Independent Oversight
Review of Nuclear Safety
at the

Lawrence Livermore National Laboratory

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Office of Independent Oversight
Office of Health, Safety and Security

HSS
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Abbreviations Used in This Report

ASME	*American Society of Mechanical Engineers*
CFR	*Code of Federal Regulations*
CI	*Configuration Item*
CM	*Configuration Management*
CSE	*Cognizant System Engineer*
DOE	*U.S. Department of Energy*
DOT	*Department of Transportation*
DSA	*Documented Safety Analysis*
ES&H	*Environment, Safety, and Health*
F&I	*Facilities and Infrastructure*
FHA	*Fire Hazards Analysis*
FPE	*Fire Protection Engineer*
FSS	*Fire Suppression System*
HEPA	*High Efficiency Particulate Air*
HGCS	*Hydrogen Gas Control System*
HGIS	*Hydrogen Gas Isolation System*
HSS	*Office of Health, Safety and Security*
LLNL	*Lawrence Livermore National Laboratory*
LLNS	*Lawrence Livermore National Security, LLC*
LLW	*Low-Level Waste*
LSO	*Livermore Site Office*
MEL	*Master Equipment List*
MIP	*Maintenance Implementation Plan*
MUSD	*Maintenance and Utility Services Department*
NFPA	*National Fire Protection Association*
NMTP	*Nuclear Materials and Technology Program*
NNSA	*National Nuclear Security Administration*
OSP	*Operating Safety Procedure*
P&ID	*Piping and Instrumentation Diagram*
PdM	*Predictive Maintenance*
PISA	*Potential Inadequacy of the Safety Analysis*
PM	*Preventive Maintenance*
PMT	*Post Maintenance Test*
QA	*Quality Assurance*
RCM	*Reliability Centered Maintenance*
RHWM	*Radioactive and Hazardous Waste Management*
RMA	*Radioactive Materials Area*
SAC	*Specific Administrative Control*
SDD	*System Design Description*
SRP	*Surveillance Requirement Procedure*
SSC	*Structure, System, and Component*
TSR	*Technical Safety Requirement*
USQ	*Unreviewed Safety Question*
VSS	*Vital Safety System*

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1 Introduction

The U.S. Department of Energy (DOE), Office of Health, Safety and Security (HSS), performed a review of nuclear safety programs at the DOE Lawrence Livermore National Laboratory (LLNL) from October through November 2009. The review was performed by the HSS Office of Independent Oversight's Office of Environment, Safety and Health (ES&H) Evaluations. The nuclear safety review was performed concurrently with an HSS visit in support of the Livermore Site Office (LSO) in which HSS reviewed selected aspects of the LLNL integrated safety management system as input to the LSO Phase II integrated safety management system verification of LLNL.

Within the DOE, the National Nuclear Security Administration (NNSA) has line management responsibility for LLNL. NNSA provides programmatic direction and funding for research and development, facility infrastructure activities, and ES&H program implementation at LLNL. LLNL also receives funding from other DOE program offices and other government and industry organizations. Within NNSA, LSO has site-level line management responsibility for LLNL. Under contract to DOE, LLNL is managed and operated by Lawrence Livermore National Security, LLC (LLNS). The LLNS management team includes Bechtel National, the University of California, Babcock and Wilcox, Washington Division of URS Corporation, and Battelle.

The HSS nuclear safety review was designed to support the DOE mission by providing NNSA and site management with information that will help in ensuring compliance with applicable nuclear safety requirements. One of the most important factors in the scope of HSS's review was the ongoing major changes in the mission of LLNL's nuclear facilities. Specifically, NNSA, LSO, and LLNL are in the process of removing most of the special nuclear materials from the LLNL Plutonium Facility complex (also known as Superblock). The current nuclear material inventory at the Superblock is approximately one-third of the inventory that was analyzed when the documented safety analyses (DSAs) were developed, and the de-inventory process is expected to be completed by 2012.

Section 2 provides HSS's overall perspectives regarding the status of nuclear safety at LLNL. Sections 3 through 9 of this report provide the results of the review of the elements of nuclear safety that were reviewed by HSS, including recommendations in each element. Appendix A provides supplemental information, including the HSS nuclear safety review team composition.

2 Overall Perspectives

LLNL has made significant progress in establishing and implementing comprehensive programs to effectively manage nuclear safety. LLNL has devoted considerable management attention and resources to enhance nuclear safety since the 2007 Independent Oversight inspection. The Nuclear Materials and Technology Program (NMTP) management and staff demonstrated their commitment to effective implementation of nuclear safety requirements and a good understanding of the issues and challenges that remain. However, much work remains to be accomplished, and some of the technical concerns underlying the previous Independent Oversight findings have not yet been fully addressed.

Independent Oversight's specific perspectives on each of the areas of review are summarized below:

- **Design and Safety Basis.** Although some open areas and technical challenges still remain from the 2007 report, significant progress has been made in resolving the engineering design and safety basis issues. The systems selected for evaluation during this HSS review – the safety significant Building 332 hydrogen gas control system (HGCS) and hydrogen gas isolation system (HGIS) – are very robust with respect to conceptual design, design execution, safety bases, and the translation of these into procedures, with several exceptions, such as the installed hydrogen excess flow valve was incorrect for this application, and the test procedure itself was inadequate to ensure that it could be followed correctly. LLNL is addressing the first deficiency through the potential inadequacy of safety analysis (PISA) process.

- **Configuration Management (CM).** The NMTP CM program has shown significant improvement since Independent Oversight's review in 2007. Implementation plans have been appropriately initiated to address gaps between the current program and the DOE standard. Although only a few new piping and instrumentation diagram (P&ID) drawings have been issued, the ones reviewed by HSS were generally correct and of high quality. The corrective actions taken by LLNL adequately address the 2007 drawing control performance concerns. Although some gaps exist and formal revision of program documents is needed, within the scope of the review, the CM program was appropriately implemented.

- **Maintenance and Procurement.** The maintenance and procurement programs have substantially improved since the 2007 Independent Oversight inspection. In particular, the LSO/LLNL formation of a working group with representatives of LSO, LLNL, Plant Engineering (now the Maintenance and Utility Services Department), and each NMTP facility, to coordinate actions to improve LLNL organization-specific maintenance implementation plans (MIPs), was determined to be a noteworthy practice. However, several aspects of the maintenance program warrant further improvement. For example, MIPs do not address the requirement for periodic inspection of structures, systems, and components (SSCs) to determine whether technical obsolescence threatens performance and/or

safety. In addition, the work permits that were reviewed and the personnel who were interviewed did not consistently reflect an understanding that the scope of post maintenance tests (PMTs) should encompass both the restoration of operability and a demonstration that the intended outcome (such as repair) was achieved. Also, although the NMTP quality-significant procurement process is generally adequate, some aspects warrant further improvement. For example, LLNL has not established processes to ensure appropriate maintenance of NMTP quality-significant items in storage or in a quality assurance (QA) hold.

- **Specific Administrative Controls (SACs).** The LLNL process for developing and implementing SACs was demonstrated to be effective for the sample of SACs that were reviewed. These SACs meet the intent of 10 CFR Part 830 Subpart B and DOE-STD-1186. NMTP periodically reviews technical safety requirement (TSR) controls as part of its annual updates to DSAs. Current processes adequately address independent validation of implementation of safety basis controls when first established. However, it would be prudent to consider performing independent validations on a recurring basis to ensure that the facility equipment, procedures, and personnel training have not degraded over time, given the importance of safety basis controls.

- **Fire Protection.** Several aspects of LLNL fire protection programs are effective or improving. Fire department inspectors and fire protection engineers (FPEs) responsible for implementation are knowledgeable and demonstrate a high level of ownership. However, there are weaknesses in the institutionalization of mechanisms to flow down fire protection requirements. For example, the LLNL fire protection requirements do not sufficiently define all of the requirements necessary for a comprehensive fire protection program, and they do not provide an adequate basis for implementation at the facility level. The lack of an effective formal self-assessment program is a significant contributor to the current deficiencies.

- **Cognizant System Engineer (CSE) Program.** The recently revised NMTP system engineering program has been substantially improved since the 2007 Independent Oversight inspection and will be compliant with the requirements of DOE Orders 420.1B and 433.1A, once it is fully implemented. NMTP management acknowledges that the system engineering program is in an early state of transition to meeting the enhanced program requirements and that much work remains. Several aspects of the system engineer program are already effectively implemented, such as system design descriptions (SDDs), vital safety system (VSS) performance trending, and support of Operations and Maintenance. However, further improvement is warranted to ensure that the acting system engineers are fully qualified and that DOE and LLNL expectations are well defined, communicated, and understood.

