

**Office of Enterprise Assessments
Lessons Learned from the 2014
Emergency Management Reviews**



April 2015

**Office of Emergency Management Assessments
Office of Environment, Safety and Health Assessments
Office of Enterprise Assessments
U.S. Department of Energy**

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Acronyms

CRAD	Criteria, Review, and Approach Document
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
EAL	Emergency Action Level
EM	Office of Environmental Management
EMG	Emergency Management Guide
EMInS	Emergency Management Information System
EOC	Emergency Operations Center
EPHA	Emergency Planning Hazards Assessment
EPIP	Emergency Plan Implementing Procedure
EPZ	Emergency Planning Zone
ERG	Emergency Response Guidebook
ERO	Emergency Response Organization
FE	Office of Fossil Energy
HAZMAT	Hazardous Material
NARAC	National Atmospheric Release Advisory Center
NNSA	National Nuclear Security Administration
OE-1	Operating Experience Level 1
PAC	Protective Action Criteria
SITREP	Situation Report

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted emergency management reviews at seven DOE sites during 2014. The National Nuclear Security Administration (NNSA) and the DOE Offices of Environmental Management and Fossil Energy provide Federal oversight of the sites EA reviewed.

Six reviews included an assessment of the sites' progress in implementing severe event planning and preparedness guidelines that DOE issued to address lessons learned from the 2011 Fukushima event in Japan. Four of the reviews also included an evaluation of the sites' response to a severe event by observing the sites' annual exercise. EA reviewed the emergency management program's technical basis and its commensurate state of preparedness at the two remaining sites. Additionally, EA examined the accident investigations and other reviews resulting from two events at the Waste Isolation Pilot Plant (WIPP) that identified broad deficiencies in site emergency planning preparedness and response, many of which EA or other organizations had previously identified but the site had not yet corrected. EA then observed the December 2014 exercise and noted that although significant progress had been made, much work remains to improve the WIPP emergency management program.

This report reflects lessons learned from the collective results of those reviews for use by all DOE/NNSA sites, including one "best practice" and the 15 lessons-learned statements listed in Appendix B (page B-1). The best practice is the Y-12 National Security Complex's computerized information management system, integrated with a web-based mapping system, that links the site's response facilities with the field responders and fosters interoperability with the offsite emergency operations centers (local, state, and DOE Headquarters) to capture, distribute, and assess emergency information that expedites rapid and accurate decision making. Other DOE/NNSA sites should consider evaluating this tool's potential benefit to their emergency management programs.

The state of preparedness for severe events varied significantly among the reviewed sites, and most sites need additional planning. Only one site had an adequate level of preparedness for severe events. The remaining sites were inadequately prepared to minimize the level of damage to infrastructure or to manage the loss of infrastructure after a severe event. Although some sites used their annual exercise as the first step in severe event planning, most sites did not consider severe event planning to be within their contract's scope of work, considered severe events to be too incredible for emergency planning, or had an incorrect technical basis insufficient for severe event planning. EA identified several important concerns in emergency response planning and preparedness and in exercise programs and performance.

Emergency Response Planning and Preparedness

- In some cases, planning does not adequately identify the source term information needed to develop accurate procedures or to inform consequence assessment teams during a response
- Planning does not always identify predicted exposures, impacting the ability to determine facility habitability, safe evacuation routes, assembly areas, and effects at receptors of interest (e.g., onsite responders, sheltered personnel, command centers, and occupied offsite facilities)
- Emergency planners' and responders' judgments about the timeliness of consequence assessments and modified protective actions are not always accurate because they do not adequately consider exposure times for personnel in a plume (e.g., how long sheltered personnel are exposed to hazardous material, the concentrations of hazardous material, or damage to structures sheltering personnel)

- Sites with lesser hazards sometimes lack a well-founded technical basis and complete preparedness documentation
- Comprehensive response plans, procedures, and supporting tools are not in place for severe events

Exercise Programs and Performance

- Exercises do not consistently test the bounding consequences of an event in which realistic hazardous material inventories could lead to significant exposure of site personnel, nor do they test the interfaces with offsite organizations or the acquisition of NNSA radiological assets
- Some exercises do not critically evaluate the full scope of the emergency management program because of weaknesses in evaluation criteria; few evaluators, many with minimal experience; and failure to test all emergency response personnel, facilities, equipment, and procedures over a multi-year period
- Responders are not always proficient in performing their tasks in a timely manner to initiate a response, provide complete and appropriate protective actions, and account for personnel
- Few sites have fully effective communications, resulting in inadequate information exchange among the site command centers, DOE Headquarters, and offsite organizations
- Corrective actions for identified weaknesses do not consistently lead to program improvements

In consideration of the weaknesses identified through independent assessments, EA developed a series of specific lessons learned and recommendations that DOE Program Offices, Field sites, and operating contractors should consider for improving emergency management planning, response execution, training, and program evaluation and corrective action management

EA will continue to evaluate site emergency response programs' capabilities and preparedness to respond to severe events, with an emphasis on performance and emergency management programmatic evaluations. EA will also evaluate the effectiveness of site exercise programs, evaluate responder performance during site annual exercises or limited-scope performance tests, and conduct programmatic reviews of the technical planning basis, plans and procedures, and readiness assurance processes

Office of Enterprise Assessments Lessons Learned from the 2014 Emergency Management Reviews

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) reviews specific areas of interest at DOE facilities. During 2014, EA emergency management reviews focused on either evaluating a site's response to a severe event or validating a site's technical planning basis and emergency preparedness for severe events.

Since the 2011 tsunami that affected the Fukushima Daiichi nuclear power electrical generating station in Japan, EA reviews have focused on severe event planning. After two years of reviewing sites' planning for severe events, the EA reviews in 2014 evaluated a site's response to a severe event by observing site-level exercises. EA based its reviews on the requirements in DOE Order 151.1C, *Comprehensive Emergency Management System*, and the 2013 Office of Health, Safety and Security Operating Experience Level 1 (OE-1), *Improving Department of Energy Capabilities for Mitigating Beyond Design Basis Events*. EA identified four sites for review that were already planning a severe event scenario for their annual site-level exercise and asked the sites to incorporate EA's focus areas of interest into the exercise. The focus areas included the site's response to a severe event, such as multi-facility event response, mass casualty response, and use of alternate communication and power systems.

EA also performed reviews of technical planning basis and emergency preparedness at two sites that have not been subject to a recent EA emergency management evaluation. These reviews focused on validating the technical planning basis for each site by reviewing the respective hazards surveys, emergency planning hazards assessments (EPHAs), emergency planning zones (EPZs), and emergency action levels (EALs), along with the associated emergency preparedness planning. Additionally, these reviews evaluated the site's progress in implementing the guidance provided in OE-1 for severe event planning.

During February 2014 the Waste Isolation Pilot Plant experienced two events that demonstrated significant deficiencies in emergency management planning, preparedness and response. Several of the deficiencies had been previously identified during EA predecessor or other assessment activities but not corrected. During December 2014, EA observed the Horizon-14 Exercise to ascertain progress in strengthening its emergency management program. EA observed that although significant progress had been made, much work remains.

1.1 Report Scope

This report provides lessons learned from the EA reviews during 2014 at DOE sites, including National Nuclear Security Administration (NNSA) sites, which meet DOE Order 151.1C requirements for having a hazardous material (HAZMAT) program. Table 1 lists the sites, responsible program office for federal oversight, type of EA review, dominant site hazards, and exercise scenario information. EA has published separate reports to document its activities and conclusions for each site reviewed; the reports are available at <http://www.energy.gov/ea/listings/assessment-documents>.

This report gives an overview of the EA emergency management reviews, lessons learned, an analysis of observed conditions against DOE requirements and initiatives, and recommendations for improving DOE/NNSA emergency management programs. EA provides this information to share best practices and significant or common weaknesses found during the past year and possible resolutions for all sites to consider when evaluating their emergency management program.

