Office of Enterprise Assessments
Assessment of the Lawrence Livermore National Laboratory
Emergency Management Program

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Acronyms

ACFD	Alameda County Fire Department
AHJ	Authority Having Jurisdiction
CQT	Consequence Assessment Team
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
EAL	Emergency Action Level
ED	Emergency Director
EMDO	Emergency Management Duty Officer
EMS	Emergency Medical Services
ENF	Emergency Notification Form
EOC	Emergency Operations Center
EPHA	Emergency Planning Hazards Assessment
EPIP	Emergency Plan Implementing Procedure
EPO	Emergency Programs Organization
ERO	Emergency Response Organization
ES&H	Environment, Safety, and Health
EVA	Emergency Voice Announcement
FM	Facility Manager
GET	General Employee Training
IC	Incident Commander
ICP	Incident Command Post
LEDO	Laboratory Emergency Duty Officer
LFO	Livermore Field Office
LLNL	Lawrence Livermore National Laboratory
LLNS	Lawrence Livermore National Security, LLC
LSPT	Limited-Scope Performance Test
MAR	Material at Risk
NARAC	National Atmospheric Release Advisory Center
NFPA	National Fire Protection Association
NNSA	National Nuclear Security Administration
OE	Operational Emergency
OFI	Opportunity for Improvement
OSC	On-scene Communicator
PA	Protective Action
PAC	Protective Action Criteria
PAR	Protective Action Recommendation
PPE	Personal Protective Equipment
RHWM	Radioactive and Hazardous Waste Management
SIP	Shelter in Place
TRU	Transuranic
UC	Unified Command

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Emergency Management Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of Lawrence Livermore National Laboratory's (LLNL) ability to implement its emergency management program. Lawrence Livermore National Security, LLC (LLNS) operates LLNL, and the National Nuclear Security Administration's Livermore Field Office (LFO) provides Federal oversight. This assessment was performed from August 29 to September 29, 2016.

EA applied limited-scope performance tests (LSPTs) to evaluate emergency response organization personnel's performance. One set of LLNS personnel participated in two test scenarios on the first day, and the scenarios were repeated on the second day with another team of participants. EA also followed up on the six findings identified in its 2013 report *Independent Oversight Review of Preparedness for Severe Natural Phenomena Events at the Lawrence Livermore National Laboratory*. Although part of the emergency response organization, LFO personnel did not participate in these LSPTs due to prior commitments.

One test scenario simulated a tritium release from a facility, and the second scenario was a transuranic waste release from the waste storage area. EA evaluated the emergency response organization's ability to respond to these two emergency events and assessed the capabilities of site personnel responsible for the initial decision-making to accurately categorize and classify the operational emergencies, make required notifications, implement protective actions for site personnel, provide protective action recommendations to offsite personnel, perform consequence assessments, release event information to the public, and mitigate the events. EA also assessed the conduct of the limited-scope performance tests to evaluate LLNS's planning and conduct of emergency management drills and exercises.

The test results revealed that the Alameda County Fire Department incident commanders properly formed a unified command with the LLNS protective force officers, established event scene command and control, and implemented initial onsite protective actions in a timely manner. At the emergency operations center (EOC), LLNS authorities appropriately categorized or classified all but one of the events within the required time, and made timely initial DOE and offsite agency notifications. LLNS personnel effectively activated the EOC staffs, and when emergency conditions worsened, the emergency directors responded appropriately and implemented the corresponding event classification upgrades. The consequence assessment teams generally demonstrated familiarity with their assigned tasks, along with conservative and technically based approaches for their analyses when information was incomplete. LLNS designed and conducted the limited-scope performance tests so that EA could effectively observe responder performance of key objectives and collect relevant data for analysis.

During the LSPTs there was some inadequate communications and information management that degraded situational awareness and prevented a common operating picture among the event scene, EOC, and offsite organizations. Consequently, not all actions and products were timely or communicated to the emergency response organization for consideration in protecting field responders. Specifically:

- Neither the on-scene support personnel nor the EOC staffs provided the incident commanders with recommendations on safe locations or personal protective equipment for the General Emergency event at the tritium facility, even when one dispersion model indicated that

responders were located inside an area where projected exposures were above the protective action criterion.
- During two of the tests, EOC staffs did not properly assess the effects of the light and variable winds, along with conflicts between plume models, on protective action decisions.

Other observations of a degraded common operating picture include:
- The EOC staffs did not comply with directions stated in the emergency notification form instructions, inappropriately calculating the offsite shelter-in-place distances.
- The staffs did not comply with news release instructions by inappropriately including protective action recommendations to offsite populations.
- Protective action recommendations were inappropriately included in text messages to onsite workers or contained confusing instructions.

LLNS had closed all six findings identified in the 2013 EA report. EA identified that LLNS had adequately corrected the deficiencies identified in three of the findings and properly closed those findings. However, the LLNS reviews for the other three findings did not identify the issues in the effectiveness of the corrective actions identified by EA.

LLNL emergency management plans and procedures were adequate, but EA observed some fundamental deficiencies in their implementation, indicating weaknesses in the LLNS exercise program. In addition, the improper closing of previously identified EA findings reveals continued weaknesses in the LLNS corrective action process. Additional attention by LLNS and enhanced oversight by the LFO is needed to further improve the LLNL emergency management program.

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Assessment of the Lawrence Livermore National Laboratory
Emergency Management Program

1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Emergency Management Assessments, within the independent Office of Enterprise Assessments (EA), assessed emergency management at the Lawrence Livermore National Laboratory (LLNL) to evaluate the effectiveness of preparedness for responding to classifiable Operational Emergencies (OEs) as established by DOE Order 151.1C, *Comprehensive Emergency Management System*. During this assessment, EA evaluated the ability of various site response organizations to recognize specific hazardous situations, notify appropriate onsite and offsite organizations and agencies, implement appropriate protective actions (PAs), establish command and control, and mitigate consequences of the postulated events.

In addition, EA followed up on its 2013 report *Independent Oversight Review of Preparedness for Severe Natural Phenomena Events at the Lawrence Livermore National Laboratory*, focusing on the status of the six findings contained therein. EA's 2013 report concluded that the contractor, Lawrence Livermore National Security, LLC (LLNS), needed to better integrate and coordinate planning with local, state, and DOE assets and upgrade the test and maintenance programs of backup power systems for response to a severe natural phenomena event. Once LLNS accomplished this planning, emergency response organization (ERO) members needed to demonstrate that these plans and procedures were effective in exercises, using scenarios that realistically portrayed the challenges faced from severe events. EA performed the current assessment of the LLNL site from August 29 to September 29, 2016.

2.0 SCOPE

EA assessed selected elements of the LLNL emergency management program and LLNS's effectiveness in implementing them, with specific attention to execution of emergency response elements during classifiable OEs. This assessment applied limited-scope performance tests (LSPTs) to evaluate selected capabilities of the ERO, emergency facilities and equipment, event categorization and classification, notifications and communications, consequence assessment, PAs, and emergency public information elements that support response functions at the site. EA also assessed LLNS actions to address the findings identified in the 2013 EA report.

3.0 BACKGROUND

The National Nuclear Security Administration (NNSA) Livermore Field Office (LFO) oversees LLNS and is responsible for administering the performance-based contract, executing assigned NNSA and DOE programs, and conducting oversight of work performed at LLNL in support of NNSA requirements and priorities. LLNL's primary mission is to strengthen U.S. security through development and application of world-class science and technology to enhance the nation's defense; reduce the global threat from terrorism and weapons of mass destruction; and respond with vision, quality, integrity, and technical excellence to scientific issues of national importance. LLNS is a partnership that includes the University of California, the Babcock and Wilcox Company, Bechtel National, Inc., the Washington Division of URS Corporation, and Battelle. Response to fire, medical, and HAZMAT incidents on LLNL property is provided by the Alameda County Fire Department (ACFD) under contract to LLNS. The ACFD staffs the LLNL fire stations with DOE security-cleared fire fighters and fire fighter/paramedics. Both LLNS

and the ACFD have ongoing contacts and mutual-aid agreements with local response agencies. According to the LLNL emergency plan, the initial response to a HAZMAT emergency is by the fire department, and the fire captain, an employee of ACFD, becomes the incident commander (IC) to establish control of the incident scene.

