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Independent Oversight Review of Integrated Safety Management System Effectiveness at Lawrence Livermore National Laboratory

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Table of Contents

Acronyms

CAM	Continuous Air Monitor
CAO	Contractor Assurance Office
CAS	Contractor Assurance system
CCP	Change Control Process
CRAD	Criteria Review and Assessment Document
dB	Decibel
DNFSB	Defense Nuclear Facility Safety Board
DOE	US Department of Energy
eCAR	Electronic Case Analysis Report
ES&H	Environment Safety and Health
F&I	Facilities and Infrastructure
FMR	Functional Management Reviews
FPOC	Facility Point of Contact
FSP	Facility Safety Plan
GFCI	Ground Fault Current Interrupter
HAC	Hazard Control Form
HSS	DOE Office of Health Safety and Security
HVAC	Heating Ventilation and Cooling
IAP	Institutional Assessment Plan
IG	Inspector General
IIA	Internal Independent Assessment
IORB	Institutional Operations Review Board
ISMS	Integrated Safety management System
ITS	Issues Tracking System
IWS	Integrated Work Sheet
JFAMLA	Joint Functional Area Manager and Line Assessment
LLNL	Lawrence Livermore National Laboratory
LLNS	Lawrence Livermore National Security LLC
LO/TO	Lockout/Tagout
LSO	Livermore Site Office
MSA	Management Self Assessment
MUSD	Maintenance and Utilities Services Department
NIF	National Ignition Facility
NMTP	Nuclear Materials Technology Program
NNSA	National Nuclear Security Administration
OEC	Operations Excellence Council
ORB	Operations Review Board
OSP	Operations Safety Plan
P&I	Planning and Integration
PIC	Person-in-Charge
PM	Preventive maintenance
PPE	Personal Protective Equipment
RHWM	Radioactive and Hazardous Waste Management
RI	Responsible Individual
SME	Subject Matter Expert
WAL	Work Authorization Level
WPCM	Work Planning and Control Manual
WPCP	Work Planning and Control Process
WP&C	Work Planning and Control

Independent Oversight Review of Integrated Safety Management System Effectiveness At Lawrence Livermore National Laboratory

1.0 PURPOSE

The purpose of this review was to assess the effectiveness of the integrated safety management system (ISMS) established and implemented by Lawrence Livermore National Laboratory (LLNL).

2.0 INTRODUCTION

This review was performed by the U.S. Department of Energy (DOE) Office of Enforcement and Oversight (Independent Oversight), within the Office of Health, Safety and Security (HSS). Support was provided by the National Nuclear Security Administration (NNSA) Office of Nuclear Safety and Governance (NA-171). The onsite portion of the review was performed during the period of July 11-21. The Livermore Site Office (LSO) will use the results of the review to support a DOE integrated safety management (ISM) declaration of the status and effectiveness of the ISMS at LLNL in accordance with DOE Order 450.2, *Integrated Safety Management* and LSO Work Instruction 450.4.1, *Annual ISM Effectiveness Review and Declaration.*

3.0 SCOPE

The review assessed LLNL's implementation of the core functions of ISM as defined in DOE Policy 450.4A, *Integrated Safety Management Policy*, and DOE Order 450.2, *Integrated Safety Management*. The focus of the review was on work planning and control for activities managed by the Nuclear Materials Technology Program (NMTP) and the Maintenance and Utilities Services Department (MUSD), and on corrective actions taken in response to previously identified ISMS deficiencies. The review also included the implementation of the institutional contactor assurance system (ISMS Core Function 5). In addition, the effectiveness of corrective actions taken in response to the February 2010 ISMS report, *Livermore Site Office Integrated Safety Management* System (*ISMS) Phase I and Phase II and Lawrence Livermore National Laboratory Integrated Safety Management System Phase II Verification Final Report, Appendix 5.2 HSS Mission Support Review of the Integrated Safety Management System of the Lawrence Livermore Laboratory* (hereafter referred to as the 2009 ISMS verification report) was reviewed, as were corrective actions taken in response to work planning and control (WP&C) deficiencies identified in a June 14, 2010 letter from the Defense Nuclear Facilities Safety Board (DNFSB).

Throughout the review, LSO, LLNL, and DNFSB staff were briefed on Independent Oversight's observations and emerging issues.

4.0 SUMMARY OF RESULTS

LLNL has established an institutional work control process in Environment, Safety and Health (ES&H) Manual Document 2.2, *LLNL Institution-Wide Work Control Process*. *Document 2.2* describes the LLNL ISMS process including activity/task level approaches to ensure that hazards associated with all work are identified and analyzed, and that appropriate controls are selected. The institutional process allows implementing organizations to apply a graded approach for classifying and categorizing work according

to the level of complexity and hazards associated with the work. Work is categorized into three authorization levels based on grading criteria that include hazard level, complexity, environmental risk, and mission needs. Work Authorization Level A (WAL A) is the simplest and consists of activities commonly performed by the public in areas where the hazards are those commonly encountered by the public. WAL A requires no supplemental hazard analysis. WAL B is more complex and requires an integrated work sheet (IWS). WAL C is the most complex, involves special hazards, and requires an IWS and a written safety plan. The institutional process includes the involvement of workers and subject matter experts (SMEs) in the analysis of hazards and determination of controls. LLNL has taken steps to better align the work planning processes of the various LLNL directorates with the institutional core requirements. Some organizations, such as NMTP, use equivalent processes designed specifically for their activities at some facilities, while using the site process at others. Other LLNL organizations, such as MUSD, tailor the site process to their needs by further defining work authorization levels and using additional hazard and control documents, such as Safety Plans.

Maintenance and Utilities Services Department Work Planning and Control

The Facilities & Infrastructure Directorate MUSD has established formal WP&C procedures in the *LLNL Facilities and Infrastructure Work Control Manual* and the *LLNL Facilities and Infrastructure Skill of the Craft Manual.* The MUSD Maintenance Management System is consistent with the Document 2.2 institutional process and defines three levels of work authorization that tie the level of hazard analysis to the level of complexity and hazards associated with the work.

Most MUSD work is categorized as WAL B, and tasks, hazards, and controls are identified on IWSs pursuant to the institutional process described in Document 2.2. MUSD implements the institutional IWS requirement through the use of Trade/Service IWSs that specify the hazards and controls associated with various maintenance work activities. In addition, Institution Wide Work Control Permits are used to communicate hazards and controls associated with the areas and facilities in which the work is performed**.** MUSD has improved IWSs since the last HSS review and subsequent internal assessments. Further hazard analysis has been performed and additional hazards and needed controls, such as the status of each approved worker's medical qualifications, have been added to Trade/Service IWSs.

MUSD has established 45 Trade/Service IWSs to define the hazards and controls associated with commonly performed tasks. Since training and qualifications are included in the specified controls, the Trade/Service IWSs provide a mechanism for ensuring that workers have the knowledge, skills, and abilities to perform assigned tasks.

MUSD has an experienced, well-trained maintenance workforce and relies heavily upon the knowledge, skills and abilities of these workers for the identification, analysis, and control of hazards associated with their assigned work.

MUSD seldom classifies work as WAL C. As discussed above, WAL C work is the most complex, involves special hazards, and requires an IWS as well as a Facility or Site Safety Plan. Complex work involving integration of the efforts of multiple crafts and supervision is often broken down into less complex work segments, each of which is classified as WAL A and/or WAL B. Segmenting complex jobs into multiple WAL A and/WAL B jobs without developing a safety plan can result in lack of adequate coordination and proper hazard control. This shortcoming was evident during the replacement of a pump motor on the U325 cooling tower (which was not classified as WAL C as the task assignments were segmented), when improper work planning and sequencing resulted in an unidentified fall and drowning hazard.

The MUSD workforce is experienced and well trained, and observations by Independent Oversight indicate that most work is performed safely; however, exceptions attributed to inadequate work planning were identified. MUSD does not tailor IWSs for specific jobs, and MUSD craft workers are not normally provided a document that links the work steps that they perform to associated hazards and controls. Institution Wide Work Control Permits are issued by facility points of contact to inform workers of the area- specific or facility-specific hazards that may be present and the controls that are required. However, no work control document specifies the hazards and controls associated with the specific work steps to be performed unless the job has been classified as WAL C and has an associated safety plan. The work scope and span of control of IWSs are too broad to permit effective analysis of task-specific hazards, and these hazards and controls are not typically addressed in work control documents. Tailgate meetings and pre-job briefings are used to remind workers of the hazards and controls associated with their work; however, the quality and content of these meetings are variable, and IWSs are not normally discussed. As previously noted, MUSD relies heavily upon the knowledge, skills, and abilities of their workers for the identification, analysis, and control of task-specific hazards.

Observations of MUSD work by Independent Oversight indicate that most workers are aware of the hazards associated with their work and understand the controls needed to mitigate them. However, several exceptions were identified, indicating the need to better inform workers of hazards that may not be readily apparent and to remind them of required controls. For example, workers testing high voltage circuit breakers were not aware of the magnitude of a high noise level in their work area, and during a fan motor replacement in Building 368 an electrical worker forgot to wear hearing protection for arc flash protection as required by National Fire Protection Association (NFPA) 70E.

Nuclear Materials Technology Program Work Planning and Control

The NMTP Work Planning and Control Manual (WPCM) describes the NMTP Work Planning and Control Process (WPCP) and Change Control Process (CCP), which are the two mechanisms used within NMTP to authorize, approve and release facility and programmatic work. In past years, NMTP WP&C processes differed significantly from those of the rest of the Laboratory, due in part to the more significant nuclear hazards associated with their work. For example, Superblock, and Building 332 in particular, did not use the IWS and had separate WP&C manuals, each with different work categories and rigor requirements than described in the institutional process. For several reasons, including reorganizations and recent concerns raised by the DNFSB with regard to NMTP work planning, NMTP has taken steps to consolidate its work planning processes into a single, cohesive WP&C manual for all its facilities, addressing equivalency and better alignment with the institutional process.

Currently, the NMTP WPCM supplements information contained in Document 2.2 and has defined four categories (A through D) of NMTP work activities. Category A, B, and C activities are in general alignment with institutionally defined work authorization WALs A, B, and C from Document 2.2. These three work categories are performed under a general work permit which references approved authorizing documentation, such as a Facility Safety Plan (FSP), Operations Safety Plan (OSP), or IWS. Category D work activities are generally complex, limited-duration facility or programmatic projects that may involve greater hazards or for which adequate controls are not specified in the FSP or in an approved IWS or OSP. Category D activities require the development of a specific work permit. These work activities are analyzed at the task level on a case-by-case basis to identify potential hazards and controls, and they are documented and controlled by a Category D work permit.

FSPs and OSPs are used in Superblock to describe and bound facility-wide operations and specific programmatic activities, respectively. IWSs are also used to define work scope in some NMTP facilities such as Radioactive and Hazardous Waste Management (RHWM), which only recently became part of

NMTP, and work permits are used in all NMTP facilities to define the scope for Category D work. Work scopes contained in FSPs, OSPs, and work permits are generally well defined and sufficiently detailed to identify hazards and controls for activity-level work. In some cases, particularly when work is controlled by an IWS, the work scope and span of control are too broad to permit effective analysis of hazards at the task level, resulting in inadequate specification of controls.

NMTP processes for identifying and analyzing hazards are generally effective. As with the site process, SME involvement in NMTP work planning is required by the WPCP, and ES&H Teams consisting of SMEs from the various safety and health disciplines are assigned to support the line in analyzing and documenting hazards. Unique to NMTP is an additional requirement for formal face-to-face meetings between personnel with responsibility for planning and executing all Category D work, including SMEs. These meetings take the form of routinely scheduled work permit meetings, work authorization meetings, change control meetings, etc., with the purpose of reviewing, commenting, revising, and approving work permits and other programmatic changes, in a single forum with all planning disciplines present. While similar roundtable type meetings between disciplines can and do occur with IWS planning efforts (both within and outside NMTP), such interactions are not formally required by Document 2.2 as part of the review and approval process. Independent Oversight viewed the NMTP work permit and change control meetings as valuable for enhancing the quality and accountability of work planning efforts.

Most hazards associated with work observed by the Independent Oversight review team were properly identified and analyzed. However there were isolated examples in OSPs and work permits where hazards were not fully and effectively identified. More systematic examples of hazard analysis weaknesses were evident for work controlled by IWSs, resulting from problems with effective implementation of institutional requirements.

Engineered and administrative controls are used effectively and extensively throughout NMTP facilities to control activity-level hazards. OSPs govern most of the operations work in Superblock facilities; these documents are generally of high quality and contain detailed and lengthy discussions of programmatic work to be performed, along with discussion of potential hazards and associated controls. An initiative to better link hazards and controls within OSPs was undertaken through development of task, hazard and control tables as appendices to all OSPs. This appears to be an effective cross reference, but similar initiatives have not been undertaken for FSPs, which could benefit from a complete linkage of OSP-related hazards and controls, or for IWSs and work permits where multiple and discrete tasks are within the defined scope of work. Finally, there are continuing problems with proper specification and clarity of controls within IWSs and/or work permits, particularly with respect to radiological controls and industrial safety/hygiene controls.

NMTP facilities plan and authorize work through formal mechanisms. Building 332 publishes a Daily Activity List and holds a daily meeting to identify and authorize all facility work for the upcoming day. The remaining NMTP facilities publish a Weekly Activity List and hold weekly meetings to identify and authorize work; this frequency is appropriate for their workload and needs. A new requirement for daily work team meetings provides a better way to ensure readiness to perform work, including face-to-face meetings with discussion of work to be performed that day. Pre-job briefings are professional and informative about the task, hazards, controls, and work flow. Fissile material handlers are particularly well trained and qualified, and they were observed to perform plutonium operations in strict accordance with controls and work practices as defined in their OSPs. Notwithstanding some weaknesses in approved work control documentation, observations across other NMTP areas also indicated performance of assigned work activities was in accordance with the approved specifications.

Contractor Assurance System (CAS)

The Laboratory has continued to strengthen its CAS processes, and the Contractor Assurance Office has developed tools and provides data analysis and performance information for management to address areas of weakness and improve performance. New procedures have been issued for some CAS elements to better detail requirements and processes. Many assurance activities continue to be performed thoroughly and comprehensively, and performance has improved since the 2009 ISMS verification. Internal independent assessments are consistently thorough and comprehensive, providing effective feedback for evaluating institutional programs. Many management self-assessments, joint functional area manager and line assessments, and management observations are planned, performed, and documented well, providing line management with essential performance information. The investigation and analysis of operational events are generally thorough, the management of associated issues is comprehensive, and recurrence controls are implemented. Many issues, including opportunities for improvement, are input to the site issues tracking system and effectively evaluated and resolved.

However, LLNL continues to struggle with implementation of several assurance system elements. The selection and performance of management self-assessments need strengthening, and more attention from management is needed to ensure that a structured, risk based methodology is being used to identify activities and processes for timely evaluation and that assessments are thorough and adequately documented. Some self-assessments insufficiently evaluate or document performance. Several aspects of the lessons-learned program need strengthening, and the management of ES&H issues and the performance analysis of events continue to present significant challenges to line and support organizations. Some institutional issues, issues that cross organizational boundaries, and issues that involve both process and line implementation deficiencies have not been effectively dispositioned in a timely manner and with appropriate mitigating actions. Other issues management deficiencies identified in the samples reviewed by Independent Oversight included improper categorization, inadequate problem descriptions, insufficient or inaccurate cause determinations and extent-of-condition reviews, insufficient specification of recurrence controls, and insufficiently thorough effectiveness reviews. LLNL has established some mechanisms to break down barriers and provide more communication, transparency, and management oversight, such as the Operational Review Boards and Operations Excellence Council. However, continued management attention is needed to ensure that assurance system elements are implemented in a compliant and effective manner.

Corrective Actions Taken in Response to the 2009 ISMS Verification Review

Independent Oversight reviewed the scope, status, and effectiveness of LLNL corrective actions taken to address the 13 findings and weaknesses identified in the 2009 ISMS verification report. Each of the issues and all of the associated actions had been completed and closed in the LLNL issues tracking system. Independent Oversight concluded/determined that for 10 of the 13 findings and weaknesses, the actions identified and implemented by LLNL were ineffective or not fully effective in addressing the issues. The issues, for which further action was necessary, involved WP&C, radiological protection, and CAS elements. Although many of the issues involving assurance system deficiencies and weaknesses were primarily implementation deficiencies, the issues were assigned to institutional functional area managers and the actions too often focused on system owners improving institutional processes, with no actions that directly addressed the inadequate performance of line organizations.

In addition, in May 2011, LLNL issued a report of their fiscal year (FY) 2010 ISMS effectiveness review. The results of this Independent Oversight review indicate that LLNL's effectiveness review was not sufficiently rigorous. The description of the approach used to evaluate effectiveness used vague terms, such as "considered" relevant activities and "use of" ISM-related assessments, which did not convey how

the information was evaluated. Many of the data sets that were included did not apply, predated the previous review, or presented facts with little or no analysis or linkage to how the data reflected ISMS effectiveness. The listing and discussion of "improvement areas" documented actions that could affect ISMS performance but did not provide useful information on the effectiveness of ISMS or these changes. The review did not identify any conclusions as to ISMS effectiveness and did not identify the issues noted by Independent Oversight during this review.

Corrective Actions taken in Response to March 2010 DNFSB Letter

In a letter to NNSA dated June 14, 2010, the DNFSB expressed concern about the NMTP work control process. The letter stated that because the NMTP process did not define work activities and boundaries in sufficient detail to support analyzing hazards and establishing controls, many operations relied too heavily on workers' knowledge and experience. LSO responded by a letter dated August 16, 2010, with commitments to better align the NMPT work control process with the LLNL institutional process. The status of this realignment is summarized in Appendix C of this report. Most actions are proceeding on schedule, and all are scheduled to be completed by the end of December 2011.

