipment) to minimize the environmental impacts of runoff (such as from a tank failure or firefighting efforts). Other equipment needs might include heavy construction equipment, portable power supplies, temporary sanitation equipment, specialized tools, replacement parts, and heavy-duty tarpaulins. Additional supplies that might be required include PPE, dosimeters, medical supplies, office supplies, firefighting expendables, and construction supplies. As with fire, medical, and hazardous material equipment, consideration should be given to arranging for the availability and compatibility of these resources with offsite organizations. The availability of such offsite resources, including names of equipment operators, should be documented in MOAs.

Emergency response personnel should have at their disposal the necessary equipment for reentry and recovery activities. Although maintaining onsite inventory of all equipment possibly required for reentry and recovery efforts is not practical, a resource list for short notice procurement should be available.

Logistic support can be arranged through elements of the ERO or from other Federal, State, Tribal, local, or private sources. Commitments to have these resources available immediately as necessary can be ensured through MOAs. Examples of facilities and services that could be needed include hazardous materials response, bomb removal, hostage negotiations, medical/morgue services, critical incident stress teams, analytical laboratory services, aerial survey support, personnel transportation, food services, contaminated laundry service, and dosimetry support. Planners should consider the potential impact of resources from offsite organizations not being available in the event of a regional disaster. Additional information on establishing interfaces with offsite response groups is provided in Chapter 4, Section 3. Administrative support, such as document and clerical services, may be required during emergencies. The upkeep records and management of information from an incident requires a recordkeeping system.

4.4.6. Maintenance of Facilities and Equipment

Emergency facilities and equipment should be periodically inspected and checked during normal conditions to ensure availability and reliability during an emergency. Designated response facilities, especially multi-use facilities, should be adequately maintained to ensure timely activation and availability to support an emergency response. Inventories of all emergency equipment and supplies should be maintained and the location of equipment identified. Periodic inspections, facility walk-downs, operational checks, calibration, preventive maintenance and testing of equipment and supplies should be carried out in accordance with the manufacturer's instructions or industry standards. Of particular importance are the communications systems and equipment. Communication systems with DOE HQ, DOE field elements, and offsite organizations should be tested annually, or more frequently as necessary. Also, communication systems used to activate both on-shift and off-shift emergency response personnel should be tested and maintained regularly.

4.5. Emergency Categorization and Classification

4.5.1. Introduction

This chapter describes the basic principles of incident categorization and classification of OEs. First, incident categorization is discussed with special emphasis on OEs that do not require classification and the development of criteria for determining quickly if an incident is an OE. Next, OEs that require classification and the relative severity (i.e., the consequences and the extent of the area impacted) associated with each emergency class are discussed. The use of Protective Action Criteria (PAC) for radiological and non-radiological releases to establish hazardous material emergency classification is also addressed. Guidance is provided for developing EALs for both Emergency Management Hazardous Materials Programs. Guidance will include the criteria used to detect and recognize onsite hazards and hazardous material release incidents and assign the appropriate emergency class for Emergency Management Hazardous Materials Programs. Appendix F provides guidance for integrating incident categorization and classification with normal operating procedures; Appendix G provides examples for the implementation of incident categorization and classification. The requirement to be categorized applies to incidents or conditions that cause or have the potential to cause:

1. Serious health and safety impacts onsite or offsite to workers or the public
2. Serious detrimental effects on the environment (40 CFR Part 300.5)
3. An actual or potential release of hazardous materials from a DOE shipment
4. Potential release of Hazardous Biological Agent or Toxins
5. Actual or potential harm to people or the environment as a result of degradation of safeguards or security conditions

In addition to being categorized as OEs, incidents involving the actual or potential airborne release of (or loss of control over) hazardous materials from an onsite facility or activity also require prompt and accurate classification as an Alert, SAE, or GE, based on the measured or predicted radiation dose or hazardous material concentration at specific locations. Conservative preplanned initial onsite protective actions and offsite protective action recommendations should be associated with the classification of these OEs.

4.5.2. General Approach – Emergency Categorization and Classification

Effective emergency response depends upon early recognition of emergency incidents and conditions, coupled with rapid implementation of emergency actions. Categorizing incidents as OEs was created to facilitate rapid early recognition and timely response. Response to OEs requires notification of offsite authorities and may require the commitment of significant resources. Categorization of incidents or conditions as OEs is intended to ensure the rapid dissemination of incident facts outward and upward; activate response activities beyond the local incident scene; and meet the time-sensitive information needs of strategic decision making in areas of national security.

In addition to ensuring rapid communications, the process of classifying selected OEs that involve hazardous materials was created to initiate preplanned local response and to protect the local site and offsite populations. For OEs that do not require classification, local emergency response activities may be unaffected by the categorization process, with the exception of more timely recognition and notifications. Classified emergencies (i.e., Alert, Site Area Emergency, and General Emergency) are a subset of the OE category. Therefore, when an incident is classified, it is (by definition) also categorized as an OE at the same time. As a result, an OE incident or condition requiring classification needs to be *categorized* **and** *classified*, as promptly as possible, but no later than 15 minutes after identification by the predetermined decision maker for the categorization, in accordance with the emergency management plan, but no more than 30 minutes from initial discovery. Emergency Management Hazardous Materials Programs will require Categorization and further Classification.

The emergency categorization/classification system includes a set of pre-approved decisions, agreed to by senior management and Tribal, State, and local officials, which allow onsite supervisory personnel to make rapid decisions affecting personnel, facilities, and resources in response to an emergency. Authority to initiate emergency communications and commit resources often rests with upper management. During the onset of an emergency, adherence to the normal management approval processes may delay the initiation of response actions and mobilization of resources. For the system to be effective, responsibility and authority for initial incident categorization and classification should be vested in on-duty supervisory personnel who are close to the problem and who are familiar with the facility.

Every DOE/NNSA SFA is required to produce an All-Hazards Survey to identify the types of emergency incidents and conditions to be addressed by the DOE Comprehensive Emergency Management System. This survey can be used to define incidents and conditions that should be categorized as OEs. SFAs are required to identify these OEs and develop criteria for categorizing them quickly, as specified in the Order. OEs involving the release of (or loss of control over) hazardous materials on or from DOE sites or facilities are classified according to their severity for the purpose of rapidly implementing planned response activities and notifications that are commensurate with the degree of hazard presented by the incident.

4.5.3. Operational Emergency Definition

DOE O 151.1D provides the following two definitions for an Operational Emergency:

For all activities, except Office of Secure Transportation (OST) activities, the following definition applies:

- A major unplanned or abnormal incident or condition that involves or affects DOE facilities and activities by causing or having the potential to cause serious health and safety or environmental impacts and requires additional resources to supplement the planned initial response offsite; and

For non-OST DOE offsite shipments:

- Any accident/incident involving an offsite DOE shipment containing hazardous materials that causes the initial responders to initiate protective actions at locations beyond the immediate/affected area.

The Order provides a number of examples of abnormal incidents and conditions that are to be categorized as OEs. The examples alone, however, may not fully convey the qualities (i.e., the seriousness and the required response efforts) that distinguish them as OEs in the DOE emergency management system. The basic characteristics of an OE, as spelled out in the Order definition, need to be considered along with the specific examples to determine whether a particular abnormal incident is an OE. The following discussion provides guidance for interpreting the OE definition given in the Order.

4.5.4. Emergency Categorization

Although it is not intended that facilities develop detailed and quantitative categorization criteria for each type of OE described in the Order, some planning and preparation will be needed to ensure that incidents meeting the Order descriptions are promptly recognized and categorized. For OEs, SFAs should develop SFA-specific criteria (e.g., predetermined EALs) to aid in accurate and rapid decision making. The decision to categorize a given occurrence as an OE should be based on the extent of the required response and the potential severity of health, safety, or environmental impacts.

Categorization as an Operational Emergency is used to identify incidents that are severe enough in nature to have the potential to cause serious health and safety risks, environmental impacts, and will require coordination beyond the local or immediate incident scene to supplement the initial response. Incidents that can be controlled by employees or maintenance personnel in the immediate/affected facility or area are not categorized as Operational Emergencies.

In a given potential operational emergency, categorization is meant to identify different types of incident scenarios (e.g., Health and Safety, Environmental, Offsite Transportation, Hazardous Biological Agents or Toxins, Safeguards and Security) so SFAs' response organizations can respond accordingly based off of the results found in All-Hazards Surveys or EPHAs, which are used to develop EALs. When incidents occur, Emergency Management staff must be able to use unambiguous decision criteria to determine if parameters for the correct categorization and classification have been met in order to issue initial protective actions. In the second phase of consequence management, the TIA is used to support and confirm if the initial pre-planned decisions were accurate. If it is determined during the TIA that the original recommendations were not sufficiently protective, then modifications of the initial protective actions should be made.

In addition to satisfying criteria based on the Order descriptions, the incident or condition should also exhibit the more subjective characteristics that define the OE, as discussed in Section 5.3. The process of OE categorization involves judgments on a number of subjective issues, including:

- Perceptions of the magnitude and duration of the incident
- Unique circumstances of the specific incident; such as unusual hazards or materials that may be involved
- General need for coordination of operations and emergency management (e.g., planning and intelligence, multiple skills, additional resources, etc.)
- A sense of what DOE/NNSA HQ needs to be informed of promptly in order to interface with other Federal agencies at the highest levels
- The site's political situation and its relationship with its neighbors

There are few absolutes in categorizing emergency incidents or conditions. The categorization process involves a qualitative and quantitative assessment of unique incidents or conditions. The categorization decision needs to consider the OE definition in its entirety, with no one aspect of the definition dominating the decision process. The subjective nature of the process makes it essential that responsible personnel are trained to recognize incidents or conditions that require rapid assessment and categorization decisions.

The following sections describe how the examples of OE incidents or conditions given in the Order should be used to develop SFA-specific criteria to support recognition and categorization of emergency incidents or conditions. A variety of techniques may be used to integrate this recognition/decision process with existing operations, management, emergency response, and reporting activities (e.g., existing occurrence reporting and hazardous materials recognition/classification procedures).

The SFA emergency management plan should clearly identify who is responsible for determining OEs and the process that they are to use to ensure that an OE is categorized as promptly as possible.

Initial discovery occurs when an individual recognizes that a potential emergency situation exists and activates the emergency system to summon the fully trained first responders (i.e., calls 911).

Additional factors may affect when discovery is considered to have occurred. For example, a single indicator (e.g., smoke detector activation in a building with multiple detectors) could require that first responders arrive on scene and investigate the situation — their *eyes on* assessment could constitute initial discovery.

4.5.4.1. Direct Health and Safety Impacts

Incidents or conditions that represent, cause, or have the potential to cause serious health and safety impacts to workers or members of the public, and exhibit the general characteristics contained in the definition given in Section 5.3, are OEs.

(1) Discovery of radioactive or other hazardous material contamination from past DOE/NNSA operations that may have caused, is causing, or may reasonably be expected to cause uncontrolled personnel exposures exceeding protective action criteria.

Discussion. This example applies to the discovery of contamination that:

1. May have caused past, unrecognized exposures of about the same magnitude as would currently require protective actions when dealing with environmental release of hazardous materials, or

2. May pose a future threat of similar exposures. An OE of this type has two defining characteristics. First, if it is possible that people were exposed unknowingly in the past, effort may be needed to identify the exposed individuals, assess their exposure, determine if any of them exhibit health effects that could be linked to the exposure, and provide them with necessary medical follow-up. Second, without prompt and effective action, it is likely that people will continue to be exposed to the contamination. In either case, the acute dose or exposure to individuals who come in contact with the contamination will be at or above the level at which protective actions are currently planned when dealing with environmental release of hazardous materials. The example applies to any newly discovered onsite or offsite contamination area that was not under access control at some time in the past, or for which access control was not immediately established upon discovery, and personnel may thereby have continued to gain access without DOE/contractor knowledge while the magnitude and extent of the

contamination was being characterized. Minimum severity thresholds for this condition may have one of several bases, as follows:

- For radioactive material in general, a multiple of the Significance Category 2 Occurrence Reporting criterion for offsite radioactive contamination (Cf. DOE O 232.2A under Subgroup 6 B) may be used.
- For gamma emitters, dose conversion factors can be used to determine the contamination level that would result in a dose of 1 rem Effective Dose (ED) to a person exposed to the contaminated area for a short period of time (for example, a week or less).
- For radionuclides that pose an inhalation hazard, inhalation dose conversion factors and an assumed average resuspension factor can be used to estimate the surface contamination level that corresponds to a 1 rem dose commitment Total Effective Dose (TED).
- For nonradioactive hazardous materials, an assumed average resuspension factor can be used to estimate the surface contamination level that corresponds to an Acute Exposure Guideline Level (AEGL)-1 (or equivalent) concentration in air above the contaminated area.

(2) An occurrence (earthquake, tornado, aircraft crash, fire, explosion) that causes or can reasonably be expected to cause significant structural damage to DOE/NNSA facilities, with confirmed or suspected personnel injury or death.

Discussion. This example applies to events such as earthquakes, tornadoes, fires, explosions, and vehicle accidents that cause significant structural damage to DOE or contractor facilities, such that death or injury to personnel has occurred or might reasonably be expected. Damage to the structure does not need to be total or exceed any particular cost threshold, nor does death or injury need to be confirmed. The threat to personnel safety in conjunction with significant structural damage is the key to this example. Accordingly, a fire that destroys a building that is abandoned (or is thought to be unoccupied) is not an OE, whereas the collapse of the roof of a normally occupied building during working hours is an OE, even if no death or injury of the occupants is initially evident.

Methods. Any facility that is routinely occupied by personnel could be subject to such events. Because initial response to an event of this nature is likely to be carried out by local fire and rescue organizations, building emergency/fire plans, management notification lists, and incident command training (regarding the initiation of additional alarms or calls for backup units as OE recognition factors) can be used effectively to ensure recognition. Local Occurrence Reporting guidelines and training of Occurrence Reporting personnel may also prompt a review of the site-specific criteria for categorizing a building evacuation as an OE.

(3) Any mass casualty incident, as determined and documented by the site. The NFPA defines a mass casualty incident as "Any number of casualties that exceed the resources readily available from local resources." Each site will determine this threshold according to their BNA.

Discussion. This example applies to events that result in numbers of deaths or injuries that significantly exceed an occurrence reporting Subgroup 2A, Significance Category 1 threshold for occupational illness/injuries. A number and severity of casualties that exceed the readily available treatment capability defines the term *mass casualty*. Indicators of this level of casualties include the need to exercise triage at the event scene, request ambulances and medical personnel from offsite, or dispatch victims to multiple medical facilities to ensure adequate and timely treatment.

Methods. Emergency planners for facilities and sites may elect to establish site-specific criteria for mass casualty based on such factors as available emergency medical resources and distance to treatment centers. Emergency medical responder and incident command training and procedures can use that definition to ensure timely recognition and categorization of an OE. Since any event that has the potential to be a mass casualty will almost certainly be recognized as a potentially reportable occurrence, local Occurrence Reporting guidelines and training materials for Occurrence Reporting personnel can be annotated with the site-specific criteria for mass casualty.

(4) An unplanned nuclear criticality.

Discussion. Any unplanned nuclear criticality is an OE because it represents major failures of safety systems and practices and has the potential to cause facility damage, significant personnel injury, and the release of radioactive material. Criticality events that result in an airborne release of significant quantities of radioactive material to the environment are OEs requiring classification, as described in Section 5.5.

Methods. Only facilities dealing with fissionable materials in quantities approaching a minimum critical mass need to consider this potential condition. Local Occurrence Reporting guidelines and training of Occurrence Reporting personnel could be used to help ensure timely recognition and categorization of criticality incidents. Because most inadvertent criticalities will be classified as Alert or higher due to actual or potential radioactive releases, emergency classification (EAL) procedures and emergency response procedures should identify the specific conditions under which a criticality is to be categorized as an OE not requiring classification.

(5) An offsite hazardous material incident not associated with DOE/NNSA operations that is observed to have, or is predicted to have, an impact on a DOE site such that protective actions are required for onsite DOE workers.

Discussion. This example applies to any release of hazardous material from an external source that requires onsite personnel to evacuate or take shelter. Examples of such include releases that may originate from fixed facilities, release from transportation incidents outside the site boundaries (non-DOE transportation accidents on roads, railroads, or rivers outside the site), or releases from private industrial activities being conducted on the DOE site. However, if hazardous materials from the offsite incident could lead to loss of control over onsite DOE hazardous materials, then the incident should be classified on the basis of the potential onsite release. (See Section 5.5)

The need for onsite protective actions may be based on measurements or consequence projections by site personnel or on a recommendation from the on-scene IC, offsite emergency management authorities, or the responsible carrier. Any significant concentration of DOE or contractor personnel should be considered onsite for purposes of this example, even if they occupy a leased offsite building or facility. Such offsite buildings should be considered if the occupants have principal site operations and management responsibilities. Offsite subcontractor offices, hotels/motels, company picnics, and conference facilities need not be included.

The Federal OSHA 29 CFR Part 1910.38(b) uses a number of greater than 10 employees to determine *significant concentration* in an offsite location that should be treated as onsite for this OE category.

Methods. Because hazardous material releases may originate from any transportation artery and many industrial facilities, this condition applies to every site and facility occupied by DOE or prime contractor staff. Initiation of local area, site, and building emergency procedures, and associated building emergency action plans developed to comply with 29 CFR Part 1910.38 may be used to specify predetermined criteria to ensure recognition of this situation as an OE. Although DOE O 232.2A does not explicitly identify offsite hazardous materials incidents impacting DOE sites/workers as reportable occurrences, local Occurrence Reporting procedures, guidelines, and training of Occurrence Reporting personnel can be used to help ensure recognition. Because incidents involving onsite releases of hazardous material are classified in accordance with Section 5.5 of this guidance, emergency classification (EAL) procedures, which are likely to be consulted for any hazardous material incident with impact on people, can be used to identify this condition as an OE not requiring classification.

4.5.4.2. Environmental Impacts

Incidents or conditions that represent, cause, or have the potential to cause serious detrimental effects on the environment and exhibit the general characteristics contained in the definition given in Section 5.3 are OEs.

(1) Any actual or potential release of hazardous material or regulated pollutant to the environment, in a quantity greater than five times the Reportable Quantity (RQ) specified for such material in 40 CFR Part 302, that could result in significant offsite consequences, such as major wildlife kills, wetland degradation, aquifer contamination, or the need to secure downstream water supply intakes.

Discussion. The specified release of hazardous material or regulated pollutant to the environment is an OE if it results in actual or potential offsite consequences of the type and magnitude specified in the example. Although the Order refers to *offsite consequences*, many DOE sites contain sensitive and valued onsite environments. Examples include wetlands, streams, rivers, lakes, aquifers, and endangered species of wildlife. Such sensitive areas should be considered if contamination would generate response and interest equivalent to similar contamination of offsite areas. To facilitate recognition and categorization, sites and facilities should identify material storage and potential release locations, including locations on transportation routes, which could produce impacts such as those described in the example. This will allow releases to be categorized on the basis of the material, quantity, and release location rather than on field/in situ measurements of the impact, which may require days or weeks to quantify. Specific material release scenarios that, in addition to causing environmental degradation, have the potential to cause acute airborne exposure hazards to people are OEs requiring classification, as discussed in Section 5.5.

Methods. This condition applies to SFAs for which the All-Hazards Survey has identified quantities of hazardous materials or regulated pollutants that could cause significant damage to the environment. Plans, procedures, and training related to environmental spill response and reporting can be used to ensure recognition of the need to categorize specific releases as OEs. Local Occurrence Reporting guidelines and training of hazardous waste management and Occurrence Reporting personnel can also be used to prompt a review of the site-specific criteria for categorizing such releases as an OE.

4.5.4.3. Offsite DOE Transportation Incidents or Conditions

Incidents or conditions that represent an actual or potential release of radiological or non-radiological hazardous materials from a DOE shipment outside a DOE site and exhibit the general characteristics contained in the definition given in Section 5.3 are OEs.

(1) Any accident/incident involving an offsite DOE/NNSA shipment containing hazardous materials that causes the first responders to initiate protective actions at locations beyond the immediate/affected area.

Discussion. Initial on-scene response to any accident/incident involving offsite transportation of DOE-owned hazardous materials will be carried out by State and local EROs responsible for the accident locale. In many cases, while the vehicle may be placarded and the driver will be carrying MSDS, he or she may have no detailed knowledge of the potential hazard and no control over the actions of the local responders. If local responders determine that protective actions are necessary beyond the immediate incident scene, the incident is to be categorized as an OE by the DOE entity responsible for the shipment (usually the shipper). Thus, only two facts from the scene are needed to support an OE declaration:

- On-scene responders (the responsible local authorities) have implemented either evacuation or shelter as protective actions in response to the accident/incident

- The area within which protective actions have been implemented extends more than about 100 meters in any direction from the vehicle or spill location.

Even if no hazardous material release occurs, implementation of protective actions is likely to cause intense public awareness and media interest in the DOE shipments. It will also require the shipper and other DOE entities to support local authorities in assessing any hazard. Finally, any of several different DOE technical capabilities may need to be deployed to the scene to determine the status of the shipment, arrange for repackaging, conduct decontamination, and oversee disposal of waste.

Methods. Responsibility for recognizing, categorizing, and reporting OEs associated with offsite transportation activities rests with the DOE entity that has direct operational control of the shipment (usually the shipper). Transportation plans, procedures, and personnel training for specific types of materials may incorporate information and criteria needed to ensure that conditions requiring an OE declaration are promptly recognized and reported to the office or individual responsible for categorization.

(2) Failures in safety systems threaten the integrity of a nuclear weapon, component, or test device.

Discussion. This example applies to systems that prevent unauthorized access to nuclear weapons, components, or test devices during transport, and to the systems that prevent or minimize the likelihood of damage to or detonation of the weapon, component, or device. Significant failures of either type should be categorized as OEs if they require the deployment of technical support to assist transportation personnel in restoring the shipment to the required envelope of safety or security conditions.

Methods. For transportation incidents involving nuclear weapons, devices, or components, OE declaration may be keyed to the initiation of response procedures or reporting conditions that are unique to nuclear explosive safety incidents. As an example, incidents occurring offsite and categorized using Department of Defense (DOD) terminology, such as a *Bent Spear* or *Broken Arrow*, would both be OEs. Some Broken Arrow incidents would clearly be classified as Alert or higher if occurring on a DOE site, depending on the potential for release of radioactive material to the atmosphere.

(3) A transportation accident results in damage to a nuclear explosive, nuclear explosive-like assembly, or Category I/II quantity of Special Nuclear Materials.

Discussion. Offsite transportation accidents that cause actual or likely damage to devices or materials specified in this example should be categorized as OEs. Based on analyses conducted in accordance with Chapter 2, Section 2, observable indications of possible damage to the weapon, device, or material (such as fire or breach of shipping container) should be determined. If these indications are observed, the condition should be categorized as an OE.

Methods. For transportation incidents involving nuclear weapons, devices, or components, OE declaration may be keyed to the initiation of response procedures or reporting conditions that are unique to nuclear explosive safety incidents.

4.5.4.4. Hazardous Biological Agent or Toxins

Incidents or conditions that represent, cause, or have the potential to cause the release of Hazardous Biological Agent or Toxins contained in the definition given in Section 5.3 are OEs.

Discussion. The Select Agent Rules require immediate notifications to CDC or the USDA Animal and Plant Health Inspection Service (APHIS) upon discovery of ". . . a release of an agent or toxin causing occupational exposure or release of a select agent or toxin outside of the primary barriers of the biocontainment area...." These criteria for notification of CDC or APHIS HQ are consistent with the fundamental objective of an OE categorization, namely, to ensure prompt notifications to initiate a timely, effective response. To maintain consistency with the Select Agent Rules, the DOE Order and guidance incorporate, where applicable and appropriate, concepts and requirements of the rules. The DOE OE definition will supplement this general condition for notifications of biological incidents with the additional criterion that any actual or potential release of a hazardous biological agent or toxin be ". . . outside of the secondary barriers of the biocontainment area." The infectious nature of Select Agents and the lack of defined de minimus hazard levels support OE declarations under conditions that leave undefined a specific level of consequences (and hence health effects) or the quantity released into the environment.

The OE represents an actual or potential release beyond the secondary barriers of the biocontainment area into the environment. The environment may be the public area outside of a laboratory contained within a facility or may refer to releases directly outside a facility/building. Multiple transport mechanisms can be associated with the OE. Hazardous biological materials can be released to the outside environment or can contaminate humans, vectors, and fomite (i.e., inanimate objects such as clothing or equipment), and then be carried outside the facility. In the environment, they can persist in water systems and on surfaces (including environmental matrices such as soil) and again be transported by multiple mechanisms. Susceptible hosts that contact contaminated air, water, or surfaces may be vectors for further transmission of infectious biological agents.

Method. DOE biosafety facilities that have quantities of Select Agents/Toxins could experience major incidents or conditions involving or affecting these inventories that have the potential to cause serious health and safety impacts to collocated workers or the public. Unlike incidents involving other types of hazardous materials, OEs declared for release of hazardous biological agents and toxins will not be classified as Alert, SAE, or GE. They will, however, be categorized as OEs. Incident categorization initiates the dissemination of information about an OE so that proper response actions can be initiated at all levels of DOE and other Federal, Tribal, State, and local organizations and authorities. The capability needs to exist at a biosafety facility to perform categorization promptly and reliably for actual or potential releases to the environment.

All DOE biosafety facilities should establish criteria or indicators for determining quickly if an incident is a biological release OE. An OE will reflect the condition that the release is outside of the biosafety facility, defined as outside the secondary barriers of the biocontainment area. This definition is applicable for either the observed or unobserved release.

The onsite medical surveillance program for facility workers should be closely tied to the biosafety program and should have ready access to data related to agents/toxins in the biocontainment and to the associated criteria for recognizing OE based on disease characteristics/symptoms or toxic effects. Offsite surveillance activities, on the other hand, will require that the biosafety facility share similar criteria (or recognition factors) related to the agents/toxins being stored or used onsite. These indicators should be available at the offsite surveillance location to initiate prompt notifications back to the facility/site if a possible outbreak might be traced to a release from the facility. An OE would then be declared by the facility based on this communication from offsite.

Discretionary criteria for declaring a biological OE should be available to the person with categorization authority. Such criteria will enable the authority to declare an OE based on circumstances that are not covered under the existing program all hazards planning/technical planning basis.

4.5.4.5. Safeguards and Security Events or Conditions with Direct Health and Safety on Environmental Impacts

Events or conditions that represent, cause, or have the potential to cause degradation of safeguards or security conditions with actual or potential direct harm to people or the environment and exhibit the general characteristics contained in the definition given in Section 5.3 are OEs.

(1) Unplanned detonation of an explosive device or a credible threat of detonation resulting from the location of a confirmed or suspicious explosive device.

Discussion. Detonation or discovery of an explosive device at any DOE or contractor facility should be categorized as an OE. However, in some cases, the location of the explosive device and its size may need to be considered. For example, a common firecracker or rifle cartridge should not be considered an *explosive device* unless the conditions under which it is found or exploded suggest deliberate placement and destructive intent. Discovery or credible threat of any explosive device in a location where it clearly threatens DOE property or site personnel is an OE. Placement or detonation of a device that causes or threatens a release of hazardous material with the potential for acute airborne exposure hazards to people is an OE requiring classification, as discussed in Section 5.5.

Methods. All DOE and prime contractor facilities and sites are potentially subject to this type of malevolent act. Security plans and security response procedures may be used to identify criteria for declaration of an OE in terms of safeguards/security status or response level triggered by an event meeting these descriptions. Local Occurrence Reporting guidelines and training of Occurrence Reporting personnel can prompt a review of site-specific criteria for categorizing explosive device incidents as OEs.

(2) An actual terrorist attack, active threat, cyber security incident that impacts critical infrastructure, or sabotage incident involving a DOE SFA.

Discussion. An armed assault involving a DOE site, facility, or operation might be directed at an individual DOE or contractor employee, at gaining access to valuable property or sensitive/classified matter, or at causing damage to the DOE property. Therefore, the term *terrorist attack* should be interpreted broadly; any armed assault that takes place at a DOE or contractor facility should be categorized as an OE because the motivation for and objectives of the assault are not likely to be known until long after the fact. Exceptions to this generalization might include violent confrontations between individuals or simple acts of vandalism that take place incidentally on DOE or contractor premises. Any confirmed attempt to sabotage facilities or equipment should be categorized as an OE, even if it initially appears to be unsuccessful, because of uncertainty concerning other undiscovered, but related potentially destructive acts. If these destructive acts impact control over or result in the release of significant quantities of hazardous materials, they are OEs requiring classification, as discussed in Section 5.5.

Methods. All DOE and prime contractor facilities and sites are subject to this type of malevolent act. Local security plans, response procedures, and guidelines for reporting events of security concern may be used to identify criteria for declaration of an OE in terms of safeguards/security status or response level triggered by an event meeting these descriptions.

(3) Kidnapping or the taking of hostage(s) involving a DOE/NNSA SFA or operation.

Discussion. Kidnapping a DOE site employee or family member, or the taking of hostages, may be undertaken to extort money, materials, or concessions from the DOE or its contractor. DOE, its contractors, and their employees may come under great pressure to meet a perpetrator's demands, some of which might have safety, health, or environmental implications. Such occurrences should not be categorized as OEs if the kidnapping or hostage taking occurs off the DOE site and motivation for the crime is not believed to involve DOE interests (the kidnapping of children involved in a custody dispute).

Methods. All DOE and prime contractor facilities and sites are subject to this type of malevolent act. Local security plans, response procedures and guidelines for reporting events of security concern may be used to identify criteria for declaration of an OE in terms of safeguards/security status or response level triggered by an event meeting these descriptions.

(4) Deliberate release of radiological materials in a malevolent act, e.g., radiological dispersal device (RDD), or a deliberate exposure with radioactive materials, e.g., radioactive exposure device (RED).

Discussion. Deliberate release of radioactive materials in a malevolent act at any DOE or contractor facility should be evaluated and, if credible, categorized as an OE. Discovery or credible threat of an RDD or RED in a location where it clearly threatens DOE property or site personnel is an OE. Release of radioactive material with the potential for acute airborne exposure hazards to people is an OE requiring classification.

Method. DOE and prime contractor facilities and sites with radioactive materials are potentially subject to this type of malevolent act. Security plans and security response procedures may be used to identify criteria for declaration of an OE in terms of safeguards/security status or response level triggered by an event meeting these descriptions.

4.5.5. Classification of Hazardous Material Operational Emergencies

Incident classification is the process of assessing hazardous materials OEs to determine if they fall into one of the three emergency classes. Classification provides further definition to this subset of OEs beyond the categorization of *Operational Emergency*.

Incidents or conditions that involve actual or potential release of significant quantities of hazardous (radioactive or non-radioactive) materials to the environment and exhibit general characteristics contained in the definition given in Section 5.3 are OEs that require classification. The following characteristics distinguish these hazardous material OEs.

- The hazardous material is, or is likely to be, released to the environment (i.e., outside of a structure or enclosure).
- The material immediately threatens those who are in close proximity and has the potential for dispersal beyond the immediate vicinity in quantities or concentrations that threaten the health and safety of onsite personnel or the public.

- The material has a rate of transport and dispersion in the environment that requires time-urgent response to implement protective actions. Essentially all of these hazardous material OEs involve airborne releases because the air pathway represents the most time-urgent situation, requiring rapid, coordinated emergency response on the part of the facility, collocated facilities, and surrounding jurisdictions to protect workers, the public, and the environment.

A hazardous material OE is to be classified as either an Alert, SAE, or GE based on the projected or measured hazardous material impact. Classified emergencies are a subset of the OE category. The emergency classification cannot be downgraded, to avoid significant health and safety impacts caused by the overestimates, until termination of an incident. An OE can be upgraded in a given scenario where the classification can remain commensurate with response activities.

4.5.5.1. Principles of Incident Classification

During the development of an incident classification system, the following basic principles governing the purpose, expected results, and incident classification methods should be taken into consideration.

The purpose of a standard incident classification system is to:

- Initiate a set of pre-planned response actions appropriate to all incidents of a given class or severity (notification, mobilization of resources, and protective actions)

- Activate necessary analytical and decision-making capabilities to make sound determinations of the need for other actions

- Enhance the likelihood that mitigative action will be taken to prevent conditions from becoming more severe

Accurate incident classification is the key to achieving a graded response. A graded response is the mobilization of personnel and resources in proportion to the severity of incidents or conditions. An underlying purpose of incident classification is to minimize the impact of the consequences of an incident by quickly bringing technical resources to bear on the problem. The implementation of the incident classification process should provide for the following:

- Prompt notification of minor incidents to prevent escalation to more serious consequences

- Mobilization of resources to provide better management of the incident or to arrest degradation of safety

- Sufficient lead-time to activate facilities and prepare for protective actions

- Protection of the public and employees at some distance from the incident site in case of a release of hazardous material

- Prompt and accurate flow of information

Incident classification methods should have the following characteristics.

- Timely: If possible, classification of a degrading safety condition should occur early enough in the progression of incidents that effective use of emergency response resources could arrest degradation or reduce consequences.

- Reliable: Classification should be based upon indications that are consistently associated with the incident/condition and, whenever possible, have a direct correlation to the severity of the incident.

- Internally consistent: Different incidents of a similar severity should result in the same classification. Different indications of the same incident/condition should lead to the same classification decision.

- Anticipatory: Classification should be based on the most likely progression and future consequences of an incident or condition, not just the situation as it exists at the time it is recognized.

- Redundant: Whenever possible, there should be several different indicators and criteria for recognizing and classifying an emergency.

- Complete: The incident classification system should provide for recognition and classification of all the emergency incidents and conditions that are identified in the EPHA.

- Conservative: Where detailed or quantitative information is lacking, incidents should be classified on the basis of reasonably conservative estimates of conditions and consequences.

- Usable: Incident classification methods should incorporate sound human engineering principles (express EALs in units consistent with instrument readings and standard terminology, use consistent and familiar format, place all necessary information and references in one location, use color coding or other pointers).

- Integrated: Incident recognition and classification should be integrated with normal and off-normal operations practices. Entry points into the incident classification procedure should be identified in procedures. Instrument readings, checklists, safety notes, and precautionary statements in procedures, and other operational practices that support emergency recognition/classification should be identified.

4.5.5.2. Incident Classification and Protective Action Criteria

For emergency incidents/conditions involving the actual or potential release of hazardous materials, each emergency class is defined in terms of health impact or risk to the general public or SFA workers. If the impact or risk approaches or exceeds some predetermined level, then steps to protect the public and workers should be taken. These predetermined levels are expressed in terms of doses, exposures, or concentrations and are termed *protective action criteria*. The Order states that the specific Protective Action Criteria (PAC) to be used in emergency planning for radioactive materials are the EPA Protective Action Guides (PAGs). For toxic chemicals, the Order specifies one of three sources of PAC values. In order of preference, they are AEGLs promulgated by the EPA, Emergency Response Planning Guidelines (ERPGs) published by the American Industrial Hygiene Association (AIHA), and Temporary Emergency Exposure Limits (TEELs) developed by DOE. These PACs are discussed in detail in Appendix C.

The threshold between emergency classes can be defined in terms of the actual or potential consequences from a release of hazardous material resulting in a dose or exposure that exceeds a PAC at the predetermined receptor location (30 meters, facility boundary, and site boundary). Alternatively, the Alert may be defined in terms of consequences exceeding the PAC could be expected outside the facility at or beyond 30 meters from the point of release, but not beyond the facility boundary. An SFA should choose one of these definitions and use it consistently. SFAs are discouraged from developing EAL sets based on both Alert definitions.

At the SAE level, consequences exceeding the PAC could occur onsite, at, or beyond the facility boundary, but not offsite or in onsite areas where the general public has unescorted access. A General Emergency exists when consequences could exceed the PAC at or beyond the site boundary or in onsite areas where the general public has unescorted access.

For purposes of this guidance, *unescorted access* correlates to the site boundary definition contained within Chapter 2, which states:

> *If the general public can gain unescorted access to areas of the DOE site, such as public highways or visitor centers, those areas should be considered as offsite for purposes of emergency class definition, unless it is assured that those areas can be evacuated and access control established within about one (1) hour of any emergency declaration.*

Note that it is not the intent of the guidance related to classification to suggest that wind direction-dependent initial classification criteria (EALs) be developed. In general, the use of real-time meteorological conditions as a factor in determining initial incident classification (*and initial protective actions*) is not encouraged. Doing so requires a sophisticated understanding of the local atmospheric transport/dispersion environment, accurate information on current meteorological conditions, and a high degree of confidence in the forecast. It also complicates, and potentially lengthens, the decision process. The need for reliable real-time weather information and on-call meteorological expertise, together with the added complexity of the decision process, make such an approach unsuitable for reaching timely, conservative, and anticipatory classification (*and protective action*) decisions as required by DOE emergency management policy.

Finally, results of the EPHA are used to identify specific indications (i.e., alarms, monitor readings, sample results, observed conditions) that correspond to actual or potential consequences that equal or exceed a PAC at the receptor of interest. These indications become the criteria (EALs) by which incidents are classified as Alert, SAE, or GE.

4.5.5.3. Emergency Class and Severity Level

The severity of each of the three OE classes and the general extent (area) of impact intended is summarized in **Table 4-1**.

4.5.5.4. Integration of Incident Classification with Normal Operations

Monitoring of various indications and recognition of abnormalities and their safety significance are routine functions of a facility's operations staff. The transition to emergency operations begins with recognition of specific indications or symptoms of an emergency incident or condition. To the extent possible, methods to enhance detection and recognition of emergencies and transition to emergency operations should be integrated with routine operating practices. Detailed guidance is presented in Appendix F.

Table 4-1. Summaries of Emergency Classes

Emergency Class	***Facility***	***Weapons/Devices/Components***
Alert	Substantial actual/potential degradation of level of safety. Hazardous material releases are not expected to exceed PAC levels at or beyond facility boundary.	Substantial actual/potential degradation of level of safety. No immediate threat to workers or general public.
SAE	Actual/potential major failures of functions needed for protection of workers. Hazardous material releases could exceed PAC levels beyond facility boundary, but not offsite.	Actual/potential system failures that threaten the integrity of the device. May adversely impact health and safety of workers in immediate vicinity, but not the general public.
GE	Actual/imminent catastrophic reduction of safety systems with potential or actual loss of hazardous material. Hazardous material releases could exceed PAC levels offsite.	Actual/likely catastrophic failures of safety or secondary systems threatening the integrity of the device. May adversely impact health and safety of both workers and public.

4.5.5.5. Downgrading Classification

In general, the emergency classification should not be downgraded until termination of the incident. However, emergency classification must be reviewed periodically to ensure the classification is commensurate with response activities.

4.5.6. Development of Emergency Action Levels (EALs)

4.5.6.1. Role of the Facility EPHA

For each release scenario, the EPHA identifies likely initiating conditions and contributing incidents (such as fire, equipment failure, or loss of power) and methods by which either the initiating condition or the release might be detected and recognized. Examples of detection/recognition methods include alarms, instrument readings, equipment status indicators, field or laboratory measurements, or direct observations of conditions or phenomena (such as fire or high winds).

For detection and recognition methods that correlate directly with consequences, the EPHA provides a basis for calculating specific values or conditions that correspond to each emergency class. Specific values or conditions (instrument readings, sample analysis results, equipment status, etc.) indicating that a PAC has been or will be reached at the facility or site boundary should be identified as EALs. For example, if a particular release of radioactive material through the facility's stack would produce consequences exceeding the PAC at the site boundary, and one means of detection is the installed stack monitor, then instrument readings corresponding to the Alert, SAE, and GE classifications should be calculated and defined as EALs.

In some accident situations, it may not be possible to confirm or quantify the hazardous material release. However, if a readily recognizable *incident* or *occurrence* is determined to have the potential to cause release of hazardous material, but the actual release would be impossible to confirm or quantify in a timely manner, then recognition of the incident itself becomes the EAL, and classification is based upon the maximum consequences determined in the EPHA. In many cases involving non-radioactive hazardous material in outdoor storage areas, there is no installed instrumentation to detect or quantify a release. As a result, EALs for this type of hazardous material storage are usually stated in terms of the initiating incident (such as a vehicle crash or explosion) or the observed release condition (spray from pressurized piping, spilling of liquid), and the resulting incident classification is based on the consequences of releasing the maximum quantity of material known to be present.

The correlation of EPHA information and data leading to the creation of EALs is briefly discussed in Chapter 2, Section 2.6.3.

4.5.6.2. Symptom-Based and Incident-Based EALs

By custom and usage, EALs that are stated in terms of specific symptoms (or combinations of symptoms) of a degraded safety condition are termed *symptom-based* or *symptomatic*. EALs that are expressed in terms of the occurrence of an incident or condition that is generally recognized by the sum of its features and characteristics are described as *incident-based*. The distinction is not absolute and some EALs may actually exhibit both qualities.

Symptom-based (symptomatic) EALs define the emergency condition in terms of one or more facts or observations, such as instrument readings or alarms. By definition, existence of the *symptom* is sufficient basis for declaring an emergency and the emergency *needs to be declared* if the symptom is observed. It is not necessary for the person making the classification decision to know anything about the underlying cause or the sequence of incidents that produced the symptom.

In general, symptom-based EALs are most applicable to well-instrumented and more complex process facilities. The symptoms may indicate actual release of hazardous material or the actual or impending failure of barriers or controls that keep such materials in a safe condition. Using symptomatic EALs, the classification decision can be reached by simply comparing the observed *symptom* (alarm, instrument reading, and equipment status) to the EAL. No additional interpretation or understanding of the underlying cause or sequence of incidents is required.

Incident-based EALs are stated in terms of incidents or conditions that are recognized by the sum of their features, indications, and characteristics (a major earthquake or ventilation system upset). To apply such an EAL, the user should assess all the observed facts/indications in the context of a written definition or common understanding (the *institutional knowledge*) of the incident addressed by the EAL. The user needs to decide if the *incident*, as represented by the sum of its indications, corresponds to the intent of the EAL.

For incident-based EALs, the degree to which the incident is expected to degrade the safety of hazardous materials will determine the emergency class. Safety degradation may result from the incident's detrimental impacts on systems and equipment, confinement barriers, or the ability of personnel to monitor or control vital processes. The rationale that connects the occurrence of the incident, the actual or possible loss of control over hazardous material, and the emergency class should be clearly documented in the EPHA. For example:

- Situation. Collapse of Building X is expected to damage containers of hazardous material. Release of the material is shown in the EPHA to produce consequences exceeding the SAE criterion. Structural analysis indicates severe damage to the building is expected if ground acceleration exceeds 0.2 g.

- <u>Incident EALs for Building X (SAE)</u>.

  – Earthquake with sensible ground motion indicated by displaced furniture.

  – Earthquake causes collapse or significant structural damage to Building X.

- Basis/Rationale. If horizontal ground acceleration exceeds 0.2 g, Building X is expected to sustain severe structural damage and may collapse. Even if the structure remains standing through the initial shocks, it may be so weakened as to collapse without warning. Until the building has been inspected for latent damage and judged sound OR the hazardous material inventory has been removed, imminent release of the material should be assumed following ground acceleration of 0.2 G (horizontal) or greater. If the building collapses without warning, the release will begin immediately and any necessary protective actions will have to be carried out under conditions that are more hazardous. In anticipation of an imminent release, an SAE declaration is warranted.

By focusing the decision-maker's attention on a few key parameters and indications, symptom-based EALs make the classification decision process more timely and less subject to error. For facilities where safety-significant systems are monitored with instruments and alarms, a large fraction of the EALs may be symptomatic in nature, whereas classification procedures for simple facilities with few instruments will consist almost exclusively of incident-based EALs. In general, all EAL sets should contain incident based EALs for major incidents (such as fire or earthquake) that are addressed in the EPHA.

Incident-based EALs should be stated in quantitative or objective terms by including, if practical, specific conditions that define the incident. For example, the first Building X example EAL given earlier in this section could be enhanced by identifying the source of the ground acceleration measurement: *Earthquake with ground acceleration exceeding 0.2 G (horizontal) as measured at (location/ instrument).* Purely symptomatic EALs are not very practical for some types of incidents. Classifying incidents involving security challenges, for example, may require that a number of qualitative factors and indications (such as the national terror alert status, the availability of backup response from offsite law enforcement agencies, or the credibility of specific threats) be taken into account when determining the overall degree of safety degradation.

Table 4-2 illustrates key differences between incident-based and symptom-based EAL statements for the same condition. **Tables 4-3 and 4-4** illustrate symptom-based and incident-based EALs for conditions of the same type and increasing severity.

4.5.6.3. Barrier Approach to EAL Development

Physical and administrative controls that maintain hazardous materials in a safe condition can be viewed as barriers to release. In some cases, it may be possible to define the degree of safety degradation in terms of the status (intact, challenged, or failed) of specific barriers. However, classification criteria (EALs) that relate emergency class to barrier status need to be justified, in each case, in terms of the basic class definitions and classification principles. Because barriers will vary widely in their importance to safety, locally defined emergency class distinctions based on barrier status will tend to be valid only for a specific material, location, and barrier configuration. Since too few applications within DOE, such as reactors, benefit from the potential advantages, simplification, and improved internal consistency of the classification system to justify the extensive development and documentation effort, the system will not be addressed in detail here. See Appendix G for suggested guidance.

Table 4-2. Examples of Incident-Based and Symptom-Based EAL Statements for the Same Initiating Condition

Initiating Condition	***Incident-Based EAL Statement***	***Symptom-Based EAL Statement***
Fire	Fire in the chemical make-up room of the ABC facility that is not extinguished by automatic fire suppression systems.	Potential loss of chemical make-up room integrity *as indicated by*: Chemical make-up room temperature greater than 300° F for >5 minutes as indicated on FP-T-007 **OR** Negative pressure in chemical make-up room of less than 0.25 in. H_2O (convert) as indicated on DP-CMR-96.
Radiological release	Fire, explosion, or cooling water system rupture reported in the 243-X HEPA filter or charcoal banks.	ABC stack alpha monitor PA-SM-691 reading > 3E+3 µCi/sec (convert) **OR** ABC particulate gamma monitor PG-SM-96 reading (convert) > 5E+4 µCi/sec.
Natural phenomena	Observed wind/tornado damage to ABC facility creating the potential for a radiological release.	ABC building integrity loss as indicated by: Any ABC Facility fence line FL-ARM-2001 system monitor reading >1 mrem/hr, **OR** HVAC system not maintaining > 0.2" w.g. (convert) negative pressure in Ventilation Zone A.

Table 4-3. Example Symptom-Based EALs for Different Severity Levels for the Same Initiating Condition

Initiating Condition	Alert	SAE	GE
Nitric acid tank release	Tank NA-15 level decreasing at > 1.0 ft/min (with no transfer operation in progress and pump discharge valve N.V.-3 indicating shut)	Tank NA-15 level decreasing at > 2.5 ft/min (with no transfer operation in progress and pump discharge valve N.V.-3 indicating shut)	Tank NA-15 level decreasing at > 5.0 ft/min (with no transfer operation in progress and pump discharge valve N.V.-3 indicating shut)
Radiological release (see formula)	Stack Monitor I-40 (µci/cc) X SF-50 (CFM) X (4.27 E-4) reading > 2E0 Ci/sec OR Any combination of two ARMs or portable survey instrument readings >500 mrem/hr in the area outside the ABC Facility, but within the security fence	Stack Monitor I-40 (µci/cc) X SF-50 (CFM) X (4.27 E-4) reading > 1E+1 Ci/sec OR Any combination of two fence line ARMs or perimeter portable survey instrument readings of >1000 mrem/hr	Stack Monitor I-40 (µci/cc) X SF-50 (CFM) X (4.27 E-4) reading > 3E+1 Ci/sec OR Any combination of two portable survey instrument readings outside the security fence of >1500 mrem/hr OR Any combination of two portable survey instrument readings at the site boundary of >500 mrem/hr
Waste tank failure by internal reaction	3 hottest RTDs > 90°F AND Any 2 pressures > + 1 in H_2O	3 hottest RTDs > 90°F AND Any 2 pressures > 1.0 PSIG in past hour AND "A" OR "B" rupture disk failure alarm	No analyzed chemical reaction and tank failure result in General Emergency

Table 4-4. Example Incident-Based EALs for Different Severity Levels for the Same Initiating Condition

Initiating Condition	Alert	SAE	GE
Nitric acid railroad tank car release within facility boundary	Rupture of 2-in. transfer line during Xfr operation **OR** Other minor breach **AND** Visible acid plume length or personnel distress at >2 RR tank car lengths	Rupture of 5-in. transfer line during Xfr operation. **OR** Other major breach **AND EITHER** Visible acid plume length or personnel distress at >4 RR car lengths **OR** Plume crossing facility security fence line	With present use of 80% nitric acid and limit of one RR tank car at the facility, there is NO RR tank car rupture scenario resulting in a General Emergency
Process line A loss of power (only applicable in mode A operation)	Loss of AC power to SWGR A-19 for >20 minutes	Loss of AC power to SWGR A-19 for >1 hour **AND** Any 2 local or panel A-RTD-10 temperatures exceed 500°F	Loss of AC power to SWGR A-19 for >2 hours **AND** Indication that process line A is auto-catalytic by ANY of following indications: Panel A-RTD-10 temperatures >1000°F **OR** Visible smoke outside room A **OR** Shift Manager judgment
Natural phenomena impact: Tornado	Tornado observed on site and approaching facility as confirmed by either: Visual report **OR** Wind speed > 80 mph on MET tower M-16 or M-19	Tornado observed to touch down within facility boundary as confirmed by either: Visual report **OR** Wind speed > 80 mph on MET tower M-20 or AM-1	Tornado-driven objects breach filter Bldg F-202 walls as indicated by either: Observed damage to building walls or exterior panels **OR** HVAC system unable to maintain > 0.2" w.g. negative pressure in F-202

4.5.6.4. Site-wide EALs

Most emergencies that involve or affect a single facility or activity will be classified using facility/activity-specific indications and EALs. However, some conditions external to the facility may also represent general or specific threats to control hazardous materials and therefore warrant classification. Such conditions are not necessarily identified through the EPHA process and are likely to be classified only by a site-wide emergency management authority. Examples include:

- Incidents such as earthquakes, severe weather or floods, that may degrade control over hazardous materials at multiple operating areas or facilities
- A security incident or degraded condition not specific to a single facility/activity that may affect site hazardous materials facilities

- Offsite hazardous material releases that may cause degraded control over onsite hazards
- Onsite hazardous material transportation accidents that occur away from any facility

Personnel responsible for developing EALs should be cognizant of initiating incidents that are site-wide (non-facility-specific) and applicable to multiple facilities and should ensure that EALs for such incidents are included in facility and site-wide classification procedures.

4.5.6.5. Discretionary EALs

To compensate for possible incompleteness in the EAL set or unanalyzed conditions, such as concurrent incidents or loss of essential instrumentation during an accident, *facility and site classification procedures should contain EALs that the responsible individual can use to declare the level of emergency that most closely corresponds to the apparent conditions, even if it cannot be determined that any other specific EAL has been exceeded.* These judgment or discretionary EAL statements are necessary to ensure that any unforeseen emergency condition can be rapidly classified using a straightforward criteria-based decision process. Judgment EALs should be provided for *all three emergency classes*. For example, if PAC has been potentially exceeded at the site boundary, then a discretionary EAL should be developed.

4.5.6.6. Equipment Availability

Equipment expected to provide key indications used to classify some emergencies may be non-operational in certain scenarios (due to loss of power, extreme environmental challenges, or conditions outside the operating range of instruments). The likely availability and usefulness of indications and instruments under emergency conditions should be considered when selecting EALs to classify those very conditions. Whenever possible, classification procedures should include redundant EALs that make use of different means of detection, such as visual observations by facility staff, and readings taken with portable survey instruments.

4.5.6.7. Facility Operational Modes

If applicable, the different operational modes of a facility (operating versus shutdown) should be considered when developing EALs. A specific instrument reading may clearly indicate an accident condition in one operating mode, but not in another. Also, an instrument that is relied upon to detect an accident condition during normal operations may not be available while in stand-by mode. For example, during routine operations in a facility, an elevated reading on a specific area radiation monitor may be a clear indication of an emergency condition; whereas the same reading may be normal and expected when shielding is removed during maintenance. Classification procedures may have separate sections for each operating mode or the mode applicability of individual EALs can be noted in the procedure.

4.5.6.8. Method of EAL Presentation

Facility EALs should be approved by management and issued in the form of an EPIP that embodies good human factors principles. The technical bases for the EALs should be maintained separately in either a basis/reference document or the facility EPHA. The following factors should be considered in determining the method of presentation.

- Intended User. A person closely associated with the facility, such as a shift manager/supervisor, senior operator, or duty officer, will usually perform the initial incident classification. Therefore, the facility's incident classification procedure should be presented in a form familiar to operations personnel. After the ERO has been activated, the classification responsibility will typically pass to an emergency director (manager) who will make classification decisions using site-wide classification guidelines and facility EALs, as well as input from facility staff and other elements of the ERO, such as a CAT in the command center or EOC.

- Conditions of Use. The facility EAL procedure should be designed for use during times of rapidly changing conditions, uncertainty and high levels of user stress, such as often exist during the initial incident classification when the decision-maker may also be directing facility response activities.

- Availability of Assistance. The initial user of the procedure will likely have the least amount of help in interpreting the EALs. Therefore, all the information necessary to make an initial classification decision should be presented clearly in the EAL statements.

The users of the EAL procedures should play an integral role in the development of the classification tool. The users should be comfortable with the presentation style of the EALs and have no difficulty in interpreting the terminology, criteria, and logic of the EAL statements. Their input should be solicited throughout the development of the procedures so that the users can take ownership of the final product and mechanisms developed for verification and validation of EAL accuracy and usability (see Section 5.7 below).

4.5.6.9. Incident Termination Criteria

Once an OE has been declared, EALs should never be used to downgrade (reduce) the emergency classification. Instead, general criteria should be established in the emergency classification procedure, or elsewhere, that will allow ERO personnel to formally terminate the emergency response and enter into a recovery phase. *Protective Actions* criteria and guidance are provided in Chapter 4, Section 8; *Termination and Recovery* is addressed in detail in Section 11.

4.5.7. Testing Categorization Criteria and EALs

4.5.7.1. Operational Emergencies Not Requiring Classification

Proposed facility or site criteria for categorizing OEs that do not require classification should be tested against potential scenarios to ensure that the criteria developed for each OE is complete; discriminates between occurrences included in the Reporting Levels *High*, *Low*, and *Informational*, and the Reporting Criteria Groups of the DOE O 232.2 Occurrence Reporting and Processing of Operations Information; depends on recognizable observables related to the incident or condition; and can be effectively and accurately used by the responsible authority to ensure an accurate and timely categorization.

4.5.7.2. Operational Emergencies Requiring Classification

The proposed facility or site EALs should be tested against a range of initiating conditions and accident/emergency incident scenarios to determine if the indicated emergency class is appropriate. If necessary, EALs should be modified or additional EALs developed to ensure that the full range of possible emergency conditions could be classified in a timely manner. It is also prudent to test the EALs in a simulated response environment (drills and table-top exercises) with the personnel who will actually apply them (Emergency Directors, Shift Supervisors, etc.), to ensure that consistent, timely, and correct classification decisions are reached.

4.6. Notifications and Communications

4.6.1. Introduction

The purpose of this chapter is to assist DOE and NNSA field elements in complying with the DOE O 151.1D requirement to ensure that *initial emergency notifications* are made promptly, accurately, and effectively to workers and emergency response personnel/ organizations, appropriate DOE/NNSA elements, and other Federal, Tribal, State, and local organizations and authorities. Following the initial notifications, accurate and timely follow-up notifications or *emergency status updates* should be made when conditions change, when the classification is upgraded, or when the emergency is terminated. Also, continuous, effective, and accurate communications among response components or organizations should be reliably maintained throughout an Operational Emergency (OE).

4.6.2. General Approach – Notifications and Communications

Prompt and accurate notifications are essential during OEs to mitigate consequences, activate EROs and facilities, recall essential personnel, and notify offsite agencies responsible for protecting the health and safety of the public. An emergency notification system should provide timely notice to site and facility personnel, DOE or NNSA field Operations Centers, and Federal, State, Tribal and local EROs and authorities for all emergencies under the most limiting set of adverse conditions. Provisions should be in place to continue effective communication throughout an emergency. All aspects of notification should be carefully preplanned, documented, and tested under a variety of adverse conditions, and implemented through approved notification procedures, reliable primary and backup communications equipment, and formal training programs.

Notifications and Communications associated with OEs are designed to perform the following:

- Protect facility and site personnel and emergency workers through dissemination of information necessary to implement accountability and protective actions (PAs), such as sheltering and evacuation;
- Notify cognizant offsite authorities and agencies, including applicable Federal, Tribal, State, and local organizations, which have PA decision-making authority for the emergency to facilitate public notification;
- Activate elements of the ERO, consistent with the categorization and classification of the emergency;
- Provide initial notifications, emergency status updates, and effective communication among EROs throughout the emergency;
- Formally document categorizations and classifications, notification times, PAs, PARs, and emergency condition changes;
- Comply with regulatory notification requirements;
- A timely, reliable, and accurate communications system is essential for emergency notifications, and provides the framework for conducting emergency response operations within the facility or site, to higher-level management, and to offsite response organizations. Establishing adequate communications to support on-scene activities is a time-urgent operation. Equally important to effective management of the emergency response is timely establishment of communications to offsite support organizations (Cf. Chapter 4, Section 3), including verification that initial notifications were received. Elements of this communications system include the communications equipment, a notification system (to include reporting requirements), and a simple and effective information management structure;
- Development and implementation of notification and communication capabilities should be commensurate with hazards and depend on the results of the All-Hazards Survey and EPHAs. The guidance in this chapter supports the development of communications systems for facilities/activities with varying types and levels of hazards and with differing organizational structure and complexity.

4.6.3. Notifications

DOE Orders and other Federal regulations require extensive internal (within facilities and DOE or NNSA) and external (offsite) notification and reporting. Emergency notifications are time sensitive and provide information necessary to initiate a variety of response actions. Incident information and reporting requirements may be duplicative across Orders and regulations. Notification procedures should be designed to differentiate between critical notifications associated with OE response and other less urgent information and reporting requirements. The SFA must have the ability to provide immediate notification and protective actions to affected employees no later than 10 minutes after the protective actions have been identified. SFAs also must have the capability to notify local, State, Tribal, and Federal authorities of classified Operational Emergencies within 15 minutes of categorization.

Due to the critical importance of response measures taken in the early stages of an emergency, such as making appropriate public notifications and implementing timely protective actions, the content of initial emergency notification messages should focus on information needed to facilitate these essential activities, including:

- Assessing accident consequences;
- Initiating onsite PAs for workers and others in the affected facility and collocated facilities;
- Developing and providing PARs to offsite authorities for notification of the public;
- Activating the ERO, EOS, and EOCs; and
- Augmenting facility staff.

If actions have already been taken, the results of the activities should be relayed. Notification should not be delayed in order to fine-tune information (the "perfect should not be the enemy of the good"). The notification system should also include a rapid method to provide emergency status updates when emergency conditions and information change. Both initial notifications and emergency status updates should use a pre-arranged and standardized content and format.

4.6.3.1. Notification System

Provisions should be in place for prompt initial notification of workers and emergency response personnel and response organizations, including appropriate DOE or NNSA elements and other Federal, Tribal, State, and local organizations. Continuing/effective communication should be maintained among the ERO throughout an emergency. Key elements of developing an effective notification system include:

- Specify the organizations or individuals to receive notifications by job position or title;

- Establish a recall system used to make initial notifications and emergency status updates to primary and alternate response staff that includes authentication and acknowledgement indicating success of the contact. Identify the most appropriate notification system(s) – pagers, cell phones, public address systems, landlines, radios, etc., to be sure all response staff are reached;

- Organizations receiving emergency notifications should have a capability to receive and acknowledge reports on a 24-hour basis;

- Notification messages, methods, and procedures should be an established part of annual training offered to affected organizations and individuals;

- Preplanning should include consideration of special circumstances, such as power outages or other conditions, which could affect notifications;

- Periodic verification of all emergency telephone and fax numbers;

- Notification systems should be designed to permit multiple notifications at the same time preferably using an automated *blast* system rather than individuals calls.

The notification system developed and implemented for a given site or facility should be consistent with the potential hazards of the facility, as determined by a current All-Hazards Survey and EPHA. Where several facilities at a site are dependent on a single site notification system, the system design will be more complex. Each additional interface increases complexity in equipment, procedures, personnel, and training. Standardization and simplification of procedures, forms, and interfaces can result in systems that are more efficient. Separating critical notifications from routine or administrative notification and reporting further simplifies critical notifications.

4.6.3.2. External Notification Requirements

According to DOE O 151.1D, the manager/administrator, or designee, of each DOE/NNSA or contractor-operated SFA should provide initial notifications to:

- The Field Element or appropriate Federal Manager, HQ Watch Office, and potentially affected State, local, and Tribal organizations, at a minimum, must be notified within 30 minutes of declaration or termination of an Operational Emergency.

- If the Emergency Operations System is activated for an incident not categorized as an Operational Emergency, the site/facility/activity must notify the Field Element and HQ Watch Office within 30 minutes of the Emergency Operations System becoming operational in accordance with the emergency management plan.

- Notifications to the DOE/NNSA HQ Watch Office should be made by individuals trained under the Emergency Operations System who contain adequate expertise to effectively detail the event or incident. Sites cannot use automated calls to the HQ

Watch Office from the site directing it to review electronic mail and fax communications for additional information.

Rapidly changing conditions should dictate more frequent status updates. Significant changes in incident conditions, requiring a change in classification or protective actions, require notification as soon as practicable. If a change occurs while a notification or follow-up message is being sent, the outgoing message should be completed and then immediately followed with an updated report.

Initial emergency notifications require time-urgent reporting to DOE/NNSA HQ Watch Office. Emergency notifications to the HQ Operations Center should consist of a phone call providing as much information as is known at the time. The same information is also provided by e-mail or a fax either immediately before or following the phone call. Information for initial notification includes as much as possible of the following:

- Description of the emergency;
- Date and time emergency was discovered or terminated;
- Damage and casualties;
- Protective actions implemented;
- Potential and actual impacts;
- Agencies involved;
- Level of public/media attention;
- Contact information.

The DOE O 151.1D Attachment 3, Notifications and Communications requires for Emergency Notifications to be made to the HQ Watch office by the SFA IAW established Line Management Authorities for the specific SFA. Such authority can be bestowed on a Federal employee or contractor M&O as determined by the responsible authority. The primary focus of this requirement is for prompt notification of event/incident and verification of situational awareness by DOE/NNSA HQ Senior Leadership. This requirement does not preclude the authorized individual or responsible agent from simultaneous notification, nor SFA-specific sequential notification as established by Emergency Standing Operating Procedures.

The intent of DOE O 151.1D is to have an individual who is closest to the SFA where an operational emergency is occurring, or potential substantial degradation of incidents for an operational emergency to occur; to provide the DOE HQ EOC with initial notifications.

The primary focus of the Office of Emergency Management Policy is that the call is made as required by the DOE O 151.1D Attachment 3, Emergency Management Core Program, Section 11, Notifications and Communications, and leaving the SFA's with the flexibility to identify how each will best meet this requirement.

4.6.3.3. Onsite Notifications

Onsite notification messages to facility personnel should support activation of the facility ERO (including necessary recall) at a level appropriate to the incident categorization/ classification. These initial notification messages should contain sufficient information to initiate immediate and appropriate protective response for personnel in the facility. Prearranged, standardized scripts for public address announcements to be made for various emergency scenarios and classifications should be used. Public address or alarm systems in high noise areas should also be considered. Pagers, where used, should provide for positive feedback through call-in or other methods to confirm that notification was successful and recall of personnel will be achieved. Other SFA-specific procedures may be necessary, depending on whether sites have collocated facilities; field offices, which are not located onsite; or other non-standard arrangements.