In a 2016 memorandum to LFO senior line management, EA identified the LLNL ERO as a target area for assessing the performance of the LLNS during LSPTs. The LSPTs would examine and validate elements of LLNL emergency management program by initiating a response to simulated, realistic emergency events/conditions in a manner that, as nearly as possible, replicates an integrated emergency response to an actual event.

4.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*. EA implements the independent oversight program through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. Organizations and programs within DOE use varying terms to document specific assessment results. In this report, EA uses the terms "deficiencies, findings, and opportunities for improvement (OFIs)" as defined in DOE Order 227.1A. In accordance with DOE Order 227.1A, DOE line management and/or contractor organizations must develop and implement corrective action plans for the deficiencies identified as findings. Other important deficiencies not meeting the criteria for a finding are also highlighted in the report and summarized in Appendix C. These deficiencies should be addressed consistent with site-specific issues management procedures.

This assessment also considered the requirements related to emergency management listed in DOE Order 151.1C and recommendations provided in the associated emergency management guides. The EA team examined key documents, such as plans, procedures, manuals, analyses, policies, training and qualification records, and numerous other supporting documents. The team interviewed key personnel responsible for developing and executing the associated programs; observed the LSPTs; and walked down emergency response facilities, focusing on systems and capabilities. Four LSPTs, based on two scenarios, were conducted to examine and validate elements of the LLNL emergency management program by simulating plausible emergency events/conditions in a manner that, as nearly as possible, enabled LLNS to initiate and implement an integrated emergency response. Both LSPT scenarios postulated radiological releases, one involving tritium that was 100 percent converted to tritiated water as analyzed in the LLNS documented safety analysis (DSA) and emergency planning hazards assessment (EPHA) fire scenarios, and the other scenario involving transuranic (TRU) material that was converted to plutonium equivalent curies to simplify consequence analysis in the LLNS DSA and EPHA.

LLNS derived these two scenarios from the approved EPHAs, which served as the technical basis for the design of the LSPTs. Both scenarios accurately reflected the current bounding facility-specific hazards, correlated technically with the EPHAs, and replicated technically accurate conditions in terms of operations and radiological, chemical, and meteorological data. The scenarios simulated a tritium release from building 331 and a TRU waste release from building 625. The ERO responded to the event scenes and the emergency operations center (EOC) in building 490. Both exercise scenarios were designed to escalate in severity. The Area 625 event was scripted to begin with the initial event being declared as an Alert by the IC, with ensuing events requiring the ERO to declare a General Emergency. The Building 331 event was designed to begin as an Operational Emergency and become a General Emergency. This escalation of events was planned to require the EOC staff to reevaluate the situation and upgrade the event classification.

One set of LLNS personnel participated in both LSPTs on day one, and LLNS repeated the LSPTs on a second day with another set of LLNS personnel participants. Throughout this report, references to "one day" refers to one of the two teams and both scenarios. "Initial event" refers to the initiating event, classified as either an Operational Emergency or an Alert.

EA evaluated the ERO's ability to respond to the two simulated OEs, assessed the capabilities of the site personnel responsible for initial decision-making to accurately categorize and classify the OEs, make required notifications, implement PAs and provide PA recommendations (PARs), perform consequence assessments, release event information to the public, and mitigate the events. EA also evaluated the conduct of the LSPTs to assess whether LLNS can plan and conduct emergency management drills and exercises by initiating a response to simulated, realistic emergency events in a manner that, as nearly as possible, replicates an integrated response to OEs.

During this assessment, EA discussed observations and issues with LFO and LLNS on a real-time basis. Findings are presented in Section 5.0, Results, and summarized in Section 6.0. Suggested program or process improvements for management consideration are listed as OFIs in Section 7.0, and Section 8.0 contains items for EA follow-up. The members of the EA assessment team, the Quality Review Board, and EA management responsible for this assessment are listed in Appendix A. A detailed list of the documents reviewed, personnel interviewed, and observations made during this assessment, relevant to the findings and conclusions of this report, is provided in Appendix B. Deficiencies are listed in Appendix C.

5.0 RESULTS

5.1 Limited-Scope Performance Tests

Criteria:

LSPTs examine and validate elements of an emergency management program by initiating a response to simulated, realistic emergency events/conditions in a manner that, as nearly as possible, replicates an integrated emergency response to an actual event. Planning and preparation use an effective, structured approach that includes documentation of specific objectives, scope, time lines, injects, and controller instructions for realistic scenarios. (Paraphrased from the *Plan for the Office of Enterprise Assessments Limited Scope Performance Test Assessment of the Lawrence Livermore National Laboratory)*

This section is based on EA's observations of two sets of emergency management LSPTs. Each set of LSPTs involved a combined assessment of response activities at the incident command post (ICP) and the EOC. EA presents the results of these performance tests according to observations at the evaluated venues (ICP, EOC, and consequence assessment) and in a cross-cutting topical area (i.e., the overall design and conduct of the LSPTs).

5.1.1 Incident Command Post

At the start of each LSPT, the Alameda County Fire Department (ACFD) officers (incident commander, response officer, emergency medical services officer), along with the LLNS protective force officer and the LLNS on-scene communicator (OSC), pre-staged at the Site 200 fire station. Field play began with a controller inject, at which time the ACFD incident commander (IC) gathered the run cards for the affected facilities, considered the wind direction and initial event information, reviewed the site map for safe routing and approach, and proceeded to the event location escorted by the LLNS protective force officer. At the start of each LSPT, LLNS also pre-staged facility personnel near the event building and

commenced play through a controller inject.

For the building 625 events, the IC established an ICP in a safe upwind location once at the event scene. Soon afterwards, the LLNS facility managers (FMs) and LLNS environment, safety, and health (ES&H) team leads arrived at the ICPs. Subsequently, the FM adequately briefed the Unified Command (UC) staffs on the event at the facility. Lastly, the ACFD ICs formed a UC with the LLNS protective force officers and, with the UC support staffs consisting of the response officer, emergency medical services officer, FM, and ES&H team lead, discussed response priorities and planning.

The building 625 FMs had a varied initial response to the initial event. One of the FMs assumed the role of IC and proceeded to set up a command post, before the ACFD arrived, in a safe location, having obtained wind direction from both the windsock and the on-line meteorological data. With one exception, the FMs appropriately addressed accountability and protective actions for employees in the facility. Once the FMs made contact with the ICs, they adequately provided facility information to the ICs throughout the LSPTs. The FMs provided useful information to the ICs on the event, including the type and amount of hazardous material involved, and were knowledgeable of operations and technical information. The FMs appropriately used the ES&H support at the ICPs.

The ICs adequately established command and control and, with the assistance of the OSCs and associated building PA sheets, effectively implemented initial PAs in a timely manner. The UC staffs maintained adequate communications among staff at the ICPs and a common operating picture of the local event scene activities, with one team more effective than the other in this process. Furthermore, the ICs appropriately relocated the ICPs to safe locations once building 625 events escalated to General Emergencies and verified habitability with ES&H monitoring.

