

# Volume I Summary Report

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Independent Oversight  
Inspection of  
Environment, Safety,  
and Health Management  
at the

# Lawrence Livermore National Laboratory



December 2004

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Office of Independent Oversight and Performance Assurance  
Office of Security and Safety Performance Assurance  
Office of the Secretary of Energy

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## Abbreviations Used in This Report

DOE	U.S. Department of Energy
EM	Office of Environmental Management
ES&H	Environment, Safety, and Health
FY	Fiscal Year
ISM	Integrated Safety Management
LLNL	Lawrence Livermore National Laboratory
LSO	Livermore Site Office
NMTP	Nuclear Materials Technology Program
NNSA	National Nuclear Security Administration
OA	Office of Independent Oversight and Performance Assurance
PAT	Physics and Advanced Technologies Directorate
R&D	Research and Development
SSA	Office of Security and Safety Performance Assurance
UC	University of California

OVERSIGHT

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA), within the Office of Security and Safety Performance Assurance (SSA), conducted an inspection of environment, safety, and health (ES&H) at the DOE Lawrence Livermore National Laboratory (LLNL) during October and November 2004. The inspection was performed by the OA Office of Environment, Safety and Health Evaluations. OA reports to the Director of SSA, who reports directly to the Secretary of Energy.

Within the DOE, the National Nuclear Security Administration (NNSA) has line management responsibility for LLNL. NNSA provides programmatic direction and funding for most research and development (R&D), facility infrastructure activities, and ES&H program implementation at LLNL. The DOE Office of Environmental Management (EM) currently has responsibility for certain legacy hazards and environmental remediation projects at LLNL. EM plans to finalize the disposition of legacy wastes by the end of fiscal year (FY) 2005 and transfer management responsibility for remaining LLNL environmental restoration and waste management operations to NNSA in FY 2006.

At the site level, the NNSA Livermore Site Office (LSO) has line management responsibility



Aerial View of LLNL

for LLNL. Under contract to DOE, LLNL is managed and operated by the University of California (UC), which has operated LLNL since its establishment in 1952.<sup>1</sup>

LLNL's primary mission is R&D in support of national security. As a nuclear weapons design laboratory, LLNL has responsibilities in nuclear stockpile stewardship that include ensuring that U.S. nuclear weapons remain safe, secure, and reliable. LLNL also applies its expertise to prevent the spread and use of weapons of mass destruction and strengthen homeland security. Other major R&D program areas at LLNL include advanced



LLNL Materials

defense technologies, energy, environment, biosciences, and basic science. In addition to NNSA funding, LLNL receives funding for specific projects from other DOE program offices, various other government agencies, and various commercial organizations.

LLNL activities involve a variety of potential hazards that need to be effectively controlled. Hazards associated with radioactive materials include ionizing radiation, contamination, and nuclear criticality. Chemical hazards are present in numerous LLNL facilities and laboratories, which use a wide variety of chemicals. Potential physical hazards include machine operations, noise, high-voltage electrical equipment, excavation, pressurized systems, and construction. Various

<sup>1</sup> Consistent with common practice, the term "LLNL" is used to refer to both the physical facility and the onsite contractor management. The term "UC" is used to refer to the UC management that provides corporate direction to the onsite LLNL management team and that performs corporate line management and evaluation functions for UC activities at LLNL.

LLNL areas also contain a number of legacy hazards from past program activities, such as radioactive contamination, beryllium, and various other hazardous materials.

The purpose of this OA inspection was to assess the effectiveness of ES&H management at LLNL as implemented by UC under the direction of LSO. Using a selective sampling approach, the OA inspection evaluated:

- LLNL implementation of the core functions of integrated safety management (ISM) for selected activities, including Nuclear Materials Technology Program (NMTP) programmatic activities, R&D performed by the Physics and Advanced Technologies (PAT) Directorate, maintenance, construction, waste management, and environmental restoration activities. Because the LLNL institutional ISM systems are mature, OA focused more on implementation of ISM at the facility and activity levels.
- NNSA, LSO, and LLNL feedback and continuous improvement systems.
- Essential safety system functionality of the safety-class ventilation and fire suppression systems at the Plutonium Building (Building 322).
- LSO and LLNL management effectiveness for selected aspects of the ES&H program that OA has identified as focus areas, including management of legacy hazards, safety during excavations and blind penetrations, the unreviewed safety question

process, and selected aspects of safety in protective force training. OA selects focus areas—areas that warrant increased attention across the DOE complex—based on a review of operating events and inspection results.

