



# **Work Planning and Control Assessment at the Lawrence Livermore National Laboratory**

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## Acronyms

|       |   |
|-------|---|
| AL    | Approval Level                                |
| CAS   | Contractor Assurance System                   |
| CFR   | Code of Federal Regulations                   |
| CHAMP | Cooling and Heating Asset Management Program  |
| CRAD  | Criteria and Review Approach Document         |
| DOE   | U.S. Department of Energy                     |
| EA    | Office of Enterprise Assessments              |
| ES&H  | Environment, Safety and Health                |
| F&I   | Facilities and Infrastructure                 |
| FAS   | Facility Activity Schedule                    |
| GFCI  | Ground Fault Circuit Interrupter              |
| GS    | Global Security                               |
| IH    | Industrial Hygienist                          |
| IHOP  | Integrated Health of the Program              |
| ISM   | Integrated Safety Management                  |
| ITS   | Issue Tracking System                         |
| JHA   | Job Hazard Analysis                           |
| LFO   | Livermore Field Office                        |
| LLNL  | Lawrence Livermore National Laboratory        |
| LLNS  | Lawrence Livermore National Security, LLC     |
| LOTO  | Lockout/Tagout                                |
| NFPA  | National Fire Protection Association          |
| NIF   | National Ignition Facility                    |
| NNSA  | National Nuclear Security Administration      |
| OFI   | Opportunity for Improvement                   |
| OSHA  | Occupational Safety and Health Administration |
| PAT   | Pre-analyzed Task                             |
| PLS   | Physical and Life Sciences                    |
| PPE   | Personal Protective Equipment                 |
| RI    | Responsible Individual                        |
| SME   | Subject Matter Expert                         |
| WCD   | Work Control Document                         |
| WCI   | Weapons and Complex Integration               |
| WO    | Work Order                                    |
| WP&C  | Work Planning and Control                     |

# **Work Planning and Control Assessment at the Lawrence Livermore National Laboratory January 27-30 and February 10-13, 2020**

## **Summary**

### **Scope**

This assessment evaluated the work planning and control (WP&C) processes at the Lawrence Livermore National Laboratory (LLNL), which is managed and operated by Lawrence Livermore National Security, LLC (LLNS). This is a follow-up to a 2017 assessment that was conducted during the early stages of implementation of a revised WP&C process. The focus of this assessment was on research and maintenance work performed in the Weapons and Complex Integration Directorate, the National Ignition Facility and Photon Science Directorate, the Physical and Life Sciences Directorate, and the Global Security Directorate; maintenance work performed by the Facilities and Infrastructure Department; and subcontracted construction work. Electrical safety and the National Nuclear Security Administration Livermore Field Office (LFO) oversight processes were also assessed.

### **Significant Results for Key Areas of Interest**

Overall, the LLNS WP&C institutional program is a best practice and could serve as a model for other U.S. Department of Energy (DOE) laboratories, and substantial progress has been made in its implementation. The assessment team noted weaknesses in the implementation of some specific WP&C program elements and in the flowdown of DOE safety requirements for subcontracted construction work. The assessment team identified six deficiencies and four opportunities for improvement during the assessment.

#### Work Planning and Control Institutional Program

The development of most elements of the new WP&C process has been completed, a suite of WP&C procedures has been implemented, and an effective, well-integrated WP&C tool is in place to aid work planners and LLNS staff in the identification of hazards and controls and online development of work control documents (WCDs).

#### Work Planning and Control Program Implementation

Job hazard analyses within research-related and maintenance WCDs are presented in a user-friendly format, with detailed, clearly-written, and effective controls for the hazards that were identified. Observed work was performed safely. However, the assessment team identified four deficiencies, indicating that challenges remain in the implementation of the WP&C program with respect to fall protection, hearing conservation, work scope definition, and pre-job briefings.

#### Electrical Safety

Collectively, the LLNS electrical safety program and its effective implementation for work activities are appropriate to the risk associated with electrical hazards. Electrical work was conducted safely by technically competent and qualified workers, who demonstrated safe work practices.

#### Construction Subcontractor Safety

The assessment team identified two deficiencies related to construction work performed by subcontractors, namely that contract documents did not effectively flow down DOE safety requirements to sub-tiered contractors performing onsite work and that control of hazardous energy was not

implemented appropriately. The new WP&C tool has not yet been applied to construction subcontractor work.

#### Contractor Assurance System

LLNS has implemented a contractor assurance system that contributes to the improvement of WP&C processes. LLNS demonstrates the qualities of a learning organization in its approach to WP&C and safety and health issues, and has a solid programmatic approach for continuous improvement activities.

#### LFO Oversight

Overall, LFO has established and implemented appropriate processes and procedures for Federal line oversight, including assessment planning and performance, operational awareness activities, issues management, and performance assurance analysis.

#### Best Practices and Findings

The LLNS WP&C institutional program has matured, with notable strengths in specific WP&C elements, including work planner qualifications, the competent worker program, task-based job hazard analysis, pre-analyzed tasks, the integration of worker training requirements into WCDs, and the WP&C tool. Collectively, the framework and integration of these program elements have resulted in the LLNL WP&C program that could serve as a model for other DOE laboratories. Additionally, the Integrated Health of the Program analysis process effectively integrates contractor assurance system and field office oversight results to provide both laboratory and LFO senior management with valuable insights regarding performance in functional areas.

There were no findings identified as part of this assessment.

#### **Follow-up Actions**

No follow-up actions are planned.