In contrast, during the building 331 General Emergency events, the ICs did not reestablish ICPs and staging areas at new locations confirmed safe for habitability by monitoring and did not don personal protective equipment (PPE). Instead, ICs discussed the location of the ICPs with the FM and ES&H lead, who recommended that the ICPs remain in their current locations on the northwest side of Superblock outside the security fence, within 130 meters of the release point. They based their recommendation on the assumption that elemental tritium would be lighter than air and did not consider that a significant quantity of tritium was converted to tritiated water, as conservatively assumed in the EPHA. Further complicating the IC's decision was that the light wind speed (less than one meter per second) allowed the wind to shift from a variety of directions, lacking a steering current to keep the wind in a constant direction (further discussed in Sections 5.1.2 and 5.1.3). Furthermore, the ICs decided to remain near the facility after ES&H personnel advised them that they could not perform real-time monitoring for tritium at the ICPs. Equally important, EOC staffs did not provide to the ICs recommendations as to the safety of the ICPs or the staging areas, even when National Atmospheric Release Advisory Capability (NARAC) projections indicated a greater than 5-rem exposure at the location of the responders (further discussed in Section 5.1.3). Lastly, the UC staffs did not recognize that the locations of the ICPs and, in one instance, the staging area, could be above the tritium PA criterion (PAC) (see **Finding F-LLNS-1** and **OFI LLNS-1**). During a follow-up interview, one of the ACFD ICs indicated that ACFD relies on LLNS for their technical support and recommendations on the safety of responders. If the IC had understood the potentially hazardous condition, the IC could have easily conducted UC operations from a nearby building while remaining sheltered in place.

Although the UC staffs performed many tasks well, they did not always share a real-time common operating picture of the events with the EOC, resulting in different understandings of the events. Numerous examples of ineffective communications degraded situational awareness, leading to inconsistent ERO performance. For example: (see **Finding F-LLNS-2** and **OFI-LLNS-2**)

- ICs provided event scene information to the EOC during the bridge line calls, and the EOC staff

asked clarifying questions. Nevertheless, EOC staffs typically did not adequately share situational information with the ICs (see **OFI-LLNS-3**).

- EOC staffs did not provide the results of plume plots showing that unprotected field responders at the ICPs and staging areas could be in areas above the tritium PAC.
- EOC staffs did not provide PARs to the ICs who implement offsite PAs for the county/city, as required by procedure. For one response to building 625, lack of PAR information from the OSC and the EOC delayed the implementation of offsite PAs by 20 minutes, at which time the IC issued a PA distance of 1 mile rather than the 3,609 feet stated in the PA sheets. Furthermore, the IC did not inform the EOC of this action until a bridge call 10 minutes after implementation.
- The Protective Force Division's practice of closing the site entry gates but leaving the exit gates open allows the general plant population to leave the site – after being directed to shelter in place (SIP) – without consultation with the IC. This action inappropriately permits plant personnel to exit the plant into offsite areas where the IC has ordered PAs.
- On one day, the OSC alone participated in the EOC bridge calls and provided minimal briefings to the UC staff. As a result, the IC and ED could not converse about geographical areas of responsibility, as described in the emergency plan. Lacking this conversation, one IC issued PAs outside the IC's area of responsibility without the ED's approval.

In summary, the ICs effectively established event scene command and control and implemented initial PAs in a timely manner. The UC staffs maintained adequate communications among the staff at the ICPs and a common operating picture of the local event scenes. Although the UC staffs performed many tasks well, EA noted weaknesses related to the selection of safe locations for the ICPs and staging areas and situational awareness. Importantly, neither the UC technical support staffs nor the EOC staffs provided the ICs with recommendations on safe location or PPE for the building 331 response. Additionally, the UC staffs and EOC staffs did not share a common operating picture or situational awareness of the events.

5.1.2 Emergency Operations Center

At the start of each LSPT, LLNS EOC personnel pre-staged in building 490 and commenced play through a controller inject, timed to reflect when specific ERO notifications would occur. LLNS always responded with an authorized emergency management duty officer (EMDO) to initially categorize and classify events and to recommend PAs necessary to protect the health and safety of employees in accordance with the Emergency Programs Organization (EPO) plans/procedures. LLNS appropriately categorized or classified all but one of the events within 15 minutes of recognition. EMDOs also made timely initial notifications to DOE and offsite agencies. Nevertheless, in some briefings EMDOs inconsistently briefed the on-duty laboratory emergency duty officer (LEDO) on initial event status and did not always consult with the LEDO to determine the appropriate level of ERO activation, as required by EPO procedures, before implementing full ERO activation protocols.

Once EMDOs activated the EOCs, the on-duty LEDO became the emergency director (ED) and the backup LEDO became the Liaison Officer. The EDs conducted their duties as assigned and followed the actions specified in their checklists. Typically, during the first bridge line call, EDs ensured that the IC defined the IC's area of responsibility, and the EDs assumed responsibility for the remainder of the site and support of the ICs, with one exception (discussed in Section 5.1.1). This action also confirmed the IC's responsibility for protecting personnel within the incident scene and the impacted offsite areas. Still, the EDs retained overall emergency management responsibility at all times during the response, and when emergency conditions worsened, EDs responded appropriately by selecting the correct emergency action levels (EALs) and implementing the corresponding event classification upgrades. EOC staffs developed the primary situation and consequence assessment information to support ED decision-making.

In contrast, EOC staffs did not adequately evaluate or share with the ICs some relevant information of the building 331 General Emergency declarations and the associated potential radiological hazards for the upgraded events, as extrapolated from the EPHA. Most importantly, EDs did not provide necessary information to establish safe locations for the building 331 ICPs and staging areas (discussed in Section 5.1.1). In addition, the EOC staffs did not communicate potential exposure concerns for unprotected personnel at the ICPs and staging areas or provide PPE recommendations for event scene responders when NARAC plume projections were above PAC. These shortfalls resulted largely from consequence assessment personnel not adequately presenting to the EDs the dispersion model projections and potential impacts at receptors of interest (e.g., ICP, staging area, medical facilities, EOC). Notably, EOC staffs did not discuss with the EDs and ICs the fact that no real-time monitoring capability for tritium is available for use at the ICPs and the event scenes. Consequently, LLNS did not verify that unprotected personnel at the ICPs and staging areas could remain at those locations safely without PPE (further discussed in Section 5.1.3) (see **Finding F-LLNS-1** and **OFI-LLNS-4**).

During both events, the wind speeds were light (less than one meter per second). In general, DOE emergency management guides discourage the use of real-time weather under these conditions as a factor in determining initial PAs. 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-making processes. The need for reliable real-time weather information and on-call meteorological expertise, together with the added complexity of the decision-making process, makes such an approach unsuitable for reaching timely, conservative, and anticipatory PA decisions, as required by DOE emergency management policy. Nonetheless, EOC staffs did not properly correlate the impact of the light wind conditions on the consequences and PA decisions, even though these wind conditions resembled worst-case response planning in the EPHA (further discussed in Section 5.1.3). Furthermore, release information was sparse or confusing, especially when the known information (stack readings) indicated elevated radiological readings, sprinkler flow alarms, and absence of real-time monitoring at responder locations.

In addition, the EOC staffs did not comply with directions stated in the emergency notification form (ENF) instructions. Generally, LLNS did not calculate the offsite SIP distances in the ENFs in accordance with the ENF guidance, which states, for PARs, to deduct the distance from the facility to the LLNL fence line and state as (miles/feet) downwind from the LLNL boundary perimeter fence line. This process resulted in a difference of up to a half-mile in offsite SIP distances. In all but one ENF, LLNL used the facility (usually unidentified) as the point of reference rather than the fence line. In addition, some ENFs contained additional contradictory or erroneous information. For example:

- An ENF containing an event classification of General Emergency stated PARs for offsite populations as “None” when the PAR linked to the EAL was to SIP for a 1-mile radius.
- One ENF update stated PARs for offsite populations as SIP in place 2.5 km, when the actual recommendation was to SIP 2.5 km downwind.

Furthermore, the EOC staff did not comply with LLNL-MI-701280, *Issue News Releases*, which correctly states that news releases are not to reference LLNS’s PARs made to offsite authorities. Several news releases contained information regarding PARs made to offsite authorities. Other concerns about the news releases regarding both onsite PAs and offsite PARs include:

- One news release stated, “Lab emergency personnel, along with city officials, have issued a SIP for all employees and residents located up to 2.5 kilometers downwind of the Laboratory.”
- Another news release stated that the surrounding community within one mile, including adjacent Sandia (National Laboratories – California), was to SIP (actual recommendation was SIP for 1 mile from the facility, an almost half mile difference).