Sections 2 and 3 provide a discussion of the key positive attributes and weaknesses identified during this review. Section 4 provides a summary assessment of the effectiveness of the major ISM elements reviewed on this inspection. Section 5 provides OA's conclusions regarding the overall effectiveness of NNSA, LSO, UC, and LLNL management of the ES&H programs, and Section 6 presents the ratings assigned during this review. Appendix A provides supplemental information, including team composition. Appendix B identifies the specific findings that require corrective action and follow-up.

Volume II of this report provides four technical appendices (C through F) containing detailed results of the OA review. Appendix C provides the results of the review of the application of the core functions of ISM for LLNL work activities. Appendix D presents the results of the review of NNSA, LSO, and contractor feedback and continuous improvement processes. Appendix E presents the results of the review of Plutonium Building essential safety system functionality, and Appendix F presents the results of the review of management of the selected focus areas. For each of these areas, OA identified opportunities for improvement for consideration by DOE and contractor management. The opportunities for improvement are listed at the end of each appendix so that they can be considered in context of the status of the areas reviewed.

Several positive attributes were identified in ES&H implementation at LLNL. Most work activities were performed with a high regard for safety, and significant progress is being made in addressing legacy wastes.

**Managers, especially Assurance Managers and ES&H Safety Officers and staff, demonstrate a strong commitment to safety and to reducing injuries and operational events.** This commitment was demonstrated by managers' attendance at safety meetings and reflected in initiatives and process changes to improve safety performance. Notable activities include the extensive safety campaign being implemented by the Plant Engineering Department that expands their behavior-based safety program, implements a worker pre-job task analysis, and establishes a more formal process for investigating and identifying corrective actions and lessons learned from incidents that are below the level at which formal reporting to DOE Headquarters is required. NMTP has made important design improvements in Plutonium Building safety systems over the last several years. For example, NMTP recently identified and aggressively addressed a significant vulnerability in its safety-class ventilation system, demonstrating management support of a questioning attitude and appropriate prioritizing of remedial action. The Security Department is conducting a detailed analysis of their processes, developing procedures, and identifying needed improvements as part of their quality assurance program. The PAT Directorate has been proactive in developing programs to minimize injuries and illnesses, such as establishing a safety office within the directorate, and taking action to identify and mitigate potential ergonomic hazards to reduce the risk of ergonomic-related injuries. Both LSO and LLNL are in the early stages of implementing improvements in safety system oversight programs for essential safety systems.

**LLNL institutional work control processes have been implemented effectively by some LLNL organizations.** The LLNL institutional and organizational work control and hazards analysis processes have been in place for

over four years. Rigorous implementation of these processes can result in effective controls. For example, LLNL managers responsible for work activities at the National Ignition Facility have applied the LLNL work control processes effectively to develop clear, documented work instructions to workers. As work progresses, these managers are conscientious and effective in monitoring work activities to ensure that workers implemented the work instructions appropriately. Engineering controls are also used extensively and effectively in many cases at LLNL to control hazards in accordance with institutional processes. For example, NMTP uses extensive engineered controls, including gloveboxes, hoods, and ventilation systems, specific to the work as a primary mechanism for controlling many activity-level hazards in the Plutonium Building.



LLNL Glovebox Activities

**NMTP operational safety plans have been effective in defining the scope of work and identifying hazards associated with activity-level program work.** The plans serve as the primary mechanism defining the scope of authorized activities within each laboratory. The plans provide considerable detail on the specific operations, processes, and activities to be performed at each individual workstation within a laboratory. Operational safety plans also provide a comprehensive listing of potential hazards associated with the work. The plans for programmatic work are reviewed and updated annually. The responsible individual, with assistance

from ES&H Team 1 subject matter experts, develops the plans by identifying hazards associated with each work evolution and then developing appropriate controls. The accuracy of the hazard information is ensured primarily through the proper involvement of ES&H disciplines, as well as the review and approval process, which includes facility safety staff, facility management, and ES&H team management.

**LLNL has established some effective programs for maintaining Building 332 safety systems.** Preventive maintenance is well defined and rigorously scheduled, tracked, and performed by Plant Engineering. LLNL performs an appropriate set of preventive maintenance procedures for the fans and motors. Corrective maintenance needs are also identified and addressed in a timely manner, so there is little maintenance backlog for safety-related systems. LLNL has defined a rigorous work control process for design change and maintenance activities. In addition, LLNL has established an effective program for assessing the remaining life of system components and establishing an appropriate replacement schedule. Although a few deficiencies in implementation were noted (e.g., some equipment trending and oil sampling tasks were not performed), in most respects, LLNL appropriately maintains safety system components to ensure their functionality.