4.6.3.4. Initial Offsite Notifications and Emergency Status Updates

Report content and format for both initial notification and emergency status updates should be prearranged, standardized, and described in the emergency management plan and implementing procedures. Initial notification messages should be brief and contain information that supports higher DOE or NNSA HQ activation decisions and offsite authorities need to alert the public and implement PAs. Although initial notification information should be tailored to offsite agency needs, the time, date, location, contact point or person, type of emergency, appropriate emergency class and time, current incident status, and the PAR should be included.

Both the site or facility and the receiving offsite agency should use identically formatted *fill-in-the-blank* and *check-box* message forms. Close coordination between the SFA and offsite agencies will be necessary to standardize the message format and the initial information requirements. In addition, offering to provide similar training to offsite communicators as given to SFA communicators could facilitate information transfer without uncertainties, questions, or delay.

At the onset of the emergency, some issues may not be known or not understood in sufficient detail. Lack of specific information should not preclude or delay notifications. When information is not available, the responsibility for emergency status updates should be identified and communicated in the initial notification message. The emergency status updates should be used to supplement the initial notification as information becomes available. The following information should be considered to update what was previously not covered in the initial notification requirement in section 6.3.2:

*(1) Location (site/facility/building) of the incident, name, organization, location, and telephone number of the caller

*(2) Indication of whether incident is still in progress

*(3) Categorization and classification of emergency and time of declaration

*(4) Brief description, date, time of the incident, and time zone

*(5) Injuries or casualties involved

*(6) Status of the affected SFA

*(7) Status of other facilities/operations/activities on the site

*(8) Type of actual/projected release and duration (source term or release characterization)

*(8A) Release in progress (Yes/No)

*(8B) Actual or projected doses or dose rates that exceed Protective Action Criteria (PAC) at a critical location (the site boundary, municipal jurisdiction, school, hospital, reservoir) relative to the organization receiving the notification

*(9) Recommended protective actions with timing considerations, where applicable

*(10) Notifications made

*(11) Level of any media interest at the scene of the emergency or at the SFA

*(12) Contact information of the DOE or NNSA point-of-contact

To document reports, the reporting organization should record the organizations notified and the names and positions of the persons contacted. Where dedicated ring-down circuits are used to established emergency or operational centers, such verification may not be necessary. Documentation is extremely important with regard to incident reconstruction, lessons learned, protective action recommendation decisions, litigation, and liability. Copies of all reporting forms should be retained and archived.

In accordance with DOE O 151.1D, all emergency-reporting messages should be preplanned and addressed in the training program, procedures, and form development so that classification considerations will not delay notification.

Content of initial notification messages to Tribal, State and local EROs should be negotiated with those agencies and documented in the SFA emergency management plan and any Memoranda of Agreement or similar documents. For those offsite organizations with their own consequence assessment capabilities, information needed to perform the consequence assessment should be provided to the extent available. In the event that state and local agencies refuse to participate in the planning effort, facility plans should call for providing the information specified in 40 CFR Part 355, as well as the incident categorization and classification.

4.6.4. Communications

A formally established and documented communication chain (including within the ERO and organization, site-wide, to the JIC, to offsite organizations) should form the basis for all notifications and communications during an emergency incident. Decisions on communications requirements should be based on an analysis of All-Hazards Survey and EPHA results that considers the severity of potential emergency incidents and the functions to be accomplished by the response organization.

4.6.4.1. Communications Equipment

Communication system equipment should satisfy the following general criteria:

- Highly reliable primary equipment with backup equipment identified, powered by uninterruptible power sources where appropriate;
- Compatibility of technologies among all onsite and offsite response organizations;
- Periodic routine testing during normal and off-hour periods and demonstration during drills and exercises;
- Security provisions commensurate with the type of information being transferred. Classification and other reviews that may be necessary should be preplanned to eliminate potential delays.
- An authentication or verification system should be established among notification network parties, except for dedicated circuits in secure facilities;
- Specific communication frequencies, telephone numbers, and verification details should not be quoted in public documents;
- Ability to handle voice and data communications, as well as a teleconferencing capability. A video-teleconferencing capability is preferred;
- Ability to record all voice communications.

Selected communications equipment, which could be used in notification and reporting systems, includes standard cell phones (including texting capabilities) and landlines, dedicated leased lines, automatic ring-down circuits, fax, radio, paging systems, and computer data transfer configurations. Dedicated phone lines, automatic ring-down circuits, and dedicated fax capabilities are preferred over standard phone lines or radio circuits, which are more subject to overload, failure, or compromise. Ring-down circuits are particularly useful where numerous towns, counties, or agencies are involved with a single site. All equipment should have formal procedures incorporating the operating instructions, qualified operators, and identified backup equipment in case of primary equipment failure independent of commercial telephone line failures.

Installed Public Address and siren systems should accomplish the notifications of workers and onsite public:

- Building and area alarms or public address systems should be installed to alert facility personnel to emergency conditions;
- Siren systems with protective action specific signals (sheltering in place, evacuation);
- Systems should be in place for notification of onsite workers and the public who are present onsite, but outside the immediate vicinity of the affected facility;
- Where agreements with offsite agencies dictate, systems should alert the public outside the site boundary;
- Facility personnel should be trained to recognize distinctive siren signals and know the appropriate actions to take.

Installed voice communications systems should be developed with the following characteristics to accomplish notification and information exchange processes consistent with potential response requirements:

- Reliable equipment exists for communications with emergency organizations and response personnel.;
- Dedicated primary and backup voice communications links are provided between key emergency response facilities and sufficient non-dedicated voice communication links are provided to access offsite organizations;
- Mobile and commercial phone lines are available.

Technical specifications, compatibility, reliability, and security of communications and data transfer equipment for use in EOCs should be considered in selecting communications equipment. Consistency and compatibility between transmission methods is essential.

Equipment should be included in a formal preventive maintenance program. Where interfaces exist between onsite and offsite equipment, agreements should be negotiated to ensure all components of the communication system are maintained. Special maintenance response agreements may be necessary for vendor-supplied notification equipment, such as pagers, tone-alert radios, copiers, or fax machines.

4.6.4.2. Effective Responder Communications

Continuous, effective, and accurate communications (for notification and reporting) among response components or organizations should be reliably established and maintained throughout an OE. *Continuous communications* implies that there is no loss of the ability to communicate when needed; there is *continuous* connectivity or capability to communicate. *Continuous* includes frequent or periodic in the sense that whenever it is necessary to communicate with a response component, nothing prevents that from happening.

Uniformity and standardization in content and format are important to each site's notification and reporting scheme to ensure that all organizations can effectively exchange technical information. Plain language should be used; the use of jargon should be avoided. Uncommon or SFA-specific abbreviations and acronyms should be fully described in oral notifications and spelled out in subsequent written reports.

Notifications and reports should use measurements, terms, acronyms, abbreviations, building names, etc., that are known and agreed to ahead of time by all parties. Notification clerks, communicators, and dispatchers should be trained and qualified to minimize communication errors.

Aspects of standardized notifications that should be considered for offsite organizations are:

- Methods and provisions for verification of message authenticity
- Possible methods, primary and backup, by which each organization may receive communications
- Feedback links for verifying information or requesting additional information (without interfering with site or facility operations)
- Facility-specific terms, acronyms, and measurements
- Methods used to conduct system tests; testing frequency
- Methods to ensure differentiation between exercise and real incidents
- Minimizing differences between facility notification systems
- Use of consistent time zones in communications. (All communications should use the same time zones or always identify the time zone when discussing times.)

4.6.5. Response Documentation

An essential activity associated with the emergency response is the implementation of a formal system to record, sequence, validate, and track the flow and chronology of emergency information. Notifications and key communications should be properly documented; they should be displayed in emergency response facilities to keep the ERO staff and decision-makers current on the emergency condition and response activities. Hard-copy or electronic logs should be maintained and other record-keeping methods used to support post-incident analysis, report production, and a legally defensible chronology of notification and communications activities. Records should be maintained according to the requirements in the National Archives and Records Administration (NARA)-Approved DOE Record Schedules, which lists the schedule for maintaining retention and dispositioning of the required records. (Record retention is a requirement of DOE O 243.1B Chg 1, *Records Management Program*.)

4.7. Consequence Assessment

4.7.1. Introduction

The purpose of this chapter is to assist DOE and NNSA field elements in complying with the DOE O 151.1D requirement that the impacts of the release of (or loss of control over) hazardous materials be evaluated during an OE. The Order requires that estimates of onsite and offsite consequences of an actual or potential release of hazardous materials be effectively estimated in a timely manner throughout the emergency. Consequence assessments are 1) to be integrated with incident classification and protective action decision-making functions; 2) incorporate facility and field indications and measurements into the assessments; and 3) to be effectively coordinated with offsite agencies.

The capabilities and processes of the Consequence Assessment program element necessary to meet the time-urgent and accurate consequence estimate needs of emergency response are addressed in this chapter. The guidance focuses specifically on the processes implemented by initial responders, CAT personnel, and others who provide the necessary information for decision makers responsible for ensuring the health and safety of workers and the public.

4.7.2. General Approach – Consequence Assessment

Consequence assessment involves the analysis, evaluation, and interpretation of available information associated with an actual or potential release of hazardous materials to the environment for estimating impacts (i.e., potential exposures or doses to the workers and to the public). These estimates are then compared to applicable human health indicators, PACs for toxic chemicals and PAGs for radiological material, and used as the basis for emergency management decision-making for DOE/NNSA and involved Tribal, State, and local organizations. Consequence assessment results support decision-making in the following areas: incident classification, protective action determinations, notifications to and communications with DOE/NNSA Field Elements and HQ, Tribal, State, and local organizations, and emergency public information.

The primary objective of the consequence assessment process is to provide timely and useful information to assist emergency response decision makers in making informed decisions to protect people (workers, the public, and responders) from the potential consequences of a release of hazardous materials. For purposes of this guidance, *timely* means rapidly enough so that informed decisions can be made and protective actions subsequently implemented to avoid or reduce consequences to people (dose savings). *Useful* means the right information in the correct units and in sufficient detail, which is communicated clearly and effectively to the appropriate people. *Information* includes answers to the following key questions: "Where will the impact be observed?", "Who will be affected?", "When will the impact begin?", "When will the impact end?", and "What will be the nature and magnitude of the impact?" In addition to facility or site emergency managers, other important recipients of consequence assessment information include responders, in-field commanders, workers, the public, the media, regulators, and Tribal or other government officials.

Consequence assessment capabilities at DOE/NNSA sites should reflect the type and magnitude of potential hazardous material releases included in SFA EPHAs and should primarily apply to worker locations and the public within the EPZ. However, the capability should be flexible enough to address consequence assessment in a limited extension beyond the EPZ to include the key receptors identified in the EPHA and provide assistance to Tribal, State, and local authorities, as requested. The capabilities should include support for confirmatory field/environmental monitoring.

The guidance identifies three phases of the consequence assessment process: 1) Incident recognition, categorization/classification, and initial protective actions; 2) TIA; and 3) Continuous Ongoing Assessment (COA). The guidance primarily focuses on the second and third phases that follow the conservative consequence estimates implicit in the *initial* assessments. TIA provides the process for supporting and confirming the critical *initial* pre-planned decisions, using available real-time data. The COA is the subsequent cyclic activity that occurs throughout the emergency that refines the initial assessments as more confirmatory information and resources become available.

The appendixes to this guide provide detailed discussions of two areas of concern for consequence assessment. Appendix H contains a brief discussion of consequence calculations related to the radioactive material ingestion pathway, which can carry over into the recovery phase following emergency termination. Appendix I provides guidance on various aspects of field monitoring and how the results can be integrated into the consequence assessment process for both radioactive and chemical hazardous materials.

4.7.3. Decision-Making in an Emergency Environment

The consequence assessment process consists of a series of technical activities in which information related to an OE involving an actual or potential release of hazardous material is identified and collected, analyzed and calculated, assessed to estimate consequences (i.e., adverse human health impacts), communicated to appropriate response personnel and agencies, and used in interfaces with other program elements. The process needs to provide useful support for emergency decision making when and where it is needed, under complex and changing conditions.

The dynamic conditions that exist during an emergency incident that have the greatest effect on the structure of the consequence assessment process and its essential decision-making role include the following:

- Time-Urgent Need for Decision Support. The need for information and timely assessments is greatest in the earliest stages of an emergency because of the need to make prompt and correct protective action decisions; unfortunately, information on the incident and the resources available to assess consequences in the initial stages of an emergency are often limited. Consequence analysis support for initial response decisions (i.e., classification and protective actions) is provided during the planning process. The tools provided to assist with these first response decisions and actions are based on consequence calculations performed for and documented in the EPHA. These *initial* determinations are among the most critical and time-urgent that the decision maker will make in the first minutes of the response; it is within this early period that the overall seriousness of the incident should be determined as accurately as possible in order to broadly establish the overall scale of the emergency response. Hence, the need is truly *immediate,* since incorrect determinations at this stage can have a significant negative effect on the subsequent emergency response.

  With the initial incident classification and initial protective action decisions (PADs) made and preplanned response actions begun, the next decision support need is to confirm that the initial decisions were accurate, appropriate, and conservative (i.e., protective of workers and the public), based on a first assessment of incident-specific information. Like the initial decision, this confirmation is a high priority and time-urgent need for the decision maker.

- More data and increasingly accurate data should become available about the incident as it progresses. This allows the usage of consequence assessment tools that are able to produce more fully informed consequence estimates.

- Availability of Information. While the need for decision support is greatest at the beginning of the response, the availability of information on which to base projections is most limited early in the emergency. Usually, very little relevant information is available at the beginning of an incident, and what information is available may have large uncertainties, may be conflicting, or may be simply wrong. These limitations and uncertainties of the information need to be understood, reconciled, and communicated. As the emergency progresses, the information needed to project consequences typically improves in both quantity and quality. The ability to acquire the available information for consequence assessment use also improves overall as more human resources become available within the ERO. In some situations, however, a fast moving, complex emergency may cause information saturation and overload to occur, where the availability of too much information, arriving too fast, becomes an unwelcome, complicating factor. In these cases, the skill of the consequence assessment personnel becomes critical in determining which information to integrate into the process.

- Availability of Consequence Assessment Resources. Both technological and human resources are needed to perform consequence assessment. The classification authority (Duty Officer, Facility Manager) usually activates these resources immediately following the classification of an OE. Thus, the real-time consequence assessment process begins after the *initial* classification and PAD have been made. As with other functions or activities in the ERO, consequence assessment capabilities will increase as individual CAT members arrive at their work center. All CAT members should be trained to perform TIA activities so that the first personnel to arrive can begin the initial assessment. As the team continues to assemble, more of the consequence assessment objectives can be met. On-call SMEs and specialists can be subsequently activated, as needed, and brought into the assessment by the core team. Finally, there are sufficient resources to establish specialized work groups to address auxiliary functions (evaluate contingency incidents, plan reentry activities, support recovery planning). If the emergency is protracted, rotating shift coverage may be required.

Considering the decision-making environment described above, it has been determined that consequence assessment can be most effectively performed in three distinct phases to meet the expected changing conditions of an OE. These phases are designated as:

1. Initial: Incident Recognition, Categorization/Classification, and Protective Actions
2. TIA
3. COA

The following section describes the general characteristics of the consequence assessment process during an OE.

4.7.4. General Consequence Assessment Process

The initial phase of consequence assessment follows incident recognition and selection of the appropriate EALs. The EALs should be developed using reasonably conservative consequence estimates to determine *initial* (default) categorization/classification and associated *initial* (default) protective actions. With this initial phase of consequence assessment completed, the next time-sensitive activity is to quickly *confirm* that the initial decisions were appropriate and conservative (i.e., protective of workers and the public). Like the initial decision, this confirmation is of high priority and time-urgent.

The TIA is the first attempt during consequence assessment to incorporate real time incident information and is conducted in the very early stages of response, as soon as trained members of the ERO are available. This activity includes a review of the most current incident information available to ensure that the most appropriate EAL was chosen and that initial calculations of consequences, based on current incident information and meteorological conditions, confirm that the *initial* PADs are protective of workers and the public. If the original recommendations are not sufficiently protective, then modifications to the initial protective actions should be made. The TIA information also serves as the initial basis for addressing health and safety concerns for on-scene response personnel and for directing the initial efforts of field monitoring teams. Hence, the results of the TIA are essential. Even if incident information is lacking or unverified, pre-planned incident and source term information (associated with the EAL) and simplified calculation methods should be available for these early, critical consequence calculations.

During COA, the improving flow of information and data is processed to enhance the accuracy of the consequence assessment estimates. The results are used to:

- Determine if changing conditions warrant increasing the incident classification;
- Modify or extend protective actions;
- Provide information to support health and safety recommendations for response personnel;
- Direct field monitoring activities;
- Integrate field-monitoring results into the total consequence picture;
- Provide field-monitoring information to the local, State, Tribal, and Federal organizations/agencies;
- Compare and reconcile assessment results with those of other response agencies;
- Perform *what-if* calculations to explore options for decision makers;
- Update protective action recommendations to offsite agencies;
- Assess consequences from additional pathways (ingestion, resuspension);
- Provide information to support the public information process;
- Provide information relevant to incident termination.

Further assessments are needed throughout the emergency as the data related to the incident becomes available, the incident itself changes, and environmental conditions change. As control is gained over the emergency and conditions stabilize, consequence assessment results are required to support the recovery planning process. This information may be necessary to support reentry activities, identify health and safety concerns, and formulate long-term protective actions related to environmental contamination.

The initial phase of the consequence assessment process uses EALs that contain an initial classification and protective actions that were developed during the emergency management program planning process, based on the analysis of scenario results documented in the EPHA. This initial phase is not strictly a process, but a single decision that produces critical initial information about the OE based on available incident information. The initial incident classification contained in the EAL represents an initial consequence projection or a bounding estimate of consequences relative to the PAC at specified distances from the incident. Hence, the initial classification is more than just an administrative label to be included on notification forms; it yields the very first estimate of consequences related to the unfolding OE incident. The initial protective actions are preplanned actions to be taken by site workers and, as appropriate, recommended for the offsite public, based on the same consequence estimates used to initially classify the incident.

The two subsequent phases can be represented by a general consequence assessment approach consisting of five basic tasks:

- Identify and Collect Data/Information
- Analyze and Calculate
- Assess and Estimate Consequences
- Communicate
- Interface

Task 1: Identify and Collect Data/Information necessary to conduct a consequence assessment. The data and information gathered is verified as much as possible within the time constraints and urgency of the requirements. This information may include: incident information for refining the source term, meteorological conditions, key receptors (impact locations, areas, or population distributions), and field monitoring results.

Task 2: Analyze and Calculate is the application of consequence assessment tools to analyze the information that has been gathered to estimate source term, based on incident observations and indicators; and perform transport and dispersion calculations to produce consequence estimates, based on the source term and meteorological conditions; compare consequence calculation results with the appropriate PAC at identified receptor locations to estimate the magnitude of impact.

Task 3: Assess and Estimate Consequences involves the assessment and best estimate of consequences at that particular time for each receptor. The task involves the integration of modeling and, as available, monitoring results to produce a best estimate of consequences. Estimated consequence projections, incident classification and the appropriate PACs are summarized for unambiguous comparison. In addition, communication with health practitioners is critical to facilitate administration of the most appropriate care for injured and contaminated or exposed personnel.

Task 4: Communicate all of the results described above. Ensure that the results are prepared and subsequently communicated in a form that can be used quickly and unambiguously by site emergency decision makers and affected Federal, Tribal, State, and local agencies in making emergency response decisions.

Task 5: Interface with appropriate ERO components. Ensure that the current classification and protective actions remain valid and sufficient to protect the health and safety of workers and the public or are appropriately adjusted. For example, interfaces with Emergency Public Information (EPI) personnel ensure that results released to the public and to the media are consistent, are interpreted correctly, and are accurately transmitted to offsite entities. (Here *accurately transmitted* implies that the information produced by the CAT and intended for distribution to offsite entities is the information actually transmitted to them.)

4.7.5. Initial Incident Recognition, Categorization/Classification, and Protective Actions

As previously stated, initial incident recognition, categorization/classification, and protective actions are the first consequence assessment results that are obtained, providing the extremely important and time-urgent decision support for initial incident classification and protective action determinations. Incident parameters and incident symptoms are recognized through direct observation of incident indicators (fire in a building; puncturing of a 55-gallon drum) or the monitoring of specific indicators, such as equipment that detects the consequences of the incident. Comparison of the observed indicators to the set of EALs leads to the selection of the applicable EAL. No specific detailed calculations are required because initial, conservative consequence estimates are provided in the selected EAL.

Because the consequences are pre-calculated, the full range of potential incident parameters associated with the specific hazardous material source, the daily variability of meteorological conditions, or possibility of frequently changing meteorological conditions occurring during the emergency *cannot* be reflected in the single calculation associated with each EAL. To account for the broad range of potential incident and meteorological condition uncertainties, the projected consequence estimates, and thus incident classification and initial protective action decisions, are developed with deliberately conservative parameters. This conservatism bounds the emergency response, ensuring that initial protective actions are sufficient to protect the health and safety of the workers and the public.

The process and methodology for performing a SFA EPHA and developing criteria for incident categorization and classification are discussed in the Chapter 2, Section 2, and Chapter 4, Section 5. Initial protective action determination is discussed in Chapter 4, Section 8.

4.7.6. Timely Initial Assessment

The purpose of the TIA phase is to provide a rapid confirmation of the initial incident classification and protective action decisions. Early in a response, actions are taken to use available real-time information to improve the quantitative understanding of potential impacts. TIA yields a rapid, incident-specific estimate of the potential consequences, based on known incident conditions and current meteorological conditions. Since TIA occurs at a time when decision support is time-urgent, information is most likely limited, and consequence assessment resources are minimal, uncertainties in the projections will usually remain substantial. However, TIA estimates of the consequences should provide sufficient accuracy and bounding conservatism to confirm that initial decisions are sufficiently conservative to protect workers and the public. TIA can also provide consequence results for preliminary emergency response planning needs (support to incident scene responders, dispatching field monitoring teams, determining rally points, facility habitability).

Prior to the arrival of the full ERO CAT, TIA may be conducted by consequence assessment-trained first response personnel, by on-call members of the CAT who possess the necessary tools and information in their homes or other remote locations, or by the first members of the CAT to arrive at the EOC.

The consequence assessment process specific to TIA is shown in **Figure 4-2**. Sufficient information and resources should be available soon after the EAL selection (~30 minutes to 1 hour) to perform an initial consequence assessment that is specific to the actual or potential incident. Source term and receptor information should be based on the EAL selected and associated calculations from the EPHA, with modifications appropriate to the incident observations and indicators based on available information from the incident scene and other sources. Meteorological information should be based on state observations from the nearest onsite meteorological monitoring station or representative National Weather Service (NWS) station unless the incident is localized. However, as indicated in the figure, the availability of field monitoring information is unlikely at this early time in the response.

Lack of verified information on the incident or source term should not preclude TIA from being performed. Since timeliness and a conservative assessment are essential characteristics of TIA, it is important that the process be designed to work effectively and efficiently using the limited information expected at this early stage of an emergency. The following discussions of the basic process tasks provide suggestions for developing an efficient TIA process that quickly produces a conservative, useable decision in spite of incomplete or uncertain information.

4.7.6.1. Identify and Collect Data/Information

The three inputs required to perform a consequence assessment are incident observations and indicators, meteorology, and receptors. Field-monitoring results are not likely to be available in the early stage of consequence assessment, except in the rare instance that the initial emergency recognition is triggered by field-monitoring activities.

To facilitate the TIA process, emergency planners should take the following steps:

- Develop assumptions and default inputs to support rapid estimates;
- Organize assumptions and default inputs and key them to recognizable incident conditions;
- Identify expected sources of real-time information to replace assumptions and default inputs and estimate when they are expected to be available;

- Make provisions for incorporating real-time information into the analysis once it becomes available;
- Identify receptor locations of interest based on initial real-time meteorological conditions.

The information listed above can be organized for use by one or more calculation tools to aid personnel in making a rapid estimate of consequences, based on the limited information available in the first few minutes of response. Well-organized material, necessary in an emergency response situation, can facilitate easy access and convenient numerical manipulation.

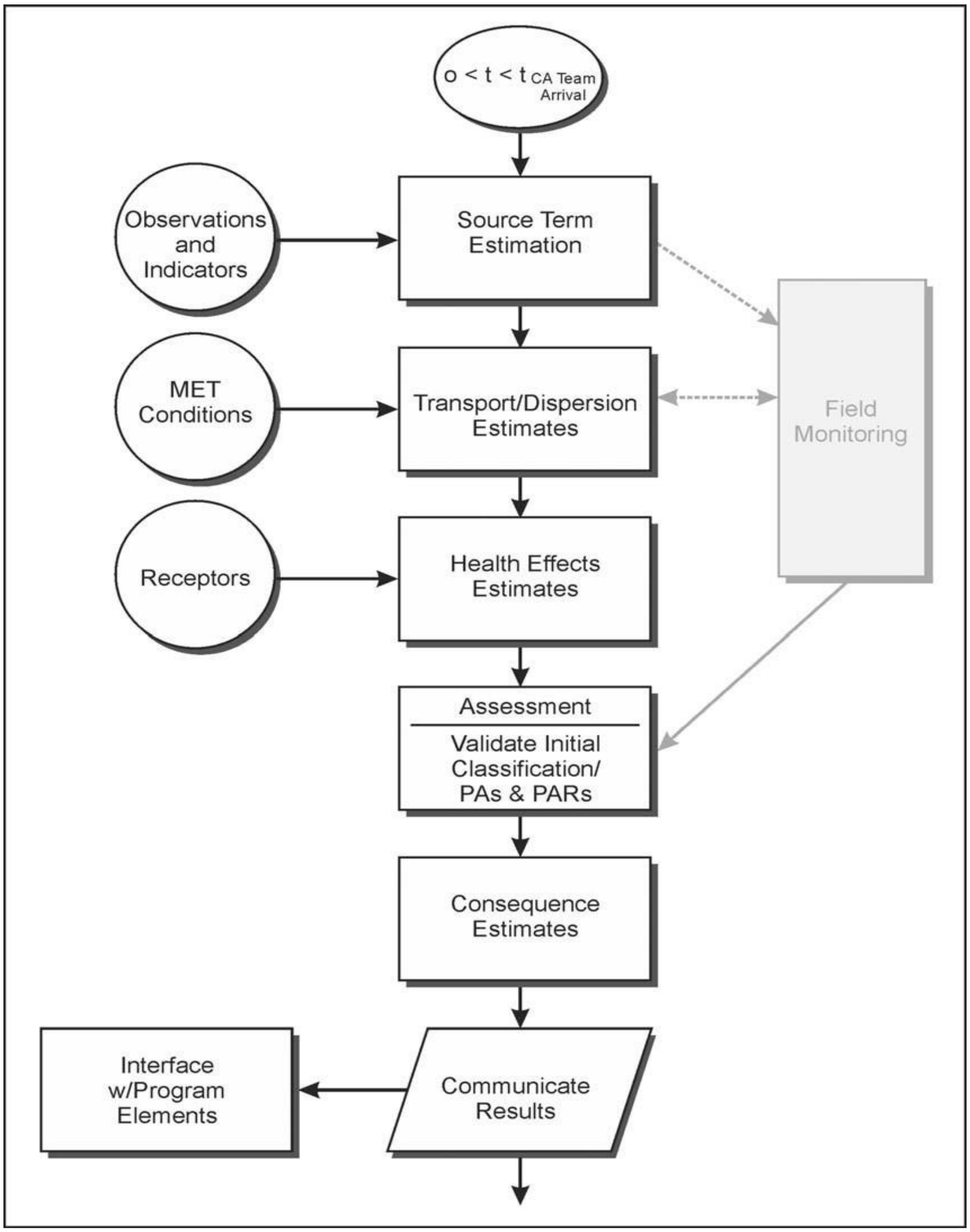

Figure 4-2. Basic Functions in the Timely Initial Assessment Process

4.7.6.2. Analyze and Calculate

Personnel responsible for the TIA should be provided with, and trained to use, fast-response consequence assessment modeling tools and simple, real-time environmental data to support their ability to quickly refine pre-calculated results.

An EPHA identifies a range of initiating incidents and scenarios that could lead to the release of hazardous materials. Potential consequences of each scenario are estimated and summarized in tabular form. These pre-calculated consequences, in conjunction with results of other types of analyses, serve as the bases for the development of initial consequence assessment tools and protective action recommendations. Central Registry codes like HotSpot and EPIcode are recommended by Subcommittee for Technical Analysis and Response Support (STARS) for use in developing predetermined protective actions because they are based on 95% worst-case meteorology at the release facility and do not need to take into account spatial and temporal variations in winds that cannot be predicted during the development of EPHAs and EALs.

For performing consequence assessment and adjusting protective actions and protective action recommendations it is recommended that workhorse models are also used for close distances and when winds are fairly constant. Typically, a Central Registry code like HotSpot or EPIcode will be run in parallel with a workhorse model to provide a quality assurance check (to ensure the models are providing results that are similar when conditions allow a direct comparison of results). Central Registry examines the SQA of a given version of a model (and only that one version) in great detail, but does not evaluate technical quality for specific applications. The STARS consequence assessment modeling (CAM) toolbox examines the SQA program in place for the development and maintenance of models so that it automatically accepts new versions from approved programs. STARS also emphasizes the need to evaluate both software and technical quality before choosing a model to apply. References that go into detail on what the STARS CAM Toolbox and Central Registry require are provided in the answer to the next question.

To support the effective use of TIA tools, pre-determined release parameters and supporting release assumptions should be gathered together, and indexed for quick reference. To help the user quickly identify the most applicable pre-calculated release parameters, they should also be keyed to observable conditions and EALs. Presentation of data in tabular or graphic format will allow the user to interpolate or more closely approximate actual conditions. Source terms and pre-determined assumptions about the release should be briefly described and readily available so that it is possible, under emergency conditions, to efficiently select the source and release information that is most representative of the incident to use as listed or to modify to fit the available information about the incident and release location.

Rapid, conservative decision making at this stage takes precedence over assuring the certainty of consequence assessment. Simplified calculation models use initial assumptions and default inputs to support rapid estimates of consequences. The data provided to models should include inputs for release rate and magnitude for radioactive or chemical source terms and atmospheric transport and dispersion conditions. Default input sets should be organized and keyed to recognizable conditions to aid users in quickly selecting the most appropriate inputs. Consequence assessment personnel should be sensitive to changes in input parameter values and be able to explain and qualify results to all decision makers.

Expected sources of real-time information that replace assumptions and default values should be identified. If some sources of information come from offsite organizations, prior arrangements should be implemented through an MOU to ensure its availability. Provisions should be made for incorporating real-time information (instrumentation readings and sample results) into analyses as soon as it becomes available. Whenever possible, back-up sources of information should be identified.

The meteorological input for TIA calculations should include real-time data on the wind direction and wind speed representative of near-surface conditions in the area of the release location. An estimate of the rate of atmospheric mixing should be provided. These may be obtained from direct measurements or be computed by the TIA models based on readily available parameters (time of day, cloud cover, wind speed). Other models used during the TIA phase may incorporate meteorological data from multiple locations (including measurements of winds aloft) to provide a more realistic estimate of initial plume movement and behavior. This may be particularly useful in areas of complex terrain.

4.7.6.3. Assess and Estimate Consequences

The resulting TIA consequence projections are assessed and compared with those from the initial EAL-based incident classification and protective actions. This comparison is used to determine if the initial EAL-based incident classification and protective actions are reasonable and appropriately conservative. It should be noted that the initial incident classification should not be downgraded as the result of the TIA analysis, unless it is determined that the classification was made in error. An incorrect choice of applicable EAL, which underestimates required protective actions, should be corrected as soon as the validation process is complete and the error is identified. In contrast, corrections of overestimates of severity should only be modified with caution and to avoid significant health and safety impacts caused by the overestimates.

TIA yields a rapid, incident-specific estimate of the potential consequences based on known incident conditions and current meteorology. TIA estimates of the consequences should reflect sufficient accuracy and conservatism to confirm that initial decisions are sufficiently conservative to protect workers and the public; if not, the protective actions should be modified.

4.7.6.4. Communicate

Results of the consequence assessment should be transmitted to decision makers in the ERO using formal, written worksheets and notification forms and briefings, as necessary. Facilities should ensure that TIA results are communicated in a clear, concise, and timely manner to the person with the responsibility to perform subsequent incident categorization/classification and notification. Key uncertainties that may affect the selection of protective actions should be documented to assist decision makers in interpreting the results and making defensible recommendations. An estimate of the time that the first complete consequence assessment results will be available should also be communicated. Information that differs from initial or previous notifications should be clearly indicated and documented and provided to the proper individuals for offsite communications.

A clear and straightforward format should be developed and used for communicating results, and both providers and decision makers should be thoroughly trained in their use. The results should be connected easily and clearly to the specific protective actions to be implemented. A map or graphic display may also be considered because a preliminary *picture* depicting the affected areas and potential consequences may lend clarity.

4.7.6.5. Interface

TIA results provide initial response personnel with the best available real-time estimate of consequences for their use in planning or implementing emergency response activities. At this point, the primary interface will be with the ED (or appropriate position title for person in charge of the ERO) and, to some degree, with the IC or on-scene support staff. The ED needs information to determine the adequacy of previous incident classification and protective actions and to determine if further protective actions are necessary. The IC will need information to determine protection measures for on-scene responders.

4.7.7. Continuous Ongoing Assessment (COA)

The purpose of COA is to project updated consequences as the emergency progresses and the incident characterization improves in both quantity and quality of information. The COA phase begins when TIA is complete and builds upon improved information and technical and human resources. The COA ends at incident termination, but may transition to a recovery phase ongoing assessment, based on recovery phase conditions, that is not bound by Order 151.1D Consequence Assessment requirements. The COA builds upon increasing levels of sophistication in the analysis tools, input accuracy (source term, meteorology), technical expertise, and eventually feedback from field monitoring efforts, all lead to refined projections, which are more reliable and realistic than the EAL-based assessments and TIA results.

The consequence assessment process specific to the COA phase is shown in **Figure 4-3**. Incident, source, meteorological, and receptor information become increasingly complete, comprehensive, and reliable during this phase. Field monitoring information may become available, especially for later assessments.

With additional resources and time for analysis, more comprehensive consequence projections can be conducted. These serve as further refinements to the results and recommendations from TIA, as well as updated analyses and recommendations for the changing incident and the changing meteorological conditions. At this point in the analysis, forecasted meteorological conditions should be incorporated. The incident classification is reevaluated, but not downgraded, during each assessment and PADs are updated.

COA is performed in a cyclic fashion, incorporating the most current data and information into each cycle. Since emergency decision making depends critically on timely consequence assessments, urgent results cannot wait on the anticipation that the data will shortly become more complete and accurate. The goal is to use all currently available information and data to refine the assessment continuously to reduce uncertainty and to improve accuracy and understanding by using improved input information, sophisticated models, and the expertise of SMEs. Tasks include the use of all available current information and data to: (1) re-evaluate incident classification; (2) re-evaluate protective actions; (3) initiate and confirm health and safety decisions for responders; (4) coordinate and reconcile results with offsite CATs; and (5) perform *what if* estimates in anticipation of changing conditions and to support requests from decision makers. In the later stages of response, COA can provide information to support a termination decision and initial recovery planning.

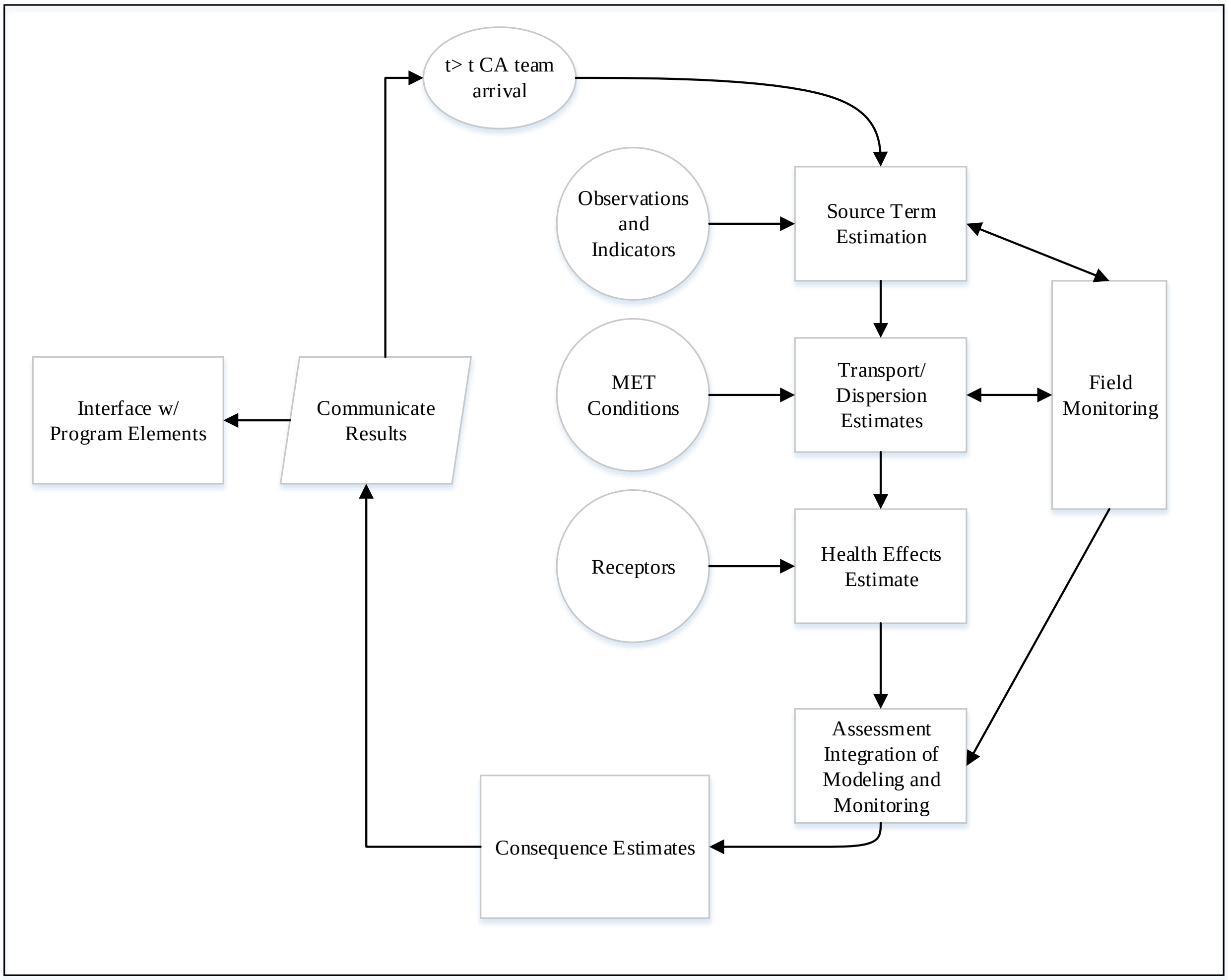

Figure 4-3. Basic Functions in the Continuous Ongoing Assessment

4.7.7.1. Identify and Collect Data/Information

As with the TIA, procedures should be established for incorporating incident-specific data into analyses as it becomes available. Methods and instrumentation should be identified to determine the status of affected systems, release parameters, and environmental conditions. These methods and instrumentation should be specific to the point of release, pathway, and material of concern. Methods and equipment should be referenced and incorporated into consequence assessment procedures, with the following considerations:

- Identify and reference in procedures any methods or documents that could be used to determine potential source-term (i.e., hazardous material) inventories.
- Establish correlations between monitoring instrument readings and consequences (dose rates from count rates).
- Identify instrumentation that provide information for developing estimates, but do not necessarily directly measure the quantity or concentration of released or stored

material; document correlations between instrument readings and quantities of interest.

- For identified instrumentation, provide all necessary conversion factors and measurement techniques.
- Develop methods to acquire and use real-time meteorological data and meteorological forecast conditions.
- Develop methods to acquire and use elevation data at a resolution capable of capturing terrain features significant enough to influence wind flows.
- Establish procedures for incorporating incident-specific data into analyses as it becomes available.
- Identify alternative methods for gathering input information.
- Develop plans and procedures for supporting field monitoring activities and provide the tools/training necessary to incorporate the information into the consequence assessment process.
- Develop a method for verifying the accuracy of data and information received.
- Identify SMEs within the organization who collectively have expertise involving the properties and health effects associated with exposure to each hazardous material of concern. Ensure that they are members of the CAT or are available for consultation at any time during the emergency response.

Data and information needed to perform consequence assessment falls into four categories: observations and indicators; meteorological conditions; receptor locations; and field monitoring results. The first category of information, observations and indicators, represents observable incident conditions and available measurable incident parameters that will be useful for estimating the source term magnitude. The source term indicates how much hazardous material has been released, is currently being released, or has the potential of being released into the environment. Meteorological information is used in dispersion models, which uses the data along with turbulence parameterizations to determine to what extent the hazardous material will be diluted, where it will be transported through the atmosphere to downwind receptors, when receptors will be impacted, how long this impact will persist, the rate of deposition, and other factors. Receptor information identifies the specific locations and distances from the release at which consequence estimates are needed and the characteristics of the specific receptor. These characteristics may include the population at the receptor, make-up of the population (include hospitals, schools, private residences, nursing homes), and mobility of the population. Lastly, field-monitoring data can provide incident scene and downwind readings of surface contaminate levels and an airborne concentration for contaminates remaining in the atmosphere. Each of these four categories of data and information is discussed in more detail below.

Observations and Indicators. The *source term* represents the amount of, or rate at which, hazardous material is released to the environment. The information from incident observations or indicators that are needed to characterize the source term can include the following parameters:

- Incident initiators and associated parameters
- Total quantity of material present (Material-at-Risk [MAR])
- Quantity of material released from the primary barrier
- Release durations for ongoing, continuous releases
- Quantity of material released from a primary barrier into secondary containment and the location of the breach
- Properties of the material (temperature, storage pressure, particle size distribution, physical state)
- Phenomenology of the release (pressurized liquid aerosolization, evaporation of a spill)
- Presence of dikes or impoundment basins that limit evaporation
- Particle size distribution of particulate or aerosol release

Not all of the information listed above may be necessary for an adequate estimate of the release source term and its duration. The information necessary will depend on the material of interest and the parametric requirements of the model or calculation technique used. Some of this information may be determined by real-time measurements and used directly in models. Other information may only be known theoretically or may be based on limited empirical evidence in order to arrive at a source term estimate that can be used in calculating consequences. Indicators (system pressure, flow rate, radiation level, release rate, etc.) necessary to continually assess consequences of the emergency incident should be identified prior to an emergency based on the known hazardous material inventory.

Other factors that are important in modeling dispersion of the source term include meteorology (discussed below) release height, buoyancy from heat effects and stack velocity, heavier or lighter than air effects, pressurized releases, building wake effects, and terrain effects.

Meteorological Data. The types of meteorological data used in consequence assessments include default and real-time wind speed, wind direction, and an indicator of atmospheric turbulence, which may not be available. Real-time information, representative of the site meteorological conditions, is gathered in the vicinity of the release to characterize the atmospheric transport in the immediate area of the source. For larger sites, or those with complex terrain, site-wide monitoring provides information on the often-significant spatial variation in the wind field. Regional meteorological information and forecasts are used to determine whether changing meteorological conditions may affect protective actions and in-field activities. Natural phenomena that may result in or exacerbate an emergency condition should be carefully monitored by either online NWS information, or similar products offered by the private sector.

For complex meteorological conditions that may be present owing to the topography of the site and its region (terrain channeling, mountain/valley circulations, land/water interactions, heat island effects), additional real-time data from the region of transport may be necessary to adequately characterize three-dimensional transport and dispersion. For DOE/NNSA facilities on these sites, real-time data should be used to replace default values as soon as practicable.

Knowing where incident emissions are dispersed to is important for emergency response. The most important real-time meteorological parameters for emergency response are related to the wind direction and the wind speed. The wind speed (which influences the initial dilution of material as it is released to the atmosphere for ongoing, continuous releases, travel time to downwind receptors, and other dispersion parameters) and the rate of atmospheric mixing (which influences the rate of spread of the material and the degree of mixing/dilution with ambient air during airborne transport) are important atmospheric parameters used to estimate the concentration of hazardous materials arriving at downwind receptors and how long that airborne material will persist over the receptors. Because wind direction and speed normally change with height above ground, measurements are needed of winds near the surface and winds further aloft to appropriately estimate atmospheric transport and dispersion conditions for many types of incidents.

Other atmospheric and source term factors that have an effect on the transport, dilution and dispersion, deposition, and resuspension of material include the mixing layer height; precipitation type, duration, and intensity; rate of gravitational settling (based in part on particle size distributions and the characteristics of the topography); temperature; and humidity. For chemical releases (particularly for liquids and gases stored under pressure), atmospheric pressure, temperature, solar radiation, and humidity are also important parameters influencing release rates (flash coefficients, pool formation, and evaporation) and the potential for chemical reactions. Incident-specific dynamics dispersing materials are important to consider.

The meteorological data requirements for consequence assessment will depend on the dispersion model used. Typically, the minimum data necessary to drive intermediate or advanced atmospheric dispersion models are wind speed, wind direction, and an indicator of atmospheric mixing. These parameters and their key roles in dispersion calculations are summarized below:

- Wind Direction
  - Establishes the direction of transport of materials released to the atmosphere.
  - Wind direction (and speed) typically varies with height above ground as well as varying over horizontal distances.
  - By convention, wind direction is given in terms of the direction from which the wind is blowing. To avoid confusion, wind direction should be stated as "the wind is blowing from the [sector] toward the [opposite sector]. It is often helpful to graphically illustrate the wind direction with an arrow showing the direction the wind is coming from and direction it is heading toward.
- Wind Speed
  - Establishes the speed of transport of release materials and plays a key role in estimating arrival times at receptors.
  - Dilutes source material when first released to the atmosphere.
  - Used to estimate the time available for radioactive decay, chemical decomposition, and depletion/deposition before released material reaches key receptors.
- Indicator of Atmospheric Mixing (Turbulence Intensity or Pasquill Stability Class)
  - Used along with other parameters to estimate the dilution due to turbulence, which, in turn, affects concentration of airborne materials at receptors.
  - Determines the rate of diffusion/spreading of release material while in the atmosphere.
  - The spreading of material, particularly vertical spreading, can use a portion of the released material to be subject to different wind directions and speeds than other portions of the released material.

Methods to acquire and use meteorological and other relevant environmental data in consequence assessments should be commensurate with quantities of radiological and chemical hazardous materials present in the facility and the need to characterize the transport and dispersion of materials during a release. The environmental monitoring program required for consequence assessment should be based on an extension of the general environmental protection program required by DOE O 436.1 for each facility. For more information related to monitoring see DOE Handbook DOE-HDBK-1216-2015, *Environmental Radiological Effluent Monitoring and Surveillance*, Chapter 5, on meteorological monitoring and ANSI/ANS-3.11-2015.

Operational Emergency Potential

If the EPHA indicates that no potential emergencies and releases of material will be classified higher than Alert, no real-time meteorological monitoring capability is necessary beyond that required by other programs (effluent and environmental monitoring, Clean Air Act compliance). Access to representative meteorological information from non-facility resources, such as the NWS at a local airport, will suffice, as long as that NWS office provides meteorological data that is spatially representative of the DOE/NNSA site and techniques are available to convert NWS parameters to establish an indicator of atmospheric turbulence.

If the EPHA indicates that no potential emergencies and releases of material will be classified higher than an SAE, then the following general criteria for the geographic area within the site boundary can be used:

- Sufficient continuous real-time meteorological information should be available to characterize atmospheric dispersion within the entire region bounded by the site boundary. This capability should include a means to determine wind speed, wind direction, and an indicator of atmospheric turbulence via in situ or remote instrumentation or by trained observation.

- Generally, the measuring station providing meteorological input should be located within approximately 2 km of the potential release points. The number and location of meteorological monitoring stations necessary to characterize atmospheric transport and dispersion conditions are dependent upon the number and location of the potential release points, the size of the affected area, and the complexity of the meteorological conditions in the region of transport.

- Calculation models used for consequence assessment should be appropriate for characterizing transport and dispersion conditions specific to the facility and its vicinity. Facility-specific characteristics to be addressed should include height of release points (elevated, ground level, or mixed-mode), effluent temperature and efflux velocity to establish mechanical and buoyant plume rise from a stack, and building geometry and configuration relative to the release point to establish aerodynamic building effects (cavity and wake regions). Local meteorological factors to be considered include terrain blocking and channeling of winds, mountain/valley circulation patterns, lake- and sea-breeze circulation patterns, urban heat island effects, and other terrain-related effects that may affect atmospheric dispersion and consequence assessments.

If the EPHA indicates potential GE classification based on postulated emergency release scenarios, the following additional criteria apply in the region of transport:

- A sufficient number of continuous real-time in situ or remote monitoring meteorological data sources should be available to characterize atmospheric dispersion for the area encompassed by offsite areas potentially affected by a maximum radiological, chemical, or biological material release. The number of monitoring stations and sophistication of monitoring equipment necessary will depend on terrain complexity and dispersion conditions particular to a DOE/NNSA site. Techniques are available to determine the appropriate placement of instrumentation to maximize characterization of the complex flows and to minimize the number of instruments required to provide sufficient meteorological data for this comprehensive consequence assessment.

- The increased distance to the EPZ boundary would require sophisticated transport and dispersion models to accurately characterize the atmospheric dispersion. The COA models should be able to provide reasonable estimates for any location of interest within and slightly beyond the limits of the EPZ, with the recognition that the uncertainty around the dose estimate increases with increasing distance from the release point.

The number of monitoring stations necessary to provide adequate real-time data is influenced by the complexity of the local terrain. Simple terrain is characterized by being generally flat, or relatively flat, with no capacity to induce complex airflow patterns. Accordingly, one monitoring station may characterize the wind field at a DOE/NNSA site located in a flat or relatively flat terrain location. Sites with a large geographical extent or those with complex airflow patterns generally require multiple monitoring stations to capture the spatial variation in winds across the area that is of interest to emergency management decision makers.

In addition to spatial variability of meteorological parameters in a complex terrain setting, temporal variability of meteorological parameters needs to be addressed in all terrain environments, from simple to complex. Temporal variations in meteorological parameters can occur as a result of changes in local to large-scale weather patterns, surface heating or cooling, terrain influences, and other factors. The COA models and some TIA models incorporate known temporal variations in their calculations, which is capturing changes in wind and other parameters that are measured between the time of the onset of an environmental release and the final passage of the last remnants of the airborne material outside the region of concern. The NWS forecasts or numerical modeling of future meteorological conditions (conducted by the site or external entities) may be used to provide estimates of future temporal variations in the modeled region that may affect consequence assessments. The need for the comprehensive treatment of site-specific factors that may impact the spatial and temporal variation in atmospheric transport/dispersion is only needed if the EPHA indicates significant impacts in the region of transport.

Receptors. As used in this guidance, a receptor is defined as a *point or location at which incident severity is determined by estimating consequence impacts on safety or human health*. Onsite receptors are facility workers or collocated workers that are in the near field and onsite workers in the far field, but within the site boundary. Offsite receptors are located beyond the site boundary to the boundary of the EPZ. For facilities with Emergency Management Hazardous Materials Programs, human health effects are the primary concern. The calculation of consequences at specific receptors helps answer the following important questions:

- Where is the release going?
- Who will be affected?
- What will the consequences be from exposure to airborne and deposited materials?
- When will exposure to the airborne hazardous materials start, peak, and end?
- Where will the consequences be above classification or protective action thresholds?

Estimating consequences at specific receptors provides information that is used in incident categorization and classification, protective action decision making, onsite and offsite notifications, placement of confirmatory field monitoring teams, potentially impacted facility habitability determinations, determination of evacuation routes and assembly areas, reentry planning, termination of emergency response, and recovery planning and activities. Onsite receptors of interest include site facilities, facility and site boundaries, facility workers, collocated workers, assembly areas, evacuation routes, and emergency response facilities. Offsite receptors of interest include population centers, special populations, evacuation routes, relocation centers, environmental monitoring stations, and Ingestion Planning Zone-related locations.

It is recommended that all receptors of interest be identified and documented for each facility requiring an EPHA. This listing, and a map that provides a spatial representation of the receptor locations, should be made part of the documentation provided to the CAT staff. Information for each receptor should identify the name of the receptor, receptor distance and direction from the release facility, and the straight-line travel time from the release location to the receptor using the wind speed prescribed in calculating the 95% worst-case meteorological conditions. This wind direction-receptor relationship is only valid for straight-line airflows over essentially flat terrain. Wind direction-receptor relationships are much more difficult to ascribe in complex terrain settings. Depending on the actual meteorological conditions, the time it takes for released material to reach a receptor may be much shorter or longer than listed in the pre-planned information provided to the CAT.

Field Monitoring Data. Field monitoring data provides incident scene and down-wind readings of contamination levels on ground level surfaces or airborne readings of radiation levels or chemical concentrations. During the earliest phase of field monitoring, the primary goal is to determine if a detectable plume was actually released and, if so, to verify the general direction of travel and begin to outline the area of impact. This data is integrated with calculation results to obtain best estimates of the consequences. Because of the limitations of each source of consequence information, neither modeling predictions nor monitoring data provide the total assessment of consequences. Field monitoring readings can either validate the calculations or provide the means for adjusting the results. However, since the monitoring cannot be accomplished over the whole region of interest, modeling can fill in some areas where data is absent.

During monitoring of a hazardous material release, standard radiation protection or industrial hygiene techniques should be employed to ensure the protection of monitoring personnel. This includes the issuance of appropriate personal protective equipment and the establishment of dose rate or chemical exposure thresholds, where monitoring teams are to retreat from the hazard zone. To accomplish the initial goals of field monitoring, it is not essential to locate the plume centerline or region of highest dose or exposure. Readings that establish the edge or region of deposited contamination will usually be all that is available in the early phases of an emergency unless autonomous monitoring equipment is quickly deployed. Reading at the edge of a plume can provide confirmation of a release but provide limited to no information on the magnitude of the release. For that, monitoring within the edges of the plume, by a field team or unmanned system, is required to characterize the actual extent and magnitude of the contamination. Measurements of surface contamination or near-surface air concentrations at the plume edge should be cautiously used to adjust consequence assessment modeling results. The presence of precipitation may impact where field teams should monitor, due to precipitation scavenging of the plume contaminants.

It should be noted that the source term estimate and transport and dispersion calculations would also provide both preliminary planning and continuing operational support to guide field monitoring efforts throughout the assessment process. In addition, field monitoring results can also provide data useful for bounding transport and dispersion calculations and modifying input parameter selection. Additional field-monitoring data may be available to support consequence assessment, if environmental radiation effluent monitoring programs are in place using installed air monitors, area radiation monitors, or in-plant surveys with readings or samples obtainable during the incident.

4.7.7.2. Analyze and Calculate

The next consequence assessment task is the analysis of the input data and its use in performing various calculations to produce estimates of the source term, transport, and dispersion calculations, and determination of health effect estimates. During COA, the CAT should use models or methods to improve the quantitative accuracy of consequence estimates, including all real-time information, as available. Depending on the hazard level, the methods need not be more sophisticated than those used during TIA. For all facilities, especially moderate- to high-hazard facilities, computer-based systems are used to increase the accuracy of the estimates. Advanced dispersion modeling systems have more features, including the ability to characterize wind fields in complex regions of transport; more sophisticated, flexible, detailed, or accurate input information; and more sophisticated, detailed, or accurate output products. However, more time, knowledge, skill, and training are required to use them effectively. In general, an SFA should employ a diverse consequence assessment system that includes EPHA analyses, simple and fast-response models, and more sophistical modeling tools that can use more detailed information for ongoing assessments. This approach involves selecting the appropriate tool at each stage in the emergency response, balancing the need for technical accuracy with data availability and the timeliness of the response. Calculations associated with estimates of the release of hazardous materials are discussed in more detail in the following sections.

Source Term Estimation. The generic formula for determining a source term is discussed in Chapter 2, Section 2, and some recommendations for determining source terms during emergency response follow:

- Gather and present information on source terms for a range of incidents and conditions. Key information should have been developed as a part of the EPHA process. This information should be extracted from the EPHA and other references and placed into a format that can be used as a quick reference by response personnel.

- Correlate the predetermined source terms with observed conditions (personnel observations, instrument readings, current inventory information, monitoring results, etc.). Users of the documentation should be able to compare available information to the predetermined source terms to select the one that is most appropriate for the incident at hand or to apply the best modifying factors. In the absence of any other information, the user may simply identify the affected building and use the most conservative source term listed, based on the known inventory of hazardous materials in the building.

Transport/Dispersion Estimates. Calculation methods and resources should be available for projecting the quantitative impact of an actual or potential release of hazardous materials within the EPZ. Most standard methods/models for calculating consequences focus on airborne release assessments, driven by the inhalation and plume submersion pathways. However, other credible dispersion pathways such as ground shine and food/water ingestion may need to be addressed, depending on the hazardous materials present and the results of the EPHA. The airborne release pathway typically represents the most time-urgent situation, requiring a rapid, coordinated response. For elevated releases of gamma-emitting isotopes, the gamma shine dose pathway is more time-urgent, especially near the release point. Ingestion pathway calculations, located in Appendix H, are of primary interest during recovery after the emergency has been terminated.

Releases to aquatic, ground, and groundwater pathways do not have the same time urgency since doses would occur from the ingestion pathway. Therefore, calculation models for these pathways should be developed on a case-by-case basis if applicable to the individual facility.

The level of sophistication of calculation methods and models should be commensurate with SFA-specific source terms, atmospheric transport and dispersion considerations driven by local terrain characteristics, and the potential severity of the consequences of a release. The following general guidelines should be applied:

- If the EPHA indicates that potential emergencies and releases of material will not be classified more severely than an Alert, then consequence assessments can make use of simple calculation methods (straight-line computer-based Gaussian models) for post-incident analysis. Sophisticated calculation methodology and models for consequence projections are usually not needed under these circumstances. Plans and procedures should identify protective actions to be implemented for personnel near the incident scene.

- If the EPHA indicates that no accident scenario analyzed will result in an incident classification higher than an SAE, then protective actions are likely to be required beyond the facility boundary and throughout the site. The calculation methods and models should quickly provide an estimate of impacts to support the time-urgent need to issue protective actions for airborne releases. Actual source term and environmental data input to a computer model may be provided by on-line systems or manual entry. The method/model used should be customized, as necessary, to address each major type of radiological or chemical release scenario. Consequence assessment may be based on complex computer calculations for a slower paced incident sequence. Advanced capabilities, such as the ability to perform rapid recalculations to consider changing conditions or information, or analyzing a range of hypothetical situations, may be desirable.

- If the EPHA indicates a potential for a GE, then a release may require personnel protective actions beyond the site boundary, and the consequence assessment methods should be capable of producing estimates to or beyond the limits of the EPZ. In addition to those capabilities discussed above under an SAE, the projection methods and models provided should yield a quantitative prediction of the offsite impact sufficient to allow timely offsite protective action recommendations. Advanced features, such as on-line data entry, may be necessary to meet the time requirements for notification.

Three tiers of calculation methods have been identified to address consequence requirements:

- **Elementary.** Pre-calculated consequences (tabulated EPHA, SAR results, ready reference graphs, and figures). The accuracy of these consequence assessment tools is limited, as they usually provide plume centerline results at a single receptor. However, they are easy and quick to use.

- **Intermediate.** Simple consequence calculations using a computer model.

- **Advanced.** Advanced computerized methods such as 3-D spatially varying and temporally varying dispersion models, capable of more realistically modeling atmospheric transport and dispersion when operated and interpreted by an SME . Plume trajectories and complex footprints are predicted more accurately. Although slower and requiring more information to use, advances in computer technology are substantially reducing model run times. Some advanced models can be initialized, run, and provide graphical output in under a minute; making these models appropriate to support some TIA applications as well as COAs. Other advanced models make take a few minutes or longer to initialize and produce results, making them more appropriate for COAs.

Elementary methods are an appropriate starting point for consequence assessments at all facilities. Intermediate methods are applicable for all facilities when performing TIAs, particularly in situations where the atmospheric transport direction and speed display little variability in the area of concern (steady-state conditions). Advanced methods may be applicable for TIAs in areas of complex flow and are recommended to support COAs at high hazard facilities. Advanced methods are recommended for COAs at high hazard facilities at sites with complex meteorological flows in the region of transport.

Comparison with PACs/PAGs. Consequence results are compared with criteria that are issued to minimize the risk of an adverse human health effect. Relevant criteria for radioactive materials are the EPA PAGs, which are expressed in units of radiation dose as TED. For an atmospheric release, the TED is proportional to the total amount of the radioactive material released during the period of exposure. Accordingly, variation in release rate over time is of much less concern than the total quantity of a radioactive material released during the period of assumed exposure. For extended release times, the assumed period of exposure is usually taken into account when determining the applicable emergency classification or protective actions.

The relevant human health criteria for most non-radiological hazardous materials are the PAC-2 values for chemicals of concern. These are based, in order of preference on AEGLs promulgated by the EPA, ERPGs published by the AIHA, and TEELs developed by DOE. In general, these values are expressed as peak concentrations in air below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms, which could impair an individual’s ability to take protective action. A key consideration in using these values as discriminators for human health evaluations is that exposure to some materials at a concentration exceeding the available PAC-2 value for a shorter period than one hour may be enough to produce the health detriment. As a result, it is recommended that these concentration criteria be compared to a calculated maximum 15-minute average concentration for purposes of determining appropriate protective actions. In order to accomplish this, the consequence assessment tools should be able to determine non-radiological release rates, as a function of time, which will permit the calculation of maximum 15-minute average concentration at receptors of interest. For exposure periods less than 15 minutes, concentrations may be calculated over a shorter time period or exposure duration. If the hazardous material is of the type for which short exposure to very high concentrations can produce severe health effects, it is important to use a consequence assessment tool to evaluate the consequences of a very short-duration or near-instantaneous release, because these scenarios produce the highest instantaneous concentrations.

The bases for selection of methods and models should be well documented and include the results of any benchmarking, SQA, and Verification and Validation (V&V). The Defense Nuclear Facility Safety Board (DNFSB) issued Technical Report Number 25 (DNFSB-25), emphasizing the importance of using a model with an adequate SQA in its pedigree.

Consistency among models used by DOE HQ, Tribal, State and local agencies, and other Federal agencies that are likely to provide assistance during an emergency should also be considered in model selection. It is good practice to model a series of representative release scenarios using the site calculation methods and models. The results can then be compared to those from models used by others for the same scenarios. Significant differences in the modeling results should be identified, explained, and documented. These comparisons will assist in understanding and reconciling results during an actual response. Calculation methods and models used in preparing EPHAs and developing scenarios for drills/exercises should be identical to, or at least very similar to, those used in the consequence assessment process.

4.7.7.3. Assess and Estimate Consequences

During the COA process, the CAT uses its judgment to integrate the calculations from the previous task and measurement results, as they become available, into the best overall estimate of the consequences. Methodologies should be developed and implementing procedures written to effectively merge and integrate the field monitoring data into source term and transport/dispersion estimates when representative field monitoring data are available to justify their consideration. Field observations of the visible hazardous materials plume can be promptly used to characterize initial release conditions. As shown in **Figure 4-7**, this basic task involves an integrated assessment of the source term estimate and consequence modeling calculations from the previous task, and is combined with field monitoring data and real-time observations or indicators yielding a best estimate of consequences. Each component of the assessment contributes in varying degrees, depending on the nature of the incident and the maturity of the response.

The modeling activities from the previous task include source term estimation (i.e., release amount and associated incident, source, and substance information) followed by atmospheric transport and dispersion modeling to project the trajectory, timing, and impacts from the release of hazardous materials. Any direct observations of the nature of the incident and its consequences may also provide key information towards confirming or adjusting the results of the modeling analyses, even early in the response. Visual plume observations and personnel responses to exposures can be especially useful indicators, when they are available. Field monitoring information is also a key contributor to a confident assessment and should be implemented and incorporated as early as practical in a response, since these results can be used to validate or adjust the earlier results of the modeling analyses.

