Independent Assessment of Work Planning and Control at the Nevada National Security Sites National Criticality Experiments Research Center

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Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	As Low As Reasonably Achievable
ALMA	Activity-level Management Agreement
ALWD	Activity-level Work Document
CA	Contamination Area
CD	Company Directive
CFR	Code of Federal Regulations
CMM	Coordinate Measurement Machine
CRAD	Criteria and Review Approach Document
DAC	Derived Air Concentration
DAF	Device Assembly Facility
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
FR	Facility Representative
HCA	High Contamination Area
IAS	Integrated Assessment Schedule
IH	Industrial Hygiene
ISMS	Integrated Safety Management System
IWD	Integrated Work Document
JLON	Joint Laboratory Office-Nevada
LANL	Los Alamos National Laboratory
LCMP	Lead Contamination Management Plan
M&O	Management and Operating
MNT	Maintenance Procedure
MOA	Memorandum of Agreement
MSTS	Mission Support and Test Services, LLC
NA-LA	Los Alamos Field Office
NCERC	National Criticality Experiments Research Center
NCERC-FO	NCERC Facility Operations
NEN-2	NCERC Advanced Nuclear Technology
NFO	Nevada Field Office
NNSS	Nevada National Security Sites
NRTL	Nationally Recognized Testing Laboratory
OFI	Opportunity for Improvement
OP	Operating Procedure
OSHA	Occupational Safety and Health Administration
PC	Protective Clothing
PCM	Personnel Contamination Monitor
PIC	Person in Charge
PPE	Personal Protective Equipment
RCT	Radiological Control Technician
REOP	Real Estate and Operations Permit
RWP	Radiological Work Permit
SAC	Specific Administrative Control
SIAP	Site Integrated Assessment Plan
SME	Subject Matter Expert
SOP	Standard Operating Procedure
TEX	Thermal/Epithermal Experiments
THWP	Toxic Hazard Work Permit

TLV	Threshold Limit Value
Triad	Triad National Security, LLC
WCD	Work Control Document
WP&C	Work Planning and Control

INDEPENDENT ASSESSMENT OF WORK PLANNING AND CONTROL AT THE NEVADA NATIONAL SECURITY SITES NATIONAL CRITICALITY EXPERIMENTS RESEARCH CENTER

Executive Summary

The U.S. Department of Energy Office of Enterprise Assessments (EA) conducted an independent assessment of work planning and control (WP&C) at the National Criticality Experiments Research Center (NCERC) in September and October 2023. The Los Alamos Field Office (NA-LA) requested this assessment to benchmark current WP&C coordination of the various participating organizations. A memorandum of agreement between NA-LA and the Nevada Field Office (NFO) is in place to provide for the safe, secure, and compliant execution of Los Alamos National Laboratory (LANL) work at Nevada National Security Sites (NNSS). The assessment evaluated NCERC's established WP&C processes and implementation of the integrated safety management system core functions: define the scope of work, identify and analyze hazards, develop and implement hazard controls, perform work safely within controls, and provide feedback and make improvements. The assessment included the evaluation of activity-level work and the Federal oversight provided by NFO.

EA identified the following strengths:

- The Joint Laboratory Office-Nevada (JLON), a local partnership of the Los Alamos and Lawrence Livermore National Laboratories, has established a comprehensive system to support and ensure that work by Triad National Security, LLC (Triad) employees at NCERC is integrated into and performed in accordance with the requirements of the NNSS, NFO, and the management and operating contractor, Mission Support and Test Services, LLC (MSTS).
- The hazard controls developed by Triad for high-hazard work, including criticality hazards and critical lifts, were implemented effectively, and work was performed in accordance with established control sets.
- Formal, daily post-job briefings that include discussion of lessons learned are required and were conducted by Triad's NCERC Advanced Nuclear Technology researchers and documented for the observed experiments. Such briefings are not common at other sites that perform research and experimental work.

EA also identified several weaknesses:

- Triad's NCERC Facility Operations staff and Advanced Nuclear Technology researchers do not always ensure that work scopes are sufficiently detailed to allow identification and analysis of hazards.
- JLON has not developed instructions for the use of the toxic hazard work permit and has not subjected NCERC's radiological work permits for critical assembly operations to require As Low As Reasonably Achievable (ALARA) review determinations that use all the currently required ALARA trigger levels.
- JLON and MSTS have not adequately assessed the radiological hazards to workers from exposure to radon within the Device Assembly Facility, where elevated background count rates observed were attributed by radiological protection staff to be the result of radon levels that were impacting the ability to reliably detect low levels of personnel contamination during whole body frisks.
- Triad's NCERC Facility Operations staff and Advanced Nuclear Technology researchers did not consistently identify and/or analyze occupational hazards, such as those associated with lead, manganese, and the setup and operation of the coordinate measurement machine.

- Triad's NCERC Facility Operations staff and Advanced Nuclear Technology researchers did not conduct required pre-job briefings before the observed building pre-operational checks at the Device Assembly Facility.
- Triad's NCERC Advanced Nuclear Technology researchers have not consistently documented completion of each step of critical assembly standard operating procedures to allow verification that all steps were executed.