Environmental Sampling

**LSO and LLNL have implemented an aggressive program for disposing of legacy waste by the end of FY 2005.** In the past two years, LLNL has effectively addressed storage issues for over 10,000

drum equivalents of transuranic waste, low-level waste, and mixed waste; previously, these drums were stored outdoors in less than optimal conditions, with no firm schedule for disposal. LSO and LLNL proactively obtained funding to address these drums and other legacy wastes. LLNL is aggressively implementing the disposition effort and is on schedule to finalize the disposition of most legacy wastes by the end of this fiscal year. In addition, LLNL's new waste management facilities are now operational, providing a protected location for storing the small amount of legacy waste that will not be sent to disposal this year.

**In coordination with LSO, LLNL has developed an effective program for protecting workers from electrical hazards during excavations and blind penetrations.** Site management recognizes the potential hazards associated with buried utilities across the site and has devoted considerable effort to minimizing the risk of striking buried and hidden utilities. LSO recognized the importance of electrical safety during penetrations and excavations, reviewed LLNL controls in this area, and worked with LLNL to implement program enhancements. Several aspects of this program are noteworthy practices. LLNL implements a rigorous permit process for concrete and soil penetrations and excavations, including gardening and landscaping activities. Identified utilities are clearly marked, and photographs are used to record the location of the markings in order to keep workers informed if the marks become obscured during work activities. Recognizing the inaccuracies in commonly-used locating technologies, LLNL requires the use of non-destructive techniques for excavations within 30 inches of a marked utility or underground obstruction, a practice that is more conservative than industry and Occupational Safety and Health Administration standards. To mark utilities, LLNL uses an electronic system that positively identifies the marked utility, its actual position, and its depth. Training for site personnel involved in these efforts is extensive and performance-based, including on-the-job training, a formal industry training course, and practical exercises. When strictly adhered to, the excavation, soil penetration, and concrete penetration processes at LLNL constitute noteworthy practices.

Although some aspects of ISM at LLNL are effective, significant work remains to ensure that ISM program elements are implemented effectively and that programs for ensuring essential system functionality are implemented with the degree of rigor and formality expected at nuclear facilities.

**Hazards analysis and control processes have not been implemented effectively by a number of LLNL organizations.** OA's evaluation of the core functions of safety management indicated systemic deficiencies in implementation of the sitewide work control processes across a wide range of LLNL facilities and activities. While some facilities and activities performed acceptably (e.g., waste management controls and National Ignition Facility construction), OA identified four deficiencies that were prevalent enough to warrant attention at the institutional level and corrective actions on a sitewide basis. First, within several LLNL directorates, divisions, and departments, LLNL management has not ensured that institutional requirements are adequately implemented at the activity level during work activities and in support of ES&H activities. Second, many work instructions (e.g., procedures) either have not been developed or are inadequate. Third, in those cases where requirements are adequately defined, they are often not implemented as specified in the work instructions. LLNL does not have adequate directions defining expectations for procedure/work instruction usage (e.g., when and how procedures need to be used, how procedures are approved, expectations for verbatim compliance). Fourth, processes for identifying and correcting deficiencies in work instructions and implementation of requirements have not been effective. As a result, deficiencies in procedures, worker performance, and attitudes toward procedure compliance have not been adequately identified and corrected.

**Deficiencies in system design, configuration management, quality assurance, surveillance and testing, and operations programs reduce safety system reliability and functionality.** Although the safety-class ventilation and fire suppression systems reviewed were, in



LLNL Facilities

general, adequately designed to perform their safety functions during normal operations, system upsets, and some accident conditions, OA identified significant deficiencies in some analyses necessary to ensure that the systems would perform adequately during design basis accident conditions. Furthermore, some important parameters supporting the system functionality were not properly included in the safety analysis report or technical safety requirements. In addition, two deficiencies in the current design of the fire protection system could render it inoperable during certain events, such as design basis seismic events. The NMTP configuration management and quality assurance programs for Building 332 have not been well defined and are not implemented so as to ensure the functionality of safety-class components. Although both LLNL and LSO previously recognized the configuration management problems, no action has been taken to address them. Most of the important safety-related components of the fire protection and ventilation systems are being appropriately tested; however, certain fire suppression components are not included in the technical surveillance requirements, one surveillance did not adequately test the technical safety requirement, and two surveillance procedures were not adequately performed. Operators are generally experienced and knowledgeable, but weaknesses were identified in certain aspects of operating procedures and operator training, including outdated procedures, no alarm response procedures, limited system design training, lack of training on recent system modifications, and unapproved/uncontrolled operator aids. There are also weaknesses in some



LLNL Facility

aspects of the unreviewed safety question program and its implementation that adversely impact configuration management at Building 332.

