Volume I

Inspection of Environment, Safety, and Health Management at the

Lawrence Livermore National Laboratory

July 2002

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

INDEPENDENT OVERSIGHT
INSPECTION OF
ENVIRONMENT, SAFETY, AND HEALTH MANAGEMENT
AT THE
LAWRENCE LIVERMORE NATIONAL LABORATORY

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Acronyms

AC	Alternating Current
ALARA	As Low As Reasonably Achievable
AMNS	Assistant Manager for National Security
ARO	Assurance Review Office
CAM	Continuous Air Monitor
CFR	Code of Federal Regulations
CY	Calendar Year
DAC	Derived Air Concentration
DAP	Discipline Action Plan
DC	Direct Current
DDSO	Deputy Director for Strategic Operations
DOE	U.S. Department of Energy
EM	DOE Headquarters Office of Environmental Management
EPD	Environmental Protection Department
ES&H	Environment, Safety and Health
FPOC	Facility Point of Contact
FR	Facility Representative
FRAM	Functions, Responsibilities, and Authorities Manual
FRTQP	Facility Representative Training and Qualification Program
FSP	Facility Safety Plan
FY	Fiscal Year
HAZCOM	Hazard Communications
HEPA	High Efficiency Particulate Air
HWM	Hazardous Waste Management
ISM	Integrated Safety Management
IWS	Integrated Work Sheet
LEPD	Livermore Environmental Programs Division
LLNL	Lawrence Livermore National Laboratory
LO/TO	Lockout/Tagout
LSOD	Livermore Safety Oversight Division
NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NNSA	National Nuclear Security Administration
OA	Office of Independent Oversight and Performance Assurance
OAK	Oakland Operations Office
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
OSP	Operational Safety Plan
PM	Preventive Maintenance
PPE	Personal Protective Equipment
R&D	Research and Development
RWP	Radiation Work Permit
SAD	Safety Assessment Document
SAR	Safety Analysis Report
SME	Subject Matter Expert
SSEP	Safety, Security, and Environmental Protection
TAP	Team Action Plan
TQP	Technical Qualification Program

Acronyms (Continued)

TSR	Technical Safety Requirement
UC	University of California
WSS	Work Smart Standard

INDEPENDENT OVERSIGHT INSPECTION OF ENVIRONMENT, SAFETY, AND HEALTH MANAGEMENT AT THE LAWRENCE LIVERMORE NATIONAL LABORATORY

VOLUME I

1.0 INTRODUCTION

The Secretary of Energy's Office of Independent Oversight and Performance Assurance (OA) conducted an inspection of environment, safety, and health (ES&H) and emergency management programs at the U.S. Department of Energy (DOE) Lawrence Livermore National Laboratory (LLNL) in June 2002. The inspection was performed as a joint effort by the OA Office of Environment, Safety and Health Evaluations and the Office of Emergency Management Oversight. This volume discusses the results of the review of LLNL ES&H programs. The results of the review of the LLNL emergency management program are discussed in Volume II of this report, and the combined results are discussed in a summary report.

The National Nuclear Security Administration (NNSA) Office of the Deputy Administrator for Defense Programs (NA-10) is the cognizant secretarial office for LLNL. As such, it has overall Headquarters line management responsibility for programmatic direction, funding of activities, and ES&H at the site. The DOE Headquarters Office of Environmental Management (EM) is responsible for directing and funding certain activities at LLNL, including waste management. At the site level, DOE line management responsibility for LLNL operations and safety falls under the Oakland Operations Office (OAK) Assistant Manager for National Security. LLNL is operated by the University of California (UC), under contract to DOE. As a multiprogram laboratory, LLNL receives funding for research and development (R&D) programs from various sources, including NNSA, EM, other DOE program offices, various U.S. agencies, and commercial industry.

In accordance with the changes in line management directed by the NNSA Administrator in March 2002, OAK is planning for a reorganization of line management responsibilities. Current plans call for establishing a Livermore Site Office that will be a direct report to the NNSA Administrator. This office will be given increased responsibility and accountability for managing and directing the LLNL contractor, including contract administration.

LLNL's primary mission is to provide scientific and engineering support to U.S. national security programs. LLNL performs research, development, design, maintenance, and testing in support of the nuclear weapons stockpile. LLNL also performs theoretical and applied R&D in such areas as energy, biomedicine, and environmental science.

To support these activities, LLNL operates numerous laboratories, test facilities, and support facilities at two major sites—the LLNL main site (referred to as the Livermore site) and Site 300. The LLNL main site, located in Livermore, California, encompasses approximately 800 acres. Site 300 occupies approximately 11 square miles and is about 15 miles east of the LLNL main site. LLNL activities involve various potential hazards that need to be effectively controlled, including exposure to external radiation, radiological contamination, nuclear criticality, hazardous chemicals, and various physical hazards associated with facility operations (e.g., machine operations, high-voltage electrical equipment, pressurized systems, noise, and construction/maintenance activities). Significant quantities of radiological and chemical hazardous materials are present in various forms at LLNL.

Throughout the evaluation of ES&H programs, OA reviews the role of DOE organizations in providing direction to contractors and conducting line management oversight of the contractor activities. OA is placing more emphasis on the review of contractor self-assessments and DOE line management oversight in ensuring effective ES&H programs. In reviewing DOE line management oversight, OA focused on the effectiveness of NNSA and OAK in managing the LLNL contractor, including such management functions as setting expectations, providing implementation guidance, allocating resources, monitoring and assessing contractor performance, and monitoring/evaluating contractor self-assessments. Similarly, OA focuses on the effectiveness of contractor self-assessments, which DOE expects to provide comprehensive reviews of performance in all aspects of ES&H.

The purpose of the ES&H portion of this inspection was to assess the effectiveness of selected aspects of ES&H management as implemented by LLNL under the direction of NNSA and OAK. The ES&H portion of the inspection was organized to evaluate four related aspects of the integrated safety management (ISM) program:

- Implementation of the guiding principles of ISM by OAK and LLNL
- OAK and LLNL feedback and continuous improvement systems
- LLNL implementation of the core functions of safety management for various work activities, including programmatic activities (e.g., experiments), facility operations, maintenance, waste management operations, and subcontracted work
- OAK and LLNL implementation of environmental protection programs at the LLNL site.

The review encompassed the application of the core functions of ISM to radiological environmental monitoring, groundwater protection, waste management, and liquid process effluent controls.

The OA inspection team used a selective sampling approach to determine the effectiveness of OAK and LLNL in implementing DOE requirements. The sampling approach involves examining selected institutional programs that support the ISM program, such as OAK and LLNL assessment programs. To determine the effectiveness of the institutional programs, the OA team examined implementation of requirements by selected LLNL organizations and facilities. Specific organizations and facilities reviewed included:

- The Defense and Nuclear Technologies Directorate, focusing on activities in Buildings 191 and 332. Building 332 is a Category 2 nuclear facility used to perform various stockpile maintenance and R&D activities involving plutonium. Building 191 is used for development, testing, and storage of explosives and initiation systems.

- The Chemistry and Materials Science Directorate, focusing on activities in Buildings 132 and 235. Building 132 houses various chemical laboratories. The Building 235 complex consists of laboratories and facilities/equipment (e.g., a linear accelerator and lasers) used for experimental R&D in chemistry and material science.

- The sitewide environmental monitoring and waste management facilities/activities performed by the Site Safety, Security, and Environmental Protection Directorate.

- Building 131 High Bay operations and activities conducted by the Engineering Directorate. Various testing and manufacturing activities are conducted in the Building 131 High Bay.

- Maintenance and engineering functions performed by the Laboratory Services Directorate.

As discussed in this report, most aspects of ISM are effectively implemented at LLNL, and work observed by the OA team was performed with a high regard for safety. Weaknesses were identified in a few areas, including testing and maintenance of fire protection systems, corrective action management, and some aspects of the LLNL work planning and controls system (Integrated Work Sheets). Although further improvements are needed in a few areas, OAK and LLNL management have made significant improvements, and the ISM program at LLNL is generally effective and continuing to mature and improve.

Section 2 of this volume provides an overall discussion of the results of the review of the LLNL ISM program, including positive aspects, findings, and other items requiring management attention. Section 3 provides OA's conclusions regarding the overall effectiveness of OAK and LLNL management of ES&H programs. Section 4 presents the ratings assigned as a result of this review. Appendix A provides supplemental information, including team composition. Appendix B identifies the specific findings that require corrective actions and follow-up. Appendix C presents the results of the review of the guiding principles of ISM. Appendix D presents the results of the review of the OAK and LLNL feedback and continuous improvement processes. The results of the review of the application of the core functions of ISM at the selected LLNL facilities are discussed in Appendix E. The results of the review of environmental protection systems are discussed in Appendix F.

2.0 STATUS AND RESULTS

2.1 Positive Attributes

The ISM program at LLNL has significantly improved as various management systems have matured and new processes have been established. Several positive attributes were identified in the institutional management systems. Many aspects of ISM implementation at the facility and activity level were also particularly effective.

The OAK operations teams are effectively implemented to perform line management oversight of LLNL. OAK operations teams are led by a line manager and include Facility Representatives, technical specialists, and program staff. Operations teams conduct a comprehensive program of day-to-day operational awareness activities and perform regular assessments. The operations teams are focusing on performance and identifying ES&H program deficiencies, and are fostering continuous performance improvement at LLNL. OAK's allocation of personnel resources and technical expertise/skill mix to the operations teams is consistent with the relative risks (e.g., the operations teams for the higher-risk facilities generally have more experienced personnel and more types of technical expertise among the team members). OA team observations indicated that the OAK operations team approach is an effective mechanism for providing line management oversight of LLNL activities.

With the support of OAK, LLNL senior management has demonstrated strong leadership to effect the cultural change necessary for the implementation of ISM. Successful implementation of an effective ISM system—a standards-based approach to safety—was a significant challenge within the decentralized and autonomous LLNL organizational structure, which historically had relied on an expert-based approach. In making the transition to ISM, the LLNL senior management team built upon effective processes, such as ES&H teams and planning and resource allocation processes, and stressed management accountability for performance. A few years ago, LLNL implemented a comprehensive and integrated work control process, which addressed the most significant weakness identified in the most recent DOE Headquarters independent oversight evaluation. LLNL senior managers have taken an active role in ISM leadership. For example, the Deputy Director for Strategic Operations serves as the "point person" and leads such major efforts as the LLNL ES&H Manual and the internal independent assessment program. LLNL organizations are also devoting considerable effort to prepare good quality documents that clearly state LLNL management expectations. The leadership is also continuing to establish and enhance communications mechanisms to reach out to employees and to emphasize personal accountability. LLNL encourages and rewards participation in safety committees, such as the Plant Engineering Division's grassroots safety committee and the Laboratory Services Directorate's behavior-based safety program. LLNL management has also emphasized strategic planning processes and has maintained effective institutional processes for integrating ES&H into mission activities, maintaining facilities and infrastructure, and allocating ES&H resources.

The LLNL ES&H team concept is an effective mechanism for integrating ES&H support and hazard control into programmatic activities at LLNL. LLNL has five ES&H teams, each of which covers certain organizations and facilities and has appropriate technical expertise in the applicable technical disciplines (e.g., environmental protection and radiation protection). The ES&H teams work closely with LLNL researchers, facility personnel, and line managers during all stages of work planning to support line management in identifying applicable hazards and tailoring the controls to the work activity. The ES&H team concept is a mature process that is effectively implemented. As implemented at LLNL, the ES&H team concept ensures that line management has ultimate responsibility for safety, in accordance with ISM principles, while providing ES&H support to facility personnel and monitoring of line management performance. OA team observations indicated that the ES&H team is a major contributor to the safety-conscious approach to work at LLNL.

LLNL has a rigorous program for establishing and controlling the safety basis at non-nuclear hazardous facilities. LLNL has implemented a systematic approach to developing appropriate safety basis documents for non-nuclear facilities, in accordance with DOE-UC contract provisions. For explosive and accelerator facilities, LLNL uses procedures that are similar to the unreviewed safety question procedure used for nuclear facilities to control the safety basis. This degree of rigor provides assurance that non-nuclear hazardous facilities are safely operated and that safety-related equipment is correctly configured and operational.

The LLNL Integrated Work Sheet (IWS) process provides a comprehensive and integrated method for defining, analyzing, and authorizing work and was effectively implemented for most programmatic work activities that were reviewed. The IWS process is appropriately designed to clearly define work, management responsibilities, and hazards. It contains and references controls, and provides an effective mechanism to certify that hazard controls are in place before starting work activities. Although the IWS process is relatively new and is still evolving and improving, the implementation of IWS by LLNL directorates has resulted in improved safety and control of work activities. The LLNL ES&H Manual clearly defines the general IWS process and responsibilities for implementing IWS provisions. The Manual also provides comprehensive controls for generic and laboratory-wide hazards, such as lockout/tagout controls and laser safety.

In many cases, engineering controls were more rigorous than those normally found at DOE sites, providing an added measure of protection to workers. For example, hazard control processes at the Chemistry and Materials Science Directorate for chemistry operations in Building 132N include stringent engineering controls, such as access controls for individual laboratory rooms that allow access only to individuals authorized by the laboratory supervisor. In Building 132N, fume hoods have variable airflow controllers to ensure that the proper flow rate is automatically maintained in all conditions. Engineering controls were also used extensively in Buildings 235 and 191.

With few exceptions, LLNL has a strong environmental protection program and highly qualified and competent environmental protection personnel. LLNL has established appropriate administrative and engineering controls for monitoring and controlling groundwater contamination from legacy sources. These controls include a series of portable treatment units that have been constructed at the Livermore site to optimize contaminant mass removal. LLNL has also devoted substantial resources to establishing engineering and administrative controls for effluent waste systems to characterize and control releases of hazardous or radioactive materials into the environment. For example, LLNL has taken action to reduce the potential impact from inadvertent release of hazardous or radioactive waste to the City of Livermore sewage treatment system or to the groundwater. These controls include upgrades to facility retention tank systems, sewer line upgrades, and diversion tanks at the site boundary to hold the sewer flow if monitoring indicates a release of hazardous or radioactive waste. These controls are implemented by highly qualified and competent environmental protection staff.

2.2 Program Weaknesses

Although most aspects of the LLNL ISM program are effective, weaknesses were identified in a few areas (corrective action management, fire protection system testing and maintenance, some aspects of IWS, and some aspects of environmental protection).

The LLNL corrective action management system is not sufficiently rigorous to ensure timely documentation, evaluation, and resolution of ES&H issues and deficiencies. The LLNL issues management process is not systematic or comprehensive and is not institutionalized in a policy, plan, and/or procedure. The ES&H Manual provisions for the ES&H Deficiency Tracking System do not adequately address crosscutting issues involving several directorates and/or of institutional programs. The deficiency tracking system is not always used by LLNL to capture and manage issues. The OA team identified several institutional issues that were known to the laboratory but were being informally managed without appropriate controls and visibility; limited progress had been made on some of these issues. In addition, there are weaknesses in the use of the tracking system and resolution of corrective actions. For example, issues were closed without rectifying the underlying root causes. Some of the weaknesses in corrective action management identified by the OA team had been previously identified through OAK and LLNL assessments, but had not been adequately addressed by LLNL.

Preventive maintenance, testing, and documentation for Building 191 fire protection systems do not meet applicable requirements. The National Fire Protection Association (NFPA) standards require annual testing of the entire fire protection system and quarterly and semiannual testing of the specific elements in the system. For Building 191, the fire protection system includes fire alarm, wet fire sprinkler, and deluge systems, which have quarterly, semiannual, and annual preventive maintenance and testing requirements. The wet fire sprinkler system has received satisfactory preventive maintenance and testing, but the fire alarm and deluge systems have not. Contrary to the requirements and recommendations of the NFPA, Building 191 preventive maintenance implementing procedures do not have provisions for comparing completed test results with the original and previous results. Additionally, these procedures do not contain acceptance criteria for the majority of the fire protection preventive maintenance testing. At the time of the inspection, LLNL's fire protection preventive maintenance and testing did not provide reasonable assurance that the fire alarm and mitigation systems in Building 191 were capable of performing their protective functions. Although completion of required maintenance and testing may address this concern in the short term, fundamental changes and improvements to the maintenance and testing program are necessary to provide reasonable assurance over the long term. Because of the sitewide applicability of NFPA requirements, similar deficiencies may exist in other facilities. In the past few years, LLNL had self-identified some aspects of the deficiencies and was evaluating corrective actions. However, the corrective actions were not always comprehensive or timely, and the extent of condition was not fully analyzed.

