Independent Assessment of the Transuranic Waste All-Hazards Planning Basis at the Lawrence Livermore National Laboratory

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Office of Enterprise Assessments
U.S. Department of Energy

Table of Contents

Acronyms

AHS	All-Hazards Survey
CRAD	Criteria and Review Approach Document
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
EAL	Emergency Action Level
EPHA	Emergency Planning Hazards Assessment
EPZ	Emergency Planning Zone
LFO	Livermore Field Office
LLNL	Lawrence Livermore National Laboratory
LLNS	Lawrence Livermore National Security, LLC
PA	Protective Action
TRU	Transuranic

INDEPENDENT ASSESSMENT OF THE TRANSURANIC WASTE ALL-HAZARDS PLANNING BASIS AT THE LAWRENCE LIVERMORE NATIONAL LABORATORY

Executive Summary

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an independent assessment of the all-hazards planning basis for transuranic waste operations at the Lawrence Livermore National Laboratory (LLNL) from June to August 2024. This assessment evaluated the effectiveness of both the Livermore Field Office and its management and operating contractor, Lawrence Livermore National Security, LLC (LLNS), in developing and maintaining the all-hazards planning basis for transuranic waste operations at the LLNL waste storage facilities and Superblock facilities. This assessment also examined the completion and effectiveness of corrective actions for a finding from a previous EA assessment, *Independent Assessment of Emergency Management at the Lawrence Livermore National Laboratory, December 2022*, that is related to the transuranic waste all-hazards planning basis.

The all-hazards planning basis includes development and maintenance of an all-hazards survey (AHS) and emergency planning hazards assessments (EPHA). DOE Order 151.1D, *Comprehensive Emergency Management System*, identifies requirements for the all-hazards planning basis, and the associated emergency management guide provides guidance for implementing the requirements.

EA focused primarily on hazard identification and screening and the documented analysis that supports the development of response plans, emergency action levels, and predetermined protective actions. EA also evaluated the utility of the EPHA as a reference for a consequence assessment team when conducting dispersion modeling of analyzed release scenarios.

EA identified the following strengths, including one best practice:

- LLNS has developed the *Site 200 Self Help Map* to assist LLNL site and response personnel in estimating distances using a distance scale based on 3.375-inch sections (the length of a site identification badge). This novel approach readily allows LLNL personnel to estimate distances using their badge, which all employees are required to possess on their person while they are on site. (Best Practice)
- The AHS and EPHAs for the LLNL waste storage facilities and Superblock are technically accurate and provide information to support the development of response plans, emergency action levels, predetermined protective actions, and protective action recommendations. In addition, the EPHAs provide the data, methods, and assumptions needed for a consequence assessment team to replicate the analysis in response to an incident.
- The corrective actions taken to address a previously identified EA finding that LLNS had not developed a technical planning basis that appropriately used the protective action guides promulgated by the Environmental Protection Agency for radioactive material releases were adequate to address the issue and reduce the likelihood of recurrence.

In summary, LLNS has developed a technically sound all-hazards planning basis for transuranic waste operations that meets DOE requirements and supports the development of response plans, emergency action levels, and predetermined protective actions. Additionally, the EPHAs provide pertinent information to support incident analysis by a consequence assessment team.

INDEPENDENT ASSESSMENT OF THE TRANSURANIC WASTE ALL-HAZARDS PLANNING BASIS AT THE LAWRENCE LIVERMORE NATIONAL LABORATORY

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Emergency Management Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of the all-hazards planning basis for transuranic (TRU) waste operations at the Lawrence Livermore National Laboratory (LLNL). The all-hazards planning basis includes the development and maintenance of an all-hazards survey (AHS) and emergency planning hazards assessments (EPHA). EA conducted this assessment as part of a series of assessments of the TRU waste all-hazards planning basis for sites that make shipments to DOE's Waste Isolation Pilot Plant. The assessment was conducted from June to August 2024 in accordance with the *Plan for the Independent Assessment of TRU Waste All-Hazards Planning Basis at the Lawrence Livermore National Laboratory, June 2024*.