5.0 CONCLUSIONS

LLNL has established an adequate ISMS that is consistent with DOE ISMS policy and requirements. The institutional work control process provides appropriate flexibility to implementing organizations, but implementation has not been fully effective. In particular, the work scope and span of control of MUSD and NMPT IWSs are too broad to permit effective analysis of hazards, resulting in inadequate or incomplete specification of hazards and controls for some work. Similarly, processes established for contractor assurance are adequate, but implementation of these processes has not been fully effective. Although work control processes have been improved since the 2009 ISMS verification review, many of the corrective actions taken in response to this review have not been fully effective. Most observed work was performed safely, and most observed deficiencies were attributed to inadequate process implementation. CAS processes and performance have been improved since 2009, and all system elements are generally providing management with needed information about processes and performance. However, improvement in implementation is needed in all assurance system elements. Assessments are not always sufficiently thorough or well documented. Issues management continues to present LLNL with challenges in addressing ES&H issues in a thorough and timely manner. Many of the actions identified and implemented by LLNL to address the weaknesses and findings from the HSS 2009 ISMS review have not been fully effective. LLNL continues to make progress on addressing DNFSB issues involving WP&C in the NMTP.

6.0 ISSUES AND RECOMMENDATIONS

The LSO annual ISM effectiveness review and declaration for 2011 will identify strengths and weaknesses in ISM implementation and opportunities for improvement. In support of these objectives, and to be consistent with LSO contractor assurance procedures, this Independent Oversight ISMS review report describes indentified areas of weakness as "issues" and provides recommendations for improving performance. LSO Work Instruction 226.1.1 defines an issue as "a generic term for any outcome, positive or negative, significant enough to be reported, tracked, and trended for use in continuous improvement activities." The six issues below are based on and referenced by the text in Appendix A of this report. Recommendations for addressing these issues are provided in Appendix D.

Issue WP&C-1: MUSD has not implemented institutional and departmental ISM processes sufficiently to ensure that workers are adequately informed of the hazards and controls as required by 10 CFR 851. (Appendix A, Sec. A.1.2, Core Function 3)

Issue WP&C-2: NMTP has not sufficiently implemented the IWS system as required by Document 2.2 and as needed to ensure adequately bounded work scopes, sufficient hazard analysis, and specification of controls tailored to discrete work tasks. (Appendix A, Sec. A.1.3, Core Functions 1 and 5)

Issue F&I-1: LLNL has not consistently implemented an effective management self-assessment program that thoroughly evaluates processes, performance, and management systems for protecting worker safety and health as specified in DOE Order 414.1D, *Quality Assurance*; the LLNL CAS description; and LLNL procedures. (Appendix A, Sec. A.2.1)

Issue F&I-2: LLNL has not fully implemented an effective program that thoroughly evaluates the causes and extent of safety issues related to operational events/incidents, injuries, and assessment activities and establishes and implements effective corrective actions and recurrence controls as required by DOE Order 414.1D, *Quality Assurance*; the LLNL CAS description; and LLNL procedures. (Appendix A, Sec. A.1.3, Core Functions 3 and 5, and Sec. A.2.2)

Issue CAS-3: LLNL has not fully implemented timely performance analysis of events or ensured that results of other performance analyses results are appropriately evaluated and dispositioned in accordance with DOE Order 414.1D and LLNL issues management procedures. (Appendix A, Sec. A.2.4)

APPENDIX A

ISMS Core Function Review Results

The review assessed LLNL's implementation of the core functions of ISM as defined in DOE Policy 450.4A, *Integrated Safety Management Policy*, and DOE Order 450.2, *Integrated Safety Management*. Implementation was assessed through review of WP&C processes and by observation of work activities performed by the Weapons and Complex Integration Directorate, the Operations and Business Directorate, and the ES&H organization. Work activities assessed included those at NMTP facilities and maintenance activities conducted by MUSD, including high voltage electrical work. The effectiveness of corrective actions taken in response to the February 2010 ISMS report, *Livermore Site Office Integrated Safety Management System (ISMS) Phase I and Phase II and Lawrence Livermore National Laboratory Integrated Safety Management System Phase II Verification Final Report*, (hereafter referred to as the 2009 ISMS verification report) was also reviewed.

A.1 Work Planning and Control Results

A.1.1 Introduction

ES&H Manual Document 2.2, *LLNL Institution-Wide Work Control Process,* describes the LLNL ISMS process, including activity/task level approaches to ensure that hazards associated with all work are identified and analyzed and that appropriate controls are selected. The institutional process revolves around a graded approach to classify and categorize work according to the level of rigor needed for planning and execution. There are three basic categories of work, Work Authorization Levels A through C (WAL A through WAL C). WAL A work activities are activities commonly performed by the public in areas where the hazards are those commonly encountered by the public. WAL A activities can be self-authorized with knowledge of the supervisor. For all work that is beyond WAL A, the LLNL institution-wide WP&C process relies on the electronic IWS to ensure a conscious, formal process for planning and performance. This process includes involvement of workers and SMEs to properly plan and document the hazards and controls associated with the work. With some exceptions described below (NMTP), the IWS is the principal mechanism used at LLNL to plan and control activity level work that is beyond WAL A.

Since the 2009 ISMS verification review, LLNL has made significant efforts in attempting to align the work planning processes of the various LLNL directorates with institutional expectations. However LLNL's institutional WP&C process continues to provide flexibility to individual directorates and departments. Although some flexibility is appropriate, it has led to implementation that deviates from institutional expectations, resulting in missed hazards and controls (discussed later in this report). Certain organizations, such as NMTP, use equivalent processes designed specifically for their activities at some facilities while using the site process at others. Other LLNL organizations, such as MUSD, use the site process and tailor it to their needs.

A.1. 2 Maintenance & Utilities Services Department Work Planning and Control

Maintenance at LLNL is conducted primarily by the Facilities & Infrastructure Directorate (F&I) within MUSD. The conduct of maintenance work is managed through the use of preventive maintenance task codes and job or work orders. Preventive maintenance is scheduled on an annual basis and, in some cases, is collected into a maintenance windowing program to minimize program impact and more

efficiently use available resources. In FY 2010, MUSD had a total of 164 workers and completed 76 job orders using 45,454 labor hours, 15,329 dispatch/minor work orders using 301,654 labor hours, and 23,106 preventive maintenance work orders using 85,509 labor hours

ISM is primarily implemented through Trade/Service IWSs and Institution Wide Work Control Permits, which are issued by facility points of contact (FPOCs) and used to communicate, review and document all known facility/area hazards and controls**.** MUSD has 45 Trade/Service IWSs that are intended to govern the different craft and shop work performed in connection with maintenance. Progress has been made in improving Trade/Service IWS(s), such as inclusion of more hazards and general controls, as well as information such as the status of each approved worker's medical monitoring requirements. Some of these items were noted as missing either during the last HSS review or subsequent internal assessment(s).

This assessment focused on all types of work performed by the MUSD including maintenance performed through the preventive maintenance windowing, and work order systems. Tasks observed included building heating, ventilation, and air conditioning (HVAC) preventive maintenance, roof access preparations, ventilation system troubleshooting and repairs, electrical lockout/tagout (LOTO), paint and heavy equipment shop activities, and work at elevation.

Core Function 1 - Define the Work

The scopes of work for MUSD maintenance activities are adequately defined for most activities. The scopes are adequately defined on most minor work orders, but in some cases, the scope descriptions lack accuracy and/or sufficient detail to accurately and clearly define the scope of work to be performed. Additional effort is needed to better define the scopes of work on minor work orders to ensure that the scopes are defined with sufficient accuracy and detail to support effective hazard analyses. **(See Issue WP&C-1.)** Work orders for larger jobs were typically more accurate and contained more detailed work descriptions. Planning & Integration (P&I) planners, supervision and/or craft personnel visit the job site and perform a walkdown when necessary to fully understand the scope of work. For emergent work, walkdowns are normally conducted by the assigned craft person before the work is performed. Additional work scope information obtained during walkdowns conducted by supervision or the crafts is not normally documented in work requests. However, additional work orders may be requested for newly identified scopes of work.

For preventive maintenance, the craft are provided with facility level work windows and task codes that further detail the work to be performed. This process may include the use of Institution Wide Work Control Permits, issued by FPOCs, which further define the scope of work to be performed.

The scope of work defined on Trade/Service IWSs is too broad to fully support the analysis of hazards associated with work steps to be performed for specific jobs. Maintenance activities performed by MUSD craft have been divided into 45 categories, and a Trade/Service IWS has been prepared for each of these categories. These IWSs are not tailored for each job and do not describe the work steps for accomplishing specific jobs.

Core Function 2 - Analyze the Hazards

The MUSD Maintenance Management System is consistent with the Document 2.2 institutional process and defines three levels of work authorization, which tie the required hazard analysis to the work authorization level. As previously discussed, WAL A is the simplest and consists of those tasks that would normally be conducted by the general public. WAL A requires no supplemental hazard analysis.

WAL B is more complex and requires an IWS. WAL C is the most complex, involves special hazards, and requires an IWS in connection with a Facility or Site Safety Plan. Most MUSD work falls into a WAL B classification.

Since most jobs are classified as WAL B and an IWS is required for WAL B work, the IWS process is the primary means of hazard identification and analysis for MUSD maintenance activities. Institutionally, the IWS is structured to identify discrete tasks, determine the hazards associated with each task, and then identify the controls necessary to minimize or eliminate the hazards. MUSD has reviewed and revised many of the Trade/Service IWS(s) to better identify hazards and general controls, and to provide additional information, such as the status of each approved worker's medical monitoring requirements, that was noted to be missing either during the last HSS review or subsequent internal assessment(s). Additionally, corrective actions have resulted in numerous industrial hygiene (IH) surveys and/or assessments to document and/or support hazard analysis and decision making for requisite controls.

MUSD relies primarily on a set of Trade/Service IWS(s) as well as Institution Wide Work Control Permits for the performance of most maintenance work. The work control permits are issued by FPOCs to provide information about facility or area specific hazards and controls**.** As used in MUSD, the IWS lists activities, workers, hazards, hazard analysis, and controls, including training and medical surveillance, however it is are rarely used or referenced during the conduct of work. (i.e. it is not a tool to assist workers with field implementation of hazard controls). The Trade/Service IWSs provide discussions of the potential hazards that may be encountered. This information is useful for ensuring that workers are qualified to perform assigned tasks and can be useful to individuals planning work: however, the IWS does not link hazards or controls to work steps or the sequence of tasks being performed for specific jobs and this information is not normally included in work control documents provided to workers for WAL B work. Tailgate meetings and pre-job briefings are used to remind workers of the hazards and controls associated with their work however the quality and content of these meetings are variable and IWSs are not normally discussed. Maintenance workers performing WAL A and WAL B work must rely primarily on their knowledge, skills, and abilities to identify, analyze, and control hazards without the aid of work control documents.

Workers were adequately informed of most hazards associated with the work observed by Independent Oversight. Two exceptions are noted below:

- Laborers conducting core drilling of concrete at Cooling Tower U325 for removal and replacement of bolts in advance of a cooling tower pump motor replacement conducted the work with an approved work order under their work group's Trade/Service IWS. The poor sequencing of the work, along with work planning deficiencies (no additional facility hazards were identified), allowed workers to be exposed to a fall hazard and potential drowning hazard as the pit below the now open hole (large enough for a large individual to easily fall through) was filled with churning cooling tower water six to ten feet deep (according to the workers). The work order identified no additional location hazards and called for no barricades or fall protection controls, and the workers did not recognize the hazard until the Independent Oversight observer and escort called it to their attention and requested that they cover the hole. Neither the work order nor the Labor Trade/Service IWS (IWS# 413.09 r6), identified these potential fall or drowning hazards. Additionally, no Institution Wide Work Control Permits were issued by the FPOC(s) for this work.

- A noise hazard was noted during conduct of high voltage preventive maintenance for breaker testing, and no hearing protection was required or utilized. During the conduct of testing the breaker is repeatedly exercised. The impact noise was noted as being quite high, and when questioned, the workers thought the equipment had been evaluated and were unaware of any need for hearing protection. The Trade/Service IWS requires hearing protection for greater than 85 dB and requires

that signs and postings be followed, again placing the burden on the worker to determine the appropriate controls. The individual conducting most of the testing was not enrolled in the medical surveillance portion of the hearing conservation program but had received hearing conservation training. The MUSD Noise Survey (Equipment Noise Surveys) December 2010 – April 2011 indicated the equipment as having a sound level of 55.3 dB; however, the noise monitoring was not conducted during actual equipment use in the field. This study also stated: "Not all employees who worked in the High Voltage Shop at the time of this assessment were enrolled into the LLNL hearing conservation program." Following an interview with the industrial hygienist who conducted measurements for the MUSD Noise Survey (Equipment Noise Surveys), it appeared that some of the measurements may not have reflected the actual noise hazards that workers may be subjected to, since the breakers were not being exercised when the measurements were made. This may provide a false basis for the determination of the need for hearing protection and/or enrollment into the hearing conservation program for some individuals.

Inadequate work planning contributed to each of the above examples. In the first example, a complex job involving multiple craft and hazards was not classified as WAL C , so no safety plan was prepared. Instead, the work was broken down into less-complex work segments, each of which was classified as WAL B. The segmenting of this complex job into multiple WAL B jobs without developing a safety plan resulted in lack of adequate coordination and proper hazard control. In the second example, the noise hazard was not analyzed as part of work planning before the work began. The workers were aware that the noise level in their work area was high, but they incorrectly assumed that it had been measured and that they would have been told if hearing protection was required. While improvements have been made, MUSD work planning continues to lack sufficiently detailed hazard analysis through job specific IWSs, accurate and complete Institution Wide Work Control Permits, and adequate pre-job briefings and tailgate meetings. These weaknesses have resulted in some hazards not being adequately addressed during work planning. (**See Issue WP&C-1**)

Core Function 3 - Define and Implement Controls

There are a variety of controls that can be applied by MUSD crafts at times during conduct of maintenance work. Controls include LOTO, roof access permits, confined space permits, low voltage outage permits, soil excavation and penetration permits, respirators and other personal protective equipment (PPE) and clothing, and fall protection.

Overall, the process for coordinating and controlling high and low voltage electrical work is sufficiently established and implemented through ES&H Manual Chapter 12.6, *LLNL Lockout/Tagout Program,* and the respective Trade/Service IWSs. Work observations demonstrated that high voltage electrical work was being conducted in accordance with most requirements established in this ES&H Manual Chapter. One exception was noted by Independent Oversight when an LLNL F&I HVAC technician while conducting a zero voltage verification of a 480 volt electrical panel LOTO did not meet the requirements of NFPA 70E. The HVAC technician donned the appropriate PPE required by the NFPA 70E for arc flash and shock protection. However, he did not test his volt meter to a known reliable source after the zero voltage check, as required by NFPA70 E. When interviewed, the technician was not aware of the requirement contained in Chapter 12.6 and NFPA 70E for the conduct of a meter functionality verification after performing a zero energy check. (**See Issue WP&C-1**)

Some IWSs identify controls external to the documents that are provided, and the work documents do not always specify exactly which controls are required for which task or activity. The following example relates to conduct of high voltage preventive maintenance for breaker testing in accordance with an approved work order and General Electrical Utility System Trade/Service (skill of the craft) IWS. The work observed was conducted safely and an adequate pre-job briefing was held. Following completion of

the work the workers were interviewed about their understanding of the task specific hazards and controls. Neither the procedure for the activity, the IWS, nor the safety plan contained in the IWS for the task (task 7) specifically states the required PPE. However, workers stated that they used the standard PPE of safety glasses, company uniform, voltage rated gloves and hard hats for work in this location and at this voltage (roughly equivalent to NFPA 70E CAT 2). Additionally, the Operations Manual for this group (MANOPS-0004 Rev-0) does not discuss the testing of breakers. It does contain information related to the testing of medium voltage cables. The observed activity is not included in the manual. The direction in the IWS to follow controls in PLAN-SAFT-0001, NFPA 70E, and ES&H 16.1 for PPE may not be sufficient in all cases and places the burden on the worker, when additional analysis maybe needed.

A second observation of a LOTO associated with Fan Motor Replacement Work Order in Bldg. 368 was conducted under an approved work order, facility release, and fall protection plan. The LOTO for the work (with the exception of one PPE omission) was conducted under institutional or NFPA 70E requirements. The assigned task required a qualified electrical worker to conduct LOTO of the 480V breaker supplying power to a disconnect serving a roof top mounted exhaust fan and verify absence of energy prior to conducting the assigned maintenance activities. Arc flash postings were not evident at the location where the work was performed (since the structure is newer than 2004, it should have been posted); however, the worker did verify that the power supplied to the facility met Category 2 PPE, which the worker used while conducting the zero energy verification. During conduct of the LOTO, meter functionality was verified (both before and after zero energy check) to a known source and the zero energy verification confirmed absence of energy. The PPE requirements specified by NFPA 70E for activity were met except for hearing protection, which the worker acknowledged forgetting. (**See Issue WP&C-1**)

In another concern, management would not authorize a worker to remove damaged equipment from service, despite a potential for injury from use of damaged equipment. A vacuum pump for use during core drilling of concrete at Cooling Tower U325 (for removal and replacement of bolts in advance of a cooling tower pump motor replacement) was damaged prior to the start of the job; a major chunk of the casing around the moving parts was broken away, and the gap was only partially covered with duct tape, leaving exposed, moving parts that could cause injury. Apparently the worker had previously taken the unit back to the shop and asked whether the pump could be replaced. Management denied a verbal request by the line supervisor to replace the damaged pump, and the unit was returned to service. The core-drilling unit does have an alternate configuration that would allow it to operate without the vacuum pump (i.e., the drilling unit would have to be lagged down). However, neither this option nor the option of borrowing another vacuum pump from elsewhere on site was pursued. The worker was asked to remove this equipment from service following this observation.