Plant Engineering work activities performed under generic IWSs are not always sufficiently well defined to facilitate identifying and tailoring hazard controls to specific work activities. Plant Engineering uses generic IWSs for many types of recurring activities, such as electrical work. In many cases, the work scopes in the generic IWSs are excessively broad, resulting in controls that are rarely tailored to the specific work activity. Consequently, many ES&H-related decisions, such as which hazards from a broad list might apply to that particular work and what controls would control those hazards, are left to the crafts personnel. Therefore, LLNL is not fully realizing the benefit of preplanned analysis by work planners, supervisors, and line ES&H personnel. Furthermore, many of the generic IWSs reference the ES&H Manual, Occupational Safety and Health (OSHA) guidelines, and other upper-tier and regulatory documents and thus do not effectively tailor the controls to the working level. Plant Engineering typically uses an ES&H assessment form to bridge the hazard controls defined by the Plant Engineering IWSs to facility IWSs. While this mechanism serves to minimize the number of work-specific IWSs generated for low-hazard jobs, the instructions in the Plant Maintenance Management Systems Manual governing use of the forms do not provide sufficient detail to correctly and consistently complete the forms. The weaknesses in the use of generic IWSs contribute to a number of problems with the implementation of hazard controls in the work activities observed by the OA team.

LLNL has a large inventory of legacy waste materials stored on site, some of which is experiencing container degradation problems associated with outdoor storage. LLNL is not achieving significant reductions in legacy waste volumes and is not systematically establishing disposal priorities that

optimize hazard reduction. LLNL has over 10,000 drum equivalents of transuranic waste, low-level waste, and mixed waste in storage, some of which is not stored under optimal conditions (e.g., stored outside). Containers with microgram quantities of plutonium, americium, uranium, cesium, and other isotopes are stored outside, unprotected from the elements. With the exception of a small number of administrative violations, LLNL meets regulatory requirements for this waste storage, and this inventory does not currently represent a significant risk to the public or the environment. However, waste storage containers are being affected by extended exposure to such environmental conditions as rain, sunlight, and thermal variations. LLNL's administrative controls to inspect these drums have not fully addressed the exposure concerns, as evidenced by rusting drums and faded labels. Although improvements are needed, no instances of leaking drums or imminent danger situations were identified. LLNL has had to defer disposal of low-level waste and extend milestones for waste on the LLNL site treatment plan because of budget limitations by EM for the legacy waste at LLNL. In addition, the performance measures in the DOE-UC contract provide incentives based on the volume of waste disposed but does not consider the relative risks. LLNL has some higher-hazard wastes that have been in storage since the late 1980s that are not a current high priority for disposal, including approximately 200 55-gallon drums that contain pyrophoric depleted uranium machine turnings.

3.0 CONCLUSIONS

OAK and LLNL have worked cooperatively to establish and implement a comprehensive ISM program at LLNL. Significant improvements have been made since the most recent DOE Headquarters safety management evaluations, and the deficiencies identified on the evaluation have been effectively addressed. Most notably, the LLNL IWS process addresses the most significant previously-identified deficiency and is a major improvement over the previous expert-based processes. The IWS provides a comprehensive, integrated, and effective approach to authorizing and controlling work, analyzing hazards, and establishing controls. The OA team's observation of numerous work activities conducted within the IWS process indicated that work activities were conducted safely and, with few exceptions, hazards were identified, appropriate controls were in place, and the work was properly authorized. The OA team identified a few weaknesses in the IWS process as applied to some types of activities (e.g., certain types of work performed by Plant Engineering under generic IWSs) and a few examples of poor implementation or a failure to follow procedures. However, implementation of the relatively new IWS process is improving as LLNL gains experience and as OAK and LLNL self-identify deficiencies and corrective actions.

Managers at all levels exhibited leadership, were involved in safety, and foster continuous improvement. NNSA and OAK have provided programmatic direction, performance expectations, and resource allocations that reflect an appropriate balance between ES&H needs and mission needs. OAK and LLNL have worked cooperatively to establish a Work Smart Standards set that appropriately addresses the hazards and conditions at LLNL. Appropriate ISM institutional policies and requirements have been established and communicated. Workers and stakeholders have multiple avenues to express ES&H concerns. OAK and LLNL roles and responsibilities are adequately defined at all levels of the organization.

OAK has implemented an effective and innovative process for ensuring that organizational and individual roles and responsibilities are coordinated to provide an integrated approach to line management oversight of LLNL. OAK management recognized the need to strengthen some teams associated with less hazardous operations, and actions were underway. OAK is also conducting effective self-assessments of its own operations and has made improvements as a result (e.g., enhanced Facility Representative training). Although OAK has adequate staffing in most areas and is effectively implementing its mission, several staff/skill shortages with the potential to impact oversight effectiveness need to be resolved (i.e., the fire protection engineer and nuclear safety analyst positions). OAK is also pursuing the development of an improved technical qualification program.

Some aspects of LLNL implementation of ISM are especially notable. LLNL has established effective processes for providing ES&H support to line management organizations through its ES&H teams. The LLNL strategic planning process effectively ensures that ES&H needs are considered in all stages of LLNL mission activities and projects. LLNL has taken a systematic approach to the development of appropriate safety basis documents for the non-nuclear facilities and implemented an effective change control process for explosives and accelerator facilities.

Most aspects of environmental protection programs are effective and have been successfully integrated into ISM. With few exceptions, the hazards for the facilities reviewed have been analyzed and appropriate controls established. However, the pollution prevention program needs to be more proactive, operational facilities have not been fully analyzed for groundwater monitoring needs, and limited progress has been made in addressing legacy waste.

There are deficiencies in preventive maintenance and testing of fire protection systems at LLNL non-nuclear facilities. Proper testing and maintenance are required by NFPA codes and are important in ensuring that these systems are capable of performing their intended function during a fire or other upset conditions. For some of the fire protection subsystems, either preventive maintenance activities were not being conducted at the prescribed frequency, or the maintenance procedures were not rigorously followed and/or completed. LLNL self-identified some of the deficiencies in testing and preventive maintenance programs for fire protection systems in the past three years and is working on developing corrective actions. However, the needed corrective actions have not been timely or comprehensive. LLNL is now taking steps to accelerate corrective action for testing and maintenance deficiencies.

The continuous feedback and improvement programs at OAK and LLNL have improved significantly and include numerous assessment activities and safety committees. Many of the feedback mechanisms are of high quality and have contributed to improvements in LLNL ES&H programs. However, there are some weaknesses in feedback and improvement, most notably in corrective action management systems and timeliness of corrective actions.

Overall, OAK and LLNL have made significant improvements in ES&H and have established an effective ISM program. NNSA, OAK, and LLNL have provided leadership and devoted resources to ES&H programs and ISM. Work observed by the OA team was performed with a high regard for safety and environmental protection. While some ISM elements require further improvement, such as testing and maintenance of fire protection systems, some aspects of IWS, certain aspects of environmental protection, and corrective action management, the overall ISM program is effectively implemented.

4.0 RATINGS

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

Safety Management System Ratings

Guiding Principle #1 – Line Management Responsibility for Safety.........EFFECTIVE PERFORMANCE
Guiding Principle #2 – Clear Roles and Responsibilities ....EFFECTIVE PERFORMANCE
Guiding Principle #3 – Competence Commensurate with Responsibility..EFFECTIVE PERFORMANCE
Guiding Principle #4 – Balanced Priorities..EFFECTIVE PERFORMANCE
Guiding Principle #5 – Identification of Standards and Requirements.......EFFECTIVE PERFORMANCE

Feedback and Improvement

Core Function #5 – Feedback and Continuous Improvement ....NEEDS IMPROVEMENT

LLNL Programmatic Work Activities, Facility Operations, and Maintenance Work Activities

Core Function #1 – Define the Scope of Work.......................................EFFECTIVE PERFORMANCE
Core Function #2 – Analyze the Hazards..EFFECTIVE PERFORMANCE
Core Function #3 – Develop and Implement Controls ....NEEDS IMPROVEMENT
Core Function #4 – Perform Work Within Controls ....EFFECTIVE PERFORMANCE

Environmental Protection

Environmental Protection (Core Functions 1-4) ....EFFECTIVE PERFORMANCE

APPENDIX A

Supplemental Information

A.1 Dates of Review

Scoping Visit	April 16-18, 2002
Onsite Inspection	June 10-20, 2002
Report Validation and Closeout	July 9-11, 2002

A.2 Review Team Composition

A.2.1 Management

Glenn S. Podonsky, Director, Office of Independent Oversight and Performance Assurance
Michael A. Kilpatrick, Deputy 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
Dean Hickman
Patricia Worthington
Robert Nelson

A.2.3 Review Team

Thomas Staker, Team Leader

Safety Management Systems
Ali Ghovanlou, Topic Lead
Tim Martin
Bernie Kokenge
Al Gibson
Robert Compton (Feedback and Improvement)

Environmental Protection
Bill Eckroade, Topic Lead
Vic Crawford
Joe Lischinsky
Tom Naymik

Technical Team
Bob Freeman, Topic Lead
Marvin Mielke
Bill Miller
Jim Lockridge
Michael Shlyamberg
Edward Stafford
Mario Vigliani
Mark Good
Shivaji Seth (Richland Operations Office)

A.2.4 Administrative Support

Mary Anne Sirk
Tom Davis

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APPENDIX B

Site-Specific Findings

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

FINDING STATEMENT	REFER TO PAGE
1. LLNL processes and implementation for ES&H and emergency management issues management and corrective action are insufficient to ensure consistently appropriate and timely identification and resolution of safety and health concerns and crosscutting or institutional issues.	41
2. LLNL is not performing some of the fire detection and mitigation system preventive maintenance actions that are required by the National Fire Protection Association and facility authorization basis documents.	56

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APPENDIX C

Guiding Principles of Safety Management Implementation

C.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) evaluation of safety management systems focused on the seven guiding principles of integrated safety management (ISM) as applied at the Lawrence Livermore National Laboratory (LLNL). This appendix discusses the results of the first five of those:

- Guiding Principle #1 – Line Management Responsibility for Safety
- Guiding Principle #2 – Clear Roles and Responsibilities
- Guiding Principle #3 – Competence Commensurate with Responsibility
- Guiding Principle #4 – Balanced Priorities
- Guiding Principle #5 – Identification of Standards and Requirements

The two other guiding principles (Guiding Principle #6 – Hazard Controls Tailored to Work Being Performed and Guiding Principle #7 – Operations Authorization) significantly overlap the core functions of safety management, which are discussed in Appendix E.

The OA team reviewed various documents and records, including the LLNL ISM system descriptions; associated procedures; Functions, Responsibilities, and Authorities Manuals (FRAMs); and LLNL plans and initiatives. In the evaluation of the guiding principles, OA considered the results of the OA review of the core functions and environmental programs. Oakland Operations Office (OAK) and LLNL personnel were interviewed to determine their understanding of the ISM program and their responsibilities, as well as the status of ongoing initiatives and corrective actions.

C.2 RESULTS

C.2.1 Line Management Responsibility for Safety

Guiding Principle #1: Line management is directly responsible for the protection of the public, workers, and the environment.

National Nuclear Security Administration (NNSA)/OAK

DOE line management—the NNSA and OAK—have worked effectively with LLNL to establish an adequate set of environment, safety, and health (ES&H) policies, requirements, and performance expectations for LLNL. These policies, requirements, and expectations are established in the contract between DOE and the University of California (UC) and include an adequate set of Work Smart Standards (WSSs). (See Guiding Principle #5.)

The DOE line management chain is clearly defined and has appropriate levels of visibility and involvement at LLNL. The NNSA Deputy Administrator for Defense Programs is the lead program secretarial officer for OAK, and is the line manager for all operations, including ES&H. As the landlord, the NNSA Associate Administrator for Defense Programs is responsible for maintaining and overseeing institutional operations, and has established suitable mechanisms for maintaining continuing awareness and involvement in major issues at the site. The OAK FRAM clearly identifies ES&H functions assigned to OAK and appropriately delegates these functions to various organizations within OAK.

The OAK organizational elements with responsibility for LLNL have established and communicated an appropriate set of ES&H policies and expectations to its workforce and to LLNL. Specifically, its policy regarding the integration of ES&H in program operations and activities, and the Integrated Safeguards & Security and Safety Management Plan document provide a comprehensive description of the ES&H expectations, goals, and objectives for implementation of DOE's ISM policy.

OAK senior management has demonstrated sustained leadership and has established appropriate mechanisms to fulfill its line management responsibility for ES&H. Its facility operations teams are an effective mechanism for performing line management oversight of LLNL facilities. OAK also performs functional assessments through its functional area managers. As discussed in Appendix D, OAK line management oversight is generally effective, although further improvements are needed in efforts to track and resolve findings and to ensure that the contractor resolves them. In addition, OAK is effectively using its oversight programs and performance measures in the DOE-UC contract to promote improvements in ES&H at LLNL. OAK senior managers demonstrate leadership by actively participating in ISM continuing improvement processes at LLNL and are involved in such activities as the ISM Change Control and WSSs Change Control Boards. Collectively, these mechanisms have contributed to the significant improvements in the LLNL ISM program in the past five years.

LLNL

LLNL senior managers have demonstrated sustained leadership over recent years in implementing an overall effective ISM program at LLNL. LLNL has made major improvements since the most recent Headquarters independent oversight safety management evaluation.

LLNL senior management has demonstrated strong leadership to affect the cultural change necessary to implement a standards-based system such as ISM. This was a significant challenge within the decentralized and autonomous LLNL organizational structure, which exhibited a traditional research and development organizational preference for an expert-based approach. In making the transition to ISM, the LLNL senior management team has built upon effective LLNL processes, such as ES&H teams and planning and resource allocation processes, and has stressed management accountability for performance. Through sustained management attention, these mechanisms have evolved and improved and are now more mature and effective, although further improvements are warranted in a few areas. The sustained management attention from OAK and LLNL has resulted in steady improvements in ISM implementation in the LLNL organizations.

Among the major accomplishments is the establishment of a comprehensive and integrated LLNL work control process—Integrated Work Sheets (IWSs)—which addresses the most significant weakness identified in the most recent Headquarters independent oversight safety management evaluations. As discussed in Appendix E, the IWS process is performing effectively in most cases, but is still maturing and evolving and needs further improvement in a number of areas to ensure consistently effective implementation across the LLNL organizations. Sustained attention and accountability, such as LLNL has demonstrated in the past five years, is needed to ensure IWS continues to improve.

A number of factors have contributed to LLNL's success in establishing and improving its ISM program.

- Extensive effort was devoted to preparing good quality documents that clearly state LLNL's safety philosophy, policies, goals, and objectives. These documents also provide management responsibilities and instructions on how to plan and conduct work in accordance with ISM guiding principles and core functions. Such documents include the ISM description documents, the ES&H Manual, and directorate-level ISM implementation plans.

- Senior LLNL management leadership has demonstrated sustained leadership and involvement in ISM. The LLNL Director's expectations for each Associate Director contain specific provisions for ensuring effective ISM implementation. A senior manager—the Deputy Director for Strategic Operations (DDSO)—has been assigned as the "point person" for the success of ISM at LLNL and is personally involved in numerous aspects of ISM development and implementation (e.g., the DDSO is the owner of the ES&H Manual).

- Communication channels have been established to provide information and receive inputs from the workforce. LLNL has many outreach activities and programs to demonstrate management commitment and reinforce the importance of ISM. Safety discussions are featured at all-hands meetings, staff meetings, and other management events at corporate- and directorate-level forums. Management presence is demonstrated through management walkthrough programs. In an employee opinion survey for 2001, 83 percent of participants (the highest score among all areas of the survey) expressed satisfaction with LLNL "Safety in Work Place."