Direct observations, consequence modeling results, and field monitoring data are used together to provide an estimate of the integrated picture of the consequences of the release in terms of location, timing, and environmental loading.

4.7.7.4. Communicate

In the fourth basic task, the best estimate of the consequences is prepared for communication in a form that can be quickly and unambiguously used in making emergency response decisions by site emergency personnel and affected Federal, Tribal, State, and local agencies. Plans and procedures should address a protocol for sharing and transmitting information among response organizations. This protocol should address the units of measure for quantities or parameters of interest including concentration, cumulative exposure and dose, and exposure and dose rate. The units of measurement used in communication and documentation should be the same as those commonly used in the emergency management community. To avoid confusion and misinterpretation in the process or results of consequence assessment, coordination of units and measurements should be included in a procedure and agreed upon with interfacing onsite and offsite organizations in advance. Field monitoring and data collection by facility and site teams, State and local teams, and Federal teams (Radiological Assistance Program (RAP), Federal Radiological Monitoring and Assessment Center (FRMAC)) should be coordinated to facilitate exchanges and correlation of information. Differences in modeling methods should be well understood by onsite and offsite emergency response personnel prior to an emergency to ensure that there is clear and coherent communication of results among all parties. CAT training should frequently acknowledge that different models will produce different results, as well as the uncertainty inherent in the dose estimates of environmentally dispersed releases.

The results of the COA should be transmitted to decision makers in the ERO using formal, written worksheets, and notification forms. Time-stamping written communications is important to maintaining a record of the COA timeline. The following provide for effective communication of consequence results:

- Establish a standard protocol for communication of data/information and results to minimize the propagation of errors.
- To effectively communicate and use the results, the types and format of information needed by each response element should be pre-determined as part of the emergency management plan and implementing procedures.
- Establish a method to compare results and resolve differences between response organizations.
- Include a process to perform a quality assurance check on assessment results and establish the degree of uncertainty prior to distribution.

Understand the capabilities of the DOE/NNSA Nuclear Emergency Support Team (NEST) and plan for incorporation into the assessment process.

Plans and procedures should address recording the parameter values and information used in a consequence assessment calculation. These values should be posted as the current status of the data and transmitted to other response organizations. The means for logging, displaying, and analyzing trends in data relevant to consequence assessment should support decision-making processes for both onsite and offsite organizations.

In order to ensure that communication of consequence assessment information will be effective during an emergency, DOE/NNSA planners should meet periodically, or when major changes to key parameters occur, with all planning partners to discuss issues that affect the comprehension and sharing of information, including changes in the following areas:

- SFA hazards
- Onsite and offsite notifications
- Calculation models and methods
- Communication methods
- Terminology
- Presentation of results
- Monitoring systems, techniques, or capabilities

4.7.7.5. Interface

Finally, the basic task involving interfaces with Program Element ERO representatives ensures that key aspects of the emergency response are updated on a continuing basis as the quality and quantity of information related to the incident and release parameters increase. As a result of this continuing refinement of information, interfaces with specific Program Element representatives in the ERO related to classification and protective actions ensure that these critical aspects of emergency response remain current and, hence, valid and sufficient to protect the health and safety of the workers and the public. The interface with ERO health and safety personnel ensures that current information is available to plan and maintain adequate protective measures for response personnel. Interfaces with EPI ERO representatives ensure that information and details related to the emergency and associated protective actions that are released to the public and the media are timely, clear and consistent, interpreted correctly, and accurately transmitted. Caveats associated with integrated consequence assessment should be developed carefully to ensure that the information presented is not likely to be misinterpreted.

Pre-planning with EPI staff should include:

- Establishing the format, content, and level of detail of information required to support each interfacing program element within the ERO.
- Identifying and training technical personnel to present results to the media and public.

The interfaces require that consequence assessment results be as reliable and current as can be obtained, based on the status of information and data available at the time. To ensure effective interfaces, calculation models and methods should provide estimates of concentrations, integrated exposures, and exposure rates from released materials at selected receptor points expressed in units or terms that correspond to those used in EALs and for determining protective actions.

4.7.8. Documentation

Post-emergency knowledge of what was known about the accident, when it was known, and what decisions were made is critical for analyzing the performance of the facility and site emergency response and for providing a legal record of response following an OE, as well as providing a database for a forensic determination. Also, careful handling of calculations and results reporting ensures that the most current results are used for discussion, decision making, and transferring information to outside users, such as DOE HQ, offsite authorities, and the media. Details, such as calculation parameters and times, should always be well documented with the associated calculations, so that Notification and Communications staff can reference the supporting calculations. For these reasons, a formal document control system should be implemented during an emergency to record, sequence, validate, and track the flow and chronology of information and decision making.

4.7.9. Quality Assurance

Quality assurance and control of the tools used in consequence assessment, such as the meteorological monitoring system hardware and software and dose modeling hardware and software, should be employed in a manner similar to the control exercised over the procedures used in consequence assessment activities. A quality assurance program is essential since faulty modeling may impact consequence assessment results and personnel protection. A systematic approach should be employed that ensures that consequence assessment tools conform to established functional, operational, and technical requirements. The sophistication of the quality assurance program for consequence assessment tools should be commensurate with SFA-specific hazards. The need for quality assurance for consequence assessment software should never be used as a rationale for using models that do not meet technical quality requirements for the situation being addressed (never use a simple, straight-line model for a COA in a complex meteorological or terrain environment just because of the better quality assurance pedigree of the simple model).

Contractors subject to 10 CFR Part 830, Subpart A, *Quality Assurance Requirements*, and DOE O 414.1D Chg. 2 (LtdChg) *Quality Assurance*, should add quality assurance requirements associated with the emergency management system to the existing quality assurance program and implementing procedures.

Operational considerations that relate to reliability and survivability of hardware and software should include such features as uninterruptible power supplies, diesel generator power backup, spare components, back-up methods, and rapid response maintenance. Consequence assessment, computer-based modeling, and meteorological systems need to be available and functional during an emergency. Adverse conditions affecting power continuity, ventilation, etc., are most likely to occur during the time of emergency; thus, adequate planning for contingencies is necessary.

A systematic approach based on a needs analysis should be employed in the development, operation, maintenance, and retirement of software and hardware to ensure that functional requirements are met. Consistency with models used by other facilities that are likely to provide assistance during an emergency; DOE HQ; and offsite Tribal, State, and local agencies should be considered in model selection. However, the consideration of consistency should not deter the use of advanced technology and the continuous improvement of capabilities to protect human health and safety. Consistency should be supported by sharing advanced modeling capabilities available to the sites with offsite agencies.

Technical requirements should be established that provide for documentation of all software codes, maintenance of hardware components, V&V of the consequence assessment system, and configuration management control of the system after inauguration. Methods and models used in consequence assessment should be documented in such a manner that the analyses and results can be critically reviewed, understood and, if necessary, reconstructed by independent SMEs. Detailed descriptions of the assumptions, methods, and models should be documented in a form that may be referenced. Software subject to DOE O 4141.1D Chg. 1 and 10 CFR Part 830 SQA requirements will find guidance for satisfying the requirements in DOE G 414.1-4, *Safety Software Guide for Use with 10 CFR Part 830, Subpart A, Quality Assurance Requirements*, and DOE O 414.1D Chg. 2, *Quality Assurance*.

4.8. Protective Actions

4.8.1. Introduction

The purpose of this chapter is to assist DOE and NNSA field elements in complying with the DOE O 151.1D requirement that protective actions be promptly and effectively implemented or recommended for implementation, as needed, to minimize the consequences of emergencies and to protect the health and safety of workers and the public. Protective actions can be implemented individually or in combination to reduce exposures from a wide range of hazardous material types. Such protective actions can include evacuation, sheltering, decontamination of people, medical care, ad hoc respiratory protection, control of access, shielding, radio-protective prophylaxis, control of foodstuffs and water, relocation, decontamination of land and equipment, and changes in livestock and agricultural practices. Protective actions should be reassessed throughout an emergency and modified as conditions change. Reentry activities, which involve reentering a facility or affected area that has been evacuated or closed to personnel access during the course of the emergency, should be planned, coordinated, and accomplished properly and safely.

The guidance focuses on emergency management planners responsible for developing pre-planned protective actions and on decision makers responsible for evaluating conditions during an emergency by assessing current protective actions to ensure that they are sufficient to protect the health and safety of responders, workers, and the public. The guidance also addresses the planning and coordination that should accompany each reentry activity during response.

4.8.2. General Approach – Protective Actions

The International Commission on Radiological Protection (ICRP) has issued recommendations and guidance on planning for protective actions. While the objectives and principles described by the ICRP and endorsed by the International Atomic Energy Agency (IAEA) are specific to radiological accidents, they are also useful in planning protective actions for Emergency Management Hazardous Materials Programs in general. These principles are:

- Severe early health effects should be avoided by taking protective actions to limit individual doses or exposures to levels below the threshold for those effects.
- Risk to individuals should be limited by taking protective actions that produce a positive net benefit to the individuals involved (i.e., the risk to the individual from taking the protective action is lower than the risk from exposure or dose that is thereby avoided).
- The overall risk to workers and the public should be limited, to the extent practicable, by reducing the population/collective dose (or exposure). This principle applies to limiting both the dose to emergency workers and to the general public.

The WHO and the ICRP have identified protective actions (see Section 8.1) that can be implemented to reduce exposures from a wide range of hazardous material types.

At DOE/NNSA SFAs protective actions include measures taken to prevent or minimize potential health and safety impacts on workers, responders, or the public from the release of hazardous materials. Onsite authorities can issue Protective Actions (PAs) that apply to the workers and other onsite populations within the facility, while PARs apply to the public outside the site boundary. Only local authorities can enforce the implementation of PARs to protect the offsite public.

Evacuation and sheltering (supported by accountability) are typically the primary protective actions that would be implemented during an emergency at DOE/NNSA SFAs or recommended to offsite authorities for their implementation. The remaining protective actions (decontamination, medical care, access control, shielding) may also be applicable to onsite or offsite agency plans, depending on the results of the EPHAs for the facilities on the site.

Reentry is a planned emergency response activity directed by the ERO to accomplish a specific objective. Reentry activities are typically time-urgent, performed during an emergency response, including such activities as hazard mitigation, damage control, and accident assessment. Reentry for search and rescue is by necessity time-urgent; its use and urgency will be based on the incident, usually determined by the IC. Some activities performed during reentry may involve entering a facility or affected area in which hazardous materials may have been released. For this reason, reentry has been included with protective actions, since the protection of the emergency workers involved in the activities is an essential component of reentry planning. Hazardous material exposure limits will guide planning for these potentially dangerous activities by determination of stay-times, exposure criteria, and guidelines for controlling exposures in various types of emergencies.

The protective action process applicable to DOE/NNSA sites and activities includes developing criteria for initiating protective actions; determining the affected area; onsite and offsite protective actions; determining EAL-specific preplanned initial protective actions; actions taken in support of or subsequent to initial protective actions, such as accountability, decontamination, and recordkeeping; and other protective actions available during the initial response and as part of the later longer-term recovery phase. Finally, planning for and conduct of reentry activities is discussed, focusing on the protection of emergency responders.

4.8.3. Protective Actions

4.8.3.1. General Concepts

The basis for planning protective actions is the results and analysis of the SFA-specific hazards contained in the All-Hazards Survey or EPHA. The potential consequences and health effects are determined from the All-Hazards Survey or EPHA and compared with Protective Action Criteria (PACs). Once the level of hazard and the consequences of a release are identified, the actions necessary to protect the health and safety of the workers and the public can be established. Determining when protective actions are necessary and where those actions should be implemented is the primary concern when planning protective actions.

The planning process has four steps.

1. Develop preplanned initial protective actions and incorporate them into the facility EPIPs associated with EALs. This includes establishing a PAC that determines

when protective actions should be initiated, specific protective actions to implement or recommend, and the specific geographic area, facilities, and onsite and offsite populations affected. These initial protective actions should be directly linked to the categorization/classification process so that the issuance of protective actions is automatic upon declaration of an Operational Emergency (OE).

2. Identify those to be notified and provided information in order to implement protective actions and respond safely.

3. Develop plans and procedures for determining, implementing, and recommending protective actions.

4. Establish the ERO positions responsible for determining, recommending, and implementing protective actions.

Preplanned initial protective actions will be implemented very early in the response, often when little information is known and what is known may be confusing, contradictory, and uncertain, especially information concerning the severity of the incident. Actions need to be taken quickly to protect workers or the public. Experience shows that preplanned initial protective actions are most effectively implemented when planning includes specific information on how evacuation or sheltering will be accomplished, such as where workers are expected to relocate and how accountability is to be accomplished. Evacuation of affected facilities and sheltering in collocated facilities is often implemented early during an incident and can be reassessed as results of consequence assessment activities become available. As a general principle, it is better to be more conservative and then scale back when more information is known.

During emergency response, the selection of the specific protective actions to be implemented onsite or recommended for the offsite public is integrated with the consequence assessment process discussed in Section 7 of Chapter 4. The primary objective of the consequence assessment process is to provide timely and useful information to assist emergency response decision makers in making informed decisions to protect people from the potential consequences of a release of hazardous materials.

During the TIA phase of consequence assessment, the emphasis is on confirming that the initial protective actions were accurate, appropriate, and conservative. If the pre-planned, initial protective actions are not sufficiently protective, then modifications to these initial protective actions should be made. Once COA is activated and additional information is acquired about the incident, including a more accurate release information, detailed incident-specific environmental data, and field measurements (sometimes called *ground truth*), the reevaluation of protective actions should continue. The reevaluation of protective actions/recommendations is a product of COA and is performed throughout the emergency response. Evaluation of the habitability of areas being used by responders and sheltered personnel is part of the continuing evaluation for protective actions. This evaluation of habitability can also include allowing personnel to reenter facilities that had been evacuated.

The following sections provide guidance for planning the implementation and recommendation of protective actions. First, criteria for the initiation of protective actions are discussed generally, and specifically for radioactive and chemical toxic materials. The determination of the area to which the protective actions will be applicable follows. The most effective protective actions for onsite workers, evacuation and sheltering, are presented, followed by a section devoted to offsite PARs. The complex and dynamic environment that will likely exist during an emergency is described in terms of its influence on protective action decision making. The development of EAL-specific preplanned initial protective actions, based on the results of the EPHA analyses of scenarios, is addressed. The protective actions section ends with a description of follow-up activities, accountability and decontamination, and a brief introduction to other protective actions.

4.8.3.2. Protective Action Initiation

PACs are predetermined concentrations, doses, or exposures of airborne hazardous materials at which protective actions will be initiated or recommended for initiation. Planning for emergencies at DOE/NNSA SFAs includes selecting or developing these criteria for protective action decision making. Emergency procedures for classifying OEs and for implementing or recommending protective actions should also incorporate these criteria.

For each specific hazardous material identified during the EPHA process, the associated PAC should be expressed in units that can be readily correlated with both the potential for health impact (peak concentration, cumulative dose, or exposure) and information that will be available to onsite and offsite decision makers during an emergency incident, such as observable incident indicators, results of consequence calculations, or measurements.

- All facilities and activities on a given DOE/NNSA site should use the same PAC for a particular hazard and that PAC should be applied to both onsite and offsite personnel.

- Facility indicators and operating parameter values corresponding to hazardous material releases that will exceed PAC should be identified. They should be incorporated into facility response criteria or EALs to ensure that the person responsible for determining the emergency class and initiating the emergency response recognizes the need for, and initiates, prompt protective action.

- Two or more PACs may apply to a particular incident or condition (a mixture of several chemicals or a chemical agent and a radioactive material released together). Unless a mixture of chemicals has been characterized and the health effects of the components of the mixture are determined to be independent of one another, the Chemical Mixtures Methodology can be used to estimate the hazard indices associated with exposure to multiple chemicals – each present at different concentrations and each with different PAC values. Information and tools for using the Chemical Mixture Methodology are provided on the publicly accessible webpages for Chemical Mixture Methodology that are maintained and made available by the

STARS webpage under the Emergency Management Issues Special Interest Group (EMI SIG) Site.

- The same PAC should be used for onsite transportation activities as for fixed facilities. However, it should be recognized that for transportation incidents occurring offsite, local authorities might take action independent of DOE/NNSA, based on other criteria. The primary source used by most offsite authorities to determine protective actions for transportation incidents involving hazardous materials is the DOT *Emergency Response Guidebook*, (current version).

A complete discussion of the definition and use of PACs is presented in Chapter 2, Appendix C.

Radioactive Materials. The PACs for releases of radioactive material are contained in the Environmental Protection Agency (EPA) *PAG Document of Protective Action Guides and Planning Guidance for Radiological Emergencies.* DOE O 151.1D specifies that these PAGs be used at DOE/NNSA sites for comparison with exposures resulting from radioactive hazardous material releases to determine the appropriate emergency class and associated protective actions.

Chemical Hazardous Materials. In accordance with the requirements of the Order, the following PACs for chemicals are listed in *order of preference*:

- **A**cute **E**xposure **G**uideline **L**evels (AEGLs), promulgated by the EPA
- **E**mergency **R**esponse **P**lanning **G**uidelines (ERPGs), published by the American Industrial Hygiene Association (AIHA)
- **T**emporary **E**mergency **E**xposure **L**imits (TEELs), developed by DOE for use until AEGLs or ERPGs are available

The AEGL values are preferred over ERPG values for several reasons. First, the EPA issues more exposure duration information for each chemical. For example, ERPG values are based on a 1-hour exposure, while AEGL values provide exposure guidelines for 8 hours, 4 hours, 1 hour, 30 minutes and, in some cases, a 10-minute exposure for particularly toxic chemicals. Secondly, AEGL values were reviewed and approved by consensus of a large number of Federal and State organizations, private industry, and other public and private organizations. Lastly, the AEGL values were peer-reviewed with final recommendation and approval by the National Academy of Sciences.

The DOE-developed TEEL values are for those chemicals that may be found at DOE sites and for which AEGL or ERPG values do not exist. The *temporary* in the TEEL name implies that TEEL values are only applicable for a chemical until AEGL or ERPG values are developed. However, for many chemicals this temporary designation will likely be measured in decades because of the very low rate at which chemicals are added to the AEGL and ERPG data set. PAC values for all chemicals that have AEGL, ERPG, or

TEEL data are found in the PAC dataset (accessible via the PAC homepage on EMI SIG). Questions, comments, and requests related to PAC values can be communicated to the PAC development team via the links provided on the PAC homepage. The method for deriving TEEL data is documented in DOE-HDBK-1046-2016.

4.8.3.3. Determination of Affected Area

Planning and implementing protective actions require the determination of the potential area affected by the release of hazardous material. The distance that PAC levels can be exceeded should be established for each scenario from the EPHA. Plume transit time, expected duration of the release, the time required to warn workers, and how quickly protective actions can be taken are all consideration factors in developing preplanned initial protective actions. Knowledge of the geographic area, the location of buildings, and evacuation routes within which PAC has been (or will be) exceeded are among factors used by decision makers to effectively apply those criteria.

During an incident and after preplanned initial protective actions have been implemented, consequence calculations and field measurements should be used to refine the area affected by a hazardous material release. Real-time consequence projections are calculated during a release incident using representative environmental data and on-the-scene observations. Physical samples can also be used to further refine protective actions after a sufficient number of samples are collected and analyzed. Real-time data, observations, and physical samples enhance the scientific validity and credibility of consequence projections. Computer models or other calculations performed in advance for various combinations of release magnitude and dispersion conditions may serve as temporary substitutes for the use of real-time data, with the results tabulated for easy reference.

Field measurements should be used to confirm the results of calculations and to refine estimates of the affected area. Reliance on field measurement results as the primary basis for PADs should be limited to those materials and exposure pathways for which PACs are not likely to be approached in the time necessary to take measurements and analyze the results (such as food pathways).

The SFA emergency management plan for determining the affected area should be coordinated with the plans of offsite officials to ensure mutual understanding of the methods to be used, the type of results likely to be obtained, and the bases for any protective action recommendations that DOE/NNSA may issue. If the DOE/NNSA activity and the offsite authorities use different calculation models or measurement methods, differences should be examined and understood during the planning process to ensure that they do not cause confusion or delay in selecting or executing protective actions.

4.8.3.4. Evacuation and Sheltering of Workers

Facility plans and procedures should include criteria for evacuation or sheltering of workers and return of workers to facilities if it is determined that a hazard no longer exists. These criteria, when associated with initial protective actions, should be related to incident categorization or the declaration of certain emergency classes based on specific EALs. The effectiveness of sheltering-in-place versus evacuation for different types of incidents should be considered in establishing criteria.

Facilities should ensure that their communications systems allow rapid communication of protective actions to all affected workers. A method should be employed that ensures emergency managers of affected workers have been warned and are implementing protective actions.

The key to protecting at-risk populations from toxic exposure is to remove them from the affected area (evacuation), or to place a physical barrier between people and the hazard (sheltering). A number of factors apply to determining the approach most appropriate to particular situations.

Evacuation is the removal of people from a geographic area that is either being impacted or is expected to be impacted during the early (plume exposure) phase of a hazardous material emergency. (*Relocation* is the term generally applied to the removal of people from affected areas in later phases of an emergency, due to residual hazardous material on surfaces or elsewhere in the environment.)

Evacuation can generally be considered 100% effective for reducing hazardous material exposures and resulting health impacts, but only if it can be accomplished before the hazard is actually present in the location being evacuated and only if all the people can exit the affected area without encountering the hazard while they are in transit. Accordingly, there are several important aspects to the decision to select evacuation:

1. Since evacuation is fully effective only if it can be accomplished before plume arrival, the decision to evacuate usually hinges not just on its effectiveness but on the following:

- Whether it can be accomplished before plume arrival, and
- The health impacts that might occur if the plume arrives during the evacuation when people are completely unprotected.

  Balancing a potential short-duration unprotected exposure while evacuating against the potential longer-duration exposure that might be incurred in sheltering are the trade-offs. The protection afforded by sheltering may diminish with the increasing duration of the release provided the sheltered location remains within the plume of the hazardous materials for a significant amount of time during the extended release.

2. Except for emergencies that affect very small areas and distances, evacuation nearly always requires some type of transportation resources. Thus, any decision to evacuate should take into account whether the transportation resources:

- Will be available where needed in the required time,
- Can accommodate the number of people expected at each location, including persons with special needs, and
- Can move them out of the affected area in time to avoid exposure to the plume.

Because cars, vans, and buses provide little or no protection from airborne hazards, evacuation can only be effective if people can be removed to a safe location without exposure to the plume, either at their point of origin or enroute.

Based on the first two considerations, evacuation nearly always requires detailed planning and preparation to be effective. Moving people from an area where they may be harmed to a safe haven without subjecting them to exposure or additional hazards along the way is not a simple matter, particularly when it should be done on a time scale of minutes to a few hours. Buses or other mass transportation vehicles should be identified, where and when drivers will be contacted and mustered, and when and where vehicles will be staged should be pre-identified**.** Ad hoc evacuation conducted without detailed planning and designated transportation resources, routes, destinations, and accountability procedures can entail greater risks to the evacuees.

Evacuation itself carries some monetary and social cost, as well as a degree of additional health risk to the evacuees from traffic accidents or other causes. While generally small, the risk to populations may be much higher when the hazardous material emergency is caused by or happens to be concurrent with a natural disaster (for example, adverse weather conditions that cause reduced visibility, flying debris, slick roads, and downed power lines), or poor or obstructed road conditions. The increased risk to evacuees under a variety of possible evacuation conditions should be considered in planning for protective actions. The risk to emergency workers (drivers, area wardens) who will facilitate the evacuation should also be considered.

Evacuation may be the only viable protective action choice if no structures suitable for shelter are available in the affected area, or if sheltering will not be effective for other reasons (a lengthy or recurring release is anticipated). When the planning process indicates that this may be the case for a particular hazard, detailed planning for evacuation is indicated. Assembly areas, modes of transportation, evacuation routes, and reception centers should be identified in facility plans and procedures and should be clearly identifiable to users. Plans should also describe how evacuation instructions will be provided to onsite personnel and describe how evacuation will be implemented.

Bus drivers should have maps indicating the selected evacuation routes and destinations and, preferably, be equipped with radios for communication with emergency managers should conditions change.

If private vehicles are to be used in evacuation, plans and procedures should make the operation as efficient as possible. Planning should include subjects such as selecting vehicles with the largest passenger capacity, ensuring that all available passenger seats are filled, ensuring that each vehicle being used has sufficient fuel to complete the trip to the reception area, and organizing vehicles into groups of manageable size. There should be plans to allow sufficient space between groups to allow for other uses of evacuation routes.

Directionally-separated facility egress points, assembly areas, evacuation routes, and reception areas should be established to direct evacuees away from or around the plume. Egress routes should be clearly marked within and between facilities, as well as routes leading offsite. Procedures should contain guidelines for determining the optimum choice of egress and destination and concise, oral announcements for use by emergency managers. Reception areas should be equipped to monitor evacuated personnel for contamination.

Evacuation plans should be closely coordinated with offsite transportation and law enforcement officials because those officials will be expected to establish controls over roads surrounding the SFA and to direct traffic. Such officials would also be the primary source of information on current road conditions created by inclement weather, range fires, earthquake damage, construction, road closures, or traffic congestion.

A sheltering (or shelter-in-place) protective action strategy reduces exposure to airborne hazardous materials by having people go (or stay) indoors while the plume is passing, thereby taking advantage of the radiation shielding provided by the structure or the lower concentration of airborne contaminants inside the structure. However, the effectiveness of sheltering can vary greatly depending on the nature of the hazardous material, weather conditions, type of structure, duration of the release, and the ability of the sheltered people to take additional measures to reduce infiltration of outside air into the structure.

Table 4-5 provides some typical infiltration rates for modern, energy-efficient houses, older more leaky houses, and industrial-type buildings and office buildings with ventilation intakes secured:

Table 4-5. Infiltration Rates – Air Change/hr

	Low-Wind	*High-Wind*
Tight house	0.1	0.8
Older house	0.5	4.0
Industrial building	0.3	2.4
Office building	0.7	5.5
Motor vehicle	0.5	15+

The Low-Wind values represent a wind speed of ~1 m/s and the High-Wind values ~8 m/s. Infiltration will typically approximate a linear function of wind speed. However, for a given release rate (source), the concentration in the plume will be inversely proportional to the wind speed.

The values given in **Table 4-6** represent estimated concentrations inside the building expressed as a fraction of the concentration in the outside air. Note that even for relatively tight shelters, the benefit of sheltering (reduction in the air concentration) is only about 50% after an hour or two, provided the sheltered location remains within the plume for that entire period of time. For a radiological release expected to last for a couple of hours or more, and with unchanging wind directions, consider early evacuation of people sheltered directly in the plume's path because the integrated exposure (and committed dose) may be lower for a short duration of unprotected transit through the plume than for breathing the reduced, but steadily increasing concentration inside a building for several hours. If a toxic chemical release is expected to last more than a couple of hours, impact the shelter location for a significant portion of that time, and the outside concentration is estimated to be in the AEGL-2 (or equivalent) range or below, the same approach should be considered. However, if the outside plume concentration of a chemical is estimated to approach the level where permanent or lethal affects are expected even from a brief exposure, personnel should remain sheltered. Shelter personnel should be provided instructions on increasing shelter effectiveness (turn off ventilation, place wet towels under doors and windowsills, fashion ad hoc respiratory protection,) and directed to remain in the shelter until outside concentrations fall below harmful levels. For both radiological and chemical releases, personnel should leave the shelter as soon as it is confirmed that the plume has passed, to avoid continued exposure to contaminants trapped within the shelter.

Table 4-6. Air Changes per Hour

Release Duration (hr)	*0.3*	*0.5*	*1*	*2*
0.25	0.07	0.12	0.22	0.39
0.5	0.14	0.22	0.39	0.63
1.0	0.26	0.39	0.63	0.86
2.0	0.45	0.63	0.86	0.98

For an exposure of radioactive materials, the parameter of concern is the total integrated exposure (or dose). The information in **Table 4-7** (from EPA PAG 2017 for radiation and PAC Rev 29 for hazardous chemicals) shows a large spread between the levels to prevent or mitigate further exposure (i.e., the applicable PAC) and the level at which acute and potentially lethal health effects may occur (Threshold for Early Lethality (TEL) for radiation, PAC-3 for chemicals). For radiation, the ratio of TEL to PAC is at least 100 and closer to 1000 for inhaled Pu. On the other hand, the ratio of PAC-3 to PAC-2 for most chemicals is on the order of 1.5 to 10.

Table 4-7. Concentration vs. Dose

Hazard	*PAC-2*	*PAC-3*	*PAC-3 / PAC-2*
Radiation	1 rem	100 rem	100+
Chlorine	2 ppm	20 ppm	~7
Ammonia	160 ppm	750 ppm	10
HF	24 ppm	44 ppm	1.8
NO2	12ppm	20ppm	1.7

These ratios represent estimates of the slopes of dose-response curves or, effectively, the margin of error for making decisions related to protecting people both in distance and in time. If a person exceeds the PAC for Pu by a factor of 100, there will be no acute health effect, though chronic health effects, including a potential future fatality, may occur. If the same person exceeds the PAC-2 for chlorine by that same factor of 100 *for even a few minutes*, they could experience a prompt and lethal health effect.

Key considerations for selecting sheltering-in-place (SIP), as a protective action include:

- Compared to evacuation, SIP, in its most basic form, requires little special planning or preparation. The affected population needs only to be notified that they should stay inside or go into nearby structures suitable for sheltering.

- Even without special preparations, sheltering in ordinary structures, such as homes and office buildings, can be very effective in reducing exposure, especially for periods of short cumulative exposure to the plume. The effectiveness can be increased significantly by shutting off ventilation and sealing doors, windows, and all means of air infiltration.

- By having people SIP, emergency management officials can communicate with them more readily and provide instructions on how to increase shelter effectiveness and take other measures to reduce their exposure.

SIP is generally considered the only practical protective action when there is not sufficient time to evacuate a population before the plume arrives at their location.

SIP is the protective action of choice for most toxic chemical release scenarios due to:

- The possible severe health consequences from even brief exposures to high concentrations of some substances,

- The large uncertainties associated with predicting the concentration of an airborne contaminant at any given time and location, and

- Typically, insufficient time for safe evacuation.

For substances that are hazardous through inhalation, the maximum reduction of dose/exposure from sheltering may be achieved if people move out of the structure promptly after passage of the plume. People who remain inside a shelter where the air is contaminated by infiltration from the passing plume could, under some circumstances, receive about the same cumulative inhalation dose or exposure as would an unprotected person exposed to the same plume.

Exposure to hazardous contamination deposited by a passing plume should be taken into account when deciding how and when to terminate the SIP. The potential exists for people to receive significant additional dose or exposure after they emerge from shelter following plume passage. The potential is greatest if the deposited contaminants produce high levels of direct (external) radiation, have a dermal route of exposure, or if the material can become re-suspended from contaminated surfaces and subsequently inhaled.

During an emergency, people who are directed to shelter-in-place can take several measures to enhance the protection provided by a structure. These include:

- Closing windows and doors
- Securing ventilation systems
- Sealing penetrations with tape or plastic
- Sheltering in interior rooms

The effectiveness and dependability of these measures can be increased significantly by simple planning/preparedness actions. Examples include:

- Selecting the rooms or corridors that will provide the most protection
- Identifying and labeling Heating, Ventilation, and Air Conditioning (HVAC) controls
- Positioning necessary materials (plastic sheeting, sealants, and tape) in the designated shelter spaces
- Providing written instructions for use by shelter occupants

4.8.3.5. Offsite Protective Action Recommandations

Emergency management plans for DOE/NNSA sites and facilities should provide for the health and safety of the offsite public through coordinated planning with State and local government authorities. Facility and site plans should provide for timely notification accompanied by recommendations to Tribal, State, or local authorities regarding protective actions for the general public during the plume passage phase and for the ingestion pathway.

- The recommendations should be made to the designated, responsible authorities as soon as possible, but no later than 15 minutes after recognition that a PAC has been or will be exceeded offsite, **or** that a General Emergency has been declared. Default criteria based on facility conditions should be prepared so that protective action recommendations to offsite authorities can be made in a timely manner, even though consequence projections have not been completed.

- The recommendation may be considered delivered when the content of the message is received and acknowledged by the EOC, communications center, or central warning points serving the offsite agencies.

- Means of communication with offsite authorities should be established such as interoperable radios, commercial telephone, cell phone, fax, e-mail, etc., preferably with backups. These should be tested regularly.

- Each notification message to offsite authorities concerning the declaration of an OE or change in emergency condition should restate the protective actions being recommended, even if the recommendation is no protective action.

The PARs to offsite authorities should be formulated using the same types of criteria developed for decisions on evacuation or sheltering of site workers. The following information should be provided to offsite authorities for their consideration in implementing the recommendations:[2]

- The time available for carrying out the protective action before the onset of the impact (i.e., plume arrival).

- The specific offsite areas within which PAC may be exceeded. These areas should be identified as sector and distances, as easily recognized geo-political areas, or by agreement with local off-site government officials Section 2.3.3 discusses designating these areas as part of development of the EPZ. During an incident, these areas are determined from consequence assessment modeling that incorporates the quantity of material released, the incident type, and the meteorological conditions. After environmental samples and other field monitoring results are collected and analyzed, these data may also be used to refine estimates of the offsite areas within which the PAC may be exceeded.

- The relative effectiveness of the different possible protective actions, considering the material and the release type. For example, sheltering-in-place may be as effective as evacuation for a short-duration gaseous release. For acutely toxic materials in high

[2] These actions should be in accordance with the Federal Advisory Committee Act (FACA). In order to abide by FACA, any interactions with local off-site government officials should consist exclusively of Federal officials and elected officials of state or local governments (or their designated employees with authority to act on their behalf). The purpose of any interactions with the above officials must be to exchange views, information, or advice relating to the management or implementation of federal programs established pursuant to statute that explicitly or inherently share intergovernmental responsibilities or administration.

concentration, sheltering may be the only practical alternative unless evacuation can be completed before plume arrival.

- If Tribal, State and local authority guidelines (values for PACs) differ from the facility's PAC, the facility should also provide offsite authorities with the equivalent information using the Tribal/State/local guidelines.

4.8.3.6. The Decision Environment

The decision to shelter or evacuate a given area or population is typically carried out in a complex and dynamic emergency response environment. The decision is usually linked to an emergency declaration and the resulting ERO activation. Immediately upon determining that an EAL has been exceeded, the classification authority is expected to declare the appropriate class of emergency and initiate the response, including predetermined initial (default) protective actions.

The initial (default) protective actions associated with an EAL will normally be initiated concurrently with emergency notifications and call-out of support staff. Later, upon their arrival, the consequence assessment staff has 15 minutes to evaluate the situation and determine whether the default protective actions should be modified. As time progresses, the consequence assessment staff and the rest of the ERO makes a continuing assessment of the emergency classification and the protective actions. Central Registry codes like HotSpot and EPIcode are recommended by STARS for use in confirming initial protective actions at distances close to the release site (3-5 km), when that area does not involve complex terrain, or winds are not variable in direction or speed. For further distances downwind, in complex terrain environments, or when winds are changing, STARS recommends using a more sophisticated site workhorse model to confirm initial protective actions. Workhorse models are typically found in the STARS toolbox, are deemed to have appropriate SQA for emergency response purposes and meet a number of needs for consequence assessment modeling.

Given the above conditions, emergency managers and technical staff should consider the following:

- When consequence assessment and other technical staff arrive to evaluate the situation, *the initial protective actions will probably already have been initiated*. The initial decision to classify an incident and activate the ERO will usually cause the default protective actions to be initiated immediately. The staff have 15 minutes to verify the initial immediate protective actions are consistent with the technical planning basis.

- Even if the initial protective actions are found to **not** be the ideal choice or too conservative, ordering changes to the protective response after it has been started may cause confusion, delay, or serious negative consequences.

- Finally, the initial protective actions selected by the planning staff, based on EPHA results and various other factors, will usually be the most effective of the several possible choices for the situation indicated by the EAL. However, the technical basis and reasoning behind the default protective action may not be entirely clear to initial responders at the time of an emergency.

Based on the considerations expressed above, the initial responders *should <u>not</u> modify the initial PAs unless there is convincing evidence that they are inadequate for the specific situation*. By reacting precipitously based on initial reports and indications that are often fragmentary or just wrong, initial responders need to know that they may be discarding products of the EPHA and planning effort without fully understanding why those products were selected in the first place. The initial protective action should be considered as the point of departure for a more refined decision that is taken based on consideration of all the information available to the consequence assessment staff and which might impact a larger area and number of people (to include offsite PARs).

The decision process can be most focused if it is structured to respond to a particular hazard type, magnitude, location, population, and set of expected consequences. The goal of the protective action decision may vary with the situation. If lethal exposures were possible, the overriding goal would likely be to avoid fatalities, perhaps at the cost of lower exposures to a large number of people; this may be the same as reducing exposure below a threshold level, where the threshold is the level at which fatalities are expected to occur (the TEL for radiation, PAC-3 for chemicals). Minimizing population exposure and risk is a typical goal for incidents involving radioactive material releases when life-threatening doses are not expected.

A decision aid can be developed that attempts to capture, usually in the form of a checklist, matrix, table, or decision/logic tree, the most important attributes of a situation and guides the decision maker systematically through the various considerations to the decision that comes closest to achieving the goal. The decision checklist approach provides the various attributes of a situation and indicates whether shelter-in-place or evacuation is indicated. This approach is suited to situations in which the conditions may vary widely and an automatic or default set of actions will (normally) already have been initiated by the time the ERO begins the confirmatory assessment. **Table 4-8** demonstrates how the value or quality assigned to each attribute of a situation points to shelter or evacuation as the preferred protective action.

Table 4-8. Decision Aid – Checklist

***Attribute**	***Sheltering***	***Evacuation***
Infiltration (shelter quality)	Tight	Leaky
Release Duration	Short	Long
Time of day	Night	Day
Population Density	High	Low
Road Geometry	Closed	Open
Road Conditions	Poor	Good
Population Mobility	Immobile	Mobile
Release Status	Ongoing	In future
Hazard Type	Chemical	Radiological
Population Location	Current affected sectors	Outside current affected sectors
Transport Means	Not available	Available
Evacuation Route	Through plume	Away from plume

Time until Plume Arrival – Approximate time available after making a decision on evacuation/sheltering before the leading edge of the plume reaches the population at the location of concern. If this time is too short to safely evacuate the population, then sheltering in place is likely your best option. This can easily be determined without a calculator or computer using real-time information on wind direction, wind speed, and the distance from a release site to the area of concern.

Variability of wind direction – A wind with variable direction will dilute the plume, limit exposures at the location of interest, and make evacuation more risky. A quick look at recent wind data can provide an initial estimate of wind variability and this can influence the evacuation/sheltering decision.

Each protective action decision (or attempt to confirm/refine a decision already reached) needs to be made with a clear understanding of the goal of the action. The goal will vary depending on the type of hazard, the expected consequences of exposure, the number of people who may be exposed, whether the offsite public is included among those who may be affected, and other factors.

4.8.3.7. Development of EAL-Specific Pre-Planned Initial Protective Actions

To assure the most rapid and effective implementation of protective actions following an emergency declaration, a predetermined set of initial protective actions should be associated with each SFA-specific EAL. Each of the factors discussed in this section should be considered before selecting the initial protective actions that are optimal for the incident or condition as implied by a particular EAL.

In general, use of real-time meteorological conditions as a factor in determining incident classification and initial protective actions is not encouraged. Caution is needed because the use of meteorological data could lengthen the initial decision process and miss the goal to quickly protect personnel. However, the improved availability of real-time meteorological data and fast response consequences models can allow for timely modifications to preplanned protective action decisions and recommendations. It also complicates, and potentially lengthens, the decision processes.

While a conservative approach, the 360-degree initial protective action distance provides sufficient protections for the health and safety of the workers and the public. Therefore, the Keyhole Concept, which adjusts the 360-degree initial protective action distance with a downwind component, is not acceptable for immediate/initial protective actions for workers but would be acceptable for follow-on actions once baselines have been established, and for determining safe route for responders. As more data is made available, distribution of updated protection action recommendations should be made where practical to reduce/eliminate criteria that may no longer be needed.

The following factors should be considered before a decision is made on the most appropriate initial protective actions associated with a specific scenario:

- **Hazard**. Any planned protective action may entail some unavoidable exposure to the hazard by some people. Therefore, the number of people affected, and the effects of that unavoidable exposure need to be considered when selecting a set of protective actions that will be the default implementation upon exceeding a particular EAL. If the hazardous material is a radioactive substance or a chemical for which the total integrated exposure or dose is of concern, the impact from the limited unavoidable exposures associated with a particular protective action may be acceptable when weighed against the potential health or risk benefit of preventing larger exposures. However, if the primary concern is the concentration of the hazardous material to which people will be exposed, the unavoidable exposure associated with a particular protective action may be unacceptable because it carries a high risk of serious injury or death.

- **Release**. If the EAL is stated in terms of an actual release, or the incident that causes a release, the hazardous material may be in the environment and affecting some people by the time the emergency declaration is made. However, if the EAL suggests a degrading safety condition that may end in a release, there may be adequate time within which to carry out protective actions before the release starts, or people are exposed to the plume. If the release were from an elevated release point, the predicted point of maximum impact may be some distance from the point of release, which means that people very near the release point may be of less immediate concern than those at a greater distance.

- **Affected Area and Population**. The analysis on which the EAL is based should provide a conservative estimate of the potential impacts. The available time to take action (before plume arrival) may be very short for some locations and the time required to implement a warning might make it impractical to do anything before the plume arrives. If, however, the EAL is stated in terms of precursors or early symptoms of a condition that will or may end in release, the ability to warn potentially impacted populations before the plume arrives may be enhanced. Whether the affected population is onsite (workers) or offsite (public) will affect how they are notified and how they can be expected to respond. Onsite protective action plans usually assume that the affected population is trained in the proper response to emergencies, and that a trained response cadre will provide direction. Even with a continuous public education campaign, neither of these assumptions is likely to be valid to a significant degree for the offsite public except in rare and visible circumstances, (in the vicinity of commercial nuclear power plant, where the public is subject to an extensive emergency preparedness awareness program with frequent drills).

- **Available Protective Actions**. The protective actions that are actually feasible and effective for the particular hazard and conditions suggested by the EAL will need to be considered. Evacuation of large numbers of people usually will require some sort of mass transportation. As noted above, availability of buses, vans, drivers, and traffic control personnel may vary depending on the time of day and the specific emergency conditions. For example, road conditions may vary and the EAL may suggest a natural phenomenon that would also inhibit orderly and rapid evacuation.

The availability and effectiveness of enclosed shelters that meet shelter-in-place criteria for reducing the impact of the hazardous material will be an important determinant of planned actions. However, when the outdoor population is large and no suitable shelter is available nearby (as, for example, on a construction site), evacuation may be the only workable option.

4.8.3.8. Accountability

Regulations, such as 29 CFR Part 1910.38, require employee emergency response plans that include procedures to account for all employees after an emergency evacuation has been completed. All DOE SFAs are subject to this basic workplace safety requirement, which is generally considered satisfied if designated persons verify that no one remains inside an evacuated building and all evacuees meet at staging areas outside the building for an informal head count. DOE O 151.1D states that provisions should be in place to account for employees after emergency evacuation has been completed. Each facility should establish a goal for time required to do this, consistent with the facility hazards and the selected protective action. A time frame of 30 to 45 minutes is an accepted industry practice. Accountability of response workers should be maintained, once established.

The objective of accountability procedures is to ensure that search, rescue, and assistance efforts can be initiated and completed promptly to provide for the safety of facility personnel who may be injured, trapped, or unaware of the emergency condition.

Assuring that all facility personnel have been accounted for should be a major consideration when an IC sizes up a situation (NFPA Standard 1021, Section 2-10) and for factoring into the decision to risk the lives and health of rescue personnel in a hostile environment to search for victims. In keeping with the principles of protective action, the risk to search and rescue personnel should be weighed against the risk to missing workers.

Positive accounting of facility personnel helps minimize the risk to search and rescue personnel.

In high hazard areas, a positive control system, such as a log or badge/card reader that records the entry and exit of employees, is often employed during routine operations and should be considered as a means of assisting with accountability during emergency response.

Full accountability should be met timely in areas where workers might be subject to risk of death or serious injury and where search and rescue operations might pose a significant risk to emergency personnel. Use of a positive control system can help achieve this goal. Specific examples of facilities where a positive control system should be applied are:

- The nature of the facility operation is such that people might become quickly trapped or incapacitated by the incident so they cannot take action to protect themselves (explosions, rapid release of incapacitating materials, nuclear criticality).
- There is substantial risk of personnel being out of communication and thereby unaware of the hazard and the need to evacuate (remote areas with poor alarm/public address coverage, high-noise areas).

A short duration accountability time standard, or a positive accountability system, need not necessarily be applied to an entire facility, but may be applied to that part of a facility or complex that contains the hazard.

4.8.3.9. Decontamination

Personnel, vehicles, and equipment evacuated from the area affected by a hazardous material release may be contaminated. Decontamination can reduce the health hazard to the evacuees, to others who might later encounter contaminated people or articles, and to the environment.

The SFA plans and procedures should provide for monitoring of personnel, vehicles, and equipment leaving areas potentially affected by a hazardous material release. Consistent with the protection of peoples' health, monitoring should be done before the personnel or equipment leaves the DOE/NNSA site. Contaminated personnel and vehicles should be directed to pre-determined decontamination stations, monitored and, if needed, decontaminated to established levels prior to release. Decontamination stations should be stocked with adequate supplies, equipment, and procedures to support all monitoring and decontamination activities. Intervention criteria should be included in procedures and personnel should be trained in their use. Antidotes and MSDSs should be available. Provisions should be made for collecting, documenting, transporting, and analyzing all samples, including biological samples.

For personnel who have been severely injured, medical treatment should take priority over decontamination for radioactive materials. In the case of toxic chemicals, the priority should be determined on a case-by-case basis, preferably during pre-planning. Procedures should also address the monitoring and decontamination of vehicles used to transport injured and contaminated victims. The MOUs with local hospitals and ambulance services should address transport, receipt, and treatment of contaminated victims and decontamination of equipment, facilities, and the disposal of wastes.

Procedures should address methods used to limit the spread of contamination from the victim to their surroundings during transportation to pre-designated facilities for treatment and later decontamination of injured personnel.

Decontamination should occur in existing facilities, if possible. If decontamination facilities of the appropriate type do not exist onsite, would not have the necessary capacity, or would be unusable because of the emergency, then procedures should identify alternative methods or provide for establishing temporary facilities.

Decontamination methods to be employed will depend on the types of contamination and the type of work activities performed during the response. Monitoring of individuals and equipment should be performed at appropriate stages prior to and after decontamination to ensure that decontamination has been successful. Decontamination plans and procedures should provide for disposal of contaminated wash and rinse solutions and contaminated articles in compliance with all applicable regulations.

4.8.3.10. Other Protective Actions

There are other protective actions in addition to sheltering and evacuation. Some of these may be useful in certain circumstances and should be considered in developing onsite response plans. Others will be primarily, or exclusively, the concern of offsite authorities, but are discussed briefly here as background for DOE/NNSA and contractor personnel who will carry on a planning dialogue with those responsible for offsite protective actions. The DOE/NNSA and their contractors should coordinate with responsible offsite agencies to plan for the recommendation and implementation of these protective actions for the facility and hazards of concern. The FEMAs Radiological Emergency Preparedness (REP) Program for commercial nuclear power plants, supported by the NRC and DOE, has a long-standing set of plans and procedures that can be consulted when selecting and implementing the full range of protective actions, both onsite and offsite. Similarly, where appropriate, the Chemical Stockpile Emergency Planning Program, jointly managed by the U.S. Army and FEMA in and around chemical weapons storage sites, offers another set of well-developed procedures.

- Medical Care. Several regulatory requirements and directives include criteria for medical support that should be in place for workers, including those with radiological or hazardous material contamination. Planning for and identifying resources to provide fundamental medical care in the event of an accident should be carried out as part of the protective actions element. When evaluating medical care as a protective action, consideration should be given to the treatment and documentation of injuries and illness and to reducing patient anxiety by explaining the potential benefits of treatment. Additional guidance on this subject is found in Chapter 4, Section 9.

- Ad Hoc Respiratory Protection. Ad hoc respiratory protection is a cost-effective protective action that can significantly reduce inhalation of some hazardous materials by both workers and the general public. Ad hoc respiratory protection is especially useful in rapidly occurring incidents. Effective protection against the inhalation of particulates and some gases can be provided through using readily available materials such as handkerchiefs, towels, and cloth. Wetting a cloth can increase its efficiency as a breathing filter for some materials.

- Control of Access. Control of personnel access to affected areas can prevent unnecessary exposures and minimize the spread of contamination. It also minimizes interference with emergency response activities. Access control is most effective when implemented immediately upon recognizing that an area has been, or will be, affected by a hazardous material release.

- Shielding. An attenuating material between the source and potentially exposed people can provide protection from radiation. The shielding provided by a structure is one factor that determines whether people can be effectively sheltered in that structure. For most releases of radioactive materials, the ability of a structure to limit infiltration of outside air, thereby reducing inhalation exposure, is far more important than the shielding it can provide and will largely determine its suitability for sheltering personnel.

- Radio-protective Prophylaxis. Taking of iodine prophylactically has some limited benefit in minimizing the uptake of radioactive materials to the thyroid. To be effective, iodine prophylaxis requires both considerable planning and warning of the potential exposure. For greatest effectiveness, stable iodine should be taken before or shortly after exposure. Because reliable radiological measurement information may be lacking during the initial stages of an incident, the decision to administer stable iodine should be based on planned estimates of exposures and risk. Use of stable iodine as a protective action should be based on a careful evaluation of net benefit. Although iodine tablets generally have few side effects, certain populations may be more vulnerable, including pregnant women and those who may sustain allergic reactions. Problems with administering stable iodine include identifying the affected population, distribution, and adverse health effects on a small percentage of the population.

  The Food and Drug Administration has determined that potassium iodide (KI) is a safe and effective means to prevent radiological uptake by the thyroid gland. FEMA supports the use of KI as a thyroidal blocking agent by emergency workers, institutionalized persons, and the general public in the event of a release from a nuclear power plant, often on a voluntary basis. For DOE and NNSA SFAs that have enough radioiodine for release, as determined by the EPHA, use of KI to protect workers, responders, and collocated workers should be considered. Responsibility for administration of KI offsite is the responsibility of the offsite local authorities.

  For optimal protection against inhaled radioiodines, KI should be administered before or immediately coincident with passage of the radioactive plume. Studies show that KI may still have substantial protective effect even if taken 3 or 4 hours after exposure. Plans should be in place for timely decision making and administration of KI if deemed appropriate. For sites located in the vicinity of a nuclear power plant, or for sites that include research reactors or other equipment capable of producing radioiodine, plans for use of KI for workers in the event of an accidental release of radioiodine should be considered.

Other prophylactic measures include the administration of chelating agents or diuretics to speed the removal of specific radionuclides from the bodies of exposed individuals. In addition, pharmacological strategies exist for reducing the sensitivity of exposed individuals to the deleterious effects of radiation. The use of such measures is part of the medical response to a release or accident and not considered as a typical protective measure for workers or emergency responders.

- Control of Foodstuffs and Water. An incident with offsite environmental consequences may require implementing controls on the distribution of contaminated food and water. Although implementation of these actions offsite will be the responsibility of State and Federal health officials, DOE/NNSA and their contractors may need to assist those agencies in developing intervention levels for specific hazardous materials and to manage onsite potable water supplies. Banning the sale of, and preventing the consumption of, contaminated foodstuffs imposes minimal risk, but may have significant costs. Selection of protective actions for control of foodstuffs and water may initially be based on the predicted or measured ground deposition. At later stages, measurement of the concentrations of hazardous materials in foodstuffs and water should be available to refine decisions. Contamination of water supplies because of an airborne release is not likely to be a source of significant exposure although there may be higher local concentrations. However, special consideration should be given to people who may consume rainwater or untreated water supplies. Long-term control of foodstuffs and water requires consideration of several factors. These include the availability, quality, and cost of alternative food sources; costs and resources associated with monitoring, control, and disposal; and rate at which the hazardous material is introduced to the foodstuffs. These will be evaluated and considered as part of offsite emergency response plans.

- Relocation. Relocation of individuals can be implemented when emergency response is terminated. Relocation can be an extension of an evacuation, or it can be initiated in the later stages to facilitate decontamination efforts. The duration of the relocation depends on the natural and remediation activities eliminating the hazard. Procedures to determine the advantages and disadvantages of relocation and its net benefit are different from those of evacuation. The costs and impact of relocation will depend upon the number of individuals affected and the social and economic disruption created.

- Decontamination of Land and Equipment. Decontamination of land and equipment can prevent the spread of contamination and reduce or eliminate exposures. The projected dose to decontamination workers should be weighed against the dose to the public that will be averted. Decontamination efforts will generate large volumes of waste requiring disposal. While decontamination of small areas may be practical and cost effective, decontamination of large areas may be very difficult and costly. Detailed planning for decontamination is conducted during the recovery phase of response.

- Changes in Livestock and Agricultural Practices. The contamination of pastures and agricultural areas due to the deposition of released materials can require specific protective actions to minimize introduction of the contamination into the human food chain. Actions could include putting livestock on stored feed, delaying slaughter of animals until the hazardous material has been removed from their systems, and treating the soil with fertilizers to minimize the uptake of the hazardous material into foodstuffs. The use of severely contaminated land for agricultural purposes may have to be prohibited.

4.8.4. Reentry

Reentry involves reentering a facility or affected area that has been evacuated or closed to personnel access during the course of the emergency. In order to protect the personnel involved in reentry, the activity should be well planned, coordinated, and accomplished properly and safely. This section will cover the preplanning necessary to ensure that personnel are prepared for reentry activities that may be encountered at the specific SFA. This includes the availability of the appropriate support materials and resources to perform the reentry activities. The remainder of the section focuses on the protection of personnel involved in reentry. Decision making and operational aspects of reentry are addressed, as well as the management of personnel exposures that depends on the specific reentry activity being attempted.

4.8.4.1. Reentry Planning

The identification and screening of facility hazards will identify the material hazards that may be encountered during reentry activities. Review of the incident scenarios developed during the EPHA analyses will provide the planner with information concerning the type and nature of possible failures; possible mitigative activities; areas likely to be accessed during reentry; degree and nature of facility damage; and, systems, indicators, or controls that may be non-functional. EPHA consequence calculations will provide source term information for each analyzed incident scenario that will help the planner determine the range of hazardous environments that may be encountered by personnel during reentry activities.

Using information developed in the EPHA, facility operations personnel should consider the following: special damage control equipment, provisions for spare parts, availability of back-ups for critical equipment, pre-arranged service contracts, and accessibility of critical items under emergency conditions.

4.8.4.2. Protection of Response Personnel during Reentry Activities

Planning and actual conduct of reentry activities should recognize that each emergency incident is unique. Therefore, the response structure for conducting reentry activities should be flexible and capable of responding to a wide range of conditions.

Reentry Decision Making. Reentry activities will often involve high risk, time-urgent actions. ERO management may be called upon to make rapid risk versus benefit type decisions and then to establish priorities for selected activities. It is important that emergency management plans and accompanying implementing procedures provide the necessary structure and guidance, including:

- The emergency management plan should identify the position within the ERO with the authority and responsibility to authorize reentry activities and approve doses/exposures that may exceed occupational or administrative limits.

- The implementation of selected reentry activities should be carried out by elements of the ERO closely associated with the facility, located at the incident scene or affected area.

- To assist with the decision-making process, training and procedures should address the following:

  - Criteria and guidance to assist in prioritizing reentry activities should be provided. Consideration should be given to the benefit achieved as well as the availability of qualified personnel and resources to carry out any given activity. Information and requests regarding reentry activities should be forwarded to the ERO position having decision-making authority. A means to record and indicate the priority of proposed activities and track progress on authorized activities should be provided.

  - Criteria and guidance to assist in making risk versus benefit determinations should be provided. Consideration should be given to protecting the health and safety of workers and the general public, minimizing damage to the facility, and limiting environmental impact or damage. A means for estimating exposure to hazardous material during the reentry activity should be provided. The possibility that the reentry activity could cause a release or worsen an existing release of hazardous material should be considered. Means to estimate consequences of a potential release on workers, the public, and the environment resulting from reentry activity should be provided.

  - Criteria and guidance to assist in making decisions concerning the authorization of emergency dose or exposure should be provided.

  - A mechanism for coordinating reentry activities within the site ERO and with State, local and other Federal agencies, as necessary, should be provided. As a minimum, information regarding reentry activities planned and in progress should be provided to these agencies. Priority should be given to communication of any pertinent information acquired during reentry activities.

Reentry Operations. Once the decision has been made to perform a reentry activity, while an on-scene operation is still occurring, personnel responsible for managing the on-scene response should develop a plan. They should have direct access to the most current information, be familiar with the facility or incident area, and have knowledge of the personnel and resource requirements of the task.

One position at the facility or incident scene level should be vested with the responsibility to coordinate the reentry planning process. Responsibilities of this position might include identification of personnel and equipment needs, determination of personnel protection requirements, assignment of personnel to reentry teams, job planning, team briefing/ training, monitoring progress of activities, de-briefing teams, and collecting data upon completion. During both planning and preparation, this position may require the support of several other disciplines such as health physics, industrial hygiene, industrial safety, facility operations, engineering, medical, security, and others.

The following items should be considered when planning reentry activities and preparing reentry teams:

- Reentry planning should make use of all available information regarding interior configurations, locations of hazards, etc. Pre-fire plans are particularly well suited for use in such planning.

- Reentry planning should include security considerations. The planning effort should consider the possibility that an insider or outsider threat initiated the incident and that additional security-related hazards are yet unrecognized. Reentry teams should understand the importance of safeguarding classified and CUI information and matter.

- Reentry preparation should include contingency planning to ensure the safety of reentry personnel, such as planning for the rescue of reentry teams.

- Provide guidance on selection of reentry team members. Teams should consist of the minimum number required to perform the job, but should not be less than two persons, one of whom has first aid training. Team members should be chosen based upon job qualifications; training; proficiency in the use of protective equipment; exposure history (radiological); and sensitivity to toxic materials. For very high-risk tasks, volunteers should be used. Criteria should be developed to determine what constitutes a high-risk task and how to select the most appropriate volunteer for a given task. Criteria for selection of volunteers may differ for radiological versus toxic material incidents. If feasible, volunteers should be evaluated with respect to age, health, and previous exposure history (for radiation exposure). Each volunteer should be advised of the known or anticipated hazards prior to participation.

- Under some circumstances, the control of contamination may be a concern. Reentry planning should address methods for reducing the spread of contamination and ensuring that reentry activities do not inadvertently increase the actual or potential release of hazardous material.

The following items should be considered when preparing reentry teams for reentry activities:

- Provide procedures or checklists to ensure that all factors are considered prior to dispatching reentry teams. Reentry planning should use current status information; provisions should exist for modifications as new information is received. All individuals involved in a reentry should receive a hazards/safety briefing, prior to emergency response activities, consistent with Federal, Tribal, State, and local laws and regulations, that will address all safety- and job-specific aspects of their assignments.

- Provide personnel performing reentry planning with training and guidance on the selection of appropriate protective clothing and equipment. Identify ERO positions (or other personnel) with the technical expertise and the responsibility to determine what protective equipment and clothing is appropriate for the situation at hand.

- Ensure that adequate job planning is performed prior to team dispatch. Even the simplest jobs may become much more complex under accident conditions. Thorough team preparation for the job is critical for the safety of the team members and the success of the task. Make sure that each team understands the job to be performed and team members understand their role. Some job preparation items to be considered include procedures, checklists, parts, tools, test equipment, use of *dry-run* or mock-up training, and appropriate monitoring equipment (health physics or industrial hygiene).

- Each reentry team should be provided with a primary and back-up means of communication. Prompt reliable communications are necessary to notify teams of changing conditions, monitor job progress, provide additional instructions, and keep in contact with those responsible for reentry control activities.

- When teams are to enter areas contaminated with hazardous materials, procedures, equipment, and supplies necessary to perform monitoring and decontamination of personnel and equipment should be provided. If decontamination cannot be performed in a facility/area designated and equipped for decontamination activities, plans and procedures should address where and how to establish a field decontamination station. The proper collection, packaging, and disposal of waste generated during decontamination should also be addressed.

- Immediately upon return from completing a reentry assignment, teams should be debriefed. The de-briefing should be designed to collect information relating to the job performed, facility status, conditions encountered, and exposure received. Information should be recorded and passed on to appropriate ERO positions.

- Provide access to records and documents necessary for reentry planning. Training, job qualification, and dosimetry records may be necessary for team selection and assignment. Engineering drawings, procedures, and technical references may be necessary for job planning.

4.8.4.3. Rescue and Recovery

This section provides guidance for determining appropriate actions for the rescue and recovery of persons and the protection of health and property during an emergency response. The *PAG Manual: Protective Actions Guides and Planning Guidance for Radiological Incidents*, EPA 400-R-17-001 (January 2017), contains guidance for conducting these operations in response to a radiological hazard.

Although they are designed for response to radioactive releases, three basic principles apply to any type of hazardous material response, especially rescue and recovery activities:

- The risk of injury to those individuals involved in rescue and recovery operations should be minimized.
- Operating management should weigh actual and potential risks to rescue and recovery individuals against the benefits to be gained.
- Volunteers should perform rescue actions that might involve substantial risk.

General Considerations. The risk of injury to persons involved in rescue and recovery activities should be minimized, to the extent practical. Control of exposures should be consistent with the immediate objectives of saving human life; recovering deceased victims; or protection of health, property, and the environment.

- Personnel managing response activities should exercise judgment in evaluating any proposed action involving exposure. Evaluation should consider risk versus benefit.
- Decisions governing rescue and recovery activities often have to be made on a time urgent basis. Emergency Planners should develop guidance and a methodology to assist decision makers in rapidly evaluating risk versus benefit. Guidance should also recognize that accident situations involving the saving of human lives would require different evaluation bases than those required to recover deceased victims or to protect property.
- Before dispatching any rescue and recovery teams, the ED or the IC should ensure that the activities have been coordinated with the head of the organization providing the team members. This discussion should ensure that all operational and safety concerns are resolved prior to team dispatch.

For controlling exposures to radiological hazards, the EPA has prepared guidance and criteria that is presented in *PAG Manual: Protective Actions Guides and Planning Guidance for Radiological Incidents (EPA 2017)*. EPA limits for workers performing emergency services apply only to doses incurred during an emergency. In accordance with 10 CFR Part 835, exposures received in emergency exposure situations are not included in meeting the occupational exposure limits to general employees resulting from DOE activities. The EPA Manual also provides tables with general information that may be useful in advising workers of risks of acute and delayed health effects associated with large doses of radiation.

- Due to the uncertainties, the general approach taken by hazardous material responders has been to perform entries only while using the maximum protective equipment for the most severe hazards present. For extraordinary circumstances (lifesaving activities, protection of large populations), guidance and criteria should be provided for determining the minimum acceptable level of worker protection. Guidance and criteria should be consistent with that governing hazardous material response for private industry. Guidance, criteria, and technical information concerning response to hazardous materials have been published by a number of organizations and Federal agencies including OSHA, EPA, the Department of Transportation, FEMA, NFPA, AIHA, and others.

Emergencies. This section presents dose criteria and judgment factors for three types of emergency action: saving of human life, recovery of deceased victims, and protection of health and property.

- Saving of Human Life (or Protection of Large Populations). If the victim is considered alive, the individual in charge of the on-scene response activity should determine the course of action. The potential exposure to rescue personnel should be evaluated, and an exposure objective should be established for the rescue mission. The evaluation of the inherent risks should consider:

  – The reliability of the prediction of injury from measured/estimated exposure rates. In this context, consideration should be given to the uncertainties associated with the specific instruments and techniques used to estimate the exposure rate. This is especially crucial for exposure to radiation when the estimated dose approximates 100 rad (1 Gy) or more.