- Only one news release contained the appropriate and useful PAR statement that "the public should listen to the Emergency Alert System radio station, KCBS 810 AM, or dial KKIQ 101.7 FM, regarding PAs that appropriate off-site emergency response agencies may direct."

In addition to news releases, LLNS uses E-Line and TxtWire to communicate with lab workers. TxtWire is used to send text messages to employee- and company-owned mobile phone devices, and E-Line is a system for delivering email messages to office computers, company-owned mobile phone devices, and iPads. As with the news releases, PARs were inappropriately included in some E-Line and TxtWire messages (residents within one mile of the Laboratory are advised to SIP) or contained confusing instructions (i.e., all lab employees are ordered to evacuate from their buildings and SIP to await further instructions) (**Deficiency**).

Throughout the LSPTs, EA observed inadequate communications and information management that degraded situational awareness and prevented a common operating picture among the event scene, EOC, and offsite organizations (see **Finding F-LLNS-2** and **OFI-LLNS-5**). Most significantly, LLNS information flow processes were ineffective in acquiring, recording, and disseminating timely and accurate event information within the ERO. Furthermore, the personnel at the ICP and EOC did not always share a near real-time common operating picture of the event, resulting in different understandings of the events (i.e., potential consequences, response actions, and PAs) at the two command locations. In addition, a significant weakness in the EOC was the ineffective use of available information management capabilities (e.g., WebEOC and geographical information system mapping), contributing to a reduced level of support to the IC (discussed later in Section 5.1.3). Further complicating communications was the IC's inability to see any WebEOC data or important technical products produced at the EOC, adversely influencing the IC's decision-making (previously discussed in Section 5.1.1). Other examples of ineffective communications and degraded situational awareness that resulted in inconsistent ERO performance included:

- Numerous inoperable EOC computers and displays on both days of LSPTs prevented ERO access to the EOC information management system.
- Occasional misinformation (explosion rather than crash, evacuation of blocks rather than a single building) led ERO teams down an incorrect response path.
- Communications between the ICs and EDs were inconsistent. On one day, the IC never communicated directly with the ED, likely contributing to the IC's reduced situational awareness.
- The EOC staffs could not provide the ICs with requested technical products needed to protect response personnel, workers, and the public. During one LSPT, EOC personnel innovatively resorted to transmitting a computer screen shot of a plume plot to the OSC via personal cell phone.
- Some EOC staff were slow to develop situation and consequence assessment information to support ED decision-making, unnecessarily delaying EOC/ICP briefings and the declaration that the EOC was operational (further discussed in Section 5.1.3).
- Inconsistent dispersion model results were not addressed and reconciled by EOC staffs or provided to the ICs to identify pre-determined potential exposures (based on the results of the EPHA analysis) at the locations of specific receptors of interest (Site 200 fire station, medical facilities, EOC, offsite schools, and public facilities).

Overall, LLNS consistently responded with an authorized EMDO to initially categorize and classify events and to recommend PAs. EMDOs appropriately categorized or classified all but one of the events within 15 minutes of recognition and made timely initial DOE and offsite agency notifications. EMDOs effectively activated the EOC staffs, the on-duty LEDO became the ED, and the backup LEDO became the liaison officer. When emergency conditions worsened, EDs responded appropriately by selecting the correct EALs and implementing the corresponding event classification upgrades. In addition, LLNS

personnel stationed in the EOC performed their duties as assigned and followed the actions specified in their respective checklists, with some noted exceptions. However, LLNS did not verify that unprotected personnel at the ICPs and staging areas were safe to remain at those locations without PPE, even when NARAC modeling indicated that responders were located inside an area with projections greater than 5-rem exposures. During two of the LSPTs, EOC staffs did not properly correlate how the light wind conditions might impact the consequences and PA decisions, even though the actual wind speeds resembled the worst-case response planning conditions in the EPHA. In addition, EOC staffs did not comply with the ENF instructions and inappropriately calculated the offsite SIP distances. EOC staffs did not comply with news release instructions and inappropriately included PARs to offsite populations in the news releases, as well as in E-Line and TxtWire messages to onsite workers (which sometimes contained confusing instructions). Lastly, EA observed inadequate communications and information management that degraded situational awareness and prevented a common operating picture among the event scene, EOC, and offsite organizations.

5.1.3 Consequence Assessment

At the start of the LSPTs, the consequence assessment team (CQT), consisting of a modeler and a leader, was pre-staged in the EOC building and was allowed to commence play through a controller inject timed to reflect when the EOC would be paged. The CQT workstation is in a room at the perimeter of the EOC with nearby access to the EOC cadre and the ES&H team. Per procedure, the CQT leader interfaces with the ED and the ES&H technical discipline.

During all LSPTs, the CQTs demonstrated familiarity with their responsibilities for producing and communicating timely initial assessments and ongoing assessments. CQTs always logged in to WebEOC, used position checklists to guide their actions, reviewed the EPHA for modeling input data, were familiar with applying the different PA criteria, and used available tools to determine and convert material-at-risk (MAR) quantities into appropriate units and access real time meteorological data for use in developing plume projections. Unless directed otherwise, CQTs consistently modeled projections by modeling scenarios with:

- Worst-case MAR quantities and worst-case meteorological conditions
- Worst-case MAR quantities and current meteorological conditions
- Refined MAR quantities and current meteorological conditions.

CQTs also used conservative and technically based assumptions for MAR quantities when information was incomplete. When MAR information was incomplete, the CQT used DSA container limits, up to the facility's inventory limit. Importantly, the CQTs modeled the tritium release fire scenarios as a tritiated water vapor release, consistent with the DSA and EPHA, to conservatively reflect the significant consequences of a tritiated water release rather than an elemental tritium release. The CQTs used Hotspot and the NARAC dispersion models for each scenario to perform the initial projections and corroborative projections, respectively. Once CQTs completed the plume plots, all but one of the CQT leaders discussed the results with the ED and ES&H team leader and directed the modelers to post the plume projections on a display screen in the EOC. The CQTs made a significant contribution to the TRU release scenario responses by recognizing and communicating the need to extend PAs beyond the distances stated in the EALs (PAs were extended from 1.6 km to 2.5 km). The extension of PAs resulted from the actual, more stable weather conditions observed during the LSPTs than stipulated by the DOE emergency management guide and used by LLNS for EAL PA development.

While CQTs generally followed site protocols, initial consequence assessments were not timely. The LLNL site emergency plan establishes a timely initial assessment as being available within about 30 minutes from initiation of a response. Consistent with the DOE emergency management guide, the emergency plan and procedure LLNL-MI-683846, *Consequence Assessment*, identifies a timely initial

assessment to be a dispersion projection using real-time information. Instead, by EPO Checklist 24, *CQT Modeler Checklist*, CQTs initially duplicated the EPHA worst-case scenario before performing an initial assessment using real-time data. While CQTs performed some initial assessments in close to 30 minutes, one took approximately 90 minutes to complete (**Deficiency**). Delays in completing the initial assessment were caused by analyzing an incorrect scenario, followed by input errors to the modeling program for release height, release fractions, and plume plot contours.

CQT ongoing assessments were limited to refined Hotspot and NARAC dispersion model projections and support to ES&H teams that were planning field-monitoring activities, even though the LLNL program has additional capabilities and record keeping and communication requirements. CQTs did not perform some tasks in accordance with procedures, and CQTs performed some tasks that are not in the procedures. In addition, CQTs had to make some decisions without procedural guidance, resulting in significant variances in responses. Specific tasks the CQT did not perform as directed by procedures include: (see **OFI-LLNS-6**)

- Identifying the scenario to model by its pre-planned scenario number, contributing to one CQT incorrectly modeling a tritium release fire scenario as an explosion scenario twice, before being corrected by the EMDO
- Performing corroborating assessments of the proper EAL in use and appropriate PAs, and logging conclusions from these activities into WebEOC
- Recording contact with NARAC personnel in WebEOC when the CQT contacted NARAC for an explanation of NARAC results during one LSPT.