In a final example, while appropriate fall protection was observed for preventive maintenance activities conducted on the roof of building 691, planning deficiencies related to materials needed for completion of this task could have put workers at unnecessary risk. (**See Issue WP&C-1**) The FPOC for the facility required all individuals accessing the roof to sign in on a roof access permit. A fall protection planning worksheet was developed by the work supervisor, and workers donned appropriate fall protection (including harnesses) within their inspection interval. A fall restraint sling was anchored to the roof fan housing base of the unit being serviced. On inspecting the fan unit, the workers determined that the replacement belt specified by the work order was the wrong item. In this case, there was a spare belt within the fan housing which was used to complete the job. Planning deficiencies such as this could unnecessarily expose workers to additional fall hazards by requiring workers to climb up and down the ladder to obtain the correct replacement part and re-perform the potentially hazardous portions of the work assignment, (i.e. LOTO, roof access with requisite fall protection planning implementation).

In a related concern, the ladder used to access the roof for a repair activity at building 368 had a yellow tag (observed by an Independent Oversight team member) stating "Do Not Use Without First Contacting the Fall Protection Competent Person and the building FPOC for information about minor ladder defects." The FPOC for the facility required all individuals accessing the roof to sign in on a roof access permit, a fall protection planning worksheet was developed by the work supervisor, and appropriate training was verified. However, the competent person for the roof was not the individual for the ladder, and neither this individual nor the FPOC could locate the yellow tag issues on either the database or specific ladder documentation. Workers were already on the roof, and both the FPOC and the individual writing the fall protection plan felt that the ladder issues most likely involved rung spacing and/or obstruction of the side rail in one location. Once made aware of these issues, the remaining individuals were allowed to access the roof. The yellow tag was not addressed in the pre-job briefing for this job. (**See Issue WP&C-1**)

The use of broad Trade/Service IWS and work control documentation, which in some cases do not specify controls for the performance of work, has resulted in a system where planners do not identify hazards and controls associated with specific work steps in work control documents, hazards and controls are not always adequately addressed in pre-job and tailgate meetings, and workers are expected to choose the controls they believe are applicable (rather than being provided with a set of controls that must be implemented prior to performing work). Directions to workers to seek assistance from external requirement documents (i.e., NFPA 70E or ES&H Manual chapters) or documents that have been renamed in order to establish controls assume that the crafts have sufficient time, knowledge, and resources to find, understand, and implement the information; this methodology is not in accordance with institutional expectations for linking or embedding controls.

Core Function 4 - Perform Work within Controls

Pre-job briefings and tailgate meetings are held to discuss planned activities and to remind workers of the hazards and controls associated with their work; however, the quality and content of these are variable and IWS content was rarely discussed at the meetings observed by the Independent Oversight team. Additionally, FPOCs routinely discuss location-specific hazards and controls with craft workers before the start of work.

A number of work evolutions observed by Independent Oversight were performed safely, in accordance with established controls, and without incident. Examples include the conduct of preventive maintenance in Building 391 by the heavy equipment craft of the Joy Fans; the troubleshooting of Building 663 Exhaust fans in response to a foul odor trouble call; the conduct of preventive maintenance of the Building 691 roof fan; the application of powder coating in the Building 418 paint shop; and the implementation of controls associated with most other work when those controls were sufficiently identified.

However, for some activities observed by Independent Oversight, hazards were not identified and controls were not understood, implemented, or followed as discussed in the following examples. (**See Issue WP&C-1**).

HVAC mechanics conducting a compressor replacement for the computer room air conditioning in building 439 were conducting the work under an approved work order, facility release, and fire permit. However, the LOTO for the work was not established in accordance with institutional or Occupational Safety and Health Administration (OSHA) requirements. The assigned task required two individuals, one HVAC mechanic and one helper; both individuals were observed handling the compressor body, unbolting the unit, and touching grounding wires and the metal portions of the compressor stand/air conditioner frame. After walkdown of the LOTO, it was observed that only one individual had signed on the tag and only one lock was utilized. When the worker who actually conducted the LOTO was

interviewed, the individual stated that the unit was isolated and the wires and fuses had been removed, so the second individual was not required to be on the LOTO. However, the wires that had been disconnected by the craft were not terminated (i.e., tapped, capped, and/or pulled back to the junction box); in actuality, the electrical box removed from the compressor was lying on the metal railing above the compressor unprotected, with a nest of wires sticking out and bare. The fuses, which had been removed, were unsecured and out of the workers' immediate control (i.e., around the corner and left unattended during lunch, end of shift, etc.), as was the circuit panel where the LOTO was in place. This condition is inconsistent with the institutional and OSHA requirement, which would have the second worker observe the zero voltage verification (if not a qualified electrical worker) or walk down the LOTO and discuss the verification and apply their own lock, to ensure positive control of the hazardous energy potential. Subsequent review with the LLNL ES&H Electrical Safety SME concluded that the condition observed was a violation of chapter 12.6 requirements (one worker; one lock; one tag). (**See Issue WCP-1**)

Laborers conducting core drilling of concrete at Cooling Tower U325 for removal and replacement of bolts in advance of a cooling tower pump motor replacement, conducted the work with an approved work order under their work group's trade service IWS. While most hazards were appropriately controlled, including potential silica exposure (wet drilling with vacuum was employed), noise (NRR 22 hearing protection utilized), and electrical hazards in wet environs (corded ground fault current interrupter (GFCI) power receptacles and tools), some hazardous conditions were created and/or uncontrolled during the conduct of the work. The task observed was a sequenced work evolution; prior work crews had de-energized and removed the pump assembly over the cooling tower basin and covered it with plywood. The core drilling crew, while drilling the concrete, removed the protective covering to access the drilling locations because the protective cover extended beyond the bolt locations. Removing the plywood exposed workers to a fall hazard and potential drowning hazard since the pit below the now open hole (large enough for a large individual to easily fall through) was filled with churning cooling tower water six to ten feet deep (according to the workers). (**See Issue WP&C-1**)

Work control, as currently implemented within MUSD, relies heavily on the individual workers' experience and situational awareness at the time of work, rather than written instructions that supplement individual knowledge and skills. Work observation indicates that for some jobs, work planning deficiencies continue to potentially adversely impact worker safety. Typically workers attempted to follow controls when controls were clearly established, but in some cases workers were either unaware of or confused about some hazard controls. These conditions represent some potential safety vulnerabilities.

Core Function 5 – Activity Level Feedback and Improvement

Feedback related to conduct of MUSD maintenance tasks is typically the responsibility of the line supervisor, responsible individual (RI), or person in charge (PIC) of the work assignment or craft performing the work. This individual is responsible for collecting safety feedback associated with performing the work and documenting feedback information on the work order or work permit. The information is then entered into the Work Control System and is automatically forwarded to an F&I Safety Team representative. For complex work, feedback information is documented on the work order (Work Planning Feedback) and IWS. The RI/PIC is responsible for ensuring that a copy of the information is provided to the work planners, an F&I Safety Team representative, and the ES&H Team, as appropriate. An F&I Safety Team representative is responsible for determining whether a safety issue exists and identifying the appropriate path for resolution. This process may include notifying appropriate personnel to determine the actions needed to resolve the identified safety concern (e.g., FPOC, facility manager or designee, ES&H Team and work planners). An F&I Safety Team representative ensures that the safety concern is addressed and communicates back to the RI/PIC and planner for complex work.

A.1.3 Nuclear Materials Technology Program Work Planning and Control

The NMTP Work Planning and Control Manual (WPCM) describes the NMTP Work Planning and Control Process (WPCP) and Change Control Process (CCP), which are the two mechanisms used within NMTP to authorize, approve and release facility and programmatic work. The NMTP WPCM supplements information contained in ES&H Manual Document 2.2, *LLNL Institution-Wide Work Planning and Control Process*, and has defined four categories (A through D) of NMTP work activities.

Category A, B, and C activities are in general alignment with institutionally defined WAL A, B, and C activities from Document 2.2. Category A is for routine, low hazard activities that require little or no coordination and have a low probability of impacting facility operations. Category B and C have the potential to impact facility operations, programmatic activities, and other groups, and require coordination. These three work categories are performed under the control of approved authorizing documentation such as an FSP, OSP, or IWS. Category D work activities are generally complex, limited-duration facility or programmatic projects that may involve greater hazards or for which adequate controls are not specified in the FSP or in an approved IWS or OSP. Category D activities require the development of a specific work permit. These work activities are analyzed at the task level on a case by case basis to determine potential hazards and controls and are documented and controlled by a Category D work permit.

Core Function 1 - Define Scope of Work

NMTP uses several mechanisms to address work scope definition at the facility and activity levels. These include authorization basis documents for NMTP nuclear and radiological facilities (documented safety analysis, safety analysis report, etc), and a combination of FSPs, OSPs, IWSs, and work permits for activity level work. Facility level program activities are described in currently approved authorization basis documents (documented safety analysis, etc.) and further described in the FSPs. At the activity level, FSPs and OSPs are used in Superblock to describe and bound facility-wide operations and specific programmatic activities, respectively. IWSs are also used in some NMTP facilities, such as RHWM (which only recently became part of NMTP) to define work scope, and work permits are used in all NMTP facilities to define the scope for Category D work.

Work scopes contained in FSPs, OSPs, and work permits are generally well defined and sufficiently detailed to identify hazards and controls for activity level work. The FSPs, OSPs, and work permits that were reviewed clearly identified the work to be accomplished and the basic tasks necessary to perform the work, and they adequately described work scope boundaries and limits. FSPs for Buildings 332 and 331 provide detailed descriptions and appropriate bounding of the facility level work scopes and support activities addressed by the FSP. OSPs within these facilities are detailed documents that thoroughly describe specific programmatic work to be performed at each workstation within a particular lab. Category D work permits are specific permits written for discrete activities and for the most part contain sufficient detail on the work to be performed, identified hazards, and established controls.

In some cases, particularly when work is controlled by an IWS, the work scope and span of control are too broadly defined to allow effective analysis of hazards at the task level, resulting in inadequate specification of controls. As a result, controls listed in the IWS were either too generic and/or require the worker to evaluate hazards, select from a wide range of generic controls, or request verbal direction from ES&H before or during performance of the work. **(See Issue WP&C-2)**

Following are work control documents that contained overly broad scope. Examples of cases where inadequate work scope contributed to inadequate specification of controls are described in the following section and in Core Function 3:

- IWS 15242.02, for container crushing, combined both radiological and hazardous waste crushing activities as one task, although the hazards and controls for operation of these units are different and must be evaluated separately. For example, in the general hazard control section, it is impossible to determine whether reference to "contamination" and PPE are intended to apply to processing of hazardous waste containers, radioactive containers, or both.

- IWS 15241.01 r2, for waste handling and shipment, covers a wide range of waste handling, including repackaging, overpacking, transportation, venting, etc., of waste containers, including those contaminated with radiological materials and/or chemicals. The scope was found to be too broad to permit hazard evaluation for discrete activities. This is evidenced by open-ended control statements requiring hazard evaluation by workers in the field (further described in core Function 3). Open-ended radiological controls are prohibited by HP-FO-103

- NMTP Work Permit RHWM-1 I-D-095, for RHWM maintenance – programmatic equipment, was in its final review and approval at a work permit meeting. The Facility Manager asked whether there were any final questions or comments prior to approval. Independent Oversight inquired about the general nature of the work description in the work permit; the specific tasks necessary to accomplish the scope of work were not identified or discernable. After further reviewing the RHWM Maintenance Manual, where, according to the work permit, the "full scope of work is detailed," it was determined that the description of work was insufficient. The RHWM Facility Manager, the RHWM Safety Officer, and the NMTP Safety and Work Control Manager agreed to improve the description of work in the IWS.

Similar concerns about inadequately defined work scopes in IWSs were identified during the 2009 ISMS verification review. The LLNL management self assessment of the LLNL work control process completed in November 2010 did not specifically identify any concerns in this area. See Section A.2 of this appendix, on the LLNL CAS, for additional discussion of weaknesses in the rigor of self assessments.

Core Function 2-Identify and Analyze Hazards

NMTP uses a combination of processes to identify hazards associated with activity-level work. FSPs are prepared and used to identify and document hazards and controls at the facility level. For example, gloveboxes are used throughout the Plutonium Facility, and hazards and associated controls for routine glovebox operations, such as bag-in and bag-out activities, are identified in the Building 332 FSP. For specific laboratories and workstations, OSPs include a narrative discussion of workstation activities, including identification of potential hazards associated with the work. The IWS process generates sections for user-defined tasks to identify unique hazards associated with each task. Category D Work permits includes a hazard checklist and Job Hazard Analysis table to convey the task specific hazards and controls.

SMEs from the various safety and health disciplines are assigned to support the line in identifying and analyzing hazards, and SMEs from all relevant disciplines are involved in the development and review of FSPs, OSPs, IWSs, and work permits. This includes analysis of hazards, and concurring with their issuance. A positive aspect of the NMTP work control process is that Category D work permits and programmatic changes require periodic face-to-face interactions between all personnel with responsibility for planning and execution, including SMEs, to review and approve work control decisions. This is accomplished through routine meetings such as work permit meetings, change request meetings, and work acceptance meetings, all of which include participation by affected personnel such as RIs, SMEs,

cognizant system engineers, facility management, and approval authorities. The Independent Oversight review team considered these meetings to be valuable in enhancing quality and accountability in work planning. This level of interaction is not required by ES&H Manual Document 2.2 for work governed by and planned using an IWS.

Several work permit meetings were observed and found to be effective in reviewing individual work permit planning efforts of all disciplines present and ensuring hazards had been appropriately analyzed and controls established prior to approval . Draft work permits were projected on an overhead screen for all personnel to review and comment. Minor changes can be made immediately and reviewed, and work permits can be finalized and signed off at these meetings if all comments are resolved and signatories are in agreement.

Several proposed work request discussions were observed during the Superblock Change Request Meeting. One of those work requests is a modification project for a centralized TRU waste processing line in B332, Room 1329. A preliminary design review of this project was scheduled for later in the week at a Facility Acceptance Review Meeting (also observed). Other work reviewed was an improvement to the vault continuous air monitor (CAM) system and gauge valve changeouts in the plenum equipment building. These meetings had strong participation and attendance by NMTP and Superblock management, SMEs, and RIs. The NMTP Safety and Work Control Manager facilitated the meeting and focused the discussions on critical review and documentation of comments for later resolution. The change request for gauge valve change outs was determined to not need this more robust review process and will proceed through the normal process for work requests in the work permit meetings.

Overall, NMTP hazard analysis processes used for OSPs and work permits are generally effective; however there were isolated examples where hazards were not properly identified and/or analyzed, indicating the need for additional rigor and diligence in work planning, particularly with regard to industrial and radiological hazards. Examples included the following:

- Both an OSP and a Category D work permit in 332 did not fully address the hazards and controls associated with elevated work. The work permit developed for replacing gloveport plugs in Rooms 1010 and 1006 included a potential for falling objects (5-8 pound tooling to remove and install new plug) from the ladder, and the potential to lose center of balance and fall while manipulating tooling at gloveports, which were offset from the ladder center. The OSP did not address routine access to elevated glove ports for inspections. Facility management appropriately suspended this work until enhancements can be made.

- Radiological hazards associated with tritium contamination inside a 331 glovebox were not quantified and analyzed prior to performing the work.

As discussed under Core Functions 1 and 3, other systematic weaknesses in implementing the IWS process were observed at RHWM, resulting in ineffective hazard analysis and/or controls.

Core Function 3 - Develop and Implement Controls

Engineered and administrative controls are used effectively and extensively throughout NMTP facilities to control activity level hazards. Engineered controls include containment devices, such as gloveboxes and hoods, ventilation systems, and alarm/air monitoring systems that are designed to contain or control radioactive materials and to provide ample warning to ensure personnel safety. Engineered controls are complemented by a variety of administrative controls including FSPs, OSPs, IWSs, postings, work permits, administrative procedures, and work instructions prepared to control a particular activity.

OSPs govern most of the operations work in Superblock facilities, and these documents are generally of high quality containing detailed and lengthy discussion of programmatic work to be performed, along with discussion of potential hazards and associated controls. WP&C issues at NMTP have been identified in recent external assessment reports and correspondence from the DNFSB, including failure to systematically link specific tasks, hazards, and controls in their OSPs. As a result, NMTP has undertaken an initiative to provide this linkage through a tasks, hazards and controls table in the appendix to each OSP. Most OSPs have been upgraded with Task Based Hazard and Control Tables, and all OSPs will have been upgraded by December 31, 2011. Review of these revised OSPs indicates that specific tasks for each OSP have been clearly identified and associated with hazard types and specific controls in these tables. The tables further improve the description of work in OSPs and thereby encourage improved application of OSPs during Daily Work Team Meetings to support tasks identified in Daily Activity Lists. However it should be noted that because OSPs also invoke FSP-defined hazards and controls, the OSP tables may not be a complete representation of hazards and controls for all OSP work. A similar effort to address FSP hazards and controls would be beneficial to address comprehensive linkage of all hazards and controls.

Comprehensive training and qualification programs have been in place within NMTP for many years. At the activity level, NMTP uses a systematic method to validate and verify that worker training is maintained current. Training requirements for all personnel are tracked using the institutional L-Train system. Worker training tables are posted monthly in each NMTP facility, with highlighted indications of workers due for retraining within 30 and 60 days. Training lists in Buildings 331, 332, and 695 were posted within the last month and demonstrated that no workers had lapsed training in any area. Workers' training was verified as current by RIs during the pre-job briefs observed by the review team. Although compliance with required reading requirements was not directly reviewed by the review team, LSO Facility Representatives reported they had identified instances where workers had not completed required reading as required by OSPs, IWSs, or work permits.

In addition to programmatic work governed by OSPs, the review team also observed various planning efforts and operations associated with work governed by Category D work permits and IWSs. Most Category D work permits provided adequate specification of controls. However, work planning deficiencies identified on one Category D work permit and several IWSs resulted in inadequate and/or incomplete specification of radiological, industrial safety, and industrial hygiene controls. Based on the number of similar concerns in the small sample of work packages reviewed by Independent Oversight, these deficiencies were not considered isolated (**see Issue WP&C-2**). Examples are discussed below.