Notwithstanding the progress and achievements, continued management attention is required in a number of areas. As discussed under Guiding Principle #4, additional attention is needed to determine the resource needs and to ensure that LLNL completes an extensive effort to develop compliant safety analysis reports (SARs). Senior management will need to take a leadership role in this effort to overcome the challenges and resource limitations. Senior management leadership is also needed to address other deficiencies and areas for improvement identified on this OA inspection, many of which cross LLNL organizational lines and thus require management direction from above the directorate level. For example, the deficient testing/maintenance of the fire protection systems was identified in a few facilities at LLNL by the OA team, but similar problems may exist at other LLNL facilities. Similarly, other areas for improvement identified by OA on this inspection will require horizontal integration of programs and activities across several directorates. Specific areas for improvements in this regard are discussed in more detail in other sections of this report and include assessments, corrective action management, lessons learned, improvements to IWS, and timeliness of updates to ES&H procedures and manuals.

Worker Empowerment

OAK and LLNL have established appropriate policies and mechanisms to involve workers in safety and empower workers to stop work if safety concerns arise and report safety concerns to management. These include the work planning and control processes that promote worker participation in hazards analysis and development of controls, the stop-work policy, the employee concerns programs, an ES&H hot line, an Ombuds program (consisting of non-supervisory employees who provide informal, confidential concern resolution assistance), and a "Dialogue" program, which provides a confidential channel for employees to raise concerns and to receive a written response from management.

The aspects of these programs that were reviewed were effectively implemented. The availability of these systems to the workforce is adequately communicated through various means (e.g., through initial employees training, bulletin boards, Web sites, and pamphlets). All employees who were interviewed were aware of several avenues for raising and resolving ES&H concerns. However, communication could be improved. Some employees were not aware of several of the available options, such as ES&H hot lines. Also, some postings were not prominent or consistently present in some areas.

Some aspects of the worker empowerment systems were particularly effective. For example, LLNL has a strong stop-work policy, and the ES&H Manual clearly describes employees' ES&H rights and responsibilities, including a clear statement that no adverse actions are permitted against those who request a work stoppage. Information gathered by the OA team confirms that LLNL managers are supportive of this policy, and that the employees are not reluctant to stop work when they believe it is appropriate. In addition, LLNL management encourages and rewards good safety behavior and participation in safety committees. A large number of grassroots safety committees are operating effectively across LLNL and provide management with valuable insight and suggestions to improve safety. For example, safety committees within the Plant Engineering Division receive considerable management attention and support and are especially effective. In addition to effective safety committees, Plant Engineering and selected other LLNL organizations are piloting a behavior-based safety program. The program, which involves peer-by-peer observation to detect and correct at-risk behavior, is well managed and effective.

Summary of Guiding Principle #1. NNSA, OAK, and LLNL management have established effective policies and have demonstrated leadership that has contributed to significant improvements in ISM and ES&H performance at LLNL. Sustained management commitment to innovative and effective programs, such as OAK operations teams, LLNL ES&H teams, and the IWS process, have resulted in major improvements in safety management and overall good ES&H performance at LLNL. Worker empowerment programs are also effective. However, continued management attention is needed to address deficiencies in corrective action management, fire protection testing and maintenance, and some aspects of IWS implementation. Senior LLNL management also needs to take a leadership role in analysis of crosscutting issues and other items that require coordination across LLNL organizational lines. An area that requires increased leadership and coordination between senior OAK and LLNL management relates to improvement in the strategic planning for authorization basis efforts across several LLNL operations (see Guiding Principle #4).

C.2.2 Clear Roles and Responsibilities

Guiding Principle #2: Clear and unambiguous lines of authority and responsibility for ensuring safety shall be established and maintained at all organizational levels within the Department and its contractors.

NNSA

Within NNSA, current line management responsibilities for LLNL are understood. The Deputy Administrator for Defense Programs provides programmatic direction to OAK and is responsible for LLNL activities. The ES&H organization, within the Associate Administrator for Facility and Operations, provides technical support to line managers on ES&H issues. The ES&H organization has recently started a program to conduct regular assessments of the effectiveness of DOE field elements in managing NNSA sites and laboratories. In addition, the ES&H organization is in the process of revising the five-year-old NNSA FRAM, with a target completion date of July 31, 2002.

NNSA is in the process of extensively re-engineering its activities and organization to enhance and streamline line management of NNSA sites. As part of that re-engineering, a Livermore Site Office will be established and will assume line management responsibilities for LLNL, including contract management and line oversight functions. OAK will function as a service center that supports the Livermore Site Office and other DOE field elements. NNSA plans to implement the reorganization between October and December 2002. The re-engineering initiative is another important step in the ongoing effort to empower the NNSA field elements to perform effective line management and line oversight of its contractor.

OAK

Within OAK, the organizational functions, roles, and responsibilities are clearly defined and understood. The Assistant Manager for National Security (AMNS) has primary responsibility for providing direction to LLNL. The Livermore Environmental Programs Division (LEPD) has responsibility for waste management activities. To ensure a consistent approach, LEPD technical specialists with responsibilities at LLNL work in accordance with processes and procedures for line management oversight of LLNL. The Livermore Safety Oversight Division (LSOD) has the primary responsibility for most assessments and ES&H support to the line organizations (except for line oversight of nuclear safety, which is delegated to the nuclear safety team). Organizational roles and responsibilities are adequately defined in the OAK FRAM.

OAK has developed appropriate mechanisms (e.g., Integrated Safeguards and Security and Safety Management Plan) to delineate the flowdown of roles and responsibilities to individual positions within OAK. To ensure individual accountability, OAK requires entering line management oversight activities into an OAK tracking system (FISHE) and uses this information in the annual performance appraisals for each individual.

OAK has implemented an effective and innovative process for ensuring that organizational and individual roles and responsibilities are coordinated to provide an integrated approach to line management oversight of LLNL. The process includes a coordinated set of division-specific operational awareness plans and facility-specific operational awareness plans that clearly delineate expectations to OAK managers and subject matter experts. Operations teams, which include AMNS, LEPD, LSOD, and nuclear safety team personnel, have been established to assess various types of facilities. Although some weaknesses were identified (see Appendix D), OA's review of the operational awareness plans and operation team activities indicates that the processes are generally effective.

OAK and the NNSA Site Office manage the UC contract for LLNL effectively through the performance measures of Appendix F and Appendix O of the contract. In most cases, the performance measures are appropriate and promote good performance and accountability. (However, see Guiding Principle #4 and Appendix F of this report for one exception.)

LLNL

LLNL Institutional Roles and Responsibilities. Institutional roles and responsibilities for LLNL organizations are clearly defined in a number of LLNL documents including the ISM description documents, directorate management plans, facility safety plans, and the ES&H Manual. These documents adequately address LLNL institutional roles and responsibilities, including development of corporate processes and standards and ES&H support by the LLNL safety organization (e.g., the ES&H Working Group and ES&H teams assigned to various directorates). For example, the ES&H Working Group—consisting of the ES&H Assurance Managers for each directorate and the heads of the ES&H and quality assurance laboratory-wide technical support organizations—approves most institutional-level ES&H implementation documents that contain LLNL-wide requirements and guidance.

At the highest levels of LLNL management, the LLNL DDSO is personally and directly involved in implementing important safety functions and responsibilities. Specifically, the LLNL DDSO has been delegated responsibility for ensuring that the performance goals specified in Appendix F of the contract are achieved, overseeing institutional activities, approving ES&H Manual requirements, resolving certain ES&H issues, and developing and tracking corrective actions for LLNL-wide ES&H evaluations performed by UC and DOE. The ES&H Working Group and the Assurance Review Office (ARO)—

which performs independent, internal ES&H appraisals of ES&H policies and their implementation—report directly to the DDSO, ensuring that they receive a high level of management support.

Roles and responsibilities of the LLNL institutional ES&H organization—Safety, Security, and Environmental Protection (SSEP)—are well defined, communicated, and understood. SSEP provides ES&H expertise and services to assist the LLNL line organizations in implementing ES&H requirements, monitoring the work environment, interpreting and documenting ES&H requirements, and providing feedback on implementation of these requirements. SSEP has established five ES&H teams that are effectively supporting the various LLNL line management organizations. The ES&H teams have clear roles and responsibilities in support of the line organizations and are a critical element of the LLNL approach to ES&H management. For example, the ES&H teams assist line organizations with identifying and analyzing ES&H hazards, and provide guidance for preparation and review of safety-related procedures and documents (e.g., hazard assessments and IWS). The OA review of work activities at selected LLNL facilities indicates that most ES&H team roles and responsibilities are understood and effectively implemented.

Plant Engineering and Utilities and Telephone (Utel)—two organizations reporting to the Associate Director for Laboratory Services—support the programmatic directorates by performing maintenance activities for certain ES&H-related systems (such as fire protection systems and criticality alarms). In most areas reviewed, these organizations provide effective support. However, as discussed under Guiding Principle #5 and in Appendix E, some aspects of preventive maintenance and testing of fire protection systems were not being performed as required. The organizational interfaces between the support organizations and facility managers were not defined in sufficient detail to ensure that all required testing and maintenance for the fire protection systems was identified and coordinated. LLNL had previously recognized a need for more detailed definition of responsibilities and is formulating plans to address this need by expanding and clarifying the expectations for facility managers, and providing them with additional tools and training.

LLNL Work Authorization Roles and Responsibilities. The LLNL work authorization process—the IWS process—is one of the most critical elements of the LLNL ISM implementation and has received significant management attention. Within the decentralized LLNL management structure, the IWS process ensures adherence to LLNL-wide standards by delegating specific responsibilities and authority to the various line management and support organizations. The IWS process, including roles and responsibilities of various organizations and organizational interfaces, is clearly described in the LLNL ES&H Manual.

Using the IWS process, designated LLNL personnel are required to plan and conduct the work according to ISM guiding principles and core functions. In addition, the IWS process appropriately delegates roles and responsibilities to specific individuals, such as the facility manager and the ES&H team leader, who are responsible for hazard identification and control. For example, facility managers are responsible for a wide range of ES&H-related actions, such as preparing a facility safety plan, implementing facility-related requirements, ensuring that personnel comply with all facility-specific requirements and training, and reviewing IWSs for compliance with facility-related requirements. The IWS process is appropriately based on a graded approach. High-hazard projects typically require more stringent hazard control documentation and concurrence from other personnel with ES&H responsibilities (e.g., the ES&H team leader and facility manager).

Based on the OA team's observations, most roles and responsibilities for the IWS process are well understood and appropriately implemented. In projects reviewed by the OA team (i.e., the B235 Laser Laboratory Project and the B191 Gun Tank Requalification Project), the assigned roles and responsibilities were consistent with the ES&H Manual and were well understood by project personnel.

The authorizing organization and management chain for these projects were clearly delineated on the IWS documents. The authorizing individuals for each of these projects were knowledgeable of their roles as well as the scope, hazards, and controls necessary to safely carry out each project. The responsible individuals understood the scope, technical requirements, hazards, and controls necessary to safely carry out each project. The facility points of contact knew the facility safety limits and confirmed that the projects could be safely carried out within those limits. ES&H team members were actively involved in the planning and project execution phases and understood their role in ensuring that all hazards were identified and that the necessary controls were in place before the each project was authorized. The composition of the ES&H team was appropriately tailored to fit specific project safety requirements. For example, individuals with explosives engineering experience were assigned to the ES&H team for the B191 Gun Tank Requalification Project, because the project involved the use of high explosives.

Although IWS is an effective process in most respects, certain aspects of the IWS need to be improved to ensure that responsibilities are carried out in strict compliance with the requirements. As discussed in Appendix E, in some cases, individual responsibilities could not be effectively implemented as described, or individuals were not strictly adhering to requirements (e.g., signing off on inaccurate or incomplete forms). Additional management attention is also needed to ensure that individuals understand that they are responsible and accountable for strict compliance with requirements, and that responsible individuals may need to stop work to resolve problems with forms or processes rather than signing off on incomplete or inaccurate forms. LLNL managers that were interviewed as part of this inspection indicated that actions are being taken to ensure that institutional expectations are clearly communicated to the appropriate personnel as part of a response to the ISM validation issues.

Accountability. LLNL recognizes the importance of strong accountability for safety and emphasizes accountability in the ISM description document and ES&H Manual. At the institutional level and senior management level, accountability has improved (see Guiding Principle #4). Through its ARO, LLNL has self-identified a need to enhance individual accountability for safety within the directorates down to the supervisor and worker levels. LLNL management is in the process of enhancing the annual performance appraisal process to achieve this goal. For example, within the Chemistry and Materials Science Directorate,the Engineering Directorate, and the Plant Engineering Division, extensive guidance related to incorporating safety into performance appraisals has been provided for the next cycle of annual performance appraisals (scheduled to begin shortly and to be completed in the first quarter of fiscal year [FY] 2003).

Although the effectiveness of the recent process enhancements could not be fully evaluated at this time, because LLNL has not completed a cycle of performance appraisal with the new processes and guidance, LLNL managers expressed strong commitment to this effort. In addition, the standards for the annual performance appraisals of managers, researchers, and workers have been modified to include safety as a performance measure. Although progress is being made, the OA team observations discussed above (signoffs on incomplete or inaccurate IWS forms) indicate a need for continued management attention on individual accountability for safety performance.

Summary of Guiding Principle #2. While a few areas warrant improvement, OAK and LLNL have established roles and responsibilities consistent with ISM expectations. The LLNL ES&H teams and OAK operations teams, with clear roles and responsibilities for safety, are notable strengths in the ISM program. LLNL recognizes the need to further enhance individual accountability for ES&H performance and is making progress.

C.2.3 Competence Commensurate with Responsibility

Guiding Principle #3: Personnel shall possess the experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities.

OAK

OAK has made significant progress in recruiting and retaining technically qualified personnel, despite significant challenges. The high cost of living, long commuting times, hiring freezes, and other such factors limit the pool of qualified candidates who have the needed skills. In addition, there have been a number of instances where personnel leave OAK for other career opportunities with higher pay or lower cost of living after they have gained job experience and qualifications while at OAK. OAK has worked to address these issues for several years and has made significant progress. Over the last three years, technical staffing of OAK personnel with ES&H responsibilities at LLNL has been substantially increased. To compensate for attrition, eight new Facility Representatives (FRs) were hired. OAK also chartered work groups in FY 2000 to investigate ways to improve employee recruitment, retention, and work environment, and implemented several of the resulting recommendations (e.g., increased FR retention bonus). The OAK Executive Committee is actively involved in reviewing and approving vacancy postings. OAK also developed and periodically updates a five-year staffing plan that addresses anticipated workload and potential attrition. The potential impacts of the pending NNSA reorganization are considered and factored into current posting and hiring decisions.

As a result of these actions, critical NNSA technical skill vacancies have been reduced to 3.5 full-time equivalent positions, and 9 of 10 authorized FR positions are currently filled. A candidate for the one FR vacancy was hired, but has been reassigned to a new vacancy that was created to support growth in authorization basis review workload. To mitigate the impact of current vacancies, OAK's personnel assigned to oversee LLNL (i.e., the FRs and operations teams) are supported by other OAK subject matter experts (SMEs) and a support services contract.

Notwithstanding the progress, recruitment and retention of qualified staff are areas requiring continuing management attention. The deficiencies identified in LLNL fire protection system testing and maintenance (discussed under Guiding Principle #5 and Appendix E) reinforce the need, previously identified by OAK, for a Fire Protection Engineer. OAK is now assessing additional options to fill this critical need in recognition of the sustained but unsuccessful effort to date to fill the authorized vacancy. In addition, FR management recently performed two analyses that demonstrated the importance of management attention to retention of FRs in light of the high cost of recruiting and qualifying new FRs, and OAK's competitive disadvantage in retention incentives compared to other DOE sites.

In response to a generally negative 2001 self-assessment of the FR program, OAK aggressively corrected FR staff shortages and substantially improved their FR training and qualification program (FRTQP). As a result, five FR vacancies were filled, and the FRTQP was revised to be consistent with DOE-STD-1063-2000 and was enhanced to streamline completion of Phase I qualifications for experienced technical staff. At the time of the inspection, five FRs were fully qualified (with one under a requalification period extension because of a high workload). A sixth fully qualified FR was lost to another site. The remaining four FRs were interim-qualified and mentored by qualified FRs. The increased FR staffing and enhanced training have resulted in demonstrated improvements in FR performance.