CQTs had to make their own judgments in performing activities due to lack of procedural guidance about: (see **OFI-LLNS-7**)

- What to do when the CQT is unable to corroborate initial dispersion modeling results. This was the case with some Hotspot and NARAC modeling results. For the tritium release scenarios, the NARAC results conflicted with the Hotspot results regarding areas above the PA criterion of one rem. The Hotspot results identified the area near the tritium facility to be safe, attributed to the elevated release point from the stack, whereas the NARAC results projected exposures above five rem in the same area. The CQTs responded differently to this information. One CQT did not share the NARAC results with EOC personnel and instead contacted NARAC personnel for an explanation and resolution. The other CQT presented the NARAC results to the EOC cadre without mentioning its conflict with the Hotspot results or elaborating on the differences between the two models and resultant plume plot products.
- What release durations and weather data to use as modeling input parameters. CQTs always used 15-minute release times when using Hotspot and 1-hour release times when using NARAC. The CQTs always used weather data for the time of modeling rather than for the time of release. This input data significantly affects the results from a puff release, although LLNL protocols do not distinguish between puff releases and prolonged releases. Modeling puff releases with other than event-time weather data would provide inaccurate projections for use in making PA decisions.
- Determining the application of consequence assessment results. CQTs focused on the safety of general employees under PA orders; did not consider field responders at the ICP, staging areas, and traffic control points; and were unaware of field responder locations (see **Finding F-LLNS-1**).
- Briefing the EOC cadre on consequence assessment results. The CQTs made only one briefing to the EOC cadre during the four LSPTs, and only at the request of the ED. CQTs consistently posted Hotspot plume plots and most NARAC plume plots. Hotspot and NARAC plume plots varied significantly in results for a number of reasons, such as the modeling capability, input parameters, and plume plot products, and the NARAC modeling product is the most sophisticated product available for this use. The Hotspot product presented one-hour exposure projections,

while NARAC projections were for a four-day exposure period. Topics not discussed in briefings include the PA criteria, which is different for TRU and tritium, and an explanation of why the Hotspot plume was shown to originate from a building other than the tritium facility. Importantly, no discussion ensued after a CQT leader presented the EOC cadre with a NARAC plume plot showing areas above five rem which had been thought to be safe, based on the Hotspot results, and, on one day, was populated by on-scene responders without PPE (see **Finding F-LLNS-1**).

- Producing timely initial assessments. Although the site emergency plan establishes a 30-minute timeframe to make the initial assessment available, response procedures do not reflect this expectation and CQTs did not demonstrate that they worked to meet a timeliness goal.
- Supporting the ES&H team with an available pre-planned survey map for use in directing and communicating field-monitoring activities. Incorporation of pre-planned survey maps into procedures provides a more consistent approach in their use.

CQTs did not use some available tools, partly because LLNS has not incorporated them into procedures, such as: (see **OFI-LLNS-7**)

- The key receptors of interest identified in the EPHA for impact of analyzed releases. During one tritium release LSPT, an ERO member asked the CQT whether the EOC was safe to operate from, and instead of establishing its distance from the release point as listed in the EPHA, the CQT inappropriately declared the EOC safe for habitability because of the high-efficiency particulate air filters in the EOC's intake ventilation system, although these filters cannot remove the tritium from the air (see **OFI-LLNS-8**).
- Projection of plume arrival times at receptors of interest.
- Integration of consequence assessment results into the LLNL geographical information system. The EOC staffs did not use the available screen display of the area map that LLNS can populate with responder positions, plume plots, and other information.

Overall, CQTs generally demonstrated familiarity with their assigned tasks and demonstrated conservative, technically based approaches to establish MAR quantities when information was incomplete. CQT proficiency varied in completing assessments and communicating results, partly because of the lack of complete procedural guidance or skipping some procedure steps, and partly because of the procedure requirement to duplicate the EPHA data first. Consequently, not all CQT actions and products were timely or communicated to the ERO for consideration for protecting field responders.

5.1.4 Design and Conduct of LSPTs

LLNS adequately designed two LSPT scenarios, derived from approved EPHAs, which were used as the technical basis for the LSPTs. Both LSPT scenarios accurately reflected the current bounding facility-specific hazards, correlated technically with the EPHAs, and replicated technically accurate conditions in terms of operations and radiological, chemical, and meteorological data.

LLNS effectively conducted the LSPTs in a manner that enabled EA to evaluate elements of the LLNL emergency management program by initiating a response to simulated, realistic emergency events/conditions in a manner that, as nearly as possible, replicated an integrated emergency response to an actual event. LSPT planning and preparation appropriately used an effective, structured approach that included specific objectives, scope, time lines, injects, and controller instructions for realistic scenarios. In addition, LLNS effectively used a sufficient simulation center staffed with experienced and knowledgeable participants to portray the agencies and individuals who would likely participate during a real event. The simulation center generated injects, received player responses, and delivered scenario

injects using telephone calls, radio messages, and facsimiles to represent actions, activities, and conversations with individuals who were not participating. As a result, the simulation center was able to maintain exercise realism and allowed the participants to simulate the necessary coordination expected during a real event. LLNS controllers also appropriately provided players with earned information when player actions would have provided them.

LLNS also provided venue controllers and simulation center personnel with adequate exercise-specific training, rules of conduct, and appropriate guidelines on interactions with players. Venue controllers executed the exercise packages as designed, and LLNS executed a "hotwash" at each venue immediately after each day's LSPTs to gather and document the participants' observations. LLNS also conducted daily controller debriefs to determine whether the assessed responders accomplished the individual exercise objectives, based on a synthesis of the observations and information gathered during the conduct of the LSPTs.

Other strengths in conduct of the LSPTs include:

- No contingency messages were needed on day 1.
- Good control ensured that no LSPTs evolved into unintended malevolent events.
- Day 2 misinformation (explosion rather than crash) was allowed to play out and self-correct.
- Day 2 EMDO drillmanship was commendable in that the EMDO did not use a radio for initial communications since he normally works in a secure area that does not allow radios.
- Day 2 IC drillmanship was also commendable in that the IC continually verbalized and elaborated to the controllers and evaluators what actions and strategy he was implementing.

Although LLNS conducted the LSPTs in accordance with DOE requirements, EA identified the following problems in LSPT conduct: (see **OFI-LLNS-9**)

- On one day, the EMDO controller inappropriately issued contingency messages for both events, without the approval of the exercise director, to provide the EMDO with the correct event classifications and EALs.
- Delays in the flow of exercise data resulting from too few controllers at the ICP to support participant responses.
- An escort who had participated in the previous day's LSPT was prompting players during one of the LSPTs.
- One of the FMs did not have time to demonstrate the role of IC before the ACFD arrived, due to confusion about radio communication.

Overall, LLNS effectively designed and conducted the LSPTs in accordance with DOE requirements. EA identified a few problems related to exercise conduct where LLNS could further improve the LLNL exercise program. However, although EA did not assess previous LLNL exercise evaluations or LFO oversight, the LSPT deficiencies observed by EA in protecting responders and disseminating PAs and PARs to workers and the public indicates potential weaknesses in the LLNS exercise program and LFO assessment and oversight. A robust contractor self-assessment program, overseen by the field office, is intended to ensure that issues are self-identified and corrected, without requiring the influence of external evaluators (**LFO-OFI-1**).