In summary, the NCERC WP&C program is generally adequate and appropriately integrates and coordinates Triad, JLON, and MSTS programs and processes to implement the integrated safety management system core functions and support the safe performance of work. However, weaknesses in WP&C implementation were identified, including insufficiently detailed work scopes; inadequate identification and analysis of several hazards, including radon, lead and manganese; inconsistent documentation of standard operating procedure step completion; and missed pre-job briefings associated with pre-operational building checks. Until the concerns identified in this report are addressed or effective mitigations are put in place, unidentified and uncontrolled hazards pose an increased risk to the workers. EA will conduct a follow up assessment to evaluate the effectiveness of corrective actions taken to address NCERC occupational hazards that were not fully identified and analyzed.

INDEPENDENT ASSESSMENT OF WORK PLANNING AND CONTROL AT THE NEVADA NATIONAL SECURITY SITES NATIONAL CRITICALITY EXPERIMENTS RESEARCH CENTER

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Worker Safety and Health Assessments, within the independent Office of Enterprise Assessments (EA), conducted a work planning and control (WP&C) assessment in accordance with the *Plan for the Independent Assessment of Work Planning and Control at the National Critical*[ity] *Experiments Research Center (NCERC) at the Nevada National Security Site*[s], *September, October 2023*. This assessment evaluated NCERC's established WP&C processes and implementation of the integrated safety management system (ISMS) core functions: define the scope of work, identify and analyze hazards, develop and implement hazard controls, perform work safely within controls, and provide feedback and make improvements. The assessment also evaluated activity-level work and the Federal oversight provided by the Nevada Field Office (NFO). The assessment was requested by the Los Alamos Field Office (NA-LA) to benchmark current oversight effectiveness and focused on the coordination of various participating organizations. A memorandum of agreement between NA-LA and NFO is in place to provide for the safe, secure, and compliant execution of Los Alamos National Laboratory (LANL) work at Nevada National Security Sites (NNSS). Onsite assessment activities were conducted on September 11-14 and October 2-5, 2023.

The NCERC critical assembly machines (hereinafter referred to as a critical assembly or critical assemblies) are located inside the secure, Device Assembly Facility (DAF) at the NNSS, which is managed by NFO's management and operating (M&O) contractor, Mission Support and Test Services, LLC (MSTS). The NCERC facility is a satellite operation of LANL and is staffed with Triad National Security, LLC (Triad) employees who are organized into two groups: NCERC Facility Operations (NCERC-FO) and Advanced Nuclear Technology (NEN-2). The NCERC-FO mission is to maintain the readiness of LANL's critical assemblies and support equipment. The mission of NEN-2 is to design experiments and operate the NCERC critical assemblies in campaigns. Coordination of Triad personnel with the NNSS community and site-specific requirements is accomplished by the Joint Laboratory Office-Nevada (JLON) organization, a partnership between LANL and Lawrence Livermore National Laboratory.

NFO controls operations at NNSS through the Real Estate and Operations Permit (REOP) process (NFO Order 410.X1, *Nevada National Security Site and North Las Vegas Facilities General Use and Operations Requirements*), which is intended to ensure that work at any location by one or more contractors is clearly defined and authorized, and that the responsibility for safety coordination is assigned to a single entity. As the managing organization of DAF, MSTS holds the primary REOP. NCERC-FO holds a secondary REOP, approved by MSTS, to ensure that NCERC work is performed within the DAF's safety envelope and boundaries.

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 (OFIs)" as defined in the order.

As identified in the assessment plan, this assessment considered objectives and criteria from DOE Guide 226.1-2A, *Federal Line Management Oversight of Department of Energy Nuclear Facilities*, appendix D, *Activity Level Work Planning and Control Criterion Review and Approach Documents with Lines of Inquiry*. EA also used elements of Criteria and Review Approach Document (CRAD) EA-30-07, Rev. 0, *Federal Line Management Oversight Processes*, to collect and analyze data on NFO oversight activities related to WP&C. In addition, EA used selected objectives and criteria from the following EA CRADs:

- EA CRAD 30-09, Rev. 0, *Occupational Radiation Protection Program*
- EA CRAD 32-03, Rev. 1, *Industrial Hygiene Program*
- EA CRAD 32-10, Rev. 0, *Construction Safety*
- EA CRAD 32-11, Rev. 0, *Control of Hazardous Energy (Lockout/Tagout)*
- EA CRAD 32-12, Rev. 0, *Material Handling Safety*.

EA observed the planning and execution of 29 onsite work activities at NCERC. EA examined key activity-level work control documents (WCDs), such as integrated work documents (IWDs), activity-level work documents (ALWDs), experiment plans, technical procedures, standard operating procedures (SOPs), hazard analysis documents, and other relevant WP&C documentation. EA also interviewed key personnel responsible for developing and executing the associated programs and walked down relevant portions of specific facilities. The members of the assessment team, the Quality Review Board, and the management responsible for this assessment are listed in appendix A.

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

3.0 RESULTS

3.1 Work Planning and Control Programs and Processes

This portion of the assessment evaluated the integration and coordination of Triad NCERC-FO, JLON, and MSTS WP&C programs and processes that flow down applicable worker safety and health program requirements to ensure the safe performance of work.

NCERC work is performed under the integration and coordination of WP&C programs and processes described by three categories: (1) LANL (home laboratory) documents, (2) LANL/JLON NNSS-specific documents, and (3) LANL-accepted MSTS documents. This collection of WP&C documents appropriately implements the ISMS guiding principles and core functions in accordance with DOE Policy 450.4A, *Integrated Safety Management Policy*, and effectively describes the requirements, roles and responsibilities, and relational processes (i.e., processes that entail the use of documents from more than one category) for Triad personnel to safely perform and coordinate work supported by MSTS employees (e.g., radiation control, DAF operators) at the DAF.