- **Radioactive Waste Management.** The radioactive waste management program is well defined and effectively implemented. Waste management controls, storage requirements, and shipment operations are adequately implemented, although some controls could be specifically identified in operating procedures.

3 Design and Safety Basis

HSS evaluation of the design and safety basis focused on (1) the safety significant Building 332 HGCS and HGIS and (2) closeout of the three design and safety basis findings (E.2, E.3, and E.4) from the 2007 Independent Oversight inspection. In both of these areas, HSS evaluated the validity of the safety bases and the systems' capabilities to perform the safety functions as defined in the safety bases.

Hydrogen Gas Control and Isolation Systems. The HGCS safety functions are to confine hydrogen gas and isolate its supply to the radioactive materials area (RMA) when potentially hazardous concentrations are detected during hydrogen operations. The HGIS safety functions are to isolate the hydrogen gas supply to the RMA in the event of an earthquake, loss of normal power, excess hydrogen flow, or when hydrogen is not being used. Both systems were very robust with respect to conceptual designs, design executions, and safety bases, with three exceptions: First, the installed hydrogen excess flow valve was incorrect for this application in that its actuation setpoint was above the TSR limit; second, the TSR surveillance test procedure for this valve had not been correctly followed, resulting in the first discrepancy not being previously identified; and third, this test procedure was inadequate to assure its correct adherence. These are described in more detail in the improvement areas and recommendations section below. Additionally, there was a minor error in DSA Section 3.4.3.7.4, which addresses the frequency of occurrence of a hydrogen leakage event. Page 3-238 described the reduction in concentration expected by operation of the room ventilation system as 10 percent; however, based on the quantities shown it should have been reduced by a factor of 10. LLNL committed to correct this in the next DSA revision.

Closeout of Previous Independent Oversight Findings. The three design and safety bases findings from 2007 were: Finding E-2, "The safety-related fire suppression/mitigation systems have design concerns with respect to required safety performance capabilities;" Finding E-3, "the capability of the Room and Glovebox Exhaust Systems' final high efficiency particulate air (HEPA) filters to survive the combustion product loading effects of an evaluation basis fire had not been formally demonstrated;" and Finding E-4, "Miscellaneous design and safety basis concerns." This 2009 HSS review confirms that LLNL had fully resolved two of the findings (E-3 and E-4) and made significant progress on the other one. HSS identified some potentially more effective or efficient options for enhancing the current LLNL approaches to resolve residual concerns.

Improvement Areas and Recommendations

In a few cases, resolution of previous concerns had not been fully realized or HSS identified alternative resolutions with potential efficiency, effectiveness, or cost benefits. In addition, several aspects of the HGCS and HGIS design and safety bases and their translation into a TSR surveillance test procedure warranted some improvements.

Hydrogen Gas Control and Isolation Systems. The hydrogen gas isolation valve is required by the DSA/TSRs to close for flows greater than 30 liters per minute. In responding to HSS team questions concerning this valve, it was discovered that its actuation setpoint was actually somewhat greater than the 30 liters per minute limit, apparently as a result of inadequate specifications for its procurement. LLNL promptly and appropriately initiated the PISA process for this discovery.

The TSR surveillance test procedure for this valve's function – Surveillance Requirement Procedure (SRP)-B332-4.12.1/4.12.2 – requires applying an argon correction factor to the measured flow values from the installed flow meter used in this test; however, the data sheet does not document that a correction factor is applied. For safety reasons, the surveillance is not performed with hydrogen, which further complicates the SRP.

Recommendation: Continue to investigate the causes of the discrepancies and develop permanent corrective actions and interim compensatory measures, including consideration of the following:

- Change the test procedure to include the required correction factors and steps for application.
- Change the DSA, TSRs, and test procedure to use standard units (standard liters per minute) in performance requirements to ensure consistent usage in these and related documents (e.g., purchase specifications).
- Resolve the issues with the isolation valve (e.g., install a suitably calibrated valve).
- Evaluate and implement timely compensatory measures to allow hydrogen operations (e.g., manual isolation or hydrogen source limitation options).
- Consider hydrogen source limitation (i.e., limiting the mass in the attached bottle to less than what is required to reach the lower flammability limit) as a permanent resolution, because it provides an absolute preventative measure, whereas the current approach (an isolation based on flow rate) does not necessarily directly prevent reaching the lower flammability limit in a glovebox for slow-leak scenarios.

Closeout of 2007 Independent Oversight Finding E-2 regarding Fire Protection. At the time of this 2009 review, LLNL had not closed this finding, and was working on developing a formal path forward for LSO approval. Currently, LLNL plans to modify the fire protection piping to eliminate dependence on the nitrogen skid. In the system's current configuration, for an actual fire event, the nitrogen skid could be depressurized, or it could be inadvertently depressurized, requiring procurement, qualification, and installation of a new nitrogen skid or other alternative measures. Since achieving such measures within the seven-day TSR limiting condition for operation period could be very problematic, such an event could significantly impact subsequent facility operations. The proposed modifications would eliminate this dependence by providing a system configuration with the required performances without dependence on the nitrogen skid. These modifications would also reduce certain system maintenance requirements. Although no technical issues were identified with LLNL's planned modifications, HSS identified several alternative strategies that could avert the need for this modification, while at the same time reducing or virtually eliminating the nitrogen skid depressurization vulnerability. Given the current intent and schedule for the facility's materials de-inventory, consideration of such options may be advisable to minimize cost and operations impacts.

Recommendation: Consider the following possible alternative strategies and options that might be used individually or in combinations to achieve the desired objectives: (1) optimize existing nitrogen skid lineup by aligning only the analyzed required number of bottles for blowdown to the blowdown manifold; (2) make the second skid manifold a backup fire protection source with a piping modification to connect the two skid manifolds with an intermediate isolation valve; (3) prevent further manifold pressure decay in both skid manifolds by a modification to install external bottles with pressure regulators set at the current manifolds' pressures; (4) obtain a backup nitrogen trailer; (5) reduce the nitrogen skid supply pressure to the fire protection tanks to the pressure required to provide the minimum required fire water flows; (6) re-certify the nitrogen skid bottles to American Society of Mechanical Engineers (ASME) Code, Section VIII standards, thereby potentially eliminating the Department of Transportation (DOT) Code requirement for re-hydro-testing before refilling; and (7) install fire water flow control valve(s) to limit fire water flows to the minimum required. If the currently planned piping modification is pursued, other alternatives to consider along with that approach might include: (1) using the existing 2,500 gallon tank as an additional depressurization air source and (2) attaching nitrogen bottles with regulators to the firewater tanks to maintain them at the required standby pressure and as additional expansion sources for the blowdown. Technical details of these options were provided to and discussed with LLNL for their further consideration.

Recommendation: As part of LLNL plans for final resolution and path forward in resolving this finding, LLNL should consider the applicability of 10 CFR 851 pressure vessel code requirements and potential continued use as an alternative strategy discussed above. The nitrogen skid is being used in an ASME VIII stationary tank application and thus should not be bound to DOT requirements. ASME VIII requires that hydrostatic testing be conducted following initial component fabrication and/or installation but prior to releasing for normal operations. Hydrostatic acceptance tests are also used to verify structural integrity or design function following component replacement, repair, or modification. If a hydro test is performed that is not associated with one of these activities, it would be considered a prudent action and not a requirement. Title 10 CFR 851 invokes ASME VIII and therefore is consistent with the above. In addition, it is suggested that LLNL prepare an evaluation stating this position, supported by an unreviewed safety question (USQ) screen. Gas suppliers should refill the tank if necessary, knowing that the tank is not bound by DOT requirements and supported by the LLNL evaluation.

In reviewing the current calculation for the required number and pressure of nitrogen skid bottles to perform the fire water tank blowdown safety function, potential non-conservative and conservative assumptions in the calculation were discussed. LLNL should assess the significance of these assumptions.