  – The effects of acute external or internal exposure.

  – The capability to reduce risk through physical mechanisms, such as the use of protective equipment, remote manipulation equipment, or similar means.

  – The progress of any mitigative efforts that would decrease or increase risk.

  – The probability of success of the rescue action.

Recovery of Deceased Victims. The recovery of deceased victims should be well planned. Except as provided below, the amount of exposure received by persons in recovery operations should be controlled within existing occupational exposure limits.

- When fatalities are in inaccessible areas due to high risk, and when the recovery mission would result in exposure in excess of occupational exposure limits, special remote recovery devices should be considered for use in retrieving bodies.

- When it is not feasible to recover bodies without personnel entering the area, the official in charge may approve personnel to exceed occupational exposure limits. This approval, for an individual, should not exceed 10 rem (0.1 mSv) in any year.

Protection of Health and Property. When the risk (probability and magnitude) of the hazard either bears significantly on the state of health of people or may result in loss of property so that immediate remedial action is needed, the following criteria should be considered:

- When it is deemed essential to reduce a potential hazard to protect health or prevent a substantial loss of property, a planned exposure objective for volunteers should be established not to exceed 10 rem (0.1 Sv) for an individual in a year. Under special circumstances, an exposure objective for volunteers not to exceed 25 rem (0.25 Sv) in any one year may be set.

- When the risk of exposure following the incident is such that life might be in jeopardy, or there might be severe effects on health or loss of property resulting in an adverse effect on public safety, the criteria for saving of human life should apply.

4.8.4.4. Management of Personnel Exposures

Careful management of personnel exposures and appropriate follow-up to reentry activities can minimize the risk of adverse health effects. If possible, exposures should be maintained within existing occupational (or administrative) exposure limits. Procedures should establish methods of controlling access to areas where hazardous material contamination might be encountered. The responsibility for controlling access to and activities within such areas should be assigned by the ERO.

Methods should be established for managing personnel exposures, including: determining allowable exposures and establishing limits on exposure or stay time; issuing appropriate protective clothing and equipment; providing devices or instruments with which to monitor exposures to the hazard; recording the movement of personnel in and out of the controlled area and the exposure, dose, or level of contamination encountered; recording and tracking accumulated emergency exposure; and, if necessary, decontaminating personnel after they exit the controlled area.

Records of emergency worker exposure to hazardous materials should be controlled, monitored, and maintained during and following emergency incidents. Records of contamination surveys and results of any decontamination performed should be recorded and maintained during and following emergency incidents. Applicable requirements for maintaining hazardous material exposure records are found in 29 CFR Part 1910.1020. Requirements for medical programs are found in 29 CFR Part 1910.120 and in 10 CFR Part 851 Appendix A, Section 8, *Occupational Medicine*.

Additional items should be considered for managing personnel exposures during reentry activities, such as the following:

- A policy governing the use of prophylactic drugs for dose reduction purposes should be created. Specific guidance on implementing that policy should be incorporated into procedures.
- The risks from entering an environment containing unknown quantities of chemical toxins are very different from the risk stemming from exposure to radiological material. The availability of installed instrumentation or portable monitoring equipment capable of detecting levels of toxic chemicals that could cause severe health effects or death may be limited. The lack of instrumentation, coupled with the uncertainty of projecting transport in a facility or the environment, makes it very difficult or impossible to calculate estimated exposures to reentry personnel that represent an acceptable risk.
- Although the concept of *As Low As Reasonably Achievable* (ALARA) was created as a general goal for reducing normal occupational exposure to radiation, it is also a useful guide for controlling emergency exposures to hazardous materials during emergency response.

4.9. Emergency Medical Support

4.9.1. Introduction

The purpose of this chapter is to assist DOE and NNSA field elements in complying with the DOE O 151.1D requirement to ensure that medical support for contaminated or injured personnel is planned and promptly and effectively implemented. Response requirements are also identified through DOE O 420.1C, BNA, and should be incorporated. In addition, the Order requires that arrangements with offsite medical facilities providing the support to transport, accept, and treat contaminated, injured personnel be documented.

Requirements for emergency medical support given in DOE O 151.1D are not unique but reinforce the requirements of DOE O 440.1B, current version, *Protection Program for DOE (Including the NNSA) Federal Employees*. DOE O 440.1B addresses the responsibility for the medical portion of the site emergency management plan. The purpose of this section is to provide specific supplemental guidance on the implementation of DOE O 440.1B, current version, requirements in the context of DOE/NNSA Emergency Management Core and Emergency Management Hazardous Materials Programs.

4.9.2. General Approach – Emergency Medical Support

Emergency medical response is an essential element in the development and implementation of a site emergency management program. This section serves as a management-level guide that addresses those aspects of emergency medical support that apply to Operational Emergencies (OEs) at DOE and NNSA SFAs. It emphasizes the management systems and interfaces that should be in place to ensure that emergency medical support will be provided for injured or injured and contaminated personnel. This document is not intended to be a technical guide for providing detailed emergency medical support, but is focused on providing an emergency management framework for such support.

It is essential that cooperation and coordination characterize the interactions between medical professionals responsible for medical emergency response and the emergency planners responsible for the overall SFA emergency management program. Each group possesses information and skills essential for the success of an emergency response. Hence, emergency management plans should be developed in concert to ensure an effective and integrated approach.

The DOE/NNSA sites do not normally maintain the full range of medical capabilities usually available in the surrounding community, particularly emergency and in-patient care. Therefore, injured employees will typically be transferred to offsite facilities when medical conditions necessitate. The availability of medical capabilities and resources within the surrounding community should be closely examined. Where advantageous and effective, agreements should be developed to use offsite capabilities rather than duplicate the same capability at the DOE or NNSA SFA. Whatever situation exists at a particular site, a close working relationship among response partners, onsite and offsite, is essential to ensure that medical support is provided seamlessly and effectively during an emergency.

Among topics to be considered in an emergency medical plan are communicating information on injuries; immediate care/first aid at the scene; transporting injured/contaminated workers away from immediate danger; stabilization; transport to an onsite clinic or medical facility; onsite decontamination; communication with local hospitals or other medical facilities; offsite transportation including, if needed, air medivac services; and MOU with offsite medical facilities, next-of-kin notification, and media notification.

Medical professionals and emergency planners should develop an emergency medical program that is commensurate with the hazards on the site to protect the health and safety of DOE workers and the public. The program should be based on the medical capabilities of the site or surrounding community, specialized medical capabilities available outside the local area, site-specific characteristics, and the site-specific results of the All-Hazards Surveys and EPHAs for facilities and activities on the site.

4.9.3. Site Emergency Medical Support

The purpose of this section is to focus on the specific requirements of emergency medical support during an OE at a DOE/NNSA site. According to DOE O 151.1D, emergency medical support should provide medical treatment and planning for mass casualty situations. Medical support should also be planned for workers contaminated by hazardous material; arrangements with onsite and offsite medical facilities to accept and treat contaminated, injured personnel needs to be documented.

4.9.3.1. DOE/NNSA Requirements and Related Standards

Emergency medical requirements for contractors are contained in 10 CFR Part 851, Appendix A, Section 8, *Occupational Medicine*. 10 CFR Part 851 requires the establishment, maintenance, review, and update of a formal written contractor occupational medical program consisting of methods and procedures used to implement the occupational medical requirements necessary for worker protection and for the promotion of a healthful work environment. The primary goal of the program is to provide health services to its employees to ensure the earliest possible detection and mitigation of occupational illness and injury.

10 CFR Part 851 also establishes requirements for facility and site programs for providing emergency medical treatment for injured personnel. The rule requires that the physician responsible for the delivery of medical services is also responsible for the medical portion of the site emergency and disaster plan. This rule also requires that the medical portion of the site emergency management plan be integrated with the overall site plan and with the surrounding community emergency and disaster plans.

The DOE G 440.1-1B current version, Section 8.8.4.7, "Emergency Preparedness," provides additional specific guidance related to the medical portion of site emergency plans, as follows:

- Capabilities for medical aid, triage, and personnel decontamination by trained, qualified medical staff members
- Capabilities for cardiopulmonary resuscitation, cardiac defibrillation, and advanced cardiac life support
- Services of health physicists and industrial hygienists to evaluate any associated radiological or chemical hazards affecting the casualties, the general public, or the environment, and to assist rescue and medical personnel
- Arrangements for adequate offsite treatment of injuries and illnesses resulting from exposure to radiation or toxic materials
- Services of medical specialists and consultants
- Services of rescue squads, ambulances, and helicopters with the capability of handling radioactively contaminated casualties
- Medical aid coverage during evacuation operations from facilities and the site

- Communication links between medical aid and triage teams, fire and rescue units, hospitals and hospital teams, local and State police, and the DOE EOC

Other standards used to define SFA medical programs may include:

- Accreditation Association for Ambulatory Health Care
- Federal Ambulance Specifications
- 29 CFR Part 1910.151 (OSHA regulations for medical services and first aid)
- NFPA 1710 Chapter 4, Section 4.1.2.1, which establishes response time objectives for first responders. For example, this standard calls for a minimum 90 percent achievement of the following objectives:
  - Four minutes or less travel time for the arrival of first responders with automatic external defibrillator (AED) or higher-level capability, to an emergency medical incident
  - Eight minutes or less for the arrival of an advanced life support unit at an emergency medical incident, where this service is provided by the fire department provided a first responder with AED or basic life support unit arrived in four minutes or less
- NFPA 99 and 473 standards for healthcare facilities and professional competency for EMS personnel
- NCRP Report No. 65, *Management of Persons Contaminated with Radionuclides*

4.9.3.2. Medical Support for DOE/NNSA Emergency Management Core Programs

The medical component of the DOE/NNSA SFA Emergency Management Core Program needs to include the following capabilities:

- Plan for handling mass casualty situations
- Capability to provide medical treatment for onsite workers, personnel, and public for potential emergencies that include exposure to or contamination by a release of hazardous materials (i.e., radiological, chemical, and biological/etiological)
- Documented arrangements with offsite medical services and facilities to accept and treat contaminated, injured personnel

Planners should recognize that although facilities may not have the potential to reach an OE classified as an Alert, they might have on hand sufficient hazardous materials to contaminate individuals in an emergency. Such a contamination incident may be categorized as a mass casualty OE, if it effectively meets the criteria given above in terms of decontamination and treatment capabilities.

Mass Casualty. For purposes of DOE/NNSA emergency management, a mass casualty OE incident is characterized by the following:

- The number of patients and nature of their injuries make the normal level of stabilization and care unachievable; **or**
- The number of Emergency Medical Service (EMS) personnel that can be brought to the site within the time allowed is not enough; **or**
- The stabilization capabilities of the hospitals that can be reached within the time allowed are insufficient to handle all patients.

The definition is based on A.M. Butman, *Responding to the Mass Casualty Incident: A Guide for EMS Personnel*, 1982. In general, the quantity of personnel and resources ultimately available is insufficient in a mass casualty situation. Only those personnel and resources that are available within the time allowed by standard medical treatment protocols are of value. The pools of available personnel and resources are limited by the time available. In the case of a mass casualty incident, the insufficiency of personnel or resources is reflected in the employment of the triage principle to prioritize the application of medical care to patients in most immediate need. Triage is the standard method, based on the local protocol, for example using a series of color tabs (red, yellow, green, and black, representing, respectively, *immediate*, *delayed*, *minor*, and *deceased*), to help on scene medical personnel prioritize individuals for medical attention.

HAZMAT Incidents. The medical portion of the site emergency management plan should provide the capability for treatment of workers, personnel, and the public during emergencies that include exposure to or contamination by a hazardous material. The development of site emergency medical programs should identify the specific hazardous materials at the site and characterize them as follows: quantities, storage, and use locations; the magnitude and impact of potential release consequences; and the characteristic health effects of each hazardous material. These factors that are addressed in the Hazard Surveys and EPHAs should be incorporated in site emergency medical planning, resource assignment and maintenance, training/drills, provisions for onsite and offsite medical support, and interfaces between onsite and offsite medical and other response capabilities. Arrangements with offsite medical services and facilities to accept and treat contaminated, injured personnel should be documented. Integration and coordination with offsite capabilities are discussed further in Section 9.3.

The planning for a hazardous materials release emergency should ensure that appropriate recognition and emphasis is focused on medical treatment versus radioactive or chemical contamination for contaminated/injured personnel. Immediate, effective onsite first aid and emergency medical treatment should be provided for injured workers, including those with hazardous material contamination. Onsite radiation protection and industrial hygiene personnel should be properly equipped to assist medical personnel in performing patient survey, decontamination, contamination and exposure control, urine and fecal analysis, and in-vivo counting methods. Proper contamination control procedures should be implemented in handling injured and contaminated personnel. Decontamination facilities should be available, adequately equipped, and staffed by trained personnel.

In the development of the medical portion of the site emergency plan, the Site Medical Director should review the results of All-Hazards Surveys and EPHAs (especially potential scenarios and consequences), chemical inventories, Safety Data Sheets, and Job Hazard Analyses. The Medical Director can determine medical support requirements based on the above considerations and the following:

- Size of site and number of workers
- Location of the work being performed Response and evacuation times for various site locations
- Levels of qualification of emergency medical responders onsite (i.e., Emergency Medical Technicians (EMTs) or Paramedics)
- Capabilities of offsite medical response organizations
- Travel time to, and capabilities of, local hospitals

Other considerations for developing the medical program will reflect the nature of the work being performed and its inherent safety problems. This SFA-specific information can be obtained from:

- Industrial/workplace incident history and lessons learned
- Occurrence report history
- Employee safety surveys

4.9.3.3. Resources for the Emergency Medical Program

No prescribed list of resources needed to support emergency medical response exists for SFAs that maintain Emergency Management Core Programs. In order to ensure that interfaces with offsite response capabilities are effective, site standards for medical facilities and equipment should be compatible with offsite standards. The necessary site resources will be based on the hazards associated with the facilities onsite and factors discussed in Section 9.2.2, above. As hazards change, and other onsite and offsite factors change, emergency management programs, including the emergency medical portion, should be reviewed and updated.

Onsite and offsite medical facilities should be outfitted and staffed to utilize specialized equipment and supplies specific to onsite hazards. Resources associated with the emergency medical programs may include the following:

- Medical response and treatment equipment and materials such as:

  - Ambulances and helicopters to transport patients
  - Onsite medical treatment facility
  - Stocked first aid lockers
  - Triage kit
  - Defibrillators and advanced cardiac life support equipment
  - Blankets and stretchers
  - Antidotes
  - Chemical burn treatments
  - Urine and fecal analysis equipment
  - Capability to perform chelation therapy treatment, as appropriate
  - Compatible communication systems and equipment for medical responders
  - Procedures that address contamination control, equipment operation, organizational interfaces
- Rescue teams that include medically trained and qualified individuals
- Health physics and industrial hygiene personnel to assist medical responders
- Personal protective equipment for medical responders
- Hazards monitoring equipment
- Personnel decontamination facilities, supplies, and equipment
- Means to control and collect contamination associated with injured/contaminated patients
- Offsite medical facilities
- Accessible employee medical records and history

4.9.4. Interfaces and Coordination

In order to provide for an effective, integrated response, site medical support personnel should plan and practice in advance how they will interact with other elements of a response. This includes interactions with other types of onsite response capabilities (such as those identified in the BNA) as well as coordination with offsite medical resources. The following sections address issues related to these interactions.

4.9.4.1. Interfaces with Onsite Resources

Internal planning and response interfaces needed to support the emergency medical program are based primarily on site characteristics, nature of site hazards, onsite capabilities, and organizational framework and responsibilities. Internal organizational interfaces may be challenging when groups have differing response priorities, when procedures differ, and when resources come into conflict. Areas of conflict or challenge between internal organizations should be identified during exercises and evaluations and resolved with appropriate corrective actions.

Typical interfaces in support of emergency medical programs include the following:

- Emergency management and medical departments should interface to ensure that planning for medical resources considers All-Hazards Survey and EPHA information, to maintain the emergency plan, and to ensure that medical professionals participate in training, drills, and exercises.

- Response and resource planning between medical and HAZMAT/fire organizations is important regarding medical training and qualification of responders.

- Coordination between medical and ERO reentry and rescue planners may also be needed to ensure that rescue teams have at least one medically trained individual per team. The primary responsibilities of rescue teams are to provide immediate lifesaving aid; remove victims from dangerous scenes or contaminated areas; remove gross contamination, if present and possible; and transfer the victim to medical personnel.

- Interface of medical professionals with industrial hygiene and health physics teams is necessary to ensure coordination of procedures for decontamination of the injured. Radiation/health protection and industrial hygiene personnel assist medical personnel and should have the necessary equipment for surveying patients, providing decontamination advice, assisting in contamination and exposure control, and assisting medical personnel in accomplishing urine analysis, fecal analysis, in-vivo counting, and radiochemical analysis for contaminated patients. **Life-saving medical care should always take precedence over decontamination**. If patient conditions do not permit time for decontamination, the patient should be encapsulated for contamination control.

- Issues of access and escorts for offsite medical responders necessitate interface of medical with site security and operations. Security actions at a site could impact the rapid provision of emergency medical services. Rapid treatment is especially critical in trauma or cardiac situations. Sites should evaluate security systems and procedures for ingress/egress to allow for rapid access of emergency medical responders, their vehicles, and equipment to critically injured or ill patients. Medical first responders should coordinate activities at the incident scene with security personnel to ensure that potential evidence is not disturbed in the case of a security incident.

- Medical interface with human resource organizations may be needed to help ensure the availability of personnel medical records during an emergency as well as identification of victims.

4.9.4.2. Interfaces with Offsite Resources

Use of offsite emergency medical resources will be determined by many factors involving the site as well as offsite capabilities. Formal planning is needed to ensure that offsite medical resources are used effectively. Formal arrangements through MOUs or MOAs for site support are important to ensure effective working relationships and to avoid problems involving communications, security access, receipt of contaminated injured, medical certifications, removal of contaminated waste, release of information to the news media, and legal liabilities. These arrangements should be reviewed annually to ensure continued applicability. The following are examples of organizations for which formal arrangements may be required:

- Hospitals (including burn centers and trauma units)
- Emergency medical response teams
- Ambulance services
- Life flight helicopter service
- Fire departments
- Hazardous Material teams
- Coroner's or medical examiner's office

The use of helicopter services requires that the site develop protocols for arrival on site, special landing zones, security, and safety procedures. The usage of the services of an offsite Coroner on a DOE/NNSA site requires an MOA that addresses the identity of the Coroner, procedures to be followed, and issues of jurisdictional authority.

Sites should consider addressing the following types of issues within MOUs or MOAs with offsite emergency medical service providers:

- Roles, responsibilities, authorities, chain of command
- Compatibility of communications systems and protocols
- Expectations for response times of offsite ambulance services
- Procedures for communication between ambulance and receiving medical facility while enroute

- Provisions for timely communication to receiving hospital regarding victim exposure and contamination
- Provisions to outfit and train offsite medical facilities to use any special equipment or supplies related to protection from onsite hazards and contamination control
- Receipt of contaminated patients for transport (via ambulance and life-flight helicopter) and treatment
- Security clearances and site access for offsite medical response personnel expected to respond onsite
- Site hazards training for offsite emergency medical response personnel
- Training for hospital emergency room staffs on handling contaminated injured, and expert technical support provided to the receiving hospitals
- Removal of contaminated waste from offsite medical facilities and vehicles
- Certifications of medical facilities. For example, a hospital with trauma center status would be expected to maintain that certification
- Assignment of primary and backup facilities equipped to provide appropriate level of care for patients, including contaminated injured
- Offsite medical facility or ambulance service participation in site medical exercises or drills
- Procedures (site and hospital) for coordinating and communicating information related to incidents or medical conditions to the public
- Routine review and renewal of MOUs or MOAs

4.9.5. Medical Records and Treatment History

During a medical emergency, certain essential patient records will be created, maintained, and preserved. These include records of emergency medical treatment, bio-samples and tests, offsite medical treatment, records of exposures to hazardous materials and contamination. A mechanism or protocol for identifying the patients and recording essential information related to medical treatment and patient movement is essential. Mass casualty incidents in particular are likely to require the coordinated efforts of several organizations and, hence, a reliable system of maintaining medical records is a critical element of the medical support program.

Health care providers can provide the information needed to complete work-related injury and illness reports with employers (or their representatives) without authorization in accordance with the implementation of the Health Insurance Portability and

Accountability Act of 1996 (HIPAA). However, sites need to establish a procedure with the local hospital to ensure that casualty information during an emergency can be shared by health providers to DOE/NNSA and their contractors.

Additionally, there may be a need for rapid access to records of personnel in order to ensure that field and hospital medical providers provide proper treatment. These could include records of general physicals, dosimetry and bioassay, offsite medical records, records of allergies, etc. Such records should be handled with confidentiality to ensure that patient privacy is respected and protected. Other records requirements apply, including those from local emergency responders (National Fire Incident Reporting System).

4.9.6. Emergency Medical Response Preparedness Activities

4.9.6.1. Training and Drills

Site emergency medical response personnel are typically associated with the site fire department or occupational medicine department. In some cases, the security or protective force department will provide emergency medical service personnel.

Regardless of how the organization is structured, the Site Medical Director specifies minimum standards for training for all emergency medical personnel. Site standards for emergency medical training should be compatible with offsite standards. State certification requirements should be met. Onsite and offsite medical personnel should be provided information and training on SFA-specific hazardous materials.

Emergency medical service providers should be trained to work within the defined incident command system. Where there are differences in agency and organizational approaches to incident command, there should be a coordinated effort to ensure that response personnel are able to communicate and work together under a unified incident command structure that supports critical decision-making, effective emergency medical response, and scene safety.

Participation of the onsite and offsite medical support organizations in the facility and site drill programs should also be encouraged.

4.9.6.2. Exercises

Onsite and offsite medical emergency response personnel should be offered the opportunity for participation in exercises in advance of emergencies. Exercises that include the medical response element should focus on realism and involve experienced medical personnel in scenario preparation and evaluation to test proficiency, equipment, interfaces, and communications critical for effective emergency medical response. In developing the yearly site exercise, offsite medical response participation and receiving patients at offsite facilities should be included in the scenarios when possible. Compatibility of all communications should be tested, including both onsite and offsite systems.

Medical SMEs should also participate in exercises as controllers and evaluators. Corrective actions related to medical response should be developed by the medical professionals and used to improve emergency medical support.

4.9.7. Federal Medical Assistance

4.9.7.1. Radiological Emergency Assistance Center/Training Site

The REAC/TS, located at Oak Ridge Institute for Science and Education in Tennessee, is a DOE/NNSA response asset that provides radiation exposure treatment consultation services on a 24-hour basis as part of the NEST. The services of REAC/TS are focused on radiological medical emergencies and are available to all private medical and governmental bodies. They can provide advice to health care providers in the first few hours of an emergency and can deploy experts to a site in a few hours. Training is provided to emergency department physicians and nurses and focuses on information and skills needed in the first few hours and for long-term care. REAC/TS also provides training for Health Physics personnel on working with medical professionals during a response.

4.9.7.2. Other Federal Medical Response Resources

Additional Federal resource groups that are designed and available to support emergency medical response include the following:

<u>Chemical-Biological Incident Response Force</u>. This arm of the U.S. Marine Corps consists of trained medical personnel and equipment capabilities for detecting and identifying chemical and biological agents. They provide casualty search, rescue, personnel decontamination, emergency medical care, and stability of contaminated personnel. This specialized unit is located 26 miles from Washington, DC.

<u>Weapons of Mass Destruction (WMD) Civil Support Teams</u>. These teams are members of the U.S. Army and National Guard who are experts in WMDs and nuclear, biological, chemical defense operations. Teams located throughout the country are federally resourced, trained and evaluated, but perform their mission primarily under the command and control of the Governors of the States in which they are located. They have the capability to monitor, detect, and identify chemical and biological agents and the ability to deploy rapidly to provide medical and technical advice to local first responders.

<u>Disaster Medical Assistance Team (DMAT)</u>. Part of the National Disaster Medical System (NDMS) of the U.S. DHS, a DMAT is a group of medical and support personnel designed to provide emergency medical care during a disaster or other unusual incident. DMATs are deployed to provide care for victims of any incident that exceeds the medical care capability of the affected local and State resources.

<u>Disaster Mortuary Operational Response Team (DMORT)</u>. The DMORTs are directed by the HHS' National Disaster Medical System. They are a team of experts in the fields of victim identification and mortuary services. This includes temporary morgue facilities,

victim identification, forensic pathology and anthropology, preparation and disposition of remains.

Critical Incident Stress Management (CISM). A variety of non-governmental organizations that provide assistance with CISM programs, designed to help responders and employees cope with traumatic incidents by caring for the emergency responder's and victim's mental health. The CISM interventions are especially directed towards the mitigation of post-traumatic stress reactions.

4.10. Emergency Public Information

4.10.1. Introduction

The purpose of this section is to provide guidance so that DOE and NNSA sites/facilities/activities provide accurate, candid, and timely information to workers, the media, and the public during an emergency, as required by DOE O 151.1D to ensure that accurate, candid, and timely information is provided to workers, the news media, and the public during an emergency to establish facts and avoid speculation. An additional responsibility of the EPI program is to inform workers and the public of emergency management plans and planned protective actions before emergencies. This section may also provide useful general guidance in the development of DOE/NNSA Field Element or HQ EPI Plans.

4.10.2. General Approach – Emergency Public Information

An effective EPI program provides the public, media, and DOE/NNSA employees with accurate, candid, and timely information. The EPI program provides the means for SFAs to coordinate the timely exchange of information among representatives from DOE/NNSA and other organizations. To be effective, EPI should be coordinated with Federal, Tribal, State, and local EROs. Timely information flow will help keep workers and the public informed, dispel rumors, and provide essential health and safety information. Coordination is critical for preventing the dissemination of confusing, conflicting, and erroneous information.

An effective EPI program ensures that information, distributed to workers, site personnel, and the public during an OE is:

- Accurate, candid, understandable, and consistent
- Current and timely
- Provided to ensure the health and safety of workers and the public
- Provided to establish facts, and avoid rumors and speculation
- Protective of classified or CUI

- Responsive to public concern and information needs

The credibility of DOE/NNSA during an emergency is enhanced through an effective EPI program developed from an over-arching EPI strategy and policy. The program should be based on day-to-day public information relationships that are expanded for an emergency response. This capability to expand during an emergency is developed in cooperation with onsite and offsite organizations through detailed planning and coordination of plans, procedures, education, and training. EPI functions and the number of EPI staff required to respond effectively to an OE will vary with the nature, severity, duration, and public and media perception of the emergency.

Each DOE/NNSA SFA needs to have an EPI plan that is coordinated with their Emergency Management Plan and procedures. This coordination is necessary to ensure that emergency management and EPI interactions involving assignment of resources, operations at command centers/EOCs, callout of EROs, release of emergency information, and other activities are handled effectively and without confusion. The EPI staff should be proactive in obtaining emergency information from the facility command center/EOC and monitoring public perception and media reports. This is particularly important in order to detect, manage, and correct rumors. Accurate information disclaiming rumors and correcting misinformation should be incorporated into all materials for public release.

The information released to the public and media should be subject to coordination among DOE and NNSA, local, State, and Tribal governments, and Federal response organizations. The DOE/NNSA Field Element official responsible for emergency public information must approve news releases or public statement following necessary reviews and coordination. The DOE/NNSA HQ UCS is kept informed of all EPI actions, as soon as practicable, and is provided with copies of all releases or statements. All updates of news releases or public statements should be coordinated with the DOE/NNSA HQ public affairs director and HQ Emergency Manager to avoid disseminating contradictory information regarding the emergency. Coordination with DOE/NNSA HQ refers to mechanisms to ensure situational awareness and messaging are complementary to the different levels of media and audience.

The level of media attention is determined by monitoring the television, newspaper, and social media platforms that have requested or reported information on the status of the emergency at the site. The level of media attention is recorded on the Emergency Notification Form that captures the site operational picture for the incident when notifying the HQ Watch Office.

Any emergency response and protective actions required for the health and safety of workers should be adequately explained with unclassified information. It is recommended sites develop pre-approved, pre-scripted messages to release timely information. State and local authorities will provide the appropriate protective actions to the off-site public.

In conclusion, advanced education of the public concerning the emergency plans, notification methods, and potential protective actions in the event of an OE is critical for public protection and effective management. A public education program should be planned, deployed, and evaluated to assess its effectiveness to educate the public before an emergency.

For further information on EPI and helpful training tools, SFAs should visit the EPI Subcommittee on the Emergency Management Issues Special Interest Group SharePoint site.

4.10.3. EPI Functions and Staffing

All DOE/NNSA facilities are responsible for developing and implementing EPI plans in accordance with the site Emergency Management Plan. The EPI plan can be a standalone or an annex to an emergency management plan. It is recommended to add proper referencing in the emergency management plan if the EPI plan is a standalone document. According to DOE O 151.1D, the EPI plan, which can cover multiple facilities on a site, should address the following:

- identification of personnel, resources, and facilities necessary to support emergency public information activities to include identification of a Public Information Officer who will interact with the media during emergencies;
- provisions for coordination of information to be released during an emergency;
- identification of public information media to be used and monitored, such as web sites, social media, news releases, and news briefings;
- identification of a location for the necessary briefings and news conferences regarding the emergency;
- identification of training and drills for personnel who will interact with the media and the public, develop messages, and monitor information;
- identification of provisions for coordination of public information activities with offsite response agencies, State, local and Tribal governments, and Federal emergency response plans, as appropriate;
- procedures to ensure that no classified or CUI is contained in the announcement;
- provisions for initial news releases or public statements to be approved by the Field Element official responsible for emergency public information review and dissemination; and
- provisions to coordinate with the HQ EOC Public Affairs Duty Officer or Office of Public Affairs on information released after the initial release. This includes information released through news releases and social media. The HQ Public Affairs

Duty Officer or Office of Public Affairs may delegate this to the local level, dependent on the incident.

The EPI Plan should specify roles and identify individuals within the EPI organization by position and responsibility. Typical (though not mandated) contents of an EPI Plan are presented in Table 4-9.

The EPI organizational functions include collection, coordination, production, and dissemination of information; and monitoring and analysis of media coverage, public concerns/perceptions, and information needs. These functions should be staffed consistent with the nature, severity, duration, and public/media perception of the incident or condition. Trained spokespersons should provide support in media interface and technical SMEs should be made available to provide a clear understanding of the incident, if necessary. One or more news writers and other trained personnel can provide support in media services, media monitoring, public inquiry, media inquiry, and management and administrative services.

Personnel are normally assigned to the EPI response organization from the site DOE/NNSA public affairs organization and the site contractor public affairs organization. However, other parts of site organizations can also augment EPI functions. For example, Human Resources and Information Center staff may answer phones or support employee communications; Information Technology and Audio-Visual Support groups may help operate EPI facilities and equipment; and Hazards Control and medical personnel may provide technical expertise for message development with appropriate training.

Position descriptions should describe the principal functions of each EPI position and include checklists. A checklist can be used to itemize the duties relevant to each emergency response position, beginning with notification and continuing with the tasks to be performed throughout an emergency until normal operations resume. At a minimum, each position should be staffed with a primary and one alternate. If possible, a third person should be assigned to serve as a second alternate.

The titles assigned to various EPI positions are generally standard across the DOE/NNSA complex and should be flexible and scalable to an emergency at any SFA. For this reason, the guidance presented here, with a few exceptions, only use a descriptive title (i.e., in lower case) in addressing an EPI position's functions and responsibilities.

Table 4-9. Typical Contents of an Emergency Public Information Plan

EMERGENCY PUBLIC INFORMATION (EPI) PLAN

Table of Contents

Appendices

4.10.4. EPI Response

4.10.4.1. Commensurate Response

EPI functions and the number of EPI staff required to respond effectively to an OE will vary with the nature, severity, duration, and public and media perception of the emergency. For DOE/NNSA Emergency Management Hazardous Materials Program facilities, there are two tiers of EPI response and associated staff activation, depending on the level of offsite involvement or media attention to an OE. First, the EPI plan for any DOE/NNSA SFA needs to have provisions for public information personnel to interface directly with the EOC and to establish a location for briefings and news conferences, which can be met by establishing a media center. A *media center* is a designated location where the Field Element Manager and facility contractor personnel can conduct the necessary briefings and press conferences regarding an OE. The initial EPI organization contains support functions and staffing levels that, at a minimum, provide for coordination between the DOE/NNSA and the SFA contractor in responding to the public and media and in keeping local, State, Tribal, and Federal authorities informed. This initial EPI organization will generally be sufficient for OE Alerts, Site Area Emergencies, and for many unclassified OEs that are not expected to produce consequences offsite.

An EPI plan needs to also have provisions to establish a JIC, which is a working location where multiple jurisdictions gather, process, and disseminate public information during an OE. A full EPI organization activated in a JIC would be necessary during an OE General Emergency involving any offsite impacts, since offsite jurisdictions could be affected and involved in the response. The support functions and staffing for a full EPI organization, representing an enhancement of functions of the initial EPI organization, should be sufficient to coordinate the EPI activities among DOE/NNSA, the SFA, and local, State, Tribal, and Federal response organizations. Some OEs not requiring classification, or classified OEs less than General Emergencies, may also require the full JIC response if the level of media interest is high. Some JIC capabilities may be needed in these cases to provide a coordinated EPI response. If a need arises to activate a JIC, the location and phone number will be immediately made available to the response organizations, the media, and the public via predetermined dissemination methods.

Each person representing a responding entity in the JIC should function in at least two capacities: 1) Representing their parent organization in carrying out its public affairs mission; and 2) Providing or contributing public affairs services/expertise in support of the coordinated JIC activities. This dual role provides the benefits of having access to coordinated information and the expertise from other responding organizations.

The key personnel involved in the initial EPI organization can be located in or adjacent to the facility command center/EOC, or in a near-by area. The JIC location can also be used, if convenient or necessary. If the incident escalates in severity or media attention, the initial EPI organization can be moved to the JIC location, if not already established in the JIC. Two important criteria for choosing the location for the media center and the JIC are the availability of space sufficient to accommodate the EPI staffs and expected media representation, and the accessibility of the facility to the media during an emergency incident, generally outside the facility’s security perimeter.

4.10.4.2. Initial EPI Organization

The nature and severity of an OE will generally dictate the EPI response. EPI organizations should be able to perform effectively in worst-case conditions and during lower severity OE incidents. For an OE with no potential for offsite impact, the EPI response functions may be reduced and may take place at a pre-designated location near the site or onsite. If safety and security conditions permit, it may also be appropriate to arrange for briefings of the news media at a pre-designated media center near the site or at an onsite location. When there is no potential for offsite impact, offsite agencies will not usually participate in the EPI response, and hence activation of a JIC may not be necessary. However, agencies will still want to be kept informed through the Joint Information System (JIS). It is necessary to establish communication with key government officials and the local media immediately after declaration of an emergency. The key to initial success is to obtain all necessary information promptly, disseminate what is known quickly in press releases, briefings, on websites and social media, and to activate personnel quickly enough to handle telephone notifications and inquiries.

Position titles may vary slightly from site to site, but the functions of information coordination, production, dissemination, and monitoring and analysis of media coverage and public perceptions should be standardized and incorporated into the EPI organization. Internal and external organizational relationships should be formalized in both the Emergency Management Plan and the EPI Plan. When a facility command center/EOC is initially activated for emergency response, at a minimum, the following general organizational EPI positions/functions are representative of those typically staffed:

- Public affairs director, a DOE/NNSA Field Element Manager representative, is usually located in the facility command center/EOC, and reports to the DOE/NNSA Field Element Emergency Director (ED) who has overall command of the response. (This is consistent with FEMA's Incident Command System.) Public affairs directs and coordinates all EPI activities; coordinates the preparation and release of all emergency public information directly with the ED; communicates directly with the facility established by the contractor to disseminate emergency information; and should be the final and only approval authority necessary for news releases or public statements. The public affairs director is responsible for informing the DOE/NNSA HQ public affairs director and HQ Emergency Manager of all EPI actions, as soon as practicable. The public affairs director provides copies of all news releases or public statements to the DOE/NNSA HQ public affairs director and the HQ Emergency Manager. The public affairs director should coordinate all updated news releases or public statements with the DOE/NNSA HQ public affairs director and HQ Emergency Manager to avoid disseminating contradictory information regarding the emergency.

- Public information manager coordinates preparation and release of all emergency public information with the public affairs director and communicates directly with the facility established by the contractor to disseminate emergency information.

- Public information officer is assigned to the local EPI response team involved in an offsite response deployment to provide information regarding DOE/NNSA roles and capabilities.

- Spokesperson briefs the media or the public on incident status and site response and recovery activities. A senior-level DOE/NNSA manager or designated contractor representative with technical understanding of the emergency and training in crisis/risk communications should be a credible spokesperson who represents site management.

- News release writer works directly with the public information manager to gather confirmed information on the incident and prepare news releases or public statements.

- Technical SME/briefer ensures that information to be publicly disseminated is technically accurate and performs an advisory role for the news release writer and public information manager. Interprets technical information provided to the media and public in lay terms (including pertinent information on radiological, chemical, other hazards, and operational implications of the incident, as needed). Technical support may be provided to the spokesperson and other EPI staff.

- Authorized official reviews news releases for classified or controlled unclassified information.

- Employee relations coordinator informs employees of incident status and emergency response and recovery activities. Responds to employee inquiries. Should be assigned responsibility for liaison with employee families; may communicate with employee families concerning special situations.

- Rumor control coordinator ensures that personnel answering inquiries from the public and monitoring the media have access to current and accurate information. Identifies problems in media reporting (incorrect information, false statements) to the public information manager. (Depending on the SFA, this activity may be accomplished by the media monitoring coordinator or the media/public relations coordinator).

- Media monitoring coordinator tracks broadcast and print coverage of the emergency and keeps the public information manager informed of what is being reported.

- Social media coordinator maintains the facility’s website and posts pre-approved information.

- Media/public relations coordinator responds to media and public inquiries.

- Government coordinator ensures authorized representatives of all local, State, Tribal, and Federal government organizations receive emergency information and updates.

4.10.4.3. Transition to a Full EPI Organization – JIC Activation

EPI organizations should have the capability for a phased-in response from a lower severity incident to a full-scale response, and to recovery after a significant accident. In a full EPI response, a JIC is a focal point for multiple EROs to release information concerning emergency conditions, activities, and decisions. Important considerations to ensure smooth transition from the initial EPI operations to a full EPI/JIC activation include:

- Planning the movement of EPI personnel to an offsite or alternate JIC when site protective actions or lockdowns are underway;

- Ensuring continued flow of emergency information (i.e., response to media and public callers) until a JIC can become operational; and

- Need for satellite EPI response to deal with news media at locations such as a site gate or local hospital, while retaining the JIC as the source of new information.

4.10.4.4. Full EPI Organization – JIC

A JIC should be established, directed, and coordinated by the senior DOE/NNSA Field Element Manager public affairs director or a designee in the event of an OE with offsite implications or significant news media interest. When necessary or desirable to evolve the EPI from the initial organization to its full activation, the JIC management team including the JIC manager, the JIC news manager, spokesperson, and outside agency representatives should be deployed (if not already at the JIC location) to the predesignated JIC facility where they can share and coordinate information. The public affairs director and the DOE/NNSA ED should determine if the nature of the incident would require 24/7 hours of operation for the JIC.

All questions from the public and the media should be directed to the JIC to ensure that the information that is disseminated is consistent and accurate. Under no circumstances should a field or program office answer any calls or emails from the public or media. Requests for information should immediately be referred to the JIC to ensure consistency and accuracy in Departmental responses for information.

The full EPI/JIC organization will include the general positions/functions of the initial EPI organization presented in Section 10.4.2, but replace/supplement rumor control, media monitoring, media/public relations, and government coordinator positions with the following representative positions and teams:

- Media monitoring team monitors broadcast, print, and media coverage, including social media of the emergency; records broadcast/digital coverage; retains a record of print media coverage; reviews all media coverage for inaccuracies and rumors; provides the JIC manager with reports; and periodically or upon request provides the JIC news manager an updated analysis of issues including perceptions of the public and media.

- Media relations team notifies the media upon activation of the JIC; ensures that approved news releases are provided to the media; updates media not present at the JIC; receives and assimilates incoming data from the media monitoring team and others; and responds to incoming telephone queries and requests. The team usually reports to the JIC news manager through a team leader. Information for response to media calls may be obtained from printed or electronic status boards, news releases, chronologies, fact sheets, supervisor's notes from news conferences, resource books, and other approved written materials.

- Public relations team answers inquiries from the general public with accurate, up-to date information to prevent the spread of misinformation and dispel rumors. Information for response to public calls may be obtained from status boards, news releases, chronologies, fact sheets, supervisor's notes from news conferences, resource books, and other approved written materials.

- Offsite agency representatives representing local governments, State, Tribal, and Federal agencies coordinate information from their agencies to release to the media with EPI representatives of other agencies and DOE/NNSA; provide accurate, timely, and applicable information to the public about emergency operations within their jurisdictions; participate as appropriate in news conferences.

- JIC manager is responsible for the timely release of clear and accurate information to the public and media. The JIC manager remains in direct communication with the DOE/NNSA Field Element public affairs director, ensures coordination with and among local, State, Tribal, and Federal designated representatives at the JIC and other locations. The JIC manager is responsible for the overall management of the JIC, oversight of the JIC facility and staff, and accommodates JIC administrative and technical support needs.

- JIC news manager accommodates the news media, coordinates news conferences, arranges for interviews, provides media kits and news releases to the media, and assists the JIC manager in all matters pertaining to interaction with the media. Serves as an extension of the JIC manager by tracking inquiries between the EOC and the JIC; keeps the public and media inquiry teams updated on emergency incidents; confirms that the JIC manager has adequate review of information prior to media briefings; participates in spokesperson pre-briefings; ensures that communications are maintained with the EOC; ensures that rumors and misinformation are corrected; and remains in direct communication with the JIC manager.

- JIC support team provides administrative and logistical support, audio-visual support, computer and communications support and associated equipment support as needed. Administrative support may include distribution (JIC facility and external) of news releases to a designated list of emergency response staff and news media; receipt of incoming information and distribution to JIC management and staff; messenger services; security; and registration of news media. Staff providing audiovisual support may help provide visual aids for briefing news media and ensure that equipment to support and record briefings is functioning. Computer and communications support include ensuring that necessary equipment is available, functional; advises JIC staff on equipment use.

The public information officer serves as the on-scene link to the EPI organization/JIC, providing the means for keeping the ED informed of all EPI activities.

4.10.4.5. Joint Information System (JIS)

The JIS is a method public affairs professionals utilize to manage information during an incident or event.

The JIS provides the mechanism to organize, integrate, and coordinate information to ensure timely, accurate, accessible, and consistent messaging across multiple jurisdictions or disciplines with nongovernmental organizations and the private sector. The JIS includes the plans, protocols, procedures, and structures used to provide public information.

In an emergency, the JIS provides the mechanism for integrating public information activities to ensure coordinated and consistent message development, verification, and dissemination.

The JIS can be:

- As simple as two PIOs talking on the phone about an incident that involves both of their agencies;
- A PIO at the EOC talking to a PIO at the site of the incident’
- PIOs from several departments working together at a single location’
- Many PIOs from numerous agencies working from several locations — all working together to ensure clear and accurate information is being delivered to the public.

4.10.5. Media Relations

In addition to disseminating critical health and safety information, the news media is also a major conduit through which the public perceives how DOE/NNSA and its contractors are responding to an emergency. Within the constraints of the emergency and available resources, every effort should be made to accommodate the needs of the media. Cooperation should result in balanced and accurate information dissemination. Senior DOE/NNSA management should be accessible, prompt, and forthright in dealing with the media prior to, during, and after emergency incidents. Credibility and empathy are imperative. Effective and prompt interface with the media and the public before, during, and after an incident builds such credibility.

Prior to and during emergencies the media should be considered a partner. The media should be invited to tour the facility, meet SFA management, familiarize themselves with emergency plans, receive DOE/NNSA EPI/JIC organizational structure and points-of contact, and be invited to participate in emergency response training, drills, and exercises. In addition, the media and public should have access to pre-written and approved electronic materials such as fact sheets and Frequently Asked Questions describing the SFA and HQ mission. Pre-prepared materials will serve the purpose of answering many of the questions that may arise during an emergency incident and should be part of every EPI Plan.

4.10.5.1. Guidelines

The following guidelines are recommended for interacting with the news media in emergencies at DOE/NNSA sites/facilities or offsite incidents involving DOE assets:

- During an emergency or as other incidents warrant, a single authoritative source of information should be established for release of information regarding the incident response, protective actions implemented onsite, interface with offsite authorities, and recovery. That single source should be the media center established by the EPI organization or the JIC, if activated. Responsibility should rest with the Lead PIO for the site/facility.

- If the health and safety of the public or site/facility personnel are in jeopardy, information addressing the situation should be shared immediately and candidly. Communication between the command center or EOC and EPI/JIC should include sharing the offsite emergency notification forms that have been released to local and State emergency management agencies.

- Response to public perception should be addressed immediately and candidly. *Perception can become reality*.

- Avoid use of technical jargon during news conferences. While it is important to have available technical details of an incident or accident, it is imperative that an explanation in lay terms is made as quickly as possible. Technical experts and SMEs should be trained to speak in plain language and present information in a manner understood by target audiences. The use of maps, photographs, graphics, and other explanatory materials should be encouraged.

- Continuing education should be provided to the news media. Media should be invited and encouraged to participate in emergency response training including drills and exercises and to acquaint themselves with the facility management, emergency plans, and emergency points-of-contact. This education could be accomplished through special events at the site, editorial board visits, tours, or similar activities.

4.10.5.2. News Releases

The following recommendations address the preparation, approval, and dissemination of news releases:

- Timely response to public/media is imperative to establish credibility. Fill-in-the blank pre-formatted news releases, and pre-scripted pre-approved messages should be prepared and approved in advance and included in both the EPI plan and in password-protected electronic folders accessible to news writer staff. News writers and managers who will approve news releases and key messages should be familiar with this system in advance. (News releases are optional as long as employees, public, and media are being provided candid, relevant, and timely information through other official mediums.) An initial announcement may state: “There has been a (nature of emergency) at X facility; trained staff are responding; details will be available at a news conference at X location. A JIC has been established and the media inquiry phone number is (number). The public inquiry phone number is (number). The official X facility website is located at….” The text of the initial news release should be pre-approved to assure dissemination within minutes of activation of the EOC.

- The approval process should not be a hindrance. In order to provide urgent health and safety information to the public in an emergency, the DOE/NNSA Field Element official responsible for emergency public information should be the final and only approval necessary for initial news releases or public statements. All subsequent news releases or public statements should be coordinated with the DOE/NNSA HQ public affairs director and HQ Emergency Manager to avoid disseminating contradictory information regarding the emergency. Copies of all news releases should be provided to the DOE/NNSA HQ public affairs director.

- Procedures for the approval of news releases should be streamlined, established, and involve a minimum number of key individuals in the review and approval process. Procedures for verbal or written acknowledgment of review of news releases should be included. All individuals and alternates who are responsible for such approvals should be designated responders within the emergency organization and fully aware of the mission of emergency public information.

- Knowledgeable staff members should review news releases for technical accuracy to ensure that information contained in the release is correct and appropriate for public dissemination. This needs to be accomplished in a timely manner to ensure that health and safety messages are disseminated quickly and that DOE/NNSA is sensitive to the public’s need for frequent updates in a developing situation.

- If the health and safety of workers and the public is at risk it is imperative to release information as quickly as possible. Unclassified information that has been provided to offsite agencies via emergency notification forms should be considered as having been approved, and spokespersons are authorized to present this information to the news media.

- While the DOE Order does not stipulate that news releases and other associated notifications or news conferences occur in a specific time frame, DOE/NNSA should adhere to the standards of other Federal agencies and private industry by releasing information no later than one (1) hour of the declaration of the incident, sooner if practicable and particularly if there is potential risk to offsite populations. However, there are cases where disseminating vague or no information other than “there’s an incident” to the public in order to meet a one-hour deadline that is not required by the order is harmful. The EPI/JIC organizations should also be sensitive to news media deadline schedules. It should be recognized that once offsite authorities are notified they may disseminate their own information and DOE/NNSA should not fall behind or risk damaging its credibility.

- Chronological files of news releases, pending releases, media inquiries, and rumor control should be maintained for reference. Printed material supplied to the media should be numbered and dated/timed for easy reference.
- Photographs, maps, charts, and other visual aids should be prepared in advance. Materials should be easy to read and of print and broadcast quality, especially for dissemination on digital formats.

4.10.5.3. News Conferences

News conferences should be held as emergency incidents or as public and media interest warrant. They should be scheduled with media when there is relevant information to be provided. News conferences should be announced sufficiently in advance to maximize attendance, and to assure local and regional outlets have an opportunity to travel to the site and setup.

News media at the media center/JIC should be made aware of those in authority and be provided with the ground rules that govern the news conference activities. A moderator should manage question and answer sessions to effectively field questions to speakers as well as to start and end the news conferences.

Information provided at news conferences should be coordinated with and monitored by each organization represented in the media center/JIC to ensure consistency. To anticipate questions during the news conference, coordination should include participation in meetings prior to news conferences to determine the ground rules, speaking order (generally critical information goes first), stage management, spokespersons, and the subjects each will address.

4.10.6. EPI/JIC Facilities and Equipment

Provisions for an EPI facility that is of adequate size, design, and location, and equipped to support the EPI functions and communications described in Section 10.4 needs to be planned. The EPI facility should include space and equipment to accomplish the functions previously addressed, and should be designed and equipped to support coordination of emergency information among onsite and offsite organizations that may gather at that location to release emergency information. An effective and reliable EPI communications system should be established among DOE/NNSA HQ, the Field Element Manager, and on-scene locations at the affected SFA.

For lower severity OEs, a facility should be available to accomplish the functions described in Section 10.4.2, which describes an initial EPI organization that utilizes a media center for the dissemination of information. A full-scale JIC capable of supporting the functions described in Section 10.4.4 should be planned for DOE/NNSA SFAs that are required to implement an Emergency Management Hazardous Materials Program. While the following descriptions focus on the JIC, the EPI facility for incidents of lesser severity can be scaled down from the JIC requirements, based on actual media needs.

The JIC plans should provide workspace for reporters and camera crews. This space could be an auditorium or other area within the proximity of the JIC where news conferences and associated media activities might be accomplished (e.g., phones, electrical connections, workspace, sufficient seats podium, lighting, microphones, internet connectivity, etc.). Requirements should be established on the basis of a media needs analysis.

The EPI plan and SFA emergency management plan should specify the exact location of the JIC by building name, street address, city, and state, as well as driving instructions from airport(s), major cities, and alternate routes. For hazardous material OEs, if the JIC is near the site, an alternate JIC should also be identified in case the primary JIC is threatened or unusable.

The EPI Plan and SFA emergency management plan should also address the following topics related to the JIC:

- **Physical Security.** Security is imperative in all aspects of an EPI program. Security personnel should be on call to control access to the JIC by restricting entrance to predesignated response personnel. Security should also control access by the media as required by procedure (pre-approved list, pre-issued credentials).

- **JIC Identification/Media Sign-in.** Procedures for media arrival and sign-in to the JIC should be established. Badges or nametags to identify media representatives and staff should be available.

- **Other Tools for the JIC**

  – List of 24-hour media and agency public information officer points-of-contact that is maintained and regularly updated

  – Position procedures, checklists, and forms for positions assigned to the SFA

  – Wireless Internet and intranet access, as appropriate

  – Pre-formatted news releases, as appropriate

  – Large area and site maps for reference and use in media briefings, with electronic versions for projection and digital formats

  – Other visual aids (drawings, photographs, schematics, EPZs) of adequate size to support media briefings in high-quality electronic format

  – Reference materials on the emergency plan, site hazards, etc.

  – Cyber security support, GIS support

- **Equipment and Supplies**. Equipment associated with the functions addressed above should be based on a media needs analysis, be readily accessible, and include items such as:
  - Adequate phones and phone lines for JIC staff, agencies represented, and news media if deemed necessary (landlines are likely necessary only for backup due to the proliferation of cell phones; cellular data connections should be accessed in the facility location)
  - Backup communication methods for JIC staff
  - Cable-ready television and radios for media monitoring
  - Computers for monitoring websites and social media
  - Recording equipment for media monitoring and recording media briefings
  - Computers, necessary software and printer to support information exchange and preparation of news releases and incident chronology
  - Facsimile machines and copiers (as backups)
  - Media kits or information pamphlets, which include information on the site, emergency plan, JIC ground rules and layout, and pre-approved site general schematics/photographs. These should also be available in electronic format
  - Status boards – electronic or hard copy
  - Clocks
  - Tables, chairs
  - Identification badges

4.10.7. EPI Preparedness Activities

4.10.7.1. Training and Drills

A successful EPI program requires specialized training and participation in the site/ facility drill program. Emergency responders should understand how to effectively deal with the public, employees, and media. A successful EPI training program should incorporate the following concepts:

- All EPI program team members should receive initial training prior to participation in an incident, drill, or exercise. Training should include an overview of EPI emergency preparedness and response; provision of a controlled copy of the EPI plan and relevant position descriptions and checklists; DOE/NNSA policy on emergency management, site plans, and procedures; SFA operations; hazardous materials risks;

and SFA-specific orientation training. Training should be position-specific and include cross-training to understand and support other positions.

- Emergency spokespersons, SMEs, and technical briefers should receive specialized training on crisis communications with the public and news media, coordination with offsite agencies, translation of technical information, message development and use of visual aids. Senior-level management should also receive spokesperson training should an incident warrant their participation in news briefings or interviews.

- Social media coordinators should receive specialized training on social media management, monitoring, message development, and use of digital visual aids.

- Drills should be conducted to help train EPI/JIC personnel on the practical application of the public information functions that should be performed in an emergency, how to interface with other positions, and how to implement new ideas and procedures.

- Team members should receive annual re-qualification training in their respective functions, EPI organization operations, and the EPI relationship to the site emergency response effort. Re-qualification training should include:

  – Refresher on key topics covered in the initial training

  – Changes in EPI plan/procedures

  – Demonstration of functional capabilities through tabletops, drills, and other related activities

  – Detailed review of findings and lessons learned from self-assessments, drills, exercises, and actual emergency incidents

  – Detailed review of issues, lessons learned, and proven concepts from the DOE Corporate Lessons Learned Program

- The EPI/JIC operations training should be made available for appropriate DOE/NNSA personnel, offsite emergency management representatives, government officials, State emergency management personnel, county commissioners, Tribal representatives, county health officials, and the media.

- Records of training and drill participation should be maintained for EPI personnel.

4.10.7.2. Exercises

Exercises provide a means for evaluating EPI/JIC plans and procedures and, during full participation exercises, provide experience in working with colleagues and offsite EROs. Exercises should evaluate personnel in areas identified as deficient during past exercises or actual incidents. The EPI organization should always provide a representative to the scenario development team for exercises involving EPI to ensure that the objectives of the EPI organization are incorporated. The EPI program should ensure that lessons learned from the exercise program are incorporated into the plans and procedures for EPI/JIC operation.

The exercise program should include sufficient and varied scenarios that test the response roles of EPI personnel. Exercises should be tailored to the scenario and training requirements to include tabletops, drills, and full-scale exercises. It is also important that the exercises offer as much realistic simulation as possible by including professional media role players and the practicing of social media interactions. All exercises should be independently evaluated to identify strengths and flaws to be incorporated into subsequent plan revisions and training.

Every EPI team member should participate in at least one exercise annually. During an exercise, attention should be focused on the EPI team's overall performance and in its effectiveness in information coordination, production, dissemination, monitoring and analysis functions, and in timely dissemination of accurate and candid information to the public and media.

4.10.7.3. Offsite Interfaces

EPI plans and preparedness activities should provide for cooperative interface and coordination of public education and information activities with Federal, Tribal, State, and local response organizations. During an emergency there should be continual interface with Federal, Tribal, State, and local representatives, local executives, and the Governor's office to ensure accuracy of information via a JIS in coordination with HQ DOE/NNSA Intergovernmental Affairs. These interfaces should be arranged and documented in formal plans, memoranda of agreement or understanding, or other arrangements.

Tribal, State, and local governments should be encouraged to prepare their own public information response plans in conjunction with the SFA EPI planning effort. However, all participants should subscribe to procedures for JIC operation. All official elements should be equal partners in operation of the JIC and in securing information disseminated by the JIC. However, a single individual should be in charge of JIC operation at all times. This should be arranged, discussed, and agreed to in advance by all parties.

Local government participation in a JIC is important if an emergency involves local government response. If the local government’s public information officer is unable to relocate to the JIC, they should still be included within the JIS using available technology.

Local, State, and Tribal governments should be encouraged to participate in EPI training and drills/exercises conducted by the site.

4.10.7.4. Public and Media Education

A program to educate the public and the media is the foundation of an effective, accurate, and reliable EPI program. Pre-planning can ensure that the public understands the messages given during an emergency that explain the risks posed to them and the protective actions they may need to take. The public education program, therefore, should be based on the actual risks posed by the SFA as identified by the All-Hazards Survey/EPHA process. The LEPC or local emergency management agency should also be involved in communicating this information to the community and planning offsite response.

Education of the public and media should include notification procedures and possible protective actions, both onsite and offsite. Information may be disseminated in lectures, television, radio, and digital programs, or written materials, such as calendars, brochures, websites, telephone books, refrigerator magnets, etc., to residences, offices, hotels, and other public locations. If appropriate, information should be provided on sheltering-in-place, evacuation routes, relocation centers, risks and hazards onsite, and radio/television/cable stations used for emergency public information and Emergency Alert System announcements. A 24-hour general public information phone number for public inquiry should be publicized. Both a digital media and media kit should be available for all radio, television, and print news media.

It must be recognized, however, that while the DOE/NNSA facility may be the source of the risk to the offsite public, it has no authority to order offsite protective actions. The DOE/NNSA facility may, per agreement, provide information and recommended actions, but only offsite authorities can issue the orders as determined by State and local statutes.

Other information to be addressed may include traffic routes and transportation for the handicapped and general public, hospital information, respiratory protection methods, and use of *radio-protective* drugs, where applicable. Issues concerning special facilities, such as schools, prisons, nursing homes, senior citizen or childcare facilities, shopping centers, and businesses within the EPZ, should be addressed. Agricultural information is also important. State and local representatives will provide educational material to farmers, market vendors, milk producers, and others dependent on land within the EPZ or potentially affected areas.

The local media should be seen as a partner in EPI. If the media is educated in the SFA and activity risks and emergency plans, they can communicate emergency information to the public more effectively and accurately. An annual media day is an excellent time to implement the public education program. A site tour in conjunction with media day, and invitations to observe an emergency exercise or participate in emergency response training programs, are excellent ways to involve the media in public education and improve communication with the community.

4.11. Termination and Recovery

4.11.1. Introduction

The purpose of this section is to assist DOE and NNSA field elements in complying with the DOE O 151.1D requirements on emergency termination and recovery. The Order requires that OEs be terminated only after predetermined criteria have been met and formal termination of the response phase has been coordinated with DOE/NNSA HQ and offsite agencies.

Depending on the nature and severity of the emergency, once the emergency is terminated, the recovery operations may involve a variety of activities directed at restoring the facility and area affected by the emergency to a safe, stable condition. Recovery activities should include communication and coordination with Tribal, State, and local government and other Federal agencies; planning, management, and organization of the associated recovery activities; ensuring the health and safety of the workers and public; and after-action reporting requirements. Recovery planning should begin during the incident response when there are indications that the situation has stabilized.

4.11.2. General Approach – Termination and Recovery

Termination is a declared conclusion of an OE. The termination of emergency response should be considered when conditions at the incident scene and other impacted areas are sufficiently well understood, safe, stable, unlikely to deteriorate, and secure, and that the capabilities of the entire ERO are no longer needed to manage the incident. Termination and the subsequent notification to all involved Federal, Tribal, State, and local organizations mark the beginning of recovery.

Recovery is the phase of activity that follows termination of an emergency. During recovery, actions are taken to restore a facility, site, or activity to normal operation or to otherwise deal with the aftereffects of an emergency. The recovery period begins when emergency response is declared terminated and continues until the objectives of the recovery effort have been met. Recovery objectives may include meeting specific criteria for resuming normal operations and activities in facilities/areas affected by the incident, or for cessation of particular remediation efforts.

The types of activities that could be conducted by the recovery organization (which may not be part of the EOS or coordinated by the EOC) during the recovery phase include (but are not limited to):

- Accident investigation
- Crime scene preservation
- Damage assessment
- Security assessments
- Environmental consequence assessments
- Long-term protective action determinations
- Facility repair and restoration

- Environmental restoration of the facility or incident scene
- Replenishment of depleted supplies and resources
- Dissemination of information to workers and the public

Some recovery activities may be similar to (or a continuation of) actions performed during the response phase, such as entering a facility or affected incident area in (or from) which hazardous materials have been released.

4.11.3. Termination

Once declared, an OE will almost certainly become known throughout DOE/NNSA, the news media, and the public. Because of the attention focused on the SFA, the reasoning behind any termination decision may receive as much outside interest and scrutiny as the emergency declaration itself. To reduce the prospect of controversial and contentious termination decisions, emergency management plans and procedures should provide the ED with a decision process and criteria for terminating the response phase, releasing the ERO, and transitioning recovery operations.

A basic difference exists between the termination of an OE that involves the release of hazardous materials to the environment (classified OE) and one that does not.

- In the case of the classified OE, the decision to terminate causes or allows some or all of the ERO to suspend or reduce their activities. Accordingly, the timing for a decision to terminate will be based on a perceived decreased need for the entire ERO to remain active to monitor and manage the incident.
- In general, a decision to terminate an OE not requiring classification formally acknowledges that the incident has stabilized and declares that the response activity is being ended or substantially scaled back.

4.11.3.1. Operational Emergencies – Not Requiring Classification

The declaration of an OE will ensure that notifications are expedited and that the magnitude and significance of the incident are recognized and highlighted through the occurrence reporting process. Thus, an OE declaration will have fulfilled most of its purpose as soon as the required notifications and reports are completed. The decision to terminate an OE will not affect the subsequent collection, analysis, and dissemination of data through the occurrence reporting process.

The following provisions should be made for the termination of an OE that does not require classification:

- Authority and lines of communication for making the termination decision should be clearly defined in emergency management plans and procedures. Response to an incident categorized as OE may be similar in nature and magnitude to *ordinary* fire, HAZMAT, or environmental spill responses that have been conducted in the past at the site or facility. To avoid confusion and indecision, the relationship between Incident Command, Emergency Management and Occurrence Reporting functions with regard to terminating an OE should be explicit.

Formal termination of an OE should be considered when the local response authorities (such as the IC in charge of firefighting, rescue, spill cleanup, etc.) determine that the response effort can be suspended or substantially scaled down. Criteria for terminating each of the various types of OEs identified in the All-Hazards Survey should be documented in emergency management plans and procedures.

- Examples of termination criteria include:
  - The affected facility, site, or incident scene is in a stable condition.
  - Fire, flood, earthquake, or similar emergency conditions or security considerations no longer constitute a hazard to critical systems/equipment or to personnel.
  - Existing conditions no longer meet the established emergency categorization criteria.
  - It is unlikely that conditions will deteriorate.
  - All contaminated and injured personnel have been treated or transported to medical facilities.
  - All initial emergency notifications have been completed.
  - Accountability of personnel is complete.
- Termination of response to a declared OE needs to involve coordination with Tribal, State, and local agencies and organizations responsible for offsite emergency response and notification. As a minimum, all parties that were notified of the OE declaration or participated in the response should be advised of the intent to terminate. The advisory should state the justification for terminating, give the date/time that the termination will be effective, and be issued sufficiently in advance of the effective date/time that recipients have the opportunity to discuss the decision and its bases with DOE before it becomes effective. Formal meetings should occur between onsite and offsite response officials, when and where appropriate, to assure that all concerns regarding the incident are addressed.
- The need for a formal Recovery Plan will depend on the complexity and expected duration of any actions to deal with after-effects of the incident. Examples of situations that may indicate the need for a formal Recovery Plan and designation of a Recovery Manager include:
  - Technical criteria for resumption of operations/occupancy at affected facilities will need to be developed.