Table 1. Sites Reviewed During 2014

Site	Program Office	Review Type	Dominant HAZMAT in Review Scope	Exercise Scenario Synopsis
West Valley Demonstration Project	EM	Technical planning basis and emergency preparedness	Transuranic waste	Not applicable.
National Energy Technology Laboratory	FE	Technical planning basis and emergency preparedness	Chemicals	Not applicable.
Savannah River Site	EM	Severe event exercise evaluation	Plutonium	Severe thunderstorm and high winds concurrent with a vehicle accident, plutonium release, and an injured contaminated worker
Y-12 National Security Complex	NNSA	Severe event exercise evaluation	Uranium and chemicals	Major regional earthquake, chemical and uranium releases, multiple damaged buildings and fire at HAZMAT facility, mass casualties, three trapped workers, and backup power tested at a command center
Pantex Plant	NNSA	Severe event exercise evaluation	Plutonium, uranium, and chemicals	Tornado and lightning, high explosive detonation and release of uranium and plutonium, chemical spill, multiple damaged buildings and overturned safeguards transporter, mass casualties, two worker fatalities, three trapped personnel
Sandia National Laboratories/New Mexico	NNSA	Severe event exercise evaluation	Plutonium, uranium, fission products, and chemicals	Tornado and high winds, a missing container of irradiated reactor fuel and unknown chemical spill, multiple damaged buildings, 40 injured people, alternate power feed tested at command center and backup communications
Waste Isolation Pilot Plant	EM	Exercise evaluation	Underground fire, fire, transuranic waste	Fire on a bolting machine in the mine with five personnel requiring medical attention, one contaminated.

1.2 Requirements and Guidance

EA compiled this lessons-learned report to comply with DOE Order 226.1B, *Implementation of DOE Oversight Policy*, which states that EA is responsible for distributing lessons learned resulting from their appraisals as part of DOE's operating experience program.

EA used DOE Order 151.1C and OE-1 as the basis for the emergency management program evaluations. The order identifies emergency preparedness and response requirements for DOE/NNSA sites and references an associated set of emergency management guides (EMGs) to establish expectations and implementing guidance. EA considered the NNSA Office of Emergency Management and Policy's relevant answers to frequently asked questions about the order. OE-1 provides results from DOE/NNSA initiatives for preparing for severe events, including beyond design basis events, and gives direction for conducting evaluations and enhancing capabilities for mitigating beyond design basis events. EA used the order, EMGs, and OE-1 to derive Criteria, Review, and Approach Document (CRAD) 45-60, *2014 Emergency Management Program Technical Basis and Emergency Preparedness Review*, and CRAD 45-61, *Exercise Program Review and Severe Event Response Evaluation*, that the EA team used for the reviews. When EA evaluated a site's response to an exercise, EA also used the site's exercise criteria, which were usually based on the site's procedures for implementing emergency plans.

2.0 LESSONS LEARNED

The following lessons learned are derived from EA observations made during reviews of emergency management programs in 2014. Appendix B provides a consolidated summary of the 15 lessons learned statements. EA recognizes that, although incorporated into the EA CRADs, the OE-1 guidelines are not requirements and some sites did not implement it after the program office evaluations.

2.1 Technical Planning Basis

DOE Order 151.1C requires all sites to complete emergency planning whether the site has an operational emergency base program or an operational emergency HAZMAT program. An operational emergency base program implements the requirements of applicable Federal, state, and local laws, regulations, or ordinances for fundamental worker safety programs including fire, safety, and security. An operational emergency HAZMAT program includes the base program plus additional requirements for HAZMAT that could pose a serious airborne threat to workers, the public, or the environment. All sites that EA visited during 2014 have HAZMAT programs. For HAZMAT programs, the order requires emergency planning to include the identification of hazards and threats, hazard mitigation, development and preparation of emergency plans and procedures, and identification of personnel and resources needed for an effective emergency response. The order and associated guides give detailed instructions on determining whether a site requires a HAZMAT program and how to establish an appropriate response based on technical considerations. For severe event planning, the order requires sites to consider scientific and historical data to determine plausible scenarios for analysis and to prepare for these events by establishing technically-based protective actions and EPZs. OE-1 provides further guidance for preparing for events that may exceed historical data after considering lessons learned from the 2011 Fukushima nuclear power plant event in Japan. As part of emergency planning, the order requires emergency classification provisions to be established to categorize and classify an emergency into one of three EALs – Alert, Site Area Emergency, or General Emergency – based on the distance that protective action criteria (PAC) are exceeded for a full spectrum of scenarios. OE-1 extends the severity of scenarios and associated consequences beyond those previously analyzed at DOE/NNSA sites. For each EAL, the order requires pre-planned timely protective actions to support an effective response that protects personnel. Although DOE does not define “timely,” the basis of the PAC that DOE requires is to

protect personnel from irreversible health effects if they inhale the HAZMAT for up to an hour. Therefore, EA considered protective actions to be timely when the site emergency response organization (ERO) implemented the actions within an hour from the time a HAZMAT release could endanger personnel.

To document the technical planning basis, DOE Order 151.1C requires sites to develop a hazards survey that identifies significant quantities of HAZMAT for a more detailed quantitative assessment; general emergency events and conditions, including severe event initiators such as high winds, tornados, flood, earthquake, wildland fire, snowstorms, lightning, and hail; and the potential impacts of such emergencies. The order requires the quantitative assessment to be documented or referenced in an EPHA and performed using accepted assessment techniques. DOE Guide 151.1-2, *Technical Planning Basis*, provides accepted assessment techniques and recommends that quantitative analyses determine exposures at specific receptors of interest (i.e., facility boundary, onsite receptor locations, site boundary, and offsite locations of interest) and determine the maximum distance from release points at which exposures could exceed the applicable PAC. Site personnel then use the results of these calculations to establish the distance where PAC may be exceeded, to serve as the basis for emergency classifications and the EPZ, and (along with additional information) to determine the appropriate protective actions for personnel in areas that may have undesirable concentrations of airborne HAZMAT.

EA identified four significant lessons learned related to emergency planning, all representing deviations from DOE published requirements and initiatives. DOE/NNSA program offices and sites may consider these lessons learned for enhancing site programs, and when planning upcoming self-assessments and oversight assessments:

- EPHAs do not always document the source term information needed to develop EALs or to serve as a response reference document
- Some EPHAs omit predicted exposures at receptors of interest, and consequence assessment teams do not quickly calculate predicted exposures at receptors of interest after a HAZMAT release
- Emergency planners and responders do not adequately consider exposure times for personnel in a plume when determining whether consequence assessments and modified protective actions are timely
- The technical planning basis for sites with lesser hazards is not always well founded, and the preparedness documentation is incomplete.

Lessons Learned Statement: EPHAs do not always document the source term information needed to develop EALs or to serve as a response reference document.

Discussion: The reviewed EPHAs do not consistently comply with the requirements of DOE Order 151.1C and do not always follow the recommendations of DOE Guide 151.1-2. Some EPHAs do not consistently include the correct HAZMAT type and quantity for material stored in facilities. This inconsistency does not support the development of correct EALs and does not provide the consequence assessment teams with correct source term information for use during a response. For example:

- Personnel at one site developed an EPHA and EALs based on information from the U.S. Department of Transportation *Emergency Response Guidebook* (ERG) for unknown chemicals because the emergency planners and operations personnel cannot keep up with the facility's HAZMAT inventory changes and the site did not establish a means for responders to determine the HAZMAT involved

- Personnel at one site stored irradiated nuclear fuel in a facility, but the EPHA contained no analysis of a release of fission products from this fuel
- One facility had a storage array containing over 450 plutonium equivalent curies of radioactive material, but the EPHA quantitative assessment assumed a maximum limit of 100 curies for the facility
- Personnel at one site developed a single EAL to cover the full range of possible inventories for a release of 1 to 10,000 kilograms of radioactive material, but did not give decision-makers a way to determine the event classification and protective actions commensurate with the consequences of a release
- Personnel at one site stopped the development of an EPHA quantitative consequence assessment because the analyses showed the consequences were very severe
- Personnel at one site developed an EPHA quantitative consequence assessment that only analyzed liquid nitrogen, neglecting other chemicals in the facility that pose a more severe inhalation hazard