Closeout of 2007 Independent Oversight Finding E-3 regarding Potential Final HEPA Filter Vulnerabilities for the Evaluation Basis Fire. At the beginning of this inspection, LLNL had the physical capabilities to protect the filters, while at the same time not challenge current DOE guidelines for public and worker exposures for this event. However, these capabilities had not been sufficiently formally documented to allow full understanding and verification by affected or participating parties. By the conclusion of this review, LLNL had documented the intended strategies in an informal draft outline, which was discussed and agreed to by the potentially affected and participating parties. The contractor further committed to formalize these strategies in appropriate facility processes, procedures, and supporting documents. Although these strategies depended, in some areas, on non-safety equipment, such as exhaust stack continuous air monitors, exhaust flow monitors, and supply fan flow controls, due to the multiplicity of indications, the strategies were judged to be adequate to ensure that the exposure guidelines are not exceeded, and the HSS team had no further concerns.

Recommendation: Ongoing actions to formally document these strategies should consider the following:

- Generate Abnormal/Emergency Operating Procedure(s) for the glovebox/room fire events that addresses subjects such as indicators that the event is occurring, potentially available situation indicators, roles of various participants, attendant special hazards to consider, available personal protective equipment, expected ventilation system responses, critical potential release indicators, and response alternatives to abnormal indications in order to maximize the exhaust system and HEPA filters' effectiveness without risking filter breakthrough.

- Generate a revised qualitative analysis of expected worker exposures for this event that demonstrates consistency with DOE Standard 3009-94 worker exposure guidelines and realistically considers such factors as the current reduced inventory levels, the source term likely to be trapped by the filters before the exhaust system is shut down, and the realistic leak path factor for the exhaust system shutdown condition.

- Revise the DSA room-fire accident analysis to document the intended strategy and expected worker exposures for the evaluation basis fire event in sufficient detail to allow a qualified reviewer to confirm that the intended strategy provides adequate assurance of not exceeding DOE guidelines.

4 Configuration Management

Independent Oversight's review of CM focused on various NMTP facility configuration products such as drawings, calculations, and modification change packages. These products were evaluated against current configuration control procedures as well as draft engineering process procedures to ensure conformance to the intent of DOE-STD-1073.

As a result of the new site contract, the LLNL site is now contractually mandated to conform to the requirements of DOE-STD-1073. Implementation plans have been appropriately initiated to address gaps between the current program and the DOE standard.

The NMTP CM program has shown significant improvement since Independent Oversight's review in 2007. While not finalized, a number of actions have been taken to strengthen elements of the CM program. An NMTP design process procedure, NMTP-FMP-0208, is currently being developed and is a positive step forward to ensure consistent and verifiable engineering products are prepared for NMTP by outside organizations such as plant and program engineering and other outside vendors. The draft procedure addresses the fundamental requirements of 10 CFR 830 Subpart A, *Quality Assurance Requirements*, and ASME NQA-1-2000, *Quality Assurance Requirements for Nuclear Facilities*, and provides a procedural framework of key elements such as identification of a technical requirements baseline, design media documents, design verification, and design change control implemented through the Superblock Work Control Manual. However, HSS has identified suggested changes and/or additions to the procedure as outlined under recommendations below that will enhance the quality of engineering products and ensure designs consistent with the safety basis. SDDs have been developed for Building 332 safety class and safety significant systems, which are an integral element of documenting design requirements recommended by the DOE CM standard. The structure of the SDDs appropriately utilized the attributes in DOE-STD-3024, *System Descriptions*, and those attributes have been integrated into these documents. The SDDs reviewed were generally well organized and were subject to the change control process.

The HSS team reviewed the gap analysis between the LLNL site infrastructure CM program (ES&H Manual 41.2) and DOE-STD-1073. Infrastructure document 41.2 flows down to the NMTP Nuclear Facility CM Plan. LLNL will be addressing the current gaps through planned revisions to Manual 41.2 and the NMTP CM program documents. Although some gaps exist and formal revision of program documents is necessary, based on discussions with system engineers and review of recent initiatives, the CM program is functionally performing acceptably and improvements to the program are under way.

HSS also reviewed the LLNL corrective actions to Independent Oversight 2007 Inspection Finding E-1, Inadequate Drawing Control. This finding documented that LLNL NMTP had not developed or maintained adequate VSS drawings, such as system P&IDs and electrical single line drawings, and had not adequately controlled such drawings. At that time, frequent use of uncontrolled red-line markup system drawings in

the possession of the system engineer was a normal practice. Since then, several notable corrective action initiatives have been or are in the process of being implemented, namely, conversion of red-line markup drawings to digital AutoCAD files. Also, until digital drawings can be created, all red-line drawings are being retained and controlled in the Building 332 Historic Information Records Center and are noted as "for information only." Additionally, Drafting Standard Manual NMTP-FMP-0210 has been issued to standardize creation of new drawings and revision to existing drawings to ensure uniformity and adherence to recognized drawing standards. The issued P&IDs for the HGCS and HGIS and for the safety class fire suppression system (FSS) were reviewed for correctness and conformance to quality drafting standards. Specifically, the HGCS and HGIS systems were walked down and found to be physically installed consistent with the P&IDs. The FSS system drawings were reviewed and several inconsistencies were found with regard to the system safety designation at the system boundary. This may have contributed to the inadvertent missed maintenance on a system check valve discussed in Section 7.2. Overall, the new P&ID drawings reviewed were considered to be correct and of high quality. The corrective actions taken were found to adequately address the 2007 drawing control performance concerns of Finding E-1.

Improvement Areas and Recommendations

LLNL recognizes that various aspects of the CM program are a work in process. Although the HSS team did not identify performance problems or significant concerns with the initiatives, a few additional potential improvements were identified for LLNL consideration.

Recommendation: Consider establishing and implementing a process for system walkdowns to validate the new system drawings before approval of new system P&IDs, with special attention to component tag numbers, order of takeoffs, and safety class boundary breaks. While a process does exist to walk down the system prior to drawing issue, it should be more formalized to address the attributes noted above.

Recommendation: Consider treating the development of new drawings and revision to existing drawings and technical documents as a reconstruction process and not a design reconstitution. Ensure that reconstructed deliverables include drawings such as P&IDs and single-line diagrams, updated master equipment list (MEL), and labeled equipment, and allow implementation using a graded approach based on facility remaining lifetime, facility hazard category, system functional classification, and mission. Consider an approach where facilities such as Building 332 may choose to implement only those CM activities that are important to the remaining operation or to the next phase of the facility life-cycle.

Recommendation: In the new draft design process procedure, place additional emphasis on the entire engineering design process that develops design output documents not necessarily related to design changes, and considers Section 3.3 of DOE-STD-1073.

Recommendation: Consider clarifying or expanding Section 2.0 and Section 4.0 of the draft design process procedure (which states that the process outlined should also be applied, to the extent practical, to new designs or modifications to non-VSSs, and provides discretion for the NMTP Facilities Manager, respectively) to include the use of a predefined, graded-approach process for non-VSS designs and deliverables to determine if the design process contained in this new procedure applies.

Recommendation: Consider establishing processes for performing formal design reviews to confirm adherence to scope and design criteria requirements at various design project milestones (e.g., initial kickoff meeting, 40 percent, 90 percent, and final design) and having a multi-discipline design review board perform the final design review.

Recommendation: Consider adding a listing of key system calculations to the SDD Appendices.

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5 Maintenance and Procurement

5.1 Maintenance Program

Independent Oversight evaluated the actions taken to resolve MIP weaknesses identified in the 2007 Independent Oversight report, Finding E-5. LSO/LLNL formed a working group with representatives of LSO, LLNL, Plant Engineering (now the Maintenance and Utility Services Department or MUSD), and each NMTP facility to discuss and coordinate actions needed to establish a set of DOE Order 433.1A compliant MIPs. A gap analysis and implementation plan was developed, and organization-specific MIPs were revised and submitted for DOE approval. LSO appropriately reviewed, challenged, verified corrective actions, and approved the Superblock, Radioactive and Hazardous Waste Management (RHWM), MUSD, and LLNL MIPs. Subsequently, LSO/LLNL performed comprehensive joint MIP implementation assessments, which identified several issues that need to be addressed in subsequent MIP updates. Based on review of the 2008 Superblock, RHWM, and MUSD MIPs against the requirements of DOE Order 433.1A, Independent Oversight determined that the 2008 revised and DOE-approved MIPs were substantially improved and that the 2007 Independent Oversight report Finding E-5 was appropriately closed. The noteworthy practice of using a working group of impacted organization representatives to guide MIP updates continues with periodic meetings to discuss and develop agreement on strategies to address the results of the joint MIP implementation assessments, emergent MIP issues, the required 2010 update of the current MIPs, and the expected revision of DOE Order 433.1A.