# Work Planning and Control Assessment at the Lawrence Livermore National Laboratory

## 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 an assessment of work planning and control (WP&C) at the Lawrence Livermore National Laboratory (LLNL), which is managed by Lawrence Livermore National Security, LLC (LLNS). This assessment, conducted January 27-30 and February 10-13, 2020, evaluated the effectiveness of the implementation of the integrated safety management (ISM) core functions (define scope of work, identify and analyze hazards, identify and implement controls, perform work safely within controls, and feedback and improvement) for activity-level work involving research and maintenance. This assessment also evaluated elements of the electrical safety program, subcontracted construction work, the contractor assurance system (CAS), and the oversight provided by the National Nuclear Security Administration (NNSA) Livermore Field Office (LFO).

The LFO Field Office Manager requested this assessment as a follow-up to EA's previous WP&C assessment at LLNL in January and February 2017, which is documented in *Office of Enterprise Assessments Assessment of Work Planning and Control at the Lawrence Livermore National Laboratory – June 2017*. In accordance with the *Plan for the Work Planning and Control Follow-Up Assessment at the Lawrence Livermore National Laboratory, January – February 2020*, the current assessment focused primarily on research and maintenance work performed in the Physical and Life Sciences (PLS), Weapons and Complex Integration (WCI), National Ignition Facility (NIF) and Photon Science, and Global Security (GS) Directorates, as well as maintenance performed by the Facilities and Infrastructure (F&I) Department.

## 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 (OFIs)” as defined in DOE Order 227.1A.

As identified in the assessment plan, this assessment considered requirements related to WP&C and the CAS included in DOE Contract Number DE-AC52-07NA27344. The assessment team used sections of 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*; Criteria and Review Approach Document (CRAD) EA-32-03, Rev. 1, *Industrial Hygiene Program*; CRAD 45-35, Rev. 1, *Occupational Radiation Protection Program Inspection Criteria, Approach, and Lines of Inquiry*; and CRAD EA-30-01, Rev. 1, *Contractor Assurance System*. The assessment team also used feedback and improvement criteria from DOE Guide 226.1-2A.

The assessment team observed the planning and implementation of work activities in two primary areas: (1) research, including research-related work in radiological facilities and areas, and (2) maintenance, including an emphasis on electrical safety. The assessment team also observed subcontracted construction activities.

The assessment team examined key documents, such as work control documents (WCDs), procedures, job hazard analyses (JHAs), laboratory instructions, manuals, analyses, policies, and training and qualification records. The assessment team also interviewed key personnel responsible for developing and executing the associated programs, observed 51 work activities, and walked down relevant portions of specific facilities. Appendix A lists the members of the assessment team, the Quality Review Board, and management responsible for this assessment.

EA's 2017 assessment of WP&C at LLNL identified no findings. Therefore, there were no findings for follow-up during this assessment.

### 3.0 RESULTS

The objective of this assessment was to verify that LLNS manages and performs work in accordance with a documented Safety Management System that (1) defines the scope of work; (2) identifies and analyzes hazards associated with the work; (3) develops and implements hazard controls; (4) performs work within controls; and (5) provides feedback on the adequacy of controls and continues to improve safety management. (48 CFR 970.5223-1(c), *Integration of environment, safety, and health into work planning and execution*, and DOE Contract Number DE-AC52-07NA27344, Clause I.091, *Integration of Environment, Safety, and Health into Work Planning and Execution*)

Since the 2017 EA assessment of WP&C at LLNL, LLNS has made significant progress in developing and issuing the core institutional WP&C procedures and in completing and refining the WP&C tool used to develop WCDs consistent with those procedures. Overall, the LLNL WP&C program has matured and could serve as a WP&C model for other DOE laboratories; EA has identified this program as a best practice.

#### 3.1 Work Planning and Control Institutional Programs

The objective of this portion of the assessment was to verify that LLNS has established WP&C processes to enable the safe performance of work.

In 2013, LLNS began developing a new WP&C process featuring a computer-based WP&C tool and a task-based hazard analysis process. LLNS designed the new process for implementation across the laboratory for all work activities (i.e., research and laboratory, maintenance, service provider, and subcontracted work). In 2017, EA assessed the progress made in the development of the new WP&C process and concluded that its implementation, although limited, had streamlined work documents and resolved a number of concerns with the existing process.

Since 2017, the development of most elements of the new WP&C process has been completed, a suite of WP&C procedures has been implemented, and a sophisticated and interactive WP&C tool is in place to support work planners and LLNS staff members in the identification of hazards and controls and online development of WCDs. The new process provides an effective framework for implementing the ISM core functions. The new process includes six innovative and effective WP&C program elements (described below) that collectively have resulted in the LLNL WP&C program becoming a model for other DOE laboratories: **(Best Practice)**

- The WP&C tool is a core web-based system that enables work planners, working in conjunction with responsible individuals (RIs) and subject matter experts (SMEs), to develop new, or modify existing, WCDs. This tool provides a mechanism to identify task-based hazards and pre-analyzed tasks (PATs); ensures consistency with institutional Environment, Safety and Health (ES&H) requirements;

and includes the Facility Activity Schedule (FAS), an innovative scheduling tool that makes it easy to see whether a work package has been scheduled and released.

- The qualified work planner program requires that work planners have broad knowledge and experience in ES&H, facility operations, and program work activities. Qualified work planners work with LLNS RIs and maintenance supervisors in developing WCDs using the WP&C tool.
- The competent worker program establishes requisite worker skills, knowledge, experience, and training such that WCDs can focus on unique tasks, hazards, and controls.
- Task-Based JHAs are documented task-level hazard analyses that form the core of the WCD and include hazards and controls, boundary conditions, prerequisites, action statements, pre-job talking points, and task notes.
- PATs are ES&H-approved task-based JHAs for specific work that can be incorporated into a WCD without change, may be customized as needed, and provide a consistent set of controls for the same tasks, improving the efficiency of planning new work that may involve tasks that have been previously analyzed.
- Worker training requirements are integrated into WCDs to provide a mechanism for work supervisors to ensure that workers are current in the training required to perform each work task. The training requirements and status in the matrix are updated nightly.

