Independent Assessment of Specific Administrative Controls at the Lawrence Livermore National Laboratory Plutonium Facility – Building 332

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Office of Enterprise Assessments
U.S. Department of Energy

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Acronyms

DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EA	Office of Enterprise Assessments
FMH	Fissile Material Handler
FSP	Facility Safety Plan
HE	High Explosives
LFO	Livermore Field Office
LLNL	Lawrence Livermore National Laboratory
LLNS	Lawrence Livermore National Security, LLC
OSP	Operational Safety Plan
SAC	Specific Administrative Control
SC	Safety Class
SS	Safety Significant
SSCs	Structures, Systems, and Components
TSR	Technical Safety Requirement

INDEPENDENT ASSESSMENT OF SPECIFIC ADMINISTRATIVE CONTROLS AT THE LAWRENCE LIVERMORE NATIONAL LABORATORY PLUTONIUM FACILITY – BUILDING 332

Executive Summary

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an independent assessment of the development and implementation of specific administrative controls (SACs) at the Lawrence Livermore National Laboratory Plutonium Facility – Building 332 from October to November 2021. This assessment was performed within the broader context of ongoing assessments of the derivation and implementation of SACs across the DOE complex. The assessment focused on the approach to meeting SAC requirements in DOE-STD-3009-94, Change Notice 3, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, and DOE-STD-1186-2004, *Specific Administrative Controls*.

EA identified the following strengths based on a sample of evaluated controls:

- SACs are appropriately identified based on the control selection in the hazard and accident analyses.
- SACs, as developed in chapter 4 of the documented safety analysis, are adequately captured in the technical safety requirements in directive action format.
- Training/qualification on SACs is sufficient to ensure SAC implementation.

EA also identified three deficiencies as summarized below:

- In four instances, SAC descriptions or evaluations do not contain all information required by DOE-STD-3009-94, sections 4.5.X.2, 4.5.X.3, and 4.5.X.4.
- In three instances, SACs rely on structures, systems, and components (SSCs) to perform their safety functions; however, the SSCs are not evaluated in the documented safety analysis and are not considered for functional classification as required by DOE-STD-3009-94, section 4.5.X.2, and DOE-STD-1186-2004, section 1.6.1.
- In three instances, SAC requirements are not adequately described in facility implementing documents in accordance with DOE-STD-1186-2004, section 2.3.

In summary, identification, development, and implementation of SACs for Building 332 generally meet the requirements of DOE-STD-3009-94 and DOE-STD-1186-2004. Although EA identified deficiencies associated with both SAC development and implementation, the SACs as written and implemented are sufficient for controlling the hazards. Resolution of the deficiencies identified in this assessment will ensure a robust and reliable control set.

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1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Nuclear Engineering and Safety Basis Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of the derivation and implementation of specific administrative controls (SACs) at the Lawrence Livermore National Laboratory (LLNL) Plutonium Facility – Building 332. This assessment, conducted from October through November 2021, was performed within the broader context of ongoing assessments of the derivation and implementation of SACs at selected high risk (i.e., hazard category 1 and 2) facilities across the DOE complex. The purpose of these assessments is to evaluate the effectiveness of both the contractor and field office in developing, implementing, and maintaining SACs.

This assessment was conducted in accordance with the *Plan for the Specific Administrative Control Implementation Assessment across the DOE Complex, October 2021 – September 2022*. The assessment focused on the line management approach to meeting SAC requirements in DOE-STD-3009-94, Change Notice 3, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, and DOE-STD-1186-2004, *Specific Administrative Controls*.

Lawrence Livermore National Security, LLC (LLNS) manages LLNL under the direction and oversight of the National Nuclear Security Administration (NNSA) Livermore Field Office (LFO). Building 332 supports the nuclear weapons program through research in the physical, metallurgical, and chemical properties of plutonium in support of stockpile stewardship, and fabrication, testing, and assembly of plutonium parts in support of the NNSA nuclear testing program.

2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which is implemented 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. The term "weakness" is used in this report to describe an issue that does not rise to the level of a deficiency and does not constitute a safety concern.