Maintenance histories for Superblock safety-related equipment were readily retrievable. Further, each inspected system had an attached logbook providing documentation of the date, nature of the performed maintenance, and the performer's signature or initials. MUSD has established appropriate procedures and has principal responsibility for performing condition assessment surveys, maintaining the Facility Information Management System database, and meeting the requirements of DOE Order 430.1B. The LLNL Facilities and Infrastructure (F&I) Directorate, with support from LSO, has developed and plans to begin implementation of their new Reliability Centered Maintenance (RCM) procedure.

The MEL for Superblock is not detailed in all instances to the component level as expected by DOE Guide 433.1-1. However, given the planned change in mission and the established preventive maintenance (PM) program, LLNL has appropriately determined that the effort to comprehensively detail all elements of the Superblock MEL to the component level is not warranted in light of the cost in limited resources and the limited safety benefit. Also, LLNL performs targeted enhancements of MEL detail, when needed, to support equipment repair, refurbishment, and modification.

Improvement Areas and Recommendations

Although improvements have been made, there are several gaps that warrant additional improvement actions.

MIP Consolidation and Consistency. The LLNL, Superblock, MUSD, and RHWM MIPs have different formats, content, and level of detail, and describe overlapping maintenance programs applicable to each LLNL non-reactor nuclear facility.

> **Recommendation:** Consider the benefit of consolidating the multiple MIPs covering current LLNL non-reactor nuclear hazard category facilities to reduce duplication and the potential for conflict in maintenance program descriptions, while enhancing clarity and consistent understanding across all LLNL organizations of the scope of the maintenance program applicable to those facilities.

Technical Obsolescence Reviews. NMTP recognizes the importance of taking action to prevent adverse consequences of technical obsolescence of SSCs, as demonstrated in the current effort to replace Superblock continuous air monitors (in response to difficulty in procuring repair parts) and in procuring additional spare criticality alarm system modules (in response to the unavailability of manufacturer maintenance services). However, the Superblock, RHWM, and MUSD MIPs do not address the requirement for periodic inspection of SSCs to determine whether technical obsolescence threatens performance and/or safety. Although the RHWM MIP indicates that system engineers are used as necessary to determine technical obsolescence, neither the RHWM MIP nor the NMTP System Engineer Program Manual requires these determinations to be periodic. Finally, LLNL acknowledges that the MUSD MIP defines the scope of periodic condition assessment surveys and that SSC age and condition are significant factors in MUSD's prioritization of "maintenance reinvestment projects;" however, condition assessment surveys are generally limited to infrastructure versus programmatic equipment and the MUSD MIP does not specifically address SSC technical obsolescence. Because obsolescence threatens SSC maintainability, operability, and reliability, early identification of obsolescence and proactive initiation of replacement are important to maintaining VSS safety functions. Further, although SSC technical obsolescence may be identified during PM activities, predictive maintenance (PdM) activities, periodic MUSD condition assessment surveys, and management and staff tours, the determination of technical obsolescence that threatens performance and/or safety is not the principal function of those activities and should not be counted upon to fulfill the DOE Order 433.1A requirement.

> **Recommendation:** Consider enhancing both the MIP and the system engineer program description to require the DOE Order 433.1A required periodic assessment of technical obsolescence be performed in concert with the DOE Order 420.1B requirement that CSEs periodically assess assigned VSS operability, reliability, material condition, and consistency of configuration with VSS documentation. Because system engineers are only assigned to VSSs, consider the need to formally assign responsibility to the CSE and MUSD staff for periodically assessing obsolescence of the respective SSCs for which they have maintenance and performance oversight responsibilities.

Scope of PMTs. Although no specific equipment performance concerns were identified, reviewed work permits and interviews indicate that there may not be a consistent understanding that the scope of PMTs should encompass both the restoration of operability and a demonstration that the intended outcome (such as repair) was achieved.

> **Recommendation:** Consider the need to enhance training of NMTP and MUSD staff who develop, review, and/or approve maintenance work permits and plans in order to ensure that responsible

personnel understand that the scope of PMTs should encompass both the restoration of operability and a demonstration that the intended outcome (such as the repair) was achieved.

PM Program Optimization: Interviewed NMTP and MUSD staff were unaware of any current or previous effort to optimize the PM program balance between maintaining appropriate SSC performance reliability versus maintenance resource costs. Further, interviewed acting system engineers had not reviewed SSC vendor manuals for their assigned VSSs to reconcile vendor PM and PdM recommendations with the current PM program.

Recommendation: Consider the need to develop NMTP CSE and MUSD High Hazard Work Center RCM subject matter experts to promote early involvement and initial trials in implementing the LLNL F&I Directorate's RCM procedure for the benefit of enhancing Superblock maintenance effectiveness and efficiency. To gain perspective of the challenges and potential benefits of use of RCM processes, consider discussion with the Y-12 and Oak Ridge National Laboratory facilities maintenance organization to understand their experiences with targeted implementation of their "Physical Asset Management Solution" process.

Correct Building 332 DSA Inaccuracies: The April 2008 Building 332 DSA, Chapter 10, Initial Testing, In-Service, Surveillance, And Maintenance, includes inaccurate references to superseded documents.

Recommendation: Revise Chapter 10 of the Building 332 DSA to correct out-of-date references to stated program requirements contained in documents that have since been superseded.

5.2 Procurement Program

Independent Oversight reviewed the LLNL closure of the 2007 inspection finding regarding weaknesses in the NMTP procurement program. Closure of the finding is supported by new procedures established by the LLNL Supply Chain and NMTP for procurement QA/supplier evaluation, verification of procured items and services, like-in-kind determination for Superblock facilities replacement/spare items, and the procurement/acceptance process for NMTP Superblock quality-significant orders. New Standard Receiving Inspection Plans and a revision of the Superblock work permit form were also established, the latter to support traceability of procurement item pedigree and related quality-significant procurement documentation to final application. No significant problems were identified in the reviewed procedures.

Six of eight reviewed 2009 NMTP quality-significant procurement packages contained sufficient documentation to demonstrate the procured items were appropriate for their intended safety-significant applications. The procurement package for fabrication of the hydrogen gas isolation panel was particularly of high quality. All reviewed quality-significant procurement packages demonstrated use of vendors/suppliers/manufacturers that were listed on the current LLNL Evaluated Supplier List.

Improvement Areas and Recommendations

Although generally adequate, there are aspects of the NMTP quality-significant procurement process that warrant further improvement.

Closure of 2007 Independent Oversight Procurement Weakness Finding E-6. LLNL documentation supporting closure of the procurement program finding indicated that procedures and processes were reviewed and that minor changes were made to address the basis for the finding. There was no documentation supporting

closure of an underlying issue associated with assuring appropriate maintenance of quality-significant items in storage or in a QA hold. Further, documented evidence was not found demonstrating the performance of a self-assessment of the procurement process as proposed in the revised corrective action plan for Finding E-6.

In addition, the documentation of two of eight reviewed procurement packages did not meet quality expectations; specifically, one did not contain receipt inspection documentation of the required verification of dimensions (although the receipt inspector had indicated to NMTP QA staff that the required dimensional checks were performed), and a second lacked a non-conformance report and documentation of the basis for a decision to use-as-is when it was determined that the provided certificate of compliance lacked the required signature and purchase order label. Although not adequately supported by required documentation, there exists reasonable basis for concluding that the procured items associated with the two challenged procurement packages are of sufficient quality for their intended application.

Recommendation: Enhance training of individuals who will be responsible for performing receipt inspection activities to ensure they understand that results of required verification activities, such as taking measurements, must be documented to the degree that supports independent assessment of the required critical characteristics and pedigree of procured quality-significant SSCs.

Recommendation: Re-evaluate adequacy of actions taken to address Finding E-6, including actions that independently verified the adequacy and effectiveness of closure of the corrective action plans.

Component Replacement. Neither the NMTP Like-In-Kind nor the Superblock Quality-Significant Procurement procedures require updating the Superblock MEL following installation of an SSC procured as other than a like-for-like replacement. Also, the stated purpose and scope of the NMTP Like-In-Kind procurement procedure does not explicitly encompass a replacement part that is fabricated by LLNL.