DES-2012, *Work Planning and Control Program*, effectively establishes the requirements for the safe performance of work, including assembling the WCD and assigning workers, confirming training and readiness, conducting pre-start reviews and pre-job briefings, performing work using disciplined operations (e.g., following procedures, such as periodic monitoring for spread of radiological contamination), collecting feedback, and conducting work close-out. As described in DES-2012, LLNL employs a graded approach to work control, based on the risk and complexity of the work task. The WP&C process consists of five Approval Levels (ALs) (AL-0 through AL-4), which determine the level of review required. AL-0 tasks consist of activities to which the public is routinely exposed (i.e., low risk/complexity), AL-1 tasks are routine tasks that fall within a single competent worker qualification and no additional controls or hazard permits are required, AL-2 WCDs are comprised completely of PATs, AL-3 WCDs are comprised of all customized task JHAs or a combination of custom JHAs and PATs, and AL-4 tasks are activities that require an independent review to ensure readiness and safety (i.e., high risk/complexity/new or unique activity). Work that is determined to be AL-1 can be accomplished with a work package consisting of the work order (WO) and the competent worker qualification and associated JHA. For work that is determined to be AL-2 or higher, the work planner is required to conduct a more rigorous planning process, including the use of the WP&C tool to create a WCD, a planning team, job walkdown, roundtable to discuss the WCD among the planning team, etc.

The WP&C process integrates input from safety and health SMEs using established protocols to identify hazards. LLNS industrial hygienists (IHs) use a well-developed and systematic risk assessment approach, described in WSH-IH-FOM-07, *Industrial Hygiene Risk Assessment and Control*, to identify industrial hygiene hazards, assess the risk of exposure, and establish the level of control necessary to reduce exposure risk to an acceptable level. Health physicists use a systematic and well-written guide, HP-FO-103, *Radiological Review of Work Control Documents*, and a comprehensive radiological work control selection checklist (Attachment 1 to HP-FO-103) to assist in determining adequate controls for radiological work. The checklist reflects requirements found in LLNL-MI-804835, *LLNL Radiological*



*Control Manual*, and includes review of engineering controls, administrative controls, As Low As Reasonably Achievable considerations, and personal protective equipment (PPE) selection.

The assessment team noted that some program documents (e.g., RID-9207, *Fall Protection*, and the F&I document MAN-GWM-0003, *Work Planning and Control*) conflict with regulatory requirements or contain errors, resulting in inadequate work planning. For example, RID-9207 inappropriately applied an Occupational Safety and Health Administration (OSHA) construction safety standard provision to a general industry work activity (see Section 3.2.2, below). As another example, MAN-GWM-0003 provides limited guidance on pre-job briefings and contains errors in Appendix A, *List of Pre-Approved Routine Work Activities*. LLNS provided the assessment team with a draft of a new document, PRO-2014, *Planning Work and Managing Work Control Documents for Service Providers*, which is consistent with the new WP&C process and once published will allow MAN-GWM-0003 to be updated appropriately.

### **Work Planning and Control Institutional Program Conclusions**

LLNS WP&C institutional programs and processes are well integrated into the planning and execution of work control. The current WP&C includes six well-developed and effective WP&C program elements that collectively have resulted in the LLNL WP&C program becoming a model for other DOE laboratories.

### **3.2 Work Planning and Control Implementation**

This section discusses the assessment of LLNS's implementation of its institutional WP&C program for research and maintenance within the PLS, WCI, NIF and Photon Science, and GS Directorates, as well as maintenance performed by the F&I Department.

#### **3.2.1 Research**

The objective of this portion of the assessment was to assess LLNS's implementation of its institutional WP&C program for research work activities. The assessment team observed 19 experimental and research-related activities. Eleven of these activities were performed within radiologically controlled areas, including three activities within nuclear facility waste management areas, and the remaining eight were non-radiological research-related. The WCDs for all observed activities were associated with planned work, and not skill-of-the-craft activities, consistent with AL-2 or higher work except for one non-radiological research-related activity, which was AL-1.

#### **Defining the Scope of Work**

Research work scope is identified and documented in WCDs through the use of the WP&C tool. Each AL-2 or higher research WCD that was reviewed included an overall activity scope of work on the WCD title page and a numerical list of work tasks, followed by a series of JHAs (one for each work task). Each JHA that was reviewed was prepared in accordance with PRO-2031, *Writing a Job Hazard Analysis*, and provided sufficient work scope definition such that hazards and controls could be identified. For each WCD that was reviewed, the overall activity scope or work was well defined in both the WCD and associated JHA(s).

Most of the WCDs that were reviewed consisted of a limited number of work tasks to be performed in sequence. For example, the seven tasks identified in the B360 Complex Central Services Operation WCD for sterilizing biologically exposed glassware were performed as written and in sequence for each glassware sterilization operation observed. Two of the WCDs included many work tasks (i.e., 18 or

more), and for those research activities typically only three or four of the listed tasks would be performed for a specific research activity or experiment on any given day.

### **Identifying and Analyzing Hazards Associated with the Work**

Research activity hazards are identified and documented in WCDs through the use of the WP&C tool. The WP&C tool provides a useful and effective mechanism for defining hazards of the overall work activity through a WCD hazards checklist, and at the task level through a “Hazards and Environmental Aspects” section in each task-related JHA. For all observed research activities, the hazard analysis requirements of LLNS procedures were followed and the appropriate hazards were identified and documented in WCDs.

LLNS uses a multi-disciplinary team approach to planning work and developing WCDs. The RI and work planner assemble planning teams, and the number of SMEs and their level of participation is determined by the AL. The ES&H SMEs and workers who would be performing the tasks were routinely and effectively involved in the identification and analysis of hazards throughout the work planning process, including walkdowns and roundtables. For example, during the field walkdown of the WCD on WCI vacuum processes, the team IH identified several significant potential hazards and controls. The IH’s observations were important in improving the WCD.