RHWM IWS # 15242, for container crushing unit operations, did not adequately address differences between radiological and hazardous drum crushing and did not adequately define the specific controls needed for each type of operation (**see Issue WP&C-2**). Examples of these deficiencies included the following:

- PPE was incorrectly defined in the General Hazards and Controls section and therefore applied to both radiological and hazardous waste crushing. However, the specified PPE did not meet ES&H Manual Document 20.2 guidelines for contamination area work.

- The Hazard Descriptions and Controls section did not discuss radiological contamination hazards and requisite controls, including establishment of a contamination area (from the crusher procedure), and associated contamination area requirements (posting, step off pads, waste receptacles, etc.).

- The Radioactive Waste section of the hazard description and controls did not address disposition of PPE and/or leather gloves as radioactive waste, as would normally be required

for contamination area work with low level waste materials.

- Radiological survey and release/down-posting requirements following operation of the radioactive crusher were not addressed.

Facility management appropriately suspended work on this IWS until it could be improved.

RHWM IWS 1345.09 r5, for waste sampling, did not follow all institutional requirements for the intended use of subordinate work control documentation, such as Waste Processing Plans (WPPs) and Hazard Assessment and Control forms (HACs), and these subordinate documents did not always provide sufficient basis for controls (**see Issue WP&C-2**). Examples include:

- There are open ended IH/IS controls throughout, such as "*If exceeding an occupational exposure limit is anticipated, contact the RI/AI who will consult with the Team Industrial hygienist prior to start of work*"; "*If direct contact with the material to be sampled is anticipated and prolonged, the selection of gloves will be made on a case by case basis in consultation with the Industrial Hygiene Professional" "The designated competent person and/or the ES&H Team Industrial Safety Professional will determine fall protection requirements"*. The presence of open ended controls indicates that the specific hazards could not be fully evaluated, which is a concern when the scope of work is being authorized by the IWS. Open ended radiological controls are not allowed by HP-FO-103.

- The relationship and linkage between the IWS and subordinate WPPs required by RHWM procedure number WIC 110 are not well defined nor systematically implemented through the IWS process. WPPs are noted as required for some hazards and conditions, but not for others that might also require one, such as whenever a solid material is to be sampled. With documented exceptions, WIC 110 requires development of WPPs for all solid waste sampling as a means of identifying specific hazards and controls tailored to the work. However, the current IWS task breakdown does not facilitate recognition of different hazards and controls for liquid and solids. A task description entitled "solid waste sampling" or "solid radioactive waste sampling" could be used to better reflect the use of WPPs and possibly eliminate many of the existing generically identified IWS hazards and controls, with reference instead to a WPP.

- WIC 110 and WIC 111 contain various radiological and other controls that are not properly referenced, extracted, and/or attached to the IWS, in conflict with Document 2.2 requirements. These procedures have also not been subject to health physicist review for compliance with HP-FO-103.

- WPP WGS-11-010 did not include all information required by RHWM procedure number TRE 106, such as description of process knowledge, past analytical results or data, and relevant hazard information. Similarly, neither the WPP nor the associated HAC contained all radiological information required by HP-FO-103. The HAC also did not clearly indicate the contaminant for which respiratory protection was being prescribed (beryllium, uranium, or both). If for uranium, radiological air sampling or characterization data would also be required to meet institutional and 10 CFR 835 requirements for air sampling.

RHWM IWS 15241.01r2, for waste handling and shipment, did not contain sufficiently specific controls tailored to individual work activities because its scope and span of control are too broad to permit effective analysis of task specific hazards. This IWS was also the subject of Issues Tracking System (ITS)

item 30069.1, from a June 2010 Joint Functional Area Manager and Line Assessment (JFAMLA), which identified weaknesses in specification of radiological controls. This issue was closed in January 2011, even though many of the same problems remained uncorrected (**see Issues WP&C-2 and F&I-2**). Examples included the following:

- There are open ended IH and radiological controls throughout, such as "*Additional PPE such as respiratory protection may be required on a case-by-case basis*"; "*If any operation has potential for dermal or respiratory exposure to beryllium, contact the ES&H Industrial Hygienist for additional guidance" ; "If the work involves uncontained radioactive material (direct contact handling of the material, opening previously packaged material, etc.) contact the Health Physicist for the work area to see if there are requirements beyond those listed here"*. The presence of open ended controls indicates that the specific hazards could not be fully evaluated, which is a concern when the scope of work is being authorized by the IWS. Open ended radiological controls are not allowed by HP-FO-103.

- The IWS still referenced a General Hazards and Controls section that was not attached in the current revision r2. The same concern was identified in the June 2010 JFAMLA but had not been corrected after closure of the issue.

- Radiological controls are incomplete and not in keeping with HP-FO-103 requirements. For example, radiological PPE requirements are not specified despite allowing for work in a contamination area, high contamination area, or airborne radiation area. If the correct radiological PPE had been specified, it would in some cases conflict with PPE specified for IH hazards elsewhere in the IWS.

- The most recent IWS change made in response to ITS 30069 was improperly processed as minor change, in conflict with Document 2.2 requirements when changing hazards and/or controls.

Work permit 331-10-D-048, for removing/installing glovebox window access panels in the 331 tritium science station workstation, did not contain adequate radiological controls. Examples included the following:

- The work permit had an open-ended radiological control "*Notify HP prior to each window/access panel removal for additional controls,*" in conflict with HP-FO-103.

- The work permit did not reflect the necessity for a radiological hold point to take and evaluate a swipe on the pump after window removal. A swipe was taken and there was discussion of actions to be taken based on the swipe results, such as use of double gloves if high levels were found. The permit did not reflect these considerations or the need for additional PPE based on swipe results.

- Swipe results indicated contamination area levels on the interior of the glovebox. The work permit did not require establishment of a localized contamination area in the vicinity where plastic was draped and where contaminated materials were to be removed.

- PPE requirements did not include shoe covers. When the window was removed, it was placed on the draped plastic but was later moved back into position. Workers were observed walking across the draped plastic where the contaminated window had been placed, resulting in the potential for inadvertent contamination spread.

- PPE requirements did not include coveralls. Workers had to kneel and remove contaminated equipment during the work, making lab coats inadequate.

- A prerequisite to ventilate and monitor the glovebox to less than 1 curie of tritium as measured on the glovebox ion chamber appears to have no basis for health and safety and cannot be measured directly as indicated by the permit. This value appears to be an FSP control related to air emissions during glovebox operations and must be calculated based on the volume of the glovebox and the tritium concentration as measured by glovebox air monitoring instrumentation.

Swipes of the glovebox interior could easily be taken and analyzed to ascertain contamination levels and therefore improve the specification of radiological controls before starting the job and breaching containment.

Core Function 4 - Perform Work within Controls

NMTP facilities plan and authorize work through formal mechanisms**.** Building 332 publishes a Daily Activity List and holds a daily activity list meeting to identify and authorize all facility work for the upcoming day. The Daily Activity List is generated from currently approved facility work permits and planned programmatic activities addressed in the FSP and OSPs. This list is reviewed and updated each day during a formal meeting with representatives from all program elements. The remaining NMTP facilities do not need the rigor of a Daily Activity List but do utilize a Weekly Activity List that is developed and implemented in a similar manner.

Final readiness to perform work within NMTP facilities is accomplished through several mechanisms, including pre-job briefings and a newly implemented daily work team meeting for programmatic work. The new daily work team meetings provide an improved method to ensure readiness to perform work for routine programmatic operations that did not previously include pre-job briefings. Several such meetings were observed during the week. They provide a daily opportunity to address the work activities of the day and to emphasize the safety considerations and integration needs for various tasks. A fissile material handlers work group meeting was found to include good discussion of each work group's planned work activities for the day, including the governing work control documents and whether scope was adequately defined and hazards and controls were addressed.

Pre-job briefings were observed for RHWM container crush activities (IWS 15242.02) and Superblock activities in Room 1378 (OSP 332.184) and Room 1353 (OSP 332.184). Each briefing was professional and informative to workers, and provided appropriate interaction on the task and related hazards and controls. The RHWM container crushing operation pre-brief was particularly detailed and well run. This activity had also been discussed at the daily work team meeting as part of the safety moment training. In each case, workers were focused on controls and their implementation during the pre-job briefing and subsequent operations.

Fissile material handlers performed plutonium operations in strict accordance with controls and work practices as defined in their OSPs. Work was observed in Building 332, Room 1353, to transfer a fissile material part out of GB5308 and to machine a non-fissile (aluminum) part in GB5306 in accordance with OSP 332.002, Fissile Material Machining Operations. Fissile material operators were knowledgeable of the controls in the OSP and competently implemented those controls. The two activities in Room 1353 and the fissile material part move between GB5308 and the vault were well coordinated for radiological and contamination control, security considerations, and work flow.
The disassembly of a stainless steel part was observed in B332, Room 1378 Fume Hood in accordance

with Superblock OSP 332.184. Two person surveillance system (TPSS) performance was observed throughout the activity to initially establish the room under these conditions and also receive the part from the vault. Fissile material room totals were systematically confirmed, updated and posted as the fissile material moved about the facility. Additional PPE (leather gloves) were donned upon opening the container and discovering protrusions on the part that were determined to be sharps.

Calcination of chips, turnings, compounds and powder activities were observed in Building 332, Room 1378, GB7801, in accordance with OSP 332.005. Fissile material handlers were knowledgeable of the hazards and controls for the activity and demonstrated the controls were met in Appendix C, Task Hazard Analysis Table, and Appendix E, Hazardous Material Table, for GB7801. During routine glovebox work in Building332, handlers were diligent about surveying hands and arms upon removal from the gloves and where appropriate, and showed good awareness of dose rates and techniques to minimize exposures. In Room 1353, a fissile material handler appropriately requested and received a new radiation survey of their work station after moving a radioactive object from their glovebox. The survey was competently performed by a Health and Safety Technician, and the posting on the glovebox was revised to reflect the survey results before the handlers resumed their work.

Workers across NMTP facilities reviewed demonstrated appropriate conduct of operations and performed their work in accordance with the specifications in approved work control documentation.

Core Function 5 - Activity Level Feedback and Improvement

NMTP uses a variety of methods to foster and utilize feedback and improvement into its work planning and execution. At the facility level, NMTP holds facility standup meetings twice a week where general safety and administrative items are discussed, including an opportunity to convey information on safety and lessons learned that should be disseminated. A safety feedback and improvement meeting is also held bimonthly to discuss matters relevant to facility feedback and improvement including initiatives and process changes that have transpired. Formal post-job reviews of OSP work is required at least annually, and can be performed more frequently if needed. A record of OSP changes from the prior review period is documented and maintained. All work permits are formally closed out upon completion of the work. Part of the closure process is to review the feedback section of the work permit and to solicit input from RIs if feedback is missing or incomplete. Work permit feedback is reviewed and important items are extracted and documented in an electronic database in for use in future work planning. Review of several recent work permit closures indicated that appropriate feedback information was being captured.

Corrective actions to a deficiency identified during a JFAMLA at RHWM in 2010 (ITS 30069) failed to address most of the specific concerns documented in the assessment. That assessment identified problems with specification of radiological controls similar to those identified during this review. The ITS item was closed in January 2011. Review of this IWS indicates it still contains a number of deficiencies in both work scope, radiological and industrial safety/hygiene controls. The IWS revision was also incorrectly processed as a minor change, which did not require full SME review. **(See Issues WP&C-2 and F&I-2)**

Work scopes identified in FSPs, OSPs, and work permits are generally well defined and sufficiently detailed to identify hazards and controls for activity level work. However, the work scope and span of control of the IWSs that were reviewed were too broad to permit effective analysis of hazards, resulting in inadequate or incomplete specification of controls for some work.

NMTP processes for identifying and analyzing hazards are generally effective. SME involvement in work planning is required by the NMTP WPCP and ES&H Teams consisting of SMEs from the various safety and health disciplines are assigned to support the line in analyzing and documenting hazards.

Periodic face to face meetings between personnel with responsibility for planning and executing work, including SMEs, are held to review and approve work control efforts for work permits and programmatic changes. These meetings were seen as valuable in enhancing the quality and accountability of work planning efforts. Most hazards associated with work observed by the Independent Oversight review team were properly identified and analyzed. However there were isolated examples in OSPs and work permits where hazards were not fully and effectively identified. More systematic examples of hazard analysis weaknesses were evident for work controlled by IWSs, due to problems with effective implementation of institutional requirements.

Engineered and administrative controls are used effectively and extensively throughout NMTP facilities to control activity level hazards. OSPs govern most of the operations work in Superblock facilities, and these documents were generally of high quality containing detailed and lengthy discussion of programmatic work to be performed, along with discussion of potential hazards and associated controls. An initiative to better link hazards and controls within OSPs was undertaken through development of task, hazard and control tables as appendices to all OSPs. This appears to be an effective cross reference; however, similar initiatives have not been undertaken for FSPs, which would be beneficial for a complete linkage of OSP-related hazards and controls, or IWS and work permits where multiple and discrete tasks are within the defined scope of work. Finally, there are continuing problems with proper specification and clarity of controls within IWSs and/or work permits, particularly with respect to radiological controls and industrial safety/hygiene controls.

NMTP facilities plan and authorize work through formal mechanisms. Building 332 publishes a Daily Activity List and holds a daily meeting to identify and authorize all facility work for the upcoming day. The remaining NMTP facilities publish a Weekly Activity List and hold weekly activity meetings to identify and authorize work; this frequency is appropriate for their workload and needs. A new requirement for daily work team meetings provides an improved method to ensure readiness to perform work, including face to face meetings with discussion of work to be performed that day. Pre-job briefings are professional and informative about the task, hazards, controls, and work flow. Fissile material handlers are particularly well trained and qualified and performed plutonium operations in strict accordance with controls and work practices as defined in their OSPs. Notwithstanding some weaknesses in approved work control documentation, observations across other NMTP areas also indicated performance of assigned work activities in accordance with the approved specifications.

A.2 LLNL Contractor Assurance System Results

The objective of this review was to determine whether LLNL has established and implemented a robust, credible, and effective feedback and continuous improvement processes as part of their ISMS to generate and capture safety performance feedback, appropriately analyze this feedback, and establish and implement effective actions that result in continuous improvement in safety programs and performance. Independent Oversight performed this review by reviewing process documents and performance records, interviewing responsible personnel, and observing various governance committee meetings. The results of these activities were compared to criteria in four areas as detailed in the review plan to establish whether the overall objective had been met by LLNL.

A.2.1 Assessments

A key element of an effective feedback and improvement program is a rigorous line management assessment program that performs comprehensive evaluations of all functional areas, programs, facilities, and organizational elements, including subcontractors, with a frequency, scope, and rigor based on appropriate analysis of risks. As indicated in the 2009 ISMS verification review, LLNL has established an adequate set of processes and requirements for conducting a credible self-assessment program including formal internal independent assessments (IIAs), management self assessments (MSAs), and JFAMLAs. These assessment processes have been strengthened since 2009, especially in the area of formalizing the process for coordinating and assessing functional area performance on an institutional level. In addition, expectations and requirements for less-formal assessments, including management walkthroughs and observations, verifications, and inspection activities, designated as "MOVIs," are defined in a formal procedure issued since the 2009 review. In the summer, the Quality Assurance Office identifies proposed institutional independent assessments for the next fiscal year and line managers, including functional area managers, determine what mandatory and elective topical areas they want to assess in the next fiscal year. The Contractor Assurance Office (CAO) provides assistance, coordination, and an assessment planning tool to aid organizations in the planning process. The resulting proposed internal and known planned external assessments are compiled by the CAO into a draft Institutional Assessment Plan (IAP), which is submitted to the Operations Excellence Council (OEC) and the Deputy Director for review and approval. The plan identifies the type of assessment, the assessed and assessing organizations, and the fiscal year quarter for completion. Each assessment in the approved IAP is entered into ITS, providing a base identifying number for documenting and managing any issues resulting from the assessment.

In both FY 2010 and FY 2011, LLNL conducted or has planned 15 internal independent assessments and 21 JFAMLAs in ES&H related areas. In FY 2010, approximately 80 ES&H related MSAs were conducted, and in 2011 approximately 60 ES&H related MSAs were conducted or are scheduled on the IAP. In addition, Lawrence Livermore National Security, LLC (LLNS) corporate governance committees conducted or chartered independent reviews in targeted programmatic and functional areas, called Functional Management Reviews (FMRs). Several ES&H related FMRs were performed in 2010 and 2011. The IIAs were consistently comprehensive and rigorous with substantive issues identified for resolution. Many JFAMLAs and MSAs were also rigorous and well documented, identifying deficiencies and improvement items that are contributing to continuous process and performance improvement. Approximately 1260 management observations were performed in FY 2010 and FY 2011 and documented in ITS.

Another form of assessment activity that has provided or has the potential to provide feedback and input to continuous improvement in ES&H processes and performance at LLNL are analysis projects employing Six Sigma techniques. Although primarily serving as a tool to identify process improvements that provide cost and efficiency benefits, some ES&H and performance improvements can result from these analyses. Several Six Sigma reviews with pertinent recommendations for ES&H process and performance improvement conducted since the 2009 ISMS verification review included projects addressing timely entry of issues into ITS, determining issue significance, the National Ignition Facility (NIF) energy isolation procedure development process, and the LSO documented safety analysis/technical safety requirement annual update review process.

Although a comprehensive suite of formal self-assessment processes has been established and many self assessments are being performed and issues are being identified, implementation remains less than fully effective (**see Issue F&I-1**). Some organizations are still not comprehensively and rigorously identifying and evaluating activities, processes, and risks in their assessment planning efforts. Documentation for selection of MSAs and JFAMLAs, such as the planning tool matrix, reflects an end product of proposed

assessments, but not the larger scope of assessment topics and risk analysis and ranking. Although 21 functional area assessments are planned or performed each year, only about three functional areas are reviewed (other than radiation protection, emergency management, and environmental management, which are typically mandatory, requirements-driven assessments). For example, radiation protection was the subject of 12 of the 21 JFAMLAs conducted in 2010, 6 of those planned in 2011, and 12 of the 23 proposed for 2012. As noted in the 2009 ISMS review report, the output mechanisms for functional area managers' assessments of the overall health of their programs based on assessment and performance analysis as specified in the CAS description are not well defined. Although the scheduling and conduct of functional area assessments are more structured in current site procedures and these assessments provide one mechanism, they only exist for a relatively few of the over 40 designated functional areas formally assessed each year.