5.2 Previous Findings Follow-up

Criteria:

Assess the contractor responses, corrective actions, and recurrence controls for issues identified in the May, 2013 Independent Oversight report. (Paraphrased from the *Plan for the Office of Enterprise*

Assessments Limited Scope Performance Test Assessment of the Lawrence Livermore National Laboratory)

EA followed up on its 2013 natural phenomena event review at LLNL, focusing on the status of the six findings. In that report, EA concluded that LLNS needed to better integrate and coordinate planning with local, state, and DOE assets and to test and maintain backup power systems to a higher level for response to a severe natural phenomena event. Once LLNS accomplished this planning, ERO members needed to demonstrate that these plans and procedures were effective in exercises, using scenarios that realistically portrayed the challenges faced in these situations. Furthermore, LFO personnel should conduct follow-up assessments to validate the closure of these actions, including follow-on actions and interactions with LLNS personnel, as a means to verify the effectiveness of completed actions.

Previous Finding F-1: LLNS does not test and maintain diesel generators serving as backup power to emergency egress lighting as level-1 diesel generators, as required by National Fire Protection Association (NFPA) 101, *Life Safety*, and NFPA-110, *Standard for Emergency and Standby Power Systems*.

LLNS addressed this finding effectively through its corrective action program. Key actions taken to address the finding include:

- Performing Authority Having Jurisdiction (AHJ) evaluations of system use and critical loads
- Performing an extent-of-condition review that identified 30 generators in need of AHJ evaluations
- Adding annual test requirements for lights without in-place testing capability
- Establishing battery replacement requirements for a failed battery test or at least every four years
- Reducing the need for generator backup power by replacing legacy lights that have no batteries with lights equipped with batteries and battery charging indicators (still in progress)
- Implementing test and maintenance procedures that are consistent with NFPA criteria and approved by the AHJ.

Previous Finding F-2: The operator's supervisory station is not equipped with a backup power source that can operate for 24 hours without refueling and the diesel generator that provides backup power is not tested as a level-1 generator, as required by NFPA-72, *National Fire Alarm and Signaling Code*.

LLNS closed this finding effectively. During EA's 2013 review of LLNL's state of preparedness for severe events, the diesel generators in the Alameda County Regional Emergency Communications Center, an onsite operator-staffed supervisory station maintained by LLNS, have integral fuel tanks with an eight-hour supply of fuel when operated at rated capacity and were tested and maintained as optional backup power systems. LLNS entered this finding into its corrective action program and effectively corrected this condition. Key actions taken to address the finding include

- Determining and recording the connected loads on these generators
- Documenting calculations showing that two diesel generators operated in a lead/lag configuration can provide power to all connected loads for more than 24 hours without refueling
- Entering the diesel generators into an NFPA level-1 test and maintenance program.

Previous Finding F-3: LLNS cannot ensure that site workers receive prompt initial emergency notifications as required by DOE Order 151.1C.

LLNS effectively addressed this finding, which identified that LLNS could not ensure that workers received prompt initial emergency notifications, including instructions to take PAs, while LLNS was

resolving reliability and coverage issues in the Emergency Voice Announcement (EVA) system. LLNS entered the finding into its corrective action program, completed the key actions, and effectively corrected the condition. Key actions taken to address the finding include:

- Performing EVA system announcements during normal working hours
- Investigating and implementing alternative methods for emergency notifications and initial PAs.

In addition, LLNS continues to resolve reliability and coverage issues of the EVA system. LLNS replaced the primary EVA system server in January 2015, established a hot backup server, and continues to systematically replace the old speakers with higher quality speakers. Overall, LLNS has effectively placed a contingency notification system in place while continually improving the reliability and coverage of the EVA system.

Previous Finding F-4: LLNS has not applied a coordinated program of training and drills to all emergency response personnel and organizations that LLNL expects to respond to onsite emergencies, as required by the DOE Order 151.1C.

LLNS closed but did not effectively address this finding. At the time of EA's 2013 review, ACFD fire captains were not required to attend training on the implementation of the EALs, so they could not reliably implement initial PAs and PARs in accordance with DOE standards. The finding was based on the premise that the battalion chief might not be available for a response at LLNL (because of other offsite responsibilities), so a fire captain could serve as the LLNL IC. LLNS entered the finding into its corrective action program and completed several actions associated with the finding. Key actions taken to address the finding include:

- Defining the approach for EALs, PAs, and PARs for ACFD
- Revising the EPO's PA and PAR documents
- Updating the PA/PAR training course, E9018-P, *Categorization & Classification Practical*
- Providing direction to ACFD on PA and PAR usage and training.

EA determined that the LLNS effectiveness review for this finding was not rigorous enough to ensure effective closure of the finding. The LLNS effectiveness review team observed two exercises as part of the effectiveness review process. One of the exercise after-action reports concluded that the IC did not complete the PA process properly and the IC needed additional training. In addition, the ICs for the exercises had not completed the revised E9018-P training course. Furthermore, the LLNS contracting officer technical representative directed the ACFD to train only the officers permanently assigned to the LLNL Site 200 fire station, so any other ACFD officers who could be called on to report to Site 200 fire station and be involved in an LLNL event would not be properly trained. Overall, the effectiveness review lacked the necessary rigor to ensure adequate finding closure.

In addition, closure of the finding was not effective in ensuring that untrained ACFD personnel did not continue to participate in LLNL emergency response activities. LLNS does not require ACFD officers to complete the EM9018-P training course before assignment on the LLNL duty roster. From a sampling of 16 dates in the past 18 months, EA identified the following examples of ACFD officers on the duty roster without appropriate training:

- Sixteen instances when no on-duty battalion chiefs had the required training
- Two instances when no on-duty ACFD officers had the required training
- Five instances when only one on-duty officer had the required training.

Likewise, in 8 of 10 exercises conducted since February 2015, the ACFD ICs did not have the required training (see **Finding F-LLNS-3** and **OFI-LLNS-10** in Sections 6.0 and 7.0 of this report).

Previous Finding F-5: The LLNL emergency plan and emergency plan implementing procedures (EPIPs) do not adequately describe and establish the concept of operations required for all operational emergencies, as required by DOE Order 151.1C.

LLNS closed but did not effectively address this finding. The identified shortcomings in the LLNL emergency plan and EPIPs used by the ACFD and LLNS could result in unnecessary delays and an ad hoc response to a time-urgent event. Importantly, LLNS and ACFD emergency planning did not adequately document the state of California Standardized Emergency Management System implementation for LLNL events, and response planning did not clearly identify the actions expected from each interface agency and the information needed to respond effectively. LLNS entered the finding into its corrective action program and adequately completed the identified key actions, which included:

- Discussing the concept of operations with ACFD and City of Livermore
- Revising the LLNL emergency plan to reflect the concept of operations.

The LLNS effectiveness review inappropriately concluded that the corrective actions effectively addressed the finding. However, the LLNS team limited its effectiveness review to the actions in the corrective action plan and thus did not address the EPIPs.

In addition, the closure of this finding was not effective in preventing recurrence of some ad hoc response. As documented in the LSPT results in Section 5.1.1, as well as the examples below, LLNS and ACFD still need additional implementation guidance on the concept of operations:

- The emergency plan does not discuss the role of the OSC.
- LLNS has not assigned important IC responsibilities in the EPIPs or the ACFD Official Action Guides, most notably the responsibility to have a conversation with the ED to define the event scene areas of responsibilities, as stated in the emergency plan. As observed during the LSPTs, only one team appropriately discussed the IC's and ED's areas of responsibilities.
- One OSC made and implemented decisions that were actually within the IC's purview:
    - Defining event scene areas of responsibility
    - Implementing PAs for additional areas
    - Changing the SIP location for evacuees to be stationed.
- One IC issued site-level PAs that, at the time, were outside of the IC's area of responsibility, as stated in the emergency plan.
- One OSC delayed implementation of PAs because no EPIP defined the process for implementing PAs at the site, outside of the IC's area of responsibility, by either the OSC or the EOC Operations Section Chief through fire alarm dispatch (see **Finding LLNS-3** and **OFI-LLNS-11** in Sections 6.0 and 7.0 of this report).