Most OAK SMEs have substantial experience and education. However, because of questions about the credibility of qualifications under a 1995 OAK Technical Qualification Program (TQP), OAK management developed a new and significantly revised TQP plan, and in early 2002 they issued their first new standard qualification plan for Senior Technical Safety Managers. The new TQP provides a credible and consistent basis for establishing and confirming the achievement of required competencies for staff who are assigned to manage and oversee defense nuclear facilities. However, the majority of new standards qualification plans and supporting test questions necessary to implement the new TQP are still under development, and some development work is not scheduled for completion until late in FY 2003. As a result, most OAK technical staff who will have to qualify under the new TQP (other than FRs) have not had the opportunity to start their qualification process. However, OAK personnel in positions for which standard qualification plans and tests are in place have made very limited progress. OAK managers recognize that limited progress has been made in completing TQP requirements, but believe the benefits of qualification under an enhanced TQP are worth the delay.

OAK managers were confident that existing technical personnel are competent for current assigned roles and responsibilities based on evaluation of their work products, experience, and education. As a result, OAK managers view the new TQP as a vehicle to confirm and provide defendable documentation for that conclusion, as well as enhancing the scope of competence of existing staff and providing a consistent basis for assessments of competence of future staff.

Although some staff shortages remain and few personnel are TQP-qualified, the results of this OA inspection indicate that OAK generally has sufficient numbers of competent staff to implement its line management oversight program in accordance with its operations team and Operational Awareness Plan concept. Further, OAK has assigned its staff effectively to fill the FR and operations team positions based on relative risks. For example, more experienced personnel are typically assigned to the operations teams for the higher-hazard LLNL facilities (e.g., plutonium facilities and explosives handling facilities). As discussed under Guiding Principle #1 and Appendices D and E, while some areas for improvement were noted, the OAK operations team and FRs have been effective in performing DOE line management safety management functions and evaluating LLNL safety performance. Operations teams and FRs have identified deficiencies and prompted corrective actions at LLNL on numerous occasions, and have contributed significantly to the overall good ISM performance at LLNL.

LLNL

Staffing. With a few exceptions, LLNL has a sufficient number of staff to perform ES&H-related assignments in the organizations and areas reviewed by the OA team. LLNL has a highly educated and experienced workforce, generally benefits from low turnover, and has few vacancies in ES&H positions. The review of work activities by the OA team indicates that the ES&H teams have sufficient personnel and an appropriate skill mix to support line management activities. Interviewed LLNL managers were knowledgeable of staff shortages and the relative difficulty in filling certain technical vacancies, such as Fire Protection Engineers and Certified Health Physicists, and were actively recruiting for those positions.

LLNL performs staffing needs analysis and planning as required for reporting of available and projected critical defense nuclear program skill needs. LLNL organizations also perform other out-year staff planning with various degrees of formality. In several cases, LLNL organizations are taking proactive actions to ensure the adequacy of future staffing. For example, Plant Engineering established and currently implements a management continuity program to develop staff for future management and leadership roles. Funding for renewal of a four-year, State-approved craftsmen apprentice program has been established. In addition, the Hazardous Waste Management Division is establishing a stipends program to address concerns about attrition of hourly technical staff; the program provides financial incentives for maintaining training and qualifications requirements and passing competency exams.

In the environmental protection area, LLNL has well-qualified and highly experienced personnel, but LLNL line managers responsible for environmental remediation indicated that budget cuts had severely depleted their technical staff, leaving them no depth in certain required skills. NNSA, OAK, and LLNL are working with the DOE Headquarters Office of Environmental Management (EM) to reevaluate funding for LLNL environmental protection activities and plan to reassess staffing levels and work priorities consistent with the available funding (see Appendix F and Guiding Principle #4).

As discussed under Guiding Principle #4, additional management attention is needed to further analyze the adequacy of LLNL staffing that is needed to complete new authorization basis documents in accordance with an established schedule. Interviewed LLNL Authorization Basis Section and Plant Engineering staff were knowledgeable of the new requirements and interpretations of 10 CFR 830-compliant documented safety analyses. Current analysts and reviewers appeared to be well qualified for preparing and/or reviewing SARs. However, LLNL has not conducted a systematic needs analysis to determine the number of personnel needed (e.g., authorization bases analysts) or the availability of other qualified resources.

Training. In accordance with LLNL's decentralized approach, each LLNL organization is responsible and accountable for the adequacy of their staff's training. For the organizations reviewed on this OA inspection, the LLNL training program provides a strong basis for establishing and maintaining required staff competence. With regard to nuclear facility training, both the plutonium facility and the hazardous waste management training programs were approved by OAK as compliant with DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*. OA's review of the training completed by a sample of craftsmen, facility authorization bases analysts, technicians, and a facility manager confirmed that these individuals were current on their required training for the applicable hazards associated with their roles and responsibilities. Further, the authorization basis training lesson plans and materials evaluated were written at a consistent level and adequately conveyed OAK's expectations for authorization basis document submittals (however, most authorization basis training plans are still under development).

Some aspects of the LLNL training program are particularly effective and/or promote efficiency.

- LLNL has established a training program committee, consisting of senior representatives from each directorate, that focuses on the value, necessity, and impact of new or revised training requirements; recommends changes in policy, standards and guidelines; and is empowered by the LLNL Director to establish institutional training and training records retention requirements.

- LLNL uses a sophisticated hierarchical Web-based relational database (LTRAIN) as a tool for efficiently managing individual training plans and records. LTRAIN provides an interactive catalog of currently available training courses, schedules training, maintains documentation of training completed, and alerts individuals and other appropriate personnel of pending training and retraining requirements. LTRAIN also creates individual training plans based on supervisor-approved responses to a hierarchical series of questions that customize training requirements to each individual's tasks and workplaces.

As part of its approach to training programs, LLNL stresses continuous improvement, self-assessments, and responsiveness to training-related findings from assessments and event investigations. For example, Plant Engineering, working with the Hazard Controls Department, enhanced their Occupational Safety and Health Administration (OSHA)-required training program following a self-assessment by tailoring and streamlining the training to better meet craftsmen training needs.

Additional attention is needed in hazard communications (HAZCOM) training. Employees receive an institutional-level HAZCOM training course as part of their initial staff orientation. However, such HAZCOM training is minimal and does not fully satisfy the HAZCOM training requirements specified in 29 CFR 1910.1200, nor does it provide workers with sufficient practical knowledge concerning labeling and access to material safety data sheets. Supervisors are required to take an additional HAZCOM training course and to provide additional HAZCOM training to their staff on work area-specific hazards. However, the content of this training or evidence that such training to workers is completed is not documented. OSHA regulations require that work area-specific HAZCOM training be provided to workers, but do not require its documentation. Based on observations by OA team members, worker knowledge of some chemical hazards (e.g., metalworking fluids) was marginal. HAZCOM is the safety violation most often cited by OSHA, and HAZCOM infractions have been contributing causes to past occurrences and near misses at LLNL. LLNL/Hazards Control Department management and OAK have recognized the need for sitewide improvements in staff HAZCOM training, and a path forward is being formulated, which includes a suite of HAZCOM training courses, refresher training, and better documentation of course completion.

Although most aspects of LLNL's training programs are excellent, the steps needed to verify workers are current on job-specific ES&H training requirements are complex, error prone, and need to be streamlined. The current IWS process requires supervisors and managers to identify the training requirements for each task and to verify that individuals assigned to the task have the required training. The verification process can be complicated and cumbersome because the IWS forms often refer to other documents and forms containing additional training requirements that are easily overlooked, some of which may not apply to all involved workers or stages of the activity. The OA team's review of a sample of IWS forms for the facilities reviewed indicated that supervisors and managers demonstrated dedication to making the current processes work and adequately verified training requirements in most cases. The Chemistry and Materials Science organization developed supplemental tools (i.e., a matrix of training requirements versus individual training needs) to help supervisors implement the process. However, in a number of facilities reviewed, this OA inspection identified examples of failure to document hazards and/or required training, failure to identify all individuals needing training, failure to ensure training plans were updated, and failure to verify training was completed and current. LLNL is aware that the current systems are not user friendly and increase the likelihood of errors. LLNL has taken some corrective actions and others are underway, including an effort to upgrade and link IWS and LTRAIN by the end of calendar year 2002. This effort is intended to facilitate comprehensive identification of training requirements and automatic verification that individuals to be involved have the required competence. Continued management attention is needed to ensure that the upgrades result in improved performance and that managers and supervisors devote sufficient attention to detail to effectively implement the requirements.

Summary of Guiding Principle #3. Although some staff shortages remain and few personnel are TQP-qualified, OAK has sufficient numbers of staff to implement its line management oversight program at LLNL and is using its personnel effectively on operations teams. Improvements in FR staffing and the FR training program were noteworthy. Similarly, LLNL has sufficiently qualified ES&H staff in most areas, and the ES&H teams are an effective mechanism for using ES&H expertise to support line management. Additional analysis is needed to determine staffing requirements for authorization basis activities in light of the anticipated workload and tight schedule. The LLNL training program provides a strong basis for establishing, verifying, and maintaining required ES&H competencies necessary to perform work safely. In most cases, OAK and LLNL have been successful in self-identifying shortcomings in their training and staffing and have either taken or planned corrective actions.

C.2.4 Balanced Priorities

Guiding Principle #4: Resources shall be effectively allocated to address safety, programmatic, and operational considerations. Protecting the public, the workers, and the environment shall be a priority whenever activities are planned and performed.

NNSA/OAK

NNSA guidance effectively defines mission, ES&H, and planning expectations that form the basis for achieving a balance between mission and safety at LLNL. OAK has established appropriate contractual mechanisms to define both mission and ES&H expectations for LLNL and to provide the basis for achieving balanced priorities. The performance measures in Appendix F of the UC/DOE contract address ES&H and serve as one mechanism for balancing priorities and focusing LLNL efforts in certain areas. In most cases, the performance measures are appropriate and promote enhancements in ES&H performance.

However, the performance measure that addresses waste shipments focuses LLNL efforts on the volume of waste shipped rather than on reducing the risk associated with onsite waste inventories. Furthermore, the current performance measure specifically excludes legacy wastes. OAK recognizes this weakness and has drafted a set of performance measures for FY 2003 that, if incorporated in Appendix F of the contract, should focus LLNL efforts on the shipment of legacy wastes, and should promote reductions in the risks associated with onsite waste inventories.

NNSA and OAK have appropriate processes for establishing budgets and integrating ES&H needs into mission and budget planning. The significantly improved and generally good ISM performance observed on this OA inspection indicate that NNSA and OAK have devoted sufficient attention and resources to ES&H programs at LLNL.

Although NNSA and OAK resource allocation and project planning processes are generally adequate, one aspect of resource planning warrants continued management attention. This aspect involves the need for resource planning to ensure that OAK can support the surge in workload associated with LLNL's anticipated submittal of a number of authorization basis documents in time to meet the April 2003 submission deadline. As discussed below, OAK is working on this area, but continued attention is needed to ensure timely resolution.

As discussed in Appendix F of this report, legacy wastes are a longstanding concern at LLNL; large volumes (10,000 drum equivalents) of legacy wastes have been stored for long periods (most for more than 10 years) in non-optimal storage conditions (many drums are stored outside, exposed to weather). The disposition of legacy wastes, and other waste management activities, at LLNL fall under the direction of EM and the OAK Office of Environmental Management. The long-term storage of various forms of hazardous legacy waste at LLNL presents some risks (e.g., degrading containers could leak and contamination could be spread or workers could be exposed, some waste materials are pyrophoric, and some drums are showing visible signs of corrosion). Long-term storage also results in recurring costs (e.g., inspecting drums and repacking and relabeling degraded drums). Although additional attention is needed to address legacy wastes, no instances of leaking drums or drums that were in imminent danger of leaking were observed.

Although the OAK Environmental Management organization and LLNL have presented EM with plans and resource needs to address these wastes, disposal of these wastes is competing for funding with other higher-priority EM projects. Thus, progress in the disposal of legacy wastes has been limited by the availability of DOE funding for several years. As part of the EM budgeting process, OAK is now preparing a performance management plan in collaboration with LLNL. This plan is intended to address how wastes will be dispositioned for two potential FY 2003 funding scenarios.

With regard to resource planning for the authorization basis document review, the OAK nuclear safety team is in the process of updating a resource-loaded schedule to determine whether sufficient resources will be available to support the review and approval of all authorization basis documentation submitted by

LLNL. Concurrently, LLNL is updating its 10 CFR 830 management plan (due on June 28, 2002), which will identify a schedule for submittal of the various LLNL authorization basis documents over the next several months. Because of the extensive effort, tight schedule, and limited qualified personnel (both at LLNL and OAK), effective and coordinated planning is essential, including contingency planning, to ensure that sufficient personnel resources are available when needed to meet the implementation deadline.

LLNL

LLNL continues to effectively use its institutional strategic planning processes to strengthen its mission and to maintain facilities and infrastructure. The most recent DOE Headquarters independent oversight safety management evaluation found that LLNL had strong institutional planning processes in place and that those processes have been further refined and strengthened. For example, the LLNL Director holds an annual strategic planning session with the Associate Directors and develops the highest priorities for LLNL, which includes safety. Each Associate Director then develops a corresponding list that supports the LLNL Director's list and that is subsequently reflected in the individual performance goals of each Associate Director and his/her subordinate managers. This approach effectively links strategic planning to individual performance.

The LLNL budget process continues to provide the necessary ES&H resources to effectively support ongoing programmatic and facility activities. The LLNL Ten-Year Comprehensive Plan serves as an effective planning tool for addressing both the mission and safety needs of the Laboratory. Specific projects, line items, facility/infrastructure, and general plant projects needs are identified and ranked using a risk-based prioritization matrix. LLNL has made improvements in its Facility Condition Assessment Survey program, which assesses the condition of all LLNL facilities and equipment on a three-year cycle. Facilities are prioritized using a risk-ranking system that has been effective in reducing the LLNL facility maintenance backlog. This program recently received positive recognition from the General Accounting Office for the manner in which facilities are assessed and maintained.

ES&H teams provide support to ongoing programmatic and facility activities, and have been an effective mechanism for integrating safety and environmental support within the LLNL line organizations. These teams are funded directly by LLNL programs, reflecting line management's commitment to safety. Except for the legacy waste funding issue (discussed earlier), the OA team did not observe any instances where the lack of ES&H resources has impacted safety or the mission of LLNL.

LLNL has achieved balanced priorities by effectively applying institutional processes for managing and authorizing projects. Resources have been effectively allocated to support project planning and implementation and to meet the scope of programmatic projects. The OA inspection team reviewed two projects—the B235 Laser Laboratory Project and the B191 Gun Tank Requalification Project. Both projects were well planned and authorized in accordance with ES&H Manual 2.2, "Managing ES&H for LLNL Work." During the planning phase, each project was broken down into sequential phases and the scope of each phase was clearly delineated on separate IWSs, approved by the authorizing individual, that serve as the authorization document for that phase of the project. The availability of resources, both funding and ES&H personnel, was confirmed prior to planning both projects and was documented on individual project IWSs. For example, for the B235 Laser Laboratory Project, funding was approved prior to planning the project and was documented on a project cost breakdown sheet that showed the approved budget for ES&H, hazardous waste management, and project management support. In addition, ES&H team members assigned to the Chemistry and Materials Science Directorate were fully integrated into all phases of the project, including the identification of hazards and confirmation that controls were in place to mitigate those hazards. Other aspects of planning and authorizing projects were effectively managed. For example, authorizing individuals were assigned consistent with the work authorization structure detailed in ES&H Manual 2.2, and workers were entered into the medical surveillance program as required.

LLNL management has recognized the need for additional resources to support the significant surge in workload associated with the preparation, review, and approval of its authorization basis documentation. LLNL is required to prepare and upgrade authorization basis documents in accordance with the 10 CFR 830 submission deadline. Recognizing the need for additional resources, LLNL increased the General and Administrative budget in FY-2002 by $1.2 million. The OAK decision to make the Decontamination and Waste Treatment Facility a Hazard Category 2 hazard facility further increases the complexity and workload of the effort.