As identified in the approved plan, this assessment considered requirements from EA Criteria and Review Approach Document (CRAD) 34-02, *Specific Administrative Controls*, and CRAD EA-30-07, *Federal Line Management Oversight Processes*. The assessment was conducted in two parts. The first part of the assessment was conducted remotely and focused on SAC identification and development. EA reviewed the Building 332 documented safety analysis (DSA), technical safety requirement (TSR) document, and relevant reference documents to determine whether SAC identification and development meet the requirements of DOE-STD-3009-94 and DOE-STD-1186-2004. EA also reviewed SAC-implementing documents (e.g., procedures, operational safety plans or OSPs) to determine whether SAC requirements are adequately captured. The second part of the assessment was conducted at LLNL and consisted of field observations of SAC-related activities, tabletop walkthroughs of activities, interviews with LLNS and LFO personnel responsible for SAC development and implementation, and implementation of DOE-STD-1186-2004 SAC maintenance requirements (e.g., periodic assessments of SAC effectiveness).

EA used a written comment and response process with LLNS to address issues identified during its review. Follow-on discussions among EA, LFO, and LLNS were conducted to clarify and resolve issues.

There were no previous items for follow-up addressed during this assessment.

3.0 RESULTS

3.1 SAC Identification and Development

The objective of the review of the DSA was to determine whether the LLNL Building 332 SACs are appropriately identified and developed in accordance with DOE-STD-3009-94 and DOE-STD-1186-2004.

EA evaluated all 10 SACs in the DSA. The SACs are generally identified as either initial conditions (i.e., Radiological Material Inventory Limits, Glovebox Solvent Limit, Induction Furnace Pressure Relief, High Explosives Controls) or safety significant (SS) controls (i.e., Corridor Movement Restrictions, Vault Storage Restrictions, Combustible Loading Limits, and Operational Wind Limit Control SACs). The Hydrogen Controls SAC comprises several elements, including initial conditions, SS controls, and one safety class (SC) control. The Toxic Gas Controls SAC is suspended, and operational restrictions are in place for the chlorination system pending a future safety basis amendment.

EA selected two safety management program key elements (KEs) to analyze based on their potential roles in hazard analysis risk reduction; this analysis was performed to determine whether the KEs are properly categorized and to ensure that they do not perform SAC safety functions. The analysis determined that the selected KEs (i.e., fire protection program maximum auto-igniting material limit and criticality safety) are appropriately developed as programmatic administrative controls.

SACs are appropriately identified based on the control selection in the hazard and accident analyses to prevent or mitigate an accident scenario. SAC safety functions are adequately derived in the hazard and accident analyses. The SAC descriptions and evaluations generally meet the requirements of DOE-STD-1186-2004. The descriptions contain sufficient detail for an understanding of each SAC's safety function and its relationship to the facility safety analysis. In most cases, sufficient detail is provided to ensure that the SAC can be effectively implemented.

However, as detailed below, in four instances, the SAC descriptions or evaluations do not contain all information required by DOE-STD-3009-94, sections 4.5.X.2, 4.5.X.3, and 4.5.X.4. (See **Deficiency D-LLNS-1**.) Incomplete descriptions of the SAC safety function and functional requirements, and the subsequent evaluation of their sufficiency, can lead to inadequate implementation of the safety control.

- The DSA SAC 4.5.3, *Vault Storage Restrictions*, evaluation is incomplete. SAC 4.5.3 relies on calcining material at 750°C (degrees Celsius) for two hours to drive off water and hydrocarbons to prevent hydrogen gas generation and pressurization of the containers. The DSA does not technically justify why 750°C for two hours is sufficient to prevent hydrogen gas generation. LLNS provided documentation justifying the temperature and time duration for calcination and committed to revise section 4.5.3 of the DSA to include this reference.
- The DSA SAC 4.5.3 description does not contain sufficient information to ensure that the SAC can meet its safety function. The SAC requires material in the vault to be calcined and stored in a sealed container or stored in a vented container, but the SAC does not describe the containers to use, vent requirements, or how to identify or respond to a bulging container. LLNS committed to revise

section 4.5.3 of the DSA to include appropriate functional requirements and performance criteria for containers and vents, and requirements for overpacking bulging containers.

- The DSA SAC 4.5.6, *Combustible Loading Limits*, description does not provide technical justification for selecting a SAC over an available structure, system, or component (SSC). Building 332 has an existing wet pipe fire suppression system that is not discussed as a potential alternative to the SAC. LLNS committed to revise the SAC description to provide justification for use of the SAC over an SSC.
- The DSA SAC 4.5.7, *High Explosives (HE) Controls*, does not contain sufficient information regarding determination of HE amounts, types of HE items, and locations to ensure that a limit is not exceeded. LLNS committed to revise the SAC evaluation to provide necessary functional requirements and performance criteria for control of HE.