### **Developing and Implementing Hazard Controls**

Each WCD contains one or more JHAs with sections for engineered controls, administrative controls, training controls, environment/waste controls, and PPE, as well as identifying special controls in supplemental JHA sections, such as boundary conditions and pre-requisites. JHAs within research-related WCDs included detailed, clearly-written and effective controls for the hazards identified, in a user-friendly format.

For research activities involving hazardous chemicals, in which the number of chemicals is limited and the chemicals are well defined in the WCD, this risk assessment process consistently identified the appropriate set of hazard controls. However, for work tasks that involved multiple chemicals (i.e., two of the seven observed activities), not all chemicals that could be used in the work task were identified or listed in the WCD, and the threshold for when to involve an IH in the evaluation of chemical usage is not well defined in the WCD. For example, as a follow-up to an inquiry by the assessment team regarding the use of adhesives, an LLNL IH identified seven adhesives in the current 300 item chemical inventory that could be used by electronics fabrication workers. These adhesives are not identified by name in the JHA or WCD. Seven of the adhesives, based upon the quantity and duration of use, were considered low hazard and the controls were appropriate for the activity. Though bounded by the JHA, if chemical use quantities were increased, additional controls (e.g., local ventilation or industrial hygiene air sampling) may be required. In this example, the line manager had established an adequate mechanism (i.e., use of a chemical risk wheel) to assist in evaluating the hazards of chemical usage. (See **OFI-LLNS-1**.)

### **Performing Work Within Controls**

For the 19 research-related work activities observed by the assessment team, work was performed safely, within established controls, and with one exception (see discussion on pre-job briefings, below), generally consistent with the LLNS institutional WP&C program requirements. A formal, documented pre-start review is required prior to performing any activity-level work under a WCD, whereas informal pre-job briefings are required periodically throughout the life of an activity (see PRO-2030, *Performing Work Safely*). Observed pre-start reviews were comprehensive; adequately addressed the work scope, hazards, and controls; and were interactive, inclusive, and employed effective discussions of the hazards and controls

content identified during the planning process, to ensure that potential hazards were identified and addressed. For example, an observed pre-start review of a synthetic chemistry research activity (WCD 101831) systematically addressed the most significant hazards and controls of the proposed research activity, as described in the WCD. The pre-start review was conducted by the RI and well attended by the research staff, facility managers, and appropriate SMEs.

Attachment 3 of PRO-2030 identifies 10 specific requirements for inclusion in all pre-job briefings. A number of these requirements were not addressed in the pre-job briefings for some research or maintenance activities (see Section 3.2.2). For example, the Safe Plan of Action process at NIF did not sufficiently verify the specific work tasks to be performed or identify significant or unique hazards associated with the work observed. For other observed research activities, it was unclear whether a pre-job briefing had been conducted before the research activity started because the pre-job briefing was often not identified as a specific activity. Based on interviews with the RIs, an informal discussion of work tasks and assignments performed prior to work was sometimes credited as constituting the pre-job briefing, although such discussions did not always include all the pre-job briefing topics as required by PRO-2030. (See **Deficiency D-LLNS-1.**)

### **3.2.2 Maintenance**

The objective of this portion of the assessment was to assess LLNS's implementation of its WP&C program for maintenance activities. The assessment team observed 18 maintenance work activities, including general work, corrective maintenance, preventive maintenance, and testing. The F&I Department Maintenance organization provides maintenance services to the laboratory through a central maintenance organization, as well as five deployed teams that are matrixed to their respective organizations.

MAN-GWM-0003 describes the WP&C process used by the F&I Department. Interviewed personnel stated that approximately 80% of the F&I Department work was performed as AL-1 work.

#### **Defining the Scope of Work**

The scope of work for maintenance activities is defined by either the WO for AL-1 work or by the WCDs for AL-2 and higher work. For AL-2 and higher activities, the WCD includes an additional scope of work for the planned activities, which was sufficient for the observed AL-3 work activities. However, for the 10 AL-1 work activities observed, the scope of work was incorrectly or incompletely described for 5 of the work activities. (See **Deficiency D-LLNS-2.**) For example, the scope of work for one WO was not updated to address work involving material that potentially contained asbestos, and another WO did not include the need to perform a lockout/tagout (LOTO) to isolate the electrical energy.

#### **Identifying and Analyzing Hazards Associated with the Work**

LLNS has developed competent worker qualifications, including job-specific JHAs, for maintenance workers. The competent worker JHAs form the basis for hazards identification in AL-1 work and appropriately include a scope of work and a job task analysis of authorized tasks, including hazards and controls. The assessment team reviewed 10 JHAs and found that they appropriately identified hazards and environmental aspects for each authorized task, with one exception. For tasks involving heights (e.g., ladders, scaffolding), the hazard statement addresses work at heights greater than 6 feet (i.e., "Work at heights of greater than 6' ...may result in falls that could lead to serious injury or death"). However, General Industry Standard 1910.28(b)(1)(i) requires fall protection for heights greater than 4 feet. As written, the JHAs do not recognize a hazard for work over 4 feet but less than 6 feet. (See **Deficiency D-LLNS-3.**)

For AL-2 and higher work, the work planner assembles a planning team and conducts a walkdown of the job site. The assessment team observed a field review and job walkdown for WCD 101848, *B332 Replace FHE-1000/FHE-2000 Fan Belt Drive Sheaves*. The field review and walkdown included appropriate representation from crafts, system engineering, facility operations, and industrial safety and discussed relevant topics, including rigging points, LOTO plan, and competent worker boundaries.