However, LLNL has not developed a comprehensive evaluation of the resources needed to meet the LLNL authorization basis workload. The LLNL Authorization Basis Section (which provides matrix support to the line and independent LLNL review) and various line management organizations are experiencing a surge in workload as LLNL works to complete the authorization basis documentation. For example, LLNL is working to complete 10 CFR 830-compliant documented safety analyses for the major Defense Nuclear Technology nuclear facility, B332, and for several hazardous waste management Hazard Category 2 and 3 nuclear facilities by April 2003, in accordance with the schedule imposed by 10 CFR 830. The organizations involved in the preparation of this documentation have limited numbers of qualified and experienced personnel who can support authorization basis work. For example, in the Hazardous Waste Management Division, resources are limited and personnel have been reassigned in an attempt to manage the heavy authorization basis workload. LLNL has already requested two schedule exemptions from the 10 CFR 830 deadline, and may request three additional exemptions due, in part, to a shortage of resources. In addition, LLNL's available authorization basis expertise is being stretched, as indicated by several openings for safety analysts, delays experienced in authorization basis procedure development and associated training, and delays in reviewing revisions to the SAR for B332. The Authorization Basis Working Group, chaired by the SSEP Associate Director, provides an excellent mechanism for discussing authorization basis issues, but had not been used to evaluate the total (program plus matrix support) resources needed to meet the LLNL authorization basis workload and to determine whether available resources are sufficient and/or properly allocated. During the OA inspection, the LLNL Safety Programs Division Leader recognized the need for such an evaluation and included the identification of total resources required as an agenda item for the next Authorization Basis Working Group meeting.

Summary of Guiding Principle #4. OAK and LLNL have the necessary mechanisms in place to balance mission and ES&H priorities. LLNL continues to refine and strengthen the institutional planning and budgetary processes to ensure that ES&H resource, mission, and facility needs are met. While projects are well planned and authorized in accordance with LLNL processes for managing work, increased OAK management attention is warranted to ensure that additional strategic planning is performed to address legacy wastes, and increased OAK and LLNL management attention needs to be placed on the extensive workload and resources associated with the authorization basis commitments.

C.2.5 Identification of Standards and Requirements

Guiding Principle #5: Before work is performed, the associated hazards shall be evaluated and an agreed-upon set of safety standards shall be established that, if properly implemented, will provide adequate assurance that the public, the workers, and the environment are protected from adverse consequences.

OAK

OAK has worked effectively with LLNL to establish and maintain an appropriate set of ES&H requirements in the DOE/UC contract. The initial set of requirements was developed in 1999 in accordance with DOE policy and guidance for WSSs. This set of standards, which included applicable requirements from Federal, state, and local laws as well as DOE and industry standards, was tailored to site needs by including only those standards, and portions of standards, considered necessary and sufficient for LLNL activities. Local standards were developed when no others existed.

Continuing involvement by OAK managers and SMEs has ensured that WSSs are maintained up-to-date. A formal process for maintaining WSSs current includes evaluation of proposed changes to WSSs by a board of LLNL, UC, and OAK managers (i.e., the WSSs Change Control Board). This process provides a forum for OAK and LLNL managers and technical staff to work together to develop a common understanding of requirements and needs. The OAK Contracting Officer for LLNL keeps OAK and LLNL managers informed of changes in DOE directives that are potentially applicable to the site, and when these changes relate to ES&H, they are reviewed by the Board for inclusion in WSSs.

The current set of WSSs is complete and appropriately tailored for the hazards at the site for activities reviewed by the OA team. Changes in DOE directives are consistently reviewed for applicability and added to the Work Smart Standard set when appropriate. References to industry standards have been maintained current. The OA team identified no performance deficiencies that were attributed to deficiencies in the WSSs.

LLNL

LLNL chairs the WSSs Change Control Board and shares a commitment with OAK for establishing and implementing a necessary and sufficient set of standards. LLNL has established and implemented effective processes for identifying new standards and for incorporating these standards into the WSSs when appropriate. These processes have ensured that ES&H requirements remain consistent with DOE expectations, current industry standards, and hazards at LLNL. Clear assignment of responsibilities to SMEs has contributed to good performance in this area. The process for updating the WSSs on an annual basis has also contributed to good performance by identifying the need for changes to the WSSs and SME assignments. LLNL recently deleted the requirement for an annual update; this change could adversely impact future performance.

Processes for organizing and communicating requirements throughout the organization and for flowing requirements down to the task level are generally effective. Most WSSs requirements are adequately implemented through lower-tier documents that assign responsibilities and provide detailed implementing instructions. WSSs and the ES&H Manual are widely disseminated to LLNL personnel via a local area network.

However, requirements from some WSSs have not been incorporated into lower-tier documents in a timely manner. LLNL maintains a tracking system that has been effective in ensuring that ES&H Manual changes are eventually completed, but this system does not include timeliness criteria and has not assured timeliness of some Manual changes. For example, the ES&H Manual provisions on pollution prevention do not establish specific requirements to implement the prevention requirements of DOE Order 5400.1, *General Environmental Protection Program*. In addition, issuance of changes to lower-tier documents, such as facility safety plans, operational safety plans, and task-specific procedures, is not tracked at the institutional level and is not always timely.

Fire protection WSSs are incorporated into the ES&H Manual by referring to the appropriate external standard. Most of the fire protection standards apply to fire system design and construction. LLNL determined that incorporating implementation details for all of these standards into LLNL manuals would not provide value and would require extensive effort to keep updated. While the design and construction requirements are not needed by LLNL facilities on a recurring basis, the fire protection standards also include some operational, testing, and maintenance requirements that facility managers and Plant Engineering and UTel personnel need to be aware of and implement as required. Such individuals are generally not familiar with the voluminous fire protection standards and would not be expected to sort though those standards to extract the testing and maintenance requirements applicable to their facilities. The lack of a suitable tool (e.g., a manual with testing and maintenance requirements extracted from fire protection standards that are applicable to LLNL facilities) has likely contributed to a failure to meet certain fire protection testing and maintenance standards. For example, until recently, both Plant Engineering and the UTel organization were unaware of National Fire Protection Association (NFPA) 90A requirements for periodically testing fire dampers or NFPA 80 requirements for testing certain fire doors. At the time of the OA inspection, Plant Engineering was reviewing facilities to identify dampers and doors that need to be tested.

OAK identified inconsistencies between WSSs and nuclear facility SARs during an ISM Verification Review in 1999. LLNL developed and implemented a reconciliation plan to address these inconsistencies and scheduled corrective action based upon safety significance. In accordance with the plan, several inconsistencies of lower safety significance are to be addressed through approval of a new SAR (SAR-2000). However, delays in approval of SAR-2000 have delayed resolution of these inconsistencies.

Summary of Guiding Principle #5. OAK and LLNL have worked together effectively to establish an appropriate set of WSSs in the DOE/UC contract. LLNL has established appropriate ES&H requirements in the contracts of its subcontractors. A formal process has been established for updating WSSs. Continuing involvement by DOE and LLNL managers and SMEs has ensured that the standards are maintained current. Most WSSs are adequately addressed in lower-tier documents. However, the process for updating lower-tier documents does not always ensure timely updates, and the process for flowdown of fire protection testing and maintenance requirements contributed to implementation deficiencies.

C.3 CONCLUSIONS

Overall, OAK and LLNL have established a comprehensive and effective ISM program. Policies have been effectively established and communicated. Workers and stakeholders have multiple avenues for expressing ES&H concerns. OAK and LLNL roles and responsibilities are clearly defined. LLNL personnel are qualified to perform their responsibilities and exhibited a good understanding of facility hazards in most cases. OAK and LLNL have established priorities that reflect the importance of safety and have implemented management systems to ensure that ES&H needs are considered and balanced against mission needs at all stages of project planning. Systems for identifying applicable requirements and ensuring that they flow down to the work level through policies and procedures are effective in most cases.

Some aspects of the OAK and LLNL implementation of ISM are particularly innovative and/or effective. The OAK operations teams and LLNL ES&H teams are both effective means to integrate ES&H expertise with facility operations. Management systems for integrated project and ES&H resource planning are also effective.

Continued management attention is needed to address deficiencies in flowdown of fire protection testing and maintenance requirements to procedures, and to ensure that IWS implementation of appropriate requirements continues to evolve and improve. Senior OAK and LLNL management also need to direct additional attention to improving strategic planning for legacy waste and authorization basis efforts, analysis of crosscutting issues, corrective action management, and other items that require coordination across DOE and/or LLNL organizational lines.

C.4 RATINGS

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

Guiding Principle #1 – Line Management Responsibility for Safety.........EFFECTIVE PERFORMANCE
Guiding Principle #2 – Clear Roles and Responsibilities.........................EFFECTIVE PERFORMANCE
Guiding Principle #3 – Competence Commensurate with Responsibility..EFFECTIVE PERFORMANCE
Guiding Principle #4 – Balanced Priorities..EFFECTIVE PERFORMANCE
Guiding Principle #5 – Identification of Standards and Requirements.......EFFECTIVE PERFORMANCE

C.5 OPPORTUNITIES FOR IMPROVEMENT

This OA review identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive. Rather, they are intended to be reviewed and evaluated by the responsible NNSA, OAK, and LLNL line management and prioritized and modified as appropriate, in accordance with site-specific programmatic objectives.

OAK

1. **Update existing resource-loaded schedules to demonstrate how OAK will meet current authorization basis commitments.** Specific actions to consider include:

    - Develop contingency plans to address how resources would be prioritized and reallocated in the event unforeseen problems and schedule impacts arise.

    - Use the LLNL/OAK Docket Meeting as a forum to identify and discuss problems related to the integration of schedules to meet all authorization basis documentation commitments.

2. **Further enhance OAK staff competence and retention.** Specific actions to consider include ensuring that staff devote appropriate priority to TQP development and qualifications, consistent with management priorities and expectations.

LLNL

1. **Develop an approach and suitable tools for extracting applicable operation, testing, and maintenance requirements from national standards referenced in WSSs and presenting them in a manual for use by facility managers and support organizations.** Specific actions to consider include:

    - For fire protection, identify and extract requirements related to operations, testing, and maintenance that would be of value to line organizations (e.g., facility managers) and support organizations (e.g., Plant Engineering and UTel).

- Perform similar reviews for other external standards (e.g., electrical).

- Develop a manual or other suitable lower-tier document that provides applicable requirements and guidance in an organized manner that is readily usable by facility managers and other LLNL personnel who are responsible for implementing such requirements.

2. **Determine the total resources necessary to support all authorization basis activities, and take the actions necessary to acquire and/or reallocate resources, as needed**. Specific actions to consider include:

   - Develop an authorization basis activities staffing needs analysis and promptly address identified gaps in staff resources.

   - Continue to use the Authorization Basis Working Group as the mechanism to identify the total resources required to meet all LLNL authorization basis commitments.

   - Based on the conclusions reached by the Authorization Basis Working Group, allocate resources as necessary to meet current authorization basis commitments.

   - Incorporate the resource requirements identified by the Authorization Basis Working Group into the 10 CFR 830 Management Plan.

   - Use the LLNL/OAK Docket Meeting as a forum to identify and discuss problems related to the integration of schedules in order to meet all authorization basis documentation commitments.

   - Working with OAK, develop contingency plans to address how resources would be prioritized and reallocated in the event unforeseen problems and schedule impacts arise.

3. **Further enhance LLNL training programs.** Specific actions to consider include**:**

   - Facilitate fulfillment of craft supervisor responsibility to ensure that assigned staff training requirements are kept current by emailing copies of certain LTRAIN training notices for craft personnel to their supervisor, thereby accommodating differences in crafts' workday access to email versus that of office and lab employees (e.g., include supervisors as addressees for email notices that members of their staff are scheduled for training in the next two days).

   - Further improve the Plant Engineering OSHA training program by assigning course numbers to their planned series of monthly required refresher training modules, thereby providing LTRAIN documentation of completion of the required refreshers and periodic alerts to supervisors when retraining is required.

   - Establish processes to enhance and document area-specific HAZCOM training provided by supervisors to their staff.

   - Revise LTRAIN reports of completed training to clearly flag situations where refresher training has not occurred. For example, consider replacing the "last completed date" with the word "expired" when a refresher period is exceeded to close an error-likely loophole in training verification where the individual's training plan did not require the training.

4. **Enhance timeliness and tracking of updated or revised requirements**. Specific actions to consider include:

    - Establish timeliness criteria for incorporating changes and additions to WSSs into lower-tier documents.

    - Develop processes for monitoring and verifying implementation of changes.

    - Reinstitute a process for updating WSSs at a specified frequency.

5. **Continue to enhance current processes with emphasis on issues that affect multiple LLNL directorates (crosscutting issues)**. Specific actions to consider include:

    - Enhance the IWS process, with emphasis on generic IWSs and task definition for Plant Engineering work and other crafts-type work. Ensure that enhancements serve the needs of individual organizations and institutional needs.

    - Continue and increase senior management attention on deficiencies and areas for improvement that cross LLNL organizational lines, including assessments, corrective action management, and lessons learned.

    - Ensure individuals understand that they are responsible and accountable for strict compliance with requirements, and that responsible individuals may need to stop work to resolve problems with forms or processes rather than signing off on incomplete or inaccurate forms.

    - Continue ongoing efforts to enhance individual accountability for safety performance within the directorates at all levels of management.

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APPENDIX D

Feedback and Continuous Improvement (Core Function 5)

D.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance's (OA) evaluation of feedback and improvement at the Lawrence Livermore National Laboratory (LLNL) included an examination of the Oakland Operations Office (OAK) and LLNL programs and performance. The OA team examined the OAK line management oversight of LLNL integrated safety management (ISM) processes and implementation, including the operational awareness program; annual and for-cause environment, safety, and health (ES&H) program evaluations; and the award fee/performance evaluation and measurement process. The OA team reviewed such LLNL institutional processes as assessments and inspections, lessons learned, corrective action/issues management, and activity-specific processes, such as post-job reviews.

D.2 RESULTS

OAK Line Management Oversight

OAK has established an innovative organizational structure and clearly delineated plans, policies, and procedures for conducting ES&H oversight at LLNL. Primary line oversight of LLNL ES&H performance is conducted by the OAK Assistant Manager for National Security (AMNS) through the Livermore Safety Oversight Division (LSOD). Environmental management programs oversight is provided by the Livermore Environmental Programs Division of the Assistant Manager for Environment and Nuclear Energy, which also provides technical support specialists to supplement AMNS needs. The processes, requirements, and commitments for OAK oversight of LLNL ES&H programs are described in a comprehensive set of plans and standard operating procedures. The Livermore site Integrated Safeguards and Security and Safety Management Plan describes the processes and responsibilities for managing and overseeing safety management at LLNL. Day-to-day oversight activities are described in a facility operational awareness program procedure and are further detailed and scheduled in annual and quarterly operational awareness implementation plans (OAIPs).

The OAK operations teams are effectively implemented to perform line management oversight of LLNL. OAK has established eight operations teams, each of which is led by a line manager and includes Facility Representatives (FRs), technical specialists, and program staff who conduct day-to-day operational awareness activities. In addition, assigned functional area managers in LSOD develop and implement OAIPs for overseeing LLNL performance in eight functional areas. The nine FRs and ES&H functional area managers and subject matter experts (SMEs) who conduct most of the monitoring of contractor safety and environmental performance are identifying ES&H program and facility condition deficiencies and fostering continuous performance improvement at LLNL. OAK is effectively allocating its operations teams based on the relative risks of the LLNL facilities. For example, an operations team is established to focus exclusively on the LLNL plutonium facilities complex (which is among the higher-hazard facilities at LLNL). Another operations team focuses on the explosives handling facilities. The other operations teams focus on groups of lower-hazard facilities. OAK's allocation of personnel resources and technical expertise/skill mix to the operations teams is consistent with the relative risks (e.g., the operations team for the higher-risk facilities generally have more experienced personnel and more types of technical expertise among the team members).