Recommendation: Consider enhancing the NMTP Like-In-Kind procurement procedure to require updating the Superblock MEL following installation of procured quality-significant replacement SSCs.

Recommendation: Consider enhancing the NMTP Like-In-Kind procurement procedure purpose and scope to encompass the process for acceptance of SSCs fabricated by LLNL for quality-significant application. The Oak Ridge National Laboratory Nonreactor Nuclear Facility Division's procedure for "Fabrication Control" provides an appropriate model for a stand-alone procedure addressing this activity.

Recommendation: Consider enhancing the NMTP Like-In-Kind procurement procedure's process for commercial grade dedication by benchmarking against the River Protection Project Waste Treatment Plant commercial grade dedication program implementation plans and processes.

PM of Stored Quality-Significant Items. LLNL has not established appropriate processes to ensure NMTP quality-significant items in storage or in a QA hold are appropriately maintained. For instance, there was no sign of temperature and humidity control or interviewee knowledge that formal PM requirements had been imposed for periodic shaft rotation for the large safety-related ventilation system spare motor in the Superblock Plenum Equipment Building.

Recommendation: Consider establishing appropriate processes, procedures, and tracking mechanisms to ensure NMTP quality-significant items in storage or in a QA hold are appropriately maintained. For example, establish new PM procedures in the Plant Maintenance Management System for each quality-significant item in storage or under QA hold that needs periodic maintenance to maintain required pedigree and quality.

6 Specific Administrative Controls

DOE Standard 1186-2004, *Specific Administrative Controls*, provides guidance applicable to SACs, as well as a "safe harbor" for the preparation of DSAs in conjunction with DOE Standard 3009, Change Notice 3, to meet 10 CFR Part 830 requirements. HSS focused on LLNL SAC implementation and LSO oversight of SACs; reviewed NMTP safety basis processes and procedures for the development and implementation of SACs that apply to Superblock and RHWM facilities; and sampled a number of SAC implementing procedures, support documents for selected HGIS and HGCS SACs for Building 332, and combustible loading and flammable liquid controls for Buildings 332, 331, and 696R, including field walkdowns and interviews with staff who implement SACs at Building 332 and RHWM.

The LLNL process for developing and implementing SACs was effective for the SACs reviewed. LLNL upgraded most of their safety basis governing procedures to address recent organizational changes and to address current standards and directives, including DOE-STD-1186-2004. Key procedures, such as AB-007, Control Item Selection Procedure, and AB-008, Technical Safety Requirement Development Procedure, have been upgraded to meet current DOE standards.

The SACs that were sampled fully meet the intent of 10 CFR Part 830 Subpart B and DOE-STD-1186. For example, SACs established for metal conversion glovebox operations were appropriate and provide hydrogen operation controls that protect the assumptions and ensure that the consequences determined in the accident analysis are not invalidated by placing the facility in an unanalyzed condition. NMTP activities supporting the SACs are further defined in SRPs, Operating Safety Procedures (OSPs), and Administrative Support Procedures that effectively flow down the applicable DSA and TSR requirements. Discussions with the responsible individual for the program work effectively demonstrated how the SACs were implemented in applicable procedures and in training requirements for workers. Workers who were interviewed were knowledgeable of SAC requirements for metal conversion glovebox operations. The HSS team walked down several combustible loading SACs in Superblock laboratories, observed combustible loads in gloveboxes and vaults, and discussed combustible loads with LLNL personnel; no deficiencies were identified. Workers displayed an adequate knowledge of combustible loading limits for their operations. One minor inconsistency was noted in the performance of a quarterly combustible loading survey discussed in Section 7.

The HSS team also reviewed the implementation of a SAC for combustion control in the RHWM TSR for Building 696R. The SAC was incorporated in the latest annual update for this TSR and was fully implemented prior to this review. The SAC establishes a limit of an average of seven pounds of combustible materials per square foot in the facility (excluding items such as those inside waste drums). The implementation of the SAC included a quarterly inspection requirement for the FPE, implementation of a procedure to calculate and track combustible loading, and implementation of weekly operator checks to ensure no major changes to the combustible loading occur between the documented quarterly inspections. Considering the magnitude of the

combustible material limit, significant changes to the combustible inventory between quarterly inspections that might approach the limit would be adequately identified by the operator checks. In addition, the HSS team followed up on selected conditions of approval related to SACs in Superblock and RHWM facilities and did not identify any concerns.

The HSS team reviewed current practices employed for the continued review and independent validation of safety basis controls. Review of LSO management assessment plans, management assessment schedules, and PEGASUS records demonstrated that LSO Facility Representatives and Safety System Oversight staff were actively and periodically reviewing SAC implementation consistent with NNSA NA-1 SD 226.1A, *NNSA Line Oversight and Contractor Assurance System Supplemental Directive*. For example, the Building 332 Facility Representative reviewed metal conversion glovebox operations, including adequacy of controls specific in the applicable OSP and Facility Safety Procedure and found that operator response to alarm conditions was not clearly defined. Corrective actions have since been taken to address this observation and the OSP was revised.

Improvement Areas and Recommendations

Use of Independent Mechanisms in Periodic Re-verification of Safety Basis Controls. NMTP periodically reviews TSR controls as part of its annual updates to DSAs in accordance with AB-011, Revision 1, Safety Basis Implementation Procedure. For annual updates to TSR documents, the safety basis implementation plan includes a crosswalk document for all individual TSRs (i.e., surveillance requirements, SACs), whether they have changed or not. As part of the update process, a specific action item is assigned to verify that the crosswalk flow down for all TSRs provided is accurate. Current processes adequately address independent validation of implementation of safety basis controls when first established. However, performing independent validations on a recurring basis to ensure the facility equipment, procedures, and personnel training have not degraded over time is considered prudent given the importance of safety basis controls.

> **Recommendation:** Consult with the draft Guide for Performance of Independent Verification Reviews of Safety Basis Controls recently issued for pilot testing and comment, and other DOE/NNSA site offices and contractors that have already developed site programs that independently sample validation of safety basis controls (e.g., Pantex) for lessons learned and tailored application at LLNL.

7 Fire Protection

The fire protection program evaluation focused on two areas: (1) sitewide fire protection program elements and (2) Building 332, focusing on the technical baseline documentation, fire protection surveillances that support the safety-class FSS, and the passive fire systems.

There have been several recent fire protection program improvements since the biennial review conducted by NNSA in October 2008. For example, LLNL has recently devoted more attention to updating and formalizing specific fire procedures and programs, including a useful tool for conducting self-assessments, a procedure to track exemptions and equivalencies, and a process for establishing priorities for fire protection deficiencies.

The deficiencies identified during recent contract transition and the lack of a formal self-assessment program are some of the recognized challenges that the management staff face, as they move towards improving their program and institutionalizing their procedures and processes.

7.1 Fire Protection Program Elements and Implementation

The LLNL fire protection program is comprised of three departments organized under the Emergency Management Division: Emergency Programs, the Alarms Group, and the Fire Marshall/Fire Protection Engineering. The Fire Marshall has been delegated certain day-to-day responsibilities and provides the key interface to LSO on resolution of fire protection compliance issues, while the Site Office Manager, as the "Head of the Field Element," is the Authority Having Jurisdiction. The management team has a significant amount of experience and is continually involved with mentoring and coaching their staff. The engineering staff members are all qualified FPEs, and several have commercial and DOE site experience. This organizational structure utilizing the Fire Marshall as the Authority Having Jurisdiction has proven to be effective.

The promulgation of contractual requirements for fire protection is documented in the requirement decision records and identifies the applicable National Fire Protection Association (NFPA) codes and standards. The LLNL Document 22.5, Fire, of the ES&H Manual is intended to provide the flow down of these requirements using policy statements for implementation of programs at the site level. Additionally, the LLNL Fire Protection Program (reference UCRL-MA-116646, Revision 1) provides a very informative and historical perspective on the program including a detailed chronological description of the fire department.

Several of the LLNL fire protection programs were observed to be effective. Fire department inspectors and fire engineers responsible for the implementation were knowledgeable and demonstrated a high level of ownership.

Improvement Areas and Recommendations

Program Documents. Even though several fire programs are described, the LLNL Fire Protection Program document and the ES&H Document 22.5, Fire, do not define all of the requirements necessary for a comprehensive fire protection program, nor do they provide an adequate basis for implementation at the facility level. The majority of the procedures and policies are outdated; many are over ten years old.