### **Developing and Implementing Hazard Controls**

Controls for maintenance work are identified in the competent worker JHA and in WCDs associated with AL-2 and higher work. The competent worker JHAs appropriately address controls for the identified hazards and contain a hierarchy of controls, including engineering, administrative, PPE, environmental, and training controls. For example, the HVAC mechanic competent worker JHA included a task for electrical LOTO and also appropriate administrative controls, PPE, and training (e.g., LOTO authorized worker). Engineered controls were appropriately established for other tasks (e.g., equipment panels or guards, ground fault circuit interrupter (GFCI) outlets, and certified refrigerant recovery units).

The WCDs included PATs from the relevant competent worker JHA and also custom hazards analysis and controls as required. For example, WCD 101976, *Remove PACM Pipe Lagging B-112 Basement*, referenced the appropriate tasks for the workers and included an analysis of and controls for the asbestos work. The controls included engineering controls (i.e., GFCI outlet and certified HEPA vacuum), administrative controls (e.g., spraying the area with amended water; installing glove bag and leak test; placing plastic sheeting underneath pipe); and PPE, including respirators. Prerequisites included contacting an IH to inspect the work area and collect results from asbestos personal air monitors. The controls were appropriate for the work activity.

An observed work activity at Building 5627 involved three LLNS workers (roofers) performing work at the edge of a single-story, low-slope roof approximately 10 feet from the ground. The task plan description associated with the WO included specific tasks, such as clearing debris from the drain, drain sump, gutter, and downspouts. A safety monitor was used as the sole form of fall protection or fall restraint for this activity, as identified on the corresponding *Fall Protection Planning Worksheet*. The regulatory basis for using a safety monitor instead of conventional fall protection or restraint is generally limited to certain construction activities or where conventional protection or restraint is not feasible, as defined by 29 CFR 1926, Subpart M, *Fall Protection*. This work activity involved gutter cleaning, which is a General Industry work activity covered under 29 CFR 1910, Subpart D, *Walking-Working Surfaces*. This standard does not provide a safety monitor option for commercial gutter-cleaning activities. RID-9207 was not implemented in accordance with 10 CFR 851, *Worker Safety and Health Program*, and 29 CFR 1910.28. (See **Deficiency D-LLNS-3**.)

### **Performing Work Within Controls**

The RI is responsible for scheduling work and ensuring that the work is included on the FAS, which involves coordination with facility management, who releases the work. The assessment team reviewed the NIF FAS from February 10-19, 2020, and confirmed that the two observed NIF jobs, WO 374654, *RM 123 Oven Installation*, and WO 369889, *AC Tech: ACD-6: Air Flow*, were on the FAS and properly released for work.

The assessment team observed five plan of the day meetings: two for the NIF deployed team, two for the GS, PLS, and Engineering deployed team, and one for the high voltage electricians. All plan of the day meetings satisfactorily addressed the planned work for the day, relevant safety topics (e.g., high wind damage), and possible hazards and controls. The scheduling and release of observed work was adequate.

The assessment team observed seven pre-job briefings: four for AL-1 work and three for AL-3 work. All observed pre-job briefings appropriately addressed the work scope, and all but one (WO 803818) addressed potential hazards and controls, including required PPE. Only one of the pre-job briefings discussed stopping or pausing work as required by Attachment 3 of PRO-2030, and none of the pre-job briefings discussed situations where performance errors were likely. It was unclear whether a pre-job briefing had been conducted prior to work for some of the jobs since the terms for “pre-job” and “prestart briefings” were used interchangeably, and pre-job briefings are not required to be documented. (See **Deficiency D-LLNS-1.**)

Most observed maintenance work was conducted safely, within established controls, by qualified and competent workers. RIs and team leaders were present during the work evolutions. Maintenance workers are required to undergo a skill-of-the-craft evaluation and tool certification process to become qualified in that craft. Additionally, each of the craft positions has a competent worker qualification and associated JHA. For the work observed involving potentially asbestos-containing materials, the IH SME and IH technician were at the work site to provide support. Workers provided valuable input during the performance of the job and wore appropriate PPE, including ergonomic knee pads.

The assessment team observed an LLNS work team removing and palletizing computer equipment in the West Computer Room of Building 453. This room was posted as a high noise area requiring hearing protection for entry. However, four of the eight individuals, including the group leader, were not wearing hearing protection as required. The assessment team observed another activity where the facility manager and another worker in Building 291 were observed entering room 1020, which was clearly posted as a hearing protection-required area, without wearing hearing protection. (See **Deficiency D-LLNS-4.**)

### **Work Planning and Control Implementation Conclusions**

Research, and most of the maintenance work, was performed safely and within the required set of controls as defined in the applicable WCDs. The assessment team observed significant progress in implementing the new WP&C process since the 2017 EA assessment. JHAs included detailed and appropriate controls for the hazards and were written in an easy-to-use format developed with the worker in mind. Implementation of the new WP&C process for maintenance continues to be a work in progress although the development of the competent worker qualification process and associated JHAs is a notable accomplishment. The assessment team noted work planning issues for AL-1 work, particularly in the areas of work scope definition and hazards identification. Challenges remain in the implementation of the WP&C program in some areas, such as work requiring fall protection or hearing protection.

### **3.3 Electrical Safety**

The objective of this portion of the assessment was to assess LLNS’s electrical safety program and its implementation, including the installation of arc flash warning labels on certain pieces of equipment, as well as electrical LOTO. The assessment team observed 13 electrical maintenance work activities (5 of which were addressed in Section 3.2).

The LLNS electrical safety program (UCRL-AM-133867-VOL-2-PT-16.1, *Electrical Safety Program*) effectively integrates the requirements of 10 CFR 851 and National Fire Protection Association (NFPA) 70E, *Standard for Electrical Safety in the Workplace*, Section 110.1, *Electrical Safety Program*. Additionally, DES-2401, *LLNL Lockout/Tagout (LOTO) Program*, and Institutional Procedure PRO-2402, *Performing LOTO*, address the requirements to establish the electrically safe work condition requirements of 10 CFR 851 and NFPA 70E, Article 120. The electrical safety program is well staffed with SMEs and Authorities Having Jurisdiction (AHJs) who are qualified in all aspects of electrical safety.