While most of the management self assessments reviewed by the Independent Oversight team were appropriately comprehensive and rigorous, some were found to be insufficiently documented, thorough, or comprehensive to effectively accomplish the stated objectives of the assessment (**see Issue F&I-1**). For example, three of the sample of ten assessment reports reviewed by Independent Oversight, identified in the IAP and ITS as MSAs, were in fact management work observations. Further, in none of these reports was actual work observed because none was ongoing in the facilities visited by the management team. In one case, a planned review of hoisting and rigging activities consisted of a "demonstration" of "general electronics work" (i.e., a different work type and not a real work activity). In another case, the supervisor performed a walkthrough of a previous work activity where the assessment conclusion was that "workers," not the supervisor, "understood and followed the elements of the work package." In the third case, a worker "demonstrated" a process conducted previously; observing such a demonstration can provide some measure of knowledge, training, and behavior, but it is much less valuable than observation of real-time performance.

The stated purpose and scope in the report of an Engineering MSA for working at heights, for which the scope included hoisting and rigging program and aerial lifts, was "to review as broad a sample of work process and activities… as possible." However, the report did not identify any work observations, and the scope and locations of facility walkthroughs and types of hoisting and rigging equipment examined in the field were not identified. No field inspection of fall protection equipment was documented. No criteria, lines of inquiry, or requirements references were identified in the report. The one issue, cited incorrectly as an observation rather than a deficiency, was inappropriately documented as an action to document the policies and procedures for inspection of fall protection equipment, rather than a statement of what the issue was.

In the self assessment of implementation of the LLNL work control process completed in September 2010, the attention to detail and rigor of performance or issue characterization were not sufficient to identify the type of deficiencies identified through a similar evaluation conducted by the Independent Oversight review team. The 2010 self-assessment, conducted by nine qualified members of the Work Control Review Board, evaluated IWSs, observed work, and interviewed workers and other responsible personnel. It was performed in accordance with the NNSA criteria review and assessment documents (CRADs) and lines of inquiry in the Activity Level Work Planning and Control Processes Guide. Twenty-nine observations, including eight strengths, were identified, and 20 issues were entered into ITS (only four as significance level 3, "action with limited analysis and follow-up," and 16 as significance level 4, "trend/action optional"). However no deficiencies (i.e., non-compliance with requirements) were identified in any of the observations or in the review of 34 converted IWSs. The assessment concluded that the WP&C process was being successfully implemented. Potential weaknesses in the approach to this assessment included selecting IWSs that had been specifically identified in the 2009 HSS ISMS review as being too broadly written in the sample of IWSs reviewed. It would be expected that these documents would have been carefully evaluated and substantially improved during conversion. In

addition, only eight work activities were observed, even though almost 100 interviews were cited, indicating that efforts needed to focus more on implementation and performance.

In some of the assessments that were otherwise generally well written, issues were sometimes poorly characterized, categorized, or documented. For example, in one case the issue, identified as an observation, lacked specificity, stating that "some" IWSs reviewed need to be "updated," when the actual issue was that workers had not completed training or were delinquent in training. Other issues that were identified as separate ITS "observations" reported that three of the five IWSs in the assessment sample needed to be converted to the task based format, without identifying why they had not been previously identified as needing conversion or had not been converted. A JFAMLA report of the implementation of the radiation protection program consisted primarily of descriptions of the content of procedures and IWSs rather than an evaluation of how they were implemented. Some of the specified lines of inquiry were insufficiently rigorous (e.g., "past deficiencies put into ITS and tracked to closure" rather than verifying the adequacy of the actions, verifying implementation, or validating effectiveness). Most of the specified lines of inquiry were not addressed in the text of the report. An issue identified as an IWS that did not adequately identify safety standards and requirements was documented as an "opportunity for improvement" rather than a deficiency. This issue was subsequently entered into ITS, screened as a significance level 4 issue, and closed with no action taken. See Section A.2.2, below, for further discussion of similar issues involving management implementation weaknesses.

Effectiveness reviews, where the adequacy of corrective actions and recurrence controls are evaluated, are not considered formal assessments by LLNL, but are essentially self assessments that are conducted using an assessment approach and documentation. As discussed in the following section, some of these "assessment-like" reports also reflected insufficient attention to detail and rigor in performance to support conclusions.

A.2.2 Issues Management

An effective contractor assurance system must have an established and effectively implemented comprehensive, structured issues management system that provides for the timely and effective identification, risk-based evaluation, and correction and appropriate recurrence controls for process and performance deficiencies and weaknesses. LLNL has appropriately defined and established generally adequate procedures that detail processes and requirements for the various elements of issues management including the overall process of identification, screening, analysis, action plan development, closure, verification and validation. Procedures and guidance are provided for the conduct of apparent and root cause analysis and effectiveness reviews. Formal procedures detail the processes and requirements for identifying, analyzing, reporting, and managing actions for events and injury and illness incidents, as well as reporting and addressing noncompliances with nuclear and worker safety requirements. ITS provides a robust issues management and tracking tool documenting source documents, issues, and the various decisions and response elements in managing the issues and actions. ITS also serves as the source for performance trending data. ITS data is easily manipulated to provide users and managers with concise, pertinent information on issue disposition status to support more effective and compliant management of issues.

Issues are risk ranked into five significance levels ranging from 1 (actions with extensive analysis and follow-up) to 5 (not actionable). Significance levels 1 to 3 require some level of analysis and action, evaluation and actions are optional for significance level 4 issues. In FY 2010 and FY 2011, over 98 percent of issues requiring action were categorized as significance level 3. The significance level appropriately establishes the level of rigor applied to analysis and management of the issues, such as approval authority, the type of causal analysis, extent of condition, verification of action completion, and reviews for effectiveness.

LLNL has established several collaborative boards and committees such as organizational and institutional Operations Review Boards (ORBs) with responsibilities to review, monitor, and approve various element of the management of significant issues. The OEC, composed of operations management representatives from each Principal Associate Directorate and representatives from the ES&H directorate and the CAO, is chartered to review and provide direction for many elements of safety significant issues management. Issues management areas required to be addressed by the OEC include the accuracy of root cause determinations and associated actions, events, adverse trends, institutional issues, Laboratory metrics, and Safety Performance Objectives and Commitments status. Workers have a direct mechanism for identifying and getting resolution of safety concerns and issues through organizational safety committees and the integrating Institutional Grassroots Safety Committee with access to the monthly Senior Safety Committee. These entities serve to improve communication between the organizations at LLNL and the communication of senior management expectations and keep management informed of the status of safety issues and performance.

When issues rise to the level of reporting thresholds to the DOE Occurrence Reporting and Processing System (ORPS) or to DOE as nuclear or worker safety non-compliances, LLNL generally performs rigorous analysis and development of effective corrective actions and recurrence controls. In these cases, LLNL generally applies appropriate priority to ensure timely management to closure.

OSHA recordable cases and first aid cases for worker injuries and illnesses are investigated and OSHA recordable and days away and restricted cases are reported to DOE in accordance with formal procedures. Injury and illness investigations, performed by the injured or exposed worker's supervisor and the safety professional from the assigned ES&H Team, are documented on an electronic Case Analysis Reports (eCAR). The eCAR contains documentation of the details about what happened, to whom, probable causes, recommended actions, and other information needed for case management and reporting to DOE.

Although generally adequate formal issues management processes have been established and many safety issues have been effectively identified, processed, and managed to resolution in the areas discussed above, fully effective implementation of these processes continues to be a challenge for LLNL (**see Issue F&I-2**). Performance deficiencies were identified by Independent Oversight in every element of these issues management processes. Of particular concern are the difficulties management has in effectively monitoring and ensuring that issues are being managed in a timely and adequate manner (i.e., holding personnel accountable for meeting high performance standards), especially for institutional issues that involve both process owners and implementing line organizations. In addition, Independent Oversight identified numerous examples of deficiencies and inconsistencies in managing issues, including improper categorization (i.e., deficiencies identified as observations), improper description of issues (e.g., stated in the form of an action statement or copying multiple findings/results from an assessment into the issue description field), insufficient/inaccurate cause determination (both formal and informal) and extent-of-condition reviews, insufficient specification of recurrence controls, and insufficiently rigorous effectiveness reviews. Following are some examples of these problems:

- Several significance level 2 issues, including issues that were also reported to the DOE Noncompliance Tracking System (NTS) as significant nuclear safety or worker safety and health issues, have not been managed or resolved in a timely or effective manner. An LLNL identified deficiency involving the lack of vendor or engineering documentation reflecting analysis or testing and certification of the capacity of 69 forklift attachments and required marking of capacities on forklifts provides a case study in inadequate management of an institutional safety issue. This significance level 2 NTS reportable deficiency (i.e., violations of OSHA, DOE, and LLNL requirements) was identified in the summer of 2009 and documented in an October 2009 internal independent assessment report on powered industrial truck safety programs. Because of the

indeterminate status of the engineering analysis, capacity certifications and markings on these attachments, there was a potential for exceeding device capacities during use and thus an increased potential for accidents. Although the site issues management procedure requires that significance level 2 issues be evaluated for the need to take mitigating measures, it does not require documentation of this evaluation, and no evaluation was documented in this case. LLNL personnel indicated that no mitigating actions (e.g. taking undocumented/noncompliant equipment out of service until evaluated by Engineering) were taken because a search of LLNL and DOE lessons learned databases did not identify events involving forklift attachments. Independent Oversight considered this undocumented decision to be non-conservative in that the extent of condition was not known for over nine months. At the time of this ISMS effectiveness review, over 18 months after issue identification, the use and status of compliance of these forklift attachments has not been documented in ITS. None of the various response elements to address this safety issue were executed or documented in a timely manner. The issue was not entered into ITS until four months after the report was issued, it took five months before the causal analysis was completed, nine months passed before completion of the extent-of-condition review (which identified 69 noncompliant devices), the issue was presented to the Institutional ORB (IORB) 13 months after report issue, and the corrective action plan was not approved until May 2011 (19 months after report issue). A Safety News "Flash" lessons learned was issued in June 2011, 20 months after report issue.

In addition, the causal analysis for this issue was inappropriately included as part of an analysis of all five issues identified in the report. The analysis distilled the five disparate issues down to a broad issue statement that DOE hoisting and rigging requirements were not being adequately identified or implemented and identified four causes, one of which applied to the forklift attachment issue. This cause was determined to be that Engineering-generated Safety Notes had not been effectively communicated to forklift operators and their supervisors. Safety Notes are LLNL Engineering department analyses of equipment to ensure a safe design; specify testing, inspection, and maintenance requirements; and provide other information necessary to operate the equipment properly. This analysis did not result in determination of a root cause and did not address all elements of the issue (e.g., why the Safety Notes were not effectively communicated; Safety Notes did not exist for at least some, maybe most of these attachments; and there are other means for determining design capacity, such as contacting the manufacturer).

Further, the corrective action plan for this issue did not address the specified cause or provide any recurrence controls. The corrective actions were to disposition each of the noncompliant devices to tag out or dispose of unused devices, obtain approval for use and the capacity for noncompliant devices in use from the manufacturer or Engineering, and to modify or add capacity plates to forklifts describing attachments and capacity modifications.

- In addition, this review team identified other DOE and ES&H Manual requirements that were not being met for forklift attachments at LLNL and not addressed in the evaluation and resolution of this issue. The annual preventive maintenance procedure for forklifts does not address the inspection of attachments as required by DOE Standard-1090-2007, *Hoisting and Rigging*, and Section 15.4 of the LLNL ES&H Manual, *Powered Industrial Trucks*. A review of engineering calculations for some RHWM forklifts and attachments specified the allowable operating load limits, but did not indicate any needed load testing as required by section 10.4.3 of DOE-STD-1090-2007.

  These deficiencies indicate a longstanding failure of many persons and organizations, including the IORB, to recognize non-compliant forklift attachments used in many organizations at LLNL as a real safety issue, to identify and address the failure, to take mitigating actions, and to ensure timely and rigorous completion of response elements.

- Other examples of untimely and inappropriate management of significant issues included the following. A significance level 2 boiler safety maintenance issue was identified in September 2008 and put into ITS in November 2009; the cause analysis was completed in June 2010; the corrective action plan was approved three weeks before the cause analysis was approved; and corrective actions were completed two weeks before the action plan was approved. Actions for a February 2008 significance level 2 electrical PPE compliance issue are still open, and no corrective/recurrence actions have been documented in ITS for LOTO violations and issues identified in October 2010 (over nine months from identification).

Despite significant effort by the CAO to assist ORBs with strengthening the oversight of issues management, including observation of meetings of each of the organizational ORBs and providing written feedback on how well the ORBs performed on 26 criteria, CAO determined in a follow-up review to the same criteria that performance had actually degraded for three of the ten ORBs.

The sample of eCARs for work activity related injury and illnesses occurring during 2010 and 2011 reviewed by Independent Oversight exhibited deficiencies similar to those identified in the 2009 ISMS review. These deficiencies included lack of documentation and analysis of work planning and control elements of ISMS (e.g., the work documents used and adequacy, pre-job briefing, and scope changes, and supervision), insufficient causal analysis, failure to address all issues (e.g., late reporting or repetitive incidents or failures of previous corrective actions), insufficient corrective actions (e.g., vague actions such as "ensure" without responsible owners or implementation mechanisms), and inadequate recurrence control (e.g., no linkage to identified or actual causes). Examples of these problems included the following:

- Five personnel were exposed to resin that caused rashes and irritation, including two OSHA recordable cases over a six-day period. Four workers reported to medical on November 2, 2010 with complaints of irritation and rashes. Per LLNL ES&H personnel, symptoms were initially noted by three persons on that day and for one worker they were noted the previous week on October 28th. The eCAR for these cases stated that supervisors had been aware of skin rash problems "for several weeks" (although no workers had reported to Medical, per the case logs) and that the ES&H Team, workers, and management evaluated the operation and "corrective actions were determined and implemented immediately." However, LLNL ES&H personnel stated that work was stopped and corrective actions were initiated on November 2. These actions were specified as new PPE requirements for long sleeve tyvec labcoats and latex or nitrile gloves and use of high efficiency particulate air (HEPA) vacuums. Ten days later (November 12) another worker was sent to Medical with a facial rash, although ES&H personnel stated that the symptoms had first appeared on October 29. The specified corrective action for this case was to ensure workers' compliance with new PPE requirements – none of which would address the facial exposure. The specified corrective actions did not address the late reporting of symptoms or the inaction of supervisors who were aware of the symptoms for some period of time (weeks per the eCAR) to address the problem operationally or to send workers for medical evaluation. Further, there were no new corrective actions to address the exposure of the worker reporting to medical on November 10 who, according to the eCAR was adhering to the new PPE requirements specified 8 days earlier or any evaluation of the effectiveness of the HEPA vacuums in controlling exposure.

- The eCAR for the exposure of two mechanics to high pressure hydraulic fluid when they exceeded the scope of an inadequately planned and briefed sprinkler modification job inadequately addressed the failure to stop work when conditions change and did not address work hazard controls (such as LOTO) or describe work planning documents or pre-job briefings. Further the eCAR specified actions to identify the pipes that will be affected during the pre-job walkthrough without identifying how this was to be achieved and by whom. No preventive actions were specified in the eCAR to

address two other work planning deficiencies cited in the cause fields that "the plan was flawed" and that the planner had not verified the drawings before issuing the plan. This event was reported in ORPs with a better analysis. However, corrective actions focused on identifying piping labeling for other hydraulic elevators on site rather than the work planning performance weaknesses.

The adequacy of corrective actions for Finding MG2.-3/F from the 2009 ISMS review is further discussed in Appendix B.

This review team also identified a number of other similar issues management problems and weaknesses for issues that were identified in various documents (e.g., assessment reports and performance analyses). Some examples included the following:

The ITS is not being effectively used to track the evaluation and resolution of recommendations from parent corporation FMRs, Six Sigma reviews, and formal performance analysis reports. These issues are not being documented in ITS or otherwise monitored to ensure that the results of these comprehensive process improvement reviews are appropriately acted upon.

- The extent-of-condition reviews for two ORPS reportable chemical exposures events were not appropriately focused on the issues. One case involved a skin contact exposure to hydrofluoric acid involving a student who did not report the exposure until the next day, when conditions prompted medical care. The extent–of-condition review was limited to identifying that no other cases of late reporting of exposure or potential exposure to hydrofluoric acid had occurred rather than evaluating if delayed reporting of injuries and exposures had occurred. Another case, involving significant WP&C deficiencies, resulted in two workers being exposed to high pressure elevator hydraulic oil; in this case, the extent-of–condition review was limited to identifying and inspecting piping for all hydraulically operated elevators on site for proper labeling, rather than addressing the extent of condition of the WP&C deficiencies.

- Failure to schedule and perform required monthly inspections of a crane was categorized as a level 4 deficiency, and the action was to schedule and perform monthly inspections. There was no discussion of why inspections were not performed or why operators who were cited as trained and knowledgeable of the requirements for monthly inspections did not identify the issue or perform the inspections (i.e., address the cause).

- A deficiency noting that DAP surveillance records had not been reviewed as required by procedure was addressed by reviewing the records, without any discussion or actions to address why these records had not been reviewed as required (i.e., address the cause).

- The FY2010 ISMS effectiveness review was not sufficiently rigorous. Many of the data sets did not apply (e.g., number of occurrences in each principle directorate and the breakdown of events by category and reporting group), predated the previous review (e.g., emergency management system), had no data (e.g., future activity is "continuous improvement," and the yet-to-be-issued Inspector General audit report of the beryllium program), or presented facts with little or no analysis of how the data reflected ISMS effectiveness (e.g., injury data, regulatory compliance inspections, and the beryllium consent order). The listing and discussion of "improvement areas" documented that actions that could affect ISMS performance had been taken but did not provide useful information on the effectiveness of ISMS or these changes. The description of the approach used to evaluate effectiveness used vague terms, such as "considered" relevant activities and "use of" ISM-related assessments that did not convey how the information was evaluated.