> **Recommendation:** Consider a program to update the current fire protection program documents to clearly reflect the DOE objectives and requirements for a comprehensive fire protection program. This open action has been identified.

> **Recommendation:** There are currently several different types of implementing documents being used for promulgating fire protection program requirements including disciplined action plans, engineering standards, department policies, and plant operating procedures. The ES&H Document 22.5, Fire, and Fire Protection Program Manual do not describe these documents or their intended use. Consider conducting a detailed self-assessment, focusing on flow down of contractually mandated NFPA codes and standards from the institutional level to the facility level in order to identify gaps and areas for improvement in institutional processes and implementing mechanisms. Consider utilizing a vertical slice methodology using several representative types of facilities (i.e., nuclear, non-nuclear high hazard, non-nuclear low hazard).

Demolition and Removal Work. There are no fire protection procedures or guidelines established for performing demolition and removal work. Life safety and property protection requirements should be established prior to significant alterations or demolition of buildings.

> **Recommendation:** Consider using the requirements delineated in NFPA standard 241 (reference Standard for Safeguarding Construction, Alteration, and Demolition Operations) as a baseline for developing a fire protection procedure for alteration and decommissioning buildings for nuclear classified facilities.

Transient Combustibles. The current method for controlling transient combustibles is through the disciplined action plan for fire protection. The ES&H teams include safety technicians who routinely perform inspections and assist the FPEs with minimizing the risk associated with fire. This concept of leveraging additional resources to supplement the limited number of FPEs is a good practice and promotes increased awareness of fire protection. The ES&H Team Fire Protection Routine #1 identifies one of their objectives as being alert for "significant accumulations of combustible trash and debris." However, the general guidelines provided to the ES&H team for controlling transient combustibles are not sufficiently defined and do not provide enough information to ensure an effective inspection, resulting in various combustible hazards in LLNL facilities (e.g., numerous cardboard boxes staged at the East side exit door of Building B331, combustibles stored in the utility rooms, and many of the office rooms of Building 332 not maintaining good housekeeping practices). Additionally, there is no process for documenting or tracking these deficiencies once they are identified.

> **Recommendation:** Where possible, consider developing a fire protection procedure for control of transient combustibles that can be utilized at the facility level or modified for unique hazards and facility operations. Additional details would be helpful to facilitate a more effective implementation and inspection. Examples include: minimum distances of combustibles from energized transformers and switch gear; prohibiting storage in specific areas including mechanical rooms, electrical rooms, and under stairwells; and proper storage requirements.

Local Alarms. LLNL does not currently have an updated program plan that defines the Fire and Emergency Voice Alarm system. The latest program document is the Fire and Emergency Voice Alarm (reference AG 08-2006), which provides a general description of the system and was last revised in August 2006.

> **Recommendation:** Consider developing a fire protection procedure and technical specifications for local fire alarm and system signaling protocols. Consider key system elements such as operation and signal response protocol, alarm system testing and maintenance, CM control, design and installation requirements, and system impairments. Ensure the document addresses the necessary protocol for maintaining the system's Underwriters Laboratory listing in accordance with UL-864 and references the essential technical baseline drawings for the system.

Legacy Deficiencies. A listing of the legacy fire deficiencies that were identified during the contract transition were recently prioritized with cost estimates and provided to LSO for their review. This recently established deficiency prioritization appears to be adequate with the exception that it does not consider such elements as critical process control, safety class systems designed to prevent an unacceptable onsite or offsite release, and unacceptable delays. In addition, ten deficiencies identified as priority number one and having a high direct impact on life safety have not yet been scheduled for completion, nor are there compensatory actions in place during this time of noncompliance.

> **Recommendation:** Consider developing a fire protection procedure for fire safety deficiency and classification that more explicitly addresses nuclear safety systems. Consider reevaluating the high priority deficiencies to determine the need for compensatory measures and defined completion schedules.

Control of Hot Work and Permits. The inspections performed by the fire department prior to authorizing the hot work permit were performed well. The roles and responsibilities governing this work were understood, and personnel were knowledgeable with the program requirements including the permitting process. A recognized good practice included the use of laminated fire watch qualification badges that were being worn by personnel in Building 391. The card identified the key elements for fire extinguisher use and fire watch responsibilities. However, the hot work permit does not establish as a minimum requirement to locate combustibles a minimum of 35 feet away from hot work operations in accordance with NFPA 51B (Standard for Fire Prevention During Welding, Cutting, and Other Hot Work). The procedure (reference policy 410.00) references the 2003 version of the NFPA code, but the latest version that is noted in the requirement decision records is the 2009 version. The list of precautions on the permit does not indicate which are mandatory or optional. For example, the requirement for a 30-minute fire watch and access to a fire extinguisher is listed in two separate areas on the form, and the permit does not indicate whether these controls are required or guidelines.

The permit does not provide a place for compensatory actions that may be required due to unique conditions and circumstances. For example, for the hot work being observed for Building 391, project #32769, the fire department inspector required that the smoke detection system be impaired and noted that on the permit. LLNL later discovered that the system was not impaired (because of an issue with specific facility training); therefore, the work was completed with the detection not impaired, the permit was not revised, and the fire department inspector was not notified of this change.

The procedure does not provide adequate information for managing dedicated hot work areas, contributing to situations where the requirements were not understood by site personnel. For example, Building 331 rooms 148 and 1124 were dedicated hot work areas but the requirements to maintain them or post hot work permits were not clearly communicated or commonly understood by FPEs and facility management.

Recommendation: Consider revising the hot work permit to clearly establish the mandatory requirements for performing hot work and allocate space for documenting compensatory controls. Consider provisions for inspecting areas that would require a standing hot work permit on an annual basis as a minimum. Review the 2009 version of NFPA 51B code for additional requirements and update the procedure as necessary.

Fire Protection Impairment Control and Compensatory Actions. The impairment control procedure (reference MOP-13001) does not reflect the current process for impairing fire systems. The document was last revised in 2001 and reflects the process that existed prior to the recent contract transition. The procedure does not reference any of the applicable NFPA codes, such as NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems or NFPA 72 - National Fire Alarm Code. Also, the procedure does not define the two recognized types of fire system impairments. The current impairment tag used by the Alarm Group for impairing fire alarm systems is not mentioned, and the permit does not allow the impairment initiator to list compensatory actions that may be necessary for the system prior to being restored.

Recommendation: Consider consolidating and updating the several versions of impairment control procedures to include the definition and requirements for the recognized types of fire impairments including emergency and planned. The procedure should also incorporate the applicable NFPA requirements.

Passive Fire Protection Features – Inspection, Maintenance, and Testing. The ES&H Manual, Document 22.5, Fire, explains in limited detail the types of fire barriers that need to be maintained. The document does not mention or make reference to the inspection and testing requirements for these passive fire systems nor does it reference the applicable NFPA code and standards. Observations regarding the fire barrier programs for both Buildings 332 and 331 highlight the gaps that can occur when institutional requirements do not flow down through the manual, as previously discussed under Program Documents. For example, the requirements for both buildings are intended to ensure the confinement of the credited safety-class boundaries, but the surveillances that involve inspections and testing do not reference NFPA 80 (Reference Standard for Fire Doors and Other Opening Protectives) and do not fully invoke all of the specific code requirements.

Recommendation: Consider developing a procedure to identify the technical requirements for maintaining passive fire systems as referenced in NFPA 80, Standard for Fire Doors and Other Opening Protectives.

Fire Department Runcards. The Pre-Fire plan and program for LLNL building and trailer runcards is governed by Policy No. 30.103. The runcards for Buildings 332 and 331 were reviewed and evaluated for accuracy and effectiveness. The specific hazard information for the labs in the RMA was very detailed and useful for describing the critical hazard type, fire hazard type, health hazard, and instability hazard type. This information was verified during the inspection and was accurate, reflecting the hazard floor plans posted on each door leading to the laboratories in the RMA. However, some information (e.g., location of natural gas shut-off valves) that was required by the policy was not reflected on the runcards. In addition, various hazards (e.g., diesel storage tanks) are located around the perimeter of Building 332 and are not currently shown on the runcard.

Recommendation: Consider revising processes to ensure that runcards include locations of post indicator valves, fire extinguishers, emergency lighting, and natural gas shut-off valves. Consider documenting significant exposure hazards that would impact the initial fire department response, including liquid-filled

transformers, compressed gas storage areas, and diesel storage tanks. Consider including a legend on the runcard to identify such systems.