**LLNL management has not ensured systematic performance of required, formal as-low-as-reasonably-achievable (ALARA) reviews for programmatic work in Building 332.** Formal ALARA reviews have not been performed for some operations that require a formal review as defined in the LLNL ES&H Manual. For example, no formal reviews have been conducted for some operational safety plan activities where workers may accumulate external doses in excess of ALARA review thresholds defined in the ES&H Manual. In a few cases, specific ALARA plans were developed but were not implemented in accordance with the ES&H Manual. Some reviews did not meet the ES&H Manual requirements for scope and content, and where specific ALARA controls were developed, they were not always properly integrated into the operational safety plans governing the work. For example, operational safety plans lacked specific information on task-specific doses or a complete listing of ALARA controls to be employed. In the absence of a systematic approach to conducting the required ALARA reviews, LLNL cannot demonstrate whether exposures have been optimally reduced or whether current ALARA goals are appropriate. This is a repeat concern from the 2002 OA safety management evaluation.

**LLNL has not adequately ensured that all construction subcontractors implement applicable safety requirements.** The DOE ISM policy is included in subcontracts. However, some LLNL construction subcontractors have not established formal processes for defining tasks associated with subcontracted construction projects, and tasks associated with these projects are not defined in

sufficient detail to support identification of task-specific hazards and controls. For example, the scope of work to be performed by an independent construction company for the construction of Building 242 is defined in drawings and specifications, but the installation of asphalt roofing on this building has not been described, and hazards associated with exposure to asphalt fumes were not identified or controlled. In addition, LLNL safety processes and procedures have not been applied to some construction subcontractors. Subcontracts require compliance with LLNL permits for excavations and penetrations and for confined spaces but do not require compliance with LLNL processes for establishing controls, such as procedures for using integration work sheets, bridging documents, or pre-task hazards analysis worksheets. Construction subcontractors have not established programs for safety management that include systematic identification and documentation of controls to be applied for planned tasks. Instead, they have relied primarily on the knowledge of their employees and subcontractors to identify applicable controls from safety plans, material safety data sheets, and regulatory requirements prior to performing assigned tasks. In addition, some safety requirements that are included in the DOE/UC contract as Work Smart Standards (e.g., requirements for worker exposure assessments) have not been flowed down to construction subcontractors.

**Management systems that provide safety feedback and ensure continuous improvement continue to be problematic at LLNL.** The policies, procedures, and guidance provided in the ES&H Manual and within directorates are not specific enough to fully define the processes and responsibilities for assessment, deficiency and issues management, injury and illness investigation and reporting, lessons learned, post-job reviews, and employee concerns. Implementation of these processes by line management and support organizations is not always rigorous or timely. Assessments and accident investigations often are not performance-based (i.e., involving observations of actual work or operations, rather than review of documents reflecting compliance with requirements), lack sufficient substance, or are poorly documented, with deficiencies and issues not clearly defined. In many cases deficiencies and associated corrective and preventive actions, especially for injury and illness incidents, are not clearly delineated or put into the Issues Tracking System. The application of the new tracking system needs further definition in the ES&H Manual, and barriers to broad access to the database information



need to be removed. The applicability of lessons learned to LLNL activities and the analysis and determination of any needed corrective actions need to be better documented and tracked. Finally, the adequacy of

safety management systems and safety programs that affect multiple LLNL organizations are not routinely assessed from a sitewide perspective.

## 4.0 Summary Assessment

The following paragraphs provide a summary assessment of the LSO and LLNL activities that were evaluated by OA on this inspection. Additional details relevant to the evaluated organizations are included in the technical appendices in Volume II of this report.

**Nuclear Materials Technology Program Activities.** NMTP demonstrated effective implementation of ISM in many areas. The scope of work and schedule for NMTP work was well defined, and work activity hazards were generally identified and analyzed appropriately. NMTP uses a combination of engineering and administrative controls effectively to prevent and mitigate hazards associated with programmatic operations, and most work evolutions were appropriately authorized and performed safely, in accordance with established controls. However, OA identified systemic deficiencies that prevent fully effective ISM within NMTP facilities. Weaknesses in implementation of some controls jeopardize their effectiveness, including the lack of required formal ALARA reviews for high-dose work, weaknesses in document control, insufficient procedural instructions for some duties, and a lack of rigor in following requirements or establishing appropriate technical bases for variations. In some cases, workers failed to follow established requirements, and management tolerated non-conservative interpretations of safety rules or requirements without initiating appropriate corrective actions. NMTP has not ensured that activities are performed with the rigor expected in a Category 2 nuclear facility and that supervisors and workers either follow safety requirements as written or stop the work activity until the requirements are corrected.

**Physics and Advanced Technologies Directorate R&D.** Work scopes for research conducted by the PAT Directorate are adequately defined in integration work sheets, facility safety plans, work documents, and facility-level hazards analyses, such as safety assessment documents and hazards analyses reports. Proactive safety initiatives within the PAT Directorate Safety Office and a knowledgeable research and

engineering technician staff have also contributed to the PAT Directorate achieving the lowest injury and illness rates among all the LLNL directorates. However, some research work activities have not been adequately addressed in integration work sheets, and a number of hazards and controls were missed. In addition, some safety procedures were not adequately followed, work documents were not prepared in accordance with the ES&H Manual or incorporated into integration work sheets, and ES&H training requirements were not clearly defined.