Operations teams and functional area managers perform an appropriate set of routine operational awareness activities, assessments, and for-cause reviews. Routine operational awareness activities include facility walkthroughs, surveillances, attendance at facility safety and experiment review meetings, and technical document reviews. OAK staff members document their line oversight activities, including observations and identified deficiencies, in a relatively new data collection relational database called FISHE. Deficiencies or concerns identified during routine operational awareness activities are communicated and resolved informally between the oversight staff and the responsible parties or facility management. Feedback and information sharing is fostered through frequent staff meetings of the operations teams, the FR, the functional area manager, and SME groups. The ES&H group also periodically (twice a year) issues a report of their oversight activities and an analysis of FISHE finding data. FRs formally summarize their awareness activities in a monthly report to appropriate OAK management and operations teams do so quarterly. OAK also conducts ES&H team assessments on an annual basis. Further, OAK conducted for-cause reviews of laser safety in June 2000 and of electrical safety in January 2001, based on their analysis of operational awareness results and concerns about operational events and trends. The OAK operational awareness activities, assessments, and reviews have identified deficiencies in LLNL ISM implementation and have resulted in corrective actions and improved ES&H performance.

OAK is using the contract and performance measures to promote improvements in LLNL ES&H performance. The DOE/University of California (UC) contract for the operation and management of LLNL includes many expectations and measures for ES&H performance (see Appendix F for discussion of one aspect of a performance measure that could be improved). OAK appropriately monitors and annually evaluates LLNL performance to the Objective Standards in Appendix F of the DOE/UC contract. In addition, two of five Appendix O focused management improvement initiatives relate to safety and award fee and may be deducted if LLNL fails to satisfactorily implement these initiatives. In addition, LLNL conducts an annual self-assessment of performance against contract measures, which is evaluated for adequacy by OAK, based in part on operations team and ES&H specialist's operational awareness results.

OAK and AMNS have conducted annual self-assessments in accordance with formal procedures. In these assessments, OAK and AMNS self-identified a number of weaknesses and opportunities for improvement. For example, a May 2002 LSOD report on analysis of FISHE data identified numerous deficiencies in the FISHE documentation that limited the value of the data in analyzing performance. As a result of this review, corrective actions were developed. OAK also conducted a critical self-assessment of their FR program in 2001 that led to significant improvements in FR staffing and training programs.

Although most of the framework for an effective program is in place and many oversight activities are being performed, several weaknesses are limiting the effectiveness of the OAK oversight of LLNL performance.

- Although some for-cause reviews have been performed, crosscutting management system areas, such as corrective actions, the contractor's self-assessment program, lessons learned, and work control, are not integrated into OAIPs or FISHE reviews for routine evaluation by OAK oversight staff.

- The details of OAK oversight activities, results, and corrective action/disposition of deficiencies are often poorly documented in FISHE, which is a recently implemented system. This concern was also documented in LSOD's recent assessment of FISHE data.

- In some cases, OAK has not been effective in ensuring that LLNL has fully resolved identified issues and operational awareness deficiencies to prevent their recurrence. For example, LLNL closed the issue regarding lockout/tagout reviews identified in the January 2001 OAK for-cause review;

however, the full scope of the finding was not adequately addressed. In another case, OAK concurred with LLNL's inappropriate closure of an ISM validation process management issue concerning deficiencies in the use of DefTrack, a modular, tiered deficiency tracking system. The OA inspection team determined that this issue still exists at LLNL. In fact, the closure report from the Assurance Review Office (ARO), which conducts analysis and reporting on DefTrack data, documented many examples reflecting continuing deficiencies. Corrective action plans were not always developed in a timely manner.

OAK has vacancies in a few critical ES&H oversight positions, limiting OAK's ability to perform oversight in a few areas. First, LSOD does not have a resident environmental health physics SME. As a result, oversight has been limited to paper reviews of certain aspects of LLNL's environmental protection program-related documentation by SMEs located in Oakland. OAK line management has not conducted routine onsite walkthroughs or functional program reviews of the contractor's environmental radiation protection program elements or of compliance with DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. The few operational awareness activities conducted since April 2001 were primarily reviews of technical documents associated with environmental radiological protection program. Second, since March 2002, OAK has had a vacancy in one of the operational team leader positions. Although the team is functioning with an acting leader, the absence of a permanent leader hinders the ability of that team to continually improve. OAK is aware of these shortages and the resulting impacts on line oversight and is working to address them in the long term (by filling the team leader vacancy) as well as the short term (e.g., mentoring the team without a permanent leader and using OAK SMEs to perform some reviews of environmental protection program documents).

LLNL

LLNL has a number of institutional programs that provide feedback on the adequacy of ES&H processes and performance. Various inspection and assessment processes are being employed at the division level. Other feedback mechanisms include the Occurrence Reporting and Processing System (ORPS), lessons learned, employee concern/suggestion programs, safety committees, and the ES&H Working Group. Other staff counterpart meetings provide additional institutional feedback vehicles for improving ES&H performance. Additionally, DefTrack is used to document and track corrective actions for identified program and performance deficiencies. As discussed below, assessment programs, corrective action management, and lessons-learned programs each have many positive aspects, but have weaknesses that need to be addressed.

Assessments. Numerous and diverse assessment activities are conducted at LLNL to evaluate safety performance and implementation of ISM guiding principles and core functions. Requirements for internal ES&H assessments are outlined in the LLNL ES&H Manual and the LLNL Quality Assurance Program Plan. These documents describe clear and appropriate expectations for directorate self-assessment programs, including planned and scheduled reviews of ISM programs, Integrated Work Sheets, and operational safety plan documents, management walkthroughs, and directorate-specific ES&H Manual-directed assessments. Annually, each directorate develops a formal and detailed self-assessment plan, which identifies the scope and schedule for self-assessments. Assessments are performed in approximately 25 functional areas identified periodically by the ES&H Working Group in a "focus areas" list of requirements from the ES&H Manual. Teams perform periodic (three per year) facility condition walkthrough inspections of each facility. These inspections are effectively identifying deficiencies and tracking corrective actions to completion. Each directorate has issued detailed annual summary reports that reflect the assessment activities performed the previous calendar year, an analysis of event and deficiency data, and input of directorate contributions to the performance measures identified in the DOE/LLNL contract. The annual reports include two noteworthy elements that are somewhat unique and are effective in promoting systemic improvements in LLNL feedback programs: (1) the identification of actions taken for LLNL-issued lessons learned, and (2) an analysis of the self-assessment program, with recommendations for performance improvement.

The ARO, reporting to the Deputy Director for Strategic Operations, conducts independent and LLNL-wide management and functional area assessments as well as periodic analysis and reporting on ORPS and DefTrack data. In addition to the approximately eight assessments and data analysis reports conducted each year, ARO also compiles information from the annual directorate self-assessments, ARO's independent assessments, and external reviews into a report of the LLNL implementation of ES&H and ISM requirements. ARO assessments were generally comprehensive, identifying strengths and compliance with requirements as well as institutional program and performance weaknesses.

The frequency and scope of various requirements for performing inspections, reviews, and assessments delineated in the ES&H Manual are identified annually by LLNL functional area SMEs in the Hazards Control Department in formal Discipline Action Plans (DAPs). The generic requirements in the DAPs are tailored by the ES&H teams matrixed to each directorate to the hazards, activities, and conditions in the facilities for which they are assigned and are detailed in team action plans (TAPs). The technicians and SMEs on the ES&H teams then conduct the inspection/assessment activities on the schedule established in the TAPs.

Periodically, special committees or task forces have been established to conduct special reviews of ES&H issues. Examples include the Safety Improvement Task Force, the Feedback and Improvement Team, and the Rollout Implementation Team, which was created to address various issues related to the ISM verification in calendar year (CY) 2000.

Although the framework for an effective self-assessment program is in place and many assessment activities are performed at LLNL, weaknesses were identified that impact their overall effectiveness in measuring performance and driving continuous improvement. Some required assessment activities are not being performed, and some are inadequately reported. Further, some assessments lacked sufficient depth and focus to effectively evaluate the adequacy of ISM implementation, and identified deficiencies are not always documented in DefTrack. In addition, issues identified by LLNL assessment activities are not consistently and effectively evaluated and resolved (discussed under corrective actions subsection). There are some inconsistencies in manuals and plans (e.g., the directorate assessment plans do not specifically list ES&H team inspections). Examples of weaknesses identified in the LLNL assessment programs include the following:

- **Institutional-level program reviews are not routinely performed.** While ES&H Manual-required functional area inspections and assessments are being performed in individual facilities and directorates, the adequacy of many functional area programs do not appear to be periodically evaluated from an institutional perspective, except for rule-driven reviews of the radiation protection program and criticality safety. For example, the significant effort involved with the new authorization basis development program has not been assessed.

- **Several reviews that are required by the Occupational Safety and Health Administration (OSHA) are not being performed.** Annual lockout/tagout program reviews have not determined and assessed the level of understanding of lockout/tagout responsibilities for all authorized and affected employees, as required by 29 CFR 1910.147. Supervisors are conducting lockout/tagout program reviews by observing performance of lockout/tagouts by some authorized employees, as required by the ES&H Manual and OSHA. However, the LLNL practice does not include all required employees. The annual confined space program review required by 29 CFR 1910.146 is not identified as a responsibility in the ES&H Manual and is not being performed at LLNL.

- **Mechanisms for soliciting worker feedback are limited**. For example, comment blocks on maintenance work documents are seldom used, and there are no requirements for formal post-job reviews for complex tasks.

- **The documentation and performance of some assessments and findings were insufficient.** Some focus area assessments against checklists were not rigorously documented to reflect items that were inspected or adequately performed (i.e., checklist questions were not clearly answered or were answered incorrectly). Examples included Plant Engineering's 2001 lockout/tagout assessment, and ventilation hood conditions in Plant Engineering facilities that had passed recent (April 2002) inspections by the Hazards Control Department, but were identified by the OA inspection team as non-compliant with ES&H Manual requirements. Findings from many management assessments and the inspections and reviews conducted by ES&H teams to meet ES&H Manual requirements are not being entered into DefTrack to support trending of problem areas.

- **Many management walkthroughs are not being performed, and observations by line management are not always documented in DefTrack to support trending.** There are clear expectations for management walkthroughs in the ES&H Manual and in directorate assessment plans. Although compliance has been improving, the walkthroughs are not consistently completed and documented.

Issues and Corrective Action Management. DefTrack is available for use by all organizations to document ES&H deficiencies and corrective actions and to track those actions to closure. The ES&H Manual provisions on the deficiency tracking process details requirements for use of DefTrack and rolling up higher priority deficiencies to the institutional level for trending. Corrective actions for many ES&H deficiencies and issues are adequately tracked to resolution.

However, the documentation, evaluation, and resolution of ES&H deficiencies and issues are not being managed in a structured, consistent, risk-based, and effective manner that fully supports continuous improvement. Examples of weaknesses in issues and corrective action management processes and performance include:

- **Policy and procedure weaknesses contribute to inadequate performance.** LLNL does not have an issues management policy, plan, or procedure. The ES&H Manual provisions on the ES&H Deficiency Tracking System do not adequately address the management of multidirectorate or institutional deficiencies, and DefTrack is not being used by LLNL to capture and manage issues. In addition, the term "deficiencies" is not defined in the ES&H Manual deficiency tracking provisions. Further, the ES&H Manual does not provide instructions for addressing essential elements of an effective corrective action system, such as the extent of condition and causal factors in the development of corrective actions to prevent recurrence. There are no instructions for establishing or revising action due dates. Further, the ES&H Manual does not provide for consistent input of deficiencies that supports trend analysis or provide adequate instructions for the analysis of deficiencies and development of effective corrective actions. The types of deficiencies that are required to be put into DefTrack are based on the source, rather than on a consistent risk/prioritization basis.

- **A number of identified institutional issues have not been formally addressed or have been informally managed without appropriate controls and visibility.** In CY 2000, LLNL identified that testing requirements specified by the National Fire Protection Association for maintenance and testing of fire doors were not being met. This deficiency/issue was not entered into DefTrack. Although actions are being taken to identify the population of affected equipment and to develop surveillance procedures, this issue is not tracked and managed by any formal process that would provide appropriate management controls. Missing management controls include causal analysis, extent of condition/generic applicability reviews, management approval, concurrence, prioritization, responsibility assignments, and action due dates. In addition, informal issues management restricts visibility of the issue and its resolution, including progress reports and schedule compliance, reportability for ORPS or Price Anderson Amendment Act, and a lack of input for trending of deficiency data. Other issues that have not been addressed or formally managed include:

- Opportunities for Improvement from the June 2000 and June 2001 ARO annual ES&H reports and ARO data analysis reports of ORPS and DefTrack data have not been formally addressed.

- Program and performance weaknesses from ARO assessments of Emergency Management (December 2000), Radiation Protection Program (June 2001), and DefTrack's Role in the Feedback and Improvement Process (January 2002); OA-30's Emergency Management reviews in 1998 and 1999; and Hazards Control Department identification of confined space program deficiencies have not been put into DefTrack.

- The issue and corrective action plan (CAP) actions that were developed in response to the EH-10 Enforcement Letter of November 1999 regarding deficiencies in authorization basis development and maintenance and the Price Anderson NTS corrective actions have not been entered into DefTrack, as required by the ES&H Manual. An informal tabulation of the major CAP actions and status has been kept by the authorization basis group, but some actions (e.g., periodic independent assessments with special emphasis on authorization basis documents) specified in the CAP have not been implemented or tracked, and the current status of the listed actions is not being maintained. No independent verification or validation is performed for the Price Anderson Amendment Act corrective actions.

- **There are deficiencies in the use of the tracking system.** Directorate DefTrack data indicates that the extent of condition and recurrence control are not typically addressed. Numerous DefTrack entries have no estimated completion date. ARO identified in a recent assessment that 62 percent of DefTrack items rolled up to ARO had no date, approximately one third of which were assigned to the two highest risk ratings. There are inconsistencies in the requirements for identifying deficiencies that must be input to DefTrack, and the practices of individual directorates, departments, and divisions vary considerably. These factors hinder meaningful analysis and trending of DefTrack data.

- **Corrective actions have been closed by LLNL without correction of the underlying issue.** The failure of some LLNL organizations to perform ES&H Manual-specified (and OSHA-required) lockout/tagout inspections, as detailed above, was identified in a CY 2000 ARO independent assessment, and again in a January 2001 OAK for-cause electrical safety assessment. The corrective action for both inspections was issuance of a memorandum. For the DOE assessment, an additional action was taken specific to National Ignition Facility subcontractors. Actions for both are closed, and the DOE finding closure was verified and validated by LLNL in April 2002. However, the corrective actions were not comprehensive, and the validations were not sufficient to verify the adequacy of the corrective actions. The required reviews are still not being performed for all applicable employees. In a second example, an ISM validation process management finding on the inadequate use of DefTrack was closed in a January 2002 closure assessment report, which identified that the system was still not being used to provide management with appropriate information.

Many of the deficiencies in corrective action management (discussed above) have been previously identified and documented, but not fully addressed by LLNL. For example, a September 2000 report by a feedback and improvement team to an institutional committee (the Safety Improvement Task Force) identified the need for a policy and procedures for managing issues and the need to hold directorates accountable for adhering to policies and procedures for ES&H deficiencies. Section F.2.2 of Volume II of this OA inspection report discusses additional examples where previously identified weaknesses in the emergency management arena were not consistently captured and effectively addressed.

Finding #1: LLNL processes and implementation for ES&H and emergency management issues management and corrective action are insufficient to ensure consistently appropriate and timely identification and resolution of safety and health concerns and crosscutting or institutional issues.

Lessons Learned. Lessons learned have been applied to improve processes and training, and to ensure that unsafe equipment was not used at LLNL. Lessons learned from approximately 50 local and DOE complex-wide events are disseminated annually to line managers and workers for application to work environments, activities, and training programs. Lessons learned from local events and incidents and the DOE list server are identified or screened by an institutional coordinator, reviewed by SMEs and the ES&H Working Group, and emailed to line managers for posting or communication to workers. Lessons learned have recommended actions tailored to LLNL practices and organizations.