- The recently completed effectiveness review of the corrective actions for the injury and illness investigation finding from the 2009 ISMS review inaccurately determined that the actions for quality of investigations had been effective.

As discussed in Appendix B, many of the corrective actions for the 2009 ISMS review findings and weaknesses were not effective were or only partially effective. These included issues weaknesses and deficiencies directly involving issues management, including documentation of apparent cause determinations and injury and illness investigations. In many of these cases, although the issues were primarily implementation deficiencies, the issues were assigned to institutional functional area managers, and actions too often focused on system owners improving institutional processes, with no actions that directly addressed the inadequate performance issues of line organizations.

A.2.3 Operating Experience

Contractor management has established and effectively implemented formal processes to identify, communicate, and apply to processes and future work activities the operating experience and lessons learned from work activities, process reviews, and incident event analyses occurring at LLNL and in the DOE complex and other external sources. LLNL has established generally adequate formal processes to identify, screen and evaluate, communicate, and act upon internally and externally generated lessons learned. A system description document details the objectives and processes of the LLNL operating experience program; an institutional procedure describes responsibilities and requirements for identifying, communicating, and applying lessons learned; and a CAO procedure describes responsibilities and processes for the site Lessons Learned Coordinator and SMEs to identify, prepare, and distribute internally and externally generated lessons learned. An internal LLNL lessons learned website is maintained by the site Lessons Learned Coordinator. The Coordinator maintains a log of HSS list server published lessons learned documenting the applicability screening results, who was on distribution, and for what purpose. Where local incidents provide immediate learning opportunities that are deemed important enough for quick dissemination without extensive analysis or defined actions, are summarized in documents called a Safety Flash. Independent Oversight observed multiple instances of anecdotal evidence of lessons learned being communicated on bulletin boards, in staff and committee meetings, in work documents, and in pre-job briefings. In addition, the F&I organization develops and distributes internal lessons learned reports communicating opportunities for improvement within their organization.

Although there is much evidence of screening, communication and application of lessons learned from local and external operating experience, weaknesses remain in some elements of the program. The process steps for generating internal lessons learned are not detailed in site level procedures, and the CAO procedure defining the responsibilities and processes for the site Lessons Learned Coordinator to screen, engage reviewers, distribute, and manage lessons learned has not been issued as a site level procedure in the SBMS format although it specifies responsibilities and action steps for parties outside of the CAO. Further, the site level procedure, PRO-87, *Identifying, Communicating, and Responding to Lessons Learned*, lists a variety of responsibilities, but contains no action steps for the Site Lessons Learned Coordinator. The Coordinator's log does not reflect screening of any source documents except HSS list server lessons learned, does not include documentation of feedback from SMEs or other reviewers on applicability or needed action, and does not reflect any feedback on how lessons were further distributed or applied in a more formal manner. Although this log is not required, it provides the mechanism to track and demonstrate implementation of the operating experience program at LLNL. Operating experience data from several sources available on the HSS website and cited in the CAO procedure to be screened by the site Coordinator has not been screened for applicability or use at LLNL. The site LL coordinator was not aware of the websites or availability of subscribing to the DOE Operating Experience Weekly or ES&H Safety Bulletins and Safety Advisories. See further discussion in Appendix B related to inadequate LLNL resolution of Weakness MG.2-3/W from the 2009 ISMS review.

A.2.4 Performance Analysis and Metrics

Line management has established programs and processes to routinely identify, gather, verify, analyze, trend, disseminate, and make use of performance measures that provide LLNL and DOE management with indicators of overall performance, the effectiveness of assurance system elements, and identification of specific positive or negative trends. LLNL has established and implemented a variety of processes for the analysis of data to identify trends, communicate performance information and potential issues to site management, the LLNS Board of Governors, LSO and NNSA. An "LLNL Dashboard," administered by the CAO, provides graphical presentations of the data and analysis of metrics and measures against goals and decision thresholds. Metrics and measures, selected by management and a stakeholders advisory group and approved by the OEC are defined with goals and action thresholds by measure owners, typically functional area and line managers, who monitor and analyze performance data, identify trends, and input results into the dashboard. The dashboard is presented and discussed at the Director's senior mangers monthly performance review meetings.

LSO and LLNL identify, monitor, and report ES&H performance objectives, measures, and targets as part of the annual Performance Evaluation Plan.

The CAO performs performance analysis of ORPS reportable events and below reporting threshold events and has conducted in-depth analysis of performance data for selected topical areas in 2010 and 2011, including bicycle accidents, work planning and control, and hazardous energy control. These analyses identified a number of systemic weaknesses and cultural performance issues and made recommendations to management, organizations, and personnel responsible for these areas or working on addressing related issues. The bicycle accident analysis identified a recommended action that was specified in an eCAR report but had not been addressed. This action, based on the eCAR cause determination, was to investigate buying bicycle pedals with more traction. Subsequently, Fleet Operations replaced the pedals on a significant number of site bicycles.

The following areas related to the implementation of performance analysis at LLNL warrant further evaluation by LLNL management (**see Issue F&I-3**):

- As discussed in Appendix B, the quarterly analyses of ORPS events for recurrence as required by DOE Manual 231.1-2 are still not being done in a timely manner, although alternative topical analyses are being performed and partial ORPS analysis are being conducted.

- As discussed in Section A.2.2, site management has not effectively acted on performance information provided by the CAO related to untimely completion of evaluation, actions, and final resolution of several significant institutional issues.

- The human performance, cultural, and performance issues identified in the special performance analysis reports on WP&C and hazardous energy control were not documented in ITS or directed at any specific owners other than "management." It is not clear whether or how any actions were taken to evaluate or implement these recommendations.

- Although the CAS description states that functional area managers are required to analyze performance measures, metrics, and ITS data for adverse trends and opportunities for improvement, this requirement and an associated output mechanism are not incorporated in site procedures. While a site procedure describes the process to conduct performance analysis, there

are no documents with specific reporting requirements and there is no process for functional area manager analysis (e.g. when, how often, reported how, and to whom).

A.2.5 Contractor Assurance System Conclusions:

The Laboratory has continued to strengthen CAS processes, and the CAO has developed tools and provides data analysis and performance information for management to address areas of weakness and improve performance. New procedures have been issued for some CAS elements to better detail requirements and processes. Many assurance activities continue to be performed in a rigorous and comprehensive manner, and performance has improved since the 2009 ISMS verification. Internal independent assessments are effective feedback mechanisms for evaluating institutional programs, and many MSAs, JFAMLAs, and management observations are providing line managers with essential performance information. The investigation and analysis of operational events are generally thorough, the management of associated issues is comprehensive, and recurrence controls are implemented. Many issues, including opportunities for improvement, are being input to ITS and effectively evaluated and resolved.

However, LLNL continues to struggle with compliant and rigorous implementation of several assurance system elements. The planning and performance of management self-assessments need strengthening and more attention from management. Effective management of ES&H issues, the foundation of continuous improvement, continues to present significant challenges to line and support organizations. One of the major challenges is how to more effectively manage the disposition of institutional issues that cross organizational boundaries and involve both process and line implementation deficiencies. Although some mechanisms have been established to break down barriers in this area and provide more communication, transparency, and management oversight, significant management attention is needed to ensure that assurance system elements are implemented in a compliant and effective manner. Management at all levels must communicate higher expectations for acceptable performance and identify and remove barriers to achieving that high level of performance. Oversight mechanisms such as the organization ORBs, the IORB, and the OEC should be strengthened to provide guidance and leadership in demonstrating expectations and holding personnel accountable. Cultural elements, such as the need for continuous attention to detail, situational awareness, and ownership of issues and institutional responsibilities need to be reinforced by supervision and managers.

APPENDIX B

Status and Evaluation of Corrective Actions from 2009 ISMS Verification Review

OP.2B-2/W: The potential for worker exposure to hazardous gases during building 321/322 complex roof does not have a documented analysis. Ventilation system exhaust streams from welding operations, plating shop baths, and the powder coating oven may contain elevated levels of chromium VI, hydrogen cyanide, nitrogen dioxide, acid fumes, and solvent vapors that may impact workers accessing roofs.

Action and Status: O&B worked with FMD and ES&H to ensure a Roof Access Hazard Analysis was performed and documented on building 321. This documentation has been inserted into the Roof Access Plan that has been developed for B321 and B322. A hazard analysis was not performed on B322, as all operations are shut off when access to the roof is necessary. (Complete/Closed 06/01/2010).

Assessment: This action was completed on schedule. A total of four procedures were developed for this complex to restrict roof access, the construction guide was amended to address roof access, and the hazard control team conducted exposure estimates for the roof tops of these two buildings. Additionally Independent Oversight observed the use of roof access permits in use at other facilities. Furthermore, institutional requirements are contained in the ES&H Manual and requirements for roof access is controlled site-wide through permits issued by facility managers.

OP.3-1/W: LLNL work control requirements were not effectively implemented by one Operations and Business Directorate subcontractor, resulting in a number of uncontrolled hazards and insufficient certification of worker training.

Action and Status: The subcontractor performing this work activity has received an official note of their lack of attention to safety. F&I PMEC performed an assessment to identify opportunities to strengthen the process to ensure contractors provide qualified workers and evaluate the revised Subcontractor Work Control process to ensure that it addresses the observed weaknesses regarding adequacy of task description, hazard identification and controls. These issues are addressed in OP.3-5/OFI and OP.3-8/OFI, and corresponds to ITS entries 30309.8 and 30309.11 where the actions taken are documented in detail. (Complete/Closed 04/15/2010).

Assessment: This action was completed on schedule. Revisions have been made to the ES&H manual section related to managing subcontractors, the general safety provisions of the LLNL Facility Specifications and the LLNL Facilities & Infrastructure Construction Manual. Additionally subcontractor training was augmented to address this issue.

OP.3-2/W: Insufficient specificity of some Operations & Business Directorate Maintenance Utilities Services Department integrated work sheet controls and the ineffectiveness of some training of maintenance craft workers have resulted in some instances of work control deficiencies or observed unsafe work practices.

Actions and Status: Specific actions related to this Weakness are captured in the following OFIs

OP.3-1 thru OP.3-4, OP.3-6 and OP3-7/OFI. This corresponds to ITS entries 30309.4, 30309.5, 30309.6, 30309.4, 30309.9 and 30309.10, respectively. The actions will be tracked to closure at those ITS entries. (Complete/Closed 06/01/2010).

Assessment: The actions reviewed indicate that there has been significant effort made in review and revision of many of the Trade/Service IWS(s) to include hazards and general controls, as well as, the inclusion of information such as the status of each approved worker's medical monitoring requirements observed as missing either during the 2009 ISMS verification review or subsequent internal assessment(s). Additionally, corrective actions have resulted in the conduct of Management Self assessments and numerous IH surveys and/or assessments to document and/or support hazard analysis and decision making for requisite controls. However the continued observation of work planning and control deficiencies during the conduct of LSO assessment of MUSD, work as well as this assessment raises concern as to the effectiveness of actions taken and/or the effectiveness review process for the actions as implemented. As such Independent Oversight considers this item to have been prematurely closed, and should be re-evaluated as part of any action to address new issue WPC-1.

MG.1-1/W: Use of risk criteria in the Facilities and Infrastructure Work Control Manual results in much of the maintenance work performed by F&I being assigned a lower risk category than specified by Document 2.2.

Actions Status: F&I Work Control Manual has been updated to identify Dispatch work activities as WAL A and WAL B. Each MUSD and EMD Division manager and Planners have reviewed the Dispatch Work Activities to ensure their accuracy. Some changes have been included in the updated revision of the manual. Changes have been communicated to affected work areas. (Complete/Closed 02/24/2010).

Assessment: This action was completed on schedule. Revisions have been made to the F&I Work Control Manual section and communication to effected individuals was confirmed through the use of notification of revisions, emails and conduct of briefings.

OP.2B-1/W: Powder Coating Hazard Analysis, Within the Science and Technology Directorate engineering activities, some hazards have not been adequately identified and analyzed for powder coating activities in TRED and, where hazards have been identified, sufficient controls have not been implemented.

Actions and Status: Review Personal Protective Equipment and medical surveillance requirement for B321B Powder Coating operations. Develop additional controls if appropriate. Review HAC associated with B321B Powder Coating operations for consistency and adequacy. Develop additional controls if appropriate. Analyze B321B Powder Coating operations for out-gassing of toxics during oven operations. If any additional hazards are defined develop appropriate controls. Analyze B321B Powder Coating Booth ventilation performance. If any additional hazards are defined develop appropriate controls. As determined by previous reviews, implement any additional procedures or controls identified. Review, update and release of IWS1096.07 completed. Summary of IWS Revisions: Scope of work edited to be more descriptive and complete. Converted to Task Based system. Attached the Powder Coating Air Sampling report HCD-T2-10-068. Updated PPE requirements and clarified statements (noise, gloves, shop coats) based on Air Sampling report/assessment. Updated chemical and explosive hazard controls based on the Air Sampling report/ assessment. A Work Observation was conducted on 12/14/10 which included a review of the

new IWS, worker training status, discussion with the RI, Alt RI, and workers, and a walk through of the work area and observation of powder coating work activity. Significant process and control improvements based on Actions 2-7 were determined to have been effectively implemented. All aspects of this work activity were found to be effective in the application of ISMS, work controls and ES&H requirements. (Complete/Closed 09/02/2010).

Assessment: This action was completed on schedule. Identified items were implemented through IWS revision, Additionally conduct of IH review and sampling of the powder coating activities in B321B resulted in the issuance of six required actions which have all been subsequently addressed, however the report also contains one recommended action to "purchase powder coating paint products that are free of 1,3,5-triglycidyl isocyanurate. This chemical can cause allergic contact dermatitis, respiratory sensitization, asthma, eye irritation, and is a known male reproductive hazard (i.e., mutagen). Cardinal manufactures powder coating materials that do not contain this substance." The status of this proposed "Recommended Action" is not addressed in the closure and the extent of this recommendation to the other major powder coating users at the LLNL was not addressed. The powder coating operations within MUSD utilizes paint materials containing the same 1,3,5-triglycidyl isocyanurate constituents.

SME.1-1/F: The radiological work authorization process (IWSs, work permits, etc.) has not always ensured that radiological hazards are fully analyzed and controls clearly identified, tailored to specific work, and conveyed to workers prior to releasing work, as required by Documents 2.2, 20.1, 20.2 and 10 CFR 835.

Actions and Status: ES&H Manual Document 20.2 was revised to explicitly reflect the requirement of DOE-STD-1098 which requires a written work authorization for work that could create contamination in an area otherwise free of radiological contamination. The Radiation Safety Section also developed procedure HP-FO-103 *Radiological Review of Technical Work Documents* to provide guidance to health physicists regarding minimum radiological expectations for technical work documents that provide radiological controls. (Complete/Closed 6/1/2010)

Assessment: The corrective action was not fully effective in resolving weaknesses in proper specification of radiological controls, particularly for work covered by an IWS. A key action item for resolution of this finding was the development of procedure HP-FO-103, *Radiological Review of Technical Work Documents*. This document was developed and became effective June 14th 2010, after ES&H Team health physicists were briefed on its purpose, content and use. While the document successfully conveys the institutional expectations with regard to radiological work authorizations, similar problems as those seen in 2009 were identified during this review, calling into question the quality of the independent verification of effectiveness used to formally close the finding. As such Independent Oversight considers this item to have been prematurely closed, and should be re-evaluated as part of any action to address new issue CAS-2.

SME.2-1/F: The IH workplace exposure assessment program for assessing and documenting workplace exposures in LLNL plant areas (i.e., facility baselines) and work activities (i.e., IWS activities) is a work in progress and has not been sufficiently planned and/or implemented to fully meet the workplace exposure assessment requirements of 10 CFR 851.

Actions Status: A baseline schedule has been completed including IH Baselines to be finalized by contractors and teams. The baseline schedule includes appropriate resources to accomplish/meet the

deadlines. Contractor resources have been aligned with team resources to ensure adequate completion. (Complete/Closed 04/02/2010).

Assessment: This action has been closed based on a schedule and identification of resources as provided for in the LLNL action tracking process. Additionally, for Calendar Year (CY) 2011, LLNL started the year with 46 periodic baselines scheduled. Based on when the previous surveys were completed, they decided to move 5 of those surveys to CY 2012. To date (58% of the way through the CY), 29 surveys have been completed (63% of the surveys), with 24 of these having final reports written. ES&H has identified 28 deficiencies and 14 observations from the completed surveys. Deficiencies identified were in turn entered into the action tracking process.

MG.2-1/F: LLNL has not performed timely, quarterly analyses of events as required by DOE M 231.1-2, *Occurrence Reporting and Processing of Operations Information*.

Actions and Status: This issue was addressed as an observation from a previous management CAO self assessment. The action was to issue a performance analysis report for the period ending 12/31/09 (issued in January 2010). The action was closed in January 2010. A CAO "verification" statement posted in ITS on July 5, 2011, stating that timely completion of the required analyses were challenging due to resource availability and describing a CAO management decision to conduct several targeted, in-depth analyses of events in areas of concern to LLNL management (i.e., control of hazardous energy in September, 2010, work planning and control in November 2010, and bicycle accidents in January 2011) instead of the quarterly ORPS and non-reportable incident analyses required by DOE M 231.1-2. This policy decision was documented in an internal CAO memorandum dated May 4, 2011. (Complete/Closed 1/28/2010)

Assessment: The corrective action did not prevent recurrence of the deficiency in 2010 as there were no recurrence controls. However, the three cited targeted performance analyses were comprehensive and rigorous, identifying a number of causal factors for consideration by others addressing institutional problems in these areas. In addition, in 2011CAO did perform limited analyses of occurrences with reports written in April, June, and July covering 2010 events and the two calendar quarters of 2011.