**Maintenance.** The Plant Engineering Department performs a significant amount of work on a daily basis at LLNL. Work controls by the National Ignition Facility work team indicate that conscientious attention to the written instructions and policies adopted by LLNL can result in clear and effective written instructions to workers. These instructions effectively supplement the knowledge and skills of the workforce. Processes at this facility are effectively implemented because the NIF project team sets high expectations and ensures that work in this organization is clearly defined. Very little of the Plant Engineering work at the remainder of the LLNL facilities is subject to the detailed planning expected of an effective ISM system. Instead, the system relies heavily on verbal communication, electronic mail, and other memoranda between craft personnel, facility points of contact, ES&H personnel, and customers. Decisions reached during those communications are not always captured within work documents, leaving workers to rely on their individual expertise to be aware of and control hazards. Workers were aware of most of the hazards they could be exposed to, but there were cases where hazards were not adequately identified, controls were not clearly implemented, and laboratory safety policies were not followed.

**Construction.** For construction activities, the work control process for activities performed by LLNL and one major construction subcontractor contains essential elements for integrating safety into planning and work execution. The process includes provisions to define the scope of work to



LLNL Construction-Like Activities

be performed, identify associated hazards and controls, and ensure readiness before authorizing work. However, the process relies heavily on workers for identifying tasks and task-specific hazards and controls, and the training, procedures, and involvement of supervisors and ES&H personnel do not fully support workers in this regard. Worker involvement is appropriate and is an important element of ISM, but some procedures, processes, and training are not adequate to support this level of reliance on workers to control hazards. In particular, processes do not include sufficient involvement of supervisors or ES&H personnel to ensure the identification and control of hazards that may not be evident to workers. The use of blanket integration work sheets increases efficiency by reducing planning time but does not always describe activities, hazards, and controls with sufficient specificity. LLNL has included a requirement for ISM in construction subcontracts but has not ensured that these subcontractors establish the formal processes necessary to systematically integrate safety into work planning and execution. In particular, planning by most subcontractors does not include systematic identification of tasks, hazards, and controls as specified by the DOE safety management system policy.

**Waste Management Operations.** Most hazards associated with waste management activities are adequately identified, analyzed, and controlled in both the central waste management facilities and at the point of generation within the divisions. The waste management activities are being performed in compliance with external regulations and DOE and LLNL requirements. Several enhancements in waste management operations have been made in the past two years, and most waste operations have been transferred to the new waste treatment and storage facility. However, integration work sheet hazards

analysis and controls and labeling are not sufficiently rigorous in a few areas. Limited progress has been made in developing the LLNL environmental management systems, such that there is not sufficient assurance that LLNL will meet the requirements set by Executive Order 13148 for implementation and self-certification by December 31, 2005.

**Environmental Restoration Activities.** The Environmental Restoration Division's operation of both field activities and fixed facilities at Livermore's main site and Site 300 demonstrates a commitment to safety. However, more disciplined operations and more rigorous implementation of the work planning and control processes are needed to ensure that DOE requirements are implemented effectively. The application of the LLNL integration work sheet process and the updating of older safety documents to the newer integration work sheet system to consolidate hazards and controls in a



LLNL Sampling Activities

single document requires continued attention, particularly at the activity level, to ensure that discrete work tasks and potential hazards are identified with their associated controls. ES&H subject matter experts have been integrated into the work planning process through the formation of ES&H teams assigned to support activities at the division level. Implementation of these capabilities, however, is not always sufficiently rigorous. Facilities and activities do not always implement the hazard controls as intended, and ES&H Manual requirements are not always explicitly addressed in work planning documents.

**Essential Systems Functionality at the Plutonium Building.** LLNL has established many appropriate elements for ensuring that safety systems can reliably perform their safety functions. The safety

functions and design criteria of the ventilation and fire suppression systems are, in general, appropriately defined in the safety analysis report, and in most respects, these systems are appropriately designed to perform their safety functions under normal conditions, system upsets, and most accident conditions. Important design improvements have recently been made to improve the functionality of these systems, including modification of dampers so that they fail in safe directions, and addition of a backup air supply to the dampers. In addition, most surveillances and tests are adequately performed, the systems are being well maintained, and operators are knowledgeable of system operations and demonstrated the ability to operate the equipment appropriately under normal conditions and for surveillance and maintenance evolutions. Furthermore, both LSO and LLNL have recently implemented improvements in safety system oversight programs that have identified some needed improvements at Building 332. However, deficiencies were identified in several areas. Deficiencies in engineering analysis and design and in configuration management and quality assurance programs are the most significant and could threaten the systems' ability to perform their safety functions in some scenarios. Deficiencies in surveillance and testing, implementation of work control processes, and operating procedures also reduce confidence in the safety systems' performance. Management has not sufficiently ensured that important programs, such as configuration management and quality assurance, are rigorously defined and implemented, and that longstanding configuration management deficiencies are addressed. Furthermore, management has not consistently ensured that work processes are rigorously implemented and that design weaknesses are addressed. LSO oversight has not been sufficient to identify some significant program weaknesses and ensure that identified weaknesses are addressed.