Analysis: DOE Order 151.1C states that the EPHA must define the provisions of the operational emergency HAZMAT program and ensure that the program is commensurate with the identified hazards. To achieve this goal, the order requires the operating contractor to implement an accurate and timely method for tracking changes in operations, processes, or accident analyses that involve HAZMAT (e.g., introduction of new materials, significant changes in inventories, or modification of material environments) for each facility/activity. The method must allow enough time for emergency management personnel to review the EPHA and modify plans and procedures, as necessary. Additionally, the contractor must review the EPHA at least every three years and update the EPHA before making significant changes to the site/facility or HAZMAT inventories. The order further states that the contractor must develop site/facility-specific EALs for the spectrum of potential operational emergencies identified in the EPHA and must include protective actions corresponding to each EAL. DOE Guide 151.1-4, *Response Elements*, also describes the EPHA as a response reference for use in the early phases of an emergency to enable understanding of the analyzed scenario and its consequences and for use in identifying affected areas and populations needing protective actions. The event classifications and areas that need protective actions are derived from the results of the consequence analyses in the EPHA, specifically the distance at which the PAC may be exceeded under adverse dispersion conditions. The lack of accurate and documented source term type and quantity at many observed sites do not support a prompt and accurate event classification or timely implementation of protective actions that are commensurate with the hazard. In the absence of this information, consequence assessment personnel could spend significant time seeking or developing source term information that should be readily available during the most critical phase of an event.

Recommended Actions: To ensure the accuracy of source term information used to develop the EPHA quantitative consequence analyses, consider:

- Establishing an effective means to ensure facility operating organizations coordinate changes to operations and HAZMAT inventories with emergency planners so the planners can complete the appropriate emergency planning changes before the operating personnel move the material into the facility. Recommended changes include:
 - Setting facility inventory limits

- Instituting review processes for the HAZMAT requisition phase and the material transfer planning phase
- Including emergency planners in the unreviewed safety question process.
- Verifying during evaluations (e.g., self-assessments, site office triennial reviews, and program office reviews), exercise and drill planning activities, and hazards survey and EPHA triennial update activities that HAZMAT inventory controls remain effective and that the HAZMAT inventory is consistent with EPHAs.

Lessons Learned Statement: Some EPHAs omit predicted exposures at receptors of interest and consequence assessment teams do not quickly calculate predicted exposures at receptors of interest after a HAZMAT release.

Discussion: Some EPHAs do not include a complete set of exposure predictions for receptors of interest based on the analyzed HAZMAT release scenarios. The EPHA analyses typically limit receptors to those used for event classification purposes (i.e., facility boundary and site boundary), and do not include receptors such as onsite responders, sheltered onsite personnel, command centers, potential incident command post locations, and occupied offsite facilities. For example, during observed exercises:

- Exercise planners at one site expected the consequence assessment team to calculate exposures and plume arrival times at receptors of interest using exercise data. However, the consequence assessment team did not perform these calculations and site evaluators did not comment on the lack of this information
- The site ERO, onsite responders, and exercise evaluators at one site did not consider how to reduce responders' exposure or what actions the command center should take, even though the response procedures addressed those topics. Additionally, the implemented sitewide default protective actions omitted one facility at risk. The site ERO did not recognize this condition because different command centers implemented the protective actions and presented the distances for the protective actions implemented in different units of measurement.

Analysis: DOE Order 151.1C requires ongoing consequence assessment to be timely throughout an emergency and be integrated into the emergency categorization and classification and protective actions processes. DOE Guide 151.1-4 further states that estimating consequences at specific receptors provides useful information for event 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 the emergency response, and recovery planning and activities. Consequences at specific receptors can also be helpful immediately after implementing default protective actions and when delays occur in assembling the consequence assessment team or gathering plume projection data. Onsite receptors of interest include site facilities, facility and site boundaries, assembly areas, evacuation routes, and emergency response facilities. Offsite receptors of interest include population centers, special populations (e.g., hospitals, schools, nursing homes, day care centers, and prisons), evacuation routes, relocation centers, environmental monitoring stations, and ingestion planning zone related locations (e.g., water supply intakes, farms, dairies, vegetable gardens, meat animal locations, and food processing plants). The guide recommends that all receptors of interest be identified and documented for each facility requiring an EPHA. This listing and a map showing a spatial representation of the receptor locations should be incorporated into the documentation that is provided to the consequence assessment

team. However, EA observed that the categorization and classification process uses EALs rather than a receptor of interest list at all reviewed sites. The lack of information on receptors of interest hinders the site ERO's ability to make appropriate protective action decisions based on habitability conditions and plume arrival time, particularly when default protective actions conflict with, or do not bound, facility-specific protective actions.

Recommended Actions: To improve the usefulness of the EPHA as a response document in the early phases of an emergency, consider including information in the EPHA to describe each analyzed scenario and its consequences. Particularly useful features and information include:

- Identifying receptor locations of interest for each facility containing HAZMAT, including:
 - Adjacent facilities with significant occupancy
 - Protected area boundaries
 - Locations accessible to the general public, such as roads, visitor centers, parking lots
 - Onsite commercial (non-DOE/NNSA) facilities and operating areas
 - Emergency response facilities and areas where responders congregate when responding to and managing an operational emergency
 - Assembly areas
 - Offsite buildings and public areas affected by General Emergencies.
- Identifying analyzed scenarios using short descriptive names with:
 - Tabulated consequences for each scenario at key receptor locations
 - Graphic or other similar presentations of scenario consequences versus distance under conservative (adverse) and average (typical) dispersion conditions
 - Distances at which the PAC and thresholds of early lethality would be exceeded using a local area map showing facility boundary, security boundary, adjacent facilities and occupancy, receptors of interest and the site boundary.
- Providing training and drills to consequence assessment team members on the use of EPHAs as a reference document during a response.

Additionally, to ensure that initial protective actions are appropriate for all populations, consider reviewing sitewide default protective actions to ensure that they are consistent with the protective actions associated with facility EALs and use the same units of measure.

Lessons Learned Statement: Emergency planners and responders do not adequately consider exposure times for personnel in a plume when determining whether consequence assessments and modified protective actions are timely.

Discussion: EA observed that many reviewed site EROs do not consider how long personnel are exposed to HAZMAT when meeting consequence assessment and modified protective action timeliness goals. Instead, site EROs consider consequence assessments to be timely if the consequence assessment team completes an assessment within one hour either from when the request was made or from when the team assembled. This is sometimes several hours after a HAZMAT release occurs by the time the consequence assessment team assembles and produces consequent assessment products. Additionally, sites often consider protective actions to be timely based on initial protective actions rather than protective actions that are most appropriate (e.g., sheltering personnel for a tornado warning, but not modifying protective actions after HAZMAT facilities have been significantly damaged). This is sometimes hours after a postulated release occurs, when people have been sheltered in the plume for the entire duration (for an ongoing release) or when the assessment is no longer relevant because the plume has dissipated (for a puff release or a quickly evaporating chemical spill). Specific examples observed during exercises that sites did not consider in evaluating whether timeliness goals were met include:

- One site did not perform a consequence assessment for safe routing of the ERO until an exercise inject provided this information, over an hour after a postulated release occurred; delaying the availability of all consequence assessment team products
- Three sites did not review all applicable EALs and the associated protective actions
- Two sites did not modify protective actions for weather conditions to protective actions for HAZMAT releases, once HAZMAT release conditions were known
- One site had no provisions for evacuating personnel in high concentrations of airborne HAZMAT or when personnel are housed in degraded shelters
- One site had evacuation recommendations from a National Atmospheric Release Advisory Center (NARAC) plume plot that was not considered for implementation
- One site considered consequence assessment data timely after it was no longer relevant; by the time the consequence assessment results were available, a radioactive material puff release was well offsite and dissipated and a chemical spill had already evaporated.