The primary WP&C documents implemented at NCERC (LANL P300, *Integrated Work Management*, and LANL P950, *Conduct of Maintenance*) were recently evaluated by EA (*Independent Assessment of Work Planning and Control at the Los Alamos National Laboratory Los Alamos Neutron Science Center, May 2023*) and were not reevaluated during this assessment. LANL/JLON NNSS-specific documents, LANL P511, *Work at National Nuclear Security Administration/Nevada Field Office Managed Sites in Nevada*, and JLON-PRO-900, *Real Estate and Operations Permit (REOP) and Work Control Process*, adequately ensure compliance with site-specific NFO requirements (NFO Order 410.X1 and NNSS-OPS.001, *NNSS Operations Manual*). LANL-accepted MSTS documents are adequately described in JLON-PLA-002, *Safety Management Program (SMP) Plan*, for processes requiring documented safety analysis-credited safety management programs (e.g., radiation protection, fire protection, and waste management), and JLON-PLA-600, *JLON Safety & Health Management Plan*, for non-credited processes (e.g., lockout/tagout, electrical safety, hazard communication, and working with cryogens).

JLON adequately ensures that implementation of WP&C is within the framework of the above documents. JLON's WP&C integration process includes an appropriate review of all NCERC WCDs for area-specific hazards and controls, and for the applicability of site-specific requirements. JLON's subject matter experts (SMEs) in different areas (industrial hygiene (IH)/safety, health physics, security, authorization/safety basis) appropriately review the WCDs using standardized checklists, and a final approval coversheet is added to the work document package, ensuring adequate approvals by NCERC's person in charge (PIC) of the work, JLON SMEs, and the JLON Manager. The completed, approved NCERC ALWD package includes an appropriate compilation of all the WCDs, such as LANL NCERC SOPs, experiment plans, in-service inspections, surveillances, and preventive maintenance procedures (MNT) with JLON and MSTS requirement and implementing documents. The MSTS DAF Operations Manager, as the M&O primary REOP holder, reviews the completed ALWD to ensure compliance with the DAF safety envelope. Worker roles and responsibilities are clearly delineated and managed using activity-level management agreements (ALMAs) or LANL Responsible Line Manager delegation forms to ensure that oversight responsibilities are clear when workers from different organizations are assigned to support work performed under another organization's process.

JLON-PLA-600 and JLON-PLA-604, *Los Alamos National Laboratory NNSS RPP* [Radiation Protection Program] *Implementation Plan*, are intended to ensure that radiological work at NCERC is performed in accordance with the NNSS radiation protection program and consistent with the MSTS radiological programs and procedures. Radiological work planning associated with these procedures is performed by JLON health physicists, with assistance from MSTS radiological control technician (RCT) supervisors and is further discussed in section 3.2 of this report.

Triad procedure LANL P101-13, *Electrical Safety Program*, is detailed and in accordance with 10 CFR 851, *Worker Safety and Health Program*, requirements, which include NFPA 70E-2015, section 110.1, *Electrical Safety Program*, as well as Occupational Safety and Health Administration (OSHA) 29 CFR 1910.331-335, *Electrical Safety-Related Work-Practices*, and 1910.137, *Electrical protective equipment*. NCERC's electrical equipment is primarily of the cord and plug connected variety, which does not require written lockout/tagout procedures, and the requirement for maintaining the cord and plug in the "exclusive control" of the individual performing the maintenance or inspection of the electrical equipment is adequately followed, in accordance with the requirements specified in 10 CFR 851. NCERC's work appropriately follows LANL's nationally recognized testing laboratory (NRTL) program, which requires that electrical equipment be approved by a NRTL or inspected and tested according to the NRTL requirements by an electrical safety officer before installation and use.

The JLON WP&C institutional processes and procedures are generally robust, but contrary to 10 CFR 830.122(e)(1), *Nuclear Safety Management*, and DOE Order 422.1, *Conduct of Operations*, attachment 2, section 2.a.(6), no instructions or training have been developed for the use of the form JLON-F-132, *Toxic Hazard Work Permit (THWP)*. (See **Deficiency D-JLON-1**.) The lack of such instructions could result in inadequate review, approval, or use of the form. Section 3.2, *Toxic Substances*, of the *JLON Safety and Health Management Plan* establishes the requirement for the development of a THWP for any work involving toxic substances (e.g., gases, chemicals, biological agents, and metals). However, neither the *JLON Safety and Health Management Plan* nor any other JLON or LANL procedure provides instructions concerning the THWP with respect to its purpose, authority, applicability, procedure, definitions (e.g., toxic hazard), responsibilities, review and approval process (including unreviewed safety question determination review), and record keeping, or provides a place to identify any applicable LANL reference documents as is typically required for other safety permits (e.g., LANL procedure P101-27, *Confined Spaces*).

Work Planning and Control Programs and Processes Conclusions

NCERC WP&C programs and processes developed by Triad staff at NCERC-FO and JLON appropriately implement the ISMS guiding principles and core functions through a collection of LANL, LANL/JLON NNSS-specific, and LANL-accepted MSTS documents. However, JLON has not developed instructions for using form JLON-F-132 for the toxic hazard work permit process.