7.2 Building 332 – Fire Program Effectiveness

The implementation and effectiveness of the fire protection program was evaluated in Building 332, focusing on the technical baseline documentation and the surveillances that supported the safety-class fire suppression and passive fire systems. A significant amount of effort is directed towards managing the combustible loading in this facility and is essential for reducing the risk due to fire and complying with the TSRs.

Improvement Areas and Recommendations

Combustible Loading. The combustible loading limits were well established. The material handlers and glovebox operators were aware of load limits, the routine inspections performed by the fire engineer, and their responsibilities for responding to a fire in the area or inside a glovebox. However, other elements of the program that may need to be strengthened include managing and controlling materials brought into the building. For example, a staging area for construction equipment that was set up in the basement area included a barricaded area, approximately 20 feet by 10 feet that was not evaluated as required by Building 332 Housekeeping and Flammable/Combustible Materials Control Procedure (reference ACP-B332-019). During the HSS review, an alternate FPE performed the combustible load procedure and inspection. This engineer was not familiar with the combustible loading spreadsheet that had been used as a tool for managing the established combustible loading limits for each room.

Recommendation: Evaluate alternative solutions for tracking and managing combustibles that ensure that established TSR limits are not exceeded. Ensure the combustible loading spreadsheet is available to the fire protection engineering group and that its intended use in inspections is briefed to the responsible individuals.

Fire Barrier Inspections and Surveillances. The Quarterly Fire Barrier Surveillance (ACP-B332-023) is intended to ensure the integrity of safety-class fire barriers (e.g., fire walls, fire dampers, and fire doors) to perform their intended design functions as a confinement barrier in the event of a fire. The procedure adequately defines the locations for these inspections, and the deficiencies are being documented by the FPE. However, the procedure does not reference or include the applicable NFPA code requirements for maintaining or testing these systems. A review of the last six completed inspections revealed that identified deficiencies are also not being resolved in a timely manner, with several of the deficiencies over three years old with limited action taken to date.

Recommendation: Consider accelerating efforts to prioritize and resolve identified deficiencies and developing compensatory actions for those items that cannot be addressed in a timely manner (e.g., due to funding constraints). Consider incorporating the associated requirements for NFPA 80 (reference Standard for Fire Doors and Other Opening Protectives) including testing and maintenance into the facility fire barrier program.

Technical Baseline Documentation. The fire hazards analysis (FHA) serves as the linking document from the facility DSA. The Building 332 FHA has just recently been updated and approved by a qualified FPE. However, several key elements are missing or not sufficiently defined.

Recommendation: Consider reviewing and revising the FHA to ensure that all key elements and fire exposures are sufficiently addressed, including fire area analysis, hazardous material analysis, life safety analysis, manual fire attack (e.g., the strategy for the intended use of the interior fire department standpipes located in Increment I and III), natural phenomena hazards, and technical references.

Safety-Class FSS. The FSS located in the basement of Building 332 serves a safety-class function. Several of the required surveillances were reviewed and observed during the inspection. The level of knowledge of the facility operator performing SRP-B322-4.3.1.a,b,e/4.3.2.a,b was very good. The operator understood the basis for the system, how the system operated, and the required response to finding an established set point out of an acceptable range. However, the HSS review of maintenance for the system and components identified a PM surveillance for a check valve on the safety-class fire system that had been missed. The valve number (CK-001 identified on drawing 332-3400-F-9000) does not appear in the list of safety-class components on Table 4-6 (reference Major Components of Safety-Class Fire Suppression System). The contractor took appropriate actions to initiate a PM on the check valve in question.

Recommendation: Review and resolve potential inconsistencies on the engineering drawings. Consider performing a review to verify that testing and maintenance requirements have been identified for other safety-class components, with a focus on the new P&IDs.

8 Cognizant System Engineer Program

Independent Oversight determined that the new (August 2009) NMTP system engineering program has been substantially improved since the 2007 Independent Oversight inspection and, when fully implemented, will be compliant with the requirements of DOE Order 420.1B and 433.1A. However, system engineers have not had sufficient time under the new program to meet its expectations, including the required development of lessons-learned logs, periodic VSS assessments, and system health reports. NMTP management acknowledges that the system engineering program is in an early state of transition to meeting the enhanced program requirements and that much work remains.

Although the program is evolving and maturing, based on a review of recent products, many aspects of the NMTP system engineering program are already effective. SDDs and performance trending that were reviewed by HSS were of high quality. The new NMTP procedure for CSE system assessment, tracking, and trending comprehensively and effectively addresses the DOE Order 420.1B requirements for periodic assessments of VSS operability, reliability, material condition, and consistency with system documentation. Further, effective system assessments were conducted by the Building 332 FSS and Glovebox Nitrogen Supply System system engineers to validate and identify needed improvements in a draft version of the new procedure.

All interviewed system engineers had walked down their systems and demonstrated impressive cognizance of the operability, reliability, material condition, and maintenance/modification history of their assigned systems. The interviews also demonstrated that CSE support of operations and maintenance was excellent.

The NMTP system engineer training program description appropriately includes three levels of qualification: General Training, Core Training, and System-Specific Training. All NMTP system engineers have been designated as acting CSEs for their assigned systems and have achieved qualification to Level 2 (Core Training) requirements.

Improvement Areas and Recommendations

Program Inconsistencies. Recognizing that implementation of the enhanced requirements of the new NMTP System Engineering Program Manual have just begun, some DOE and LLNL expectations are currently not well defined, communicated, or being met:

- Some system engineers had not reviewed vendor manuals related to their assigned system for the purpose of reconciling PM and PdM recommendations with existing periodic maintenance activity plans. Evidence of assessments of the adequacy of the current PM/PdM was not identified.

- Contrary to the implications of the Building 332 Facility Safety Plan, interviewed system engineers believe their role in updating maintenance histories is limited to ensuring the in-field equipment log book is updated by the maintenance staff who perform maintenance.

- Despite the fact that NMTP system engineers have been designated configuration item (CI) owners for their assigned VSS SSCs and are responsible to the Facility Manager for the configuration and operability of their assigned VSS, the current NMTP CM program description does not require the assigned system engineer to be a part of the CM Change Control Board/Work Permit Review and Approval Board that is charged with recommending rejection or approval of a proposed change. However, the NMTP CM program description does require system engineers to review all changes to their CIs.

- The NMTP system engineering and maintenance programs do not require the system engineers to specify or concur in PMT requirements for maintenance, modification, and surveillance activities that may temporarily or permanently change their assigned systems' configurations.

- Several reviewed procurement and maintenance documents assign to the QA engineer the CM function expected of the system engineer. For example, the work plan for refurbishment of the Fan Glovebox Enclosure 3000 and 4000 fans highlights the role by the QA engineer in determining rebuild and testing specifications without mention of the role of the system engineer. Further, the plan for replacing the fans asserts that the QA engineer establishes the PMT acceptance criteria, while later indicating the system engineer can add requirements.

- One interviewed system engineer did not appear to understand that all components within a safety-significant boundary should be treated with the same formality and process restrictions for operations, maintenance, modification, and procurement that are due the subset of SSCs listed in the MEL, unless formally designated as not safety related through the change control/USQ process.

- The job task analysis that provides the underpinning for the system engineer training and qualification program does not accurately reflect the scope of CSE-assigned roles and responsibilities. For example, the NMTP System Engineer Program Manual indicates a Level 3 qualified CSE is expected to be able to perform failure modes and effects analyses, root cause analyses, and trend system performance; however, the CSE job task analysis and qualification cards do not address these competences.

- Several required reading assignments for CSE Level 2 qualification were not completed by Level 2 qualified system engineers because the reading assignment involved procedures that only recently were approved.

- Interviewed system engineers do not have a schedule for completing their qualifications and have not received formal training in failure modes and effects analysis, root cause analysis, and data trending analysis. LSO is working with NMTP to establish incentives for completing the CSE qualification process.

Based on the above, near-term effort is warranted to better align the CSE program with DOE and LLNL expectations and to incorporate best practices, as appropriate.

Recommendation: Revise the NMTP system engineer job task analysis and the resulting system engineer training and qualification program to ensure NMTP managers have a basis for concluding that system engineers have competence consistent with assigned responsibilities and advertised capabilities defined by the new NMTP System Engineering Program Manual and related program implementing

procedures. Ensure the resulting training program verifies that system engineers understand that all components within a safety-significant boundary must be treated with the same formality and process restrictions for operations, maintenance, modification, and procurement that are due the limited subset of SSCs listed in the MEL, unless those components are formally designated not safety related through the change control/USQ process.