The Livermore Field Office (LFO) and its management and operating contractor, Lawrence Livermore National Security, LLC (LLNS), are responsible for the development of the all-hazards planning basis for TRU waste operations at LLNL. The all-hazards planning basis is used to develop response plans, emergency action levels (EALs), predetermined protective actions (PAs) or PA recommendations, and the emergency planning zone (EPZ). The assessment evaluated the effectiveness of both LFO and LLNS in developing and maintaining the all-hazards planning basis for TRU waste operations at the LLNL waste storage facilities and Superblock facilities (Buildings 239, 331, 332, and 334), where the operations for the storage, characterization, processing, and preparation for offsite shipment of TRU waste occur.

2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which EA implements through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. This report uses the terms "best practices, deficiencies, findings, and opportunities for improvement" as defined in the order.

As identified in the assessment plan, this assessment considered requirements specified in DOE Order 151.1D, *Comprehensive Emergency Management System*. EA also used section 4.2, *All Hazards Planning Basis*, of EA criteria and review approach document (CRAD) 33-09, Revision 0, *DOE O 151.1D Emergency Management Program*, and considered the guidance provided in DOE Guide 151.1-1B, *Comprehensive Emergency Management System Guide.*

EA examined key documents, such as LLNS's procedures for developing and maintaining an AHS and EPHAs, the AHS and EPHAs for facilities where TRU waste is generated or stored, the documented safety analysis (DSA) for reviewed facilities, and other relevant programmatic documentation supporting the preparation of the all-hazards planning basis. EA toured the LLNL waste storage facilities and Superblock facilities and interviewed key personnel responsible for the development of all-hazards planning basis documents. The members of the assessment team, the Quality Review Board, and the management responsible for this assessment are listed in appendix A.

EA conducted a previous assessment of LLNL's emergency management exercise program in 2022, as documented in the EA report *Independent Assessment of Emergency Management at the Lawrence*

Livermore National Laboratory, December 2022. This current assessment examined the completion and effectiveness of corrective actions for the EA finding F-LLNS-3 described in the previous assessment, which is related to the TRU waste all-hazards planning basis. Results of the corrective action review are included in section 3.4 of this report.

3.0 RESULTS

3.1 Procedures

This portion of the assessment determined whether LLNS procedures provide clear and appropriate guidance for developing, documenting, and maintaining AHSs and EPHAs, including identifying roles and responsibilities for review and approval.

AHS and EPHAs for LLNL waste storage facilities and Superblock are developed by LLNS, which is responsible for preparing both emergency management and vulnerability assessment analyses. LLNS has developed and implemented an adequate set of program documents that meet all DOE requirements for developing and maintaining a technically based emergency management program. Together, LLNS procedures LLNL-MI-860951, *Document Control*; LLNL-MI-853988, *All-Hazards Planning Basis*; and LLNL-MI-846079, *Emergency Planning Hazards Assessment Preparation*, implement DOE Order 151.1D technical and administrative requirements for the development and maintenance of AHSs, EPHAs, EALs, and predetermined PAs, including identifying roles and responsibilities for review and approval.