All observed 208-volt and greater, three-phase, electrical panels, disconnect switches, motor control centers, and switchgear have a current arc flash warning label installed as required by 10 CFR 851 and NFPA 70E, Section 130.5. These labels provide warnings and guidance for maintenance, operations, and research personnel of the potential arc flash hazard, arc flash boundary, and the required PPE for anyone working on or operating equipment within the arc flash boundary.

Collectively, the LLNS electrical safety program and its effective implementation for work activities are appropriate to the risk associated with electrical hazards. The 13 observed electrical maintenance work activities were performed on de-energized electrical equipment safely in accordance with the requirements of the electrical safety program. Workers wore appropriate PPE and demonstrated proficiency in their craft and safe work practices, including redundant zero energy checks, the use of a second qualified worker, and three-way communication.

### **Electrical Safety Conclusions**

Qualified workers safely conducted electrical work in accordance with the requirements of the LLNS electrical safety program and LOTO program. All of the electrical equipment that was observed had a current arc flash warning label installed as required by 10 CFR 851 and NFPA 70E, Section 130.5.

### **3.4 Construction Subcontractor Safety**

The objective of this portion of the assessment was to verify that LLNS has appropriately flowed contract safety requirements to its sub-tiered construction contractors and ensured that the requirements are implemented.

During the onsite assessment activities, the assessment team observed LLNS sub-tiered contractors performing physical construction work. Three subcontractors managed this work: Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) performed Cooling and Heating Asset Management Program (CHAMP) work; Clause Construction performed B151 High Level Radiochemistry Laboratory Refurbishment work; and Nova Probst performed Exascale Computing Facility Modernization Site Preparation work.

For the CHAMP and B151 refurbishment work, contracts did not clearly flow down DOE contract and regulatory requirements to sub-tiered contractors in accordance with 10 CFR 851.1, Contract No. DE-AC52-07NA27344, Clause I-0084(e) I-091(h), and DES-2450, *Worker Safety and Health Program*, Section 3.2.1. (See **Deficiency D-LLNS-5**.) For example, the contract for a Burns & McDonnell sub-tiered contractor (Element 26) requires adherence to Burns & McDonnell's project safety and health program, rather than stating the requirements in the contract. Element 26 performed work in areas identified and posted as hearing protection required; however, Element 26 did not maintain a continuing and effective hearing conservation program. For example, Element 26 did not develop or implement a noise monitoring program, did not provide employees with hearing conservation training, and did not provide baseline and annual audiograms.

Neither Burns & McDonnell nor LLNS took effective steps to verify sub-tiered contractor compliance with hearing conservation requirements. The assessment team identified similar hearing conservation concerns about work conducted by Clause Construction workers during the B151 refurbishment work. Even though the JHAs for sub-tiered work at two observed locations did identify noise hazards and required controls, the subcontractors did not appropriately assess noise levels to establish the required PPE controls. (See **OFI-LLNS-2**.)

LLNS and construction subcontractors have inconsistently communicated and applied LOTO requirements under 29 CFR 1910.147, *Control of Hazardous Energy*. (See **Deficiency D-LLNS-6.**) The assessment team observed a forum (*PMO Quarterly Partners Discussion*) held by the LLNS Project Management Office with the site's construction subcontractors. During the forum, contrary to OSHA requirements, LLNS representatives stated that individuals identified as "affected workers" are permitted to apply individually controlled keyed locks under some circumstances. Under 29 CFR 1910.147, only trained "authorized workers" are permitted to lockout equipment or machinery. This presentation also conflated the application of arc flash and electrical shock boundaries under NFPA 70E to when affected workers must apply individual locks to a group LOTO. The assessment team later experienced this confusion directly when a construction subcontractor would not allow the assessment team to enter a construction area without first applying an individual lock to the group LOTO, even though team members were not "authorized" workers under the OSHA standard and should have been allowed entry with training on the LOTOs that were in place and what each team member needed to do to maintain a safe work environment. (See **OFI-LLNS-3.**)

### **Construction Subcontractor Safety Conclusions**

The assessment team identified two deficiencies, namely that contract documents did not effectively flow down DOE safety requirements to sub-tiered contractors performing onsite work and that LOTO of hazardous energy was not implemented appropriately.

### **3.5 Contractor Assurance System**

The objective of this portion of the assessment was to ensure that LLNS has established a CAS to plan and conduct assessments, identify and manage WP&C issues and associated corrective actions, and analyze CAS results to provide feedback on the adequacy of controls and continue to improve safety management.

LLNS DES-0600, *Contractor Assurance System Description*, reviewed and approved by LFO, provides a comprehensive system to "improve management and performance" as required by contract clause H-4 of DOE contract No. DE-AC52-07NA27344. Quarterly LLNS self-assessments and Issue Tracking System (ITS) 44758, *LFO Livermore Field Office Assessment Report*, determined that the CAS was effectively implemented. In addition, the results of LLNS CAS and LFO oversight are made available for analysis by all organizations to identify improvement opportunities.

LLNS assessment planning is systematic, comprehensive, integrated with LFO assessment planning, and approved by both LLNS and LFO management. Annual plans for fiscal year (FY) 2020 are satisfactory in the WP&C functional area, and included planned effectiveness assessments by the parent contractor organization and an independent external assessment. In addition, LLNS developed WP&C checklists for use during management observations to evaluate current work performance in the five ISM core functions. Eight of sixteen WP&C assessments conducted in FY 2017-2019 were evaluated by the assessment team and were found to be sufficiently self-critical and identified areas that are not yet fully effective. The assessment team also evaluated two assessment quality peer reviews conducted by the LLNS Management Assurance System quality assurance office and found them to be effective in providing improvement feedback to the assessment leads.