3.2 Work Planning and Control Implementation

This portion of the assessment evaluated the implementation of WP&C, including the integration and coordination between Triad, JLON, and MSTS, observed during ongoing work through the ISMS core functions of defining the scope of work, identifying and analyzing hazards, developing and implementing hazard controls, performing work within controls, and providing feedback to support continuous improvement.

Defining the Scope of Work

The work scope definition in NCERC ALWDs and IWDs for the observed work was generally effective and adequate to permit proper identification of hazards and necessary controls. The IWD, *NCERC Critical Assembly Operations* (no document number) outlines most general work steps and tasks needed to complete specific critical assembly operations detailed in SOPs and experiment plans for each critical assembly and experimental configuration.

The work scope for criticality experiments observed on the Planet and Comet critical assemblies was generally adequately defined in the experiment plans, and the SOPs properly contained detailed step-by-step instructions for in-hand use. Work scopes for quarterly and annual preventive maintenance activities were clearly defined in MNT sections that properly bounded the required maintenance steps.

Most work scopes were well defined, but contrary to LANL P300, section 3.1.1, work scopes in the SOPs, experiment plans, and ALWD of one observed work activity had insufficient detail to allow identification and analysis of hazards, and one reviewed ALWD included work in the scope that was not covered in the IWD. (See **Deficiency D-Triad-1**.) Inadequately defined work scopes can result in hazards not being identified and/or adequately controlled. Specifically:

- The setup and use of a coordinate measurement machine (CMM) were not included in the work scope for the observed Planet and Comet experiments. Following the attainment of a criticality event, a CMM is set up within the round room, but at some distance from the critical assembly to record the precise measurements of the experimental configurations. In preparation for using the CMM, components are removed from the critical assemblies one layer at a time and transported to the CMM, where the assemblies are reconstructed. The process of dismantling and then reconstructing the critical assemblies, including the use of the CMM in performing the measurements, is not documented in SOPs, experiment plans, or ALWDs. Consequently, any hazards and controls associated with the CMM were not identified.
- One reviewed ALWD (JLON-ALWD-CEF-0012, *Area 11 Test Compound NCERC Support*) did not include a step describing "assemble various configurations" and the associated hazard analysis in the IWD. The scope of work included handling various types of materials (nuclear and non-nuclear) and assembling them in various configurations for experimental purposes.

Identifying and Analyzing Hazards

Comprehensive facility-level hazard analysis and controls for high-hazard criticality experiments are appropriately flowed from DAF safety basis documentation to NCERC documents. Applicable technical safety requirements, limiting conditions for operation, surveillance requirements, specific administrative controls (SACs), and administrative controls are appropriately included in critical assembly WCDs. ALWDs/IWDs serve as the principal LANL mechanism for documenting activity- and task-level hazards and controls for NCERC work. The reviewed documents and interviews demonstrated that SMEs are effectively engaged in identifying and analyzing activity-level hazards.

The reviewed ALWDs/IWDs were generally adequate in identifying a comprehensive set of hazards compiled during development and evaluation of the scope of work, experiment plans, and SOPs:

- JLON-ALWD-CEF-0001, *LANL NCERC Operations at DAF*, contains four IWDs, *NCERC Critical Assembly Operations*, *NCERC Material Balance Area*, *NCERC Subcritical Operations*, and *NCERC Decontamination*. Each IWD includes work steps with hazards and potential accident/incident scenarios.
- JLON-ALWD-CEF-0006, *NCERC Contact Work at DAF*, contains one IWD that identifies general hazards applicable to material handling, installation maintenance and repair of NCERC equipment, performing surveillances and in-service inspections, and corrective maintenance if needed.
- JLON-ALWD-CEF-0002, *NCERC Warehouse 06-911*, and JLON-ALWD-CEF-0003, *NCERC Warehouse CP-150*, appropriately identify the hazards of warehousing activities and radioactive material areas where needed.

Most radiological hazard analyses are appropriately accomplished through the radiological work permit (RWP) development process, which is described in company directive (CD)-0441.005, *Radiological Work Permit Process*, and operating procedure (OP)-0441.306, *Radiological Work Permit Process*. NCERC-RWP-004 for the observed Planet critical assembly operations using Plutonium Zero Power Physics Reactor plate target material and NCERC-RWP-023 for the observed Comet assembly work using uranium target material contained the required radiological hazard information, including general area and maximum expected dose rates, contamination levels, airborne concentration, and suspension limits for each of these categories.

The need for a critical lift plan was appropriately recognized for the installation and removal of large copper reflectors on the Comet critical assembly. CEF-PLA-009, *Critical Lift Plan for ZEUS Experiment on Comet*, was detailed with precise drawings and weights of reflector components to be lifted over the Comet critical assembly.

While most hazards were adequately identified and analyzed, EA identified the following weaknesses:

- Contrary to LANL P300, section 3.1.2, some hazards and/or controls were not properly identified and/or analyzed in IWDs. (See **Deficiency D-Triad-2**.) The lack of hazard identification and analysis can result in unnecessary risk to workers. Specifically:
    - Manganese hazards for the observed thermal/epithermal experiments (TEX)-Hanford experiment were not addressed in the IWD. The experiment plan, CEF-EXP-010, *TEX Critical Experiments*, section 1.1.1, states that in addition to the use of iron (which was observed), manganese could also be tested (although manganese was not in use during this work observation). Manganese is a toxic metal with an American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) of 0.02 milligrams per cubic meter, which is lower than the TLV for lead (another toxic metal identified in the IWD). The hazards associated with the use of

    manganese in the experiment have not been analyzed, and the use of manganese is not addressed in the IWD associated with the experiment.