Recommendation: Establish a schedule and mechanism to track and report progress in achieving full Level 3 qualifications for each acting system engineer, including completion of the Level 2 qualification required reading for which they were previously exempted.

Recommendation: Revise the Building 332 Facility Safety Plan to accurately describe the system engineer's role and responsibility for use and oversight of assigned VSS maintenance histories.

Recommendation: Consider revising the NMTP System Engineering Program Manual to explicitly require system engineers to review vendor manuals related to their assigned system for the purpose of reconciling PM and PdM recommendations with existing periodic maintenance activity plans. Since all recommended maintenance may not be required given the NMTP operating environment and operational challenges to reliability and material condition, ensure the reconciliation includes an assessment of need for and frequency of maintenance. Once confidence in the new LLNL F&I Directorate's RCM process is established, consider using the RCM process for this reconciliation.

Recommendation: Consider revising CM, maintenance, and procurement program plans, descriptions, and procedures to emphasize the primacy of the NMTP system engineer's role and authority in:

- Recommending approval or rejection of proposed changes in VSSs for which they are designated the CI owner
- Establishing or formally concurring in post-maintenance/modification test requirements and acceptance criteria for VSSs for which they are held responsible for operability and reliability
- Establishing or formally concurring in the critical characteristics that must be possessed, the tests and/or inspections that must be performed, and the acceptance criteria that must be met by quality-significant procured items for the VSSs for which they are designated the CSE
- Revising the NMTP Configuration Management Plan to require including the designated CI owner or CSE on each Change Control Board/Work Permit Review and Approval Board addressing activities that could affect management-designated VSSs.

Recommendation: Because technical obsolescence can impact future VSS maintainability and operability, and DOE Order 433.1A requires the maintenance program to include periodic assessment of obsolescence, consider expanding the NMTP system engineer periodic VSS assessment requirements to include periodic assessment of obsolescence.

Recommendation: Recognizing that the Savannah River Site Tritium Facility has experienced reliability issues with oxygen monitors, developed a root cause analysis, and has initiated action to test alternative designs, consider establishing communications between the Savannah River Site and the LLNL Superblock Hydrogen Gas Control system engineer to share knowledge on oxygen monitor reliability issues and potential solutions to avoid similar problems.

Recommendation: Recognizing that Y-12 has conducted practical exercises to enhance system engineer sensitivity to problems and issues that can and should be identified during system walkdowns, consider establishing communications between LLNL and the Y-12 system engineer manager to understand their process and experience and the benefit that might be gained by NMTP initiating similar training.

9 Radioactive Waste Management

LLNL effectiveness in managing radioactive waste was evaluated by selectively reviewing the implementation of DOE Order 435.1 requirements for solid low-level waste (LLW) and mixed waste at the point of generation for work activities in the Superblock and Site 300, and for waste receipt, storage, and shipment in RHWM facilities. As part of this evaluation, initiatives to reduce the amount of waste generated were reviewed.

Overall, at the point of generation, solid low-level and mixed wastes were being effectively managed. Documents, including waste procedures at Site 300, and work permits or OSPs at Superblock, are effective in conveying waste management controls. Deployed waste expertise provides direct support to these line organizations including participating in pre-planning and the work permit development meetings. Comprehensive information gathering documents have been developed to determine waste characteristics and disposal paths. Also, at the Superblock, the Facility Safety Plan requires all radioactive material handlers to have taken waste generator training. Although generally adequate, the work permits do not provide specific links between the task, hazard, and control for waste management, and the OSP could be improved by better linkage between a work task and waste controls.

Physical facilities within Superblock and at Site 300 for LLW and mixed waste were being effectively operated. Waste minimization initiatives were appropriate. For example, dedicated containers were used to allow unpacking items outside radiation areas, thus preventing packaging material becoming LLW.

RHWM has comprehensive procedures for setting requirements for LLW and mixed waste management at LLNL based on the LSO-approved LLNL Radioactive Waste Management Basis. These procedures were recently revised to address NNSA findings from the *Headquarters Biennial Review of Site Nuclear Safety Performance for the Livermore Site Office*, dated October 2008. Waste Acceptance Criteria, *LLNL-MI-410403*, effectively sets requirements for waste generators, documents a plan to ensure compliance, and requires support to generators by trained field technicians. Waste-stream-specific waste acceptance criteria clearly define requirements for accepting radioactive waste into RHWM and for meeting offsite disposal criteria. Waste certification program procedures complement the waste acceptance criteria and clearly establish requirements for certifying shipments. For waste going to the Nevada Test Site, NNSA/Nevada Site Office's radioactive waste acceptance program has reviewed and accepted this suite of documents.

Observed RHWM storage and shipment operations were being effectively conducted. In some cases, containers are still stored in tents. Newly generated waste was being characterized and packaged for offsite disposal before being accepted for storage. Significant inventory reduction over the last several years has allowed all containers to be stored under cover and deteriorated containers to be overpacked. The electronic tracking system accurately reflects these containers in storage. An observed shipment to the Nevada Test

Site was effectively performed, including ensuring that the required documentation and certification process was completed and the physical inspections of container and vehicle were made.

Surveillance reports, performed in accordance with RHWM Quality Assurance Plan, serve as an effective tool for determining whether radioactive waste management generation and storage activities within RHWM facilities and at Superblock/Site 300 are within requirements. Reports that coincide with activities reviewed by this evaluation were comprehensive, including identifying concerns that require correction to ensure effective waste management at the point of generation.

LLNL was keeping LSO informed on the status of waste held beyond DOE and/or regulatory limits including information about approved disposal paths and schedules. LSO, in turn, was informing the regulatory agency biannually on the status of these activities.

Improvement Areas and Recommendations

Tent Storage. At the old waste storage area, waste containers are stored under a tent. In the current configuration, rainwater flows around pallets holding drums.

> **Recommendation:** Consider relocating containers to the tent that has better runoff controls or improving the runoff diversion curbing.

Specificity of Controls. The waste management procedure at the Contained Firing Facility does not always sufficiently define controls (e.g., terminology such as "appropriate" controls) or reference environmental regulations instead of stating specific controls. Also, the procedures do not require users to unpack materials and supplies outside contaminated areas to prevent the creation of unnecessary LLW (although this is the practice at LLNL). The Superblock work permit form separates environmental (including waste) controls from safety, health, and radiological controls. The hazards list does not include waste hazards, and the waste is not addressed in the section that breaks out tasks and associated hazard and controls. OSPs convey specific safety and health controls but only included references to standing information gathering documents/waste management OSP without providing specific controls for the tasks that will generate waste.

> **Recommendation:** As waste management procedures are converted from a Site 300 to a RHWM document, consider replacing references to environmental regulations and non-specific controls with specific requirements and controls, and establish provisions that require unpacking items in uncontaminated areas.

> **Recommendation:** Consider adding waste management to the hazards list and including waste management controls in task-hazards-controls section.

> **Recommendation:** Consider improving the OSPs by providing specific controls for waste management beyond routine practices addressed in standing information gathering documents and waste OSPs.

Appendix A
Supplemental Information

A.1 Dates of Review

Planning Visit	October 6-8, 2009
Onsite Review Visit	October 19-29, 2009
Report Validation and Closeout	November 17-19, 2009

A.2 Review Team Composition

A.2.1 Management

Glenn S. Podonsky, Chief Health, Safety and Security Officer
William Eckroade, Deputy Chief for Operations, Office of Health, Safety and Security
John Boulden, Acting Director, Office of Independent Oversight and Office of Enforcement
Thomas Staker, Director, Office of ES&H Evaluations
William Miller, Deputy Director, Office of ES&H Evaluations

A.2.2 Quality Review Board

John Boulden	Steven Simonson	Thomas Staker
Dean Hickman	Robert Nelson	William Sanders

A.2.3 Review Team

William Miller, Overall Review Team Leader
Robert Freeman, Nuclear Safety Review Team Leader

Victor Crawford	Joe Lischinsky	Tim Martin	Joe Panchison
Don Prevatte	Jeff Robinson	Chris Chaves	

A.2.4 Administrative Support

Tom Davis
Mary Anne Sirk