LLNS has effective processes to analyze CAS data in order to measure performance and identify trends and improvement opportunities. The ES&H organization maintains robust laboratory-wide performance metrics and trend charting related to injuries and illness, radiation control, LOTO, and other safety-related areas. The Operations and Business Principal Directorate and the PLS Directorate analysis of performance data (e.g., injuries and illness metrics, safety training status, occurrences) provided some

insights to WP&C implementation from the line organization perspective. For most functional areas, including WP&C, LLNS and LFO functional managers jointly analyze and present their view of the functional area effectiveness during an Integrated Health of the Program (IHOP) presentation to laboratory and LFO management. The IHOP analysis process effectively integrates CAS and field office oversight results to provide both laboratory and LFO senior management with valuable insights regarding performance in functional areas. **(Best Practice)**

However, for some WP&C functional areas, the performance indicators are still under development. Both the LLNS and LFO WP&C functional managers have recognized that LLNS has not yet fully developed WP&C effectiveness performance metrics. The WP&C IHOP in particular was appropriately self-critical by recognizing that WP&C performance measures are not fully developed and WP&C implementation is not yet fully effective. LLNS has identified a number of additional WP&C metrics, and methods to obtain data, that when implemented may be beneficial in better understanding WP&C performance.

The assessment team reviewed the laboratory's ITS procedures and the local tracking database, the Occurrence Reporting and Processing System, and the Noncompliance Tracking System; interviewed seven management assurance managers, the Occurrence Reporting Manager, and the Regulatory Compliance Analyst responsible for conducting causal analyses; and reviewed the root cause training course and associated training records for individuals responsible for conducting causal analyses. Based on these reviews and interviews, the assessment team concluded that the process for issue and corrective action management is systematic and effectively identifies events, causes, and associated corrective actions. LLNS has established an appropriate procedure for categorizing issues for their significance and type of causal analysis, and categorization was appropriate for issues reviewed during a demonstration of the ITS database. Six causal analysis reports reviewed by the assessment team effectively identified apparent and root causes.

LLNS maintains an effective lessons learned program that gathers information from multiple sources, including the DOE Lessons Learned and OPEXShare websites, and shares lessons learned with appropriate organizations on site. The assessment team observed workers using a lessons learned from a previous work activity that had resulted in a serious injury to eliminate the tripping hazard that had caused the injury. In the area of WP&C, all work planners meet biweekly to discuss lessons learned and to gather feedback on how to improve the WP&C process and tools. For example, in one WP&C Planner Forum, a relevant lesson learned from Brookhaven National Laboratory regarding LOTO implementation was shared, and its application to future LLNL work packages was discussed. Additionally, work planners shared various WP&C implementation lessons learned and suggested improvements to the WP&C process.

### **Contractor Assurance System Conclusions**

LLNS has effectively developed and implemented a CAS that contributes to the improvement of WP&C processes, but performance measures specifically for the WP&C functional areas have not yet been fully developed. Feedback is shared and used by workers, and lessons learned are used to improve work packages and the WP&C process. LLNS demonstrates the qualities of a learning organization in its approach to WP&C and safety and health issues and has a solid programmatic approach for continuous improvement activities.



### **3.6 Livermore Field Office Oversight**

The objective of this portion of the assessment was to assess the LFO WP&C oversight process for overseeing and evaluating LLNL operations managed by LLNS and the implementation of specific LFO programs, including assessments and operational awareness activities, issues management and performance assurance analysis.

LFO Manual 450, *Integrated Safety Management System (ISM) Description*, effectively describes the tools for implementing ISM, ensuring the safe performance of work. LFO Manual 450.2, *NNSA Functions, Responsibilities and Authorities Document for Safety Management at LFO*, adequately defines line management's expectation regarding ISM. The LFO safety management system integrates all ES&H elements into an integrated management system, promoting the full inclusion of ES&H into every aspect of work. LFO and LLNS jointly develop assessment plans for WP&C that evaluate LLNS performance related to ISM core functions. The assessment team reviewed the results of 22 planned oversight activities and determined that LFO used a risk-informed, graded process to ensure that its oversight program is comprehensive and integrated with LLNS CAS activities. Planned assessments and operational awareness activities are efficiently managed and tracked through ITS.

LFO has implemented an effective Facility Representative program. Procedure LFO Process 1063.1, *Facility Representative Program*, is consistent with DOE-STD-1063-2017, *Facility Representatives*, and adequately describes Facility Representative duties, responsibilities, and authorities. The Facility Representatives are well integrated into LLNL operations. The Facility Representative biweekly activities reports document critical results of daily operational awareness activities and are included in the quarterly assessment reports reviewed by management. The assessment team reviewed LFO's quarterly assessment reports from 2017-2019 and determined that they were detailed and effectively reported performance deficiencies. For example, during one operational awareness activity observed by the team during the assessment, a Facility Representative identified discrepancies in the hazardous materials inventory and pressure relief devices with out-of-date calibrations. LFO issued deficiencies to LLNS for not maintaining an accurate hazardous materials inventory and prompted an investigation of the pressure relief device calibration issue.

LFO has approved the LLNS CAS Description per NNSA Supplemental Directive 226.1B, *NNSA Site Governance*. LFO reviews the Management Assurance System IHOP (functional and subject areas) and determines whether its expectations of the CAS are met. Issues identified through the integrated assessment process are effectively managed to resolution in ITS. For example, LFO identified a lack of an appropriate level of oversight of subcontractor activities by LLNS and issues that inhibit the effective flowdown of contractual health and safety requirements to subcontractors. This subcontractor requirement flowdown issue was also noted by the assessment team. The persistence of this issue suggests that additional LFO evaluation of subcontract work is necessary. (See **OFI-LFO-1**.)