Analysis: DOE Order 151.1C requires consequence assessments to be timely throughout the emergency and integrated with the emergency classification and protective action process. Some sites use initial default protective actions linked to EALs that shelter people in place until the site ERO gathers more information. As a result, people are sometimes sheltered in buildings that could collapse or buildings with unknown or high air infiltration rates within a HAZMAT plume. For instance, if the plume is from an ongoing release, rather than a puff release, airborne HAZMAT concentrations could quickly increase in these shelters in a relatively short period and expose personnel to HAZMAT for hours. Site EROs do not have plans to evacuate people from these conditions or do not always comprehend the consequences of these releases. When coupled with untimely reviews of all applicable EALs, delays in collecting data for performing assessment activities and delays in assembling consequence assessment teams keep people in potentially hazardous atmospheres longer than desired. Emergency planners and responders inappropriately view the conservative nature of the consequence assessments used to develop the EAL protective actions as a sufficient safety margin to justify keeping personnel sheltered in place before the site ERO knows the actual HAZMAT concentrations, even when there is potential for extremely high exposures. Other reasons site personnel gave for not evacuating people near plumes included security considerations and the risk of exposure to outside atmospheres when people evacuated using safe routes. The security considerations and safe route protocols also cause problems when staffing the emergency

operations center (EOC), because the plume may not allow the ERO to use a safe route to the EOC or the EOC is near HAZMAT facilities and lacks an operable habitability system to protect the occupants. Because consequence assessment teams assemble in the EOC, emergency planners commonly measure timeliness (i.e., one hour) starting at the team's arrival at the EOC and ending with the development of the first plume projections. This approach conflicts with the basis of the PAC to avoid irreversible health effects from breathing HAZMAT for up to an hour. Emergency planners should consider the allowable HAZMAT exposure time when measuring timeliness, rather than the time to implement initial default protective actions or the time the consequence assessment team takes to gather data and develop a plume projection.

Recommended Actions: To improve the timeliness of evacuation decisions, consider:

- Establishing timeliness goals in procedures that avoid keeping personnel in plumes exceeding the PAC for over an hour
- Establishing a specific procedure or protocol to determine when evacuations are necessary, particularly after an initial recommendation to shelter in place
- Performing evacuation planning that considers safe routes, security considerations, assembly points, accountability processes, and other facility-specific obstacles that hinder facility evacuations
- Training and drilling the site ERO on reviewing all applicable EALs and evacuating people within an hour for prolonged releases of high concentrations of HAZMAT
- Testing safe routes and evacuation procedures during exercises.

Lessons Learned Statement: The technical planning basis for sites with lesser hazards is not always well founded, and the preparedness documentation is incomplete.

Discussion: At the two sites with lesser hazards, EA observed that emergency planners incorrectly applied the requirements for establishing a well-founded technical planning basis and did not achieve an adequate state of emergency preparedness. Although these sites have lesser hazards than some of the larger DOE sites, the hazards are still significant enough that the requirements in DOE Order 151.1C for an operational emergency HAZMAT program apply. The following factors contributed to this situation:

- Lack of personnel participation from these sites in complex-wide emergency management activities
- Small emergency management program budgets
- Infrequent oversight from DOE program offices and other external organizations with in-depth knowledge of DOE requirements and emergency management programs across the complex.

Analysis: DOE Order 151.1C requirements and associated guides give detailed guidance on determining whether a site requires an operational emergency HAZMAT program and establishing appropriate response capabilities based on the level of hazards. For severe event planning, DOE Guide 151.1-2 recommends using scientific and historical data to determine plausible scenarios for analysis and to prepare for these events by establishing technically-based protective actions and EPZs. For emergency preparedness, the order requires that emergency planning include development and maintenance of emergency plans including the identification of personnel and resources needed for an effective response. Emergency planners then develop specific emergency plan implementing procedure (EPIPs) for the plan

and provide the necessary detail, including decision-making thresholds, for executing an effective emergency response, irrespective of its magnitude. Emergency planners must closely coordinate and integrate these plans and procedures with offsite authorities who help support the site's response efforts and receive DOE protective action recommendations.

Recommended Actions: To ensure that emergency planners at lesser hazard sites develop a valid technical foundation for developing the emergency management program, consider:

- Attending the annual Emergency Management Issues Special Interest Group annual conference and participating in associated working groups
- Increasing the frequency of program office oversight and assistance from organizations within DOE (e.g., the Office of Emergency Response) to aid the lesser hazard sites in improving their programs.

2.2 Emergency Response Performance

EA identified four significant lessons learned relating to emergency response and representing deviations from DOE published requirements and initiatives. These lessons learned are provided for all DOE/NNSA program offices and sites to consider for enhancing site programs, and when planning upcoming self-assessments and oversight assessments:

- During exercises, some emergency responders did not demonstrate proficiency or use available response tools to promote effective performance
- During exercises, consequence assessment teams did not adequately use consequence assessment tools or resultant products to confirm that initial protective action decisions were accurate, appropriate, and conservative for protecting workers, first responders, and the public
- During exercises, few sites provided continuous, effective, and accurate communications among response components, resulting in inadequate communications and information management that degraded situational awareness and prevented a common operating picture among the site, DOE Headquarters, and offsite organizations
- Site EROs rely heavily on an experience-based, rather than a process/procedure-based, approach to decision making for emergency responses, leading to ineffective implementation of the emergency plan based on individual knowledge of a given situation.

Lessons Learned Statement: During exercises, some emergency responders did not demonstrate proficiency with or use available response tools to promote effective performance.

Discussion: EA observed that emergency responders do not use the many readily-available tools or used them incorrectly. These tools include:

- EALs
- EPHAs
- Consequence assessment modeling programs
- Protective action plotting programs

- Plume projections
- Responder checklists
- Radiological release data sheets
- Source term determination tools
- Manuals
- Handbooks
- Procedures
- Record forms
- WebEOC, and situation report (SITREP) reporting mechanisms.

In some cases, responders were familiar with the need to collect and disseminate event data but were unfamiliar with data fields, error messages, and how to distribute the information.

Analysis: DOE Order 151.1C requires initial training and annual refresher training to be provided for the instruction and demonstration of proficiency by all primary and alternate ERO personnel. Emergency responders attain proficiency by frequently using emergency response tools, but responders often use these tools only during training drills and exercises. Although training and drill programs alert responders to the available response tools and their purpose, responders may not have enough opportunity to practice using the tools or responders may not receive critical feedback during drills and exercises to correct performance weaknesses. The response procedures do not always contain sufficient details on roles and responsibilities, give clear implementing instructions, or specify record keeping requirements. Furthermore, responders do not refer to procedures containing tool instructions, and evaluators do not give feedback when responders fail to perform tasks using the tools. As a result, responder proficiency suffers and does not lead to improved timeliness and methods that are vital to effectively protecting people and mitigating event consequences.

Recommended Actions: To improve responder proficiency, consider:

- Reviewing drill and exercise schedules to determine whether primary and alternate ERO members have enough opportunities to practice their response tasks
- Reviewing response plans, procedures, checklists, and other implementing documents to ensure that they give enough details on roles, responsibilities, instructions, and record keeping requirements
- Ensuring that response procedures establish appropriate adherence requirements
- Observing and critically evaluating training, drills, and exercises to ensure that responders perform appropriately and receive appropriate feedback for incorrect actions
- Providing remedial training to trainees who do not demonstrate proficiency.

Lessons Learned Statement: During exercises, consequence assessment teams did not adequately use consequence assessment tools or resultant products to confirm that initial protective action decisions were accurate, appropriate, and conservative for protecting workers, first responders, and the public.