**Legacy Hazards.** LLNL is making good progress in reducing legacy hazards through institutional initiatives and processes identified in the Ten Year Comprehensive Site Plan, including an effective facility deactivation and disposition process. An aggressive program for disposing of legacy waste by the end of FY 2005 is under way, but could be impacted by a funding shortfall in FY 2005. LSO has been actively involved in the oversight of certain legacy hazards projects. However, these initiatives could be further strengthened through more consistent management attention to legacy hazards and supporting institutional initiatives, and better documentation.

**Construction and Excavations/Blind Penetrations.** LLNL is expending considerable effort to minimize the risk of striking buried and hidden utilities. All personnel conducting excavation activities were aware of the requirements to perform utility location surveys. When strictly adhered to, the excavation, soil penetration, and concrete penetration process at LLNL constitutes a noteworthy practice.

**Unreviewed Safety Question (USQ) Process.** In most regards, the sitewide procedure correctly reflects the applicable USQ requirements. LSO's 2003 review of implementation of the site USQ determination process identified needed improvements in this area. The USQ determinations reviewed during this OA inspection were appropriately and correctly processed in accordance with the procedure. However, concerns were identified with USQ screenings both in the procedure and in the implementation of the procedure. In some cases, changes in procedures or facilities were incorrectly screened out, and therefore the required USQ determinations were not performed. For example, modifications to glovebox ductwork were incorrectly categorized as a maintenance activity and thus inappropriately screened out, and no USQ determination was performed.

**Safety During Protective Force Training.** Hazards related to protective force training at the firearms training facilities are sufficiently identified and analyzed. Some aspects of hazard control procedures, documentation, and communications warrant further improvement. LLNL is taking actions to address injury rates, which are high in comparison to other DOE facilities.

**LLNL Feedback and Improvement.** Many mechanisms are being used to provide feedback and improvement in safety performance at LLNL. Line managers, ES&H personnel, and assurance managers all demonstrate involvement and commitment to improving safety performance and reducing injuries and operational incidents. Independent and management self-assessments are performed, deficiencies and issues are identified, corrective actions are developed and implemented, and lessons learned are frequently and widely disseminated. The new issues tracking system tool for tracking ES&H deficiencies and issues provides much better flexibility and accessibility for monitoring performance and identifying trends. However, inconsistencies and weaknesses in processes and the implementation of feedback and improvement mechanisms have hindered their effectiveness in driving continuous improvement in ISM implementation. Assessments are not sufficiently focused on work

observation, operations, and implementation of ISM. ES&H issues are not effectively and consistently managed to ensure that corrective actions fully address program and performance deficiencies. Increased rigor is needed to ensure that lessons learned are consistently evaluated for applicability to LLNL activities and conditions and that corrective/preventive actions tailored to LLNL are identified and implemented where appropriate. Additional rigor is needed in the investigation and development of preventive actions for injuries and illnesses. Documentation of the management of employee concerns also lacks sufficient rigor. Most of these weaknesses were identified during the 2002 OA inspection but have not been fully or effectively addressed by LLNL management.

**LSO Oversight.** LSO performs a number of line management oversight activities and is making progress on revising its procedures and processes to reflect the NNSA reengineering effort and line oversight/contractor assurance system (a DOE initiative to enhance feedback and improvement systems for DOE organizations and

contractors). LSO recently completed an effective organizational self-assessment that identified a number of deficiencies, which are consistent with the deficiencies identified during this OA inspection. Also, some LSO elements perform effective line oversight activities that are contributing to improvements in ES&H performance at LLNL. In a number of cases, LSO assessments have been effective in identifying deficiencies in LLNL safety controls and have resulted in improvements in ES&H programs and performance (e.g., electrical safety during penetrations/excavations and USQ determinations). However, many of the needed procedures and directives are not currently in place or are not fully and effectively implemented. In addition, some important mechanisms for assessing LLNL ES&H performance, including operational awareness activities, assessments, Facility Representative reviews, and issues management processes, are not consistently implemented or are not sufficiently rigorous.