Additionally, in three instances, SACs rely on SSCs to perform their safety functions; however, the SSCs are not evaluated in the DSA and are not considered for functional classification as required by DOE-STD-3009-94, section 4.5.X.2, and DOE-STD-1186-2004, section 1.6.1. (See **Deficiency D-LLNS-2**.) Not functionally classifying or fully evaluating SAC supporting safety SSCs may result in an inadequate control.

- The DSA SAC 4.5.2, *Corridor Movement Restrictions*, relies on robust containers (i.e., 3013, SAVY-4000, or 6M) to eliminate the radiological source term and protect the worker from a potential spill in the corridor; however, these containers are not functionally classified as SS. LLNS committed to functionally classify the 3013 and SAVY-4000 containers and include them as design features in the TSR document. LLNS plans to perform an evaluation to determine whether 6M containers will be needed in the facility.
- DSA SACs 4.5.3 and 4.5.4, *Hydrogen Controls*, do not identify the calciner temperature instrumentation as a support SSC relied upon to ensure that the temperature is held at 750°C prior to material transfer. LLNS is evaluating a method for ensuring that temperature is reliably monitored and will incorporate the updated functional requirements and SAC evaluation into the DSA.
- The DSA SAC 4.5.4 does not identify the "safe gas" mixture as a support SSC relied upon to prevent an explosion in oxidation furnaces. LLNS committed to functionally classify the gas mixture to ensure that appropriate quality requirements are applied through the procurement process.

Further, DSA SAC 4.5.6 is not designated as an SC administrative control, as required by LLNL Procedure AB-007, *Control Item Selection Procedure for Hazard Category 2 and 3 Nuclear Facilities*, section 5.5.1, *SAC Designation*. The SAC ensures that SC SSCs (i.e., room ventilation system final high efficiency filtration stages and fire barriers) can meet their safety functions. Addressing this weakness should not result in substantive changes to the control. LLNS committed to revise the DSA to identify the combustible loading SAC as SC.

SAC Identification and Development Conclusions

In general, SACs are adequately identified and developed, based on the control selection in the hazard and accident analyses, either as an initial condition or to prevent or mitigate an accident. SAC safety functions are adequately derived in the hazard and accident analyses. The SAC descriptions and evaluations generally meet the requirements of DOE-STD-1186-2004. The descriptions contain sufficient detail for an understanding of each SAC's safety function and its relationship to the facility safety analysis. SAC descriptions and evaluations generally include sufficient detail to support effective implementation except in four instances, where the level of detail in the SAC descriptions and evaluations did not meet the requirements of DOE-STD-3009-94. Additionally, in three instances, SACs rely on SSCs to perform their safety functions; however, the SSCs are not evaluated in the DSA and are not considered for functional classification as required.

3.2 SAC Implementation

The objective of this portion of the assessment was to determine whether the Building 332 SACs are implemented and maintained in accordance with the requirements of DOE-STD-1186-2004.

The Building 332 SACs, as developed in chapter 4 of the DSA, are adequately captured in the TSRs in directive action format as prescribed by DOE-STD-1186-2004. OSPs, which contain an evaluation of job hazards and list requirements and limits (e.g., TSR material limits, criticality limits), are generally used instead of detailed operating procedures. A limited number of operating procedures guide routine activities, such as material transfers. EA reviewed OSPs, the Facility Safety Plan (FSP), and procedures related to SAC implementation. Due to the nature of the research facility, LLNS relies heavily on training and qualification of personnel, in particular fissile material handlers (FMHs), to perform SAC-implementing activities. The implementing documents, in combination with training and qualification of the FMHs, are generally adequate to ensure effective SAC implementation.

Although personnel are trained on SAC requirements and implementation is generally adequate, EA identified three instances where SAC requirements are not adequately described in facility implementing documents in accordance with DOE-STD-1186-2004, section 2.3. (See **Deficiency D-LLNS-3**.) Incomplete descriptions of the SAC requirements can lead to inadequate implementation of the safety control.

- The individual container and item specific limits of DSA SAC 4.5.1, *Radiological Material Inventory Limits*, are not implemented in OSPs or operating procedures. LLNS committed to incorporate individual container and item specific SAC inventory limits into applicable OSPs.
- The token system for material movements in the corridors, described in the FSP and procedure OP-B332-001S, *B332 Superblock Facility Material Movements*, does not address the requirements of DSA SAC 4.5.2. LLNS promptly initiated a compensatory measure via timely order (i.e., an interim directive that takes immediate effect) and committed to incorporate appropriate procedural changes.
- DSA SAC 4.5.6 and its implementing documents do not address all aspects of implementation (i.e., combustible loading spreadsheet three-year review cycle, biweekly fire protection engineer walkthroughs, and timely verifications of the passive/active neutron [PAN] shuffler no-combustibles zone). LLNS committed to revise the SAC description and evaluation to further address combustible loading requirements and update implementing documents.