- Investigation and fact-finding activities are expected to be lengthy or involve multiple contractors or jurisdictions.

- Substantial and prolonged coordination and communications will be required with offsite governments, agencies, or response organizations to assess the extent of area or property damage or contamination.

- The incident resulted in a large number of personnel injuries or illnesses requiring protracted follow-up treatment, analysis, and public information.

4.11.3.2. Operational Emergencies – Requiring Classification

Response to an emergency involving actual or potential release of hazardous materials to the environment can be terminated only when capabilities and resources of the ERO are no longer needed to manage the incident. Provisions should be made for termination of classified OEs. General criteria for termination should be documented in the emergency plan/procedures. The criteria should be used by emergency managers to decide when to end the emergency response phase and initiate recovery.

The following are selected examples of incident termination criteria:

- Security measures have been reviewed and it has been determined that operational levels of security can be maintained.

- Protective actions have been reviewed and adjusted (as needed) for extended recovery operations.

- Radiation or hazardous material exposure levels within the affected facility or areas are stable or decreasing with time.

- The affected facility, site, or incident scene is in a stable condition.

- Fire, flood, earthquake, or similar emergency conditions or security considerations no longer constitute a hazard to critical systems/equipment or to personnel.

- Releases of hazardous material to the environment have ceased or are controlled within permissible regulatory limits, and the potential for an uncontrolled release is low.

- Contaminated areas are identified, isolated, and secured.

- Existing conditions no longer meet the established emergency categorization or classification criteria, and it appears unlikely that conditions will deteriorate.

- No surveillance relative to protective actions is needed, except for ingestion pathway concerns and contamination or environmental assessment activities.

- All contaminated or injured personnel have been treated or transported to medical facilities.
- All initial emergency notifications have been completed.
- Access to affected areas necessary for conducting recovery operations has been obtained.
- Accountability of personnel is complete.
- The incident scene can be preserved until the responsible investigative authority agrees that recovery operations may begin.
- The SFA and DOE/NNSA management, in consultation with appropriate offsite agencies, are unable to identify a sufficient rationale for continuing to operate in the emergency response mode.
- Initial recovery activities have been clearly identified and prioritized.
- The recovery staffing plan has been developed, approved, and can be implemented.
- Recovery Manager and staff have been fully briefed by the Emergency Director.
- All principal participating response organizations have agreed to the key elements of a Recovery Plan.

4.11.4. Recovery

The goal of any recovery effort is to restore affected facilities and areas (onsite and offsite) to normal conditions following the termination of emergency response. Upon recovery to normal conditions an SFA should have the capabilities for the site/facility ERO to effectively respond to the next incident. Recovery activities and the level of effort required will be determined by the nature and magnitude of the emergency incident. Emergency management plans and procedures will need to address a wide range of possible circumstances and, as a result, will be general in nature.

If a determination is made that a Recovery Plan is needed, the specific objectives of the recovery activity should be established at the time of termination and documented in the Recovery Plan. If the emergency produced offsite impacts, the recovery organization should include a liaison position for offsite interface with the State, local, and Tribal agencies for development and implementation of the recovery actions. Depending on the nature and severity of the incident requiring a formal recovery plan, some or all of the considerations addressed in the following sections may be applicable.

Preparation for recovery from an OE requiring classification should address the following general areas: recovery organizations, recovery plans, recovery planning and scheduling, accident assessment and investigation, and repair and restoration.

4.11.4.1. Recovery Organization

Prior to terminating the emergency, the ERO should establish a recovery organization and determine that resources are available to begin recovery operations. The recovery organization is responsible for coordinating all recovery activities. Responsibilities include, but are not limited to:

- Prioritization and scheduling of activities
- Protection of worker and general public health and safety
- Dissemination of information
- Coordination of site and offsite activities
- Collection of data, including any necessary sampling and analysis, and assessment of long-term effects associated with the release of hazardous materials
- Formulation and implementation of long-term protective actions for the affected areas
- Providing assistance as requested to state and local agencies in the formulation of long-term protective actions for affected offsite areas

If negative effects to facilities or the environment are minimal, normal operations and maintenance organizations may be able to perform all necessary recovery actions. At a minimum, a Recovery Manager should be appointed to coordinate planning and authorize recovery operations. When a dedicated recovery organization is necessary, it should parallel the normal facility or site operating organization, when possible. To the extent possible, recovery activities should be carried out through normal facility and site operations. This arrangement provides the recovery management and staff with established and recognized channels of communication, authority, processes, and controls to accomplish their mission.

The composition of the recovery organization should be based on the extent and nature of the emergency. Functional elements in a recovery organization should include, at a minimum, the following:

- Analogous to an On-Scene Commander, a Recovery Manager who has the responsibility and authority to coordinate onsite recovery planning; authorize recovery activities; protect the health and safety of workers and the public; and initiate, change, or recommend protective actions. This position should have management authority commensurate with the requirements of the recovery activities.
- Personnel assigned to the Recovery Organization should be based on their normal duties and responsibilities. Assigning personnel based on their ERO position or on knowledge of the incident from their response efforts should be discouraged if the

assignment could affect their availability to respond to their ERO position for future incidents during recovery operations.

- An offsite liaison who has the responsibility and authority to coordinate offsite recovery planning; protect the health and safety of workers and the public; recommend protective actions to the local, State and other agencies. This position should have management authority commensurate with the requirements of the recovery activities.

- Personnel with the technical expertise to direct post-accident assessment activities, to analyze the results and to identify/conduct repair and restoration activities. (Maintenance and operations personnel and engineers normally staff these positions).

- A public information specialist to deal with inquiries or concerns from employees, the public, and the news media and to coordinate with parallel offsite public information officers. A Public Information Specialist may expect to address accident investigation results, the extent of onsite and offsite impacts, and the status of recovery operations. While a Media Center and JIC may stand down, periodic briefings may continue to occur.

4.11.4.2. Recovery Plan

If a recovery plan is necessary to return the affected facility/area to normal operations following the termination of the OE, it should, at a minimum, address the following areas:

- Dissemination of information to Federal, State, local and Tribal organizations regarding the emergency and possible relaxation of protective actions

- Notifications associated with termination

- Accident assessment and investigation

- Recovery planning and scheduling

- Repair and restoration

- Planning for decontamination

- Environmental compliance

- Waste management

- Security

- Communication and notifications

- Development and approval of recovery procedures

- Replenish, repair, or replace emergency equipment or consumables
- Health and safety
- Reporting requirements
- Criteria for the resumption of normal operations

Recovery planning and implementation will start with assessment of facility, site, and environmental conditions. Some recovery activities may be conducted under conditions similar to those of the reentry activities. Therefore, the reentry considerations discussed in Chapter 4, Section 8, may be applicable to recovery operations. There are three general areas of recovery operations: recovery planning and scheduling, accident assessment and investigation, and repair and restoration.

4.11.4.3. Recovery Planning and Scheduling

The initial Recovery Plan developed by the ERO does not need to have detailed recovery and planning information. The following types of recovery activities should be planned and scheduled:

- Notification of the establishment of the recovery organization and the name of the Recovery Manager to persons and agencies involved in the emergency response.
- Evaluation of Emergency Management Plans to determine if adequate emergency preparedness status can be maintained, while the incident scene or facility conditions are degraded (e.g., critical infrastructure protection, inaccessibility of assembly areas, inoperative emergency/safety instrumentation and equipment, etc.).
- Establishment of specific criteria to be met prior to the resumption of normal site operations or facility use.
- Preparation of plans for the establishment of safe long-term conditions when the assessment indicates that a facility or affected incident area cannot be safely returned to normal operation or use.
- Identification of required repair and restoration work based on the assessment results.
- Plan for the proper handling and disposal of all hazardous waste generated during recovery activities.
- Establishment of a Tracking Group to monitor all assigned tasks, including developing work packages, scheduling activities, and estimating costs.
- Formation of a Procedures Review Group to determine if specialized procedures are required and should be developed, and to review and approve all special procedures.

- Continued evaluation of site or facility hazards and contamination levels as well as estimating exposures to workers.

4.11.4.4. Accident Assessment and Investigation

The SFA management, in coordination with DOE/NNSA management, may need to establish an Investigation Board to determine the root cause of the incident and prepare a formal accident report in accordance with DOE O 225.1B, *Accident Investigations*. Upon recovery of normal operations, SFAs need to provide sufficient communication and coordination with State, Tribal, and local governments as well as corresponding Federal agencies. The determination of the need for an Investigation Board and compliance with DOE O 225.1B should be completed within the initial Recovery Plan. For further guidance on conducting accident investigations review DOE-HDBK-1208-2012 Volumes I & II.

4.11.4.5. Supporting Follow-On Actions for Recovery

- Prior to the start of repair and restoration, the accident scene should be preserved so critical evidence will not be lost. This evidence is needed to determine what caused the incident and to determine responsibility. See DOE O 225.1B for more information about Accident Investigations and activities.

- All documentation produced during the emergency response that is potentially useful to accident investigation should be collected and organized.

An assessment and investigation of the incident scene or SFA conditions should be consistent with the incident severity. Engineering/Maintenance/Operations personnel should assess the condition of the facility including structural integrity, equipment status, hazardous material containment/confinement barriers, and safety systems. Health Physics, Industrial Hygiene, environmental compliance, security, law enforcement, and medical personnel should assess the impacts/consequences of the incident.

4.11.4.6. Repair and Restoration Activities

The following items should be considered during repair and restoration activities:

- Ensure that occupational exposure limits are followed as indicated in 10 CFR Part 835.202 or 10 CFR Part 835.204.

- Ensure that any discharges from recovery activity are controlled within regulatory and environmental compliance limits. If discharges are necessary beyond these limits, ensure that all necessary documentation is prepared, approvals obtained, and notifications made.

- Conduct recovery activities through normal SFA work organizations, practices, limitations, and procedures to the extent practical.

- Replenish, repair, or replace any emergency equipment or consumable materials used during emergency response.

- A comprehensive assessment of contamination in all affected areas should be performed. As soon as sufficient information is available, consideration should be given to modification or termination of SFA protective actions instituted during emergency response. Monitoring and laboratory analysis results should be used as the bases for determining long-term protective actions for affected areas. More information on long-term protective actions is contained in the EPA manual 400-R-17-001, *PAG Document of Protective Action Guides and Planning Guidance for Radiological Emergencies*. Local and State governments, and Tribal authorities, should be notified of recommendations for long-term protective actions and modifications or termination of existing protective actions.

4.11.5. Resumption of Normal Operations

Affected facilities and areas should be returned to normal operations or use only when all criteria established by the recovery organization have been met and all approvals have been granted by cognizant organizations and agencies. At a minimum, compliance should be required with Technical Specifications, Technical Safety Requirements, health and safety regulations, and environmental regulations. Federal, Tribal, State, and local organizations should be consulted prior to terminating recovery operations, if required by regulation or Memorandum of Agreement/Understanding. Otherwise, notifications to these organizations should be made prior to the resumption of normal operations. As required, all documentation of recovery operations should be collected and processed for permanent storage as part of the record management program. A final report should be written related to the emergency, in accordance with DOE O 231.1B Admin Chg 1.

Chapter 5. Biosafety Facilities

5.1. Biosafety

5.1.1. Introduction

The Department of Energy (DOE) O 151.1D, *Comprehensive Emergency Management System*, describes the DOE and National Nuclear Security Administration (NNSA) Emergency Management System. The Order sets Departmental policy, assigns roles and responsibilities, and provides the framework for the development, coordination, control, and direction for DOE/NNSA emergency management programs.

Since 1991, DOE/NNSA emergency management programs have focused on radioactive materials and hazardous chemicals. However, priorities in national security emphasizing anti-terrorism have caused a change in national security research priorities at DOE/NNSA sites, facilities, agencies (SFAs) to include studies involving hazardous biological agents or toxins. The use and storage of these materials in DOE/NNSA facilities has the potential to harm workers and the general public, as do toxic chemicals and radioactive materials, through an unplanned incident or condition that releases an agent or toxin to the environment.

Integration of hazardous biological materials into the DOE/NNSA emergency management program is directed by DOE O 440.1B Change 2, *Worker Protection Program for DOE (Including the NNSA) Federal Employees*, Attachment 1, Section 6. Note: Part 851 applies to contractors and the Order applies to DOE employees. According to this rule, contractors must establish and implement a biological safety program that establishes an Institutional Biosafety Committee (IBC) or equivalent. The IBC must review the site's security, safeguards, and emergency management plans and procedures to ensure they adequately consider work involving biological, etiologic (disease causing) agents. In addition, the biological safety program confirms that the site safeguards and security plans and emergency management programs address biological etiologic agents, with particular emphasis on biological Select Agents. Other Federal regulations that govern the use and storage of Select Agents and Toxins require that mandated incident response planning be integrated with any site-wide emergency response plans.

The purpose of this guidance is to assist DOE/NNSA field elements and operating contractors in incorporating hazardous biological agents/toxins into emergency management programs. The intended result is an integrated and comprehensive emergency management program that provides assurances of a timely and effective response to an onsite release of a radioactive, toxic chemical, or hazardous biological material. Note that the guidance presented in this document does not explicitly address acts of terrorism in which biological agents or toxins, not owned or controlled by DOE/NNSA, are brought onto a DOE/NNSA site or facility.

It is not the intent of this section to establish operational biosafety requirements for biosafety facilities. Topics (biological agents, *Biosafety in Microbiological and Biomedical Laboratories* (BMBL) biosafety, BMBL risk assessment, barriers) will be introduced to familiarize emergency management personnel with various concepts related to hazardous biological materials that they must be cognizant of in order to address integration of hazardous biological materials with site-wide emergency management planning. Likewise, the discussions can also raise the awareness of biosafety experts to recognize aspects of their discipline that are important to emergency management personnel. These sections should not be used to develop, implement, or evaluate a biosafety program. They are focused simply on introducing biosafety concepts relevant to emergency management programs. As will become evident in subsequent sections below, emergency management plans and programs already implemented on DOE/NNSA sites provide the programmatic and response framework/structure and, in many instances, the specific functions and activities (training program, offsite interfaces) that will support implementation of all response requirements included in the Select Agent Rules.

5.1.2. General Approach – Biosafety Facilities

The guidance in this chapter focuses on biological hazards. The SFA planners will ultimately integrate the biological aspects of the emergency management program elements with those of other identified hazardous materials to produce a single facility Emergency Management Hazardous Materials Program. The purpose of this chapter is to address major aspects of an emergency management program that need to be modified to include emergency response to a release of hazardous biological materials.

The applicability of computer modeling to biological release scenarios should be established for the source and conditions of release represented in the specific scenarios. Conventional modeling techniques, such as Gaussian plume models, may not be appropriate for planning calculations and consequence assessments during response for the types, quantities, and release mechanisms of biological agents/toxin of interest. For this reason, and for others to be discussed later, the Order does not require that biological releases be OEs requiring classification (Alert, Site Area Emergency (SAE), or General Emergency (GE)), as are traditional hazardous material releases. Also, some non-traditional incidents involving biological agents can result in releases that may not be recognized or detected by the facility staff when they occur. In such cases, detection of the release may only happen when people present with infections at medical treatment locations, onsite or offsite, in sufficient numbers to trigger recognition of an operational emergency (OE).

The OE response measures focus on collocated workers, the public, and the environment outside of the biosafety facility, while the biological worker safety program response appropriate for the specific facility will focus primarily on protection of the laboratory workers and the environment inside the biosafety facility.

The traditional approach to protective action planning applied to biological releases has the additional complication of infection control, which deals with vector or person-to-person transmittal of the agent, after initial infection of a receptor. Specific agent data can assist in determining potential spread, dissemination, infectivity, and treatment or prophylactic protocols that can influence the selection of appropriate protective actions.

Because a strictly quantitative analysis of Select Agents may not be an appropriate or feasible planning technique for many biological sources found in DOE/NNSA facilities, a structured qualitative analysis approach is presented for Emergency Planning Hazards Assessment (EPHAs), which can be used to reveal release scenario parameters necessary for recognizing OEs and for developing initial protective action strategies for protecting onsite workers and the offsite public. Appendix I contains several notional OE release scenarios developed to provide examples of the analysis approach.

Biological toxins are essentially extremely toxic chemicals generally covered by guidance contained in the above chapters; however, clarifications and discussions in this Guide will specifically address the release of toxins when necessary.

5.2. Hazardous Biological Materials and Biosafety

This section provides a brief introduction to characteristics of hazardous biological materials and biosafety concepts related to the safe use and storage of these materials in approved facilities. An understanding of basic biosafety concepts will facilitate the integration of biosafety requirements and DOE/NNSA SFA emergency management program elements. Original National Institutes for Health (NIH), Center for Disease Control (CDC), and World Health Organization (WHO) reference materials should be accessed for a complete and in-depth presentation of the guidance for interpretation or implementation of the various biosafety concepts to be discussed in the following sections. For further references on basic biosafety concepts see the current BMBL.

5.2.1. Hazardous Biological Agents and Toxins

Biological materials that may be associated with DOE/NNSA facilities fall into two major categories: biological agents (microorganisms) and biological toxins. Hazardous biological agents include naturally occurring or genetically modified microorganisms that can cause disease and death in an exposed and vulnerable population. Biological toxins are toxic chemicals that are biologically produced and behave in the environment much like other toxic chemicals. However, these toxins represent some of the most hazardous in the category of toxic chemicals. An extremely small amount of either an infectious biological agent or a biological toxin can cause disease, severe toxic reaction, or death.

5.2.2. Select Agent Regulations

Federal regulations establishing requirements for certain biological agents and toxins regarding their possession and use in the U.S., receipt from outside the U.S., and transfer within the U.S. are:

- 42 Code of Federal Regulations (CFR) Part 73, *Select Agents and Toxins*. Contains two lists of agents and toxins regulated by Health and Human Services (HHS)/CDC: 1) HHS Select Agents and Toxins; and 2) Overlap (posing severe threats to both humans and animals) Select Agents and Toxins.

- 7 CFR Part 331, *Possession, Use, and Transfer of Select Agents and Toxins*. Contains a list of Plant Protection and Quarantine Programs (PPQ) of the Animal and Plant Health Inspection Service (APHIS), Select Agents and Toxins.

- 9 CFR Part 121, *Possession, Use, and Transfer of Select Agents and Toxins*. Contains two lists: 1) Veterinary Services Programs (VS) of the APHIS, Select Agents and Toxins; and 2) Overlap Select Agents and Toxins.

The HHS Select Agents and Toxins pose severe threats to humans alone, while overlap Select Agents and Toxins pose severe threats to both humans and animals. Overlap Select Agents and Toxins are subject to regulation by both CDC and APHIS; the lists are identical in both regulations. PPQ Select Agents and Toxins have the potential to pose a severe threat to plant health or to plant products. VS Select Agents and Toxins have the potential to pose a severe threat to animal health or animal products. Note that the total aggregate quantity of each toxin under the control of a “principal investigator, treating physician or veterinarian, or commercial manufacturer or distributor” in a biosafety facility must exceed quantities specified in their respective regulations to be subject to rule requirements, while no quantity is specified for biological agents. In addition, Select Agents or Toxins may also be excluded from the regulations if they meet any of several other criteria (non-viable Select Agents or nonfunctional Toxins). As indicated in Section 1, the three rules will be referred to as the *Select Agent Rules* for purposes of this guidance, unless there is a reason to cite the specific rule.

The entities regulated under the Select Agent Rules include Federal facilities/laboratories. The rules establish requirements concerning registration, security risk assessments, safety plans, security plans, incident response plans, training, transfers, record keeping, inspections, and notifications. The external exportation and transportation of these materials are not covered under this rule; the U.S. Department of Commerce (DOC) and Department of Transportation regulate these activities.

A key element of the HHS/CDC regulations is the development and implementation of a safety plan considering the following biosafety standards and Federal regulations:

- CDC/NIH publication, Biosafety in Microbiological and Biomedical Laboratories ;

- OSHA regulations in 29 CFR Part 1910.1200, Hazard Communication;

- 29 CFR Part 1910.1450, Occupational exposure to hazardous chemicals in laboratories; and

- NIH Guidelines for Research Involving Recombinant and Synthetic Nucleic Acid Molecules (April 2019).

The APHIS regulation related to PPQ Select Agents/Toxins (plant pathogens).

5.2.3. Principles of Biosafety, Containment, and Barriers[3]

Biosafety is the discipline addressing the safe handling and containment of infectious microorganisms and hazardous biological materials. The two basic principles of biosafety are containment and risk assessment.

Risk assessment is the BMBL biosafety methodology used to select the appropriate microbiological practices, safety equipment, and facility safeguards that define the level of containment to be implemented in a facility/laboratory, *commensurate with the hazards* associated with the biological agent(s) used or maintained within. The risk assessment process is similar in purpose to the EPHA process, which results in the emergency management technical planning basis for *commensurate-with-hazards* Emergency Management Hazardous Materials Programs at DOE/NNSA SFAs.

The principles of biosafety and the associated risk assessment process are described in the BMBL. All facilities registered under 42 CFR Part 73 or 9 CFR Part 121 are required by the regulation to consider the BMBL in developing their safety programs. The BMBL describes a comprehensive approach that evaluates hazards of the biological agents present in the facility, the type of work to be performed, and the mitigative features utilized. The application of this risk assessment process results in a determination of the appropriate biosafety level (BSL) for each infectious biological agent/toxin to be used or stored in the facility. The information developed for the risk assessment process (Agent Summary Statements) will provide much of the information needed as input to the EPHA process for the biosafety facility.

Facilities/laboratories, equipment, and procedures appropriate for work with toxins of biological origin should also reflect the intrinsic level of hazard posed by a particular toxin as well as potential risks inherent in the operations performed. If both toxins and infectious agents are used, then both need to be considered when containment equipment is selected and when policies and procedures are written. If animals are used, animal safety practices must also be considered.

A basic understanding of containment and barriers is essential for developing an integrated emergency management program that addresses all hazards. The term *containment* (or equivalently, biocontainment) is used in describing safe methods for managing infectious materials in the laboratory environment where they are being handled or maintained. The purpose of containment is to reduce or eliminate exposure of laboratory workers, other persons, and the outside environment to potentially hazardous agents.

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[3] Unless otherwise indicated, biosafety, containment, and barrier concepts/definitions are derived directly from BMBL (1999) or BMBL (2009). However, since the discussion of these topics is not complete, the original source document(s) should be accessed for developing and implementing a biosafety program.

5.3. Operational Emergencies Involving Biological Materials

This section will focus primarily on biological agents, not toxins. Emergency planning for the release of biological toxins to the environment is similar to that for the release of a toxic chemical. Its extreme toxicity, however, places it in a special category for regulation and, as defined in DOE O 151.1D, in the same OE category (i.e., incidents that do not require classification) as hazardous biological agents.

5.3.1. DOE O 151.1D and Hazardous Biological Materials

The emergency management order, DOE O 151.1D, includes criteria for identifying hazardous biological materials subject to its requirements. In addition, according to the Order, each DOE/NNSA facility with specific biological agents or toxins that pose a serious threat to workers, the public, or the environment, must develop and maintain a "quantitative EPHA and meet more detailed emergency planning requirements." At a minimum, these agents and toxins must include " . . . Federally regulated agents and toxins identified in lists published by HHS in 42 CFR Part 73 and the U.S. Department of Agriculture (USDA) in 7 CFR Part 331 and 9 CFR Part 121." If any listed biological agents or toxins are excluded from federal regulation under the Select Agent Rules [42 CFR Part 73.3(d)], then the exclusion also applies to the requirements of DOE O 151.1D.

According to DOE O 151.1D, if a DOE/NNSA facility is governed by HHS or USDA Select Agent Rules because it uses or stores Select Agents or Toxins exceeding minimum quantities, then an EPHA needs to be prepared and an Emergency Management Hazardous Materials Program is required for that facility.

5.3.2. Emergency Management Issues

Hazardous biological agents are similar to hazardous chemicals and radioactive materials in that they:

- Are defined as hazardous materials in the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard (29 CFR Part 1910.120)
- They *(most)* can be dispersed into the air to pose a threat to workers and the public via the inhalation pathway
- Have a range of responses to environmental conditions

The characteristics of hazardous biological agents differ from other hazardous materials and these differences impact DOE emergency planning and response. Some unique characteristics of hazardous biological agents are described below:

- **Threshold Quantities.** Since biological agents differ dramatically in terms of characteristics that determine their ability to cause harm to humans, animals or plants, firm *de minimus* hazard levels are difficult to discern. In addition, the characteristics of available transport mechanisms for biological agents make the definition of a general threshold screening value even more difficult, if not impossible. Consequently, judging the perceived risk associated with the release of a specific agent involves an assessment of the agent characteristics and activities conducted, irrespective of the volume or concentration of agent involved.

The Select Agent Rules provide minimum quantities for each HHS and Overlap hazardous biological toxin subject to the regulations. These quantities establish *de facto* minimum hazard levels for the toxins that determine whether the toxin is subject to the requirements. Similarly, minimum quantities should also represent screening thresholds in the context of the DOE emergency management system.

- **Infection Control Concepts.** Agent characteristics related to the transfer of an agent from one human to another, and the capability of the agent to cause infection in a human, are important for emergency management planning for biological agents but are not applicable to other hazardous materials. Because definitions of these terms vary, several were specifically selected for this guide:

  – Infectivity:

    - Infection: detrimental colonization of a susceptible host by a disease-causing microorganism (pathogen), where the infecting microorganism seeks to enter and survive in a host and to utilize the host's resources in order to multiply at the host’s expense.

    - Infectious: the capability [of a disease-causing microorganism (pathogen)] of entering, surviving, and multiplying in a susceptible host.

    - Infectivity: a relative measure of the capability with which a disease-causing microorganism (pathogen) establishes an infection in a susceptible host.

  – Virulence:

    - Virulent: the capability [of a disease-causing microorganism (pathogen)] to rapidly overcome the natural defenses of a host, causing a serious and injurious condition(s).

    - Virulence: a relative measure of the capability of a disease-causing microorganism (pathogen) to rapidly overcome the natural defenses of a host, causing a serious and injurious condition(s).

  – Transmissibility:

    - Transmission: the passing/transmitting of a disease from an infected individual or group to a previously uninfected individual or group. One or more of the following mechanisms may transmit the disease-causing microorganism (pathogen) from one person to another (person-to-person):

+ Droplet contact – coughing or sneezing on another person
+ Direct physical contact – touching an infected person
+ Indirect contact – usually by touching a contaminated surface
+ Airborne transmission – if the microorganism can remain in the air for long periods
+ Fecal-oral transmission – usually from contaminated food or water sources
+ Vector-borne transmission – carried by insects or other animals

- Transmissible: the capability [of a disease-causing microorganism (pathogen)] to be passed person-to-person. [*Transmissible* will also be used to describe a disease that is transmitted person-to-person (i.e., *transmissible* disease).]
- Transmissibility: a relative measure of the capability with which a disease-causing microorganism (pathogen) spreads person-to-person.

- **Measure of Severity.** The DOE emergency management system uses a Protective Action Criterion (PAC) as a measure of severity for the airborne release of a radioactive or chemical hazardous material. When the consequences of a release exceed their respective PAC, adverse health effects are possible and protective actions should be taken. (Cf. Appendix C.)

- Individuals vary widely in their susceptibility to a particular biological agent. For example, the ID (Infectious Dose) for anthrax that results in disease in 10 percent of the population, ID_{10}, is hundreds of organisms. ID_{50} is tens of thousands and ID_{95} is millions of organisms. Since the characteristics of IDs for many agents do not reflect a delimiting value that can be used to represent infectious vs. not infectious doses, or permissible vs. not permissible exposure levels, a specific value of infectious dose will not be used in DOE emergency management programs to measure release severity (i.e., below a specific value, no protective actions required vs. above the value, take actions.)

  This position is supported in part by a study that asked whether "infectious doses for organisms could be defined in such a way to potentially develop permissible exposure levels to those infectious agents." The study concluded that ". . . attempts to develop quantitative values for human infectious dose are not currently feasible." [*OSHA Infectious Dose White Paper*, Applied Biosafety, Volume 8, Number 4 (2003), pp. 160-165.]

Because no measure of severity is currently available for use as a PAC for releases of hazardous biological materials, DOE O 151.1D specifies that *immediate protective actions are required for any release of biological agents and toxins outside of secondary containment barriers.*

- **Amplification.** Biological agents (bacteria, viruses) are living organisms and have the ability to grow and multiply – to *amplify*. The communicable nature of some biological agents means that the amount may amplify and spread dramatically after it is released to the environment. If a host is infected with a communicable agent, it could be transmitted from host to host, growing and multiplying within each infected subject.

  This characteristic of living biological agents presents an additional unique, and possibly unsolvable, challenge for emergency management planning and response in attempting to define a quantity of biological material that represents a threat to collocated workers and the public.

- **Stability in the Environment.** The persistence of hazardous biological agents in the environment can vary dramatically among different types of such organisms. Some viruses may survive in the environment from minutes to hours, while some bacteria, such as Bacillus anthracis, can transform into extremely stable dormant spore forms under adverse conditions that can survive for decades in the environment under adverse conditions. Stability in the environment can influence specific initial protective actions taken and the time duration for maintaining them.

- **Incubation Period.** The time between infection/uptake and the onset of symptoms (i.e., incubation period), which can vary from hours to days, may in some cases enable the facility staff to analyze the incident and perform lab tests and monitoring to confirm that a suspected release has in fact occurred. Once confirmation takes place, the incubation period can allow a window of opportunity during which effective treatments can begin (prior to onset) for individuals who may have been exposed. However, the incubation period does not provide a similar opportunity to reduce or eliminate further exposures. Unless appropriate initial protective actions are promptly implemented, the source of biological material released during the incident may continue to expose workers or the public. This is particularly true for the infected host, since some infections are most transmissible during the incubation time.

  The incubation period is a mitigating (i.e., degrading) factor in the timely detection of individuals who are unknowingly infected or who do not report an exposure or incident. Variability in symptom onset also makes it difficult to establish the time of the release when attempting to confirm that the release originated at the facility.

- **Detection Difficulties.** Releases of biological agents are difficult to detect directly and to identify with certainty in real time. Various generic detection devices respond to the presence of biological agents, but do not identify the specific agent. Unlike radiation monitors and hazardous chemical detection devices, real-time equivalent biological identification devices currently available may not be feasible for use in DOE biosafety facilities. Consequently, laboratory testing is generally used to confirm the presence of biological agents, although results can take up to several days to obtain.

Reliable detection of the onset of an outbreak of infections, due to an unobserved release of a biological agent from a DOE/NNSA facility, cannot be based solely on the initial appearance of symptoms among site workers or in the local community. A biological agent release could be due to a natural outbreak or epidemic. Also, early symptoms may appear to be the same as many non-lethal diseases produced by common infectious agents.

5.3.3. Biological Operational Emergencies

The Select Agent Rules require immediate notifications to CDC or APHIS upon discovery of ". . . a release of an agent or toxin causing occupational exposure or release of a select agent or toxin outside of the primary barriers of the biocontainment area...." These criteria for notification of CDC or APHIS HQ are consistent with the fundamental objective of an OE categorization, namely, to ensure prompt notifications to initiate a timely, effective response. To maintain consistency with the Select Agent Rules, the DOE Order and guidance incorporate, where applicable and appropriate, concepts and requirements of the rules. The DOE OE definition will supplement this general condition for notifications of biological incidents with the additional criterion that any actual or potential release of a hazardous biological agent or toxin be ". . . outside of the secondary barriers of the biocontainment area." The infectious nature of Select Agents and the lack of defined *de minimus* hazard levels support OE declarations under conditions that leave undefined a specific level of consequences (and hence health effects) or the quantity released into the environment.

The OE represents an actual or potential release beyond the secondary barriers of the biocontainment area into the environment. The environment may be the public area outside of a laboratory contained within a facility or may refer to releases directly outside a facility/building. Multiple transport mechanisms can be associated with the OE. Hazardous biological materials can be released to the outside environment or can contaminate humans, vectors, and fomite (i.e., inanimate objects such as clothing or equipment), and then be carried outside the facility. In the environment, they can persist in water systems and on surfaces (including environmental matrices such as soil) and again be transported by multiple mechanisms. Susceptible hosts that contact contaminated air, water, or surfaces may be vectors for further transmission of infectious biological agents.

5.3.4. Biological Agent/Toxin Transport Mechanisms

In general, airborne transport and dispersion of hazardous materials can have the greatest area of impact and require the most time-urgent emergency response actions. This is especially the case when source terms consist of large quantities of hazardous materials and inhalation is the primary receptor pathway. For hazardous chemicals and radioactive materials, the spread of significant amounts of contamination by animate or inanimate objects is often easily detected and the initial area of contamination caused by airborne dispersion predictable. Implementation or recommendation of applicable protective measures to prevent or limit worker or public exposures is straightforward.

Significant quantities of living biological agents (microorganisms) can be transported as aerosols and by additional transport mechanisms, including transmission from an infected or contaminated host or object to one or many other receptors. Biological agents can spread beyond their point of initial release in air-handling systems, by the re-aerosolization of contaminants (from floors and other surfaces as a result of foot traffic or indoor air handling systems; through adhesion to people or their clothing; and by transmission from one person to another) resulting in a widespread dispersal of contaminants. Since no threshold or permissible quantities have been established for biological agents, transport mechanisms not normally considered or applicable when hazardous chemicals and radioactive materials are released should be evaluated for biological agents.

Biological toxins are non-living chemical materials produced by living organisms. The transport mechanism for toxins is basically the same as for particulate inorganic or organic hazardous chemicals. However, because they represent extremely toxic materials (poisons), release of even small quantities from the facility as an aerosol, either to be inhaled directly by receptors or to be deposited as contamination, is of time-urgent concern.

Three general categories of transport mechanisms that should be considered for hazardous biological materials:

1. Environmental dispersion
2. Infected host (agents only)
3. Contamination

Transport of hazardous biological materials from a facility to external receptors in the environment can involve combinations of several mechanisms. The specific paths available will depend on facility design, geographic and demographic characteristics of the surrounding area, and, especially, characteristics of the biological agent. The following sections contain brief discussions of these transport mechanisms.

5.3.5. Environmental Dispersion

Two potential mechanisms for the transport and dispersal of biological agents/toxins in the environment are *airborne* and *waterborne*. Although many can be dispersed into the air and transported as aerosols, most do not readily aerosolize in their natural form. If the agent/toxin has been processed to readily aerosolize (e.g., weaponized), then the airborne dispersal of material could be the most likely mode of transport with the greatest impact.

The ability to aerosolize is an individual agent/toxin characteristic and may be modified dramatically by the formulation of material containing the biological agent. This enhanced ability to aerosolize should be specifically identified in analyzing potential emergency scenarios. The ability of the agent/toxin to survive in the environment after release should also be assessed in determining the impact of a release into the air. The aerosolized agent or toxin can directly impact receptors through inhalation or other pathways, or by ingestion when receptors are exposed to contaminated food products.

Some biological agents/toxins also have the ability to remain viable in water and can pose a serious hazard if released into wastewater or drinking water. The ability of a particular agent/toxin to survive and remain a threat once it enters a water supply needs to be considered.

5.3.6. Infected Host

A transport mechanism unique to biological agents is the exposure of receptors (collocated workers or the public) to a biological agent by an infected host. The infected host moves from the facility to the environment and in the environment to a receptor.

The infected host transmits the agent through direct or indirect contact with receptors. This method of transport applies only to a subset of hazardous biological agents referred to as transmissible agents. These agents, such as the virus responsible for smallpox or the bacteria that causes plague, can be transmitted from one individual or animal to another, where it can establish an infection, multiply, and be passed on to other individuals or animals. Other types of hazardous biological agents, such as the bacteria that cause anthrax, are not transmitted directly from person to person. The transmissibility of hazardous biological agents should be established for any agent handled in a facility in order to understand the potential consequences of a release to the environment.

Transmissible diseases present the greatest potential danger since they can result in epidemics and pandemics. The Severe Acute Respiratory Syndrome (SARS) epidemic is a recent example. This disease was initially detected in poultry and was then transmitted to humans through close contact. The disease then proved to be highly contagious and lethal in humans. If small rodents or insects enter a facility and become infected, they can infect humans and non-humans. Infections can spread through droppings, biting, and contamination of food sources outside the facility.

If a release of a hazardous biological agent to the environment occurs via an infected host, such as a facility worker or a vector, the incident could go undetected until symptoms are recognized in one or more individuals or animals as the result of infection. Medical surveillance of facility workers, identification of a disease outbreak by the local medical community, or diagnosis of diseased domesticated or wild animals by veterinarians may provide this recognition.

- **Human Host** – Infection of a human host by a biological agent within a facility can occur due to an accident, such as a needle stick that penetrates PPE. Other mechanisms that can create an infected host are also due to human errors, which could occur where PPE is not used properly, or safety precautions are not followed. Once the human host is infected, the agent can grow within its host and infect collocated workers and the public through aerosolization, direct physical contact, or through foods. Humans are highly effective carriers of some transmissible agents and can be effective sources of dissemination.

- **Animal/Insect Hosts (Vectors)** – Infected, live vectors can spread vector-borne diseases. Arthropod or rodent vectors, for example, that enter laboratory spaces may become infected and carry an infectious agent out of the facility. The most common vectors are arthropod hosts such as mosquitoes, ticks, or fleas. Rodents are the most likely animal vectors (other than humans). Infected laboratory animals that are the subjects of scientific investigations may transmit the agent via direct contact, droppings, or being bitten by a vector.

- **Plant Host** – As with human and animal diseases, infected plants can spread disease to other plants. Plant bacterial, viral, fungal, and protozoan pathogens can spread through direct contact, proximity, or carrier/vector. Plant epidemics can have severe economic consequences.

5.3.7. Contamination

Biological agents and toxins can also be transported outside a biosafety facility through contamination. The contamination mechanism for agents is only possible if the agent can also survive in the environment for a time sufficient to allow a receptor to become infected. Workers in a biosafety facility may come into physical contact with a biological agent and carry it outside the facility on their skin or clothing, where it may be deposited or transferred to suitable hosts or receptors. If an infectious biological agent contaminates a surface within the facility that is potentially transportable to the outside, then contamination should be considered as a transport mechanism. It is possible for an insect or rodent to contact a biological agent and carry it outside the facility. Alternatively, insects or rodents could be exposed to the agent outside the facility from another source. Objects (i.e., fomite) within a facility may become contaminated with a biological agent and transport the agent to receptors outside the facility.

5.3.8. Biological Agent Release Scenarios

Analyses of OE releases of biological agents from a biosafety facility will involve an understanding of the characteristics of the agent, its formulation and use (activities) in the laboratory, barriers and failure modes, potential initiators of releases, mechanisms for transport from the facility and in the environment, the external environment, how the agent interacts with potential receptors, and the medical indicators of infection. In the context of OE releases of biological agents, the *environment* might be the public area within the facility, but outside the biocontainment area, where the specific biosafety protocols associated with the agent/toxin are not required.

In order to facilitate analyses, a simplified schematic representation of scenario development is given in **Figure 5-1**. The scenario sequence is divided into six groups of parameters or components to be addressed:

1. Source
2. Failure(s)
3. Transport outside biocontainment area to the environment
4. Transport in the environment to the receptor
5. Agent-Receptor interactions
6. Effects on the receptor

The schematic shown in **Figure 5-1** represents the sequence of agent-activity-facility characteristics that may contribute to a particular biological release scenario. The agent needs to be specified to determine which characteristics play a role in each step in the scenario. As should be apparent, the figure is not to be interpreted as a description of the parameters and considerations that enter the analysis of every biological agent release scenario. The agent-activity-facility and scenario to be analyzed will dictate the characteristics that will enter into the analysis.

Each potential release scenario has six basic components:

- **Source**. The source term for each scenario will depend on the specific agent, its form/formulation and quantity (and concentration), and, if applicable, the specific activity involving the agent that results in a release. Other source terms may apply to scenarios involving initiators such as natural phenomena or external incidents. The procedures and protocols associated with use of the agent and its containment status (Class II biosafety cabinet (BSC), PPE required, ventilation design) will provide the characterization of the hazard required for analysis.

  The maximum planned quantity of material to be used by the scientists/technicians will determine the upper limits for emergency management analysis and the potential release quantity to assume for planning purposes, especially related to environmental dispersion and contamination transport mechanisms. Although the quantity in use will certainly influence the chance for an exposure to occur, it will have little effect on pre-planning for releases via an infected host transport mechanism, given that an exposure has occurred.

- **Failure(s)**. In DOE emergency management analyses of hazardous material releases, barriers are physical or administrative features that maintain each material in a safe condition. The primary barrier is generally the one physically nearest to the material to be controlled. In contrast, the BMBL methodology for addressing biological containment uses the term *primary barrier* more generally. *Primary barriers* are intended to protect personnel and the immediate laboratory environment from exposure to infectious biological agents. The biocontainment area may consist of multiple primary barriers, with some barriers having dual roles in preventing exposures both within the area and outside in the environment (secondary barriers).

A postulated release of biological material will usually involve failure of one of the primary barriers (to be referred to as the *initial barrier* in this guidance), while additional primary and secondary barriers are intended to protect the personnel and the immediate laboratory and to prevent release of material outside the laboratory. Biocontainment barriers intended to prevent releases of material are generally consistent with emergency management terminology for *barriers*. Significant exceptions are the PPE and similar worker safety barriers that have a role as a barrier to a biological release only for the infected host transport mechanism.

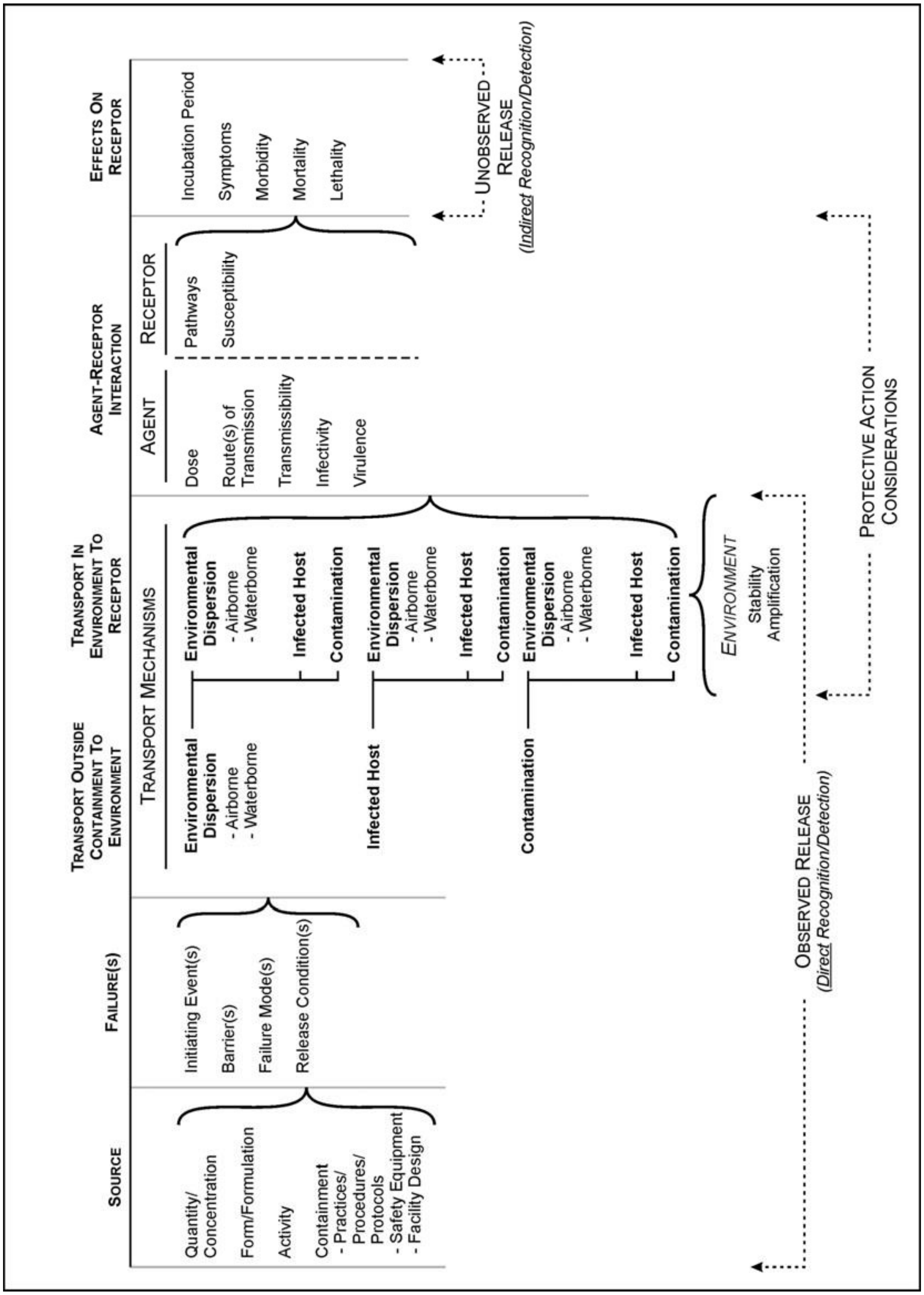

Figure 5-1. Schematic Representation of Biological Release Scenario

Potential failures associated with the barriers and additional mitigating factors can represent variations in the quantities of released material and expected transport mechanisms associated with the specific biological source term. **Table 5-1** contains representative examples of generic types of barriers/controls and the primary agent transport mechanism they may effectively prevent. Many of these will become the barriers/controls and release conditions or mitigating factors involved in the scenarios.

Table 5-1. Transport Mechanisms and Barriers / Controls

Barriers	***Transport Mechanism: Environmental Dispersion***	***Transport Mechanism: Infected Host***	***Transport Mechanism Contamination***
Access control		X	X
Precautionary Safety Reminders	X	X	X
Decontamination			X
Medical Surveillance		X	
Physical Containment	X		X
PPE		X	
Physical Separation(s)	X	X	X
Portal Design	X		X
Air Handling Design	X		X

As indicated in **Figure 5-1** under Failure(s), a potential release of biological materials will depend on the initiator causing the failure of the initial barrier (i.e., closest to the material), failures in additional barriers or controls, and potential mitigating release conditions. Further detailed discussions associated with failure analysis and release scenarios are contained in Chapter 2, Section 2, *All Hazards Planning/Technical Planning Basis*.

- **Transport Outside Containment to the Environment**. In this step, the initiator(s) is specified for each failure mode, the source term is estimated, and specific transport mechanisms that apply to each initiator are identified. The agent release scenario should specify how the agent is transported into the environment from the facility. Each agent transport scenario will provide an individual set of parameters that will contribute to the analysis of the scenario.

- **Transport in the Environment to the Receptor**. Initial transport of an agent out of the biocontainment area may continue through a variety of mechanisms. For example, an environmental dispersion of an agent out of the biocontainment area can result in a host becoming infected outside, or the contamination of a vector that continues to spread the agent in the environment. Thus, a release that may begin as a single transport mechanism can eventually involve several candidate paths to a receptor. This is indicated schematically in **Figure 5-1**.

- **Agent-Receptor Interaction**. The effects of agent-receptor interactions depend on agent characteristics, exposure level, and available receptor pathways and receptor susceptibility. These parameters may not directly impact the analysis of the scenario but can certainly influence the selection of initial pre-planned protective actions.

- **Effects on Receptor**. The final scenario characterization step reflects potential effects of the agent and its associated disease on the receptor. The resulting infection caused by a specific agent could be recognized through consideration of the characteristics shown in the figure. Hence, scenarios may reflect releases that went unobserved at the facility, which should now be recognized by onsite worker medical surveillance or at offsite disease surveillance centers.

Scenarios form the basis for planning and response to OEs involving biological agents. The purpose of the EPHA is to analyze a spectrum of these scenarios to enable the facility to recognize that an agent has been or might have been released and to respond appropriately. The recognition of OEs is introduced briefly in the next section.

5.3.9. Recognizing Operational Emergencies

For emergency response measures to be effective, early recognition of an actual or potential release of a hazardous biological material is essential. Transition to emergency operations depends on detection and recognition of specific emergency incident or condition indicators/symptoms that suggest an actual or potential release outside of secondary barriers. At any given time, different indicators and symptoms may be monitored to determine if facility conditions are normal or if any abnormal incident/condition may have occurred. Monitoring of these indicators and the recognition of the significance of abnormalities is generally a routine function of the biosafety facility staff.

Routine surveillance (cf. Section 2.5) should include an *active* process that integrates and interprets the data in the context of potential releases, rather than simply as individual datum to be monitored, compared to expected performance, and recorded. Methods employed to implement detection and recognition of emergency incidents/conditions and to make the transition to emergency response should be integrated with routine operational practices to the greatest extent possible. Staff responsible for this routine surveillance should be specifically trained to perform this recognition function.

To implement an *active* recognition activity/function, an emergency management program at a laboratory facility should take advantage of control capabilities that are already an integral part of good microbiological practices and the biosafety program in the facility. Biosafety control measures, such as routine surveillance activities, are features of laboratory operations that could support development of recognition factors for an emergency management program. Requirements and criteria for establishing a specific biosafety level and for implementing a risk assessment methodology represent a variety of measures intended to control the biological agents or toxins contained within the laboratory. They range from laboratory practices and equipment reflecting direct control, to routine surveillance activities monitoring and maintaining expected performance of the biosafety systems and at-risk personnel involved in the work. These biosafety control measures are barriers to the release of hazardous biological material, and, hence, failure of one or more of these controls could result in a release of an agent or toxin outside the laboratory via one of the transport mechanisms.

Any site working with hazardous biological agents should have an effective agent identification capability either in-house or available on an as-needed basis from an external source. Note, however, that it is not the intent of this section to support the purchase of new equipment or capabilities, if the current situation adequately supports the needs of emergency response commensurate with the hazards. Various technical methods are available for detecting and identifying the presence of hazardous biological materials. The surest method (the *gold standard*) is laboratory analysis, which takes hours to days, and is most appropriate as a confirmatory test and not a real-time detection method. Other methods vary from real-time generic (i.e., lacking specificity) detection to various field and laboratory devices and methods that can identify the presence of an agent in minutes to hours. Some commercial detection and identification systems are available, and a number of others are being developed. Simple antibody-based methods yield results in less than 15 minutes and are suitable for routine monitoring of specific agents being used in a particular laboratory, but, in general, they are limited in terms of throughput and scope of agents detected. Antibody-based methods may also lack specificity and sensitivity. More complex nucleic acid-based systems are sensitive and specific. However, the time to detect ranges from about 20 minutes to several hours, and they are costly to operate and maintain. In addition, nucleic acid-based systems are limited in terms of throughput scope of agents detected. Since the agents/toxins to be used or stored in a biosafety facility will usually be known, it may be possible to identify the specific detection methods needed and to include these in emergency planning.

Note that the scenario components that may provide recognition factors are indicated in **Figure 5-1** and associated with two separate groups of scenario components: those that may be directly observable at the facility and those that are associated with manifestations of the infection caused by the disease. This implies that two categories of biological agent releases should be considered in emergency management planning: observed and unobserved releases. Recognition of observed releases will likely occur at the facility, as the result of direct detection of the release through observations of incident indicators. In this case, the agent will generally be known, and response measures can usually be initiated shortly after recognition of the incident.

In contrast, unobserved releases (unreported infected host, contaminated vectors) could remain undetected for a substantial period following the actual incident at the facility. Recognition of these incidents can occur as the result of indirect detection of the release when an infected receptor presents symptoms of the disease. An active, ongoing medical surveillance program within the DOE/NNSA community and in the local community can provide an essential detection capability for identifying a possible release from the facility. As with observed releases, early recognition of an actual or potential unobserved release of a biological agent is essential for emergency response measures to be most effective.

5.3.10. Initial Protective Actions

Planning and developing initial protective actions for biological agents and toxins require a coordinated effort between DOE/NNSA site medical personnel and offsite public health agencies. In the event of an OE at a biosafety facility, it is expected that local or State public health agencies will assume responsibility for initiating long-term measures for protecting the local population, including onsite workers, while the site will be responsible for initiating prompt, initial protective actions onsite and recommending protective actions offsite. For an effective response, it is imperative that site medical personnel coordinate protective action planning with the local/State public health agency to ensure that initial measures taken by the site, or recommendations made to offsite response organizations, are consistent with expectations of local/State public health authorities, as different public health jurisdictions may have different capabilities.

The specific initial protective actions to be taken will depend upon a number of factors (indicated schematically in **Figure 5-1**), including:

- Transport mechanism of the release (i.e., airborne, infected host, contamination)
- *Observed* vs. *unobserved* release
- Characteristics of the biological agent released
- Location of populations in relation to the source of biological agents/toxins
- The time available to issue and take protective actions

Initial protective actions that can be taken in the event of a biological OE release are general measures that can apply to many observed releases of hazardous agents/toxins. These measures may include:

1. **Access control**: Control of personnel access to areas of potential exposure or contamination outside the biocontainment area to prevent unnecessary exposures and minimize the spread of contamination. Access control is most effective when implemented immediately upon recognizing that an area has been, or will be, affected by a hazardous material release.

2. **Sheltering/Shelter-in-place**: Directing people to seek shelter inside a building or similar location and to remain inside until the threat of exposure at dangerous levels passes. Sheltering/shelter-in-place is used when evacuating collocated workers or the public would cause greater risk than staying where they are, or when an evacuation cannot be performed. Identification of areas for sheltering with potential isolation capacity should be considered.

3. **Evacuation**: Moving all people from a threatened area to a safer place. To perform an evacuation, there should be enough time for people to be warned, to prepare, and to

leave an area. Evacuees should be sent to a definite place, by a specific route, far enough away from the incident site so they will not have to be moved again if the wind shifts. Consideration should be given to development of a default radius around the facility based on wind speed and a 1- to 2-hour time span after the release, to define the area of immediate concern.

4. **Decontamination**: Removal of hazardous material from personnel and equipment to the extent necessary to prevent potential adverse health effects. Contaminated clothing and equipment should be removed after use and stored in a controlled area until cleanup procedures can be initiated. In some cases, protective clothing and equipment cannot be decontaminated and needs to be disposed of in the proper manner. Decontamination also applies to removal of hazardous materials that may have been deposited on the ground and on other structures in the vicinity of the release. Use of disinfectants on people or material is a form of decontamination.

5. **Medical Surveillance**: Immediate and active medical surveillance activities, including a process to identify, screen, test, and assess people most likely to have been exposed. Based on medical surveillance results, identify candidates for continued monitoring or treatment.

6. **Quarantine**: Separation and restriction of movement of persons, who while not yet ill, have been exposed to a transmissible biological agent and therefore may become infectious. Since quarantine may sometimes require long periods of time pending definitive laboratory results, considerations for support of personnel may include food, water, and diversionary activities.

Several longer-term protective actions may also be initiated soon after a biological OE release has been identified, such as:

7. **Vector control**: Management of vectors by reducing or eliminating their populations and chances of disease transmission; or reducing or eliminating their ability to cause harm. For most scenarios, vector control may be considered a long-term protective action.

8. **Control/Disinfection of Contaminated Water Supplies**: Shutting off contaminated water supply and water supply intake points to prevent contaminated water usage. This decision may be based on recommendations of appropriate health or agricultural agencies. Water supplies may be restricted at the point of origin or distribution, confiscated, stored, or destroyed. Destruction or neutralization (disinfection) of disease-carrying microorganisms in contaminated water supplies (lakes, reservoirs, tanks, ponds, etc.) may be conducted to restore them to use.

9. **Control of Contaminated Food Products**: The embargoing or destroying of contaminated agricultural products is appropriate to control the physical movement of food products both raw and processed in an affected area (animal, dairy, plant). This

decision may be based on recommendations of the appropriate health or agricultural agencies.

10. **Changes in Livestock and Agricultural Practices**: Contamination of pastures and agricultural areas due to deposition of released materials can require specific protective actions to minimize introduction of contamination into the human food chain. Actions could include putting livestock on stored feed, delaying slaughter of animals until the hazardous material has been removed from their systems, and treating soil to minimize uptake of the hazardous material into foodstuffs. Use of severely contaminated land for agricultural purposes may have to be prohibited.

In the case of an unobserved release, the source may not be confirmed for some time after recognition (of disease outbreak) and initial protective actions may not be employed until sometime after the release incident. However, many of the above measures (medical surveillance, access control, decontamination) should be considered when any actual or potential release from a biosafety facility is recognized.

In general, for either an observed or unobserved release, State or local public health officials specify long-term protective action criteria and associated measures to be implemented both onsite and offsite. These measures are often agent-specific, reflecting the different agent characteristics, facility design, and geographic and demographic characteristics of the surrounding area. For example, a high concentration of material coupled with additional risk factors, such as high potential for airborne transmission and a high infectivity, virulence, and lethality, should elevate the protective actions necessary.

For an effective response, it is imperative that site medical personnel coordinate protective action planning with local/State public health agencies to ensure initial measures taken by the site, or recommendations made to offsite response organizations, have been agreed upon and can be seamlessly integrated with the public health response. Because public health jurisdictional knowledge and experience may vary, onsite emergency managers may have to provide technical agent expertise necessary to determine appropriate protective actions.

The protective actions indicated above do not directly address worker safety requirements, an integral part of biosafety response to an occupational accident within the laboratory. In the event of an incident or OE, the laboratory workers will implement the facility-specific BSL program safety protocols. Development of these protocols is the responsibility of each DOE/NNSA biosafety facility and will not be addressed in this chapter. Similarly, specific protective action requirements for initial responders will be left to facility and response organizations to identify and address as part of the planning process.

5.3.11. Public Health Response

A primary function of local, State, and Tribal public health agencies is to provide a capability for identifying a “communicable disease emergency” in communities for which they are responsible, and for responding with measures to confine and arrest the spread of the disease. In this capacity, public health assets will play a major role in response to a release of hazardous biological materials from a DOE/NNSA biosafety facility. Whether a release is strictly onsite or involves an offsite impact, public health will ultimately assume primary responsibility for ensuring that the community is protected from further exposure.

Local, State, or Federal public health response falls into three categories, which represent a graded approach:[4]

1. **Continuous Medical Surveillance**. Continuous medical surveillance, a primary community public health function, is a routine activity performed by public health professionals who monitor incoming disease reporting data for indicators and patterns to determine whether a communicable disease emergency is imminent. State-based public health departments provide a central communications point for ongoing surveillance, disease reporting, and epidemiological investigations. These departments also serve as repositories for agent-specific knowledge. Routine disease reporting, which is both mandated and regulated, originates from medical facilities, clinics, laboratories, and private clinician offices. These diseases usually have potential for a broad community impact and necessitate a public health response. Surveillance efforts have been increased and broadened in both the public health and medical communities to include rapidly emerging infectious illnesses (SARS, avian and pandemic influenzas).

2. **Active Investigation**. Active investigation is a routine public health practice initiated by a positive surveillance incident. Active investigations occur on a daily basis as public health professionals interpret incoming data from reports or direct observations. As a result, they make professional judgments on the scope of further actions based on potential impact and anticipated severity.

3. **Emergency Response**. Initiated by public health organizations to mitigate an unusual public health occurrence, emergency response actions can include broader epidemiological investigations, medical screening and laboratory sampling, mass prophylaxis/vaccination, isolation/quarantine, public information and risk communication, hazards/site remediation, and legal involvement. Local public health departments may lack the personnel to support a robust surge response capacity and will need to be linked to regional assets and the State public health agency. Emergency response will vary depending on locale, population affected, and relative hazard as perceived by the local public health officer with legal authority.

[4] Development of Models for Emergency Preparedness, Personal Protective Equipment, Decontamination, Isolation/Quarantine, and Laboratory Capacity, Agency for Healthcare Research and Quality, U.S. Department of Health and Human Services (HHS), Bettina M. Stopford, RN, Laura Jevitt, Michele Ledgerwood, Christa Singleton, MD, MPH, Martin Stolmack, EMT-P, AHRQ Publication No. 05-0099 August 2005.

DOE/NNSA site emergency managers should become familiar with local and State public health capabilities. They should coordinate and reach agreement on sole and shared responsibilities in order to coordinate efforts during an observed release OE at the biosafety facility, or in response to an identified communicable disease emergency that can be associated with an unobserved release OE at the facility. To enhance Departmental response capabilities, DOE/NNSA biosafety facilities should provide agent-specific data to local public health agencies as part of pre-planning.

Following an OE declaration, DOE/NNSA emergency managers should expect to provide agent and procedure- /protocol-specific information and personnel accountability data; and should have pre-planned methodologies in place for: 1) rapid identification of potentially exposed personnel; and, 2) isolation for medical screening and treatment purposes. To ensure an integrated response, plans should be developed in coordination with the appropriate public health agencies by providing symptom-specific awareness training for all personnel and maintaining a central reporting process for ongoing medical surveillance. The public health and medical communities will likely look to the DOE/NNSA biosafety facility to provide expert level professionals familiar with facility specific agents and to initiate an active, systematic monitoring program and response protocols addressing DOE/NNSA personnel tracking and epidemiological investigations.

5.4. Biosafety Facilities: All Hazards Planning /Technical Planning Basis

The following sections will address the effects of the unique hazards posed by biological agents and toxins on the associated processes and content of the All-Hazards Survey and the EPHA. Issues, information, and methods that may be different than those typically used to address radiological and chemical hazards will be the focus of this document. This discussion will not attempt to repeat the detailed guidance already provided in Chapter 2. If the facility has other hazardous materials (chemical, radiological), in addition to biological agents/toxins, these should be included in the All-Hazards Survey and subsequent EPHA according to the guidance in Chapter 2.

5.4.1. All-Hazards Survey

Facilities involved in growth, handling, storing, or transporting of hazardous biological materials are required to perform All-Hazards Surveys containing the same information at the same level of detail as other DOE/NNSA facilities.

The hazardous material screening process identifies hazardous biological materials that require further analysis in an EPHA. All hazardous biological agents and toxins that are subject to the Select Agent Rules listed above in section 2, including published updates, require further analysis in an EPHA in accordance with DOE O 151.1D. Thus, DOE/NNSA biosafety facilities that use or store any of the Select Agents/Toxins (subject to the Select Agent Rules) need to perform an EPHA and implement an Emergency Management Hazardous Materials Program.

Note that the screening process for biological agents does not include threshold quantities, since no basis was identified for differentiating between quantities expected to remain strictly an internal facility problem versus those that can potentially result in an external release to the environment. In contrast to agents, each toxin listed should exceed a specified aggregate amount under the control of “a principal investigator, treating physician or veterinarian, or commercial manufacturer or distributor” in order to be subject to the Select Agent Rules. If the toxins do not exceed the quantities specified, then they would not be subject to the Select Agent Rules and, therefore, would not require registration or containment in the biosafety facility, as long as the quantities remained below the specified aggregate limits for “a principal investigator, treating physician or veterinarian, or commercial manufacturer or distributor.” These toxins would not require further analysis in an EPHA or an Emergency Management Hazardous Materials Program. It is consistent with the Order to screen out these excluded quantities of toxins. Hence, if a toxin maintained by an individual or commercial entity is excluded, it no longer enters into consideration in emergency management planning but becomes the sole responsibility of biosafety response.

The Select Agent Rules require that each biosafety facility maintain an accurate, current inventory of each Select Agent and toxin held. This inventory includes the following information:

- Name and characteristics of agent/toxin
- Quantity acquired from another individual or entity, date of acquisition, and source of agent/toxin (i.e., individual or entity)
- Location where the agent/toxin is stored
- Record of agent/toxin use:
  - Select agent/toxin used and the purpose of use
  - When moved from storage and by whom
  - When returned to storage and by whom

The emergency management organization should have access to this inventory data and should be notified in a timely manner when changes occur that modify the current All-Hazards Survey. Changes resulting in a reduction of hazards with no adverse effect on safety or emergency preparedness or response may be included in the next scheduled review and update.