    - Hazards and hazard mitigating controls (e.g., training and mentoring) for the setup and operation of the CMM, which is used in some critical assembly operations, are not addressed in the ALWDs or IWDs.

- Contrary to CD-0441.003, *ALARA [As Low As Reasonably Achievable] Program*, and OP-0441.306, the JLON ALARA review determinations for RWPs governing critical assembly work were prepared using an outdated JLON ALARA review form (JLON-F-059B, revision date November 2017) that contains different or missing ALARA review trigger level tests that are currently required by MSTS CD-0441.003, appendix A, *ALARA Review Criteria*, and OP.0441 MSTS FRM-1420, *Formal ALARA Review Determination*. (See **Deficiency D-JLON-2**.) Not following current requirements for performing ALARA reviews can result in incomplete hazard analysis and inadequate radiologial controls during higher hazard radiological work. The following specific weaknesses were identified:
    - JLON did not have a formal mechanism to ensure that any changes to MSTS ALARA review trigger levels were properly updated on form JLON-F-059B to reflect new requirements since 2017. As a result, current NCERC RWPs for critical assembly operations have not been subject to ALARA review determinations using the currently required MSTS trigger levels.
    - The JLON Radiation Control Manager and health physicist do not have direct access to MSTS radiological CDs and OPs on their computer workstations, possibly contributing to the lack of awareness of MSTS procedure and form changes.
    - While some of the trigger levels on the JLON form are more conservative than the current trigger levels, the JLON form is missing two new ALARA trigger levels, which have therefore not been evaluated for new RWPs issued in 2023 for the observed work. The missing information includes new trigger levels for removable contamination and derived air concentration (DAC)-hours of inhalation exposure, above which a formal ALARA review would be required.
    - CD-0441.003 states a trigger level of 12 DAC-hours inhalation exposure, while the MSTS FRM-1420 form lists a trigger level of 40 DAC-hours inhalation exposure.
- Contrary to 10 CFR 851.23(a)(9), MSTS and JLON have not adequately assessed radiological hazards to workers from exposure to elevated levels of radon within the DAF have not been assessed. (See **Deficiency D-JLON-3, D-MSTS-1**.) Inadequate assessment of radon levels represents a potential unevaluated worker exposure concern. High alpha radiation levels on radiological instruments used to frisk personnel for contamination was attributed to elevated radon levels, as described below in *Performing Work Within Controls.* This concern has not been formally evaluated to determine whether worker exposures to radon pose a hazard to workers' health. NNSS provided EA with radon survey results obtained in 2021, taken at locations in the DAF where automated personnel contamination monitors (PCMs) experienced spurious alarms due to higher-than-normal levels of radon gas, and in 2023 of specific areas where security personnel maintain round-the-clock occupancy. However, no comprehensive radon monitoring plan or study has been completed to ensure occupational safety of workers in all areas of the DAF. For example, radon measurements were not taken within buildings 302 and 304 and other regularly occupied areas. MSTS radiological personnel indicated that buildings 302 and 304 would be expected to contain the highest levels of radon in the DAF due to the design of the ventilation systems.
- The practice of using ALWDs/IWDs that contain identified hazards from previous activities diminishes the effectiveness of the primary activity-level hazard analysis and control tool. (See **OFI-Triad-1**.) For example, the *NCERC Critical Assembly Operations* IWD associated with the observed TEX-Hanford experiment on the Planet critical assembly identified the hazards and controls of toxic metals (cadmium, lead, and beryllium) and "operations with Class 3B or 4 lasers," which were

associated with previous experiments but had no relevance to the observed work activity. Also, work planning discussions for the control room upgrade confirmed that NCERC-FO staff would be performing the work using JLON-ALWD-CEF-0006, since the work is within the hazard controls for installation of NCERC equipment and checkout or troubleshooting of control racks. However, the ALWD does not address the planned construction of a raised floor. Such construction may involve hazards not adequately analyzed or controlled by this ALWD, such as the use of unique hand tools, adoption of manufacturer's installation instructions, or the introduction of an unreviewed adhesive.

Developing and Implementing Hazard Controls

Hazard controls for high-hazard work, including criticality hazards, are effectively developed and implemented. The reviewed experiment plans provided appropriate radiological requirements, operational limits, safety considerations, and personnel training requirements, as well as the consolidated activity steps with references to the appropriate NCERC SOP and section used to perform each plan section. Further, the reviewed SOPs for the operation of critical assemblies were detailed and specific to prevent accidental criticality and ensure that the approach to critical can occur only during remote operations with no personnel in the building. The reviewed SOPs appropriately identified the critical assembly modes and specified the activities allowed in operational, standby, or shutdown mode. Technical safety requirements, limiting conditions for operation, surveillance requirements, SACs, and administrative controls were appropriately referenced in the reviewed critical assembly SOPs and require the crew leader and crew member (two-person rule, SAC 5.9.12) to provide their initials verifying completion of steps, such as:

- Avoiding potential inadvertent operation of the critical assembly through Key Access Control (SAC 5.9.1)
- Ensuring that only remote operations take place after the nuclear material hand stacking limit is reached (SAC 5.9.3)
- Verifying that all personnel have exited the building (sweep procedure) before initiating a reactivity insertion experiment (SAC 5.9.10).