Further, the *NMTP Conduct of Operations Manual*, section 2.p.(1), is not consistent with the Building 332 TSR document, section 5.3, with respect to the use of safety plans (FSP and OSPs) as SAC-implementing procedures. The manual does not consider the FSP and OSPs as procedures, whereas the TSR document does. Addressing this weakness would clarify expectations for the development and implementation of operating procedures.

EA reviewed the training and qualification, and periodic retraining and requalification, of LLNS personnel responsible for SAC implementation and compliance activities to determine whether the training is sufficient to ensure SAC effectiveness. Training effectiveness was evaluated through discussions with FMHs and the Weapons and Complex Integration Principal Directorate Training Manager, and review of training and qualification records. FMH training is sufficient to ensure effective

SAC implementation. LLNS management and staff responsible for SAC implementation and compliance are knowledgeable and experienced.

EA reviewed recent TSR implementation assessments performed by LLNS. LLNS performed independent verifications of all Building 332 SACs in 2019, as documented in the LLNL report *Implementation Verification Review B332 DSA/TSR Re-Verification*. DOE-STD-1186-2004, section 2.2, requires that SACs be independently assessed on a periodic basis to verify safety function performance and focuses on performance-based methods for this verification. The LLNL report appropriately included document reviews, observations of evolutions, and personnel interviews. Procedure AB-009, *Implementation Verification Review Procedure*, recommends performance of these assessments every three years. The 2019 implementation verification meets the requirements of DOE-STD-1186-2004 for a periodic verification of SAC effectiveness.

EA reviewed Federal oversight of SAC implementation, which is primarily performed by LFO nuclear safety specialists, with operational reviews by Facility Representatives. The review included operational awareness assessments and interviewing LFO nuclear safety personnel and Facility Representatives. LFO tailors the oversight program according to the hazards and risk of the site/activity. LFO procedures appropriately emphasize oversight of controls for high consequence activities. Oversight has been limited in fiscal year (FY) 2020 and FY 2021 due to COVID-19 restrictions. LFO plans to resume operational awareness assessments of nuclear safety controls in FY 2022.

SAC Implementation Conclusions

The evaluated SACs, as developed in chapter 4 of the DSA, are adequately captured in the TSRs in directive action format as prescribed by DOE-STD-1186-2004. SAC-implementing documents generally include appropriate SAC requirements and limits for implementation. However, three instances were identified where SAC requirements were not adequately described in facility implementing documents. Training on SACs is sufficient and appropriately tailored for operations, engineering, and supervisory personnel. In 2019, LLNS independently verified all Building 332 SACs, meeting the DOE-STD-1186-2004 requirement for periodic verification of SAC effectiveness. LFO oversight, although limited in FY 2020 and 2021, is appropriately focused on high-risk activities.

4.0 BEST PRACTICES

There were no best practices identified as part of this assessment.

5.0 FINDINGS

There were no findings identified as part of this assessment.

6.0 DEFICIENCIES

Deficiencies are inadequacies in the implementation of an applicable requirement or standard. Deficiencies that did not meet the criteria for findings are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

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Deficiency D-LLNS-1: In four instances, SAC descriptions or evaluations do not contain all required information. (DOE-STD-3009-94, sections 4.5.X.2, 4.5.X.3, and 4.5.X.4)

Deficiency D-LLNS-2: In three instances, SACs rely on SSCs to perform their safety functions; however, the SSCs are not evaluated in the DSA and are not considered for functional classification. (DOE-STD-3009-94, section 4.5.X.2; DOE-STD-1186-2004, section 1.6.1)

Deficiency D-LLNS-3: In three instances, SAC requirements are not adequately described in facility implementing documents. (DOE-STD-1186-2004, section 2.3)

7.0 OPPORTUNITIES FOR IMPROVEMENT

There were no opportunities for improvement identified as part of this assessment.

8.0 ITEMS FOR FOLLOW-UP

EA will follow up on the revisions to the DSA and SAC-implementing documents committed to by LLNS (discussed in sections 3.1 and 3.2 of this report) in the next annual DSA update.

Appendix A
Supplemental Information

Dates of Assessment

October to November 2021

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