5.4.2. Emergency Planning Hazards Assessment (EPHA)

The DOE/NNSA biological OE involves the actual or potential release of a hazardous biological agent/toxin to the environment outside the BSL secondary barriers of the biocontainment area. The environment might be the public area outside of the building/

facility, if the laboratory has external walls or air exhausts to the outside, and could even include publicly accessible corridors or other laboratories if the biosafety laboratory is contained within a facility.

The Select Agent Rules require that an Incident Response Plan fully describe response procedures for the release of a Select Agent or Toxin, severe weather and other natural disasters, workplace violence, bomb threats, suspicious packages, and emergencies such as fire, gas leak, explosion, power outage, etc. Response procedures should account for hazards associated with the Select Agents and Toxins and provide appropriate actions to contain them. Each of these incidents/conditions should be analyzed in the EPHA as potential initiators for the release of hazardous biological materials. Other emergencies, such as accidents in the facility and other external incidents, should be also analyzed to develop a spectrum of representative scenarios. The spectrum of scenarios required for the planning basis of the emergency management program should cover the scope of recognition factors and potential protective actions that might be needed for the specific facility inventory. An EPHA for a biosafety facility will follow similar steps as mentioned above in Chapter 2, Section 2, *All Hazards Planning/Technical Planning Basis*:

1. Define and describe the facility and operations
2. Characterize the hazardous materials
3. Select scenarios for analysis
4. Analyze scenarios:
    a. Estimate source term (if appropriate and feasible)
    b. Identify/estimate/calculate consequences (as appropriate)
    c. Identify recognition factors and protective actions
    d. Finalize technical planning basis scenarios
5. Document the results of the analyses

Biosafety facilities that work with biological agents/toxins may not have a SAR/DSA to support the identification and development of scenarios. However, facilities should have a hazard analysis prepared in accordance with DOE Health and Safety Program requirements. Also, the risk assessment used to determine the assigned BSL for the laboratory should provide information about biocontainment barriers.

5.4.2.1. Emergency Planning Zone (EPZ)

The hazards assessment process includes a determination of the size of the geographic area surrounding the site, known as the EPZ. Within the EPZ, special planning and preparedness activities are required to reduce the potential health and safety impacts from an incident involving the airborne release of hazardous materials. The methodology for the determination of the size of an EPZ is based on consideration of the range of consequences at various distances calculated for each scenario analyzed in the EPHA. However, because the current approach to analysis of biological hazards for planning purposes does not lend itself to such considerations, hazardous biological material release consequences will not be used at this time for determining EPZ size.

5.4.2.2. Documentation of the EPHA

In addition to the detailed guidance for documenting the EPHA presented in Chapter 2, it is particularly important to emphasize the possible impact that the hazards will have on determining the size, scale, characteristics of required functions, activities, or components of the emergency management program. This section of the EPHA should characterize those aspects of the hazards that will enable the emergency management staff to tailor the emergency management program to be commensurate with the hazards.

5.4.3. Example Release Scenarios

A limited set of notional OE biological release scenarios has been developed for purposes of further illustrating an approach for analysis in the EPHA. Examples of equipment and operations that may create hazards in a biosafety facility can be found in the WHO *Laboratory Biosafety Manual*, 3rd Edition.

The scenarios describe possible failures that could lead to a release of hazardous biological materials outside secondary barriers. Eight notional scenarios were developed to demonstrate various operations and incident initiators. Scenario narratives are presented in Appendix I of this Guide, where the results of the analysis approach provide a general indication of the information needed to develop an effective and prompt response. Analysis is focused on the development of recognition factors and protective actions.

These notional scenarios are intended to convey general aspects of the approach without incorporating technically accurate, facility-specific details necessary for producing a realistic set of recognition factors and protective actions. Thus, details related to facility design, its relationship to other facilities on the site, and the surrounding geographic, economic, and demographic characteristics are not part of the protective actions to be presented later in this section, especially with regard to the longer-term actions.

5.4.3.1. Source and Release Parameters

The following is the narrative describing the first scenario contained in Appendix I:

> **Accident Scenario 1: Tube Breakage in Centrifuge (release of B. anthracis spores as an aerosol)**
>
> **Incident**: Two 50 ml tubes containing 40 ml each of $1x10^9$ spores/ml of Bacillus anthracis are placed in a centrifuge. A floor model centrifuge is used outside of the Class II BSC. A hairline crack in one of the centrifuge tubes goes unnoticed, causing the test tube to break early in the centrifuge run, releasing the solution. The technician

opens the centrifuge door immediately after hearing the tube break, potentially releasing aerosolized spores (0.1 -1% of the solution = 50,000,000 to 500,000,000 spores or 500 to 5000 times ID_{50} value) into the laboratory environment.

Conditions: The biosafety program requires that all centrifuges be used only in a Class II BSC, since the centrifuges in the facility are not equipped with a HEPA filtration system on the exhaust to the environment outside the biocontainment area.

Because the centrifuge was used outside of the Class II BSC and the facility HVAC system does not have a filtered exhaust, an aerosolized solution containing Bacillus anthracis spores may have been released to the environment outside the biocontainment area. The assumed release duration is 30 minutes, based on evaporation, settling, and an air exchange rate of 10 room-air-exchanges per hour.

Recognition: The possible release of a biological agent into the external environment outside the biocontainment area is the basis for declaring an OE. Recognition indicators include:

- Laboratory personnel observe or discover damage to the test tube and release of the solution of *Bacillus anthracis* spores.
- The centrifuge is used outside the Class II BSC, in violation of laboratory biosafety procedures.

Incident is intended to describe the source, form, activity, initial barrier (physically closest to the material), and initiator of the incident. *Conditions* are expected to provide details of other containment barriers or mitigating factors that will fail and subsequently release the material to the environment. Specific transport mechanisms are also indicated. *Recognition* provides the candidate a set of indicators that will represent scenario-specific criteria, which, if satisfied, will result in categorization of the incident as an OE.

The eight scenarios from Appendix I are summarized in **Table 5-2**, which identifies the information/data needed in the key areas that each scenario should identify as part of the EPHA process (from **Figure 5-1**). Tables in this section are presented to demonstrate a process for collecting and structuring information for analyzing each scenario. *They do <u>not</u> represent the only acceptable way to collect, organize, and analyze information used to develop recognition tools and initial protective actions.*

5.4.3.2. Recognition Factors

Recognition of observed releases will occur at the facility as the result of direct indicators of the release. In contrast, unobserved releases could remain undetected for a substantial period of time following the actual facility incident. Indirect detection of these incidents can occur as the result of the employee medical surveillance program or identification of a disease cluster above expected norms in the local population by the medical or public health community.

Table 5-4 contains recognition factors related to the example scenarios in Appendix I. Most of the scenarios relate to *observed* releases. However, as indicated in Appendix I, failure to check operability of a specific system during a facility accident/incident, or to identify correlations between observables in some scenarios, could result in facility staff not recognizing that a release has actually or potentially occurred and, hence, the incident could remain an *unobserved* release. Criteria for *unobserved* releases to be used in epidemiological aspects of the onsite medical surveillance program or for offsite disease surveillance activities are not addressed in this Guide; this task should be addressed at each DOE/NNSA biosafety facility.

A facility-specific analysis will lead to a more definitive set of OE criteria resulting in an OE declaration that would provide the facility with higher level of confidence that an actual or potential release to the environment has occurred. In addition, a reliable and timely monitoring and detection capability would further enhance the level of confidence.

5.4.3.3. Initial Protective Actions

Many of the protective actions implemented in radioactive and chemical hazardous materials incidents/situations are generally effective in response to biological agents/toxins releases. Protective action examples in this section address primarily onsite workers in collocated facilities and the offsite public. These examples differ from the agent/toxin-specific medical protective measures, which are developed at each facility.

Initial protective action examples for biological releases have been defined in Section 3.9, above.

Some of these protective actions, such as vector control, control/disinfection of contaminated water supplies, control of contaminated food products, and changes in livestock and agricultural practices, are generally longer-term measures where planning can begin in the initial time frame. Protective actions to be implemented for each scenario will depend on the expected transport mechanisms in the environment. In the table below, the most commonly implemented protective actions for the biological agent release (using the numbering scheme given above) are identified. The three transport mechanisms in the environment are: 1) Environmental dispersion (i.e., airborne, waterborne); 2) Release via an infected host; and 3) Release via a contaminated person or object. Example initial protective actions and potential longer-term measures (*italics*) are provided for each transport mechanism, as follows:

Transport Mechanism in the Environment	Protective Actions
1. Environmental Dispersion	
• Airborne	1, 2, 3
• Waterborne	1, 8
2. Infected Host	
• Human	6
• Vector	1, 3, 7
3. Contamination	
• Human	6
• Vector	1, 3, 7
• Medium/Objects	
• Soil	1, 3, 6
• Water	1, 3, 8
• Agricultural products	9, 10
• Equipment	1, 6

The table provides selected protective actions that may be implemented or recommended for the set of scenarios in Appendix I. Actual facility-specific protective actions for the set of scenarios would reflect the real situation onsite and offsite (distances, directions, collated facilities, geographical features, agricultural enterprises).

Note that in some instances, groups of initial protective actions within the set assigned to the scenarios in **Table 5-5** appear multiple times. This provides the opportunity to implement generic subsets of initial protective actions (consisting of several measures) for a variety of scenarios. This use raises the possibility of developing a simpler and more effective protective action strategy, especially for facilities that may be involved with several agents.

Examples of generic scenario characteristics are presented in **Table 5-6**. A common Standard Initial Protective Actions set is defined in **Table 5-6** and two example airborne release scenarios are given in **Table 5-7**. Associated with each airborne release scenario are candidate protective actions. In the first scenario, the agent is assumed not transmissible and protective actions are based on the Standard Initial Protective Actions.

Because the agent is transmissible in the second example scenario, protective actions include the Standard Initial Protective Actions plus additional measures to be considered as shown in **Table 5-7**. These examples of initial protective actions are presented for two cases of an airborne release of a biological agent in order to demonstrate the dependence of protective actions on agent characteristics.

Methods presented in this section for developing and implementing protective actions for biological OEs are intended to focus on general concepts and convey a structured process for analysis. However, biosafety facility emergency planners should implement an approach best suited for their hazards, the facility, and the emergency management program in place at their location.

Table 5-2. Eight BSC Scenarios from DOE O 151.1D

Scenario	Agent/ Toxin	Form / Activity	Containment Barriers	Procedure/ Protocols	Initiating Incident(s)	Barrier (Initial)	Failure (Modes)	Release Conditions
1	*Bacillus anthracis*	2 tubes with 1 x 109 spores each	Spores in solution; being centrifuged	Class II BSC with HEPA filter; PPE; facility design	Centrifuge procedures, Biosafety Program	Vial containing spores in solution	Spill/drop caused by the centrifuge tube break	Facility HVAC system picks up aerosolized material then exhausts them to the environment
2	*Yersinia pestis*	Unknown	Infected laboratory animals in cages	Pest Control Program (cages, traps, pesticides, training); facility design	Pest Control Procedures, Change Control Procedure	Pest Control Program	Construction personnel fail to cap new cable entries	Uncapped cable entries: feral rodents enter facility, contact infected rodents, fail to be trapped, and escape to environment
3	*Clostridium botulinum* toxin	300 ml with 1 x 109 cells per ml	Production of *Botulinum* toxin from spores in solution	Anaerobic jar; Class II BSC with HEPA filter; HEPA filter on HVAC exhaust; PPE; facility design	Procedures for using anaerobic jar in BSC II	Anaerobic jar	Shattering of the anaerobic jar	HEPA filter in Class II BSC fails/not in use; HEPA filter on HVAC exhaust fails /not in use; air-handling systems on the BSC and the facility draw air from laboratory space and exhaust to the environment.
4	*Bacillus anthracis*	1 gram (1x1012 spores/g)	Experimentation conducted with B. anthracis dry spores in a single container	Container	Facility Biosafety Program, DOE Safety Analysis Program	Earthquake	Container	Container is broken due to earthquake shock effects
5	*Clostridium botulinum* toxin	0.5 gram	Experimentation conducted with *Clostridium botulinum toxin* as dry powder in a single container	Container	Biosafety Program, DOE Fire Protection Program	Facility Fire	Container	Container is broken due to shock effects of being dropped

Scenario	Agent/ Toxin	Form / Activity	Containment Barriers	Procedure/ Protocols	Initiating Incident(s)	Barrier (Initial)	Failure (Modes)	Release Conditions
6	*Yersinia pestis*	Unknown	Multiple experiments being conducted with *Yersinia pestis* Bacteria in solution	Test tubes and flasks; facility design	Biosafety Program	Explosion of propane truck near facility	Test tubes and flasks	Test tubes and flasks break due to shock effects of the blast
7	Crimean Congo hemorrhagic fever virus	Unknown	Infected host being transported	Biosafety cage and transport vehicle	Transportation procedures for infected laboratory animals; protocols for blood borne pathogen protection	Transportation accident	Biosafety cage and transport vehicle	Damage to the transport vehicle and cage, injures the infected laboratory animal causing it to bleed
8	Bacillus anthracis	Container with 1-gram (approximately $1x10^{12}$) spores	Dried Bacillus anthracis spores in a container set up in a BSC for an experiment	Class II BSC with HEPA filter; PPE; facility design	Centrifuge procedures, Biosafety Program	Malevolent act, disgruntled employee smashes container and discards PPE outside of biocontainment area	Container	Airborne release caused by malevolent Act. Contamination caused by employee violating contamination control procedures

Table 5-3. Source and Release Parameters

Scenario (Agent/Toxin)	Transmissibility	Transport to Environment	Recognition Factors
1. Tube Breakage in Centrifuge [release of *B. anthracis* spores as an aerosol]	No (inhalation pathway)	Airborne dispersion via the ventilation system	The experimenter or other laboratory personnel observe or discover the damage to the test tube and the release of the solution of *Bacillus anthracis*. The centrifuge is used outside the Class II BSC.
2. Failure in Pest Control Program [release of *Y. pestis* bacteria via infected host]	High	Infected Host (vector)	Discovery of trapped feral mice within the facility (indicating a potential failure in the pest control program). Discovery of unsealed cable penetrations, which could allow rodents and other vectors direct access to the interior of the facility.

Scenario (Agent/Toxin)	Transmissibility	Transport to Environment	Recognition Factors
3. Anaerobic Jar Explosion [*C. botulinum* bacteria and toxin released as an aerosol]	No	Airborne dispersion via the ventilation system	The anaerobic jar explodes in the Class II BSC. The HEPA filters in the Class II BSC are non-operational. The HEPA filters in the HVAC system are non-operational
4. Earthquake [release of dried *B. anthracis* spores; airborne, contaminated personnel and fomite transfer]	No (inhalation pathway)	Airborne dispersion and transfer of contaminated material	Earthquake occurs and causes significant damage to the facility structure (including creating openings to the environment). The container holding dried Bacillus anthracis spores was reported by personnel involved to have been spilled, releasing the contents to the environment. HEPA filters (Class II BSC, HVAC) are inoperable due to the loss of ventilation flow. Emergency evacuation of personnel from laboratory spaces without following the standard decontamination and disrobing procedures.
5. Facility Fire [airborne and contaminated water release of *C.* *botulinum* toxin]	No	Airborne dispersion through the ventilation system, and water borne release through building outfall	The fire detection system activates fire alarms and the fire suppression system. The researcher handling the toxin reports the spill of the material after exiting the room. Water runoff from the activation of the sprinklers is discharging through the outfall.
6. Explosion [release of *Y. pestis* bacteria; personnel contamination and infected host]	High	Airborne dispersion Transfer of contamination Infected Host (Human)	The explosion causing visible damage to the facility structure including creating openings to the environment. The tubes/beakers containing solutions of *Yersinia pestis* bacteria break and release their contents. The loss of electrical power to the Class II BSCs ventilation and associated HEPA filters.
7. Transportation Accident [arthropod and animal to human transmission of a viral pathogen (Crimean-*Congo hemorrhagic fever virus*)	Moderate	Contamination from infected host (animal)	Initial responders initiating protective actions at locations beyond the immediate/affected area.
8. Malevolent Act [Disgruntled employee releases dried *B. anthracis* spores]	No (inhalation pathway)	Airborne dispersion via the ventilation system Contamination from discarded PPE	Returning laboratory personnel find the discarded PPE outside the containment area. Laboratory personnel discover the smashed container inside the containment area, approximately 30 minutes after the employee leaves the work area. Facility HVAC system is *operating* when the incident is discovered; no mitigative actions took place prior to the arrival of coworkers.

Table 5-4. Recognition Factors

Scenario (Agent/Toxin)	Transmissibility	Transport to Environment	Recognition Factors
Tube Breakage in Centrifuge [release of *B. anthracis* spores as an aerosol]	No (inhalation pathway)	Airborne dispersion via the ventilation system	The experimenter or other laboratory personnel observe or discover the damage to the test tube and the release of the solution of *Bacillus anthracis*. The centrifuge is used outside the Class II BSC.
Failure in Pest Control Program [release of *Y. pestis* bacteria via infected host]	High	Infected Host (vector)	Discovery of trapped feral mice within the facility (indicating a potential failure in the pest control program). Discovery of unsealed cable penetrations, which could allow rodents and other vectors direct access to the interior of the facility.
Anaerobic Jar Explosion [*C. botulinum* bacteria and toxin released as an aerosol]	No	Airborne dispersion via the ventilation system	The anaerobic jar explodes in the Class II BSC. The HEPA filters in the Class II BSC are non-operational. The HEPA filters in the HVAC system are non-operational.
Earthquake [release of dried *B. anthracis* spores; airborne, contaminated personnel and fomite transfer]	No (inhalation pathway)	Airborne dispersion and transfer of contaminated material	Earthquake occurs and causes significant damage to the facility structure (including creating openings to the environment). The container holding dried Bacillus anthracis spores was reported by personnel involved to have been spilled, releasing the contents to the environment. HEPA filters (Class II BSC, HVAC) are inoperable due to the loss of ventilation flow. Emergency evacuation of personnel from laboratory spaces without following the standard decontamination and disrobing procedures.
Facility Fire [airborne and contaminated water release of *C. botulinum* toxin]	No	Airborne dispersion through the ventilation system, and water borne release through building outfall	The fire detection system activates fire alarms and the fire suppression system. The researcher handling the toxin reports the spill of the material after exiting the room. Water runoff from the activation of the sprinklers is discharging through the outfall.

Table 5-5. Example Protective Actions

Scenario (Agent/Toxin)	Transport to Environment	Stability of Agent/Toxin in the Environment	Transport to Receptors	Candidate Protective Actions for Co-located Workers & the General Public
1. Tube Breakage in Centrifuge [release of *B. anthracis* spores as an aerosol]	Airborne dispersion via the ventilation system	The spores are very stable and may remain viable for many years in soil and water. They resist sunlight for varying periods. [High stability in the environment]	Inhalation through airborne dispersion	**1 2 3**
			Contamination	**1 3 6** *7 8 9 10*
			Infected host (insects, food animals, pets)	**1 3** *7 10*
2. Failure in Pest Control Program [release of *Y. pestis* bacteria via infected host]	Infected Host (vector)	At near freezing temperatures, it will remain alive from months to years but is killed by 15 minutes of exposure to 55°C. It also remains viable for some time in dry sputum, flea feces, and buried bodies but is killed within several hours of exposure to sunlight. [Moderate stability in the environment]	Infected host (insects, food animals, pets)	**1 3** 7 10
			Contaminated animal droppings	**1 6** *9 10*
3. Anaerobic Jar Explosion [*C. botulinum* bacteria and toxin released as an aerosol]	Airborne dispersion via the ventilation system	The stability of botulinum toxin is not equal in all environments. It is most stable in neutral or alkaline foods. Aerosolized botulinum toxin is estimated to degrade at a rate of 1% to 4% per minute. [High stability in the environment]	Inhalation through airborne dispersion	**1 2 3**
			Contamination	**1 3 6** *7 8 9 10*
4. Earthquake [release of dried *B. anthracis* spores; airborne, contaminated personnel and fomite transfer]	Airborne dispersion and transfer of contaminated material	The spores are very stable and may remain viable for many years in soil and water. They resist sunlight for varying periods. [High stability in the environment]	Inhalation through airborne dispersion	**1 2 3**
			Contamination	**1 3 6** *7 8 9 10*
			Infected host (insects, food animals, pets)	**1 3** *7 10*
5. Facility Fire [airborne and contaminated water release of *C. botulinum* toxin]	Airborne dispersion through the ventilation system, and water borne release through building outfall	The stability of botulinum toxin is not equal in all environments. It is most stable in neutral or alkaline foods. Aerosolized botulinum toxin is estimated to degrade at a rate of 1% to 4% per minute. [High stability in the environment]	Inhalation through airborne dispersion	**1 2 3**
			Waterborne	**1** *8*
			Contamination	**1 3 6** *7 8 9 10*

Scenario (Agent/Toxin)	Transport to Environment	Stability of Agent/Toxin in the Environment	Transport to Receptors	Candidate Protective Actions for Co-located Workers & the General Public
6. Explosion [release of *Y. pestis* bacteria; personnel contamination and infected host]	Airborne dispersion. Transfer of contamination. Infected Host.	At near freezing temperatures, it will remain alive from months to years but is killed by 15 minutes of exposure to 55^0 C. It also remains viable for some time in dry sputum, flea feces, and buried bodies but is killed within several hours of exposure to sunlight. [Moderate stability in the environment]	Inhalation through airborne dispersion	**1 2 3**
			Contaminated animal droppings	**1** 6 *9 10*
			Infected host (insects, food animals, pets)	**1 3** *7 10*
			Infected host (human)	**1 3 4 5 6**
7. Transportation Accident [arthropod and animal to human transmission of a viral pathogen (CCH)]	Contamination from infected host	The virus is rather fragile and does not survive well outside the host. It is rapidly killed by ultraviolet light. It is very stable in the tick vector and infected ticks remain infected throughout their lives. [No stability in the environment]	Contamination caused by direct contact with fluids from an infected host	**1 4 5 6**
			Infected host (insects, food animals, pets)	**1 3** *7 10*
8. Malevolent Act [Disgruntled employee releases dried *B. anthracis* spores]	Airborne dispersion via the ventilation system Contamination from discarded PPE	The spores are very stable and may remain viable for many years in soil and water. They resist sunlight for varying periods. [High stability in the environment]	Inhalation through airborne dispersion	**1 2 3**
			Contamination	**1 3 6** *7 8 9 10*
			Infected host (insects, food animals, pets)	**1 2 3** *7 10*

Table 5-6. Examples of Generic Initial Protective Actions – Standard Initial Protective Actions

Standard Initial Protective Actions
Access control: Control of personnel access to areas of potential exposure or contamination outside the biocontainment area to prevent unnecessary exposures and minimize the spread of contamination. Access control is most effective when implemented immediately upon recognizing that an area has been, or will be, affected by a hazardous material release.
Sheltering/Shelter-in-place: Directing people to seek shelter inside a building or similar location and to remain inside until the threat of exposure at dangerous levels passes. Sheltering/shelter-in-place is used when evacuating collocated workers or the public would cause greater risk than staying where they are, or when an evacuation cannot be performed.
Evacuation: Moving all people from a threatened area to a safer place. To perform an evacuation, there must be enough time for people to be warned, to get ready, and to leave an area. If there is enough time, evacuation is the best protective action. Evacuees should be sent to a definite place, by a specific route, far enough away from the incident site so they will not have to be moved again if the wind shifts.

Standard Initial Protective Actions
Decontamination: The removal of hazardous material from personnel and equipment to the extent necessary to prevent potential adverse health effects. Contaminated clothing and equipment should be removed after use and stored in a controlled area until cleanup procedures can be initiated. Decontamination also applies to removal of hazardous materials that may have been deposited on the ground and on other structures in the vicinity of the release.

Table 5-7. Airborne Release Scenarios

1. Airborne Release of a biological agent; the agent is not transmissible.
Standard Initial Protective Actions
Medical Surveillance: Immediate and active medical surveillance activities, including a process to *identify, screen, test,* and *assess* people who are most likely to have been exposed. Based on medical surveillance results, identify candidates for monitoring or treatment.
2. Airborne Release of a biological agent; the agent is transmissible.
Standard Initial Protective Actions
Quarantine: Separation and restriction of movement of persons, who while not yet ill, have been exposed to a transmissible biological agent and therefore may become infectious. Since quarantine may sometimes require long periods of time pending definitive laboratory results, considerations for support of personnel may include food, water, and diversionary activities.
Medical Surveillance: Immediate and active medical surveillance activities, including a process to *identify*, *screen, test,* and *assess* people who are most likely to have been exposed. Based on medical surveillance results, identify candidates for monitoring or treatment.

5.5. Biosafety Facilities: Programmatic Elements

Guidance in this section will emphasize integration of the requirements of the Select Agent Rules with DOE/NNSA programmatic requirements (i.e., planning, preparedness, and readiness assurance) for hazardous biological materials and with an existing site emergency management program. Documentation of these program elements in the Emergency Management Plan or program descriptions should clearly characterize the role of tailoring in applying commensurate with hazards.

5.5.1. Program Administration and Management

An individual or entity (facility) required to register under the Select Agent Rules also must designate an individual to be the Responsible Official (RO) with the authority and control to ensure compliance with the Select Agent Rules. According to the Select Agent Rules, the RO should:

- Have authority and responsibility to act on behalf of the entity;
- Ensure compliance with the requirements of the Select Agent Rules;

- Ensure that annual inspections are conducted for each facility/laboratory where Select Agents or Toxins are stored or used in order to determine compliance with the Rule requirements. Results of each inspection should be documented, and any deficiencies identified during an inspection should be corrected.

In order to facilitate the seamless integration of CDC/APHIS incident response requirements with DOE/NNSA biosafety facility emergency management requirements and guidance, it is recommended that the designated RO also have overall responsibility for implementing and maintaining the emergency management program as the biosafety facility emergency management program administrator. As such, the designated administrator/official has responsibility for program administration and management tasks that involve compliance with Select Agent Rule requirements and existing DOE/NNSA emergency management policy as expressed in DOE O 151.1D. This responsibility includes:

- Development of a specific, integrated, comprehensive emergency management and incident response program based upon a graded approach commensurate with the hazards. An integrated response program should include response to incidents involving hazardous biological materials as well as response to other identified site hazards.

- Development of an Emergency Management Plan (including Select Agent Rule Incident Response Plan requirements) to fully describe facility response to incidents involving "theft, loss, or release of a Select Agent or toxin, inventory discrepancies, security breaches (including information systems), severe weather and other workplace violence, bomb threats, suspicious packages, and emergencies such as fire, gas leak, explosion, power outage, etc." The emergency management plan should account for hazards associated with Select Agents/toxins and should detail appropriate actions for containing such materials.

- Documentation of the comprehensive emergency management program in the Emergency Management Plan to describe provisions for biosafety facility response to OEs and, specifically, provisions for response to an OE involving the release of a biological agent or toxin from the biosafety biocontainment.

- Development of Emergency Plan Implementing Procedures (EPIPs) to describe how the emergency management plan should be implemented.

- Development of training, drill, and exercise programs for hazardous biological materials response. These programs should be coordinated and integrated with existing SFA emergency response programs to prevent conflict with other activities and to ensure that resources are available.

- Oversight by the emergency management program administrator of biosafety program implementation and maintenance, especially routine surveillance of biosafety protocols and practices, safety equipment, and systems that represent an integral component of the safety and emergency management programs.

Other specific requirements are contained in the Select Agent Rules and DOE O 151.1D.

5.5.2. Training and Drills

Training and drill tasks for DOE/NNSA SFAs with biological agents or toxins involve integration of Select Agent Rule training requirements with existing emergency management training policy given in DOE O 151.1D. For those DOE/NNSA biosafety facilities registered under the Select Agent Rules, facilities containing biological agents/toxins should provide incident response information and training to everyone approved for access to the facility. All workers required to take protective actions are to be provided the appropriate hazard-specific training for their responsibilities and periodic drills. Training should address the particular needs of the individual, the work they will do, and risks posed by the Select Agents or Toxins. Symptom-specific awareness training should be provided for all personnel.

Routine surveillance of experience and skill levels of personnel in at-risk positions, such as laboratory technicians/workers and maintenance, housekeeping, and animal care personnel, needs to be maintained. Monitoring of biosafety facility activities will identify additional training and education necessary to ensure the safety of persons working at each BSL. Establishment of a regular education/recertification process is essential to ensure the safety of all personnel at the location/activity.

Refresher training should be provided annually. A record of the training provided to each individual working in biosafety facilities should be maintained, including name of the individual, date and description of the training, and means used to verify that the employee understood the training.

Training and drills for hazardous biological agents/toxins should be hazard-specific, and address two generic response scenarios. The first is the observed release scenario based on observed facility accidents and initiating incidents. The second is the unobserved release scenario based on recognition through medical surveillance. Training and drills for both should involve onsite medical personnel; offsite public health officials and community medical personnel who should be invited to participate regularly.

General guidance for developing, conducting, and recording training and drill activities can be found in Chapter 3, Section 2.

5.5.3. Readiness Assurance

As indicated in Section 6.3, below, the Select Agent Rules require that exercises be conducted to test and evaluate the effectiveness of the emergency management plan. In addition, the HHS Secretary is allowed to inspect any biosafety facility at which activities regulated by the Select Agent Rules are conducted. Prior to issuing a certificate of registration to an individual or facility (entity), the HHS Secretary may inspect and evaluate the premises and records to ensure compliance with the Rules.

The biosafety facility emergency management program is subject to internal and external program and exercise evaluations. Routine surveillance of biosafety protocols and practices, safety equipment, and systems provides assurances that required maintenance, equipment tests, certifications, inspections, reviews, and other activities intended to maintain laboratory control measures at high performance levels are accomplished as required. Skill level and training for at-risk personnel should also be monitored to provide assurances that a high level of performance is maintained and to ensure the safety of laboratory personnel. A structured and comprehensive approach to these surveillance activities can provide an effective tool for sustaining a continuous process of self-assessment.

Other components of a Readiness Assurance program involve reliable improvement and lessons learned programs. Of particular importance for biosafety facilities is a system for incorporating and tracking lessons learned from internal training, drills, and actual responses, as well as from external sources. Mutual sharing of lessons learned among similar BSL laboratories in DOE/NNSA, academic institutions, and private industry is expected to increase, as biosafety emergency management becomes a more mature discipline.

Exercises

The Select Agent Rules require that exercises be conducted at least annually to test and evaluate effectiveness of the emergency management plan. A lessons learned and corrective actions program should also be implemented if no site-wide program is available. After any drill, exercise, or incident, the emergency management plan should be reviewed and revised as necessary. Further guidance related to evaluations, lessons learned, and corrective actions can be found in Chapter 3, Section 3, *Readiness Assurance*.

Each biosafety facility must exercise its emergency response capability annually and include at least facility-level evaluation and critique. The exercise program for DOE/NNSA biosafety facilities should be hazard-specific and address the two generic types of scenarios, *observed* and *unobserved* releases. These exercises should involve onsite medical personnel and, if possible, offsite public health officials and community medical personnel. Although DOE O 151.1D only requires offsite response organizations be invited to participate in site-wide exercises every 3 years, the essential role of the offsite response in the case of biological releases suggests that more frequent participation is desirable and should be encouraged.

Further guidance for developing and conducting exercises and other Readiness Assurance topics can be found in Chapter 3, Section 3.

5.6. Biosafety Facilities: Response Elements

Guidance in this section will emphasize integration of the requirements of the Select Agent Rules with DOE/NNSA response requirements for hazardous biological materials and with an existing site emergency management program. Documentation of these program elements in the Emergency Management Plan or program descriptions should clearly characterize the role of tailoring in applying commensurate with hazards.

5.6.1. Emergency Response Organization (ERO)

The emergency management program administrator [Responsible Official (RO)] at a DOE/NNSA biosafety facility should be responsible for establishing and maintaining the facility-level component of the site-wide ERO. This is not meant to suggest that the RO has overall responsibility for the site response during a biological OE. This site-specific ERO responsibility during an emergency response [Emergency Director (ED)] should be determined locally.

Select Agent Rules require incident response plans to contain personnel roles and lines of authority for the biosafety facility incident response; information necessary for the development of the biosafety facility-level component of an ERO structured to respond to a biological release. A facility with biological agents and toxins will require positions and roles for personnel from the biological health and safety program and an expanded role for the site medical staff. The integration of these facility-level ERO positions with the site-level ERO will require that position qualifications and personnel requirements be formalized, and responsibilities and authorities of each be detailed in the site emergency management plan and procedures for response to OEs. These positions are added to the ERO call lists for response to biological releases.

Personnel from the biological health and safety program and laboratory personnel (i.e., facility personnel such as microbiologists and toxicologists) who are familiar with the facility and the hazards should be available to provide their technical and subject matter expertise as members of the ERO. The onsite medical staff should be part of the established medical surveillance program, utilized to detect and recognize symptoms of illnesses and toxic effects on workers or the public following a biological release. This staff will ultimately partner with the Tribal, State and local medical and public health agencies to support initial and ongoing activities during a response. Depending on the local situation and agreements, a position on the ERO might be considered for the offsite public health authority. The medical staff will provide the technical expertise that supports the Consequence Assessment Team (CAT) similar to the support provided by health physics and industrial hygiene staff in response to a radiological or chemical release.

Further detailed guidance related to ERO organizational structure, roles, and responsibilities is contained in Chapter 4, Section 1.

5.6.2. Emergency Operations Systems

See above requirements as listed in Chapter 4, Section 1.

5.6.3. Offsite Response Interfaces

In addition to DOE O 151.1D requirements, the Select Agent Rules require that incident response plans include planning and coordination with local emergency responders. In the case of hazardous biological materials, offsite response interfaces should be established with HAZMAT teams and external agencies that have public health or agricultural incident response roles. Agencies and organizations may include HHS/CDC, USDA/APHIS, and State and local public health or agricultural organizations, and, in some cases, local medical providers and veterinarians. Depending on specific arrangements for the DOE/NNSA site, local HAZMAT responders or fire and medical resources may provide primary or backup response to site emergencies. In either situation, interfaces need to be established and plans developed for coordination during an onsite response. All offsite response agencies expected to respond to a biological OE should also be offered the opportunity to participate in SFA drills and exercises that involve potential releases of hazardous biological materials.

Local initial responders should be informed of the presence of hazardous biological materials at DOE/NNSA facilities, as is routinely done with all classes of hazardous material. DOE emergency planners should provide specific information (specific, but within the constraints of security) or offer training on the nature and characteristics of the specific biological agents or toxins present at the DOE/NNSA facility. Local responders should be informed whether vaccines are available as a prophylaxis against facility-specific hazardous biological materials. They should be informed of appropriate PPE, provided information on effective decontamination methods, and provided information for contacting experts on the agents/toxins.

State and local agencies, and organizations responsible for the identification of public health emergencies, may ultimately take the lead in response, especially if the emergency becomes an offsite public health emergency or involves an agricultural incident. Many of these agencies have developed emergency management plans and response procedures that relate to bioterrorism or naturally occurring epidemics, but do not contain specific reference to local biosafety facilities. DOE SFAs that have biological agents/toxins should interface with these agencies and coordinate their planning activities; especially to:

- Provide guidance for detecting disease outbreaks or toxic effects by identifying the symptoms (presented by people or animals) associated with the facility-specific agents and toxins.

- Establish a mutual understanding of response measures to be implemented by the SFA in anticipation of involvement of local and State public health agencies or agricultural authorities.

Local medical and academic communities may provide a backup capability for responding to an outbreak. A DOE/NNSA biosafety facility may develop this capability by contacting the appropriate local infectious disease physicians, veterinarians, or agricultural experts to identify personnel who may be willing to respond if needed.

5.6.4. Emergency Facilities and Equipment/Systems

Specifically, DOE/NNSA sites are responsible for ensuring that an adequate and viable command center is available, as necessary, and PPE is available and operable to meet the needs of the responders. A command center dedicated solely to biological OEs is not necessary, but an identified command center onsite should be fully prepared to respond to a hazardous biological release. Also, provisions should be established for the use of an alternate location if the primary command center is not available. If an Emergency Management Hazardous Materials Program is in place at the site, then a command center and alternate have already been established/designated.

Select Agent Rules require that the incident plan provide lists of PPE and emergency equipment and their locations. Response equipment and facilities need to support actions to contain hazards associated with facility-specific agents or toxins. Medical treatment and decontamination equipment should also be available for supporting the response.

All DOE/NNSA biosafety facilities should provide and maintain equipment to notify its employees of an emergency to facilitate their safe evacuation from the workplace, immediate work area, or both. Communications equipment should be kept in operational condition and tested at least annually. Biosafety equipment should be monitored and maintained regularly to ensure it will provide barriers and containment intended to prevent unacceptable releases to the environment. Routine surveillance of safety equipment and systems provides assurances that required maintenance and equipment tests are accomplished as required.

Note that it is not the intent of this section to support the purchase of new equipment or capabilities, if the current situation adequately supports the needs of emergency response commensurate with the hazards.

5.6.5. Emergency Categorization and Classification

DOE/NNSA biosafety facilities that have quantities of Select Agents/Toxins could experience major incidents or conditions involving or affecting these inventories that have the potential to cause serious health and safety impacts to co-located workers or the public. Unlike incidents involving other types of hazardous materials, OEs declared for release of hazardous biological agents and toxins will not be classified as Alert, SAE, or GE. They will, however, be categorized as OEs. Incident categorization initiates the dissemination of information about an OE so that proper response actions can be initiated at all levels of DOE/NNSA and other Federal, Tribal, State, and local organizations and authorities. The capability needs to exist at a biosafety facility to perform categorization promptly and reliably for actual or potential releases to the environment.

All DOE/NNSA biosafety facilities should establish criteria or indicators for determining quickly if an incident is a biological release OE. An OE will reflect the condition that the release is outside of the biosafety facility, defined as outside the secondary barriers of the biocontainment area. This definition is applicable for either the observed or unobserved release.

The onsite medical surveillance program for facility workers should be closely tied to the biosafety program and should have ready access to data related to agents/toxins in the biocontainment and to the associated criteria for recognizing OE based on disease characteristics/symptoms or toxic effects. Offsite surveillance activities, on the other hand, will require that the biosafety facility share similar criteria (or recognition factors) related to the agents/toxins being stored or used onsite. These indicators should be available at the offsite surveillance location to initiate prompt notifications back to the SFA if a possible outbreak might be traced to a release from the facility. An OE would then be declared by the facility based on this communication from offsite. Discretionary criteria for declaring a biological OE should be available to the person with categorization authority. Such criteria will enable the authority to declare an OE based on circumstances that are not covered under the existing program technical planning basis. Predetermined conservative onsite protective actions and offsite protective action recommendations should be associated with the categorization of these OEs.

5.6.6. Notifications and Communications

Upon recognition of an OE, DOE O 151.1D requires that prompt, accurate, and effective initial emergency notifications be made to workers and emergency response personnel/ organizations, including appropriate DOE/NNSA elements, and other Federal, Tribal, State, and local organizations and authorities. Accurate and timely follow-up notifications should also be made when conditions change, or the emergency is terminated. Continuous, effective, and accurate communications among response components or organizations should be reliably maintained throughout an OE.

The authorized official needs to notify the Field Element Emergency Operation Center and HQ Operations Center within 30 minutes of the declaration of an OE. In addition, notifications should be made to local, State, and Tribal response organizations within 30 minutes or as established in mutual agreements with these entities. For biological OEs, the local and State response organizations should include local or State public health organizations, based on prior agreements.

According to the Select Agent Rules, upon discovery of a release of an agent or toxin causing occupational exposure, or release of a Select Agent or Toxin outside the primary barriers of the biocontainment area, an individual or entity needs to immediately notify CDC or APHIS. Since a release outside primary barriers of the biocontainment area precedes a release outside of secondary barriers, the above notifications to CDC/APHIS apply to the associated OEs. The following is an example initial notification format for a biological release OE that incorporates both DOE O 151.1D and CDC/APHIS requirements:

1. An Operational Emergency has been declared;

2. Description of the Operational Emergency –

a Name of the Select Agent or Toxin and any identifying information;

b Estimate of the quantity released;

c Duration of the release;

d Environment into which the release occurred;

e Location (building, room) from which the release occurred; and

f Hazards posed by the release.

3. Date and time the emergency was discovered;

4. Damage and casualties;

5. Potential and actual impacts of release;

6. Whether the emergency has stopped other SFA operations or program activities;

7. Protective actions taken or recommended;

8. Notifications made;

9. Weather conditions at the scene of the emergency;

10. Level of any media interest at the scene of the emergency or at the SFA;

11. Agencies Involved; and

12. Contact information of the DOE/NNSA on-scene point of contact.

All DOE/NNSA biosafety facilities should include communications planning for an OE in the Emergency Management Plan (Incident Response Plan).

5.6.7. Consequence Assessment

DOE O 151.1D requires that biosafety facilities establish provisions to assess the potential or actual onsite and offsite consequences of an OE involving the release of hazardous biological material(s).

Traditional activities associated with the consequence assessment program immediately following an actual or potential release, and continuing during an OE, are usually based on determining the area impacted by different levels of either doses or concentrations for airborne radioactive or toxic chemical releases, respectively. The consequence assessment process provides the means for updating estimates of consequences as additional information is obtained. The full process is normally focused on OEs that require classification. The consequence assessment process needs to be integrated with the classification and protective action process to provide a periodic review of measures implemented to protect workers and the public.

In contrast, calculations for an airborne release of a biological agent/toxin may not be available or reliable. Since there is no unique measure of severity for adverse health effects associated with biological agents, a determination of dose contours (ID_{10}, ID_{50}) may provide sufficient information to estimate criteria for making safety determinations. The protective action process can be integrated with this assessment method to review the actions taken to protect workers and the public. For some airborne biological sources, calculations may not be possible or reliable and, hence, even infectious dose contours may not be available. In that case, data that influence airborne dispersal of materials should be accessed and best estimates of protective action parameters should be obtained.

For transport mechanisms other than airborne releases, consequence assessment can involve an approach that applies only to biological agents, namely, an analysis of disease outbreaks. In this case, release of a biological agent in a human host could be suspected because of control failure indicators or there may be no reason to suspect a release. In either case, an unobserved release may not be confirmed or discovered until symptoms caused by the released biological material begin to appear in persons presenting themselves for treatment at site or local health care facilities. Efficient discovery of a possible release involves methods of detection that rely on epidemiological modeling and medical expertise, which are normally conducted by local and State public health departments. As discussed in Section 4.2, above, to ensure a prompt response, the local public health agencies and DOE/NNSA biosafety facility should agree to pre-determined criteria that would initiate prompt notification of the facility in the event that a local outbreak is detected and the facility is potentially the source of the release.

In most circumstances involving biosafety facilities, the primary role of the consequence assessment process for releases of biological agents will ultimately involve the confirmation that a release to the environment has occurred. Such a role is essential for verifying that the release occurred and for initiating measures onsite to ensure that the release has stopped and the situation that led to the release is corrected. The Timely Initial Assessment, which provides the initial incident and consequence assessment by the CAT, will develop the first description of the incident (observed incident) required for the initial notification of CDC/APHIS. The continuing confirmation process will depend on periodic review of information from the incident scene and the results of biological material detection techniques. Unless direct detection devices are available, the CAT will depend on laboratory analyses for monitoring the release, which may take an extended period of time. As incident information is gathered and the incident is reconstructed, the consequence assessment process will combine the incident analysis with laboratory results to confirm or deny the release of an agent/toxin. A general description of the consequence assessment process can be found in Chapter 4, Section 7.

5.6.8. Protective Actions

All DOE/NNSA facilities should be prepared to execute general protective actions, such as evacuation or sheltering of employees, along with provisions to account for employees after emergency evacuation has been completed. Employees in a biosafety facility collocated with other Emergency Management Hazardous Materials Programs should also be prepared to respond to notifications to implement protective actions in the event of hazardous material releases from other facilities.

Protective actions to be implemented or recommended for biological OEs will likely be a combination of general protective actions and specific measures that depend on the agent transport mechanism, characteristics, and the associated disease. General protective actions might include evacuation, accountability, access control, and sheltering. The Select Agent Rules Emergency Management Plan (Incident Response Plan) requirements include a description of the procedures for emergency evacuation, including type of evacuation, exit route assignments, safe distances, and places of refuge.

Further policy and guidance related to protective actions and reentry can be found in DOE O 151.1D and in Chapter 4, Section 8, *Protective Actions*.

Specific protective measures may also depend on characteristics of the agent and associated disease. These protective actions may include PPE, decontamination, quarantine, and medical prophylaxis. Selection of these measures will depend on agent/disease characteristics, including stability in the environment, transmissibility, and infectivity.

The EPHA will provide release scenarios that can be used to establish initial protective actions implemented when OE categorization criteria are met. The nature of most biological release scenarios and the lack of a PAC will likely preclude detailed technical consequence estimates traditionally used for establishing areas of possible exposure and contamination. For example, the facility may only develop a best estimate radial distance and use the current wind direction to focus initial protective actions for actual or potential airborne releases. These specific initial protective actions should be developed with the cooperative involvement of facility and site experts representing a broad scope of interested functions, including Operations, Safeguards and Security (S&S), medical, and safety/biosafety, in addition to emergency management analysts. Of particular importance is the cooperation and active assistance of medical personnel and biosafety experts who provide essential expertise for assessing agent/toxin characteristics.

Planning and development of initial protective actions requires a coordinated effort between DOE/NNSA site medical personnel and offsite public health agencies. Site medical personnel should coordinate protective action planning with the local/State public health agency to ensure that initial measures taken by the site, or recommendations for offsite, are consistent with the expectations of local/State public health authorities.

Reentry is a planned emergency response activity directed by the ERO to accomplish a specific objective. Reentry activities are time-urgent, performed during an emergency response, and include such activities as search and rescue, hazard mitigation, damage control, and accident assessment. Some activities performed during reentry may involve entering a facility or affected area in which hazardous biological materials may have been released. For this reason, reentry has been included with protective actions since the protection of emergency workers involved in the activities is an essential component of reentry planning. The same considerations involving agent/toxin characteristics used in determining protective actions will guide planning for these potentially dangerous activities by the determination of guidelines for controlling exposures in various types of emergency situations. Procedures to be followed in performing these reentry activities should be part of the Emergency Management Plan according to the applicable Select Agent Rules.

Further policy and guidance related to protective actions and reentry can be found in DOE O 151.1D and in Chapter 4, Section 8.

5.6.9. Emergency Medical Support

DOE O 151.1D requires that medical support be available and provided to injured workers (potentially) contaminated by hazardous biological materials. Arrangements with offsite medical facilities to transport, accept, and treat contaminated, injured personnel should be established and documented.

Both onsite and offsite medical organizations need to develop plans and procedures for responding to OEs involving hazardous biological agents or toxins. The following are key recommendations for these plans and procedures:

- Identify responsibilities for medical surveillance and reporting
- Develop surveillance plans for detecting unusual medical events
- Involve the veterinary profession in surveillance activities, as appropriate
- Establish key indicators and medical surveillance baselines for each agent/toxin
- Enhance epidemiological capability to detect and respond
- Enhance training for health care professionals regarding the biological agents/toxins present

During an incident involving the release of hazardous biological material, medical personnel will assume a primary role as responders. Medical personnel will assist in release detection/confirmation, consequence assessment, and development of protective actions. A key to an effective medical response for health safety is advanced knowledge of personnel susceptibility and on-hand or rapid access to both treatment and prophylactic doses. An ongoing active medical surveillance system onsite tied into the local health community and including a method for post-OE exposed personnel tracking and testing, with rapid pharmaceutical administration, is essential. Depending upon the lethality of the virus involved, an aggressive ongoing surveillance program can positively affect morbidity and mortality rates post-exposure in an OE.

Stopping or preventing the spread of a rare disease in the first hours after it is detected in the community, or after exposure of site personnel to the agent, may require rapid access to vaccines, antibiotics, or other specialized medicines and supplies. Sources for these specific materials (regional medical centers, national stockpiles, etc.) and the means for obtaining them (points-of-contact, release protocols, etc.) should be detailed in the Emergency Management Plan to ensure that they can be accessed without delay in an emergency.

Further requirements and guidance related to emergency medical support following OEs involving hazardous biological materials can be found in DOE O 151.1D and Chapter 4, Section 9.

5.6.10. Emergency Public Information

The same guidance regarding the development of emergency public information for other hazardous material classes will apply to biological agents and toxins. Medical and biosafety personnel should be involved in development of materials to be used in news releases to ensure that characterization of the hazard is conveyed accurately.

DOE/NNSA SFAs with hazardous biological agents or toxins should follow the policy in DOE O 151.1D and guidance in Chapter 4, Section 10.

5.6.11. Termination and Recovery

Termination criteria for hazardous biological material release OEs will be similar to OEs that require classification, such as the release of toxic or radioactive materials. The decision to terminate a biological OE will be based on the perceived need for the ERO to remain fully active to monitor and manage the situation. In this case, termination is essentially a declaration that the full ERO is no longer needed and the ERO may now begin to reduce its support.

For biological agents and toxins, the decision to terminate an emergency and begin recovery planning will involve active participation of onsite medical personnel and offsite public health agencies.

Recovery from a biological release OE can involve significant coordination with local and State public health organizations, and possibly with CDC/APHIS.

Further requirements related to termination of, and recovery from, an OE will be found in DOE O 151.1D and Chapter 4, Section 11.

Appendix A. Hazardous Material Screening Process

A.1 Introduction

The purpose of this appendix is to provide background information on hazardous material identification and to present a recommended approach for screening radioactive materials and hazardous chemicals. The hazardous material screening process is intended to identify specific hazardous materials and quantities that, if released in an uncontrolled manner, could produce affects consistent with the definition of an operational emergency (OE) involving the airborne release of a hazardous material. Specifically, the uncontrolled release of such a hazardous material would represent a significant degradation in the level of safety at a site/facility, resulting in potential health and safety hazards to workers or the public.

Of primary concern are hazardous materials that are highly dispersible and have high acute toxicity or high radiotoxicity. Adverse health effects, which “threaten or endanger” the health and safety of workers or the public, occur where the consequences of the release of a hazardous material approach or exceed the applicable Protective Action Criterion.

Some materials may be excluded from analysis in an Emergency Planning Hazards Assessment (EPHA) based on use, form, dispersibility, or toxicity. The criteria specified in this appendix can be used to make definitive (yes/no) decisions on excluding materials from further consideration. The screening criteria are sufficiently conservative that it is unlikely that a substance screened out using those criteria could cause an OE. However, because the screening criteria are generic and do not reflect exactly the hazard associated with each individual substance, there may be facility-specific circumstances recognized prior to application of the screening criteria, under which a particular substance that would otherwise be excluded from consideration using the criteria might cause affects consistent with the OE definition. If, during the screening process, the sites, facilities, agencies (SFA) recognize the existence of process conditions or release mechanisms that might exaggerate the impact of a particular substance, they may choose to analyze the material in an EPHA even though it could meet one of the stated criteria for exclusion. This appendix also recommends fixed minimum screening values for chemicals determined in accordance with the provisions of 29 Code of Federal Regulations (CFR) Part 1910.1450 and referred to as quantities that are “easily and safely manipulated by one person” (commonly referred to as *laboratory scale* quantities). The Order allows sites to determine values locally, appropriate to the activities and operations at their facilities, but still satisfying the provisions expressed in the CFR. Specific values will be recommended in this appendix to demonstrate the intent of the Order. Use of those screening values will exclude from further consideration small quantities of most hazardous materials that, in practice, have little or no potential to cause affects consistent with the general definition of OEs given in Chapter 4, Section 4, and the specific OE definition given above for the airborne release of hazardous materials.

Using this screening process, any chemical or radionuclide, which is identified as a potential candidate for further analysis, should be examined in an EPHA. After further consideration and analysis of the specific quantities and release scenarios, some materials may be subsequently excluded from quantitative analysis in the EPHA. Hazardous materials that are not identified as candidates for analysis should be considered as possible initiators or promoters of a release of other toxic substances.

The following sections contain background information on hazardous material screening requirements and methods, and present recommended screening approaches for radioactive materials and hazardous chemicals.

A.2 Radioactive Material Screening

1) General Screening Discussion

All radioactive materials are to be initially considered for possible analysis in an EPHA. However, DOE-STD-1027-2018, Chg Notice 1, allows exclusion of some materials for facility hazard categorization purposes; and the Nuclear Regulatory Commission provides for similar exclusions when determining the need for material licensee radiological contingency plans.

Small quantities of most radionuclides can be excluded from further consideration by the use of threshold screening quantities. The DOE-STD-1027-2018, Chg Notice 1, Attachment 1, Table 1-1, Category 3 threshold values were derived from the Reportable Quantities (RQs) developed by the Environmental Protection Agency (EPA) under the Comprehensive Environmental Response, Compensation, and Liability Act. Whereas the EPA based the RQs on a maximum individual dose of 0.5 rem (5m/Sv) by the most limiting exposure pathway, DOE applied a dose criterion of 10 rem (100 mSv), consistent with the EPA recommended dose limit for emergency workers engaged in protecting valuable property. Accordingly, DOE multiplied the limiting release values from the EPAs RQ background document by a factor of 20 to arrive at the Category 3 radionuclide thresholds. In a few circumstances, the chemical toxicity of a radioactive substance may actually be of greater health concern than the potential radiation dose. Because the DOE Category 3 radionuclide thresholds are based on radiation dose alone, chemical toxicity may need to be considered when applying the screening values to very low-specific-activity radionuclides (or mixtures) that are known to also be chemically toxic. For practical purposes, the concern is limited to uranium of low enrichment in the form of compounds that are relatively soluble in body fluids (such as nitrates, fluorides, and sulfates). Depending on the exact proportions of the different uranium isotopes, the chemical toxicity concern becomes dominant as the nominal enrichment (^{235}U weight percent) decreases through the range from about 16 percent to 5 percent. (Standard, J. N., *Radioactivity and Health – A History*, Chapter 2, IV. DOE/RL/01830-T59. Battelle Memorial Institute. 1988.)

2) Recommended Screening Approach

This section presents a recommended screening approach that embodies the general principles and considerations discussed previously in Section A.2.1. **Figure A-1** shows the steps in the radioactive material screening process.

From available process records and documentation, identify all radioactive materials stored, used, or produced within the SFA. Some materials that do not represent the type or magnitude of hazard that is intended to form the technical basis for hazardous material emergency management programs, when in quantities greater than the largest Category 3 value (or if the sum of the ratios) as listed in DOE-STD-1027-18, Chg Notice 1, Hazard Categorization of DOE Nuclear Facilities, should be excluded from further consideration, as follows:

License-Exempt Commercial Products. Radioactive materials used in license exempted, commercially available products as described in 10 CFR Part 30.11-30.19 should be categorically excluded from consideration.

Non-Dispersible Materials. The degree to which a substance represents an acute airborne health hazard to humans is a major consideration in determining the need for further analysis in an EPHA. Sealed sources and other materials engineered to meet *special form* requirements may be excluded from consideration with documented justification. Materials in solid form that cannot be reduced to small particles (less than about 10 microns in diameter) by some plausible mechanism can be excluded from quantitative analysis because they cannot be suspended and transported in air. Materials stored in Department of Transportation Type B shipping containers with overpack may be excluded, if the Certificates of Compliance are current and authorize the specific materials stored.

Exclusions are for compliant containers only, and approvals for non-compliant and non-certified DOE and NNSA containers/packaging must be authorized via the appropriate authority for their continued use.

Those materials associated with a facility/activity being defined as an accelerator per DOE O 420.2C, *Safety of Accelerator Facilities*, may be screened out if analysis indicates that all incidents would be classified as less than an Alert.

Apply Threshold Screening Quantities. Compare facility allowable radioactive material inventories against Category 3 values in DOE-STD-1027- 2018, Chg. Notice 1, Attachment 1, Table 1-1; exclude from further consideration quantities less that those thresholds. The DOE-STD-1027-2018, Chg. Notice 1, Category 3 values should be used for initial hazards screening and when updating existing All-Hazards Surveys. Widely separated units of inventory can be considered separately for comparison to the screening list, even if the facility total exceeds the listed quantity. Only the quantity that could realistically be considered part of the Material-At-Risk for a single release incident should be compared to the screening quantity. The threshold screening quantities should not be used to eliminate from consideration very low-specific-activity substances such as depleted, natural, or low enriched uranium in soluble forms. For those materials, chemical -- not radiological -- toxicity may actually be the dominant concern.

If the physical properties of the material, or the manner in which it is stored or packaged, indicate that the respirable release fraction would be significantly lower than the value used in calculating the threshold screening quantity, those factors should be considered in the quantitative analyses of release consequences in the EPHA.

When more than one radionuclide is present in the same location, it is appropriate to use the summation-of-radionuclide-threshold-ratios approach specified in DOE-STD-1027-2018, Chg. Notice 1, Attachment 1. A quantitative hazards assessment is required if the sum of the fractions of all radionuclides subject to the same release incident equals or exceeds one.

A.2 Chemical Screening

1) General Screening Discussion

For any chemical, the overriding emergency management concern is the acute human toxicity of the substance by the airborne pathway (inhalation, dermal contact, absorption through eyes and mucosa, etc.). Hazardous chemicals with local impacts on workers in the immediate incident scene are not the primary concern of an emergency management system but are among the hazards addressed by worker health and safety programs. The screening process examines potential chemical hazards and eliminates materials from further consideration if they are commonly found in public use, are not readily dispersed in the atmosphere, are not hazardous (*toxic*) to humans, or exist in limited quantities. For such materials, response to any accidental release should be within the management scope and technical capabilities of ordinary workplace safety and hazard control programs. It is not expected that the hazardous material conditions following such an accidental release would constitute a hazardous material (classifiable) OE, the basic definition of which suggests that outside technical support, planning and preparedness measures are needed to ensure an effective response.

Chemicals that do *not* represent the type or magnitude of hazard that is intended to form the technical basis for hazardous material emergency management programs are excluded from further consideration, as follows:

Public Use. In general, materials should be eliminated as candidates for analysis if the materials are commonly available to, and used by, the general public. This includes any substance to the extent it is used for personal, family, or household purposes or is present in the same form and concentration as a product distributed for use by the general public (for example, bleach, motor oil, gasoline).

Dispersibility. The degree to which a substance represents an acute airborne health hazard (*toxic*) to humans is a major consideration in determining the need for further analysis in an EPHA. Solids that cannot be reduced to small particles (less than about 10 microns in diameter) by some plausible mechanism can generally be excluded from quantitative analysis because they cannot be suspended and transported in air.

The volatility of a chemical (how readily it evaporates) is normally expressed as the vapor pressure (or partial pressure, if in a solution) at a given temperature. For liquid spills, the rate at which the substance becomes airborne increases with increasing vapor pressure and increasing pool surface area. As part of the creation of the Clean Air Act, the EPA was chartered to create a list of hazardous substances and thresholds to focus accidental release prevention efforts on those sources and substances that pose the most significant risks to the community. The EPA established a vapor pressure cut-off value of 10 millimeters (mm) of mercury (40 CFR Part 68.115) for chemicals to be listed. However, experience indicates that some substances with lower vapor pressures may represent a significant airborne source if the potential spill volume is sufficiently large. Accordingly, a value of <10 mm of mercury is recommended as the cut-off value for EPHA purposes. Substances with vapor pressures below this value pose little potential for air release due to an accidental spill. Although focused on the liquid spill scenario, a vapor pressure below <10mmHg at about 25^{o}C can be used as a general criterion for excluding liquids from EPHA analysis.

Human Health Hazard. The OSHA hazard communication standard (29 CFR Part 1910.1200) requires that all chemicals in the workplace be labeled in a manner that warns of any hazards the chemical may present. The actual format and method of labeling is not specified, so there are several different formats in use. The National Fire Protection Agency (NFPA) hazard diamond is one such method. The NFPA 704 specifies a system for identifying the hazards associated with materials.

The NFPA hazard ratings can be used for initial screening to determine when the acute health effects of a chemical are severe enough to consider evaluation. Although the system was developed primarily to serve the needs of fire protection agencies, it is useful to anyone involved in the handling of potentially hazardous substances. The system identifies the hazards of a material in terms of three principal categories: health, flammability, and instability. It indicates the degree of severity by a numerical rating that ranges from four (4), indicating severe hazard, to zero (0), indicating no hazard. In general, for each of the categories, levels 3 and 4 represent effects that are the most severe, have the longest lasting impacts, impact the largest area or involve the largest energy release. Chemicals without a health hazard rating should be retained for further consideration. For purposes of screening, therefore, any chemical with a health hazard rating of 0, 1, or 2 is presumed not to represent a significant toxic health hazard to humans and may be excluded from further analysis. Any chemical assigned a health hazard rating of 3 based solely on cryogenic properties and the resulting frostbite hazard may likewise be excluded.

Quantity. Hazardous materials should be eliminated as candidates for analyses if the materials are stored and used only in small quantities. From the definitions in 29 CFR Part 1910.1450, *Occupational exposure to hazardous chemicals in laboratories, laboratory scale* means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be *easily and safely manipulated by one person.* The DOE 151.1D Order allows sites to determine values appropriate to the activities and operations at their facilities, but still satisfying the provisions expressed in the CFR. Amounts less than or equal to 5.00 gallons (19 L) of liquid or the corresponding weight of solid material (less than or equal to 40.00 pounds [18 kg]) is the maximum that can be safely handled by one person. For compressed gases, cylinders with a full gross weight of less than or equal to 40.00 pounds (18 kg) will typically contain less than or equal to 10.00 pounds (4.5 kg) or less of most common toxic gases is the maximum that can be safely handled by one person. Hence, it is consistent with the intent of the Order to screen out individual containers with capacities less than or equal to 5.00 gallons (19 L) for liquids, 40.00 pounds (18 kg) for solids, or 10.00 pounds (4.5 kg) for compressed gases.

Individual containers that are being used, and small numbers of such containers kept in ready storage within or very near an end-user facility, may be screened out. However, larger numbers of such containers (capacity totaling greater than about 5-10 times the applicable laboratory scale threshold) in warehouses or other storage locations should be examined closely before screening them out. In these situations, if there are plausible scenarios that could release the contents of multiple containers, the material should be retained for analysis.

A one pound (0.45 kg) threshold value is recommended for substances that, because of high acute toxicity and dispersibility, may represent an extraordinary toxic hazard beyond the local incident scene. Those substances should include, but may not be limited to chemical warfare nerve agents; any substance of similar toxicity [Acute Exposure Guideline Level (AEGL)-3, Emergency Response Planning Guideline (ERPG)-3, or Temporary Emergency Exposure Limit (TEEL)-3 values less than about 3 ppm] that has been *weaponized* or designed for efficient dispersal as a gas, vapor, or aerosol, and compressed gases with acute toxicity in the same range.

The fact that a substance is flammable, combustible, or explosive is not by itself sufficient cause to analyze it in an EPHA. However, a substance should be considered a potential release initiator or promoter if it is combustible or capable of a violent chemical reaction that could cause or enhance the release of other hazardous materials with the ability to cause severe injury or death beyond the immediate vicinity of the release. If a substance meets the following conditions, its flammable or explosive properties should be noted for possible consideration in the EPHA as a factor potentially influencing the release of existing toxic materials:

- The substance is flammable or explosive and capable of a violent/energetic reaction (BLEVE, deflagration, explosion), and
- The energy available in the substance could cause significant damage to facilities/equipment and disperse other substances stored or used in close proximity to it.