Some organizations are generating and distributing detailed and informative internal lessons learned, and there is evidence that some lessons learned have resulted in enhancements to LLNL processes. Lessons learned are shared in safety and committee meetings. Approved lessons learned are also posted and retained on the LLNL internal and external Web sites, grouped into fourteen different functional areas. The Web sites also provide a link to general information and resources for generating internal lessons learned. A requirement that directorates include in their annual ES&H self-assessment report the actions taken on issued lessons learned is effective at driving more formality and accountability by the line. The Safety, Security, and Environmental Protection Directorate maintained excellent records of lessons-learned reviews and the actions taken.

Notwithstanding the above examples of excellence and communication of lessons learned, there are several weaknesses that are limiting the effectiveness of the lessons-learned program. LLNL is not taking full advantage of DOE complex lessons-learned resources to identify and disseminate pertinent lessons learned. Few externally generated DOE lessons learned are formally issued for dissemination. Neither the ES&H Manual provisions on lessons learned, nor the LLNL lessons-learned Web site inform, direct, or encourage potential users to access the much more extensive and searchable DOE list server database for topic-specific information. Only the use of the relatively few LLNL-issued lessons learned is addressed. Further, issued lessons learned from external sources are condensed summaries and do not provide a link to the source or identifier of the original report for potential users to access more detailed information. In addition, issued lessons learned do not appear to have a sufficient focus on events related to significant work hazards at LLNL. For example, the only lessons learned that are related to inadvertent penetration of energized utilities (blind wall penetrations or excavations) are from 1998, although there were at least seven events of this type at LLNL in the last two years. The latest radiation protection lesson learned was issued by LLNL in September 2000.

D.3 CONCLUSIONS

OAK has established an effective organizational and administrative framework for conducting operational awareness and evaluation activities related to contractor ES&H/ISM performance. Operations teams and functional area managers are conducting numerous operational awareness activities and have a significant presence in nuclear and radiological facilities and other facilities. The operations teams are using a graded approach based on hazards and risks and are effective in identifying deficiencies and promoting improvements. Annual ES&H assessments and occasional for-cause program reviews have identified program and performance deficiencies and are also driving process improvements. Safety performance measures are included in the DOE/UC contract and are used to promote improvements in performance. Although generally effective, the OAK line oversight program could be further strengthened through better documentation of findings and their resolution and more rigorous verification of the effectiveness of LLNL corrective actions and recurrence controls. Also, the effectiveness of some OAK operations teams would be enhanced by additional emphasis on structured surveillance activities and more observation of work.

Many mechanisms are being used to provide feedback and improvement in safety performance at LLNL. The rigor of planning, execution, and documentation of directorate self-assessments is significantly improved since the most recent Headquarters independent oversight safety management evaluation. ES&H deficiencies are identified and often documented in DefTrack, corrective actions are developed and implemented, and lessons learned are disseminated. However, inconsistencies and weaknesses in processes and in the implementation of feedback and improvement mechanisms have hindered their effectiveness in driving continuous improvement in ISM system implementation. Assessment programs need further strengthening to ensure that all required assessments are being scheduled and performed, including institutional evaluations of ES&H program adequacy, and that assessment results are being input to DefTrack. The processes and performance for managing ES&H deficiencies needs management attention to ensure that the extent of condition and root causes are addressed and that implementation of actions is timely and effective. Identified institutional and multidirectorate safety issues have not been adequately addressed in some cases, resulting in continuing program and performance deficiencies and untimely or ineffective problem resolutions. The lessons-learned program can be strengthened to ensure that more and appropriate lessons from across the DOE complex are communicated to workers for information and application in training, work planning, and performance.

Overall, OAK and LLNL employ many different mechanisms for gathering feedback information, sharing lessons learned, implementing corrective actions, and conducting oversight of ES&H activities. However, a number of process weaknesses and inadequate implementation of these mechanisms have hindered their effectiveness in driving consistent, continuous improvement, especially in managing the evaluation and resolution of institutional program and performance issues.

D.4 RATING

Core Function #5 – Feedback and Continuous Improvement ....NEEDS IMPROVEMENT

D.5 OPPORTUNITIES FOR IMPROVEMENT

The OA review identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive. Rather, they are intended to be reviewed and evaluated by the responsible OAK and LLNL contractor line management and prioritized and modified as appropriate, in accordance with site-specific programmatic objectives.

OAK

1. **Continue to strengthen OAK processes and oversight activities for evaluating contractor performance and for documenting, communicating, and tracking the resolution of LLNL**

performance deficiencies that are identified during oversight activities. Specific actions to consider include:

- Strengthen processes and closely monitor performance for recording operational awareness information in FISHE, especially with regard to identifying and tracking the resolution of deficiencies in programs and performance.

- Expand the use of surveillances to evaluate LLNL performance in specific topical areas, functional area programs, and crosscutting institutional management systems, such as issues management, training, and lessons learned. Consider establishing a quarterly focus area(s) where all operations teams and functional area managers collect data that is pooled to evaluate institutional performance.

- Ensure that some OAK operations teams in lower-hazard facilities increase their focus on critically evaluating ES&H performance, including observation of work and reviews of objective evidence of ISM implementation.

- Establish a routine, periodic (monthly or quarterly) written report to LLNL senior management communicating recent oversight activities, concerns, and issues.

- Establish a mechanism to periodically or routinely document an evaluation of the adequacy of the LLNL assessment and corrective action processes.

- Ensure that OAK is adequately evaluating the LLNL environmental protection program and complying with DOE Order 5400.5.

LLNL

1. **Continue to strengthen the processes and conduct of assessments to drive improvement in safety programs and performance.** Specific actions to consider include:

    - Clarify and proceduralize the use of the ES&H Working Group focus areas list, and correct erroneous references to Section 1.3 of ES&H Manual Document 2.1.

    - Capture all types of self-assessment activities within the directorate self-assessment plans, including ES&H Manual-mandated reviews that are conducted by ES&H teams.

    - Establish requirements for periodic institutional-level ES&H program reviews.

    - Ensure that deficiencies in LLNL requirements for and performance of confined space and lockout/tagout program reviews were isolated outliers by performing ES&H Manual-mandated reviews and assessments to ensure that they are in compliance with external standards and are performed as required.

    - Ensure that the LLNL lockout/tagout program meets all review requirements of 29 CFR 1910.147 and that all organizations with authorized employees meet these requirements.

2. **Strengthen the management of ES&H deficiencies and issues to ensure effective evaluations and resolutions that address the extent of condition and causal factors, especially for institutional issues.** Specific actions to consider include:

- Establish and implement a formal issues management process.

- Establish interim controls to address ongoing informal corrective action plans and tracking systems and for managing emerging issues pending the issuance of new ES&H Manual issues management requirements and procedures.

- Strengthen ES&H Manual Document 4.2 to clarify its applicability to all deficiencies, regardless of source, and address essential elements of issues management, such as expectations for determining the extent of condition, causal analysis, time frames for completing process evolutions, and determination and definition of "institutional" issues.

- Routinely publish and distribute a status report of DefTrack corrective actions to appropriate levels of management, and hold line management accountable for effective and timely resolutions.

- Conduct regular assessments of the adequacy and implementation of the issues management processes at all levels to ensure their effectiveness in resolving deficiencies and preventing recurrence.

3. **Continue to strengthen the lessons-learned program to ensure that appropriate lessons learned are consistently developed, screened, and applied to training and work activities at LLNL**. Specific actions to consider include:

    - Establish procedural guidelines and lower thresholds for selecting lessons learned to share with line management and workers, ensuring that selections are based on risk and applicability to the hazards and work activities at LLNL.

    - Include guidance, directions, and links to external DOE lessons-learned sites to LLNL procedures and Web sites that foster access to and use of the more detailed and extensive lessons-learned information by work planners and training.

    - Conduct periodic user surveys and program implementation assessments of the lessons-learned program.

    - Expand the Safety, Security, and Environmental Protection Directorate lessons-learned application review process and documentation methods to all directorates.

APPENDIX E

Core Function Implementation (Core Functions 1-4)

E.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) conducted an evaluation of work planning and control and implementation of the first four core functions of integrated safety management (ISM) at the Lawrence Livermore National Laboratory (LLNL). The evaluation focused on safety performance during conduct of facility maintenance and operations and programmatic work activities associated with Defense and Nuclear Technologies (Buildings 191 and 332), Chemistry and Materials Science (Buildings 132 and 235), and Safety, Security, and Environmental Protection (sitewide environmental monitoring and waste management facilities/activities) Directorates. Some activities associated with the Engineering (Building 131 High Bay) and Laboratory Services (e.g., Plant Engineering—maintenance) Directorates were also reviewed. Observed work activities included numerous preventive and corrective maintenance and small project work performed by Plant Engineering, Buildings 332 and 191 facility operations, and Buildings 332, 191, 235, 132N, and Building 612 Complex programmatic work. In addition, work control systems and their implementation, and surveillance testing and preventive maintenance (PM) implementation within selected facilities were reviewed. Procedures and policies, such as authorization basis process procedures and stop-work policies, were evaluated, and hazard analysis and control systems were examined. This approach enabled OA to evaluate the implementation of work control processes governing a broad spectrum of work for facility management, facility operations, and laboratory programmatic work.

LLNL's Integrated Work Sheet (IWS) process was a major focus of the OA inspection of the core functions. The lack of an effective process for planning, controlling, and authorizing work was the most significant deficiency identified in the most recent Headquarters independent oversight review. The IWS process provides a comprehensive and integrated approach to authorizing and controlling work, analyzing hazards, and establishing control. It contains and references controls, and provides an effective mechanism to certify that controls are in place for the hazards before starting work activities. Although a relatively new process, all LLNL directorates, with the exception of the Defense and Nuclear Technologies Directorate, have implemented the IWS process. The Defense and Nuclear Technologies Directorate uses an ISM process that is different but equivalent in approach and content.

E.2 STATUS AND RESULTS

E.2.1 Core Function #1 – Define the Scope of Work

Missions are translated into work, expectations are set, tasks are identified and prioritized, and resources are allocated.

LLNL has processes and mechanisms in place that adequately define and bound the scope of work depending on the size and nature of the work, the directorate performing the work, and the risk and cost of the work. DOE authorization agreements, authorization basis documents, and facility safety plans (FSPs) establish limits and requirements that effectively define what work is allowed and bound the scope of work within the various facilities. Operational safety plans (OSPs) supplement the FSPs and further define the scope of work. These upper-tier mechanisms are in place, maintained current, and with few exceptions are appropriately used to define and bound the scope of work. Additionally, defining the scope of work includes consideration of mission, prioritization, and allocation of resources. At the work-activity level, mechanisms and processes were in place that ensured adequate work prioritization and allocation of resources based on risk and facility mission. Those processes adequately address the prioritization of individual work activities for Plant Engineering facility/infrastructure work and programmatic work performed by other directorates.

Larger work activities, such as budget line items and general plant projects, were well defined and were guided by project management, acquisition, and procurement manuals and associated procedures. Large projects were not selected for review during this OA inspection.

With some exceptions, task-specific IWSs, OSPs, surveillance-required procedures, maintenance work packages, and administrative control procedures are effectively used to define the scope of work activities associated with facilities, equipment operation, and maintenance. As examples, the Building 332 and 191 operational plans and procedures adequately define the scope of work for building operations; the IWSs and OSPs reviewed in Buildings 132N, 235, and 131 High Bay describe work activities in sufficient detail that would allow identification of hazards and the development of controls; most Plant Engineering whiz tags (trouble calls), preventive and corrective maintenance work requests, and small project job orders adequately define the scope of the work activities.

Work planning and scheduling processes varied across LLNL but were generally effective and included both formal and informal mechanisms, such as daily activity scheduling, day-to-day and weekly planning meetings, and pre-job briefings that refined and confirmed the scope of work for planned activities. The IWS or an IWS-equivalent is implemented in all directorates and is used as the controlling process to specify the work activity, identify the hazards, and list or reference the controls. The IWS process, as implemented, has limitations in some directorates. For example, it does not provide for sufficient flexibility for repetitive, low-risk, routine work performed by Plant Engineering and does not accommodate facilities, such as Building 332, that have a somewhat different work control system or that may already have adequate operational procedures for certain activities. For example, a facility procedure that identifies all the hazards, has the necessary controls, and has been through a formal approval process duplicates much of the same information required in an IWS, and thus the IWS adds little value. During the evaluation, LLNL indicated that the IWS process, as described in the Environment, Safety, and Health (ES&H) Manual, was being revised and that the next revision should address some of the current limitations.

While effective for the most part, the IWS process is a relatively new process at LLNL and is still evolving and improving as experience is gained. The quality and detail of the IWSs for similar hazard work varied between directorates. In many cases, individual LLNL directorates and departments are modifying IWSs as they gain experience or are developing supplemental instructions to adapt to the current limitations of the IWS format for the sections of the IWS that address hazards and controls. For example, departments have attached supplemental documents, such as a job safety analysis, to augment the IWS in those areas. In another example, the Engineering Directorate in the Building 131 High Bay has split a single IWS into 27 separate IWSs to gain the required specificity. Chemistry and Materials Science has developed detailed IWSs with change control processes to track scope-of-work changes for IWSs.

Most IWSs reviewed by the OA team provided an adequate description of the work, such that hazards could be identified and the appropriate controls implemented. However, the OA team identified weaknesses in some generic and specific IWSs (e.g., electrical work, carpentry, roofing, and plating) where the scope of work and subtasks allowed under the IWS were not adequately defined such that hazards and corresponding controls could be linked to a specific work activity. (Generic IWSs cover a span of recurring or routine activities, such as electrical work, while specific IWSs cover a specific task or activity, such as a single operation or an experiment.) The types of problems encountered were somewhat different for programmatic work, versus the type of work activities performed by Plant Engineering (for which the work scope is typically more broadly defined).

The defined scope of work for some Plant Engineering IWSs is overly broad and lacked work breakdown structures to identify subtasks within the broad categories of work. For example, the Plant Engineering roofing IWS addresses installation of equipment, routine maintenance and repairs, and modifications, and could include demolition. Subtasks are not defined or linked to specific hazards and controls. Hot mopping with a gas-fired tar pot may have significantly different hazards and controls than installing membrane or shingle roofing. Because of the deficient work definitions, several hazards associated with roofing were not identified in the IWS. Similar deficiencies exist with the generic IWSs for carpentry and low- and high-voltage electrical work. Because the scope of work conducted under the generic IWS was broad and the list of hazards not inclusive, the "define work" portion of the IWS did not facilitate identifying all hazards (such as the instances of working near overhead lines as discussed in Core Function #2). In many cases, because the tasks were listed so broadly, hazard identification did not always envelope all possible tasks. A contributing factor may be that the ES&H manual does not provide detailed instructions on how the IWS scope of work, hazards, and control blocks are completed and does not mandate a one-to-one correspondence between a particular defined job task and the hazard controls for that job. In addition, the ES&H Manual instructions allows an IWS to address multiple work activities but does not fully address work definition or limitations on generic IWSs. These characteristics of the manual did not appear to present a problem for programmatic work, indicating that supplemental instructions for Plant Engineering and other broadly defined tasks may be appropriate.

For programmatic work reviewed, most programmatic IWSs provide more specificity. However, there were a few deficiencies with IWS definition of work and implementation in some areas. For example:

- Programmatic equipment set-up, maintenance, and dismantlement activities for some research and development equipment are not addressed in the generic IWS, which describes the equipment operations. Some of these maintenance activities, which are performed by engineering technicians, involve electrical hazards, pressurized systems, and hazardous chemicals, which may not be bounded by the IWS or other referenced IWSs. Sometimes equipment set-up and maintenance work is defined in the equipment manufacturer's manual, or in test plans associated with the research. However, such manuals and plans are seldom referenced or incorporated into the IWS, and are not routinely evaluated by the ES&H teams.

- IWSs for some programmatic work do not address exceptions to the normal operations. There are some conditions during the operation of the vibration and shock equipment when technicians may be exposed to hazardous levels of noise or magnetic fields for a short duration. These exceptions are not addressed in the IWS, and subsequently the hazards are not analyzed.

The OA team also identified some deficiencies in definition of work on Plant Engineering whiz tags and job orders. The scope of work stated for whiz tags is generally a restatement of the reported problem rather than a statement of work to resolve the problem. Some statements of work were cryptic and did not address whether the work was electrical, mechanical, or both. A possible contributor to deficiencies is that most whiz tags are not reviewed by a work planner or other technical person to ensure a clear work scope. In one case, for a job observed at Building 411, neither the electrical craft nor the alternate facility point of contact (FPOC) could identify the equipment from the whiz tag description.