#### **Livermore Field Office Oversight Conclusions**

Overall, LFO has a comprehensive integrated process for Federal line oversight for WP&C, and has implemented effective assessment planning and performance, operational awareness activities, issues management, and performance assurance analysis. The LFO review of WP&C functional and subject areas in IHOP provides an effective evaluation of LLNS management of EH&S program elements.

## 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 practices were identified as part of this assessment:

- The LLNL WP&C program has matured with strengths identified in six specific WP&C elements, including qualified work planners, the competent worker program, task-based JHAs, PATs, the integration of worker training requirements into WCDs, and the WP&C tool.
  - The WP&C tool is a core web-based system that enables work planners, working in conjunction with RIs and SMEs, to develop new, or modify existing, WCDs. This tool provides a mechanism to identify task-based hazards and PATs; ensures consistency with institutional ES&H requirements; and includes the FAS, an innovative scheduling tool that makes it easy to see whether a work package has been scheduled and released.
  - The Qualified work planner program requires that work planners have broad knowledge and experience in ES&H, facility operations and program work activities and who work with LLNS RIs and maintenance supervisors in developing WCDs using the WP&C tool.
  - The competent worker program establishes requisite worker's skills, knowledge, experience, and training such that WCDs can focus on unique tasks, hazards, and controls.
  - Task-Based JHAs are documented task-level hazard analyses that form the core of the WCD and include hazards and controls, boundary conditions, prerequisites, action statements, pre-job talking points, and task notes.
  - PATs are ES&H-approved task-based JHAs for specific work that can be incorporated into a WCD without change, may be customized as needed, and provide a consistent set of controls for the same tasks, improving the efficiency of planning new work that may involve tasks that have been previously analyzed.
  - Worker training requirements are integrated into WCDs to provide a mechanism for work supervisors to ensure that workers are current in the training required to perform each work task. The training requirements and status in the matrix are updated nightly.
- The IHOP analysis process effectively integrates CAS and field office oversight results to provide both laboratory and DOE field element senior management with valuable insights regarding performance within functional areas.

## 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.

## **Lawrence Livermore National Security, LLC**

**D-LLNS-1:** LLNS has not effectively implemented pre-job briefings for some research and maintenance activities consistent with one or more requirements for a pre-job briefing. (Attachment 3 of PRO-2030, and Section 3.3.8.5, *Pre-Job Briefs*, of DES-2012)

**D-LLNS-2:** LLNS did not provide a complete, detailed, or accurate scope of work for five AL-1 maintenance activities. (Section 6 of MAN-GWM-0003)

**D-LLNS-3:** LLNS did not identify, analyze, or control fall hazards:

- The competent worker JHAs do not recognize a hazard for work performed over 4 feet but less than 6 feet. (OSHA General Industry Standard, 29 CFR 1910.28(b)(1)(i))
- RID-9207 was not implemented in accordance with 10 CFR 851 for a Building 5267 gutter cleaning work activity. This work activity utilized a safety monitor when conventional fall protection or restraint was available and feasible, employees were required to work at and near the unprotected edge of the roof, and the use of a safety monitor is not permitted for general industry. (29 CFR 1910.28)

**D-LLNS-4:** LLNS did not ensure that workers were required hearing protection in Building 453, West Computer Room, and Building 291 as required by noise hazard signage. (29 CFR 1910.95(i)(2))

**D-LLNS-5:** For the CHAMP and B151 refurbishment work, LLNS did not clearly flow down DOE contract and regulatory requirements to sub-tiered contractors. (10 CFR 851.1, Contract No. DE-AC52-07NA27344, Clauses I-084(e) and I-091(h), and DES-2450, Section 3.2.1)

**D-LLNS-6:** LLNS and construction subcontractors inappropriately permitted “affected workers” who were not trained as “authorized workers” to apply individual locks. (29 CFR 1910.147)

## **7.0 OPPORTUNITIES FOR IMPROVEMENT**

The assessment team identified four OFIs (three for LLNS, one for LFO) 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.

## **Lawrence Livermore National Security, LLC**

**OFI-LLNS-1:** When research activities involve a spectrum of hazardous chemicals, many of which are not listed in the WCD, consider attaching an approved chemical list to the WCD, similar to the chemical listing and hazard analysis process used at the Idaho National Laboratory for such research activities, to ensure that the chemical hazard controls in the JHA adequately bound the risk levels of each of the chemicals.

**OFI-LLNS-2:** Consider enhancing oversight by LLNS and subcontractors serving as the general construction contractor to ensure that the LLNS worker safety and health program is fully implemented at the work task level. Moreover, consider extending or adapting the WP&C tool to construction subcontractor work to ensure that safety hazards are clearly identified and controlled by the sub-tiered contractors performing the work.

**OFI-LLNS-3:** Consider developing a documented action plan that clearly and holistically implements compliant LOTO procedures across all construction subcontractor work. This action plan could be integrated with the ongoing Project Management Office *Subcontractor Improvement Plan*, November 2019.

### **Livermore Field Office**

**OFI-LFO-1:** Consider enhancing LFO oversight of the flowdown of worker health and safety program requirements to subcontract projects as part of the Worker Safety and Health IHOP review.

## **Appendix A Supplemental Information**

### **Dates of Assessment**

Onsite Assessment: January 27-30 and February 10-13, 2020

### **Office of Enterprise Assessments (EA) Management**

Nathan H. Martin, Director, Office of Enterprise Assessments  
John E. Dupuy, Deputy Director, Office of Enterprise Assessments  
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments  
Kevin G. Kilp, Deputy Director, Office of Environment, Safety and Health Assessments  
Sarah C. Rich, Acting Director, Office of Nuclear Safety and Environmental Assessments  
Charles C. Kreager, Director, Office of Worker Safety and Health Assessments  
Anthony D. Parsons, Acting Director, Office of Emergency Management Assessments

### **Quality Review Board**

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### **EA Assessors**

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