MG.2-2/F: LLNL issues management procedures are not effectively implemented so that issues are accurately documented, issue types are properly classified, causes are identified and addressed, and so that effectiveness reviews, when performed, accurately determine whether corrective actions have been fully effective in addressing the issue as required by DOE O 226.1A, *Implementation of Department of Energy Oversight Policy*, and LLNL PRO 0042, *Issues and Corrective Action Management*.

Actions and Status: 1) The CAO office instituted a mentoring process to provide feedback to organization ORBs regarding the implementation of their issues management responsibilities specified in procedure PRO-0042 their review and handling of issues, 2) Revised PRO-0042 to add issue screening information action steps for determining if issues are "systemic" or "repetitive" (a single Y/N field in ITS) and definitions for these terms (see same action in MG.2-2/W) and, 3) Revised PRO-0042 to require that a root cause analysis or a "symptom/problem/cause" analysis be performed prior to developing corrective actions as a prerequisite for conducting effectiveness reviews. This last action has since been included in a prerequisites section of PRO-0077, *Conducting an Effectiveness Review*. (Completed/Closed 6/30/2010)

Assessment: These corrective actions have not been effective in preventing recurring deficiencies in the implementation of a fully effective issues management program. See Appendix A for the analysis of the effectiveness of the LLNL issues management program.

MG.2-3/F: The investigation and corrective and preventive actions for occupational injuries and illnesses were not sufficient, in many cases, to ensure that causes are adequately identified and appropriate corrective actions and recurrence controls established and implemented as required by DOE O 226.1A, *Implementation of Department of Energy Oversight Policy*, and LLNL ES&H Manual Document 4.5, *Events: Notification, Analysis, and Reporting*.

Actions and Status: Posted examples of eCARs that were considered to reflect appropriate documentation of rigorous investigations on the ES&H intranet site and discuss these examples with PAD assurance managers and with industrial safety professionals responsible for participating in injury and illness investigations. (Complete/Closed 7/28/2010)

Assessment: The actions taken were not fully effective. A sample of eCARs for work activity related injury and illnesses occurring during 2010 and 2011 reviewed by Independent Oversight exhibited similar weaknesses including lack of documentation and analysis of work planning and control elements of ISMS (e.g., the work documents used and adequacy, pre-job briefing, and scope changes, and supervision), insufficient causal analysis, failure to address all issues (e.g., late reporting or repetitive incidents or failures of previous corrective actions), insufficient corrective actions (e.g., no implementation mechanism or responsibility), and inadequate recurrence control (e.g., no linkage to identified or actual causes).

MG.2-1/W: LLNL organizations have not implemented a robust, credible, risk-based management self-assessment program that includes a formal, structured, risk-based process that identifies activities, facilities, processes, management systems, risk levels, and prior performance/events that prioritizes these elements, and produces rigorous self-assessments that evaluate processes and performance and drive continuous improvement.

Actions and Status: 1) Issued formal procedure for management observations, verifications and inspections (MOVIs) describing expectations for conducting, documenting, and managing results from assessment like activities that are less formally planned and documented than internal independent assessments, management self-assessments (MSAs) , joint functional area manager and line (JFAML) assessments. 2) Revised the Institutional Assessment Plan procedure to "recommend" that organizations and functional area managers consider their work activities, facilities, processes, management systems, risk level, prior performance/events to prioritize assessment activities and updated the planning tool to support these considerations. 3) Revised the procedure governing MSAs to define minimum criteria for report content, established training for conducting MSAs, and offered an option workshop on conducting MSAs. (Completed/Closed 4/22/2010)

Assessment: The actions taken were partially effective. The process documents now provide more guidance on proper assessment planning and the availability of training can enhance assessment performance. More management observations are being performed in many organizations and often these activities are identifying ES&H issues that are being entered into ITS for tracking to resolution. However, based on a review of the FY2010 and FY2011 IAP and a limited review of organizational planning documentation, it is no apparent change in the rigor applied to comprehensive assessment planning and few ES&H related MSAs and discretionary JFAML assessments are being scheduled by some organizations.

MG.2-2/W: Although the LLNL issues management procedure requires that, for significance category 3 issues, issue owners conduct an apparent cause review and develop corrective actions that address the identified causes, it does not require the documentation of the analysis results.

Actions and Status: Revised PRO-0042 to add issue screening information action steps for determining if issues are "systemic" or "repetitive" (a single Y/N field in ITS) and definitions for these terms. This action was established by IORB rather than documenting the identified causes for "lower significance" (e.g., level 3) issues. (Completed/Closed 6/30/2010).

Assessment: The action taken was not effective. The action taken only addresses a small subset of issues that require apparent cause determinations and still does not require any statement of the identified cause(s) or cause coding. Therefore, it does not provide any benefit to enhancing effective preventive action development that a simple statement of the cause determination would provide. In 2010 and 2011, "lower significance" Level 3 issues comprise approximately 98.5 percent of LLNL issues requiring action and well over 99 percent of all issues entered into ITS. However, because NTS and ORPS reportable issues require casual analysis, approximately 13 percent of Significance Category 3 issues have had cause determinations documented. Further, although general definitions and guidance are provided in PRO 0042 for "systemic/repetitive" issues, there is no direction or guidance to address the level of effort to be applied, or the scope, or mechanisms to use in determining if the issue is systemic or repetitive (e.g., look within the organization or beyond, search of ITS or other data sources, for what period).

MG.2-3/W: Implementation of the LLNL lessons learned program does not sufficiently demonstrate that external operating experience data is being sufficiently screened, evaluated by subject matter experts, and applied to safety processes when appropriate.

Actions and Status: The action taken was to "revise the lessons learned procedure to ensure external operating experience is reviewed, incorporated and documented." (Completed/Closed 7/20/2010).

Assessment: The action taken was not effective. Although the CAO procedure for identifying, preparing, and distributing LLNL Lessons Learned, not yet issued as an institutional procedure in the SBMS format, identified HSS operating experience source documents such as Operating Experience Summaries, ES&H Safety Bulletins, and Safety Advisories, the Lessons Learned Coordinator had not been screening them (they were not included in the database of screened information) and was unfamiliar with these sources and their location on the HSS website. These were the specific examples of DOE source documents not being screened cited in the 2009 HSS ISMS review.

APPENDIX C

Status and Evaluation of Corrective Actions for 2010 DNFSB WP&C Issues

The Defense Nuclear Facilities Safety Board (DNFSB) forwarded work planning and control deficiencies at NMTP facilities to NNSA in June 2010. The Laboratory responded to NNSA with planned and completed actions in August 2010 and these actions were later forwarded to the DNFSB in September 2010. The NMTP plans and schedule commitments were based upon an NMTP assessment of the DNFSB deficiencies and a gap analysis of the NMTP Work Control Requirements and the LLNL Institute-Wide Work Control Process Requirements. A summary of observations regarding the progress/completion of LLNL commitments follows:

- Task Based Hazard and Control Tables have been established for most Superblock OSPs and the remaining (low risk) OSPs are due to be completed by December 31, 2011. Established tables are comprehensive and effective in communicating identified hazards and established controls with specific tasks. An initiative to better link hazards and controls within OSPs was undertaken through development of task, hazard, and control tables as appendices to all OSPs. This appears to be an effective cross reference, but as noted in Appendix A of this report, similar initiatives have not been undertaken for FSPs, which could benefit from a complete linkage of OSP-related hazards and controls, or for IWSs and work permits where multiple and discrete tasks are within the defined scope of work. Finally, there are continuing problems with proper specification and clarity of controls within IWSs and/or work permits, particularly with respect to radiological controls and industrial safety/hygiene controls.
- The NMTP Work Control Manual has provided detailed instructions to work planners with a common work permit form for RHWM and Superblock. Implementation instructions are provided in an Appendix to the Manual and systematically addressed by the NMTP organization. The Manual also details expectations for procedures and work instructions in work permits, OSPs and change requests. Engineered and administrative controls are used effectively and extensively throughout NMTP facilities to control activity-level hazards. OSPs govern most of the operations work in Superblock facilities; these documents are generally of high quality and contain detailed and lengthy discussions of programmatic work to be performed, along with discussion of potential hazards and associated controls
- NMTP was observed in the conduct of meetings for change requests and work permits. These meetings are part of the compensatory measures employed until all OSPs are modified. These meetings are providing effective mechanisms for implementing the work planning requirements and reaching sound decisions.
- The prioritized update of Superblock OSPs has proceeded on or ahead of schedule with compensatory measures in place. LLNL reports that these compensatory measures are intended to remain as permanent improvements to the work planning and control process.
- NMTP is behind schedule in implementing a database search capability for providing feedback and lessons learned data to responsible individuals as work permit modifications are developed. Beta testing of the electronic permit process and population of the database is in progress for a system that was promised in March 2011. Full implementation is expected in December 2011.
- Finally, NMTP Work Permit Review Team members are trained to Hazard Analysis Techniques. A course was offered in July 2010 and currently, three subject matter experts from ESH Team 1 are not trained. Additional training for all Work Control Team members was released on July 9, 2011 and is a further improvement to establish fully functional teams.

Implementation of the LLNL WPCP is generally effective but, as discussed in Appendix A, further improvement is needed. For example:

- FSPs and OSPs are used in Superblock as required by the WPCP to describe and bound facility-wide operations and specific programmatic activities, respectively. IWSs are also used to define work scope in some NMTP facilities such as RHWM and work permits are used in all NMTP facilities to define the scope for Category D work. Work scopes contained in FSPs, OSPs, and work permits are generally well defined and sufficiently detailed to identify hazards and controls for activity-level work. In some cases, particularly when work is controlled by an IWS, the work scope and span of control are too broadly defined to allow effective analysis of hazards at the task level, resulting in inadequate specification of controls. As a result, controls listed in the IWS were either too generic and/or require the worker to evaluate hazards, select from a wide range of generic controls, or request verbal direction from ES&H before or during performance of the work. (**See Issue WP&C-2**.)
- SMEs are involved in work planning and control as required by the WPCP. Pre-job briefings are professional and informative about tasks, hazards, controls, and work flow. Although most hazards associated with work observed by the Independent Oversight review team were properly identified and analyzed, there were isolated examples in OSPs and work permits where hazards were not fully and effectively identified. More systematic examples of hazard analysis weaknesses were evident for work controlled by IWSs, resulting from problems with effective implementation of institutional requirements.

Notwithstanding some weaknesses in approved work control documentation, observations indicated that performance of assigned work activities was in accordance with the approved specifications.

APPENDIX D

Recommendations

Work Planning and Control Recommendations

MUSD

1. **Improve the quality and completeness of information provided to workers and supervisors in order to enhance both safety and efficiency. Specific actions to consider include:**
   - Revise the existing work order processes to provide workers and supervisors with information which further details work steps for workers to ensure appropriate controls (e.g., lockouts, PPE) and provide system information prior to the conduct of field assignments. Currently, workers, in many cases, must self-identify such information, often causing delays and potentially resulting in safety vulnerabilities.
   - Populate the existing PM Windowing equipment maintenance databases (e.g., PM procedures provided to workers and supervisors) with equipment-specific LOTO procedures, panel schedules, arc flash calculations etc.

2. **Strengthen analysis and control of arc flash hazards. Specific actions to consider include:**
   - Ensure workers provide feedback of locations where arc flash posting are either missing or study information is not available and provide information or post as appropriate.
   - For areas identified as needing redress, prepare labels as part of routine PM activities (and/or corrective maintenance as appropriate), since this information is required for PM conduct. Adding this information to both the PM database and the actual location will keep workers from having to track this information down so often. For properly marked installations, qualified workers would need only to confirm there have been no configuration changes or sources of back-fed energy.
   - Consider use of a check-list or other documentation method to ensure briefings conducted include all the appropriate information including EH&S requirements, and workers understand hazard and requisite control information presented.

3. **Strengthen the current hazard identification efforts conducted by work planners and by Facilities Point of Contacts. Specific actions to consider include:**
   - For multi sub task work activities, consider treating these as complex work to avoid the pitfall of one skill of the craft activity generating additional hazards, which were not considered in the planning process.
   - Further integrate information about the work location hazards provided by Facility Point of Contacts (either contained in permits or through activity specific IWS development) with planning efforts conducted by individuals assigned to work planning to ensure activities are evaluated for potential hazards, through analysis, anticipation, elimination and/or mitigation of potential hazards.
   - Consider conducting activities such as joint walk-downs by work planners, FPOCs and coordination with the crafts to identify and control hazards.
   - Consider additional training of MUSD line management and FPOC(s) in the conduct of pre-job briefing process, which not only reviews maintenance tasks to be performed, but also reviews salient IWS or other work permit (i.e. hot work, fall protection, etc.) hazard controls; any

established ES&H hold points (i.e. required ES&H monitoring, fall protection controls etc.); facility specific health and safety requirements.

- Consider use of a check-list or other documentation method to ensure briefings conducted include all the appropriate information including ES&H requirements, and workers understand hazard and requisite control information presented.

NMPT

4. Improve implementation and quality of IWSs and work planning within NMTP. Specific actions to consider include:

- NMTP should consider performing an extent of condition to determine the causes and extent to which deficient IWS's are being used to control work. Compensatory measures and additional corrective actions should be evaluated and considered.
- RHWM should consider using Category D work permits or other mechanisms such as waste processing plans as subordinate work control mechanisms if broadly written IWSs are used to control work with variable hazards and controls
- RHWM should consider strengthening requirements in procedures such as FRE 106 to ensure consistency of subordinate work control mechanisms with Document 2.2 requirements.
- NMTP should consider extending its work permit meeting structure to include work planning efforts associated with development of IWS's.
- NMTP should consider developing task, hazards and control tables for FSPs which are also used to control some hazardous activities, and to IWS's.
- NMTP should consider creating separate work packages for each glovebox maintenance activity to ensure task specific hazard analysis and assessment of actual radiological hazards prior to performing the work. Alternatively, the existing work permit should be modified to include a hold point for assessment of glovebox contamination levels prior to removal of access panels. Swipes of the glovebox interior could easily be taken and analyzed to ascertain contamination levels and therefore improve the specification of radiological controls before breaching containment.

Institutional

5. Improve implementation of institutional work planning requirements. Specific actions to consider include:

- LLNL should consider evaluating root causes for inconsistent/incomplete implementation of important ES&H Manual Document 2.2 requirements, and determine appropriate corrective actions. Specific examples of concern that should be addressed include:
    - IWS changes that meet criteria for major changes are being processed as minor changes without review and concurrence of ES&H
    - Information such as hazards and controls from divisional documents or procedures are not are being properly extracted, attached and or linked to the governing IWS and included in the IWS hazard analysis and control output
    - Work scope and span of control is sometimes too broad to permit effective work planning and tailoring controls to specific hazards

- LLNL should consider revising Document 2.2 to include a prohibition on the use of open ended controls, the use of which anticipates and requires worker hazard analysis and request for additional SME review and verbal direction during work. Additional requirements and

clarification should be considered with respect to the difference between and proper use and meaning of hold points, with work able to continue, and a suspension limit or boundary, where work cannot proceed under the IWS is revised.

- LLNL Industrial safety/Industrial hygiene should consider development of procedural guidance for ES&H team members responsible for preparing IWSs, and should also consider a prohibition on open ended IH/IS controls.
- LLNL should undertake a formal effectiveness review of closure to Finding SME 1-1 from 2009. This effort is needed to determine extent of condition with regard to ineffective implementation of HP-FO-103 by ES&H Team members across the site, and to implement any additional corrective actions needed.

Contractor Assurance Recommendations

1. **Strengthen implementation of the self-assessment program to ensure that safety programs, topical areas, management systems, and work activities are rigorously assessed and documented on an appropriate frequency. Specific actions to consider include:**
   - Establish an independent review process and/or a cadre of trained and qualified reviewers to provide feedback on self assessment performance and documentation quality to performers, reviewers and approvers.
   - Include a quality review of a sampling of self assessment reports to the responsibilities of ORBs.
   - Include review of organization assessment planning tool content and assessment selection processes to ORB responsibilities to ensure full scope of activities, risks, processes, past performance, performance and available resources are being appropriately evaluated in determining assessment priorities, selection, and scheduling.

2. **Strengthen implementation of the issues management program to ensure safety problems are more rigorously evaluated for causes and extent of condition and that appropriate and effective corrective actions and recurrence controls are identified, implemented and confirmed. Specific actions to consider include:**
   - Revise PRO-0042 to require a statement of the result of the cause analysis to promote linkage of actions to causes for recurrence control.
   - Perform Six Sigma process improvement analysis to improve the rigor and timeliness of the management of high significance and institutional level issues that will address the interface and cooperation between functional area managers and implementing organizations.
   - Revise PRO-0042 to provide guidance on the scope (i.e., institutional or organizational), mechanisms (e.g., search of ITS) and expected level of effort (e.g., time period or source/mechanisms) to be applied to making categorization decisions on systemic or repetitive issues.
   - Establish review mechanism for SME(s) to monitor and provide feedback on the quality of line management implementation of response elements such as causal analyses, extent of condition reviews, and effectiveness reviews.
   - Document issues and recommendations from performance analysis reports, FMRs, and Six Sigma analyses into ITS to ensure assignment to an appropriate owner and to provide a documented evaluation and disposition.
   - Revise the eCAR fields to better conform to current terminology and concepts of ISMS and establish an independent SME review of the quality of completed eCARs before approval.

3. **Strengthen the implementation of the operating experience program to provide greater assurance that the lessons are effectively applied to improve processes and programs and applied by end users. Specific actions to consider include:**
   - Establish more formal expectations and/or strengthen the procedure to ensure feedback on use is provided to the site Lessons Learned Coordinator.
   - Use the site Lessons Learned Coordinator's Log to document screening of sources other than lessons from the HSS list server and to document a summary of responses from SME reviewers and to document feedback on how lessons were applied by users.