## 5.0 Conclusions

LSO and LLNL have established ISM systems that are conceptually sound but are implemented with varying levels of effectiveness across and within the various directorates. Many work activities were performed with a high regard for safety. However, there are systemic deficiencies in implementing the work control processes, ensuring adequate work instructions, adhering to work instructions, and ensuring that process and performance deficiencies are identified and corrected at the activity level. Collectively, the deficiencies in the work control process indicate that although the work control process has been in place for four years, LLNL still relies largely on an expert-based approach to safety, rather than the ISM principle of clear standards and requirements.

The essential safety systems reviewed at the Plutonium Building have many appropriate design features and are generally well maintained, and LLNL has implemented some noteworthy design improvements. However, the systems have some significant engineering analysis and design deficiencies, and the configuration management, quality assurance, surveillance and testing, and operations programs have deficiencies that jeopardize essential system reliability and functionality in certain scenarios.

For the most part, NNSA, EM, LSO, and LLNL have been proactive and effective in addressing the complex issues associated with legacy wastes and have developed a noteworthy program for controlling hazards associated with

electrical penetrations. However, additional improvements are needed in the USQ process.

While some enhancements have been made in LSO and LLNL feedback and improvement processes, many process and performance weaknesses remain. Further refinement and effective implementation of the new LSO safety system oversight process are needed. LLNL needs to address weaknesses in feedback and improvement processes and implementation in the areas of assessments, issues management, lessons learned, and injury and illness reporting at the institutional and activity levels. Improvements in feedback and improvement processes are key to achieving the needed improvements in safety management across LLNL activities and essential systems.

Several improvements are needed to fully and effectively implement ISM at LLNL. Consistent sitewide implementation of the integration work sheet process and other institutional requirements is important to ensure an adequate framework for analyzing and controlling hazards. Improvements are also needed in the quality of work instructions and procedure adherence at the institutional level and within the LLNL directorates. Finally, given the seriousness and extent of safety system program and system design deficiencies, LLNL and LSO should take near-term actions to evaluate their collective impact on safe operation and extent of condition, and to determine whether compensatory measures are needed.

## 6.0 Ratings

The ratings reflect the current status of the reviewed elements of the LLNL ISM program.

**Implementation of Core Functions for Selected Work Activities** (See Appendix C, Section C.4, for a more detailed breakdown of the Core Function ratings.)

Core Functions #1-4 Implementation – NMTP .....	NEEDS IMPROVEMENT
Core Functions #1-4 Implementation – Physics and Advanced Technologies .....	NEEDS IMPROVEMENT
Core Functions #1-4 Implementation – Maintenance .....	NEEDS IMPROVEMENT
Core Functions #1-4 Implementation – Construction .....	NEEDS IMPROVEMENT
Core Functions #1-4 Implementation – Waste Management .....	EFFECTIVE PERFORMANCE
Core Functions #1-4 Implementation – Environmental Restoration .....	NEEDS IMPROVEMENT

### **Feedback and Improvement**

Core Function #5 – Feedback and Continuous Improvement .....	NEEDS IMPROVEMENT
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### **Essential System Functionality**

Engineering Design .....	SIGNIFICANT WEAKNESS
Configuration Management and Quality Assurance .....	SIGNIFICANT WEAKNESS
Surveillance and Testing .....	NEEDS IMPROVEMENT
Maintenance .....	EFFECTIVE PERFORMANCE
Operations .....	NEEDS IMPROVEMENT

# APPENDIX A

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## SUPPLEMENTAL INFORMATION

### A.1 Dates of Review

Planning Visit	September 27-October 1, 2004
Onsite Inspection	October 18-28, 2004
Report Validation and Closeout	November 16-18, 2004

### A.2 Review Team Composition

#### A.2.1 Management

Glenn S. Podonsky, Director, Office of Security and Safety Performance Assurance  
Michael A. Kilpatrick, Director, Office of Independent Oversight and Performance Assurance  
Patricia Worthington, Director, Office of Environment, Safety and Health Evaluations  
Thomas Staker, Deputy Director, Office of Environment, Safety and Health Evaluations

#### A.2.2 Quality Review Board

Michael Kilpatrick	Patricia Worthington
Dean Hickman	Robert Nelson

#### A.2.3 Review Team

Thomas Staker, Team Leader

Phil Aiken	Vic Crawford	Brad Davy	Connie Eimer
Marvin Mielke	Bill Miller	Jim O'Brien	Bob Compton
Al Gibson	Bernie Kokenge	Joe Lischinsky	Jim Lockridge
Don Prevatte	Michael Shlyamberg	Ed Stafford	Mario Vigliani

#### A.2.4 Administrative Support

MaryAnne Sirk  
Sandy Pate  
Tom Davis

### A.3 Ratings

OA uses a three-level rating system to provide line management with a tool for determining where resources might be applied toward improving environment, safety, and health. It is not intended to provide a relative rating between specific facilities or programs at different sites because of the many differences in missions, hazards, and facility life cycles, and the fact that these reviews use a sampling technique to evaluate management systems and programs. The three ratings and the associated management response are:

- Significant weakness, which indicates a need for immediate management attention, focus, and action
- Needs improvement, which indicates a need for significantly increased management attention
- Effective performance, which indicates that management should address any identified weakness.