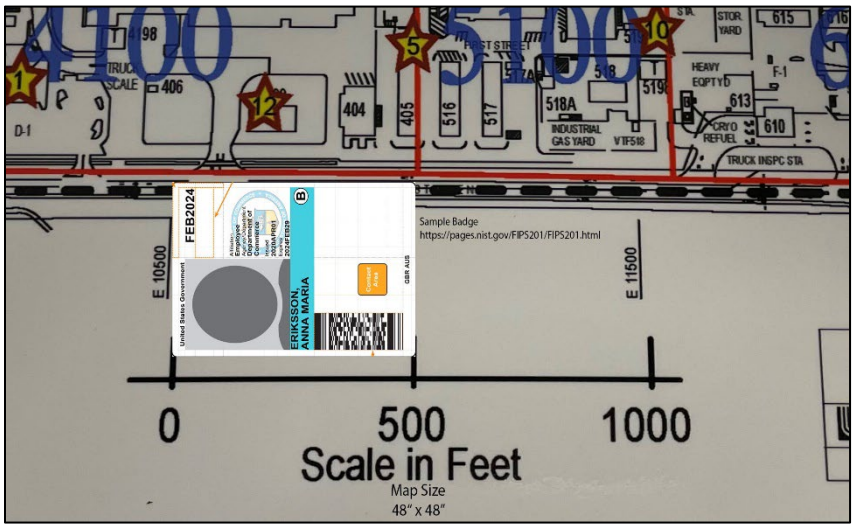
Procedure LLNL-MI-853988 appropriately directs that AHSs be developed to identify, record, and screen facility hazards in accordance with DOE Order 151.1D. LLNL-MI-853988 provides adequate guidance on identifying and estimating hazardous material release scenarios, both human-caused and those associated with natural phenomena, in terms of type, quantity, and form of radioactive and other hazardous materials. LLNL-MI-853988 also provides a clear description of the hazardous materials screening process and its application to AHS and EPHA development.

As with the AHS process, procedure LLNL-MI-846079 appropriately directs that EPHAs be developed as required by DOE Order 151.1D. LLNL-MI-846079 requires a quantitative analysis of all hazardous materials identified in the AHS; provides correct criteria for excluding hazardous materials from further analysis in the EPHA; identifies receptors of interest for consequence projections; and provides source term determination instructions that effectively establish conservative material-at-risk quantities. In addition, LLNL-MI-846079 appropriately defines conservative and average meteorological conditions and includes PA guides for both radioactive and chemical hazardous materials. Finally, LLNL-MI-846079 effectively describes the establishment of a spectrum of potential emergency incident scenarios for analysis in the EPHA.

Procedures LLNL-MI-853988 and LLNL-MI-846079 appropriately require facility management and suitable technical expert involvement in developing, reviewing, and approving AHSs and EPHAs and have adequate provisions for maintaining these documents. Specifically, the procedures appropriately require technical peer review and approval of the AHS and EPHA by the Planning and Preparedness Division Manager prior to being submitted to LFO for review and approval. Additionally, EPHAs require review and concurrence by the appropriate facility manager. Furthermore, procedures LLNL-MI-860951 and LLNL-MI-846079 appropriately require the AHS and EPHAs to be reviewed after any update to the facility's safety basis documents and be updated prior to significant changes to the facility/site operations or to hazardous material inventories, or reviewed at a minimum of every three years as required by DOE Order 151.1D, attachment 4, section 2, paragraph o.

LLNS has also developed an innovative and effective method to assist LLNL site and response personnel in estimating distances using an emergency management map when PAs are determined during an emergency incident. The *Site 200 Self Help Map* is sized with a distance scale based on 3.375-inch sections (the length of a Homeland Security Presidential Directive 12 and site identification badge) to aid in map use, as shown in figure 1. This novel approach is considered a **Best Practice** because it readily allows LLNL personnel to estimate distances using their badge, which all employees are required to possess on their person while on site.

Figure 1: Distance Scale on *Site 200 Self Help Map*



Procedures Conclusions

LLNS has prepared procedures that are compliant with DOE Order 151.1D and provide accurate guidance for developing, documenting, and maintaining the all-hazards planning basis. LLNS's method to assist personnel in easily estimating distances from an emergency management map is considered a best practice.

3.2 All-Hazards Survey

This portion of the assessment determined whether the AHS prepared by LLNS and approved by LFO identifies all the hazards applicable to LLNL waste storage facilities and Superblock and establishes the appropriate input for the all-hazards planning basis of the emergency management program.

LLNS prepared, and LFO approved, an AHS that meets DOE Order 151.1D and procedural requirements. The AHS (LLNL-TR-852690, *Lawrence Livermore National Laboratory All-Hazards Survey*) covers all facilities and operations at LLNL and accurately identifies and screens hazardous materials associated with TRU waste operations. The results of the AHS are informative and technically sound, consistent with DOE guidance.