4. **Provide necessary resources for conducting event performance analysis to ensure that the required analysis and reporting to contractor line management and DOE specified in DOE M 231.1-2 are performed.**

APPENDIX E

Documents Reviewed, Interviews and Observations

WP&C-Maintenance & Utilities Service Department

Documents Reviewed:

- Maintenance & Utilities Service Department Craft IWS(s)
- Building U325 Heavy Equipment corrective maintenance work package
- Building 543 Electrical modification work package
- Building U424 High Voltage breaker testing preventive maintenance work package
- Building 439 HVAC Compressor replacement maintenance work package
- Building 391 Heavy Equipment Joy Fan preventative maintenance work package
- Building 691 Semi-Annual fan preventative maintenance work package
- Building 691 Heavy Equipment Condensing Unit preventative maintenance work package
- Building 368 Exhaust Fan Facility Modification maintenance work package
- Building 418 Powder Coating Application and facility walkdown
- ES&H Manual, Document 2.1, *General LLNL Worker ES&H Responsibilities*
- ES&H Manual, Document 2.2, *LLNL Institution-Wide Work Control Process*
- ES&H Manual, Document 11.1, *Personnel Protective Equipment*
- ES&H Manual, Document 12.6, *LLNL Lockout/Tagout Program*
- ES&H Manual, Document 16.1, *LLNL Electrical Safety Program*
- LLNL-MI-416189, *Tools for Identifying and Analyzing Task and Area Hazards Selecting Controls*
- MAN-GWM-0004*, LLNL Facilities and Infrastructure Skill of the Craft Manual*
- MAN-GWM-0003*, LLNL Facilities and Infrastructure Work Control Manual*
- LLNL-MI-413381*, LLNL Safety Toolbox*
- MANOPS-004 (Rev-0), *High Voltage Operations Manual*
- Management Self-Assessment of LLNL Work Control Process
- MUSD Noise Study-High Voltage Shop

Interviews:

- Designated responsible individuals and persons in charge for maintenance work
- Facility Managers, at various Buildings
- ES&H Team 2 Industrial Hygienist
- Work Control Review Board members
- Maintenance & Utilities Services Department Fall Protection Subject Matter Expert
- Maintenance & Utilities Services Department Safety Officer
- Maintenance & Utilities Services Department heavy equipment mechanic
- Maintenance & Utilities Services Department heavy equipment supervisor
- Maintenance & Utilities Services Department Work Control Subject Matter Expert
- Maintenance & Utilities Services Department Low Voltage electrician
- Maintenance & Utilities Services Department painter
- Maintenance & Utilities Services Department High Voltage electricians
- LLNL Hazards Control, Electrical Safety, Lockout/Tagout Subject Matter Expert
- Maintenance & Utilities Services Department HVAC mechanical worker
- Maintenance & Utilities Services Department HVAC mechanical supervisor

- Maintenance & Utilities Services Department Fleet Maintenance worker
- Maintenance & Utilities Services Department Fleet Maintenance supervisor
- Maintenance & Utilities Services Department Hoisting and Rigging worker
- Maintenance & Utilities Service Department Hoisting and Rigging supervisor

Observations:

- Installation of conduit for the Building 543 facility modification
- Heavy Equipment core drilling, anchor bolt removal and replacement facility Modification corrective maintenance Building U325
- HVAC preventive maintenance Building 691 Semi-Annual fan preventative maintenance
- LOTO for Building 691 Heavy Equipment Condensing Unit preventative maintenance
- High Voltage breaker testing Building U424
- Exhaust fan troubleshooting Building 663
- HVAC compressor replacement Building 439
- Heavy Equipment Joy Fan preventative maintenance Building 391
- HVAC Condensing Unit preventative maintenance, breaker lockout/tagout (LOTO) and testing Building 691
- Exhaust Fan Facility Modification maintenance breaker lockout/tagout (LOTO), air gapping, roof access and fall protection planning, Building 368
- Powder Coating Application and facility walk down Building 418

WP&C-Nuclear Materials Technology Program

Document Reviews:

- LLNL-AM-47919 WCI NMTP Work Planning and Control Manual, March 2011
- LLNL-AM-405814 LLNL Institute-Wide Work Control Process Requirements, July 30 2008
- NMTP OSP Development and Implementation Guide, 60% Draft, June 2011
- MM-001 Radioactive and Hazardous Waste Management (RHWM) Maintenance Manual, April 2011
- NMTP Work Permit B696-10-C-153, Container Crushing Unit Operation, 10-18-10
- NMTP IWS#15242.02 for Container Crushing Unit Operation, 4-5-11
- NMTP Work Permit RHWM-11-D-095, RHWM Maintenance – Programmatic Equipment, 7-12-11
- NMTP Work Permit RHWM-10-W-088, RHWM Maintenance – Programmatic Equipment
- NMTP Work Permit 332-10-C-002, OSP Activities, 11-1-10
- Operational Safety Plan (OSP) 332.002-06 Change Memo, 6-8-11
- Operational Safety Plan (OSP) 332.002-05 Change Memo, 12-15-10
- Operational Safety Plan (OSP) 332.002-04 Change Memo, 10-18-10
- NMTP Work Permit 332-11-C-0249, OSP Activities (Room 1378 previously 332.005), 5-31-11
- NMTP Work Permit 332-10-C-005, OSP Activities (Room 1378), 12-28-10
- Operational Safety Plan (OSP) 332.005-01 Change Memo, 12-28-10
- NMTP Work Permit 332-10-C-184, OSP Activities (Room 1378), 11-2-10
- Superblock Off-Hours Work Request, Fire Suppression System 5 Year Check Valve Inspection, 4-6-11
- Superblock Off-Hours Work Request, Circuit Breaker Maintenance B335 Panel 1080A1-22 and 1094A, 4-6-11
- Superblock Off-Hours Work Request, Replace AC Compressor, 4-7-11
- Building 332 Daily Activity List for Tuesday, July 12, 2011

- Buildings 239, 334, 331, and Superblock Yard Weekly Activities List for July 11-18, 7-11-11
- Facility Change Request List for 2011 in Superblock, 7-7-11
- 2011 History Log of planned/completed Work Permits for FY12Q3, 7-7-11
- Course Completion Log for Hazard Analysis Techniques, 7-11-11
- NMTP B332 Daily Work Team Meeting Summary Log for July 12, 2011
- NMTP Standing Order for Defining Scope of Work in Work Control Documents, 9-17-10
- RHWM Standing Order for Work Control, 1-8-10
- RHWM Standing Order Extension for Work Control, 1-4-11
- Letter from Don Cook (NA-10) to Peter Winokur (DNFSB), September 9, 2010
- Letter from Bruce Goodwin (LLNL) to Alice Williams (LSO), LLNL Response to issues identified in the DNFSB letter on Activity Level Work Planning at LLNL as directed by LSO, August 9, 2010
- Letter from Alice Williams (LSO) to Thomas Gioconda (LLNL), Recent Operational Events and Work Control Implications, August 31, 2010
- Letter from Thomas Gioconda (LLNL) to Ronna Promani (LSO), Contract DE-AC52-07NA27344, Clause I-091, Integration of ES&H into Work Planning and Execution, April 29-2011
- LLNL Fiscal Year 2010 Integrated Safety Management System (ISMS) Effectiveness Review, May 2011
- Superblock OSP Priority Listing, 10-1-10
- Record of Course Completion for HS8011, Hazard Analysis Techniques, (2003-2011), printed 7-11-11
- B132N IWS #16523, High Explosives Analytical Laboratory, Proposed 7-3-11
- RHWM IWS 1345.09 r5 Waste Sampling Operations 7-15-11.
- B331 Work permit 331-10-D-048 –Remove/Install Glovebox Window access Panels 7-14-11
- B332 Room 1006 OSP 332.194 General Glovebox Operations
- B 332 Work Permit-11-D-0079 Decontaminate and/or Replace Gloveport Plugs Rooms 1010 and 1006
- B332 Work Permit 332-11-D-0236 Install Glovebox Flush Gas Supply Orifices in Room 1353

Interviews:

- Program Leader, Nuclear Materials Technology
- NMTP Operations and Engineering Manager
- NMTP Safety Officers
- NMTP Safety and Work Control Manager
- NMTP QA and Configuration Management Manager
- NMTP Training Manager
- NMTP Conduct of Operations Manager
- NMTP Fissile Material handlers
- RHWM Facility Manager
- RHWM Division Leader
- RHWM RIs and AIs
- RHWM Safety Officer
- LLNL Radiation Protection Functional Area Manager
- ES&H Team 1 Managers
- ES&H Team 1 Health Physicists

Observations:

- RHWM IWS 1345.09 r5 Waste Sampling Pre-Job Briefing 7-15-11
- RHWM IWS 1345.09 r5 Waste Sampling Operations 7-15-11.
- RHWM IWS 15241.01.01r2 Waste Handling and Shipment
- B331 Work permit 331-10-D-048 –Remove/Install Glovebox Window access Panels Pre-job Briefing 7-14-11
- B331 Work permit 331-10-D-048 –Remove/Install Glovebox Window access Panels 7-14-11
- RHWM IWS # 15242 Container Crushing Unit Operations
- B332 Room 1006 OSP 332.194 General Glovebox Operations
- B 332 Work Permit-11-D-0079 Decontaminate and/or Replace Gloveport Plugs Rooms 101 and 1006
- B332 Work Permit 332-11-D-0236 Install Glovebox Flush Gas Supply Orifices in Room 1353 Pre Job Briefing 7-13-11
- B332 Work Permit 332-11-D-0236 Install Glovebox Flush Gas Supply Orifices in Room 1353
- B332 Operations Daily Work Team Meeting for 7-12-11
- B332 Room 1353 GB5308 part move pre-job brief under OSP 332-002, 7-12-11
- B332 Room 1353 GB5308 part move under OSP 332-002, 7-12-11
- B332 Room 1353 GB5306 machining under OSP 332-002, 7-12-11
- B332 Daily Activity List meeting, 7-12-11
- Superblock Change Request Meeting, 7-12-11
- RHWM Work Permit Meeting for RHWM-10-D-095, 7-12-11
- RHWM Weekly Maintenance Coordination Meeting 7-13-11
- RHWM Daily Program Operations Meeting, 7-13-11
- RHWM Container Crushing Pre-Job Brief, 7-13-11
- RHWM Container Crushing operation, 7-13-11
- B332 Daily Meeting for Room 1010 and 1378 operations, 7-14-11
- B332 Room 1378 part disassembly pre-job brief for OSP 332-184, 7-14-11
- B332 Room 1378 part disassembly operations under OSP 332-184, 7-14-11
- Superblock Level 3 Facility Acceptance Process Meeting, 7-14-11
- B132N IWS Roundtable Meeting for High Explosives Analytical Laboratory, 7-18-11
- B332 Room 1378 calcining activity under OSP 332-005, 7-18-11

Institutional/ES&H/ Followup Activities:

Documents reviewed

- **L**awrence Livermore National Laboratory B-511 Facility Hazard Ranking B Final Periodic Industrial Hygiene Survey Report, 5/19/2011
- Lawrence Livermore National Laboratory B-858 Facility Hazard Ranking [A] Industrial Hygiene Survey Final Report, 4/7/2011
- Schedule and Performance of IH Surveys spreadsheet
- LLNL-AM-409863 LLNL Institutional ESYH Document 2.2 – Work Planning and Control Process, January 31, 2011

Interviews

- Deputy Director, LLNL
- Work Control Functional Area Manager
- ESH Director (Acting)
- O&B Deputy Principal Associate Director for ISMS and Waste Management Services

- Industrial Hygienists
- Observations:
- Work Control Review Board meeting
- Tour of HEAF highlighting some of the facility safety controls
- Physical and Life Sciences IWS 16523 Roundtable Discussion

Contractor Assurance System

Documents Reviewed:

- Program Description DES 0541, *Integrated Safety Management System* , 3/1/11

- Program Description DES 0600, *Contractor Assurance System* , 9/30/10
- Program Description DES 0080, Rev 0, *Event Notification and Reporting*, 8/18/10
- Program Description DES 00048*, LLNL Assessment Program* , 5/3/11
- Program Description, Rev 1, DES 0086, Rev 0, *Operating Experience Program*, 11/16/10

- LLNL Multi-Year Performance Strategy, May 2011
- LLNL Contractor Assurance System (CAS) Annual Assurance Letter for FY2010, 12/20/10
- Contractor Assurance System Quarterly Report, 6/2/11
- ES&H Manual Document 4.7, *Analysis Methods*, 9/9/2009
- Procedure PRO 0042, Rev 3, *Issues and Corrective Action Management*, 10/8/10
- Procedure PRO 0050, Rev 0, *Internal Independent Assessment*, 9/20/09
- Procedure PRO 0052, Rev 2, Management Self-Assessment, 10/1/10
- Procedure PRO 0049, Institutional Assessment Plan (IAP), 5/3/11
- Procedure PRO 0053, *Management Observations, Verifications & Inspections (MOVI)*, 6/2/11
- Procedure PRO 0069, Rev 2, *Configuration Control for Performance Measures and Metrics on the LLN Dashboard*, 2/11/11
- Procedure PRO 0072, Rev 0, *Conducting a Critique*, 6/30/11
- Procedure PRO 0073, Rev 2, *Analyzing Events and Condition for Apparent Cause*, 6/28/11
- Procedure PRO 0077, Rev 2, Conducting an Effectiveness Review, 2/11/11
- Draft Procedure PRO 0079, *Determining Culpability When Analyzing for Causes*
- Procedure PRO 0081, Rev 1, *Accident/Incident Scene Management (Post Emergency Response),* 11/16/10
- Procedure PRO 0082, Rev 0, *Reporting Occurrences to DOE*, 7/9/10
- Procedure PRO 0084, Rev 0, *Incident Analysis Committee Manual*, 8/27/10
- Procedure PRO 0087, Rev 1, *Identifying, Communicating, and Responding to Lessons Learned*, 11/16/10
- Procedure PRO 0089, Rev 0*, Reporting and Tracking Noncompliances with DOE Safety*, 5/27/10
- Procedure PRO 0090, Rev 1, Executive Management Operational Directive, 6/23/09
- CAO Procedure, Identifying, Preparing, and Distributing LLNL "Lessons Learned", Rev 5, 2/23/11
- CAO Summary of 2010 ORB Feedback on Issues Management, 2/9/11
- Report, *Fiscal Year 2010 Integrated Safety Management Systems (ISMS) Effectiveness Review*, May 2011
- Office of Independent Oversight Nuclear Safety and Integrated Safety management System (ISMS) Phase II Corrective Action Plans (CAPs), January 28, 2010
- Management Self-Assessment, LLNL Contractor Assurance System (CAS) Level of Functional Maturity, July 2010

- Corrective Action Plan for issues from the LLNL Contactor Assurance System MSA, 9/11/09
- LLNL FY10 and FY11 Institutional Assessment Plans
- CAO Performance Analysis Report, *Bicycle Accidents 2008-2010*, 1/11/11
- CAO Performance Analysis Report, *Control of Hazardous Energy*, September 2010
- CAO Performance Analysis Report, *Work Control*, November 29, 2010
- Performance Analysis of Events: Data Through December 31, 2009, 1/25/11
- Partial Analysis of Occurrences, July 1, 2010-June 30, 2011, July 6, 11
- Partial Analysis of Occurrences-CY2010, April 29, 11
- LLNL-AR-490323, Partial Analysis of Occurrences April 1, 2010-March 31, 2011
- Performance Analysis: ITS Data through March 30, 2010, 7/10
- Injury and Illness Investigation Checklists for Supervisors and Case Investigators
- Various Injury and Illness electronic Corrective Action Reports from CY2010 and CY2011
- ITS reports for Management Walkthroughs FY 2010 and FY2011
- Various FY2010 and FY2011 Internal Independent Assessment reports, Joint Functional Area Manager and Line Assessment reports, and line Management Self-Assessment reports and associated ITS issue reports
- Various Occurrence Reports for events occurring in CY2010 and CY2011
- Various LLNL lessons learned reports and Safety Flash reports
- LLNL Operating Experience/Lessons Learned Coordinator's log
- F&I HPI/Behavior Observation Tool form
- Mission and Vision Statement/Charter for Institutional Grassroots Safety Committee
- Minutes and Agendas from various committees (e.g., ORBs, IORB, OEC, Assurance Managers meetings)

Interviews:

- Acting Principal Associate Director, Operations & Business
- Director, Office of Environment, Safety, Health & Quality Directorate Assurance Managers for WCI, Operations and Business, and F&I
- Director, Laboratory Contractor Assurance Office
- Laboratory Quality Assurance Manager
- CAO Managers and staff with responsibilities for Assessments, Issues Management,
- Performance Analysis and Reporting, Lessons Learned, Performance Metrics, and Six Sigma analysis
- Alternate Worker Safety & Health Functional Area Manger
- Injury and Illness Analysis Office Lead
- Industrial Hygiene, Subject Matter Expert
- Past Chairman of the Institutional Grassroots Safety Committee
- LSO CAS Subject Matter Expert

Observations:

- Assurance Manager's meeting
- Institutional Operations Review Board meeting
- ORB Meetings for Operations and Business and ES&H
- Operations Excellence Council meeting
- Contractor Assurance Manager's meeting

APPENDIX F

Supplemental Information

Dates of the Review July 11-21, 2011

Management

Glenn S. Podonsky, Chief Health, Safety and Security Officer
Williams A. Eckroade, Deputy Chief for Operations, Office of Health, Safety and Security
John S. Boulden III, Director of Office of Enforcement and Oversight
Thomas R. Staker, Deputy Director for Oversight, Office of Enforcement and Oversight

Quality Review Board

William Eckroade	John Boulden	Thomas Staker
George Armstrong	Michael Kilpatrick	Robert Nelson

HSS Team Composition

HSS Team Members
Patricia Williams, HS-45, Team Leader
Bob Compton
Joe Lischinsky
Mario Vigliani
Al Gibson, Technical Writer
Mary Anne Sirk, Administrative Assistant

NNSA Team Member
Jim Winter