The fact that a chemical reacts with other substances is not by itself sufficient cause to analyze it in an EPHA. If an energetic reaction involving substance A could cause the release of hazardous material B, then the reaction should be considered as a potential initiator during the analysis of substance B. If an identified reaction creates an acute inhalation hazard as a by-product, and if the quantity created could be a significant hazard beyond the immediate vicinity of the incident, then the reaction and its by-product should be considered for analysis in the EPHA. If a substance meets the following test, its chemically reactive properties should be noted for possible consideration in the EPHA as the source of a toxic release:

- The substance will react with other chemicals or materials used or stored in the same location, and
- The reaction could be sufficiently energetic to cause significant damage to facilities/equipment and disperse other toxic substances stored or used in close proximity to it, or
- The reaction products are toxic and pose an acute airborne hazard.

NOTE: The initial identification of potential chemical reactions could be made using the *Chemical Reactivity Worksheet* developed at the Office of Response and Restoration, National Ocean Service /National Oceanic and Atmospheric Administration (NOAA) in cooperation with the Chemical Emergency Prevention and Preparedness Office of the EPA. NOAA also provides the Computer-Aided Management Emergency Operations Chemicals database which can be used for initial identification for reactions as well. For chemicals not listed in the Chemical Reactivity Worksheet database, information from the SDS, *SAX's Dangerous Properties of Industrial Materials*, project documentation, and other available sources can be used to determine potential interactions. Application of the Worksheet has some limitations. For example, there is no way to adjust the results to account for specific chemical form, quantity, or concentration, and reaction by-products are not explicitly identified. As a result, some potential reactions identified by the Worksheet may require additional investigation to determine if they are possible, to identify the toxic airborne by-products, and to estimate the resulting consequences. Additional information on the limitations and possible misapplications of reactivity worksheets can be found in the article, *Use and Misuse of Chemical Reactivity Worksheets*, published in the September/October 2006 Journal of Chemical Health and Safety.

A brief statement of the rationale for the application of these exclusions should be included in the All-Hazards Survey or EPHA to document which materials were considered and excluded. The possible effect of such materials as an initiator or promoter of a release (for example, due to their combustible, explosive, or corrosive properties) of other more hazardous material should still be considered. If a material that is eligible for exclusion has the potential for initiating releases by contributing to the dispersal of non-excluded materials, it should be carried forward to the EPHA to ensure the completeness of initiating scenarios considered.

2) Recommended Screening Approach

This section discusses a recommended SFA chemical screening approach that embodies the general principles and considerations discussed previously in Section A.3.1. **Figure A-1** shows the steps in the recommended screening process, as applied to a single chemical.

All chemicals with known or suspected toxic properties should be subjected to screening. Facility chemical inventory records, permits, licenses, shipping/receiving records, Technical Safety Requirements, process standards, and equipment specifications and any other relevant sources should be used to identify such materials and the maximum quantities of each.

Chemicals should be excluded from further consideration if they do not represent the type or magnitude of hazard that is intended to form the technical basis for hazardous material emergency management programs, as follows:

Public Use. Eliminate from further consideration any material that is commonly available to and used by the general public, if the formulation and concentration is the same as for products that are distributed without significant restrictions to the public. Examples include cleaning products, bleach, motor oil, gasoline, propane, and pesticides not designated *restricted use* by the EPA.

Dispersibility. Eliminate from further consideration any material that does not present an airborne exposure hazard due to its physical form or other factors. Materials may be eliminated if they meet one of the following tests:

- The substance is a solid at normal temperatures and does not contain or include a significant fraction of small particles (less than about 10 microns in diameter) that can readily be suspended in air.

- No plausible release mechanism/process is identified by which a *large fraction* of a solid material can be reduced to small particles (less than about 10 microns in diameter) to be suspended and transported in air.

- The substance is a liquid that exhibits a vapor pressure (or partial pressure of a hazardous material in a solution) of less than <10mmHg at about 25 degrees C.

These tests should be applied to a substance as it exists under normal conditions of use or storage (temperature, pressure, particle size, concentration). The dispersibility determination should not assume any energetic or dispersive incident/condition unless it results from the inherent qualities of the material (such as pyrophoric properties) or process conditions (for example, liquid pumped at high pressure that could, in event of a leak, produce aerosol-sized droplets). To ensure that the dispersibility tests are applied A-11 (and A-12) correctly, the storage and use conditions may need to be determined (by physical inspection, document review, or other means) during the screening process. Any reactive properties that could result in a substance being converted from a non-dispersible to dispersible state should also be understood before screening it out.

Human Health Hazard. Materials that have been assigned an NFPA health hazard category rating (or a health hazard rating assigned locally using the criteria published in NFPA 704) 0, 1, or 2 are presumed to not represent significant toxic health hazards to humans. Such materials do not have toxic properties of the type that need to be considered in a quantitative EPHA. Materials that have no assigned value for the health hazard rating should be analyzed in the EPHA, if they exceed the small quantity thresholds discussed below.

Quantity. Unit quantities (individual containers) smaller than those "easily and safely manipulated by one person" (i.e., laboratory scale quantities) should not be analyzed quantitatively in an EPHA. As used here, containers with capacities of no more than 5 gallons (19 L) for liquids, 40 pounds (18 kg) for solids, or 10 pounds (4.5 kg) for compressed gases are defined as being "easily and safely manipulated by one person." Individual containers that are being used, and small numbers of such containers kept in ready storage within or very near an end-user facility, may be screened out. As previously noted, a one (1) pound (0.45 kg) threshold value should be used for substances that, because of high acute toxicity (AEGL-3, ERPG-3, or TEEL-3 < 3 ppm) and dispersibility, may represent an extraordinary toxic hazard beyond the local incident scene.

For discussion on Hazardous Biological Agents/Toxins and how they fit into an emergency management program, see guidance listed in Chapter 5, *Biosafety Facilities*.

A.2 Other Exclusions

1) Explosives

Explosives are any chemical compound or mechanical mixture that is designed to function as an explosive, or chemical compound that functions through self-reaction as an explosive, and that, when subjected to heat, impact, friction, shock, or other suitable initiation stimulus, undergoes a very rapid chemical change with the evolution of large volumes of highly heated gases that exert pressures in the surrounding medium. The term applies to materials that either detonate or deflagrate. DOE explosives may be dyed various colors except pink, which is reserved for mock explosives.

Not all explosives are toxic and dispersible. Therefore, the analysis should focus on the toxicity of the explosives in the All-Hazards Survey. Explosives should be analyzed as a dispersible toxic chemical hazard in an EPHA. If this is done, they can then be excluded from any further analysis in an EPHA, regardless of the facility designation.

A.4.2 Asphyxiants and Cryogenic Materials

Simple asphyxiants are gases that do not provide sufficient oxygen to support life. If the release of a material with a health hazard rating that, in large quantities, does not pose an asphyxiation hazard or a cryogenic hazard to collocated workers, it can be excluded from analysis. (See guidance on collocated workers in section 1.4.)

A.4.3 Chemical Waste

Chemical waste requires further analysis if the storage quantities exceed those above and the concentration is comparable to that which would require such a similar classification (i.e., very dilute and chemically neutralized chemical waste does not require further analysis).

A.4.4 Ordinary Products of Combustion

Ordinary products of combustion that are released in typical fires involving hydrocarbons, building components, wood, and plastic, are exempt from analysis in an EPHA. See Appendix D, Combustion Products and Toxicity in Hazards Assessments, for a detailed discussion of this topic.

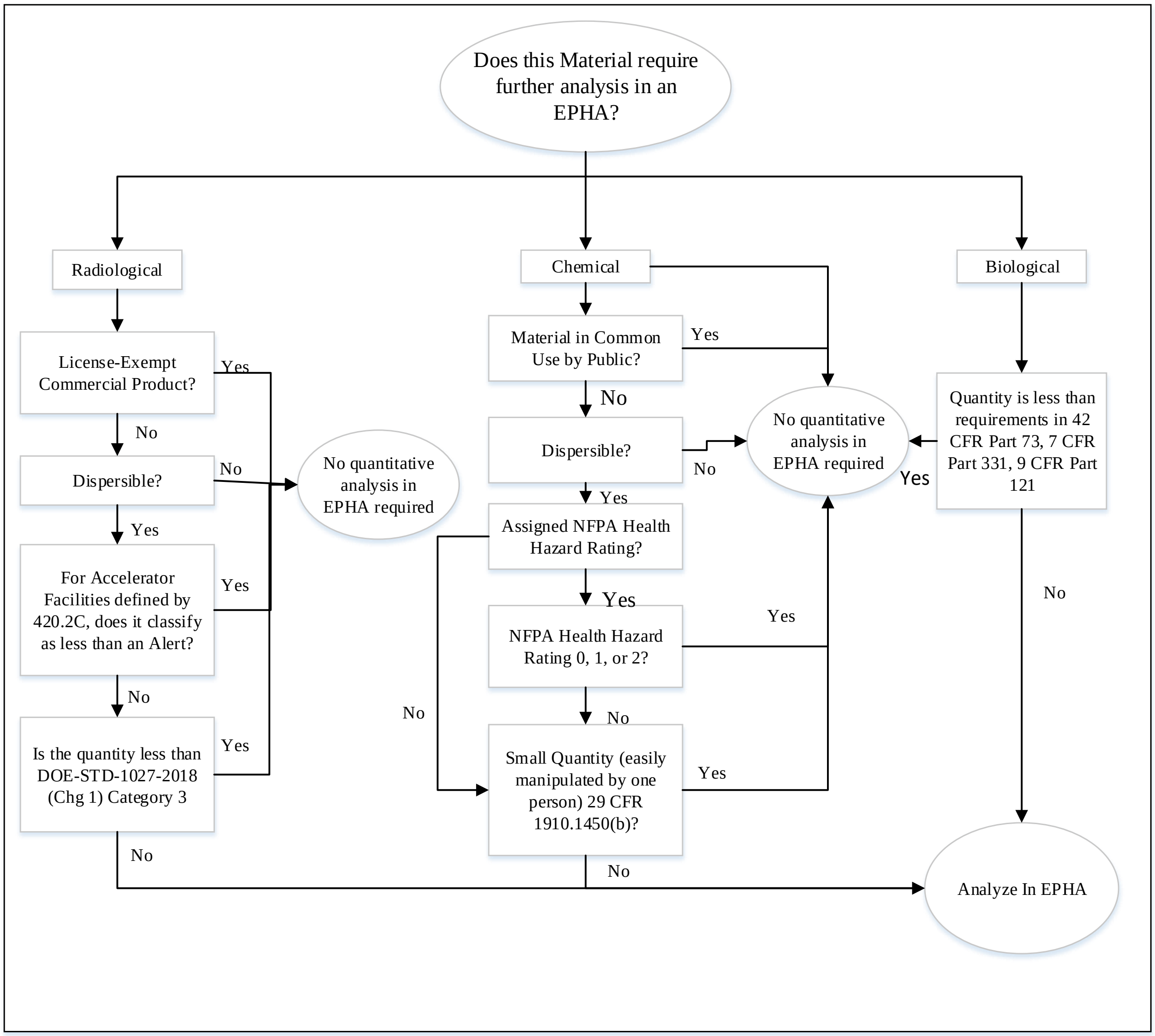

Figure A-1 Hazardous Material Screening Process

Appendix B. Onsite Transportation Analysis

B.1 Introduction

Planning and preparedness for transportation-related hazardous material emergencies on Department of Energy (DOE) or National Nuclear Security Administration (NNSA) sites should be an integral part of the site comprehensive emergency management program. An Office of Secure Transportation (OST) host site, as defined in DOE O 151.1D, is any Department of Defense or DOE site that receives or ships material through the OST that requires OST access to the Site/Facility as part of this operation. Successful integration requires that the approach to hazard identification, analysis, and the application of the results be consistent with the process used for fixed-facility EPHAs. The purpose of this appendix is to provide specific guidance on the analysis of hazardous material transportation activities on DOE/NNSA sites and the use of the analysis results in emergency management programs.

This appendix is applicable only to onsite transportation activities involving between-facility transfers of hazardous materials. Non-DOE commercial shipments of hazardous materials to, from, or across the site that are not exclusively within a contiguous DOE site/facility boundary where public access is restricted, are typically governed by Department of Transportation (DOT) regulations and specifications for commercial hazardous materials transport and do not require an All-Hazards Survey or Emergency Planning Hazards Assessment (EPHA). Also exempt from the All-Hazards Survey/EPHA requirements is inter-facility transport of hazardous materials that complies with all DOT regulations and specifications applicable to the movement of those same materials over public transportation arteries. Protective actions such as applicable Initial Isolation and Protective Action distances for emergencies involving these shipments on DOE/NNSA sites should be determined by information in the DOT Emergency Response Guide, using the substance ID number and Guide number. Analysis requirements for DOE or NNSA shipments moving on or off the site will also depend on the governing DOT regulations and specifications. However, these DOE/NNSA shipments are not covered by this appendix.

The onsite transportation of hazardous materials not exempted by the above criteria may be addressed either in the EPHAs for fixed facilities with which the materials are associated, or in a stand-alone site transportation hazards assessment. In either case, an All-Hazards Survey of transportation activities is required. The screening process conducted as part of the All-Hazards Survey effort identifies those hazardous materials involved in onsite transportation activities that require quantitative assessment. If the quantitative analysis of site transportation hazards is documented in one or more of a site's fixed facility EPHA or in the site's Transportation Safety Document**,** the transportation All-Hazards Survey should identify and reference the specific EPHA documents or Transportation Safety Document section in which specific transportation hazards are addressed.

B.2 All-Hazards Survey

The All-Hazards Survey for onsite transportation activities should follow the general steps outlined in Section 1.2, with the following clarifications:

Identify and briefly describe each facility (Step 1).

Instead of *facilities*, it is the onsite hazardous material *transportation activities* that should be identified and briefly described. The description of each identified transportation activity need only include a brief characterization of the hazardous substances involved, the origin, destination, and mode/method of transport.

Screen hazardous materials to determine need for a quantitative EPHA (Step 2).

In general, hazardous materials in transport are vulnerable to the same types of release and dispersal incidents/conditions considered in fixed-facility hazards assessments. Therefore, screening of transportation hazards should follow the process outlined in Appendix A.

Any onsite shipment of hazardous material in a quantity exceeding the applicable screening quantity needs to be quantitatively analyzed in an EPHA to provide the technical planning basis for response.

Identify the generic types of emergency incidents and conditions that apply (Step 3).

The only type of emergency incident that need be identified is "release/loss of control over hazardous materials."

Identify the types of potential impacts of the applicable emergencies (Step 4).

The only potential impacts of the identified types of emergencies that need be identified are "exposure of people to radioactive or other hazardous substances" and "environmental damage/degradation."

Identify and document the applicable Emergency Management Core Program planning and preparedness requirements (Step 5).

List any Federal, State, or local planning/preparedness requirements that apply specifically to the transportation of hazardous materials on the site. Such requirements may include:

- Driver certification/training on emergency notification and response;
- Vehicle specifications for certain cargos;
- Means for notifying site authorities in the event of an accident;
- Notification of site authorities prior to specific shipments entering the site;

- Safety/security escorts or route control;
- Emergency management oversight of specific shipments; and
- The DOT standards for placards, labels, and manifests.

B.3 Emergency Planning Hazards Assessment

Repetition should be avoided by consolidating material that applies to all site transportation activities (site description, methodology) in a single document section, then devoting a separate chapter or annex to the quantitative analyses of each particular transportation activity. The quantitative hazards assessment for onsite transportation activities should follow the general steps outlined in Section 2.2, with the following clarifications:

Define and describe the facility and operations (Step 1).

The definition and description should be specific to each transportation operation involving hazardous material quantities in excess of the applicable screening threshold quantity. The definition statement should give the scope of the particular analysis in unambiguous terms. For example: "This analysis addresses the transport of solid radioactive waste generated by the decommissioning activities in the ____ Area to the _____ solid waste burial ground."

At a minimum, the description of the activity should include:

- The hazardous substances being transported (Examples: sulfur dioxide gas, low-level radioactive waste from laboratory operations);
- General packaging type or container information (Examples: 55-gallon drums, DOT spec 3AL2015 gas cylinders);
- Mode of transport or type of vehicle used (Examples: 2000-gallon tanker truck, enclosed van)
- Onsite routes used, including any restrictions (Example: Building 340 to Central Waste Management, via Hazel Street and Route 4. Daylight only)
- Any other controls or restrictions applicable to this shipment type (Example: Driver to notify Security 60 minutes before departure. Speed limit of 35 mph to be observed)

Characterize the hazardous materials (Step 2).

As in fixed-facility analyses, the hazardous material characterization should include the facts and information necessary to support the quantitative assessment of release consequences. Specifically:

- The common name, Chemical Abstract Service number, and concentration of hazardous chemicals;

- Radionuclides and concentration, specific activity or unit dose (dose-per-unit-intake);

- Properties related to release potential and dispersibility;

- Typical and maximum (if known) quantities in each package and shipment; and

- Packaging or container information that will help define DR and LPF for different accident types (cardboard cases of glass bottles, 55-gallon drums, special shipping containers).

Select and analyze emergency incidents and conditions (Step 3).

The events and conditions that could lead to the release of hazardous materials in transport may be different from those selected for fixed-facility analyses. The following release incidents should be considered, as applicable:

- Puncture of one or more individual packages/containers during handling;

- Energetic impact of containers during collision (crush, rupture);

- Involvement of the entire shipment in fire;

- Detonation/deflagration of materials (if applicable);

- Spill of dry materials; and

- Spill/venting of tanker contents (liquids and pressurized gases).

One or more releases of each applicable type should be analyzed. For a given type of incident, only the bounding incident need be analyzed if it is determined that there would be no way to distinguish between different release magnitudes at the time of the incident (for example, the number of packages breached in a crash followed by fire).

Estimate the consequences (Step 4).

In general, the calculation models and approaches used for fixed-facility analyses are appropriate for transportation analyses. However, because transportation accidents may occur anywhere on the travel route, distances from the point of release to key receptors are not fixed. Consequences of each postulated release should therefore be calculated at 30 m, 100 m, and several other distances extending out to the maximum distance at which the PAC would be exceeded under the conservative dispersion conditions.

Transportation incident releases to the atmosphere should be modeled using a *standard* or *open country* terrain factor unless the transportation route is entirely within a built-up area of the site where the *urban* terrain factor better represents the local dispersion environment.

Document the results of the analyses (Step 5).

The results of the consequence calculations should be documented in a manner that makes them useful for interpolating the consequences of actual incidents at specific locations. Tabular or graphic representations of the data can be very useful to responders for determining the area potentially affected by a release and for executing protective actions.

The distance at which the PAC will be exceeded for each scenario should be clearly identified. If an incident occurs and the distance to the site boundary or other public receptor location is within the distance at which the PAC will be exceeded, classification as a General Emergency is indicated.

Appendix C. Consequence Thresholds

C.1 Introduction

The purpose of this appendix is to provide additional guidance regarding the definition and use of the terms Protective Action Criteria (PACs), Protective Action Guide (PAG), Acute Exposure Guideline Level (AEGL), Emergency Response Planning Guideline (ERPG), Temporary Emergency Exposure Limit (TEEL), and Threshold for Early Lethality (TEL), as consequence thresholds for hazardous material effects.
The Order specifies the consequences of an actual or potential hazardous material release as a key determinant of the emergency class. The PAGs published by the Environmental Protection Agency (EPA) are specified as the applicable consequence thresholds for radiological exposures. The AEGL-2 published by the EPA, the ERPG-2 published by the American Industrial Hygiene Association (AIHA), and the TEEL-2 developed by Department of Energy (DOE) are identified, in order of preference, as the corresponding consequence thresholds for chemical hazards. However, the Order does not address the limitations of these standards or describe the precise manner in which they are to be used for hazards assessments and emergency planning.

Chapter 2, Section 2.6, directs the user to calculate the consequences of hazardous material releases at several locations and compare the results with the applicable threshold to determine the appropriate emergency class. The user is also directed to calculate the maximum distance at which PACs and TELs would be expected and to use those distances in determination of emergency planning zones (EPZs).

C.2 Protective Action Criteria (PACs)

The *PAC* is the general term for the level of hazardous material impact that, if observed or predicted, indicates action is needed to prevent or limit exposure of people to the hazard. PAC is used for both radiological and non-radiological consequence criteria in DOE facility emergency planning and response.

C.2.1 Radiological PAC

DOE O 151.1D specifies that the EPA PAGs published in its *PAG Document of Protective Action Guides and Planning Guidance for Radiological Emergencies* (EPA 400-R-17-001) should be used for comparison with exposures resulting from radiological releases to determine the appropriate emergency classification. These PAGs are intended to apply only to projected doses resulting from exposures to airborne releases of radioactive materials during the early phase of an emergency. The pathways considered include the external gamma and beta dose from direct exposure to airborne and deposited material and the committed dose to internal organs from inhalation of radioactive material.

The projected dose value for initiating protective actions (evacuation or sheltering) specified in Table 2.1 of EPA-400 is 10 to 50 mSv (1 to 5 Roentgen Equivalent Man (rem)), where the projected dose represents the sum of the effective dose (ED) resulting from exposure to external sources and the 50-year committed effective dose (CED) from all significant inhalation pathways during the early phase. The sum of the ED and CED is the Total Effective Dose (TED). The PAG values for committed dose to the thyroid and the skin are 50 to 250 mSv (5 to 25 rem) and 500 to 2500 mSv (50 to 250 rem), respectively.

The terms PAG and EPA Protective Action Guides used in the Order should be interpreted as follows:

- A projected dose equivalent of 10 mSv (1 rem) TED to reference man, where the projected TED is the sum of the ED from exposure to external sources and the CED from inhalation during the early phase; or
- A projected committed dose (CD) to the adult thyroid of 50 mSv (5 rem); or
- A projected CD to the skin of 500 mSv (50 rem).

EPA 400-R-17-001 states that, for planning purposes, “The exact duration of the early phase depends upon site conditions, but one should plan to project doses for four days.” However, it also states that the assumed time of exposure to deposited materials may depend on “time frames for releases from other facilities will depend on the characteristics of the facility” and that exposure pathways contributing less than 10 percent of the dose in the early phase need not be considered.

External exposure to deposited materials may be excluded from the early phase dose projection if the exposure for a period equal to the estimated EPZ evacuation time (or a maximum of four days) can be shown to contribute less than 10 percent of the TED. If no official prior estimate of EPZ evacuation time exists, an estimate may be developed and documented within the EPHA.

Facilities having substantive and persuasive arguments for using other protective action threshold values may propose values that are specific to their radioactive material holdings and operations. Requests for exemption from the Order requirement should be submitted in accordance with the procedure specified in the Order. Any exemption request should be supported by an analysis that addresses the four principles that form the basis for the selection of the EPA PAG values and the other considerations utilized in the selection process, as discussed in Section 2.5 of EPA 400-R-17-001.

For ingestion pathway exposure, the U.S. Food and Drug Administration (FDA) has issued recommended PAGs that correspond to the “intervention levels of dose” consensus values set by international organizations (FDA 1998). Those PAGs are 5 mSv (0.5 rem) for CED or 50 mSv (5 rem) committed dose equivalent to an individual tissue or organ, whichever is more limiting. The FDA also recommended Derived Response Levels (DRL) corresponding to the PAGs for several groups of radionuclides. The DRLs corresponding to the ingestion pathway PAGs may be derived locally according to the FDA recommendations for specific radionuclides, foodstuffs, and animal feeds of interest.

C.2.2 Non-radiological PAC

DOE O 151.1D specifies that AEGL-2, promulgated by the EPA; ERPG-2, published by the AIHA; and TEEL-2, developed by DOE are to be used, in order of preference, as PACs for non-radioactive hazardous materials.

AEGLs are guideline levels for once-in-a-lifetime, short-term (not repeated or chronic) exposures to airborne concentrations of acutely toxic chemicals. These exposure limits are intended to protect most individuals in the general population, including those that might be particularly susceptible to the toxic effects of the chemicals. However, certain individuals could experience effects at concentrations below the corresponding AEGLs. AEGL-1, -2, and -3 values are being developed for each of five exposure periods, ranging from 10 minutes to 8 hours.

The AEGLs are first published as proposed in the Federal Register for a review and comment period. Following resolution of relevant issues raised through public review, the values are classified as *interim*. The interim values are available for use, as deemed appropriate, on an interim basis by Federal and State regulatory agencies and the private sector. When concurrence by the National Research Council AEGL Subcommittee is achieved, the AEGL values are published as final. Final AEGL values may be used on a permanent basis by all Federal, State and local agencies and private organizations.

Within the AEGL system, three biological reference values are defined for each material as follows:

- **AEGL-1** is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible on cessation of exposure.

- **AEGL-2** is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

- **AEGL-3** is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

ERPGs use a similar definition for their three levels. TEELs use the AEGL definitions for each level.

About 260 interim and final AEGLs have been published as of June 2018. ERPGs have been issued for approximately 150 chemicals as of the Fall 2019. Because there are no final AEGL or approved ERPG values for many hazardous chemicals of particular interest to DOE and its operations, the Department of Energy commissioned the development and publication of a method for determining TEELs.

DOE SFAs in need of PAC values for other substances should request that the Office of Emergency Management Policy (NA-41) develop and publish the TEELs. All TEEL requests are submitted via the Technical Support Request process in EDMS. Future requests for TEELs should be for chemicals that are used in sufficient quantities that could result in an OE.

To determine whether a chemical consequence exceeds PAC, the highest time-weighted average (TWA) concentration predicted or measured for any 15-minute period (the maximum or peak 15-minute TWA concentration) should be compared to the PAC. For exposure periods of less than 15 minutes, concentrations for comparison with the guidelines may be calculated over a shorter time period.

Some consequence assessment dispersion codes will calculate the desired maximum 15-minute average concentration directly, by allowing the analyst to specify the averaging period.

To determine the average concentration manually, the following formula can be used.

$$\mathbf{TWA} = \frac{C_1T_1 + C_2T_2 + \ldots C_nT_n}{T_1 + T_2 \ldots + T_n} = \frac{\sum C_nT_n}{\sum T_n}$$

Where:

C= Concentration (ppm or mg/m^3), and
T= Time of period exposure (min)

It is not recommended that individual time intervals less than 1 minute be used in the numerator of the above formula for calculating the TWA. For the peak 15-minute TWA, the 15-minute period of maximum exposure (concentration) is selected and input (as 15 one-minute segments) into the above formula. For exposure periods of less than 15 minutes, the product of C_xT_x may equal zero during the exposure period. These zero results may be factored into the 15-minute average, or the use of a shorter averaging duration, such as the actual exposure period, may be warranted depending on the acute toxicity of the chemical of interest and the peak concentration observed.

For purposes of applying the Order emergency class definitions, the term *PAC* should be interpreted to mean the following:

> *A 15-minute TWA concentration of the substance in air that equals (in order of preference) the Final or Interim AEGL-2 (60-minute), the ERPG-2, or TEEL-2 value for that substance; if none of these values is available, an alternative concentration criterion may be selected in accordance with this guidance.*

C.3 Threshold for Early Lethality (TEL)

Chapter 2, Section 3, specifies use of the maximum distance at which facility emergency consequences could exceed a TEL as one element in the determination of EPZ size. In general, early lethality is equated with deterministic processes (a threshold of exposure exists below which the effect is not observed and the severity of the effect is related to the dose or exposure).

As used here, the early lethality threshold applies to the general population and is intended to approximate the level of dose or exposure at which the sensitive groups within any large population would begin to show an increase in mortality. The definitions below are intended only for use in the facility hazards assessment process.

For purposes of conducting facility hazards assessments, the term *TEL* should be interpreted as follows.

For radioactive releases, the TEL is:

> *A projected dose (TED) of about 100 rem (1 Sv) to reference man, where the projected TED is the sum of the ED from exposure to external sources and the CED from inhalation during the early phase.*

Using 100 rem (1 Sv) TED as an approximation of the TEL is conservative. Radiation effects studies have estimated a 5 percent risk of early fatality following a 140 rem (1.4 Sv) acute dose, with a smaller, indeterminate risk expected for lower doses. Little if any risk of early fatality would be associated with a TED equal to 100 rem (1 Sv), if the dose were received over a period of time from radioactive material taken into the body.

For chemical releases, the TEL is

> *A projected 15-minute average concentration of the substance in air that equals (in order of preference) the Final or Interim AEGL-3 (60 minute), the ERPG-3, or TEEL-3 value for that substance. If none of these values is available, an alternative concentration criterion may be selected in accordance with this guidance.*

Appendix D. Combustion Products and Toxicity in Hazards Assessments

D.1 Introduction

The Department of Energy (DOE) Emergency Management system provides for analysis of hazards and hazard-specific planning to prevent or reduce negative impacts on people and the environment. Of paramount concern is the prevention of death, injury, and serious near-term health effects in populations that may be exposed to hazardous material releases originating from DOE sites/facilities/agencies (SFAs). To ensure that DOE/National Nuclear Security Administration (NNSA) hazardous material (HAZMAT) identification and screening approaches remain consistent with the historical and policy bases of the DOE Orders and with current Federal, State and local emergency management requirements and practices, this appendix clarifies how certain toxic hazards should be assessed and the results used in emergency planning and response.

D.2 Background

The process of determining whether a substance should be considered HAZMAT for DOE emergency management purposes is complicated somewhat by the fact that many very ordinary and ubiquitous substances are, in fact, toxic to humans, or have other hazardous properties under specific conditions of exposure or misuse. In addition, other substances that are generally regarded as hazardous for one specific reason may have several different hazardous properties. Flammability dominates the safety/handling concerns and it is generally excluded from the domain of hazardous material emergency planning under DOE O 151.1D.)

Finally, burning almost anything will produce combustion products that meet the basic definition of HAZMAT as that term is used in the context of emergency planning. In recent years, it has become apparent that by taking certain passages from DOE Orders and guidance documents in isolation and interpreting them narrowly, many commonplace substances can be deemed hazardous materials and almost any fire can be considered a hazardous material emergency. However, that kind of narrow and selective interpretation is not consistent with DOE emergency management policy and the intent of the Order.

D.3 Chemical Explosives

As part of their weapons development and research missions, several DOE facilities and activities store, process, or dispose of chemical explosives in substantial quantities. Beyond the obvious danger from inadvertent explosions, some chemical explosives are also acutely toxic if inhaled or taken into the body by other routes. Most chemical explosives are solids with low vapor pressures at ambient temperatures and, therefore, do not conform to the general definition of a *dispersible* toxic substance upon which the DOE emergency management requirements are based. Historically, the toxic effects have been observed only in persons involved in directly handling or fabricating the materials without adequate workplace environmental controls or personal protective equipment.

Accordingly, chemical explosives are not normally considered dispersible toxic substances requiring analysis and hazardous material emergency planning.

Another aspect of the hazard associated with chemical explosives is the production of toxic combustion products when they burn. Many explosives burn readily in air and open burning is, in fact, a common disposal method for surplus explosives. Several DOE activities have recognized the potential hazard posed by the combustion products and attempted to quantify it as a basis for emergency planning. Using combustion yield data derived from theoretical studies and field experiments, the amount of nitrogen oxides and other toxics produced by burning of explosives can be calculated. Taken as a potential airborne source, the toxics associated with combustion of a few pounds of TNT, RDX, or any of several other commonly used explosives can exceed applicable PAC at significant distances, implying that categorization and classification as an operational emergency (OE) may be required. However, it is an established fact that many other materials used in building construction, furniture, and fabrics produce copious amounts of toxics if burned. Therefore, the question: Is there any rational basis for applying the hazardous material emergency definition to fires involving explosives and not to other ordinary fires that represent equal or greater toxic sources? In an attempt to answer this question, the following section examines the toxic hazard from ordinary fires and compares it with that produced by burning explosives.

D.4 Toxic Releases from Chemical Explosives Compared with Structural Fires

Any structure fire will produce toxic products of combustion from the burning of structural materials, preservatives, refrigerants, paint, plastics, and so forth. Dangerous concentrations of carbon monoxide, hydrogen cyanide, hydrogen chloride, oxides of nitrogen, and various organics can be expected in the vicinity of even the most ordinary structure fire, and profound respect for the toxic properties of all smoke is a guiding principle of modern firefighting and Incident Command practice. The position of the fire protection community is made perfectly clear in the National Fire Protection Administration Fire Protection Handbook, which concludes its discussion on smoke toxicity (Section 3, Chapter 1) with the following unambiguous statements:

> Combustion products produced in a fire are always toxic and extremely hazardous to life safety,
>
> AND
>
> Smoke, even of “average” toxicity, is still <u>very</u> toxic.

To quantitatively assess whether the toxic releases from burning of explosives was substantially different from what might be expected from an ordinary structure fire, data on the combustion yield of toxics for different materials was sought from a variety of sources. The yield of various products depends greatly on the combustion conditions (temperature, surface area, excess oxygen) under which the fuel is burned, and the yield under bench-top experiment conditions may be much different than would be typical in a real-world fire condition. In April 2003, the National Institute of Standards and Technology (NIST) published Technical Note 1453, *Smoke Component Yields from Room-Scale Fire Tests*. The report presented the methodology and results for a series of room-scale fire tests conducted by the NIST Building and Fire Research Laboratory to produce data on the yields of toxic products in fires. The combustibles examined in the tests included a sofa made of upholstered cushions, particleboard bookcases with a laminated finish, polyvinyl chloride sheet, and household electrical cable. The report gave results in terms of yields (gram of toxicant per gram of fuel) for each of several highly toxic substances, including HCN and HC1. The yield values were based on analysis of the exhaust smoke stream in both the pre-flashover and post-flashover phases. The pre- and post-flashover HCN and HC1 yield values for the sofa, bookcase, and electrical cable are presented in Table 25 of the NIST report and summarized in Table D-1. The higher yield values for each gas and fuel are shaded.

Nearly all common explosives are nitrogen-rich compounds and the toxic combustion products are primarily NO and NO_2. Because the yield of NO was not reported in the NIST room fire tests, and the NO_2 results were reported only as *less than* values, HCN and HC1 yields from the test fuels were used to represent smoke toxicity in this comparison. First, the amounts of NO_2, HCN, and HCl needed to produce a 15-minute average concentration equal to the ERPG-2/TEEL-2 value at various distances were calculated using EPIcode, version 2.0 (under conditions of 1 m/s, F stability and a 4 m by 10 m "surface area source," simulating release from a fire in a trailer or small building).

Table D-1. Yields of Hydrogen Cyanide and Hydrogen Chloride from NIST Room Fire Tests (grams of combustion product/grams of test fuel)

Gas	Fire Stage	Sofa	Bookcase	Cable
HCN	Pre-flashover	3.5E-3± 50%	4.6E-4± 10%	6.3E-4± 50%
HCN	Post-flashover	1.5E-2± 25%	2.5E-3± 45%	4.0E-3± 30%
HCl	Pre-flashover	1.8E-2± 30%	2.2E-3± 75%	6.6E-3± 35%
HCl	Post-flashover	6.0E-3± 35%	2.2E-3± 65%	2.1E-1± 15%

Table D-2 presents the results of the EPIcode trials in which the amount of toxic gas needed to produce a concentration equal to applicable ERPG-2/TEEL-2 at 100 m, 800 m, and 1600 m were calculated.

Table D-2. Amount of Toxic Gas Needed to Exceed Applicable ERPG-2 Value at Various Distances

Gas	ERPG	*Q(100m) (kg)	*Q(800m) (kg)	*Q(1600m) (kg)
HCN	10	0.33	5	15
NO_2	15	0.85	14	38
HCl	20	0.9	14.4	42

*Q(___m) = amount (kg), if released under the specified conditions, will produce 15-minute average concentration equal to the applicable ERPG-2 value at the specified distance.

Using the bounding values for combustion yields for the three test fuels from Table D-1 (sofa cushions, bookcases, and electrical cable) and four common explosives (TNT, RDX, TATB, and HMX), the amount of each substance that would need to be burned in 15 minutes to release that amount of the particular toxic gas was calculated. The values of Y (combustion yield) used for explosives are *burn emission factors* provided by the Pantex Plant (Environmental) Regulatory Compliance Department, which has developed a spreadsheet to calculate emissions from HE detonation and combustion. The emission factors are used to document the compliance with environmental permits for the Pantex Firing Sites and Burning Grounds. The spreadsheet value for *oxides of nitrogen* was used to calculate a yield of nitrogen dioxide. This is a conservative approach because NO_2 is more toxic than NO. The amount of combustible substance is given by the following equation:

$$M_{comb} = M_{Tox} / Y$$

Where:

M_{comb} = Mass of the combustible required to produce toxic release of M_{Tox}.

M_{Tox} = Mass of toxic gas necessary to produce 15-minute average concentration equal to the ERPG-2 value at the specified distance

Y = Combustion yield of the toxic gas (mass of combustion product/mass of fuel)

For this comparison, the values of Q(100m) from **Table D-2** are used to represent M_{Tox}. The masses of combustibles thus calculated correspond to the amount of each substance that would have to be burned in a period of 15 minutes or less to yield enough of the particular toxic gas to produce a concentration just equal to the applicable ERPG-2 value at 100 m under the specified release and atmospheric transport conditions.

Table D-3 presents the calculated values of M_{comb} for the three test fuels used in the NIST experiment and the four common explosives.

Table D-3. Mass of Combustibles to Produce a 15-Minute Average Concentration of Specified Toxic Gases Equal to ERPG-2 at 100 meters

Combustible	*Toxic Gas*	*Q(100m) (kg)*	*Y Value*	*M_{comb} (kg)*
Sofa	HCN	0.33	1.5E-2	22
	HCl	0.9	1.8E-2	50
Bookcase	HCN	0.33	2.5E-3	132
	HCl	0.9	2.2E-3	409
Electrical cable	HCN	0.33	4.0E-3	82.5
	HCl	0.9	2.1E-1	4.3
TNT* (explosive)	NO_2	0.85	6.62E-2	12.8
RDX (explosive)	NO_2	0.85	2.12E-2	40

TATB (explosive)	NO_2	0.85	4.27E-2	19.9
HMX (explosive)	NO_2	0.85	2.10E-2	40.5

*Although little if any TNT is currently used in DOE weapons programs, it is included here for comparison because it is the most oxygen-deficient of common explosive compounds and therefore produces the highest yield of nitrogen oxides.

When the values in the final column are viewed as an index of combustion toxicity (lower values mean higher toxic impact per unit mass of combustible), it can be seen that ordinary household electrical cable (the insulation and sheathing of which is primarily polyvinyl chloride) is by far the worst actor in this group, its combustion products having about 3 times the toxic impact of the worst explosive (TNT) on a burned-weight basis. Based on HCN alone, the polyurethane sofa cushions are about equal to the next worst explosive (TATB). On a pound-for-pound basis, the particleboard bookcases have about 10 to 30 percent the toxic yield of the explosives. From this small sampling alone, it can be seen that the constituents of ordinary smoke are indeed extremely toxic, and that the toxic impact of gases generated by burning explosives is of the same order of magnitude as for several of the mundane articles used in the NIST test.

D.5 Other Explosives

The most obvious hazard from explosives is the blast or shock wave produced by an explosion or detonation. Although many explosives will burn evenly if unconfined, explosion should always be considered a possibility. In addition to the blast/shock effects, flying objects (missiles) may also be propelled outward from the explosion at high speeds and hazardous objects, such as rounds of ammunition, and fragments of explosive may be spread over a wide area. Having been subjected to the effects of a blast, such unexploded materials may be very sensitive to shock, friction, or temperature change, and therefore dangerous to personnel.

As introduction to the topic of "Effects of Explosions and Permissible Exposures," DOD 6055.9 STD, *DOD Ammunition and Explosives Safety Standards*, (Chapter 2) states: *In the assessment of the hazard associated with a given situation, the principal effects of the explosive output to be considered are blast pressure, primary and secondary fragments, thermal hazards, and chemical agent hazards*. "Chemical agent hazards" refers not to the intrinsic chemical toxicity of the explosives but to chemical warfare agents, such as nerve gas or blister agents contained in munitions that also include an explosive charge. The standard describes the expected damage and injury from blast and fragments and specifies storage separation and other controls for munitions based on those specific effects and the quantity of explosive.

The Department of Transportation Emergency Response Guide provides first responders with information on the specific or generic hazards of the materials involved in a transportation incident and recommendations for protecting themselves and the public. Guide number 112 applies to all explosive groups except 1.4 (no blast potential). Guide 112 uses the highest degree of typographical emphasis (all capitals, bolded) to identify the chief potential hazard associated with such shipments, specifically: MAY EXPLODE

AND THROW FRAGMENTS 1600 METERS (1 MILE) OR MORE IF FIRE REACHES CARGO. In case of fire, Guide 112 goes on to recommend that responders NOT fight the fire when the fire reaches the cargo, but to isolate and evacuate the area out to a distance of 1600 meters (for heavily encased explosive) in all directions. Although the Guide states that fire ". . . may produce irritating, corrosive and/or toxic gases," it clearly represents blast and fragments as the dominant hazards. In addition, the firefighting guidance section of Guide 112 makes it clear that if fire reaches the cargo, explosion should be considered imminent.

D.6 Ordinary Products of Combustion

All fires produce dispersible toxic substances. Toxic impacts from combustion of commonplace materials like particleboard, polyurethane foam, and polyvinyl chloride appear comparable to impacts from burning the same weight of explosives. If explosives are singled out as hazardous material release hazards when burned, then many other substances (including diesel fuel and rubber tires) could likewise be analyzed and brought under the hazardous material emergency planning program based on the toxicity of their combustion products. Selective reading of certain parts of DOE O 151.1D and Chapter 2, Section 2, can lead to even the most ordinary fires being characterized as DOE hazardous material release incidents. However, DOE emergency management does not exist in isolation. The DOE definitions and conventions regarding what is and is not a hazardous material emergency need to be consistent with established Federal, State, local and industry programs and standards and with the historical roots of hazardous material emergency management, in general.

The toxic impact of smoke from ordinary fires is currently managed through standard firefighting and Incident Command practices. Trained firefighters and Incident Commanders (IC) understand that: a) all smoke is toxic, b) exposure to well-defined smoke plumes should be avoided, by response personnel and others, and c) protection of nearby people is an express responsibility of the IC. In addition, fires tend to be energetic incidents, announced by flames, smoke, fire alarms, sirens, the arrival of fire apparatus and the attendant actions of firefighters. Smoke itself tends to give direct visual and olfactory evidence of its presence and relative concentration, allowing firefighters and others to avoid exposure or remove themselves from areas of highest concentration. These facts contrast starkly with the picture of a silent, unnoticed threat from airborne radioactive materials or toxic chemicals that forms the doctrinal basis for current hazardous materials emergency management practice. At this time, there is no compelling evidence that exposure to toxics in smoke from ordinary fires is a significant source of human health risk that is not being adequately managed by firefighting and Incident Command practices, or that application of hazardous material models, planning criteria, and response practices to ordinary fires would do anything to enhance protection of workers and the public.

For military personnel and transportation emergency planners, blast and fragments are the hazards of greatest concern from explosives, and any fire that involves or threatens explosives should be treated as an imminent explosion. As with numerous other hazardous substances, the toxicity of combustion products is recognized, but is clearly of secondary concern and is not a prominent consideration in planning for emergencies.

D.7 Conclusions

1. Fires in buildings or facilities that do not contain large inventories of hazardous materials may need to be categorized as OEs if they result in significant structural damage with suspected personnel injuries or death (DOE O 151.1D, Attachment 3, Section 8). However, even if they are categorized as OEs, ordinary fires should not be classified on the basis of incidental releases of hazardous materials (combustion products). If a documented Fire Hazards Analysis or an assessment by a qualified fire protection engineer suggests that there is an extraordinary toxic release potential and that protective actions beyond those normally implemented for structure fires will be needed, the toxic material release should be addressed in an EPHA. In general, the blast, missile and burn hazards posed by conventional explosives (and certain other materials like natural gas and propane) are outside the scope of the Hazardous Material emergency management program specified in DOE O 151.1D. The chemical toxicity of explosive residue and combustion products will be of secondary concern compared to the inherent blast and missile hazard and can be adequately managed by trained ICs using standard and accepted firefighting and HAZMAT response practices.

2. An explosive should be analyzed as a dispersible toxic chemical hazard only if it is used or stored in a form (such as a powder or liquid) that represents a plausible air-dispersible source of the substance.

3. If an explosion has occurred and there is no potential for another, the most significant safety impacts (blast, shock, missiles) will already have ended and therefore will not be mitigated by the same kinds of protective actions and response measures (evacuation, sheltering) that are usually applied to hazardous material release emergencies. However, the distribution of unexploded material and items around the vicinity of an explosion is analogous to the situation existing after a chemical or radiological release (i.e., hazardous contamination requiring control of personnel access, planned reentry and recovery actions, and response by specialized support personnel). Accordingly, as a means of facilitating response, individual facilities and sites may choose to classify OEs involving actual or potential explosions that could distribute explosive materials outside the immediate vicinity of the explosion. The classification should be at a level that is consistent with the size of the affected area and the resources that will be needed to deal with the consequences.

Appendix E. Integration of Incident Categorization/Classification with Normal Operations

E.1 Introduction

Even the best-designed set of event recognition procedures will not function properly if the detection, recognition, and communication chain necessary to alert those responsible for incident categorization and classification fails. In this context, *categorization* refers to determining if an incident is an Operational Emergency (OE), as defined in the Order. These incidents may require classification if they involve a potential or actual release of radiological or non-radiological hazardous materials. A major problem encountered when designing an incident recognition system is ensuring that incidents/conditions are compared to categorization and classification criteria in a timely and efficient manner. In general, if the severity of a condition or incident is beyond that covered by Department of Energy (DOE) O 232.2A, Occurrence Reporting, then there should be some way of detecting it, a means to ensure that its significance is recognized, and a mechanism for communicating the information to those responsible for incident categorization and classification.

Elements that ensure the proper sequence of actions leading to incident categorization and classification include the following:

- Means of detecting symptoms/indications
- Recognition of the significance of indications
- Proper response to recognition (communication with categorization and classification authority)

Within the site/facility/agency (SFA) operating structure, many varied detection methods exist.

Recognition of the significance of what is detected depends on training, the existence of attention-getting devices, and procedural links. Transmission of information to the person with the authority to perform incident categorization and classification depends on the establishment of clear, well-understood reporting relationships.

The symptom, detection, recognition, and communication chain can be implemented through integration with normal operational activities and procedures. Categorization will usually be based on general criteria and judgment of the need to notify people up the chain. Classification should be less subjective and based on pre-established emergency action level criteria. Rigorous integration of incident recognition procedures is unnecessary and could cause difficulty in maintaining facility procedures. However, keeping the recognition procedures totally separate and relying solely on memory and training during periods of high stress is equally insufficient. Visual cues and other indicators are sometimes employed in facility procedures to alert users to consult the incident recognition procedures.

Some accident/emergency incident symptoms/indicators, potential methods of detection, and methods for incorporating the recognition of incident classification into normal operations are discussed in the sections that follow. Sections G.2 – G.4 address methods that apply to the management and operation of three types of facilities that are typical of many DOE/National Nuclear Security Administration (NNSA) operations: complex hazardous material facilities, ordinary industrial facilities, and office buildings. Section G.5 discusses methods that apply to emergency services organizations and first responder elements. Section A.6 addresses detection and recognition of natural phenomena that may result in emergencies.

Note that the groupings and listings used in these discussions are not intended to be all-inclusive, but are used only for illustrative purposes.

E.2 Complex Hazardous Material Facilities

Complex processes, such as reactors and waste vitrification facilities, are included in this group. Potential symptoms or indications that could identify the onset of an accident condition include abnormal indications for temperatures, pressures, fluid levels, flow rates, power losses, radiation levels, and fire detection. Detection methods include the following:

- Installed instrumentation/hardware
- Routine or off-normal sampling results
- Operator observation during log-taking and other inspection/walkdown routines
- Employee observation during normal work activities

Methods for implementing the categorization and classification transitions include the following:

- **Facility operating procedures**. Facilities with complex processes have a system of procedures that may include individual equipment procedures, integrated plant procedures, normal operating procedures, system compliance procedures, alarm response procedures, off-normal operating procedures, and emergency procedures. Technical Safety Requirements or Technical Specifications may also govern the facility. These procedures and documents can be annotated, where appropriate, to refer the user directly to an incident categorization or classification procedure. Many methods use accepted human engineering principles for annotating text to call the user's attention to a particular piece of important information. Some of these include the use of flags, margin notes, color-coding, or other special symbols, such as stars or triangles. Regardless of the method used to catch the user's attention, the entry should be specific as to the condition for triggering the comparison with the incident categorization and classification procedures and the section of the categorization or classification procedure that applies.

- **Inspection/walk-down observations**. The formality of these activities varies from one facility to another. Procedures, standing orders, checklists, log sheets, or verbal instructions may govern these activities. Using the results of the facility's Emergency Planning Hazards Assessment, it can be determined which accident symptoms/indicators these activities could be expected to detect. Procedures, checklists, log sheets, and other instructions can be annotated, as discussed above, to assist the user in recognizing when an accident indicator has been encountered. The annotation should contain specific instructions on whom to notify and how to notify them. A specific reference to the procedure and section could also be included. Personnel performing inspections/walkthroughs form a human interface with the system or process. Judgment and interpretation are required to initiate the recognition, communication, and incident categorization and classification chain. As a result, training is a key element in ensuring that this chain functions properly.

- **Standing orders/instructions to personnel**. General guidance provided to personnel, often job-specific, encouraging awareness of certain conditions, symptoms, and indicators for making notifications of such to specific personnel or responding with prescribed actions. A standing order should contain guidance on how to recognize and interpret symptoms and indicators, as well as instructions on who to contact and how to contact them in the event that they are observed. The person identified should be directly responsible for comparing the symptom/indicator to incident categorization and classification criteria, or be provided with additional guidance and instructions to ensure that the information is promptly communicated to someone who is authorized to perform these tasks. Once again, recognition and communication are highly dependent upon human judgment and interpretation; therefore, training plays a key role.

  Facilities in this grouping are generally comprised of relatively complex systems required to have a variety of detection systems and alarm features. Usually, the operation of these facilities is highly formalized and controlled by detailed procedures. A system of inspections and walk-downs should augment the detection process. Personnel working in these facilities should be highly trained to improve the probability that symptoms/indicators will be recognized, and a prompt response initiated. The path from detection to the personnel responsible for incident recognition is often short and direct, which is necessary because these are often high-hazard facilities with a small response window for protective actions.

E.3 Industrial Facilities

This grouping covers activities such as shops, transportation, laboratories, burial grounds, tank farms, storage tanks, transfer lines, etc. Hazardous materials may be involved with some of these activities. Methods for detecting an emergency include the following:

- Observation during inspections/walk-downs

- Alarms and monitors

- Sampling or measurements
- Employee or public report

Methods for implementing the recognition/categorization and classification transition include the following:

- **Procedures and reporting relationships**. There are fewer and less formal procedures within this grouping than the previous group. The procedures that do exist can be annotated, where appropriate, to refer to emergency categorization and classification procedures. Because fewer procedures exist, the associated reporting structure is less formalized and complete. The normal reporting relationship between the point of detection/recognition and the position responsible for performing event categorization and classification may be less direct than it was in the previous grouping. For example, the reporting chain might include supervisor, operations manager, and building/area emergency director. Therefore, in addition to the considerations mentioned above for annotating procedures, it is important to shorten the normal reporting chain to bring the information to the attention of the authority responsible for incident categorization and classification as rapidly as possible.

- **Procedural response to alarms and monitor readings**. Within this grouping, less instrumentation exists for the detection of incident symptoms/indicators. Examples of the types of instrumentation that may exist include radiation monitors (Continuous Air Monitors, Area Radiation Monitors, transfer line monitors, environmental surveillance monitors) and non-radiological hazardous materials monitors (oxygen level indicators, chlorine monitors, explosive level indicators, fire detectors, tank level indicators/alarms, transfer line leak detectors). As discussed above, these response procedures can be annotated to facilitate the recognition to incident classification chain.

- **Response to sampling and measurement results**. Sampling and monitoring activities are usually governed by procedures and the results recorded on checklists, log sheets, or another form of permanent record. Any of these are candidates for notations to alert the user that they have encountered the symptoms/indicators of a potential OE. Methods for implementing this form of user aid have been discussed above.

Within this grouping, the detection/recognition/categorization and classification chain is less reliant on installed instrumentation and more on human judgment and interpretation. Therefore, training is once again an important element. The individual at the point of detection is further removed from the incident classification authority. A strong training program and periodic safety meetings coupled with good procedural and reporting interfaces are necessary to ensure the completion of the detection/recognition/categorization and classification transition.

E.4 Office Buildings

Large office buildings may have a building management organization for utilities, a building security force, volunteer building evacuation wardens, and a building emergency management plan. Although smaller office buildings will likely have none of these building-specific organizations and plans, they may be covered by a site-wide plan and emergency organization. Contractors may also have company policy manuals that address emergency notifications and response. At office buildings, emergency detection will usually depend on employee or public report and installed fire detection systems. Applicability of the Order to contractor and subcontractor employees in offsite buildings should be determined on an individual basis by contracting officers.

Methods for detecting the symptoms/indicators of an emergency at an office building include the following:

- Fire alarm systems
- Security and building management force observations
- Employee observations or public report

Methods for implementing the recognition/categorization and classification transition include the following:

- **Security force and building management organization procedures and standing orders**. Procedures that do exist can be annotated, where appropriate, to refer to emergency categorization and classification procedures, or to notify a designated person in the occupant organization who is trained to make the categorization and notification determination.

- **Building emergency plans**. Large multi-story office buildings will have an emergency management plan that identifies evacuation routes and provisions for the evacuation of handicapped persons. As previously mentioned, references and notations can be included to link these plans to the categorization authority and procedures.

- **Security force, employee, or public recognition of an emergency**. Office building occupants should be trained to respond to fire alarms and other potential emergencies at their work location, but most of them will have little, if any, knowledge of incident categorization and reporting requirements. The assignment of a building warden can provide the link to categorization and notification. Large DOE sites typically have an Emergency Duty Officer (EDO) who is notified of all emergencies on the site. The EDO can categorize the emergencies for buildings that do not have an established emergency organization. Contractors typically arrange to be notified by security and fire departments for off-hours emergencies that affect their buildings. The public generally receives no formal training, but is often provided with phone numbers and points of contact for use when conditions that may impact security or health and safety are observed.

E.5 Emergency Response Organizations (EROs)

The EROs may include security forces, fire departments, emergency medical providers, 911 centers, and fire dispatch centers. These organizations are often the first to know of an emergency, since employees are trained to call them immediately to obtain aid. Notification is usually by telephone or installed security and fire alarms. Their first priority is the dispatch of the needed aid. These organizations can either provide the emergency categorization and classification directly or initiate a notification call tree to the categorization and classification authority. This authority is typically a Site EDO, Facility/Building Emergency Director, centralized occurrence notification center, or On Call Manager.

Methods for detecting the symptoms/indicators of an emergency include:

- Security alarm systems
- Fire alarm system
- Employee observations or public report

Methods for implementing the recognition/categorization and classification transition include the following:

- **Procedures and standing orders**. Procedures, standing orders, and training can identify specific conditions that require declaration of an OE or notification of the categorization and classification authority. It is important that the security, fire, and emergency preparedness plans establish the structure for close coordination between the organizations. The working-level implementation is carried out within the procedures, standing orders, checklists, and training. Links between the security and fire response systems and the emergency response system need to exist to ensure that the potential health and safety aspects of an emergency are recognized, and that the information is communicated to the emergency response incident categorization/classification authority. Establishing specific measurable criteria as trigger points for notifying the incident categorization/classification authority is not always straightforward. Annotations and references in procedures and standing orders may require more than simple margin notes, and the success of the transition will depend heavily on training.

- **Operating, off-normal, and emergency procedures**. These may contain specific instructions for operations during a security incident. As previously mentioned, references and notations can be included.

- **Training security personnel to recognize a health and safety threat**. Fire department personnel are well-trained to fight fires, but are less prepared to recognize when an incident also has health and safety implications. Employees receive limited training on how to recognize a reportable emergency condition and respond according to general standing orders. Training on the recognition of health, safety, and operational implications stemming from emergency incidents is important for emergency response personnel and general employees. The public generally receives no formal training but is often provided with phone numbers and points of contact should any conditions that may impact security or health and safety be observed.

- **Procedural reporting relationships**. Within the EROs, the reporting relationships governing the response are proceduralized and understood. However, the reporting relationship between emergency response groups and the ERO is often poorly defined and understood. Even less distinct and understood are reporting relationships for general employees.

Emergency response groups (security and fire) maintain a highly structured response system implemented by well-trained personnel whose responsibilities are well-defined within their emergency response plan. However, their incident classification criteria may not be integrated with facility incident classification criteria. Site emergency management plans and security and fire plans should be coordinated to ensure strong, well-understood links in both directions. Procedures, standing orders, and training should include information and aids for fire and security personnel to coordinate with other elements of the ERO.

E.6 Natural Phenomena

This group covers those emergency conditions that occur as a result of natural phenomena. Symptoms/indications that could identify an actual or potential threat include observed tornado, high winds, high/low water levels, range or forest fire, earthquake, and lightning. Methods for detecting the symptoms/indicators of incidents caused by natural phenomena include the following:

- Meteorological instrumentation
- Weather forecasts
- Water level sensors
- Seismic monitors
- Employee/public observation
- News media reports

Methods for implementing the recognition/classification transition include the following:

- **Comparison of observed or measured conditions to limits/specifications**. Often personnel at the point of detection are not directly related to the operational organization of a particular facility and do not have the experience or training to recognize when their observations indicate that an operational limit is being approached or exceeded. Field measurements are not always taken in the same units specified in the Technical Safety Requirements or incident classification criteria, thus adding to the difficulty in recognizing their significance. Therefore, log sheets or other methods used to record observations should be annotated, and training should include instructions to aid personnel in recognizing and reporting incidents needing comparison to the incident classification criteria.

- **Procedural response and reporting relationships**. Procedures used for taking measurements that are indicators of natural phenomena should be annotated where appropriate. Because the personnel at the point of detection are often separate from the facility operations organization, the path for reporting information may be long and informal.

Diverse, unrelated groups who are often far removed from both the facility operations organization and the incident categorization/classification authority may perform the function of detection of natural phenomena incidents or conditions that affect facility safety. Few formalized procedures or other aids exist to facilitate the recognition/reporting/ categorization/classification process. To make the transition work properly, it is important to establish trigger points that direct personnel to bring abnormal conditions to the attention of the incident categorization and classification authority.

Appendix F. Methods and Examples for Implementation of Incident Categorization and Classification, including Barrier Approach to Emergency Action Level Development

F.1 Introduction

This appendix contains suggestions for the implementation of incident categorization and classification procedures. Section G.2 addresses the placement of Operational Emergency (OE) categorization criteria within existing site/facility/agency (SFA) programs and procedures for operations, safety, security, emergency response, and occurrence reporting procedures. Sections G.3 and G.4 discuss the application of the barrier approach to Emergency Action Level (EAL) development and provide examples of EAL organization and format by presenting EALs developed for the hypothetical facilities.

F.2 Operational Emergency Categorization Procedure Integration

Section 5.4 of Chapter 4 includes a general discussion of the means by which the recognition and categorization of OEs could be implemented through the development of facility and site procedures, based on the examples of OEs given in the Order. It is not intended that SFAs develop detailed and quantitative categorization criteria for each type of OE described in the Order. If, however, upon examining the OE potential and likely response, SFA officials determine that additional measures are needed to ensure prompt recognition and categorization, these methods and examples may prove useful. The following sections provide examples of how OE recognition criteria and alerting or prompting questions may be inserted within several types of existing SFA procedures. For SFAs that have existing, consolidated occurrence reporting and classification procedures, the new OE categorization criteria should be summarized in a companion procedure or appendix to existing procedures.

F.2.1 Health and Safety

1. **Order Example**: *Discovery of radioactive or other hazardous material contamination from past Department of Energy (DOE)/National Nuclear Security Administration (NNSA) operations that may have caused, is causing, or may reasonably be expected to cause uncontrolled personnel exposures exceeding protective action criteria.*

   Possible Implementation Method:

   - Include referral to local OE criteria in site-specific Radiological Control Manual and internal procedures for reporting radiological problems and abnormal survey findings.

   - Include criteria in site Occurrence Reporting guidelines, such as: *Radioactive contamination in an uncontrolled area in excess of 500 times the surface contamination levels specified in Appendix D, 10 Code of Federal Regulation*

(CFR) Part 835, is to be reported as an OE in accordance with DOE O 151.1D, Attachment 3, Section 11.

2. **Order Example**: *An offsite hazardous material incident not associated with DOE/ NNSA operations that is observed to have, or is predicted to have an impact on a DOE/NNSA site such that protective actions are required for onsite DOE workers.*

   Possible Implementation Method:

   - Provide standing instructions to the single point of contact for emergency communications (site 911 operator, Security Watch Commander, or equivalent) to the effect that: *Any advisory or warning that an offsite hazardous materials release is in progress or imminent and that onsite people may be affected is an OE.*

   - Insert a statement in the SFA emergency classification procedure, Hazardous Materials Incidents section, such as: *Any hazardous material release from offsite that requires evacuation or sheltering of onsite personnel is to be reported as an OE in accordance with DOE O 151. 1D, Attachment 3, Section 11.*

3. **Order Example**: *An occurrence (earthquake, tornado, aircraft crash, fire, explosion) that causes or can reasonably be expected to cause significant structural damage to DOE/NNSA facilities, with confirmed or suspected personnel injury or death or substantial degradation of health and safety.*

   Possible Implementation Method:

   - Include provisions in site fire/rescue procedures and building pre-incident plans such as: *Any fire or rescue response to building may require prompt notification of DOE HQ and offsite authorities. Immediately notify (emergency duty officer) of call-out to this facility.*

4. **Order Example**: *Any facility evacuation in response to an actual occurrence that requires time-urgent response by specialist personnel, such as hazardous material responders or mutual aid groups not normally assigned to the affected facility.*

   Possible Implementation Method:

   - Include provision in site fire/rescue, HAZMAT team, or security augmentation procedures and building pre-incident plans such as: *Any fire, HAZMAT or security response to building may require prompt notification of DOE HQ and offsite authorities. Immediately notify emergency duty officer (EDO) of call-out to this facility.*

5. **Order Example**: *An unplanned nuclear criticality.*

   Possible Implementation Method:

   - Include specific criteria in an SFA EAL procedure to allow distinction between a criticality that requires classification and one that does not, such as: *Valid criticality alarm or other indication of criticality in cell with effluent high range monitor or facility Area Radiation Monitors reading less than (value indicating dose outside facility walls exceeding site specific Alert criterion) is to be reported as an OE in accordance with DOE O 151.1D, Attachment 3, Section 11.*

6. **Order Example**: *Any mass casualty event.*

   Possible Implementation Method:

   - Provide training and a checklist item for IC to require them to make the judgment call on whether they are dealing with a *mass casualty*, such as: *Onsite illness/injury events requiring activation of mutual aid from both (offsite medical centers/ambulance services) to transport casualties is an OE. Have Dispatcher immediately advise EDO of situation.*

F.2.2 Environment

1. **Order Example**: *Any actual or potential release of hazardous material or regulated pollutant to the environment, in a quantity greater than five times the Reportable Quantity specified for such material in 40 CFR Part 302, that could result in significant offsite consequences such as major wildlife kills, wetland degradation, aquifer contamination, or the need to secure downstream water supply intakes.*

Possible Implementation Method:

- Provide training and a checklist item in spill response plan/procedures to direct the team leader to initiate notifications under certain conditions, such as: *The following conditions have been identified as potential OEs requiring prompt notification of DOE HQ and offsite authorities. Immediately advise EDO of the situation.*

  – Breach of tank with contents reaching the drainage canal.
  – Overflow or breach of the retention dam.

2. **Order Example**: *Any release of greater than 1000 gallons (24 barrels) of oil to inland waters; greater than 10,000 gallons (238 barrels) of oil to coastal waters; or a quantity of oil that could result in significant offsite consequences (need to relocate people, major wildlife kills, wet-land degradation, aquifer contamination, need to secure downstream water supply intakes). (Oil as defined by the Clean Water Act (33 U.S.C. 1321) means any kind of oil and includes petroleum.)*

Possible Implementation Method:

- The same discussion applies as in example 1 above.