Hazard controls for identified task-based hazards were generally effectively developed and implemented in the reviewed IWDs and hazard-specific permits (RWPs, critical lift plans). For example, RWPs (NCERC-RWP-004 and NCERC-RWP-023) appropriately contained the required procedure-based radiological controls, including specific radiological training, dosimetry and bioassay monitoring, personal protective equipment (PPE), radiological survey and air monitoring, and contingency plans related to the specific work. Further, CEF-PLA-009 was detailed with precise drawings and weights of reflectors to be lifted, including torque specifications for lifting eyes installed into the copper reflectors. The forklift with factory-approved boom attachment for below-the-hook lifting and all rigging were appropriately rated for the loads. The forklift load chart was appropriately modified to reduce the load capacity of the forklift with the boom extension.

While hazard controls were generally adequate, EA identified the following weaknesses:

- Contrary to LANL P101-35, *Lead Management*, section 3.16, no lead contamination management plan (LCMP) has been developed for the lead bricks stored in NCERC Warehouse 06-911. (See **Deficiency D-Triad-3**.) If not appropriately controlled, lead dust can result in worker exposures to lead and spread of contamination. In June 2023, JLON IH conducted two lead sampling campaigns in an area of Warehouse 06-911 where lead bricks had been stored for several years. Sampling results identified several surfaces (bricks, ledges, etc.) that were contaminated in excess of the LANL lead housekeeping limit of 21.5 micrograms per 100 square centimeters. The area was decontaminated, and surfaces were sampled again by JLON IH, resulting in "cleaned" areas exhibiting surface lead levels that were still above the housekeeping limit. LANL P101-35 requires the development of an LCMP for contaminated lead surfaces that cannot be remediated to below the housekeeping limit. An LCMP had not been developed.

- RWPs for the observed critical assembly operations (NCERC-RWP-004, NCERC-RWP-023, and NCERC-RWP-006) cover a broad range of radiological work that can be performed under different radiological conditions. Consequently, the PPE section provides conflicting or inappropriate controls, resulting in multiple check boxes for required PPE that were all checked, even though not all of them would apply to the specific radiological conditions and posting in the work area. (See **OFI-JLON-1**.) During the observed Comet critical assembly experiment activities, five PPE check boxes in NCERC-RWP-023 were checked when only two applied for the observed work: (1) contamination area (CA)-full protective clothing (PC) (coveralls, shoe covers, gloves) and (2) other-if reaching into a high contamination area (HCA) from a CA, wear full PC, disposable sleeves, and double gloves. The remaining three check boxes were also checked even though they did not apply and were inappropriate for the specific radiological conditions in the work area: (1) CA-light work (laboratory coat, shoe covers, gloves), (2) HCA-double PC, and (3) hood underneath critical assemblies. Similar examples existed for other RWPs, such as NCERC-RWP-006 for re-entry and post-operational activities.

Performing Work Within Controls

The observed plan-of-the-day meetings and pre-job briefings were effective in communicating the specific work planned to be performed each day, ensuring that personnel training/qualifications were met, and verifying that the facility status was appropriate for the work to be performed. Formal plan-of-the-day meetings are held to appropriately authorize and release work for the day. The observed pre-job briefings were generally comprehensive and covered all items on the JLON pre-job checklist. Stop-work instructions and lessons learned were appropriately discussed in each briefing. Workers were attentive and engaged during the observed pre-job briefings. In addition, several PICs were observed conducting pre-job briefings and routinely asked questions of the attendees, and the attendees frequently asked questions, demonstrating effective worker engagement.

The crew chief appropriately verified that current training and qualification requirements were met before the start of work, using a weekly printed hard copy of the *List of Qualified Individuals*, an MSTS database of qualified workers. The MSTS DAF Operations Supervisor attended and participated in NCERC work activities as the primary REOP holder's representative, as required during mode changes (i.e., execution of an experiment plan or preventive maintenance) performed within DAF. The DAF Operations Supervisor effectively ensured that building pre-operational checks were completed and work was scheduled and released during the plan-of-the-day meeting and began the pre-job briefing with an emphasis on DAF-focused requirements and hazards.

Most of the observed work was performed in accordance with established control sets. During the observed TEX-Hanford experiment on the Planet assembly, NCERC operators followed step by step instructions documented in SOPs as written, as subsequently verified by crew members and/or the crew chief, demonstrating effective performance. During Comet control room operations, SOP steps were performed using the reader-checker technique, with appropriate repeat-back of the step to be performed. The crew chief and crew member discussed the next section of steps to be performed and confirmed agreement before moving forward. A formal walkthrough and sweep of the building were conducted to ensure that all personnel had left the room each time the building was cleared for remote operations. Additionally, one observed SOP-DAF-FA01-024, *Preoperational Checks for NCERC Building 304*, was properly performed by NCERC-FO staff and NEN-2 researchers with MSTS RCT assistance.

The observed critical lifts were performed safely and within the controls specified in the critical lift plan. Based on the reviewed training records, the PIC and forklift operator were appropriately qualified for the work. Lifting eyes were appropriately torqued when installed in the copper reflector blocks. A spotter was used to guide the forklift in the extremely tight working space. Good communication was maintained with others in the work area.

For the observed radiological work, radiological practices associated with donning and doffing PPE, radiological job coverage, surveys, and contamination control were effectively implemented. Personnel were diligent and followed appropriate donning and doffing practices in accordance with RWPs. Workers were also observed to properly wear required PPE, including whole body and extremity dosimetry, and required respiratory protection. RCT job coverage was appropriate, and radiological survey reports for job coverage and routine area surveys were legible and properly documented.