The AHS identifies all hazards applicable to operations at LLNL, including chemical, radiological, and biological hazards. The AHS effectively identifies and documents the generic types of potential emergency conditions (e.g., fire, explosion, natural phenomena, environmental release, hazardous material release, malevolent acts, workplace accidents, external hazards, and accidental criticality) and impacts to which waste storage facilities may be exposed. The AHS also identifies the applicable core program planning and preparedness requirements that constitute the basis for the emergency management

program. The hazardous materials and emergency conditions identified in the AHS are consistent with the DSA for LLNL waste storage facilities.

The AHS appropriately screens hazardous materials to identify those requiring quantitative analysis in an EPHA. The screening criteria meet DOE Order 151.1D and procedural exclusion requirements as described in procedure LLNL-MI-853988. The AHS appropriately screened out from further evaluation all chemical hazards within LLNL waste storage facilities (quantities were below thresholds) and screened in chemical hazards for Superblock facilities. The AHS requires further analysis in an EPHA of TRU waste at the LLNL waste storage facilities and Superblock facilities due to the presence of radioactive material exceeding the category 2 thresholds in DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*.

All-Hazards Survey Conclusions

LLNS has prepared, and LFO has approved, an AHS for LLNL that effectively evaluates TRU waste operations at LLNL facilities where TRU waste is generated, stored, and packaged for shipping. The AHS identifies all applicable hazards and establishes the planning basis for the emergency management program in accordance with DOE Order 151.1D requirements.

3.3 Emergency Planning Hazards Assessment

This portion of the assessment determined whether the EPHAs define the provisions of the emergency management hazardous materials program and provide the basis for establishing a graded approach that meets the hazardous material program requirements in DOE Order 151.1D, attachment 4, section 2. The assessment also evaluated the utility of the EPHAs for conducting consequence assessments during a response.

LLNS prepared, and LFO approved, EPHAs that meet DOE Order 151.1D and procedural requirements for LLNL facilities where TRU waste is generated, stored, and packaged for shipping. The reviewed EPHAs (LLNL-TR-854726, *Emergency Planning Hazards Assessment Waste Storage Facilities*, and LLNL-TR-849950, *Emergency Planning Hazards Assessment Superblock: Buildings 239, 331, 332 & 334*) used a comprehensive, systematic process to identify and analyze hazards associated with TRU waste operations. Both EPHAs contain a quantitative analysis of all hazardous materials identified in the AHS for further analysis, and the assumptions made in the EPHAs are consistent with operational activities and the DSAs.

The facility and process descriptions in the EPHAs are consistent with the LLNL AHS and DSA, and the EPHAs contain a current and accurate compilation of hazardous material maximum quantities associated with TRU waste operations at LLNL. For each incident scenario, consequence assessment results and a corresponding incident classification are provided.

The reviewed EPHAs present the analysis of a comprehensive set of incident scenarios based on LLNL operations. LLNS evaluated scenarios in the EPHAs ranging from low consequence and high probability to high consequence and low probability. The EPHAs identify analyzed scenarios using short descriptive names with: (1) tabulated consequences for each scenario at identified receptor locations, (2) consequences versus distance under severe (i.e., conservative) and average dispersion conditions, and (3) distances at which the PA criteria and thresholds of early lethality are projected to be exceeded at identified receptor locations. The source term for each scenario was appropriately converted to an equivalent isotope (plutonium-239) to facilitate dispersion modeling calculations. LLNS detailed the source term conversion to plutonium-239 equivalent for each incident scenario evaluated in the EPHAs.

Calculations use the appropriate PA criterion of 1 rem for the radioactive material analyzed, as stated in the EPHA development procedure. Modeling parameters used in EPHA calculations are documented in the EPHAs and are consistent with guidance in LLNL-MI-846079.