Discussion: EA observed that consequence assessment teams developed plume projections; however, at most sites, the site ERO did not use the plume projections to identify areas needing evacuation, reconcile discrepancies between plume projections and EAL classifications and protective actions, or brief the EOC cadre. Further, most sites did not give plume projections to incident commanders and offsite authorities. For example:

- The consequence assessment team at one site displayed the plume projection depicting the distance to PAC on a map of the entire site rather than on a map of the affected area. This did not allow the site ERO to ensure the adequate protection of on-scene and nearby facility personnel or validate the event classification and protective actions
- The consequence assessment team at one site inappropriately developed a plume projection based on 12-hour exposures for unprotected workers rather than a 1-hour PAC-based exposure
- The consequence assessment team at one site developed a plume projection indicating where HAZMAT concentrations exceeded the PAC, but did not display the plume and did not validate the event classification and protective actions
- The consequence assessment team at one site did not use available tools to develop plume projections for validation of event classification and protective actions.

Analysis: DOE Order 151.1C requires establishing provisions to adequately assess the potential or actual onsite and offsite consequences of an emergency. The order states that consequence assessments must be timely throughout an emergency; integrated into the event classification and protective actions processes; and coordinated with Federal, state, local, and tribal organizations. DOE Guide 151.1-4 further elaborates that 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 workers, responders, and the public from the potential consequences of a HAZMAT release. To fulfill this objective, consequence assessment teams must use their tools to develop and display useful plume projections that assist decision-makers and incident commanders in validating event classification and protective actions, and to ensure the health and safety of workers, emergency responders, and the public.

Recommended Actions: Consider improving the quality of consequence assessments by emphasizing in consequence assessment team drills and refresher training:

- The purpose and use of the plume projection products
- The need to provide timely and accurate plume projection products for validation of EALs and protective action decision-making
- The need to ensure that plume plots clearly indicate the PAC and threshold for early lethality concentration, dose areas of concern and concentrations, and doses at the facility boundary to aid in protective action decision-making for workers and first responders
- The importance of providing an initial assessment within an hour from the time of release to ensure personnel can take timely protective actions

- The importance of providing real-time meteorological plume projections for all HAZMAT releases to determine event-specific estimates of the consequences.

Lessons Learned Statement: During exercises, few sites provided continuous, effective, and accurate communications among response components, resulting in inadequate communications and information management that degraded situational awareness and prevented a common operating picture among the site, DOE Headquarters, and offsite organizations.

Discussion: During 2014, most annual exercises that EA evaluated had inadequate communications and ineffective information flow processes for acquiring, recording, and disseminating timely and accurate event information among the ERO and offsite response organizations. Emergency planners have not defined information flow processes among command centers and field responders by documenting the responsibilities for collecting information and distributing validated information. Additionally, incident management tools did not enable the ERO to share important event information among the command centers and field responders. Although most sites use WebEOC as their incident management tool, the ERO only entered some significant event and status information into the tool rather than using the tool to capture, distribute, and assess all relevant emergency information among the entire ERO. As a result, the EROs lacked a common operating picture of the emergency response and shared situational awareness among all teams. Examples of significant communication and information management issues include:

- First responders at one site were unaware of the Site Area Emergency declaration for the emergency or the potential radiological hazards and did not implement appropriate protective actions for themselves or nearby facilities
- EOC personnel at one site incorrectly advised offsite authorities of a General Emergency declaration, while field responders responded to a Site Area Emergency declaration
- Communication weaknesses at one site led to significant delays in activating the ERO, dispatching the fire department, recalling off-duty fire fighters, and identifying the medical triage location
- At several sites ERO members did not obtain pertinent information, such as the names of injured personnel and their locations and injuries, when documenting injury reports; did not provide information on all injured personnel to the incident commander; and did not inform other ERO members of injured personnel numbers and locations

At all but one site, EA observed inadequate interoperability among the site EOC and the local, state, and DOE Headquarters EOCs. As examples:

- At one site the offsite officials could not view WebEOC data or important technical products that the site produced; offsite officials need access to this information for timely and accurate decision-making
- Most EROs did not send an adequate SITREP to DOE Headquarters; some sites do not give DOE Headquarters access to WebEOC and instead rely on the SITREP to send emergency status updates and ensure effective communications between the site and DOE Headquarters throughout the emergency.

Key weaknesses that EA observed regarding situational awareness included:

- Failing to clearly assign the responsibilities for collecting specific event information and the processes used to validate and disseminate that information in a formally defined information flow process between the site's response facilities, field responders, and offsite organizations
- Using incident management tools only during emergencies, providing no opportunity to practice using them in drills and exercises
- Restricting offsite organization's access to unclassified emergency response information, such as notification forms, emergency status updates, plume projections, significant events data, and field monitoring data. Offsite officials need access to this information for timely and accurate decision-making
- Providing incomplete emergency status updates to DOE Headquarters and restricting access to the site's WebEOC event information

Analysis: DOE Order 151.1C requires the contractor to provide effective communications among response organizations throughout an emergency and establish effective communications methods between event scene responders, emergency managers, and response facilities. Additionally, effective implementation of the National Incident Management System requires communications among the ERO to provide a common operating picture of the emergency response and shared situational awareness among all teams. A misunderstood event could lead to an unsafe and ineffective emergency response and DOE Headquarters would be unable to satisfy the demands of Departmental senior management and meet the requirements associated with requests from the White House.

Recommended Actions: Consider improving communications among response facilities, field response elements, and offsite command centers to promote a common operating picture of the emergency response and shared situational awareness among all teams by:

- Formally defining emergency information flow processes between the onsite and offsite response organizations
- Clearly assigning the responsibility for capturing, validating, and disseminating specific event information
- Enabling access by offsite agencies and DOE Headquarters to unclassified emergency response information, such as notification forms, emergency status updates, plume projections, significant events data, and field monitoring data
- Expanding the use of incident management tools to allow a rapid interface with other systems necessary to communicate a common operating picture and shared situational awareness by:
 - Providing a real-time description of events at the incident scene
 - Providing details of the ERO's response to the incident
 - Enabling the ERO to predict changes during the incident
 - Supporting ERO objectives that forecast future actions.

- Integrating incident management tools with other web-based geographical information systems to provide ERO personnel with views, data, and analysis tools for the site, the surrounding area, and interiors of many onsite buildings, including:
 - Meteorological monitoring data
 - Plume projections
 - Damage assessments
 - Field monitoring data
 - Site master planning data and engineering drawings (such as site drawings, utility drawings, and facility floor plans)
 - Personnel data
 - Facilities information management data.
- Automating the news release approval process for public information officers in different locations by coordinating a quick, consistent, factual message that contains relevant information
- Integrating the use of social media as an additional means to answer, enhance, or verify information
- Defining expected actions for achieving and maintaining situational awareness among all teams.

Lessons Learned Statement: Site EROs rely heavily on an experience-based, rather than a process/procedure-based, approach to decision making for emergency responses, leading to ineffective implementation of the emergency plan based on individual knowledge of a given situation.

Discussion: EA observed that most sites have a mix of plans, procedures, guides, and operator aids to implement the emergency plan; however, some contractors use an experience-based, rather than a process/procedure-based, approach to decision making for emergency response. The experience-based system relies more heavily on the knowledge of key decision-makers and staff to implement the emergency plan and make time-urgent decisions. EA observed the following examples of inadequate ERO performance attributed to the experience-based approach and a lack of adequate EPIPs:

- Plans, procedures, and operator aids did not give enough detail to accomplish timely ERO activation
- Consequence assessment team protocols did not produce accurate and timely consequence assessments, did not contain adequate quality control checks of dispersion modeling input and output data, and lacked integration with the NARAC support staff
- Consequence assessment teams did not determine the dose consequences at critical receptor locations (i.e., the incident command post and nearby facilities), and did not take action when plume projections indicated high levels of radiation (above 25 Roentgen equivalent man) at the incident scene
- One site lacked evacuation procedures because evacuation from secure facilities was considered

problematic

- One site ERO gave inaccurate information to the news media and public; in this case, there were no procedures to ensure that official notifications, emergency status updates, news releases, and emergency public information releases contained only verified information
- Several sites did not provide accurate notifications on the extent of the emergency at the site, and some procedures did not require offsite notification forms to include information on all HAZMAT events when emergencies involve multiple facilities.