The observed quarterly preventive maintenance of the critical assemblies was generally adequately performed in accordance with the applicable MNT. The reader-checker technique was appropriately used to perform these "general use" preventive maintenances, with the PIC reading each step and the performer repeating the step and stating satisfactory or unsatisfactory. Completion of each step was appropriately documented in the MNT and signed by the maintenance performer, with review and verification of completion of the MNT by the cognizant system engineer. However, EA identified the following weaknesses:

- Contrary to LANL P315, *Conduct of Operations Manual*, section 16.4.1, NEN-2 researchers have not consistently documented completion of each step of critical assembly SOPs to allow verification that all steps were executed. (See **Deficiency D-Triad-4**.) Not checking completion of procedural steps could lead to missed steps and exposure to hazards, particularly given the number of non-sequential steps in the SOPs and frequent movement between SOPs. A review of completed SOPs for the observed Planet and Comet operations showed that procedural steps were not always marked with a checkmark when completed. Two interviewed crew chiefs stated that checking each step was optional and at their discretion; this statement was confirmed by the NCERC-FO Director. However, LANL P315, section 16.4.1, requires that "[t]he completed procedure must be reviewed by the worker to confirm that all steps were executed and appropriately documented."
- Contrary to SOP-DAF-FA01-024, step 5.1[1], pre-job briefings were not conducted before the observed building pre-operational checks. (See **Deficiency D-Triad-5**.) Not performing a pre-job briefing before entering a CA could lead to worker exposure to a radiological hazard. Interviews confirmed that pre-job briefings for daily pre-operational checks are not normally performed.
- Elevated levels of radon gas in radiological areas at DAF appear to pose a significant problem to reliably detect alpha contamination during required whole-body frisks. (See **OFI-MSTS-1**.) EA observed RCTs performing required whole-body frisks of personnel after working in Building 302 and 304 CAs and removing their PPE. The RCTs used Ludlum 3002 survey instruments with alpha background levels fluctuating in a range from several hundred disintegrations per minute (dpm) up to 800 dpm, when normal alpha background levels should be close to zero. RCTs and radiological management attribute this elevated alpha background to be the result of high radon levels in the DAF, presumably resulting from its construction material composition and its below-grade design. MSTS survey procedures do not address the proper determination of actual personnel contamination during whole body frisking in the presence of high alpha background from radon that would likely mask the presence of low levels of personnel contamination.

  At the past urging of Triad radiological control management, installation of automated personnel contamination monitors (PCMs) in the DAF was recommended to ensure consistent and statistically sound whole-body frisking. PCMs were procured and installed but were found to be ineffective due to excessive spurious alarms caused by elevated radon levels. All whole-body frisks are currently performed manually by RCTs, but the effectiveness of manual frisking even under low background conditions is variable and depends strongly on RCTs' diligence.

Providing Feedback

Daily post-job briefings are appropriately required and were effectively conducted for the observed experiments and maintenance. Post-job debriefings observed for the Planet and Comet experiments and preventive maintenance activities adequately identified and documented overall successes as well as discussion of specific problems, underlying causes, and potential solutions. Each post-job debriefing also appropriately provided an opportunity to identify and document any improvements and lessons learned. NCERC-FO management, in conjunction with the NEN-2 Critical Experiment Group Leader, stated that they have initiated quarterly reviews of all post-job lessons learned for discussion and dissemination among the workers. The reviewed initial quarterly presentation material demonstrated appropriate communication of post-job feedback and lessons learned.

Work Planning and Control Implementation Conclusions

The work scope definition in NCERC ALWDs and IWDs for the observed work was generally effective and adequate to permit identification of hazards, as compiled from the scope of work, experiment plans, and SOPs. In addition, most radiological hazard analyses were appropriately accomplished through the RWP development process, and hazard controls for identified task-based hazards were generally effectively developed and implemented in the reviewed IWDs and hazard-specific permits. Plan-of-the-day meetings and pre-job briefings were used effectively to authorize and release work, and post-job briefings were effective. However, some work scopes were insufficiently detailed to allow identification and analysis of hazards. Additional weaknesses were identified related to RWPs for critical assembly operations lacking the required ALARA review determinations, a lack of lead management planning and controls, inadequate documentation of SOP step completion, missed pre-job briefings before pre-operational DAF building checks, and elevated radon gas levels in DAF buildings that hinder the effectiveness of whole-body frisking and pose a potential worker exposure concern that has not been fully evaluated.

3.3 Nevada Field Office Oversight

This portion of the assessment evaluated NFO's oversight of WP&C for LANL's NCERC project.

At NNSS, Triad and other M&O contractors conduct work that is typically hands-on, high-hazard experiments, operations, and activities in accordance with the respective M&O contracts' statement of work, the Contracting Officer-approved work authorizations, and associated program implementation plans. For LANL's NCERC project, DOE oversight is conducted under DE-GM58-19NA25526, *Memorandum of Agreement* [MOA] *between The National Nuclear Security Administration Nevada Field Office and National Nuclear Security Administration Los Alamos Field Office, November 2019*. The MOA's overarching aim is to ensure the safe, secure, and compliant execution of laboratory work at NNSS and other facilities under NFO's purview. The MOA satisfactorily outlines objectives and responsibilities, including worker safety oversight, by NFO and NA-LA.