Previous Finding F-6: LLNS has not implemented effectiveness reviews that successfully validate whether corrective actions resolved identified weaknesses, as required by the LLNL effectiveness review procedure and DOE Order 151.1C.

LLNS closed but did not effectively address this finding. LLNS entered the finding into its corrective action program and adequately corrected some aspects of the finding. Key actions taken to address the finding include:

- Conducting a new effectiveness review for prompt emergency notifications (Previous Finding F-3 above)
- Conducting a new effectiveness review for concept of operations (Previous Finding F-5 above)
- Revising PRO-0077, Conducting an Effectiveness Review.

LLNS satisfactorily closed the first action, but as noted above for Previous Finding F-5, the corrective

actions for the second action were not effective. LLNS also did not revise PRO-0077, prior to the closure of the finding, to address prevention of recurrence or continuing problems in the topical area as required by the corrective action plan. (EA notes that PRO 0077 was subsequently revised to address the required corrective actions after the finding was closed).

In addition to the specific corrective actions for the effectiveness review Finding F-6, EA also examined the effectiveness reviews for Previous Findings F-1 through F-5.

Previous Finding F-1: Testing and maintaining diesel generators. LLNS did not complete an effectiveness review; it was reassigned to another action with a closure due date of 2017.

Previous Finding F-2: 24 hour backup power source. LLNS completed an effectiveness review, including an effectiveness review plan and an effectiveness review report. EA reviewed the evidence files and found no issues in the effectiveness of the corrective actions.

Previous Finding F-3: Prompt initial emergency notifications. LLNS completed an effectiveness review and issued an effectiveness review report, but no effectiveness review plan was provided. LLNS stated that the plans had been prepared but did not provide them or the plans identified in the subsequent findings. EA reviewed the evidence files and found no issues in the effectiveness of the corrective actions.

Previous Finding F-4: ERO training and drill program. LLNS completed an effectiveness review and issued an effectiveness review report, but no effectiveness review plan was provided. The effectiveness review took credit for an emergency exercise. EA reviewed after-action reports and training records; the after-action report identified issues in that LLNS did not use the PAs appropriately, and the IC was not trained. These issues indicate that the corrective actions were not effective.

Previous Finding F-5: **Concept of operations**. LLNS completed an effectiveness review and issued an effectiveness review report, but no effectiveness review plan was provided. The LLNS effectiveness review inappropriately concluded that the finding was effectively closed because it considered only the actions stated in the corrective action plan, without reference to the finding, as stated.

Overall, the LLNS and LFO reviews for three of the six findings did not identify apparent issues in the effectiveness of the corrective actions. (See **Finding F-LLNS-3, OFI-LFO-2,** and **OFI-LLNS-12** in Sections 6.0 and 7.0 of this report).

6.0 FINDINGS

Findings are deficiencies that warrant a high level of attention from management. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers and the public, or national security. DOE line management and/or contractor organizations must develop and implement corrective action plans for EA appraisal findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 226.1B to manage these corrective action plans and track them to completion. In addition to the findings, deficiencies that did not meet the criteria for a finding are listed in Appendix C, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution

Finding F-LLNS-1: LLNS has not fully integrated consequence assessments with emergency classification and PA decision-making. (DOE Order 151.1C, Attachment 2, 13)

Finding F-LLNS-2: LLNS has not provided continuous, effective, and accurate communications among response components. (DOE Order 151.1C, Attachment 2, 12)

Finding F-LLNS-3: LLNS has not implemented a verification and validation process, associated with previous EA emergency management findings, that verifies that corrective actions have been put in place and validates that the corrective action has been effective in resolving the original finding, thereby preventing recurrence. (DOE Order 151.1C, Attachment 2, 7)

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified some OFIs to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in appraisal reports, they may also address other conditions observed during the appraisal process. EA offers these OFIs only as recommendations for line management consideration; they do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

Livermore Field Office

OFI-LFO-1: To improve LFO oversight and assessment of the LLNS exercise program, including exercise evaluation and corrective actions, consider:

- Confirming the LLNS exercise program validates all elements of the emergency management program over a five-year period.
- Confirming the annual site-level exercise is designed to test and demonstrate the site's integrated emergency response capability
- Ensuring LLNS has implemented an emergency management self-assessment program that effectively identifies problem areas

OFI-LFO-2: To improve LFO oversight of LLNS corrective actions, consider:

- Ensuring the effective implementation of OFI-LLNS-12
- Increasing the periodicity of both assessing the LLNL readiness assurance program from the required once every three years and the annual review of the LLNL self-assessment program
- confirming the LLNS improvement program ensures that corrective actions are rigorously developed, implemented, verified and validated to correct identified problems

Lawrence Livermore National Security, LLC

OFI-LLNS-1: To improve field responder safety, consider:

- Using the iPad available on the battalion chief’s vehicle to receive plume plots
- Establishing a WebEOC presence at the command post vehicle
- Keeping the EOC apprised of the current ICP and staging area locations
- Requesting the distance to PAC to confirm that the ICP and staging area for offsite assets are in safe locations for unprotected personnel based on 360 degrees around the point of release, with consideration for the predominant wind direction if different than the existing wind direction

- Requesting the distance for the potential radiological dose to exceed PAC and obtaining ED concurrence before entering that area.

OFI-LLNS-2: To improve situational awareness between the UC and EOC staffs, consider:

- Using the global positioning system associated with the ACFD response vehicles to automatically populate the EOC Global Imaging System maps, like the Alameda County Regional Emergency Communication Center
- Modifying the PA sheets by identifying the actual offsite PA distance instead of the distance from the source facility
- Conducting a periodic phone bridge directly between the IC and ED
- Establishing a briefing sheet for critical information discussed during IC/ED phone bridges that includes both IC and ED priorities and strategies.

OFI-LLNS-3: To improve IC efficiency and effectiveness, consider revising the *IC Checklist* by:

- Replacing "EALs" with "Review protective action sheets guide for PAs and PARs"
- Replacing "NARAC connectivity" with "Obtain briefing on plume plot"
- Adding "Conduct a phone bridge with the ED" with specific objectives, such as conveying:
    - Event status
    - Response priorities and strategy
    - Areas of responsibility
    - IC/ED priorities and strategy.

OFI-LLNS-4: Consider improving PA planning and response by revising the EALs and/or EPIPs by:

- Ensuring that the EOC staff maintains situational awareness of the current ICP and staging area locations
- Requiring the EOC staff to confirm that the ICP and staging area for offsite assets are in safe locations for unprotected personnel based on 360 degrees around the point of release
- Ensuring that the EOC staff provides the IC with evacuation and/or SIP distances corresponding to PAC distances for all receptors of interest identified in the EPHA
- Requiring the EOC staff to confirm projected dose concentrations triggering PAs at critical onsite receptors of interest (e.g., fire department, ICP, EOC, medical facilities).

OFI-LLNS-5: Consider improving communications among response facilities, field response elements, and offsite command centers to provide a common operating picture of the emergency response and shared situational awareness among all teams by:

- Fully implementing the WebEOC automated information management system at all response venues
- Defining information flow processes within LLNL's response facilities and field response elements
- Fostering interoperability with offsite response facilities (i.e., joint information center, local and state EOCs, and the DOE Headquarters EOC) and enabling access 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 computerized information management systems capable of rapidly interfacing with other systems that may be vital during an emergency response, to communicate a common operating picture and shared situational awareness by:

    - Providing a real-time perception of what is occurring at the incident scene(s)
    - Providing awareness of what the ERO is doing in relation to the incident(s)
    - Enabling the ERO to predict changes to the incident(s)
    - Supporting ERO objectives that forecast future actions
- Defining expected actions for achieving and maintaining situational awareness among all teams.

OFI-LLNS-6: To achieve a more proficient CQT, consider applying more critical evaluations of CQT performance during drills and exercises and incorporating procedure requirements into the evaluation criteria.