Analysis: DOE Order 151.1C states that the emergency plan must document the emergency management program and describe the provisions for response to an Operational Emergency. EIPs describe how the actions in the emergency plans will be implemented. Sites' EIPs vary in documentation and level of detail with some sites having very few EIPs or opting to use manuals and team books instead of EIPs; however, the manuals and team books generally lacked specificity. When the manuals did give specific instructions, responders frequently relied on their personal experience and knowledge rather than the manuals and team books. These conditions sometimes led to incomplete, incorrect, or untimely responses.

Recommended Actions: Consider improving ERO proficiency and validation of effective emergency plan implementation by:

- Determining and providing the appropriate mix of plans, procedures, guides, and operator aids to implement the emergency plan
- Evaluating the ERO's performance against emergency plan implementing documents
- Training and drilling EROs on the use of EIPs and operator aids more frequently.

2.3 Emergency Preparedness

EA identified six significant lessons learned that related to emergency preparedness and represent deviations from DOE published requirements and initiatives. These lessons learned are provided for all DOE/NNSA program offices and sites to consider for enhancing site programs, and when planning upcoming self-assessments and oversight assessments:

- Site processes are ineffective in identifying and tracking the locations and status of injured people and completing personnel accountability in a timely manner
- Corrective actions for identified weaknesses do not consistently resolve the issue or prevent recurrence, and do not always lead to program improvements
- Sites do not always effectively use exercise planning activities to improve the emergency management program
- Site exercise evaluators do not evaluate performance critically
- Emergency planners do not provide periodic drills for all workers who may have to take shelter-in-place protective actions

- Exercises typically do not include the response to EPHA bounding scenarios, which represent the upper end of the consequence spectrum and require a clear understanding of the interactions with offsite organizations.

Lessons Learned Statement: Site processes are ineffective in identifying and tracking the locations and status of injured people and completing personnel accountability in a timely manner.

Discussion: EA observed exercises in which 1 to 40 people were injured. All site EROs had difficulty identifying the names of the injured, the extent of their injuries, and their locations. The number of injuries included in the severe event exercise scenarios were typically well beyond the site’s mass casualty planning. Additionally, at one site, personnel accountability was not complete when the exercise terminated after approximately 6 hours of exercise play. Contributing factors to accountability weaknesses include:

- Privacy information requirements
- Call centers overwhelmed by incoming calls
- Communication errors
- Incomplete accountability reports
- Difficulty in determining the number of people transported to medical versus walk-ins and whether transported personnel included uninjured personnel along with the injured
- Discerning between injured and deceased personnel
- The lack of a reporting and tracking system for many injured people.

Analysis: DOE Order 151.1C requires planning for mass casualty situations and developing a procedure to account for employees after completing emergency evacuations. DOE Guide 151.1-4 recommends a personnel accountability system that can determine the location and status of onsite personnel, including visitors and subcontractors, during an emergency. The guide further recommends that to meet the order requirement for accountability, facility personnel should be able to identify any missing persons and establish that no one needs assistance or rescue within 30 to 45 minutes from the categorization and classification of an emergency. Accounting for people as soon as possible during an emergency assists in timely rescue and recovery operations.

Recommended Actions: To improve personnel accountability and the identification and tracking of injured personnel, emergency planners should consider:

- Reviewing and testing personnel accountability procedures under severe event conditions to ensure that missing persons can be identified and establish that no one needs assistance or rescue within 45 minutes from the categorization and classification of an emergency
- Establishing a process for tracking the location and status of injured personnel; the process should consider logical data collection points (e.g., medical transports, medical center walk-ins, and reports from facility accountability coordinators) and designate a central point for collecting accountability reports.

Lessons Learned Statement: Corrective actions for identified weaknesses do not consistently resolve the issue or prevent recurrence, and do not always lead to program improvements.

Discussion: EA observed that weaknesses identified during previous inspections remain uncorrected or recur when emergency planners make changes to the site's program. In general, emergency planners prioritize weaknesses into categories (e.g., findings, deficiencies, weaknesses, or improvement items) that vary in rigor for conducting a causal analysis, developing corrective action plans, tracking the completion of corrective actions, and independently validating the effectiveness of corrective actions. Emergency planners infrequently perform extent-of-condition reviews. They focus instead on a specific instance such as a non-compliance with a specific step in a procedure. This practice misses the overall result, which is a failure to meet a requirement that would rise to a finding level and require the highest rigor in improving the program.

Analysis: DOE Order 151.1C requires corrective actions for issues identified during evaluations, including exercises, to support continuous improvement. The order states that completion of corrective actions must include an independent verification and validation process that verifies that the corrective action has been implemented and validates that the corrective action has been effective in resolving the original issue.

Recommended Actions: To promote continuous program improvement through the issues management process, consider enhancing procedures and processes in the following areas:

- Performing extent of condition reviews
- Identifying root causes
- Ensuring corrective actions cover all aspects of the issue
- Developing corrective actions that prevent the issue from recurring
- Tracking corrective actions
- Following up on overdue corrective actions
- Independently verifying that corrective actions have been implemented and validating that the corrective actions were effective.

Lessons Learned Statement: Sites do not always use exercise planning activities effectively to improve the emergency management program.

Discussion: EA observed that some exercise packages do not provide the anticipated response because exercise planners could not determine what is expected of a responder. Missing items include:

- The correct EALs to be used
- The correct event classification
- How a responder will identify the HAZMAT type and quantity
- What should happen when sitewide shelter-in-place protective actions are implemented in buildings

that are compromised (e.g., by fire).

Also, at one site, the exercise planners gave draft procedures to participants and evaluators on the morning of the exercise, leaving no opportunity for the responder training beforehand.

Analysis: DOE Order 151.1C requires a formal exercise program to validate all elements of the emergency management program. Consistent with that purpose, planners should develop exercise plans that will validate the use of response tools such as the means to identify HAZMAT released, event categorization and classification processes, protective action decision making, and consequence assessment tasks. A useful tool in developing exercise plans that drives developers to examine site plans and procedures for exercise planning and evaluation is Exercise Builder. Exercise Builder is an easy-to-use computer-based tool that drives developers to examine site plans and procedures for exercise planning and development. Participants in the Emergency Management Issues Special Interest Group Exercises and Drills Subcommittee developed Exercise Builder under the sponsorship of the DOE Office of Emergency Management. DOE Guide 151.1-3 recommends using this tool to develop DOE emergency exercises. When exercise planners do not know how a responder should react in analyzed scenarios, that should be an indicator a missing programmatic element needs to be addressed. Missing programmatic elements include the hazards survey, EPHA, EAL, HAZMAT inventory control systems, or sufficiently detailed response procedures. Without these elements, responders cannot be expected to have completed training on how to perform these tasks. The guide emphasizes that the training and drill program should be coordinated with scheduled exercises to ensure that all participants have completed their required fundamental emergency management training before a scheduled exercise. Therefore, when exercises are conducted without knowing how a responder should react, then their performance cannot be evaluated, and program elements cannot be validated.

Recommended Actions: When exercise planners cannot determine the appropriate responder actions for evaluation purposes:

- Site management and emergency planning organizations should take actions to ensure that sufficiently detailed response tools are available for use
- Responders should then be trained to use these tools before validating the tool and the user's proficiency.

To help identify missing or incomplete response tools, consider using Exercise Builder software for developing exercise packages.

Lessons Learned Statement: Site exercise evaluators do not evaluate performance critically.

Discussion: EA observed that:

- Exercise planners do not always provide site evaluators with objective evaluation criteria
- Site evaluators do not objectively evaluate performance when evaluation criteria are not met
- Evaluators sometimes have little experience in the area they are evaluating, or they are evaluating their managers or peers
- The lack of relevant experience, or being potentially critical of their manager or co-workers can contribute to a less critical evaluation

- The lack of evaluation criteria sometimes stems from the lack of sufficiently detailed implementing procedures.