## APPENDIX B

### SITE-SPECIFIC FINDINGS

**Table B-1. Site-Specific Findings Requiring Corrective Action**

FINDING STATEMENTS
1. Within several LLNL directorates, LLNL management has not fully and effectively implemented the integration work sheet system and institutional ES&H requirements.
2. LLNL management has not ensured that requirements are clearly defined and communicated in accurate work instructions (i.e., procedures, requirements documents, permits, and other documents that define safety requirements and how to properly implement them).
3. Within several LLNL directorates, LLNL management has not provided clear expectations for verbatim compliance with requirements and procedures, contributing to a number of instances where safety requirements were not implemented as written and/or the procedure was not corrected before proceeding with the work.
4. LLNL management has not ensured that deficiencies in work instructions and implementation of requirements at the work-activity level are identified and corrected.
5. Formal ALARA reviews for some operations in Building 332 that meet applicable dose thresholds have not been performed and results have not been integrated into work documents as required by ES&H Manual Document 20.4, resulting in an inability to demonstrate that doses are being maintained ALARA and that ALARA goals are appropriate.
6. LLNL has not ensured that all independent construction subcontractors fully implement safety management systems consistent with DOE Policy 450.4, <i>Safety Management System Policy</i> , and existing processes failed to define work in sufficient detail to support identification of task-specific hazards and controls.
7. LLNL has not ensured flowdown of some ES&H requirements to construction subcontractors to the extent necessary to ensure compliance as required by Clause I-066 of the DOE/UC contract.
8. Important elements of the LSO line management oversight program are not fully established or effectively implemented in the areas of memoranda of understanding, clear responsibilities and authorities, standard operating procedures, assessment schedules, employee concerns programs, the lessons-learned process, technical qualifications, and document storage.
9. LSO operational awareness activities, assessments, Facility Representative reviews, and issues management processes are not sufficiently rigorous to ensure continuous improvement in LLNL ES&H programs and performance.
10. The LLNL self-assessment program lacks sufficient rigor in planning and execution to be fully effective in evaluating ES&H performance.

**Table B-1. Site-Specific Findings Requiring Corrective Action (continued)**

<b>FINDING STATEMENTS</b>
11. LLNL deficiency and issues management processes and performance are not fully effective in documenting ES&H program and performance deficiencies and ensuring that effective corrective and preventive actions are developed and tracked to completion.
12. Injury and illness investigations lack sufficient rigor to ensure that causes are identified and that appropriate, effective corrective and preventive actions are identified and implemented.
13. NMTP has not adequately analyzed the design of the safety-class ventilation and fire protection systems and has not adequately translated some critical system parameters into technical safety requirements (TSRs).
14. NMTP did not adequately evaluate and process system modifications, degrading a safety-class system to the extent that it might not be capable of performing its safety function under all design basis accidents conditions.
15. NMTP has not adequately implemented the LLNL potentially inadequate safety analysis (PISA) process to address some Building 332 design and safety analysis deficiencies.
16. NMTP has not resolved longstanding and significant configuration management deficiencies that prevent NMTP from fully meeting all of the TSR-required configuration management elements. LSO has not ensured that appropriate actions are taken to resolve these configuration management deficiencies.
17. NMTP has not adequately defined and implemented its current configuration management processes to ensure maintenance of safety system configuration and functionality during day-to-day work activities.
18. NMTP has not effectively defined its quality assurance (QA) organization and responsibilities in its QA program, has not maintained its QA procedures, and has not effectively implemented all of its QA functions.
19. NMTP has not established a procurement process for safety-class components that fully meets 10 CFR 830 and DOE Order 414.1A requirements and is not rigorously implementing its current procurement process.
20. NMTP TSRs for Building 332 have not included or tested some important safety-class components, and one Building 332 TSR surveillance procedure did not adequately demonstrate full compliance with its associated TSR requirements.
21. NMTP has not adequately implemented the current work control processes described in its Work Control/ Design Change Control Process Manual.
22. NMTP has not adequately established and maintained operations procedures as required by the Building 332 TSRs.
23. The site unreviewed safety question procedure does not fully implement 10 CFR 830 requirements.
24. The unreviewed safety question process is not being executed in Building 332 in accordance with the requirements of the site unreviewed safety question procedure or 10 CFR 830.