During the 2022 independent assessment of emergency management at LLNL, EA identified a concern with a TRU waste EPHA regarding parameters used in modeling releases resulting from fires. In response to this weakness, LLNS made effective changes to the EPHA and associated EALs. In addition, LLNS conducted a compensatory review of EPHA-derived products, including the EPZ, EALs, and PAs, to ensure that revisions resulting from use of revised fire modeling parameters were incorporated. Additionally, the LFO Emergency Management Program Manager directed reviews of the LLNL emergency plan, emergency plan implementing procedure, and emergency preparedness administrative plan to strengthen technical planning. Notably, the LLNL technical planning basis program coordinated with the Emergency Management Issues Special Interest Group Subcommittee on Technical Analysis and Response Support, multiple field elements, and the National Atmospheric Release Advisory Center to develop a refined methodology that analyzes impacts from small, intermediate, and large fires. These efforts strengthened the LLNL technical planning basis.

The results of the reviewed EPHAs are consistent with DOE guidance and are accurate and technically sound. Conservative assumptions are used, and the calculations are accurate based on EA's replication of a sample of 6 of the 10 TRU scenarios presented in the documents using the HotSpot dispersion-modeling program. The EPHAs clearly identify hazardous materials that were analyzed, how the results were formulated, and how the results relate to facility operations and configurations in a way that can be replicated and effectively used by LLNS consequence assessment personnel during an Operational Emergency response. LLNS has used the results of the EPHAs in developing response plans and EALs for LLNL facilities.

Emergency Planning Hazards Assessment Conclusions

LLNS has prepared, and LFO has approved, EPHAs for TRU waste operations at LLNL facilities that are technically accurate; effectively implement the EPHA requirements in DOE Order 151.1D; provide sufficient information to support EALs, PAs, and EPZ development; and provide necessary information for a consequence assessment team to replicate the analysis. LLNS has used the results of the EPHAs in developing response plans and EALs for LLNL facilities.

3.4 Finding Follow-up

This portion of the assessment determined whether the corrective actions developed by LLNS were effective for finding F-LLNS-3 in EA report *Independent Assessment of Emergency Management at the Lawrence Livermore National Laboratory, December 2022*.

2022 EA Finding F-LLNS-3: This finding identified that LLNS had not developed a technical planning basis that appropriately used the PA guides promulgated by the Environmental Protection Agency for radioactive material releases. LLNS incorrectly used a radioactive material PA criterion of 5 rem for analysis of releases involving long-lived radionuclides, such as plutonium, instead of 1 rem, as required by DOE Order 151.1D. In response to this issue, LLNS revised LLNL-MI-846079 to formally establish 1 rem as the LLNL PA criterion for radiological releases. Additionally, LLNS revised the EPHAs for the waste storage facilities and the Superblock facilities to appropriately incorporate the PA criterion of 1 rem for radiological releases. An LLNS action verifier independently evaluated and verified the corrective actions as required by the LLNL issues management system, and the issue was closed. The corrective actions taken to address this finding were adequate.

4.0 BEST PRACTICES

Best practices are safety-related practices, techniques, processes, or program attributes observed during an assessment that may merit consideration by other DOE and contractor organizations for implementation. The following best practice was identified as part of this assessment:

- LLNS has developed an effective method to assist LLNL site and response personnel in estimating distances from an emergency management map. The *Site 200 Self Help Map* is sized with a distance scale based on 3.375-inch sections (the length of a Homeland Security Presidential Directive/site identification badge) to aid in map use. This novel approach readily allows LLNL personnel to estimate distances using their badge, which all employees are required to possess on their person while they are on site.

5.0 FINDINGS

No findings were identified during this assessment.

6.0 DEFICIENCIES

No deficiencies were identified during this assessment.

7.0 OPPORTUNITIES FOR IMPROVEMENT

No opportunities for improvement were identified during this assessment.

Appendix A
Supplemental Information

Dates of Assessment

June 17 to August 5, 2024

Office of Enterprise Assessments (EA) Management

John E. Dupuy, Director, Office of Enterprise Assessments
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