Analysis: DOE Order 151.1C requires each exercise to be evaluated using a critique process. A critique process includes gathering and documenting participant observations and identifying corrective action items that must be incorporated into the emergency management program. DOE Guide 151.1-3 indicates that an effective evaluation and critique process is based on specific evaluation criteria, ensures clear and useful findings are accurately developed, and ultimately will lead to lessons learned and corrective actions that result in an improved emergency management program. The guide further describes evaluation criteria as the standard and activity- or function-specific criteria for evaluating an exercise. The guide states that specific evaluation criteria should be developed for measuring performance with a procedure or checklist. References to specific plans, procedures, or standards incorporated in facility/site- or activity-specific evaluation criteria will reflect that a general objective has been accomplished and evaluated. The assessment consists of a comparison of performance against predetermined and documented facility/site- or activity-specific evaluation criteria based on program-specific plans/procedures. Information from the evaluation and critique processes provides useful feedback for identifying corrective actions and improving the emergency management program. However, EA noted that some evaluation criteria are not based on site-specific plans, procedures, or standards because there are insufficient details in plans and implementing procedures. Rather than correcting deficiencies in plans and procedures, sites revert to free play and record actions for later analysis. In cases where deficiencies are identified, the deficiencies are graded to determine the rigor of the corrective action process used for program improvements. In some cases, deficiencies are downgraded to below where needed improvements are required. The rigor of the corrective action process typically affects whether a casual analysis, a corrective action tracking system, and/or an effectiveness review of completed actions are implemented.

The guide also provides recommendations for selecting evaluators. One recommendation is to use experienced members of participating organizations and the ERO who are not involved in the play because they are familiar with the organizations, plans, and procedures. However, sites often prefer to use the most experienced person as an exercise responder and a less experienced person as the evaluator. This preference adds to the reluctance of an evaluator to give critical feedback, especially if the responder is the manager of the evaluator.

Recommended Actions: To improve evaluation criteria, consider:

- Reviewing EIPs and other implementing documents to ensure that they are up to date and provide sufficiently detailed instructions on how to implement the emergency plan
- Using sufficiently detailed site-specific EALs, procedures, manuals, handbooks, and other protocols as the basis for a correct response and incorporating the actions into evaluation criteria
- Using Exercise Builder software to consistently incorporate procedure based actions.

To improve exercise evaluations, consider:

- Using the most experienced responders as evaluators
- Using evaluators who do not evaluate their supervisor or higher levels of management
- Using evaluators from offsite sources that have an appropriate experience for the area they evaluate

- Promoting an exercise evaluation culture that seeks program improvements
- Providing training for evaluators on use of evaluation criteria and other tools, and the promotion of critical assessments.

Lessons Learned Statement: Emergency planners do not provide periodic drills for all workers who may have to take shelter-in-place protective actions.

Discussion: EA observed that sites give instructions for expected employee emergency response actions and conduct evacuation drills; however, several sites do not conduct periodic drills to practice sheltering. Some sites give written instructions to workers on the actions needed for sheltering and may address actions that will enhance the effectiveness of sheltering such as closing windows and doors, securing ventilation systems, sealing penetrations with tape or plastic, and sheltering in interior rooms. However, the contractors at several sites do not routinely give their employees the opportunity to practice sheltering. As a result, contractors do not effectively prepare site workers to implement this protective action.

Analysis: DOE Order 151.1C requires that contractors provide initial training and periodic drills to all workers who may have to take protective actions (e.g., shelter in place, assembly, and evacuation). DOE Guide 151.1-3 further states that employees assigned with specific emergency response responsibilities (e.g., employees assigned to support personnel accountability, shut down ventilation systems, or close doors and windows) should receive additional training.

Recommended Actions: To enhance the site’s ability to implement effective protective actions for onsite personnel, consider:

- Incorporating the practices recommended in DOE Guide 151.1-4 for enhancing the effectiveness of sheltering
- Ensuring that employee and visitor emergency training, visitor pamphlets, and procedures describe the sheltering process
- Adding a requirement to conduct periodic drills that allow employees to practice sheltering, and provide practice for employees assigned with specific responsibilities (e.g., securing ventilation, etc.).

Lessons Learned Statement: Exercises typically do not include the response to EPHA bounding scenarios, which represent the upper end of the consequence spectrum and require a clear understanding of the interactions with offsite organizations.

Discussion: None of the annual exercises that EA observed during 2014 included consequences that represented the upper end of the consequence spectrum or required implementation of offsite protective actions and response measures. Most annual exercises represented the lower end of the consequence spectrum. EA found that some offsite organizations are unfamiliar with the bounding EPHA scenarios and unaware of the distance to PAC and plume arrival times at specific offsite receptors beyond the EPZ for these scenarios.

Analysis: DOE Order 151.1C states that sites must establish and maintain effective interfaces to ensure the integration and coordination of emergency response activities with Federal, tribal, and local agencies and organizations that are responsible for emergency response and protection of the workers, public, and environment. Additionally, offsite response organizations must be invited to take part in a sitewide

exercise at least once every three years. However, there are no specific requirements for including a range of consequences in sitewide exercises to test a response to a scenario resulting in bounding consequences and significant participation by offsite authorities and NNSA assets. These scenarios are also more problematic for site workers and responders. Consequently, offsite officials may be unaware that protective actions may need to extend beyond the EPZ. Furthermore, some General Emergency declarations may require the implementation of integrated offsite field monitoring to determine offsite protective measures that may be necessary, but have not been pre-planned and validated during exercises. Consequently, the state and potentially impacted counties may lack site-specific emergency planning, because of the incorrect perception that there is no need to extend protective measures beyond the EPZs.

Recommended Actions: To improve offsite emergency planning and preparedness for the full spectrum of potential events, consider:

- Conducting site-level exercises using bounding scenarios documented in the EPHA
- Providing information to appropriate state and county agencies on the distance to PAC and plume arrival times at specific offsite receptors outside the facility EPZs for bounding event scenarios
- Coordinating offsite protective action recommendations with offsite agencies, based on the analyses documented in the EPHAs
- Planning with responsible offsite agencies for expanding protective actions outside the EPZs.

2.4 OE-1 Implementation Status

Before Japan's Fukushima nuclear reactor event in 2011 and the publication of OE-1, DOE emergency planning focused on the response to a HAZMAT release at a single facility assuming that the site infrastructure was largely intact and mutual aid was available from offsite resources. To incorporate the response to severe events recommended by OE-1, emergency planners must consider additional damage and the need for more onsite response resources. These considerations entail added complexities for emergency planners related to aging site infrastructure and to command centers and shelters with high air infiltration rates that were not built to survive severe events. Shrinking budgets and fewer people add more challenges, and sites have made few changes to address their response to a severe event, although three sites are having some success in acquiring new command centers. OE-1 states that all program offices, in coordination with responsible contractors, shall evaluate their site emergency management programs' response to severe accidents/events (including beyond design basis events) that could have a sitewide impact, using the guidance attached to OE-1. OE-1 required the evaluations to be completed by the end of calendar year 2014. OE-1 also states that hazards surveys shall be updated, in accordance with the existing requirements, to include additional multi-facility, sitewide events identified through lessons learned from the Fukushima nuclear accident, and that the emergency management program shall be adjusted accordingly. OE-1 provides guidelines to enhance base programs, as well as HAZMAT programs, in responding to beyond design basis events by:

- Establishing self-help programs that provide basic life-sustaining needs while isolated from offsite assistance
- Developing "walk-away" strategies to stabilize HAZMAT, delay safety degradation, or prevent further damage
- Preparing site evacuation plans

- Providing pre-determined delegations of authority, consistent with continuity-of-operations plans
- Adding severe event scenarios, including multi-facility HAZMAT release scenarios, to the drill and exercise program.