According to the MOA, NFO is responsible for providing Facility Representative (FR) oversight as appropriate for work activities executed in nuclear or high-hazard facilities at NNSS. To fulfill this responsibility, two qualified FRs are based at the DAF, affording them day-to-day access to NCERC activities. The FRs maintain operational oversight by attending planning meetings, reviewing work packages, and conducting frequent site walkdowns. Moreover, the FRs have recently reviewed several NCERC activities, including academic criticality-safety research, criticality-safety training, and security-related training. In addition, the NFO WP&C SME maintains regular communication with the FRs to stay informed about safety and health concerns and for operational awareness for NCERC.

The MOA also mandates that NA-LA and NFO collaborate on developing site integrated assessment plans (SIAPs) to ensure comprehensive Federal oversight of LANL activities at NNSS and related facilities under NFO's jurisdiction. NA-LA has submitted to NFO approved institutional integrated assessment schedules (IASs) for fiscal years 2023 and 2024, comprising 10 and 11 assessments, respectively, that are all directly tied to NNSS activities. These SIAPs align with NFO SDD 226.X, *NFO Oversight System Description Document*, and prioritize assessments based on risk and performance requirements. Notably, none of the assessments on the IAS and SIAP specifically address NCERC WP&C.

Safety concerns related to NCERC are documented within the LANL issues management system, as stipulated by the MOA. It falls under NFO's purview to request corrective actions through NA-LA and assess whether issues have been adequately resolved. However, NFO does not have access to LANL's issues management system. (See **OFI-NFO-1**.) Without such access, NFO cannot oversee issue resolution effectively and efficiently.

Nevada Field Office Oversight Conclusions

The MOA between NFO and NA-LA satisfactorily outlines objectives and responsibilities, including worker safety oversight. In addition, NFO provides appropriate FR oversight for work activities, and NA-LA and NFO collaborate on developing SIAPs to ensure comprehensive Federal oversight for LANL's NCERC project. However, the inability to access LANL's issues management system impedes NFO's oversight of issue resolution.

4.0 BEST PRACTICES

No best practices were identified during this assessment.

5.0 FINDINGS

No findings were identified during 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.

Joint Laboratory Office-Nevada

Deficiency D-JLON-1: JLON has not developed instructions or training for using form JLON-F-132 for the toxic hazard work permit process. (10 CFR 830.122(e)(1) and DOE Order 422.1, att. 2, sec. 2.a.(6))

Deficiency D-JLON-2: The JLON ALARA review determinations for RWPs governing critical assembly operations do not use all the currently required ALARA trigger levels. (CD-441.003 and OP-0441.306)

Deficiency D-JLON-3: JLON has not adequately assessed the health hazards to workers from exposure to elevated levels of radon within the DAF. (10 CFR 851.23(a)(9))

Triad National Security, LLC

Deficiency D-Triad-1: Triad's NCERC-FO and NEN-2 do not always ensure that work scopes are sufficiently detailed to allow identification and analysis of hazards. (LANL P300, sec. 3.1.1)

Deficiency D-Triad-2: Triad's NCERC-FO and NEN-2 did not identify and/or analyze the hazards associated with manganese or the setup and operation of the CMM. (LANL P300, sec. 3.1.2)

Deficiency D-Triad-3: Triad's NCERC-FO has not developed an LCMP to prevent worker exposure and contamination spread from the lead bricks stored in NCERC Warehouse 06-911. (LANL P101-35, sec. 3.16)

Deficiency D-Triad-4: Triad's NEN-2 researchers have not consistently documented completion of each step of critical assembly SOPs to allow verification that all steps were executed. (LANL P315, sec. 16.4.1)

Deficiency D-Triad-5: Triad's NCERC-FO and NEN-2 did not conduct required pre-job briefings before the observed building pre-operational checks. (SOP-DAF-FA01-024, step 5.1[1])

Mission Support Test Services, LLC

Deficiency D-MSTS-1: MSTS has not adequately assessed the radiological hazards to workers from exposure to elevated levels of radon within the DAF. (10 CFR 851.23(a)(9))

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified the OFIs shown below to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in assessment reports, they may also address other conditions observed during the assessment process. These OFIs are offered 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.

Joint Laboratory Office-Nevada

OFI-JLON-1: Consider subdividing broad work scopes with a variety of possible radiological conditions into discrete RWP tasks to clarify the PPE requirements for the specific radiological conditions to be encountered.

Triad National Security, LLC

OFI-Triad-1: Evaluate the usefulness of retaining hazards and controls in ALWDs that are not applicable to current work activities and consider developing criteria to help differentiate between appropriate expansion of the umbrella of hazards versus the need for a new IWD.

Mission Support and Test Services, LLC

OFI-MSTS-1: Consider collaborating with JLON to facilitate the design and construction of either an engineered enclosure or tent structure within the DAF with proper space, shielding, and ventilation that offers a low radon background area that could house personnel contamination monitors, or other suitable space without radon interference, to conduct official manual whole-body frisks.

Nevada Field Office

OFI-NFO-1: Consider providing NFO with access to LANL's issues management system to enhance oversight of LANL activities being conducted at NNSS.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: September 11-14 and October 2-5, 2023

Office of Enterprise Assessments (EA) Management

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William F. West, Deputy Director, Office of Enterprise Assessments
Kevin G. Kilp, Director, Office of Environment, Safety and Health Assessments
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