OFI-LLNS-7: To achieve more consistent, complete, and timelier functions from the CQT, consider revising the consequence assessment procedure by:

- Adding actions to take when initial and corroborating plume plots conflict
- Adding instructions on the appropriate weather and release durations data input for plume modeling
- Adding instructions to distinguish between puff releases and prolonged releases for modeling
- Adding instructions that consider the locations of field responders when applying consequence assessment results
- Adding instructions for the CQT lead to brief the EOC cadre on all posted plume plots and the content of briefings, such as model capabilities, limits, and product information
- Adding the emergency plan goal to complete the initial assessment in approximately 30 minutes
- Adding a reference to the pre-planned survey maps used for field monitoring activities
- Adding a reference to the use of key receptors of interest in the EPHAs when applying consequence assessment results
- Adding a reference to communicate projected plume arrival times at receptors of interest
- Adding a reference to incorporate consequence assessment results into the EOC geographical information system display
- Removing the step to duplicate the EPHA data.

OFI-LLNS-8: To ensure that CQT members have the proper understanding of high-efficiency particulate air filter capabilities, ensure that CQT training periodically refreshes members' understanding of the installed equipment at the EOC and its capabilities and limitations.

OFI-LLNS-9: Consider improving the control of drills and exercises by:

- Staffing each responder venue with a controller knowledgeable enough to answer responder questions and provide information on the status of the exercise
- Emphasizing, during controller training, the importance of giving players earned information and the availability of the controller network for controllers to obtain additional guidance when needed
- Ensuring that controllers appropriately issue contingency messages with the approval of the exercise director.

OFI-LLNS-10: To ensure that ACFD ICs understand DOE requirements for PAs and PARs, consider:

- Training all ACFD officers who may serve at Site 200 fire station on E9018-P
- Conducting annual refresher training on E9018-P to ensure proficiency on PA sheet usage
- Upgrading E9018-P to a web based course with a proficiency test so ACFD officers can incorporate the training into their shift schedules

- Conducting periodic EPO training oversight of ACFD ERO training to ensure compliance
- Including information on both onsite and offsite receptors of interest in E9018-P training
- Including information on recommended actions for similar events where real time monitoring is not possible at the ICP and staging with General Emergency conditions existing.

OFI-LLNS-11: To ensure consistent, effective, and efficient response in accordance with a defined concept of operation, consider:

- Integrating the city of Livermore evacuation concepts related to defined geographical areas into the emergency plan and EPIPs to assist with offsite PA implementation and description
- Issuing a directive to the ACFD to include that interface actions taken are consistent with the emergency plan and incorporated into ACFD procedures
- Including the specific responsibilities of the IC in procedures versus an indirect reference
- Updating the emergency plan to include the OSC role
- Clarify the process for communicating offsite PARs to appropriate implementing authorities to ensure that the roles and responsibilities are understood
- Defining the process for implementing onsite PAs outside the IC's area of responsibility by either OSC or the EOC Operations Section Chief
- Clearly distinguishing between the roles and responsibilities of the IC and the OSC.

OFI-LLNS-12: To improve the effectiveness review process, consider:
- Training the emergency management staff on PRO 0077
- Conducting a management assessment of the effectiveness reviews for emergency management findings

8.0 ITEMS FOR FOLLOW-UP

LLNL plans and procedures were adequate, but EA observed some fundamental deficiencies in their implementation, indicating weaknesses with the LLNS exercise evaluation program. In addition, the improper closing of previously identified EA findings reveals continued weaknesses in the LLNS corrective action process. Additional attention by LLNS and enhanced oversight by the LFO is needed to further improve the LLNL emergency management program. EA should follow-up on the LLNS evaluation, issues tracking, and corrective actions programs, as well as LFO oversight.

APPENDIX A
SUPPLEMENTAL INFORMATION

Dates of Assessment

Onsite: August 29-31, September12-15, and September 27-29, 2016

Office of Enterprise Assessments (EA) Management

Glenn S. Podonsky, Director, Office of Enterprise Assessments
William A. Eckroade, Deputy Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments
William E. Miller, Director, Office of Nuclear Safety and Environmental Assessments
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APPENDIX B
KEY DOCUMENTS REVIEWED, INTERVIEWS, AND OBSERVATIONS

Documents Reviewed

- ACFD Duty Rosters (select dates during last 18 months)
- ACFD Incident Commander checklist
- ACFD Run Cards
- B331 Facility Safety Plan, 1/16
- Disaster/Self-Help Plan, Radioactive and Hazardous Waste Management (RHWM) Facilities, Zone 2 and 2A, 10/15
- Disaster/Self-Help Status Report, 8/14
- E9018-P, *Categorization & Classification Practical* training records
- EPO Checklist 23. *CQT Lead Checklist*, Rev. 3, 8/16
- EPO Checklist 24. *CQT Modeler Checklist*, Rev. 1, 8/16
- Exercise after action reports (last 18 months)
- Letter to File, *Emergency Generators B-313*, 8/15/13
- Letter to File, *Emergency Generators B-313*, 9/26/13
- LLNL-AM-703937, *Facility Safety Plan Waste Storage Facilities*, 2/2/2015
- LLNL-MI-642752, *Corrective Action Plan for the U.S. DOE Independent Oversight Inspection of Emergency Management at the Lawrence Livermore National Laboratory*, 9/13 and associated findings corrective action closure packages.
- LLNL-MI-681599, *Lawrence Livermore National Laboratory Emergency Plan*, Rev. 21, 1/16
- LLNL-MI-683846, *Consequence Assessment*, Rev. 0, 2/16
- LLNL-MI-700077, *Protective Actions*, Rev. 2, 8/16
- LLNL-MI-700180, *Categorize and Classify Operational Emergencies*, Rev. 1, 8/16
- LLNL-MI-700638, *Declaration of EOC Operational Status*, Rev. 3, 8/16
- LLNL-MI-701280, *Issue News Releases*
- LLNL-MI-701657, *Issues Tracking System Documentation for ITS 35598.1: Diesel Generators for Emergency Egress Lighting*, 8/16
- PRO-0077, *Conducting an Effectiveness Review*, Revisions 2, 3 and 4
- Training Records (web-based training for GET Emergency Preparedness Orientation, Disaster/Self-Help Overview, Disaster/Self-Help Leadership; B331 Facility Safety Plan; Superblock Required Reading; RHWM Required Reading for Management and Safety Basis Personnel)
- UCRL-AR-135652, *Nuclear Materials Technology Program, Zone 8 Self-Help Plan for Superblock*, Rev-5, 10/13
- Zone 8 Supervisor Guidelines

Interviews

- ACFD Incident Commanders
- Building 332 Facility Manager
- Building 239/334 Facility Manager
- EPO Emergency Planners
- Fire Marshal/Fire Protection Manager
- LLNS Fire Marshall/AHJ

- On-scene Communicators
- RHWM Nuclear Facility Manager
- RHWM Nuclear Facility Deputy Manager
- RHWM Backup Zone Supervisor
- Superblock Facility Safety Coordinator

Observations

- Building 332 Facility Manager Response
- Consequence Assessment Response
- Emergency Operations Center Response
- Incident Command Response
- RHWM Facility Manager Response

Appendix C
Deficiencies

Deficiencies that did not meet the criteria for a finding are listed below, with the expectation from U.S. Department of Energy (DOE) Order 227.1A, *Independent Oversight Program*, for site managers to apply their local issues management processes for resolution.

Lawrence Livermore National Security, LLC

- **Deficiency: LLNS did not provide accurate, candid, and timely information to workers, the news media, and the public during an emergency as required by LLNL procedures.** (DOE Order 151.1C)
- **Deficiency: LLNS did not always provide timely initial assessments, as required by the LLNL emergency plan and procedures**. (DOE Order 151.1C, Attachment 2, Section 13.a.(1))