EA identified one significant lessons learned related to OE-1 guidance implementation, representing deviations from DOE initiatives. DOE/NNSA program offices and sites may consider this lessons learned for enhancing site programs, and when planning upcoming self-assessments and oversight assessments:

<p>Lessons Learned Statement: Few sites have made progress in implementing the OE-1 guidelines.</p>
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Discussion: Only one of the seven sites EA visited this year had started implementing the guidelines provided in OE-1 for severe event planning before their 2014 exercise. That site tested these additions during their 2014 exercise. Two sites had completed their program reviews using the OE-1 guidance, but neither site had implemented the OE-1 recommendations because the staff considered the extent of planning needed was either outside the scope of the existing operating contract or the events were too incredible to warrant planning. Two of the remaining sites took their first step towards severe event planning by using their 2014 exercises to identify response needs for a severe event. This approach identified many needs, but the exercise did not serve as a test of a planned response to a severe event, as intended by DOE Order 151.1C and OE-1. One site had not started the OE-1 review when EA completed their review.

During exercises, EA observed that:

- Response procedures, plume projection software, and forms that give offsite notifications and serve as response records do not typically account for multiple HAZMAT releases, significant infrastructure damage, and mass casualties.
- Only one site demonstrated the capability to give multiple plume projections on a single map
- As stated in sections 2.1 and 2.3:
 - Decision-makers did not fully review all applicable EALs
 - ERO duty stations could not receive and record multiple event-related phone calls and alarms because of insufficient equipment and staffing
 - The ERO did not have the means to track the status and location of many injured personnel.

Analysis: DOE Order 151.1C and associated guides do not list the specific response capabilities required for a site. Emergency planners determine response capabilities based on a baseline needs assessment required by DOE Order 420.1C, *Facility Safety*, and establish mutual aid agreements with local entities for support beyond the site's capabilities. Because the staff at each site prepared and approved the baseline needs assessments, the requirements established for response capabilities vary among the sites. Typically, a site's baseline need assessment establishes the response capability needed to respond to a single facility event (fire or HAZMAT release) with an injured worker.

OE-1, published in April 2013, broadens this response concept using the lessons learned from Japan's 2011 Fukushima event to include planning for a beyond design basis events that results in multiple facilities damage and no immediate offsite assistance available. OE-1 provides a process for incorporating these lessons learned into DOE's emergency management programs that makes use of the DOE Order 151.1C requirement to update hazards surveys and EPHAs at least every three years, which would lead to updated capabilities needed for a beyond design basis event response. The three-year update cycle will finish in April 2016, although the program office reviews and resulting program enhancements were due by December 31, 2014. Except for one site, site emergency planners delayed implementing any immediate program enhancements. Some sites do not believe they must comply with the guidelines in OE-1 as DOE did not add it to their contract, as was done for the order, and OE-1 uses non-mandatory language by only providing program enhancement guidelines and recommendations.

Recommended Actions: To improve the site's emergency preparedness for severe events, including beyond design basis events, consider:

- Providing explicit program office direction to sites regarding expectations for implementation of OE-1
- Identifying emergency response needs for severe events that include multi-facility damage and self-help capabilities when offsite aid is unavailable
- Identifying essential initial response actions that include safe shutdown of facilities to support facility evacuations
- Establishing responsibilities between facility operations management and site emergency management so that the responsible organizations pre-plan any transfer of responsibility based on established criteria and readily understand the appropriate actions to take throughout the event progression
- Analyzing scenarios where the same severe event triggers HAZMAT releases from multiple facilities
- Verifying that EPHAs contain information about the impact of simultaneous or sequential HAZMAT releases on collocated facilities on the site
- Integrating severe event planning across the site by using the anticipated post-event response time constraints for offsite resources included in the beyond design basis accident evaluation within the documented safety analysis (for nuclear facilities)
- Coordinating changes to facility, site, and community emergency plans to include a site evacuation under severe event conditions
- Reviewing continuity of operations plans to identify mission essential functions that may help determine the priorities for restoration/mitigation efforts during and after a severe event
- Conducting emergency drills to train responders and exercises to validate plans, procedures, and training for severe event scenarios
- Incorporating drill and exercise scenarios that impact multiple facilities and can cause the loss of infrastructure capabilities (e.g., onsite and offsite power, communications, and roadways), and the

unavailability of mutual aid, and also include secondary or compounding severe events that happened during critical stages of initial response or later remediation efforts

- Ensuring contract mechanisms are in place for severe event planning and acquisition of capabilities
- Validating severe event planning and preparedness activities during the next annual exercise.

3.0 BEST PRACTICES

During the 2014 reviews, the EA team identified a notably effective practice at the Y-12 National Security Complex regarding maintaining situational awareness. Other DOE/NNSA sites should consider gathering additional information about this notable practice and determining whether this practice would benefit their emergency management programs.

Situational Awareness

At Y-12 National Security Complex, the ERO effectively maintained situational awareness during their 2014 annual exercise using the Emergency Management Information System (EMInS), an incident management tool. EMInS linked the site's response facilities with the field responders and fostered interoperability with the offsite EOCs (local, state, and DOE Headquarters) to capture, distribute, and assess emergency information that expedited rapid and accurate decision making. The site has integrated EMInS with their web-based geographical information system to provide the ERO with maps, data, and analysis tools for the site, the surrounding area, and interiors of many onsite buildings. Also, the site developed other response tools, such as an automated damage assessment process that incorporates prioritized damage assessment analyses and mapping help the ERO use available resources effectively.

4.0 FUTURE REVIEWS

EA will continue to evaluate the capabilities and preparedness of selected site emergency response programs to respond to severe events. The emphasis of the reviews will include performance and programmatic evaluations focused on response to severe events, consistent with the guidance in OE-1. EA will also evaluate the effectiveness of selected site exercise programs, evaluate responder performance during site annual exercises or limited scope performance tests, and conduct emergency management programmatic reviews of the technical planning basis, plans and procedures, and readiness assurance processes. EA review plans, CRADs, and other guidance documents, as well as review reports, can be viewed on the EA website at <http://www.energy.gov/ea/listings/assessment-documents>.

Appendix A Supplemental Information

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Appendix B

2014 Lessons Learned	
2.1	Technical Planning Basis
	Emergency planning hazards assessments (EPHAs) do not always document the source term information needed to develop emergency action levels or to serve as a response reference document.
	Some EPHAs omit predicted exposures at receptors of interest and consequence assessment teams do not quickly calculate predicted exposures at receptors of interest after a hazardous material release.
	Emergency planners and responders do not adequately consider exposure times for personnel in a plume when determining whether consequence assessments and modified protective actions are timely.
	The technical planning basis for sites with lesser hazards is not always well founded, and the preparedness documentation is incomplete.
2.2	Emergency Response Performance
	During exercises, some emergency responders did not demonstrate proficiency with or use available response tools to promote effective performance.
	During exercises, consequence assessment teams did not adequately use consequence assessment tools or resultant products to confirm that initial protective action decisions were accurate, appropriate, and conservative for protecting workers, first responders, and the public.
	During exercises, few sites provided continuous, effective, and accurate communications among response components, resulting in inadequate communications and information management that degraded situational awareness and prevented a common operating picture among the site, DOE Headquarters, and offsite organizations.
	Site EROs rely heavily on an experience-based, rather than a process/procedure-based, approach to decision making for emergency responses, leading to ineffective implementation of the emergency plan based on individual knowledge of a given situation.
2.3	Emergency Preparedness
	Site processes are ineffective in identifying and tracking the locations and status of injured people and completing personnel accountability in a timely manner.
	Corrective actions for identified weaknesses do not consistently resolve the issue or prevent recurrence, and do not always lead to program improvements.
	Sites do not always use exercise planning activities effectively to improve the emergency management program.
	Site exercise evaluators do not evaluate performance critically.
	Emergency planners do not provide periodic drills for all workers who may have to take shelter-in-place protective actions.
	Exercises typically do not include the response to EPHA bounding scenarios, which represent the upper end of the consequence spectrum and require a clear understanding of the interactions with offsite organizations.
2.4	OE-1 Implementation Status
	Few sites have made progress in implementing the OE-1 guidelines.