F.2.3 Safeguards and Security

1. **Order Example**: *Actual unplanned detonation of an explosive device or a credible threatened detonation resulting from the location of a confirmed or suspicious explosive device.*

   Possible Implementation Method:

   - Link the OE declaration to the security response level that corresponds and include notifications in the security force procedures and checklists for that level response, such as: *Security Alert II – Any unplanned detonation of an explosive device or a credible threatened detonation may be an OE requiring prompt notification of DOE HQ and offsite authorities. Immediately advise EDO of the situation.*

2. **Order Example**: *An actual terrorist attack or sabotage event involving a DOE/NNSA SFA or operation.*

   Possible Implementation Method:

   - The same discussion applies as in example 1 above.

3. **Order Example**: *Kidnapping or the taking of hostages involving a DOE/NNSA SFA or operation.*

Possible Implementation Method:

- The same discussion applies as in example 1 above.

F.2.4 Hazardous Biological Agents or Toxins

1. **Order Example**: *Any actual or potential release of* a hazardous biological agent or toxin (identified in 42 CFR Part 73, Select Agents and Toxins; 7 CFR Part 331, Possession, Use and Transfer of Select Agents and Toxins; and 9 CFR Part 121, Possession, Use and Transfer of Select Agents and Toxins outside of the secondary barriers of the biocontainment area).

   Possible Implementation Method:

   - Provide training and a checklist item for plans/procedures for observed or unobserved releases and direct the team leader to initiate notifications under certain conditions, such as: *The following conditions have been identified as potential OEs requiring prompt notification of DOE HQ and offsite authorities. Immediately advise EDO of the situation.*

F.2.5 Offsite DOE Transportation Activities

1. **Order Example**: *Any accident/incident involving an offsite DOE/NNSA shipment containing hazardous materials that causes the initial responders to initiate protective actions at locations beyond the immediate/affected area.*

   Possible Implementation Method:

   - Provide drivers, dispatchers, and responsible program personnel with criteria for determining the protective actions taken by local responders and explicit instructions to follow if a criterion is exceeded. For radioactive shipments, such criteria and instructions might be: *Any mishap that causes local emergency authorities (police, fire, HAZMAT responders) to order evacuation or sheltering for people at distances greater than about 100 meters from the vehicle or spill location is a DOE OE. Immediately notify EDO at (telephone number).*

2. **Order Example**: *Failures in safety systems threaten the integrity of a nuclear weapon, component, or test device.*

   Possible Implementation Method:

   - Provide drivers, dispatchers, escorts, and responsible program personnel with criteria for determining emergency status of shipments and explicit instructions to follow if a criterion is exceeded. Such criteria and direction might be incorporated within Office of Secure Transportation procedures for reporting and responding to abnormal conditions that meet the *Broken Arrow* or *Bent Spear* description.

3. **Order Example**: *A transportation accident results in damage to a nuclear explosive, nuclear explosive-like assembly, or Category I/II quantity of Special Nuclear Materials.*

   Possible Implementation Method:

   - The same discussion applies as in example 2 above.

F.3 Determine Emergency Class Using Barriers to Measure Safety Degradation

A method for using the condition or state of protective barriers as a quantitative measure of facility or process safety degradation for purposes of determining hazardous materials facility event class is described in this section. The method can be adapted to a broad range of facilities and processes, and be used to develop an internally consistent EAL scheme for each major hazard at a DOE site.

The Order requires that OEs requiring classification be placed in one of three classes by degree of severity. The assigned emergency class should reflect the actual or potential consequences of the situation. The Order emergency class definitions are stated in terms of *safety degradation* and *actual or potential failure of safety functions*, as well as in units of consequence (dose, exposure, or concentration).

In developing EALs, each facility should determine the observable conditions that equate to various levels of safety degradation. The standard set of Example Initiating Conditions provided by the Nuclear Regulatory Commission (in NUREG-0654 and in Industry Standard NUMARC/NESP-007) defines the levels of degradation for commercial nuclear reactors in terms that are specific to large light-water-cooled power reactors. This method has worked well for the commercial nuclear industry because the facilities are quite homogeneous (virtually every site has the same basic design features and similar organizational structure). To provide technically consistent and coherent examples initiating conditions for each type of emergency at all the possible types of DOE hazardous materials facilities would be a formidable task.

Lacking standard sets of example initiating conditions, facilities can develop coherent systems to drive graded, anticipatory responses to threats, challenges, and failures. This is done by viewing physical and administrative controls as the barriers that maintain hazardous material in a safe condition and constructing the EAL scheme around the status of those barriers. The EAL schemes developed in this manner may be event-based, but are typically more symptom-based in nature. The character of the site-specific EAL scheme will be largely dependent on the type and level of sophistication of installed systems that monitor the barrier status. In general, the more complete and quantitative the information provided by monitoring systems, the more symptom-based the EAL scheme can be. Conversely, if monitoring is largely dependent on staff observation of events, the scheme will tend to be more event-oriented.

F.3.1 Barrier Definition

The various layers of protection afforded facility and site personnel, the general public, and the environment by the design and operational controls of each facility can be thought of as barriers. Facility design features that contain hazardous materials, or separate them from people or the environment, are physical barriers in the traditional sense. This concept of barriers is the one typically applied when analyzing commercial nuclear reactor plants. However, in order to develop a complete EAL scheme, barriers other than those of a physical nature (such as administrative or procedural controls) may have to be considered. Examples of various types of barriers are as follows:

- Physical

– Containments

– Glove boxes

– Binding agents

– Confinements

– Hot cells

– Overpacks

- Cylinders
- Process piping
- Shipping casks
- Tanks
- Tunnels/shafts
- Building Heating, Ventilation, and Air Conditioning (HVAC) systems

• Configuration

- Safe geometries
- Segregated storage
- Process controls
- Temperature controls
- Cryogenic traps
- Humidity controls
- Arming circuits
- Security systems

• Administrative

- Procedural compliance
- Inventory control
- Two-man rules
- Access controls
- Safeguards and security rules
- Meteorological restrictions
- Training
- Knowledge
- Line management oversight

F.3.2 Criteria for Failure and Challenge of Barriers

In order to develop EALs based on barrier condition, *barrier failure* and *barrier challenge* should be defined. Failure of a barrier can usually be recognized by the readings or output from plant instruments, such as valve position indicators, failed fuel monitors, pressure sensors, or stack effluent monitors. Criteria for declaring that a particular barrier is failed should be stated in terms of specific values on specific instruments ("Main Stack Radiation Monitor System (RMS)-19 indicates > 1.5E + 8 uCi/sec," or "Any Valve Position Indicator on panel CI-903 indicates Open").

To achieve an anticipatory and conservative declaration in the case where all indications of a barrier's condition are lost during an upset condition or operating transient, it may be necessary to consider the barrier to be failed until conditions can be verified satisfactory by other means. For example, if, following a building isolation signal, the control room position indicators for two of the ten installed isolation valves/dampers show neither an open or shut indication, then the associated valves/dampers should be considered failed and open until they can be verified shut by another method.

A barrier should be considered threatened or challenged if the events in progress may result in a barrier failure. In general, classification should not be delayed by the expectation that mitigating activities in progress are likely to correct the degraded conditions. EAL statements should take into account the likelihood that corrective actions can and will be taken within the time necessary to prevent barrier failure such that the decision is not left to the user. For example, recognition of a fire that could challenge a barrier may be a good basis for classifying the incident at a level corresponding to failure of that barrier. The degree of challenge is directly related to the duration of the fire (and thus indicative of the success of mitigation efforts) and can be reflected in an EAL statement such as "Fire in Zone 1 lasting more than 15 minutes," where the 15 minutes is related to the time that the barrier could remain intact under fire conditions.

F.3.3 Based On Barrier Status

A method for developing facility-specific EALs based on barrier status is outlined in the following steps:

1. Identify, from the facility EPHA prepared in accordance with the Order (and as further detailed in Chapter 2), the radiological and hazardous/toxic materials sources of significant operational concern.

2. For each material and source (storage or process location), determine the highest possible emergency class from release of that material, as analyzed in the facility EPHA.

3. Determine the physical, administrative, and configuration barriers between each of the sources and the outside environment.

   For the purposes of the EAL development process, it is unlikely that more than three barriers (physical and other) can be reasonably credited for any hazard source. For simplicity, no more than three overlying and independent barriers should be considered. Justification for selecting barriers should be provided in an accompanying technical basis document. For example, a building and its HVAC system should not be considered a barrier unless the HVAC filtration system can remove a high enough percentage of the material of interest during the maximum credible release to prevent exceeding any exposure criterion at the facility perimeter while maintaining a negative pressure in the building. Additionally, the continued operation of the filtration system should be assured due to design considerations such as redundant power supplies.

NOTE: This method is based on the assumption that the barriers are approximately equal in their safety significance. If the barriers differ widely in the degree to which they ensure control over the hazardous material, their failures (or challenges) cannot logically be treated as equal safety decrements for purposes of assigning an emergency class. No more than three significant barriers should be considered.

4. Develop facility-specific EALs for each hazardous material source at the facility using the concepts of barriers *failed* or *challenged* as follows.

- Select the independent barriers (between the source and the environment) for which credit will be taken.

- For each barrier selected, identify the symptoms or observable indications of the barrier being either failed or challenged.

- If all of the barriers are either failed or challenged, then the symptoms of barrier challenge or failure, taken collectively, constitute an EAL for declaring the highest emergency class, identified in Step 2 above. For example, in the case of a hazardous material source that is capable of producing a General Emergency and has three barriers preventing its release, the comprehensive EAL set for the General Emergency class would include indications of the following combinations.

  – Three barriers failed

  – Two barriers failed, one barrier challenged

  – One barrier failed, two barriers challenged

  – Three barriers challenged

- For the second and third combinations, there may be three permutations each. For example, if A, B, and C designate the individual barriers, the second combination (two barriers failed and one challenged), may be either:

  – A and B failed, C challenged, or

- A and C failed, B challenged, or
- B and C failed, A challenged.

- If all except one barrier is failed or challenged, the condition is classified at one level lower than if all are failed or challenged. In the three barrier examples cited above, the class would be Site Area Emergency (SAE) and the comprehensive EAL set for the SAE class would include indications of the following combinations:
  - Two barriers failed, one barrier intact and not challenged;
  - One barrier failed, one barrier challenged, one barrier intact and not challenged; and
  - Two barriers challenged, one barrier intact and not challenged.
- If all except two barriers are failed or challenged, the condition is classified two levels lower than if all are failed or challenged. For the three barrier example cited above, the class would be Alert and the EALs for the Alert classification would be based on indications of one barrier either failed or challenged and two barriers intact and not challenged. This case requires some special attention, since the purposeful and controlled breaching of a barrier (in a multiple barrier facility), such as the temporary opening of a truck lock door or the performance of carefully planned maintenance activities on a barrier, should not be considered a failure or challenge.

5. Incidents or conditions that represent a reduced margin of safety, but with no predicted barrier failure or challenge in the next few hours, should be treated as an OE not requiring classification or under the DOE Occurrence Reporting System, as applicable. Similarly, if the third barrier is failed, but the inner barriers of fuel clad and primary system have not failed and reactor shutdown must occur, the containment failure should be treated as an OE not requiring classification since an actual release of hazardous materials has not occurred and the potential for release is very low.

F.3.4 Examples of EALs Based On Barrier Failure and Challenge

The process described in the previous sections can be applied to hazard sources having less than three barriers and sources for which the highest emergency class is SAE or Alert. In the example below, only two barriers exist, a single-wall chemical process tank and the building within which it is located. The building can be sealed against maximum credible pressures. It has been calculated that the maximum credible release, a sudden complete breach of both the tank and the building, should be classified as an SAE. If the barriers are considered to be nearly equal in their safety significance, their condition can be used as a measure of the degree of safety degradation and, hence, as the basis for determining emergency class.

The EALs for SAE should include indications of the following conditions.

- Two (both) barriers failed
- One barrier failed, one barrier challenged
- Two barriers challenged

Likewise, the EALs for Alert should include indications of the following conditions.

- One barrier failed, one barrier intact and not challenged
- One barrier challenged, one barrier intact and not challenged

Accordingly, SAE EALs might read as shown in **Table F-1**.

The example in **Table F-1** represents only a subset of the possible EALs applicable to the hypothetical facility. The EAL development process should attempt to define all of the symptoms of failure or challenge to barriers. To the maximum extent possible, EALs should be stated in terms of specific installed indications, such as individual fire alarm panel temperature and ion detectors identified by zone, or process pressure and temperature indicators identified by panel and instrument number. There are obviously hazards capable of generating an SAE or General Emergency to which the barrier approach cannot be applied. The EALs for incidents impacting such a hazard are usually worded to describe incidents, even though the incidents are really single-barrier failures.

Between 5 and 20 categories will be sufficient for most facilities. If more categories are used, the categories will tend to be more explicit and narrowly defined. While it is easier for the user to understand and relate to more explicit individual category titles, the resulting larger number of categories makes it more difficult for a user to scan the entire EAL set and select the applicable statements in a limited time.

Example List of EAL Categories

The following list of 12 EAL categories covers a wide range of possible incidents and conditions that could occur at a DOE facility:

1. Barrier status
2. Radiological releases
3. Hazardous chemical releases
4. Fire or explosion
5. Electrical failures (power supply)

6. Abnormal process system conditions (leakage, temperature, pressure, reaction rates)

7. Loss of control and indicator features (automatic trips, indicating systems, safe shutdown systems)

8. External incidents (man-made)

9. Safeguards and Security events

10. Natural phenomena impacts

11. Criticality control

12. Miscellaneous

Table F-1. Example SAE EALs Two Barriers Failed

Two Barriers Failed	***As Indicated By***
Tank 501A ruptured	*Any two building sump high alarms* ***OR*** *Tank 501A rapid level decrease* ***OR*** *Monitor HF-23 >1000 PPM* ***OR*** *Relief 501A-2 open*
AND	**AND**
Building 602 failed	Visual observation **OR** One or more HVAC dampers not shut **OR** Truck lock air seal failure alarm
One Barrier Failed; One Challenged	***As Indicated By***
Tank 501A ruptured	Any two building sump high alarms **OR** Tank 501A rapid level decrease **OR** Monitor HF-23 > 1000 PPM **OR** Relief 501A-2 open
AND	**AND**
Building 602 challenged	Fire potentially degrading HVAC or door seals **OR** HVAC air operating system pressure <85 PSIG **OR** Building 602 pressure >2“ H_2O

OR	**OR**
Building 602 failed	Visual observation **OR** One or more HVAC dampers not shut **OR** Truck lock air seal failure alarm
AND	**AND**
Tank 501A challenged	501A pressure > 125 PSIG **OR** 501A temperature > 355° F **OR** Loss of cooling water flow to 501A **OR** Fire out of control in Building 602
Two Barriers Challenged	***As Indicated By***
Tank 501A challenged	501A pressure > 125 PSIG **OR** 501A temperature > 355°F **OR** Loss of cooling water flow to 501A **OR** Fire out of control in Building 602
AND	**AND**
Building 602 challenged	Fire potentially degrading HVAC or door seals **OR** HVAC air operating system pressure <85 PSIG **OR** Building 602 pressure >2" H_2O

Table F-2 provides examples of expanding the EAL category, Barrier Status, depending on the type of facility and the degree to which barrier status is used to quantify the safety state of the facility and processes.

Table F-2. Example EAL Sub-Categories for Category Number 1

Facility Type	***Possible Barrier-Status EAL Sub-Categories***
Reactors	Fuel cladding, reactor vessel and coolant piping, confinement or containment building
Expended fuel	Fuel cladding, storage building, and HVAC system
Chemical/materials processes	Tanks, pipes, traps, hot cells, building, and HVAC systems
Radioactive waste	Binding/solidifying agent, drums and tanks, buildings, geologic containments
Toxic material storage	Tanks, cylinders, building, and HVAC system
Weapons and fissile material	Configuration, arming features, assembly facilities, geologic containment, configuration controls

Appendix G. Ingestion Pathway Calculations for Radioactive Releases

G.1 Introduction

The purpose of consequence assessment during recovery is to provide support for key protective action decisions that occur once the emergency situation is well under control. Planning and supporting consequence assessments following an Operational Emergency (OE) involving the release of radioactive materials will often begin as soon as resources can be made available from the earlier more urgent analyses of the ongoing consequence assessments. Key recovery decisions that may need consequence assessment support include the following:

- Protective actions for workers and the general public from exposure during reentry and recovery activities, including relocation and resettlement
- Relaxation of earlier public protective actions
- Food and water intervention
- Soil and food sampling activities
- Decontamination
- Resumption of normal operations at all affected facilities

The decision-making support required during recovery is an extension of the Continuous Ongoing Assessment (COA) process, but with additional calculations for food and water interdiction actions. Depending on the radioactive isotopes released, assessments of impacts on the ingestion pathway can be initiated during emergency response as part of the recovery planning activity.

G.2 Recovery Assessments

At some point in the emergency response, comprehensive and reliable information should be available for consequence projections, and comprehensive consequence projection tools and methods appropriate to recovery decisions have been employed. Moreover, predetermined decision criteria appropriate to the specific recovery actions have already been identified and are documented on worksheets. When the above situation exists and accident mitigation has been essentially accomplished, assessments of the impacts of the radiological release on the ingestion pathway can be initiated, depending on the type of emergency. Planning for the initiation of this latter phase application of consequence assessment generally occurs during recovery. However, for Department of Energy (DOE)/National Nuclear Security Administration (NNSA) sites where ingestion pathway is a sensitive matter to the State and local emergency response organizations (EROs), ingestion pathway assessments should be initiated even prior to the implementation of recovery activities.

The length of time for performing the ingestion pathway assessment is strongly dependent upon the type of emergency and other circumstances, and requires a graded response. Ingestion pathway consequence assessment is not one-size-fits-all and should be designed for the specific parameters at each DOE/NNSA site location. The ingestion pathway assessment and its associated response are dependent on the type and quantity of radionuclides released, and the ingestion pathways specific to the local environment. The availability of field monitoring equipment and analytical laboratory capabilities also plays a role in the execution of the ingestion pathway assessment.

To perform effective ingestion pathway assessments, the source term should be known with reasonable certainty and a field monitoring and sampling plan should be developed to obtain confirmatory measurements. In cases where a major radiological emergency has been declared and a Federal Radiological Monitoring and Assessment Center (FRMAC) response is already in place, the field monitoring teams will be dispatched from the FRMAC. If all FRMAC assets are called out, this phase of consequence assessment could be quite large and involved, requiring a time-intensive response that could last weeks.

Projected consequences are compared to the decision criteria and consequence-based recommendations are developed. These recommendations are specific to the recovery activities and decisions being evaluated; incident classification is no longer within the scope of this phase. In addition, recommendations are no longer focused solely on protective actions, but move toward recovery considerations; information is transmitted to decision makers in the ERO using formal, written worksheets and notification forms. Notification forms to the Tribal, State, and local emergency response agencies should be modified to include ingestion pathway assessment reporting parameters and ingestion pathway-based protective action recommendations. Moreover, the ability of these response organizations to mobilize interdiction response needs to be considered. The development of the source term, affected ingestion pathway elements, and confirmatory monitoring may take several days.

G.3 Ingestion Phase Assessments

Ingestion phase assessment is a recovery activity. As with other recovery phase assessments, much more will be known about the incident and the source term than was available for use in plume exposure (early) phase consequence assessment efforts. However, the plume trajectory, time-integrated air concentrations, and ground deposition levels calculated during plume exposure phase assessments can and should be used to identify the geographic areas and specific foodstuffs that may be contaminated. If food and pasture become contaminated, intervention is required to prevent unnecessary exposure.

Dose assessments involving the ingestion pathway require source terms that involve the total airborne release (of all particle sizes) for each isotope released. Use of the total airborne source term, explicit consideration of the larger size of non-respirable particles (and therefore faster deposition velocities), and related release factors will likely produce a different and more accurate deposition pattern for determining ingestion dose. Precipitation patterns during and subsequent to the incident should also be considered.

Whether the incident occurred during the growing season and what phase of the growing season for each crop in the region should be considered, as well.

The Food and Drug Administration (FDA) has developed Derived Response Levels (DRLs) which represent the radionuclide-specific concentration in food present throughout the relevant period of time that without intervention could lead to an individual receiving a radiation dose equal to the PAG. In the event of an emergency, concentrations in various food types are compared with these levels to make interdiction decisions. The FDA has published guidance and recommended DRL values for ingestion pathway planning and response (FDA, 1998).

The DRLs are the radionuclide-specific concentrations in food at which the introduction of protective measures should be considered. In general, food with concentrations below the DRLs has no restrictions on ingestion. Above the DRLs, food is not permitted in the food supply. Knowledge of the specific radionuclides that comprise a source term and the characteristics of the ingestion pathway environment (soil-to-crop transfer factors, livestock types, sources of feed and water) can be used to estimate values of air concentration or ground deposition during the plume exposure phase that correspond to a DRL in specific agricultural commodities at some later time. The calculated or measured plume concentration (Bq m^{-3}) for a gas or surface deposition (Bq m^{-2}) value for particulates that suggests a derived intervention level will be exceeded in the future is termed a Derived Response Level (DRL). The DRLs are expressed in units of air concentration or surface deposition and can be compared directly with the results of early phase consequence assessment modeling and field measurements to make preliminary ingestion pathway intervention decisions.

As part of the site-specific consequence assessment preparedness effort, each constituent of each source term and its behavior in the environment (transfer from air to soil to vegetation to animals) need to be evaluated for possible significance to the ingestion pathway dose. By accounting for the deposition on surfaces and vegetation, as well as transfer between soil and plants, plants and animals, site-specific DRLs can be calculated. When site- and source term-specific DRLs are available, the results of the plume exposure pathway consequence assessment calculations can be interpreted directly to alert responders and authorities to the possibility of significant ingestion pathway doses. This information can be used during the plume exposure phase to:

- Make requests for FRMAC activation or other outside assistance
- Target preliminary sampling of foodstuffs using local response assets
- Advise State and local health authorities regarding the foodstuffs and locations of most concern

For most small releases, this information can also help demonstrate to local authorities and the public the absence of any ingestion pathway dose concerns, thereby avoiding costly and unnecessary boycotting or destruction/loss of foodstuffs.

Appendix H. Field Monitoring

H.1 Introduction

Field monitoring is the process of acquiring *in situ* information about the impact of an actual or suspected release of radiological or chemical hazardous material by taking direct measurements in the environment, or by sampling environmental media for subsequent laboratory analysis. The resulting data and information are ultimately used to confirm or refine the initial or earlier consequence estimates and, as a body of data is acquired, to characterize the extent and magnitude of the dispersal of hazardous materials in the environment. Types of measured information that can be directly acquired by field monitoring teams include concentrations of contaminants in air, dose rates from radioactive materials deposited on surfaces, and surface contamination levels. Environmental samples, acquired from sampling and subsequent laboratory analysis of soil, water, and vegetation, identify specific contaminants and their concentrations in those media.

Once an incident involving the airborne release of a hazardous material is classified as an Operational Emergency (OE) and the emergency response organization (ERO) is activated, it takes time to assemble, equip, brief, and dispatch the field monitoring teams to the desired locations. The time from decision to dispatch until the first data arrives depends on the development of a field monitoring plan, assembly and briefing time, the distance that the teams need to travel, the terrain to be encountered and route to be taken (including finding a safe route of travel), the area to be covered, the specific sampling locations, and the types of measurements or sampling activities that are performed.

It requires time to gather a sufficient body of field monitoring data to significantly impact the consequence assessment-protective action decision-making process. Due to the large uncertainties involved with calculating the transport, dispersion, and deposition of materials in the environment, especially in regions of complex terrain, a significant number of field measurements are necessary to characterize the impacts from a release to achieve sufficient confidence in the calculations. As a result, field monitoring data becomes increasingly important to the decision-making process as time progresses. Depending on the nature and magnitude of the release, field-monitoring activities may need to continue well into the recovery phase, including the ingestion phase assessments, in order to gather sufficient data to confidently characterize the contamination in the environment and to support decision making for long-term mitigation, recovery, and protective actions.

Initial data points can be used to verify that a release has actually occurred, is in progress, or is no longer occurring, and can help to determine if the general direction of plume (or surface contamination) travel is consistent with atmospheric transport and dispersion model estimates/predictions. This is especially important at Department of Energy (DOE)/National Nuclear Security Administration (NNSA) sites/facilities/agencies (SFAs) located in regions of complex terrain. Field-monitoring information is useful in verifying that current protective actions or protective action recommendations adequately protect those most at risk. This body of information is also useful in confirming the safety and health of the workers and the public associated with the choice of evacuation routes, staging areas, or relocation centers.

As more field-monitoring information becomes available, the monitoring and modeling results can be used to gain confidence in the projected impact area, the projected severity of the impact, and the estimated amount of material released. Thus, a reliable estimate of the general size and shape of the impacted area will start to emerge. This data can be used to develop a systematic plan to subsequently monitor and sample the impacted area in order to fully characterize the extent of the environmental contamination. The resulting data can be used to support a decision to terminate the emergency response by verifying that the release is no longer occurring, the situation in the affected areas is stable, most areas of contamination have been generally identified, and specific areas are now safe to reoccupy. The resulting data also assists in planning for recovery by identifying and quantifying areas of contamination that may require remediation and long-term protective actions, such as food intervention.

Depending on the extent of the area impacted and the nature of onsite activities and offsite land use (water supply, dairy production, farming, grazing, etc.), field monitoring data may be necessary to develop protective actions or protective action recommendations for the ingestion pathway. If the area impacted is large, it may take many data points to fully characterize the extent of environmental impact, and particularly to identify the boundaries of the contaminated areas. This effort might require monitoring resources beyond those available at the local DOE/NNSA site. If the extent of contamination is severe enough to require outside assistance from the DOE/NNSA Nuclear Emergency Support Team, it may take a few days for this assistance to arrive, mobilize, begin to function, and produce useful data. Hence, the DOE/NNSA site Consequence Assessment Team (CAT) should have the ability to use existing data to develop initial protective actions or protective action recommendations for the ingestion pathway (see also Appendix H). The Federal Radiological Monitoring and Assessment Center Assessment Manuals provide assistance in understanding the assessment methodologies and monitoring capabilities necessary to implement this capability.

H.2 Field Monitoring for Radiological Releases

The DOE/NNSA community has been monitoring radioactive materials in the environment for decades, and the traditional technologies and methodologies associated with radiological field monitoring are mature. As a result, each DOE/NNSA site that manages radioactive materials has equipment, supplies, procedures, and trained personnel that can be applied to the task of field monitoring for radiological releases. Field monitoring during an emergency response utilizes similar methods, supplies, and equipment to those used during routine environmental and workplace monitoring activities. Additionally, most of the larger DOE/NNSA sites have laboratory facilities equipped to analyze environmental samples, or are near such laboratories.

Much of the available radiation detection equipment is designed for field use, is capable of detecting emissions from a range of isotopes, and has sufficient range of response to be useful under accident conditions. Many DOE/NNSA facilities have installed interior radiation detection equipment (i.e., process monitors in stacks, room area monitors, and room continuous air monitors) that can also be used to help verify and quantify releases of radioactive material. In some cases, a DOE/NNSA site might have permanently installed environmental radiation detection equipment that can provide continuous field monitoring data.

With the application of proper precautions for team safety and health, and development of a field monitoring plan, in addition to employing As Low As Reasonably Achievable (ALARA) principles, it is possible to use field teams to identify the edge of plume at ground level, perform monitoring while a release is still ongoing, and operate for extended periods in areas that have a low levels of airborne or surface contamination. Field teams may also be able to provide a ground level transect of the affected area provided the level of exposure is consistent with ALARA. The new technologies and methodologies that further reduce potential health and safety impacts for field team members is an increasingly attractive approach to supplement traditional field monitoring – especially when these new methods also increase the timeliness, quantity, and quality of the data collected. These new methods could involve the use of remote controlled or autonomous monitoring equipment, including both ground-based and aerial systems.

H.3 Field Monitoring for Hazardous Chemical Releases

Field monitoring in response to the release of a hazardous chemical is significantly different than monitoring a radioactive release. Because of the potential immediate lethal consequences to responders from inadvertent exposure to an unknown/uncharacterized concentration of a hazardous chemical, responders should wear appropriate personal protective equipment (PPE). This equipment greatly reduces personal mobility, the ability to remain hydrated, and the stress and heat generated limit the time that a responder can safely and effectively operate. These issues are particularly acute in high ambient heat conditions. Under severe circumstances, this equipment is used for search and rescue or to mitigate an ongoing release that is endangering human life. Because of the extreme hazard to response personnel, attempting to characterize a toxic plume while a release is in progress by field monitoring, using methods similar to characterizing a radioactive plume, is generally regarded as impractical and should not be attempted.

Successful use of field monitoring teams during a chemical release usually involves monitoring in locations that require minimal PPE and allow for the use of typical portable industrial hygiene instrumentation. Due to the potentially severe consequences from exposures to hazardous chemicals, one of the first priorities will be to establish whether locations where personnel are sheltered or assembled are safe for continued occupancy. Areas in which response personnel operate also need to be verified as safe. As the response progresses, measurements will be necessary to confirm that the release has been terminated, the situation is stable, and areas are safe to reoccupy. Once the emergency response is drawing to a close and recovery planning begins, field measurements and sampling will be necessary to identify areas of contamination that may require remediation and long-term protective actions.

Equipment capable of detecting hazardous chemicals in the environment also have limitations.

- Recent advances in instrumentation have made industrial hygiene equipment more portable and useable in the field. However, in order to equip a monitoring team with the correct equipment, the specific chemical or class of chemical needs to be known before the team's deployment. Decisions related to what monitoring equipment to keep in stock and calibrated should be based on the chemical inventories at the specific SFA.

- A number of different pieces of equipment may be necessary to detect the types and quantities of hazardous chemicals that could be released. Much of industrial hygiene equipment available is designed for workplace monitoring to support health and safety surveys. Often this equipment does not have the upper ranges needed to measure the higher contaminant concentrations that could exist following an accidental release.

- Chemical monitoring equipment is usually not available in large quantities at DOE sites and may be very costly for sites that have numerous hazardous chemicals in their inventories. Also, the number of personnel with the appropriate training and expertise to operate this equipment in the field is somewhat limited. Judgments about chemical field monitoring are needed to ensure that an appropriate risk-based, cost-effective suite of monitors and supporting equipment are selected and maintained.

H.4 Comparison of Monitoring and Modeling Results

As time progresses, a primary function of Continuous Ongoing Assessment is to develop a clearer understanding of the characteristics of the release in terms of the actual trajectory of the plume, the doses or concentrations experienced by receptors, and the resulting levels of contamination. Comparing monitoring and modeling results can help to answer some important confirmatory questions related to these issues, such as:

- Did a significant release actually occur?

- Is the projected direction of the plume correct?

- Is the projected area of impact correct?

- Is the estimated amount of material released correct?

- Are the estimated consequences correct?

Monitoring data that can be compared with modeling results include real-time air concentrations, air concentrations from an in-place monitoring network, ground deposition measurements, and aerial surveys. Monitoring limitations, however, may impact the nature and quantity of field monitoring data available for comparison. General limitations include personnel safety, logistics, and monitoring techniques and methodologies.

- **Personnel Safety** can limit the ability to send teams into areas of suspected contamination.
  - The unknown nature or magnitude of the hazard may require the maximum level of PPE, which imposes a high degree of physical stress on personnel, limits their mobility, and places a time limit on operations.
  - Available PPE may not be capable of adequate protection.
  - Inability to safely decontaminate response personnel may limit activities.
  - Weather conditions may pose safety concerns.
- **Logistics** can limit the ability to collect field-monitoring data. The number of available trained personnel, types and quantity of monitoring equipment/supplies, accessibility of terrain, and the availability of vehicles and communication may limit the number of teams that can be placed in the field.
- **Monitoring Techniques and Methodologies** can make location of contamination in the environment problematic and can cause delays in the availability of monitoring results.
  - The type/quantity of material may make detection difficult with portable instrumentation, requiring sampling with follow-up laboratory analysis.
  - Material that does not deposit on surfaces cannot be detected once the plume has passed.
  - The timing of data collection before, during, or after plume passage can have an impact on the ability to compare field data with modeling estimates.

To facilitate comparison, specific modeling and monitoring products should be compiled, including:

- A map of the plume footprint
- A map of atmospheric concentrations
- A map of ground deposition
- A map showing where, when, and type of measurements taken
- Record of laboratory analysis results of field samples
- Record of analysis results obtained at any pre-designated monitoring/sampling locations

These modeling output products should use measuring units that can be easily compared to those used in field data. Input parameters and assumptions, such as meteorological conditions, duration of release, release height, receptor exposure time, and deposition velocity, should be available and easily associated with the outputs. The monitoring and modeling results should be compatible for a valid comparison. There should be a match (or established basis for comparison) between units, locations, plume-transport time, sampling times, and sampling durations.

The following are types of field measurements and samples that could be obtained:

- Continuous monitoring or a series of samples showing changing concentrations over time
- Time-integrated samples, usually from fixed monitoring sites
- “Grab”/instantaneous samples, usually from sampling teams
- Plume boundary at ground level, if plume or deposition footprint can be measured
- Ground-level transect of plume, if possible and safe to measure
- Vertical transect of plume, but not ordinarily possible
- Environmental samples

If teams are equipped with field deployable samplers/monitors, they can be placed and left in the anticipated path of the plume to gather measurements of time-integrated concentration, changing concentrations, or exposure/dose rate (depending on instrument capability) over time. This type of data may also be available from fixed monitoring stations that are in the path of the plume.

It is likely that there will be errors in both the monitoring and modeling results. For example, errors may occur in the area/shape of the plume footprint, horizontal placement of plume footprint, vertical distribution of the plume, maximum impact within plume footprint, and timing of plume passage. Early in the field monitoring effort, it may not be possible to differentiate between sources of the errors. As more field-monitoring data becomes available, the confidence in the data and resulting estimates of consequence results should increase. These differences between calculation and measurement results define an envelope of uncertainty that bounds the consequence estimates.

When initial field data are received, confirmation of several aspects of the consequences can begin in order to verify that a significant, measurable release has occurred. These include:

- **Impacted Area**. Involves identification of the plume boundary or area of ground contamination and verifies that the predicted plume direction is correct. A practical approach involves the following steps:

  - Begin with the projected plume path.
  - Detection techniques will involve:
    - **Sample/monitor for air concentration or ground deposition; or**
    - **Retrieve fixed samples or dispatch sampling teams.**
  - Move from outside projected impact area toward plume, until the plume is detected.
  - Move back, away from the plume, and sample toward the plume, either further upwind or downwind, to establish boundaries of the deposition.

- **Severity of the Impacts**. Involves comparison of maximum measured impact to maximum predicted value. A practical approach involves the following steps:
  - Find the plume.
  - If safety allows, conduct at least one ground level transect of the plume (two or more preferred).
  - Compare maximum observed impact along transect (concentration or deposition) to maximum impact modeled, at same distance along plume trajectory.

- **Amount of the Release**. Involves comparison of the integrated plume content along a transect using measured and modeled values. A usually viable approach involves the following steps:
  - Find the plume.
  - If safety allows, conduct at least one ground level transection of the plume (two or more preferred).
  - Conduct at least one vertical transection of the plume (if possible) ***or*** assume that the actual vertical structure matches the modeled vertical structure.
  - Integrate the impact (concentration or deposition) along the transection for both observed and modeled results.
  - Compare integrated impact along the monitored transection to the integrated modeled impact along a transection at the same distance along the plume trajectory.
  - Compare observed data to modeling results that both match the properties of the observed data (integrated, instantaneous, time measured) and correspond to the same locations as the observed data.

There are several reasons why the plume or ground deposition may not be immediately found. The quantity released may be too small to be detected using available portable instrumentation; in this case, the plume may be detected/confirmed later using sample results and laboratory analysis. The plume may be in a different location than projected. The plume may not have been transported to the present location of the field monitoring team. If the release point is elevated, the plume may still be overhead. If the plume cannot be found and the release was assumed to be at ground level and not extremely buoyant, the field teams should continue monitoring in a pattern moving across the projected path of the plume, while moving towards the point of release, until a detectable reading is obtained. If the release was elevated or the plume buoyant and the material is expected to deposit on surfaces, it may be necessary to send at least one team in a cross plume search pattern towards the point of release and another team on a downwind search pattern. If the material is not expected to deposit surface contamination, it is possible that the plume could completely dissipate before it is located.

Field data and the modeling results will not agree exactly when compared. Some of the possible reasons for these differences are:

- The amount or release rate may be different then estimated.
- The particle size distribution of the release is not known and not accounted for in the model.
- Wind fields that are not fully consistent with Gaussian assumptions; may exhibit spatial and temporal variability.
- The actual atmosphere terrain and turbulence is not simulated accurately in the dispersion model.
- The vertical distribution of the plume may differ from the model assumption.
- The deposition may differ from that estimated.
- The timing of plume passage may be different than expected.
- The model is simply an imperfect representation of reality.
- Limited field measurements may not reflect the average behavior of the plume and its broader scale impacts.

As more data becomes available, it should become easier to identify the conditions that contribute to the differences. Re-running the models and adjusting the input parameters and assumptions to try to achieve better agreement with the field data can also provide insights into the reasons for the differences.

Ultimately, it may be difficult or impossible to account for all of the factors that impact the ability to reconcile the differences between the calculation and measurement results.

In spite of this possibility, the CAT should combine the calculation and measurement results into the best overall picture using their judgment of the level of confidence for each piece of information. The amount of field monitoring data to adequately support comparison may not be available until after the emergency response has been terminated, and even then, it may be difficult to interpret. However, the body of field monitoring data and comparisons to modeling results will always prove to be useful in reconstructing actual impacts in the investigation that follows any emergency response.

H.5 Field Monitoring Team Equipment and Resources

Equipment and supplies designated for the use of field monitoring teams should be identified prior to an emergency and, if possible, prepared and stored for use only during an emergency. The means of transportation for its use by field teams during an emergency should also be identified. Vehicles should be readily available to support a response at all times and capable of holding all equipment and supplies for easy access and use during monitoring activities. In areas where weather or terrain are a significant factor, four-wheel drive vehicles should be considered.

Radio and back-up communication equipment should be available to field teams and CAT personnel responsible for field team direction, control, and data transmission. Radio frequencies chosen should not be shared with other high traffic activities.

Laboratory resources for the analysis of field samples should be identified and a means for sample handling and transporting should be designated. Many DOE/NNSA sites have onsite laboratories for the analysis of environmental samples for radioactive contaminants. It may be necessary to establish a contractual relationship with a certified commercial laboratory for the analysis of samples containing chemical contaminants.

H.6 Field Monitoring Team Preparations

The process of taking field measurements may be very similar to that used for routine environmental sampling, particularly for radiological measurements, and these procedures can serve as a starting point. Field monitoring teams should have the proper skills and knowledge to accomplish their tasks, including:

- Proper use of instrumentation
- Knowledge of field measurement and sample collection methods
- Familiarity with data forms and data recording
- Knowledge and use of communication protocols
- Experience with data transmittal procedures

The CAT members who support and direct field monitoring activities have responsibility for the following:

- Team briefings
- Team health and safety
- Dispatch and control of field teams
- Utilization of radio communication protocols
- Prioritization of monitoring activities and allocation of resources
- Transmission and recording of data
- Data analysis and interpretation
- Dissemination of results within the ERO

Personnel for field monitoring team assignments should be identified, provided with the required training, and assigned to the ERO roster. If both chemical and radiological release hazards are possible, both health physics and industrial hygiene personnel will be necessary. Field monitoring training should be developed for radiological field team members, hazardous chemical field team members, and CAT members.

H.7 Field Monitoring Team Recordkeeping

Depending on the length and complexity of the field monitoring effort, a large body of data and information could be generated over several days or weeks. The ability to accurately record all information relevant to each data point is necessary to implement and execute a systematic monitoring process and provide a permanent legal record of the results. Thus, an efficient method should be developed for recording, archiving, assuring quality, and displaying field monitoring data.

Appendix I. Operational Emergency Scenarios for Biosafety Facilities

I.1 Introduction

The purpose of this appendix is to provide examples of biological operational emergency (OE) scenarios to illustrate an approach that develops an integrated description of scenarios (see Section 4.2.4, above) for analyzing biological agent releases. These notional scenarios and associated summary tables should not be interpreted as an exact model to follow at all Department of Energy (DOE)/National Nuclear Security Administration (NNSA) biosafety facilities. These tools are not required, but represent a suggested thought process that may assist analysts in development of facility-specific release scenarios in Emergency Planning Hazards Assessment (EPHAs) and in application of EPHA results to develop categorization criteria and associated initial protective actions.

The Select Agents used in these scenarios were identified in the *Biosafety in Microbiological and Medical Labs* (BMBL), and either biosafety level (BSL) 2 or 3 conditions were recommended. The general assumption for all of the scenarios is that the facilities described are designated as BSL-3 facilities. It is assumed that the facility biosafety program requires laboratory personnel to wear PPE when working with infectious material. When a Class II biosafety cabinet (BSC) is equipped with an operable high-efficiency particulate absorbing (HEPA) filter, it is assumed that no release to the laboratory or the environment occurs (in accordance with the BMBL) when material is released in the Class II BSC, either accidentally or as the result of an activity being performed.

The scenarios presented below focus on one set of parameters that describe an incident and subsequent release. Each incident described might lead to one or several different conclusions, depending on the observables acquired and used to determine whether the incident should be categorized as an OE. In several of the scenarios given below, conditions stated for detecting/recognizing the OE release might not be investigated and available to the staff personnel for various reasons, including:

- Failure to recognize that safety systems were not operable or were compromised at the time of the release;
- Failure to identify appropriate correlations among observed indicators of a release;
- Failure to recognize limitations of secondary containment barriers when some indicators may not provide definitive conclusions on the possibility of a release.

If any of these types of conditions (or others) exist, then the release may only be recognized indirectly. Observables that may be used to recognize an OE indirectly can include:

- Agent/toxin is found during routine environmental sampling and analysis;
- Medical Surveillance program detects infected individuals;
- People (or animals, for overlap agents) are found to have manifested symptoms of infection consistent with the incubation period, either onsite or offsite.

If the agent found by an environmental monitoring program is not naturally occurring in the local area and is on the facility inventory, then an OE is declared, mobilizing resources to determine if a release did occur from within the facility. If the agent was naturally occurring, then the OE would not be declared based on the environmental monitoring program alone; additional confirmation would be needed. If public health authorities report an outbreak of the associated infection above expected norms, then an OE may be declared. If an agent of concern is discovered during routine environmental sampling and analysis that is not naturally occurring and is not on the facility inventory, then an investigation should be conducted to determine the source and take appropriate actions.

The Select Agent Rules require registered laboratories to develop incident response plans that address:

". . . theft, loss, or release of a select agent or toxin, inventory discrepancies, security breaches (including information systems), severe weather and other natural disasters, workplace violence, bomb threats, suspicious packages, and emergencies such as fire, gas leak, explosion, power outage, etc."

The following scenarios were developed to address OE incidents, such as natural phenomena, accidents within the facility, external accidents, and malevolent acts to assist in the development of incident response plans using the EPHA process to establish a technical planning basis. The operations and agents described in the scenarios are not necessarily representative of DOE/NNSA biosafety facilities, but are presented to illustrate the approach suggested in this Guide.

I.2 Accident Scenario 1 – Tube Breakage in Centrifuge (release of *B. anthracis* spores as an aerosol)

Incident: Two 50 ml tubes containing 40 ml each of $1x10^9$ spores/ml of *Bacillus anthracis* are placed in a centrifuge. A floor model centrifuge is used outside of the Class II BSC. A hairline crack in one of the centrifuge tubes goes unnoticed, causing the test tube to break early in the centrifuge run, releasing the solution. The technician opens the centrifuge door immediately after hearing the tube break, potentially releasing aerosolized spores (0.1 -1% of the solution = 50,000,000 to 500,000,000 spores or 500 to 5000 times the ID_{50} value) into the laboratory environment.

Conditions: The biosafety program requires that all centrifuges be used only in a Class II BSC, as the centrifuges in the facility are not equipped with a HEPA filtration system on the exhaust to the outside of the biocontainment area.

Because the centrifuge was used outside of the Class II BSC and the facility heating, ventilation, and air conditioning (HVAC) system does not have a filtered exhaust, an aerosolized solution containing *Bacillus anthracis* spores may have been released to the environment outside the biocontainment area. The assumed release duration is 30 minutes, based on evaporation, settling, and an air exchange rate of 10 room-air-exchanges per hour.

Recognition: The possible release of a biological agent into the external environment outside the biocontainment area is the basis for declaring an OE. Recognition indicators include:

- Laboratory personnel observe or discover damage to the test tube and release of the solution of *Bacillus anthracis* spores.

- The centrifuge is used outside the Class II BSC, in violation of laboratory biosafety procedures.

I.3 Accident Scenario 2 – Failure in Pest Control Program (release of *Yersinia pestis* bacteria via infected host)

Incident: The facility is undergoing an information systems upgrade. The work requires installation of new communications cables. At the end of the workday, openings for the new cables are left uncapped. Additionally, during the day, workers discard food waste in the area of the cable entries. Attracted by the food, local feral mice enter the facility through the open cable runs and enter the room where rodents infected with *Yersinia pestis* and that have exhibited the symptoms for pneumonic plague are housed. The cages have an open mesh that allows direct contact between the feral mice and the laboratory animals. The feral mice are infected with plague by their close contact through the cage mesh.

Infected feral mice leave the laboratory avoiding the rodent traps and go back into the wild before the open entryway is found and closed. Once back in the wild, the fleas on the feral mice become infected by feeding on the infected mice. The infected fleas then transmit the bacteria to other mice. Coyotes and cats catch and feed on the infected mice and become infected in turn. The bacteria are spread by fleas of the infected hosts and continue to multiply in the mammal and insect populations, eventually infecting humans.

Conditions: The facility conducts experimental work with laboratory animals infected with *Yersinia pestis*. Workers handling infected animals are required to use PPE designed to prevent direct transmission. Caging systems are used to contain infected animals. An Integrated Pest Control Program, as defined in the BMBL, is in place. Treatment of laboratory animals with a pesticide/repellent and daily flea infestation inspection is part of the program to prevent the spread of the plague bacteria from laboratory animals to workers. Workers installing the cables were not briefed on the facility pest control program.

Recognition: The OE would be declared based on the potential that feral mice avoided the traps and may spread the disease outside the biocontainment area. Recognition indicators used as the basis for an OE incident declaration may include:

- Discovery of trapped feral mice within the facility (indicating a potential failure in the pest control program)
- Discovery of unsealed cable penetrations, which could allow rodents and other vectors direct access to the interior of the facility

I.4 Accident Scenario 3 – Anaerobic Jar Explosion (*C. botulinum* bacteria and toxin released as an aerosol)

Incident: An experiment is set up using a 2-liter flask with 300 ml of *Clostridium botulinum* bacteria at a titer of approximately $1x10^9$ cells per ml in liquid medium contained in an anaerobic jar. The jar creates an artificial anaerobic environment permitting the growth of anaerobic bacteria. The anaerobic environment is achieved using a chemical reaction to generate hydrogen gas. In the presence of a catalyst, the hydrogen gas reacts with free oxygen in the air to form water. This reaction removes the oxygen from the sealed atmosphere. The bacterial culture is then incubated at the desired temperature. A wire capsule is normally placed around the catalyst as a safety measure. On day 6 of the experiment, the catalyst is replaced. The wire capsule is not used and the anaerobic jar, and flask inside, explodes. As required by laboratory procedures, the anaerobic chamber is used in a Class II BSC.

Conditions: The Class II BSC in this facility exhausts directly to the HVAC system rather than to the laboratory space. The facility has installed a HEPA filter on the HVAC system ensuring that all of the exhaust streams are filtered prior to exiting the facility. A release to the environment from an anaerobic jar exploding in the Class II BSC requires that the HEPA filters in the Class II BSC and in the HVAC system are both nonoperational at the same time. If the jar were outside of the Class II BSC, then just the HEPA filters in the HVAC would have to be non-operational for a release to the environment.

Recognition: Possible release of a biological agent into the external environment is the basis for declaring an OE. Recognition indicators used as the basis for an OE incident declaration may include:

- Anaerobic jar and flask inside explode in the Class II BSC
- HEPA filters in the Class II BSC are non-operational

- HEPA filters in the HVAC system are non-operational

NOTE: Although the release is similar to A.1, this scenario was included to emphasize redundancy in biosafety design.

I.5 Accident Scenario 4 – Earthquake (release of dried *Bacillus anthracis* spores; airborne, contaminated personnel, and fomite transfer)

Incident: An earthquake occurs and seriously damages the facility. At the time of the earthquake, an experiment is being conducted with dried *Bacillus anthracis* spores. A container with approximately a gram ($1x10^{12}$ spores/g or $1x10^{7}$ ID_{50}) of *Bacillus anthracis* spores is thrown about, releasing respirable spores.

The research staff is in the vicinity of the containers that are broken when the earthquake occurs, and a number of these individuals are exposed to aerosolized spores. Contaminated personnel exit the building without going through normal decontamination and disrobing process, due to falling debris within the building and the perceived danger of building collapse. These individuals are in danger of infection from inhalation of aerosolized spores, contact with their eyes, noses, or mouths, or from bacteria entering through cuts or breaks in their skin caused by broken glass and falling debris. They remove their overgarments after exiting the building and discard them in the open. *Bacillus anthracis* spores released from the building or carried out on exposed persons or discarded protective garments, could be dispersed by the wind, or could contaminate unwitting persons attempting to provide assistance to affected workers.

Conditions: The impact of the earthquake causes internal building damage and falling debris. Exterior walls of the facility are cracked, and openings to the environment develop. Once released, spores are blown through the facility and out into the environment through openings in the structure. The assumed release duration is 12 hours or more, based on movement of air through the openings in the building blowing suspended spores out into the environment. Additional personnel and environmental contamination may occur as a result of contact with contaminated laboratory personnel and garments. Involved laboratory personnel, and persons who come into contact with them, should be tracked; medical monitoring and prophylactic antibiotic treatment should be started as a precaution.

Recognition: Release of a biological agent into the external environment is the basis for declaring an OE. Recognition indicators used for an OE incident declaration may include:

- Earthquake occurs and causes significant damage to facility structure (including creating openings to the environment).

- Container holding dried *Bacillus anthracis* spores was reported by personnel involved to have spilled, releasing the contents to the environment.

- HEPA filters (Class II BSC, HVAC) are inoperable due to loss of ventilation flow.

- Emergency evacuation of personnel from laboratory spaces occurs, without following the standard decontamination and disrobing procedures.

I.6 Accident Scenario 5 – Facility Fire (airborne and contaminated water release of *Clostridium botulinum* toxin)

Incident: A researcher is conducting experiments with *Clostridium botulinum* toxin. The researcher is carrying a container holding 0.5 grams of toxin (one nanogram [$1x10^{-9}$ g] per kg of body weight to kill 50 percent of the animals studied) to a BSC in the laboratory, when a short in the electrical system causes a fire to break out in the laboratory. The researcher is startled by the fire alarm and drops the container. The container opens on impact with the floor, releasing the toxin. As a result, the toxin is temporarily airborne and is released into the laboratory environment. The facility HVAC system does not have a HEPA filter on its exhaust. Some of the toxin is carried out of the room by the HVAC system. Sprinklers are activated shortly after the toxin is spilled and it is washed out of the air and off of surfaces by the sprinkler water. Contaminated sprinkler water runoff is discharged through the facility outfall to the environment.

Conditions: The facility has a fire protection system, including alarms and sprinklers that reduce the spread of the fire.

Recognition: Release of a biological agent into the environment is the basis for declaring an OE. Recognition indicators used as the basis for an OE incident declaration may include:

- The fire detection system activates fire alarms and the fire suppression system.
- The researcher handling the toxin reports the spill of the material after exiting the room.
- Water runoff from activation of the sprinklers is discharging through the outfall.

I.7 Accident Scenario 6 – Explosion (release of *Yersinia pestis* bacteria; personnel contamination and infected host)

Incident: A propane truck has an accident near the facility, causing an explosion. At the time of the explosion, experiments are being conducted in the facility with solutions containing *Yersinia pestis* bacteria. Test tubes and flasks in several Class II BSCs containing *Yersinia pestis* bacteria in solution are broken from the shaking and movement of the building and projectiles created by the blast wave. Splashing of the solution creates aerosolized droplets, contaminating skin and mucous membranes of the workers conducting the experiment. Personnel evacuating the laboratory follow prescribed exit procedures and remove all contaminated PPE prior to exit.

Conditions: Although laboratory personnel followed the prescribed exit procedure and removed their PPE, they were exposed to the *Y. pestis* bacteria via inhalation of the aerosolized droplets and contact with their eyes and mucous membranes. Inhalation of *Yersinia pestis* bacteria usually manifests as Pneumonic Plague and is highly transmissible. These employees need to be thoroughly decontaminated as soon as possible, subjected to close medical monitoring, and started on prophylactic antibiotic treatment. Additional personnel and environmental contamination may occur because of contact with contaminated laboratory personnel and garments. These persons should be tracked and started on medical monitoring and prophylactic antibiotic treatment as a precaution.

Recognition: Release of a biological agent into the breached laboratory environment is the basis for declaring an OE. Recognition indicators used as the basis for an OE declaration may include:

- Explosion causing visible damage to the facility structure, including creating openings to the environment;
- Test tubes and flasks containing solutions of *Yersinia pestis* bacteria break and release their contents;
- Loss of electrical power to the Class II BSCs ventilation and associated HEPA filters.

I.8 <u>Accident Scenario 7 – Transportation Accident</u> [arthropod and animal-to-human transmission of a viral pathogen (CCH)]

Incident: A non-human primate was injected with the virus, causing Crimean-Congo hemorrhagic fever (CCH) approximately 30 days before being transported from the CDC to a DOE facility in a biosafety cage on a transport truck. Relocation is due to tornado damage suffered at the primary laboratory. While at the DOE facility gate waiting for clearance into the facility, another truck runs into the rear of the transport truck, severely damaging the transport truck and the biosafety cage.

The driver of the transport truck, the transporting crew, and the non-human primate are all injured and rendered unconscious. The DOE emergency responders are notified of the accident and go to the scene. On arrival, they see the biohazard placards on the vehicle and implement protective actions in accordance with the Emergency Response Guidebook (Guide 158), immediately isolating a 25-meter radius around the accident site. Once the responders review the information on the CCH virus, they establish a limited access zone around the isolation area of one city block in all directions and request specialized disinfectants to clean up the area and equipment to catch all runoff. The local public health department institutes a sampling program after the accident to determine if insect vectors have picked up the virus.

Conditions: Responding personnel are in typical blood-borne pathogen protective clothing. Initial responders perform injury surveys on the human victims and the bleeding non-human primate. Additionally, mosquitoes and other insects are beginning to congregate on the animal and body excrement in the vehicle and the ground surrounding the vehicle. There are no secondary barriers or mitigative features.

Release of CCH is through the blood lost by the nonhuman primate. The virus is transmitted through aerosolized respiratory droplets from infected hosts, bites by infected vectors such as mosquitoes, and human-to-human (or animal-to-human) through contact with blood or other body fluids, as well as viral particles transmitted in fluids. The assumed release duration is 60 minutes, based on time required to receive critical information regarding necessary steps to disinfect the area properly.

Recognition: An OE is declared based on the following criterion from DOE O 151.1D:

"Offsite DOE Transportation Activities: The following incidents or conditions represent an actual or potential release of hazardous materials from a DOE/NNSA shipment.

- Any accident/incident involving an offsite DOE/NNSA shipment containing hazardous materials that causes the initial responders to initiate protective actions at locations beyond the immediate/affected area."

Notifications to DOE/NNSA by local responders from the incident scene cause the declaration of an OE based on initiation of protective actions at locations beyond the immediate/affected area. Confirmation of human exposure will be determined by isolation and observation of potentially infected personnel.

I.9 Accident Scenario 8 – Malevolent Act (Disgruntled employee releases dried *Bacillus anthracis* spores)

Incident: A disgruntled employee, angry about being disciplined, picks up and throws a container against the wall of the laboratory, smashing the container. The employee is wearing PPE and is alone in the laboratory. He exits the room, discards the PPE, and leaves the site.

The container holds 1 gram (approximately $1x10^{12}$ spores) of dried *Bacillus anthracis* spores. The entire contents of the container are released into the laboratory environment and, initially, all of the spores (in the 1-10 micron range) are aerosolized. Spores in this size range remain airborne for up to 24 hours. A large number of spores are subsequently released outside of the biocontainment area via the HVAC system. Workers entering the room discover the incident and are exposed to a large concentration of spores; their activity also stirs up particles that have settled.

Conditions: The biosafety program for the facility requires that all work with Select Agents be conducted in a Class II BSC. The facility HVAC system is not equipped with filtration on the exhaust to the outside of the biocontainment area.

Since the container is smashed outside of the Class II BSC, aerosolized *Bacillus anthracis* spores have been released into the laboratory space. The assumed release duration is at least 24 hours, based on settling of particles in the 1-10 micron range (10 micron particles fall 10 ft in about an hour, 1 micron particles can remain airborne for up to 24 hours) and an air exchange rate of 10 room-air-exchanges per hour. Since the facility HVAC system does not have a filtered exhaust, *Bacillus anthracis* spores may have been released to the environment outside of the biocontainment area. In addition, unwitting workers who enter the room subsequent to the release are assumed to receive very high doses of spores in the optimal respirable range.

Recognition: The possible release of a biological agent into the external environment outside the biocontainment area is the basis for declaring an OE. Recognition indicators used may include:

- Returning laboratory personnel find the discarded PPE outside the containment area;
- Laboratory personnel discover the smashed container inside the containment area, approximately 30 minutes after the employee leaves the work area;
- Facility HVAC system is *operating* when the incident is discovered; no mitigative actions took place prior to the arrival of co-workers.

Appendix J. Acronyms

AAR – After Action Report

AC – Area Command

AED – Automatic External Defibrillator

AEGL – Acute Exposure Guideline Levels

AHS – All Hazards Survey

AIHA – American Industrial Hygiene Association

ALARA – As Low As Reasonably Achievable

APHIS – Animal and Plant Health Inspection Service

ARF – Airborne Release Factor

BIO – Basis for Interim Operations

BLEVE – Boiling Liquid Expanding Vapor Explosion

BMBL – Biosafety in Microbiological and Biomedical Laboratories

BNA – Baseline Needs Assessment

BSC – Biosafety Cabinet

BSL – Biosafety level

C/E – Controller/Evaluator

CAP – Corrective Action Plan

CAM – Consequence Assessment Modeling

CAT – Consequence Assessment Team

CCH – Crimean-Congo Hemorrhagic Fever

CDC – Center for Disease Control

CED – Committed Effective Dose

CEMP – Comprehensive Emergency Management Program

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CFR – Code of Federal Regulations

CISM – Critical Incident Stress Management

COA – Continuous Ongoing Assessment

COSIN – Control Staff Instructions

CPG – Comprehensive Preparedness Guide

CRAD – Criteria Review and Approach Document

CUI – Controlled Unclassified Information

D&D – Decontamination and Decommissioning

DBT – Design Basis Threat

DCF – Dose Conversion Factors

DHS – Department of Homeland Security

DMAT – Disaster Mortuary Assistance Team

DMORT – Disaster Mortuary Operational Response Team

DNF – Defense Nuclear Facility

DOC – Department of Commerce

DOD – Department of Defense

DOE – Department of Energy

DOT – Department of Transportation

DRL – Derived Response Level

DSA – Documented Safety Analysis

EAL – Emergency Action Level

ED – Emergency Director

EDMS – Enterprise Data Management System

EDO – Emergency Duty Officer

EEG – Exercise Evaluation Guide

EIS – Environmental Impact Statement

EMG – Emergency Management Guide

EMS – Emergency Medical Services

EOS – Emergency Operations System

EPHA – Emergency Planning Hazards Assessment

EPI – Emergency Public Information

EPIP – Emergency Plan Implementing Procedures

EPZ – Emergency Planning Zone

ERAP – Emergency Readiness Assurance Plan

ERG – Emergency Response Guide

ERPG – Emergency Response Planning Guidelines

ERO – Emergency Response Organization

EVALPLAN – Evaluation Plan

EXPLAN – Exercise Plan

FAQ – Frequently Asked Question

FDA – Food and Drug Administration

FE – Functional Exercise

FEM – Field Element Manager

FEMA – Federal Emergency Management Agency

FHA – Fire Hazard Analyses

FPE – Full-Participation Exercise

FSE – Full-Scale Exercise

GE – General Emergency

GET – General Employee Training

HAZMAT – Hazardous Materials

HEPA – High-efficiency particulate air

HHS – Health and Human Services

HIPPA – Health Insurance Portability and Accountability Act

HSEEP – Homeland Security Exercise and Evaluation Program

HVAC – heating, ventilation, and air conditioning

IBC – Institutional Biosafety Committee

ICS – Incident Command System

ID – Infectious Dose

IP – Improvement Plan

ISM – Integrated Safety Management

JIC – Joint Information Center

JIS – Joint Information System

KI – Potassium Iodide

LEPC – Local Emergency Planning Committee

LPF – Leak Path Factor

M&O – Management and Operating

MAA – Mutual Aid Agreement

MAR – Material at Risk

MOA – Memoranda of Agreement

MOU – Memoranda of Understanding

MSDS – Material Safety Data Sheet

MSEL – Master Scenario Events List

MSHA – Mine Safety and Health Administration

NARAC – National Atmospheric Release Advisory Center

NCP – National Oil and Hazardous Substances Pollution Contingency Plan

NEST – Nuclear Emergency Support Team

NFPA – National Fire Protection Agency

NIH – National Institutes of Health

NIMS – National Incident Management System

NIST – National Institute of Science and Technology

NNSA – National Nuclear Security Administration

NPDES – National Pollutant Discharge Elimination System

NRC – Nuclear Regulatory Commission

NRF – National Response Framework

NWS – National Weather Service

OE – Operational Emergency

OSHA – Occupational Health and Safety Administration

OST – Office of Secure Transportation

PAC – Protective Action Criteria

PAD – Protective Action Decision

PAG – Protective Action Guide

PIO – Public Information Officer

PMA – Power Marketing Administration

PPBE – Planning, Program, Budgeting, and Execution

PPD – Presidential Policy Directive

PPE – Personal Protective Equipment

PPQ – Plant Protection and Quarantine Programs

PAC – Protective Action Criteria

PAG – Protective Action Guide

PRA – Probability Risk Assessments

PSO – Program Secretarial Office

RCRA – Resource Conservation and Recovery Act

REAC/TS – Radiation Emergency Assistance Center/Training Site

REM – Roengten Equivalent Man

RQ – Reportable Quantities

S&S – Safeguards and Security

SAD – Safety Assessment Documents

SAE – Site Area Emergency

SAR – Safety Analysis Report

SARA – Superfund Amendments and Reauthorization Act

SARS – Sudden Acute Respiratory Syndrome

SERC – State Emergency Response Commission

SFA – Sites, Facilities, Agencies

SIMCELL – Simulation Cell

SITMAN – Situation Manual

SME – Subject Matter Expert

SNM – Special Nuclear Material

SPR – Strategic Petroleum Reserve

SQA – Software Quality Assurance

SSQA – Safety Software Quality Assurance

STARS – Subcommittee for Technical Analysis and Response Support

TED – Total Effective Dose

TEEL – Temporary Emergency Exposure Limits

TEL – Threshold for Early Lethality

TERC – Tribal Emergency Response Commission

THIRA – Threat and Hazard Identification and Risk Assessment

TIA – Timely Initial Assessment

TTX – Tabletop Exercise

TWA – Time Weighted Average

UC – Unified Command

UCS – Unified Coordination System

USDA – United States Department of Agriculture

VA – Vulnerability Assessment

VS – Veterinary Services

WHO – World Health Organization

WMD – Weapons of Mass Destruction