Summary. Overall, there has been significant improvement in the processes for defining work across LLNL. The IWS has strengthened that process by providing a sitewide mechanism that documents work to be performed. Documentation of routine work has improved for both Plant Engineering and programmatic activities. In some cases, the IWS process would benefit from more detailed instructions in the ES&H Manual or supplemental guidance. As the IWS process evolves and matures and each directorate adapts it to its own needs, continued institutional management is needed to ensure the site-wide IWS does not evolve toward numerous different work control systems across LLNL.

While generally effective and improving, enhancements in the work scopes and task definition for some types of work would further strengthen IWS implementation. Specific tasks are not well defined for some generic Plant Engineering IWSs, resulting in a "people dependent" process where craft decide what hazards and controls are applicable to the work, rather than the IWS and responsible individuals who authorize the work. In addition, the definition of work on some Plant Engineering whiz tags needs to be more specific. Work definition for programmatic work as defined in most IWSs is adequate. However, improvements in the definition of set-up and maintenance work performed by research technicians, and inclusion of exceptions to operating conditions, when applicable, are needed. Although some improvements are warranted, the deficiencies identified under Core Function #1 did not lead to significant performance deficiencies in the work observed by the OA team. Further, the identified deficiencies are not systematic breakdowns, but are indicative of a generally effective process that is continuing to evolve and mature as experience is gained.

E.2.2 Core Function #2 – Analyze the Hazards

Hazards associated with the work are identified, analyzed, and categorized.

Institutional and Facility-Level Hazard Analyses

Institutional and facility-level processes are established at LLNL to identify and analyze hazards associated with the performance of research and development, engineering, and plant maintenance activities. Each LLNL facility is subject to a hazard analysis to identify and evaluate the associated hazards, and to determine the appropriate facility authorization levels based on facility categorization. General industry facilities with hazards below the thresholds in the ES&H Manual or activities commonly performed by the public or office work are assigned a Facility Authorization Level 1. Facilities with the potential for minor onsite or negligible offsite impacts, or facilities with moderate radioactive material inventories are categorized as low-hazard or radiological facilities (Levels 2 and 3, respectively) and require a hazard analysis report, in addition to a facility safety plan (FSP). An FSP, approved by the Facility Associate Directorate, with concurrence from the ES&H team leader, is required for each hazard-ranked facility (Facility Authorization Level 2 and above). Accelerator, moderate-hazard, explosives, and nuclear facilities (spanning Facility Authorization Levels 4 through 8) each require a formal safety assessment and analysis, as well as DOE approval.

LLNL's program for establishing and controlling the safety basis for non-nuclear facilities is effective. LLNL has taken a systematic approach to developing appropriate safety basis documents for the non-nuclear facilities, as required by Appendix O of the DOE/University of California contract. For explosive and accelerator facilities, LLNL has established a safety question review (SQR) process to evaluate proposed activities against the authorized facility basis. The SQR process is analogous to the unreviewed safety question procedure for nuclear facilities. LLNL is also developing a new safety analysis standard for non-nuclear facilities, which will provide a greater level of guidance than the current guidance provided in the ES&H Manual in areas such as integrated assessment of hazards, radioactive and hazardous material storage, and synergistic impacts of nearby operations. LLNL also has a systematic process for reviewing and monitoring the hazard categorization of facilities, based on inventory levels.

The Oakland Operations Office (OAK), responsible for LLNL operations and safety, also has implemented an effective process for reviewing and approving the safety basis of non-nuclear (explosive and accelerator) facilities, as required by DOE directives. As a result of this process, four LLNL non-nuclear facilities have upgraded their safety analysis reports, including new provisions for limiting conditions of operations for certain safety-significant equipment. OAK's thorough review of facility hazard categorization is ensuring that facilities exceeding the specified criteria in DOE-STD-1027 are categorized as nuclear facilities.

The hazard analysis documents for Building 235, 132N, and the 131 High Bay are maintained current. Radiological and chemical hazards are identified, and analyzed commensurate with the risk to onsite and offsite populations. The Building 235 safety assessment document for the 4 MeV ion accelerator was prepared in accordance with the requirements of DOE Order 420.2, *Safety of Accelerator Facilities*, and accurately describes the accelerator facilities, potential hazards, and protective measures. Hazard analysis documents for these facilities are consistent with hazards observed in the facilities and as described in FSPs, OSPs, and IWSs. The current safety analysis report (SAR) for Building 191 is adequate, and an extensive revision to the SAR is in progress. Building 191 also has an FSP that identifies and rigorously analyzes the hazards, especially with regard to explosives.

For nuclear facilities, such as Building 332, a significant effort remains in upgrading existing authorization basis documents (i.e., SARs) to be in compliance with the DOE Nuclear Safety Rule 10 CFR 830 by the April 2003 implementation deadline. Although significant challenges to fully implementing 10 CFR 830 requirements remain, LLNL has made considerable progress in developing authorization basis procedures and processes, identifying potential hazards, and rigorously analyzing identified hazards. Recent institution accomplishments in the authorization basis program include:

- Establishing an Authorization Basis Section within the Hazards Control Department
- Substantially increasing the number of facility hazard and safety analyses performed
- Developing new and/or upgraded procedures, including procedures for evaluating hazards, selecting hazard controls, and performing unreviewed safety question screens and determinations
- Developing new authorization basis procedures and completing training on the new procedures.

Fifteen new procedures are in various stages of development, review, and approval, before being incorporated into the ES&H Manual. At the time of this assessment, most of the procedures critical to the preparation of adequate safety analyses were in advanced stages of review and approval. While not fully implemented, the procedures are becoming available and are being used judiciously by safety analysts and reviewers. A review of selected new authorization basis procedures and training course materials, as well as interviews with LLNL preparers and reviewers, indicate that new procedures and courses are technically adequate and the competence and experience level of the authorization basis staff has been significantly strengthened. In particular, sufficiently detailed checklists for compliance with 10 CFR 830 Subpart B are being utilized in preparing the authorization basis documents; the documents are receiving the necessary independent reviews; and the quality of authorization basis submittals has significantly improved. In addition, OAK has also developed a fairly comprehensive set of procedures and criteria for reviewing the safety basis of nuclear facilities. The OAK nuclear safety team, which has a lead role in reviewing and recommending approval of authorization basis documents, has sufficient knowledge and experience, properly integrates the insights and perspectives of Facility Representatives, and coordinates its efforts effectively with activities of the OAK operational awareness teams. This coordination results in effective OAK line oversight in this area.

LLNL and OAK have jointly developed a concept for the authorization basis review process, which is based on lessons learned from past safety basis submittals. To date, LLNL has submitted for OAK's review and approval three Hazard Category 3 nuclear facility authorization basis documents that are in compliance with 10 CFR 830. OAK has completed the acceptance review for one of these documents. Experience gained during the reviews indicates that the established process for preparing authorization basis documents has significantly contributed to the overall technical adequacy of the document.

Because the nuclear facility SARs are currently being revised to comply with 10 CFR 830, the OA team did not perform a rigorous evaluation of the existing SARs. However, one concern was noted with respect to the Building 332 SAR. Some assumptions for the continuous air monitors (CAMs) described in the SAR lack a sufficient technical basis and may result in erroneous conclusions. For example, the Building 332 SAR states that CAMs are set to alarm at 25 counts per minute, which corresponds to approximately eight derived air concentration (DAC)-hour exposures to plutonium. However, there are specific conditions and assumptions that are not defined in the SAR or other technical basis documents, and 25 counts per minute may not be equivalent to eight DAC-hours under all conditions. Some plutonium solubility classes, particle sizes, and environmental factors will result in higher levels (24 DAC-hour exposures or more.) The alarm set point was actually based on the lowest setting that will not result in excessive false alarms. Site management intends on clarifying this basis in the 20 CFR 830-compliant authorization basis.

Activity-Level Hazard Analysis

LLNL has established processes and procedures for identifying and analyzing the hazards for work activities, in accordance with the provisions of the ES&H Manual. The organization authorizing a work activity, with team support from operations, is responsible for ensuring that the associated hazards are identified. In most cases, hazards are identified and analyzed consistent with the provisions of the ES&H Manual. ES&H professionals and subject matter experts are involved in the identification and analysis of most work activity-level hazards, and provide guidance on the application of the ES&H Manual and applicable Work Smart Standards to ensure consistent implementation across LLNL. In addition, the Hazards Control and Health Departments conduct periodic meetings to discuss the interface between medical and ES&H teams and worker safety and health issues.

For most work, IWSs provide the initial identification of hazards associated with a work activity. For higher-hazard work activities, OSPs can supplement the information in the IWS. In addition to IWSs and OSPs, activity-level hazards are also described in such facility-level documents as FSPs, safety assessment documents (SADs), authorization basis documents for nuclear facilities, and Plant Engineering maintenance operating procedures.

Most activity-level hazards were adequately identified in IWSs and supporting documents for the directorates reviewed during this evaluation. For example, hazards for work observed in Building 235 and 132N were adequately covered in the associated IWSs and in the Accelerator SAD. In addition, the IWS for laser spectroscopy of DAC samples in Building 235 is comprehensive and addressed all requirements of the ES&H Manual. The LLNL ES&H teams and facility management supporting Buildings 235, 132N and 131 High Bay were also active in the preparation and concurrence of the IWS. IWSs reviewed for the Chemistry Directorate operations in Building 132N adequately identified hazards associated with the research being performed. Plant Engineering effectively uses an ES&H assessment form, as well as IWSs, to identify hazards because much of Plant Engineering's work is performed in programmatic facilities. For Waste Management Operations, the IWS for laboratory-packaging operations adequately identified the hazards associated with that work activity. For Building 191, hazards related to specific tasks were clearly identified and analyzed in the hazards assessment and control documents. In Building 332, radiological hazards associated with observed work activities were appropriately identified in the FSP, OSPs, and/or special work permits.

However, in a few cases, the OA team observed some hazards that were not identified or sufficiently explained in an IWS. Several examples are as follows:

- The Building 131 High Bay machine shop uses several brands of oil- and water-based metalworking or cutting fluids to lubricate equipment. Although some of the cutting fluids are listed in the Building 131 High Bay fabrication IWS, others are not. Furthermore, the potential hazards associated with metalworking fluids are not addressed in the IWS, and controls, such as a metalworking fluid management program, are not identified. Industry concerns over the potential health hazards associated with some metalworking fluids (e.g., dermatitis and respiratory effects) prompted the Occupational Safety and Health Administration (OSHA) to issue a Safety and Health Best Practices Manual on Metalworking Fluids in 1999.

- As discussed in Core Function #1, when work activities are not adequately described, the hazards can be missed. For example, working near overhead electrical lines is not listed as an electrical hazard and is missing on Plant Engineering IWSs that could involve working near overhead electrical lines. Because the tasks are so broadly described, hazard identification did not always envelope all possible tasks.

Although most work activity hazards are identified, some hazards identified in IWSs are not sufficiently analyzed, characterized, or documented to ensure that the appropriate hazard controls are implemented. Examples include:

- The Building 131 High Bay IWS for environmental test operations identifies a high noise hazard associated with some test equipment (i.e., shaker table and the drop towers). However, because the noise hazard has not been characterized, the need for hearing protection, medical surveillance, and the type of hearing protectors required to mitigate the noise is indeterminate and not indicated on the IWS. In addition, while some welding hazards associated with the Building 131 High Bay machine shop are identified in the fabrication IWS, LLNL has not performed sufficient analysis of some welding fumes (e.g., machine shop brazing bench and general welding areas) to verify that the local exhaust is effective, or to determine the concentration of ozone, if any, that is present in the fume.

- While most hazards (radiation, noise, and elevated work) involved with high efficiency particulate air (HEPA) filter testing in Building 332 were identified, the description of hazards in work documents did not address the special condition of workers being in the HEPA plenum with the doors fastened shut and no ability to rapidly egress from the plenum. Consequently, controls to protect the workers were not identified or documented in the work planning document (although the work activity, as implemented, had a control in place—an operator was stationed outside the plenum door with a radio). In addition, the permit did not address the actions to be taken by the worker if a criticality alarm is received when workers are in the plenum and unable to exit without assistance.

- Although potential hazards for spray painting in Plant Engineering paint booths are identified on IWSs, exposure assessments have not been completed for paint shop paint booths as they are currently configured (the booths were converted from water column to dry filter-type booths). Without exposure assessments, the magnitude of the exposure hazard is uncertain, and the safety of painting without respiratory protection cannot be confirmed.

- In the Building 511 carpentry shop, carpenters routinely cut wood coated with laminated plastic. The laminated plastic has a formaldehyde resin surface and wood bonding that, according to the material safety data sheet, recommends the use of a dust mask approved by the National Institute of Occupational Safety and Health. Dust masks are not worn in the carpenter shop when cutting this material because table saws and shapers have dust collection systems. Although exposure assessments have been performed for cutting industrial grade wood, exposure assessments have not been performed on the laminated plastic.

In general, non-radiological exposure assessments, when performed and documented by the ES&H teams, are thorough and establish a sound technical basis to support the selection of hazard controls, or to justify when controls are not necessary. However, in many cases, the number of exposure assessments is not sufficient to support the selection of hazard controls, or there is a reliance on expert-based exposure assessments, which are not always documented. DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, and the related DOE technical standard for industrial hygiene practices (DOE-STD-6005-2001) recommend supplementing exposure assessments where no significant exposures are expected or determined. The latter is important since new exposure effects may be identified, and retrospective health concerns can only be addressed by documented assessment records.

Institutional guidance for hazards analysis needs to be reevaluated for two types of activities. The ES&H Manual allows some exceptions to developing an IWS for work that is “commonly performed by the public.” The ES&H Manual further defines those activities commonly performed by the public as being where control of the hazards requires “little or no guidance or training,” and provides an example list of these types of activities. Two examples may not be appropriate for exclusion: arc welding or torch cutting of common metals, and working with fixed machines tools (e.g., lathes, mills, and drill presses). Because of the potential hazards and tool-specific training requirements associated with these two activities, LLNL should consider removing these two items from the “public” list. The OA team identified deficiencies with operation of several different machine grinders (grinding on the side of wheels, grinding on aluminum, and improperly adjusted tool rests) that would merit additional controls or additional training for these activities. Deficiencies identified during the fiscal year (FY) 2001 operational awareness and ISM assessment by OAK also identified this issue. As a result, some LLNL directorates, such as the Engineering Directorate in Building 131 High Bay, have recognized the complexity of the hazards associated with these activities and require an IWS when welding or when working with fixed machine tools. LLNL is currently revising the ES&H Manual to clarify the limitations on workers when performing these activities.

Summary. Effective hazard analysis processes have been developed and implemented at both the facility and work-activity levels for those LLNL directorates evaluated. Since the most recent DOE Headquarters safety management evaluation, a significant improvement in the identification and analysis of hazards is evident at all of the facilities evaluated by the OA team, particularly at those directorates responsible for research and development work activities. Some directorates, such as Chemistry and Materials Science, have improved the rigor of their hazard analysis processes, while others have increased the extent to which the hazard analysis is applied. For example, the Engineering Directorate at the Building 131 High Bay has expanded the number of IWSs and OSPs from a solitary document to 27 such documents within a two-year period.

However, continued attention and improvements are needed in the identification, characterization, analysis, and documentation of hazard analyses at both the facility and work-activity levels. Significant efforts remain to upgrade existing authorization basis documents for consistency with the new 10 CFR 830 regulations. At the work-activity level, a few hazards were missed, and a few of the hazards identified were not adequately analyzed, characterized, and/or documented. This is most evident for generic IWSs, which by their nature cover a broad range of hazards.

Overall, the hazard analysis processes were effective in identifying hazards in the vast majority of cases. Considering the numerous work activities reviewed by the OA team, the small number of hazards that were not adequately analyzed indicates an overall effective system, with a need for improvement in certain areas, such as documentation of non-radiological exposure assessments, and welding and machine tool hazard identification and control. Continued management attention is needed to ensure that the LLNL hazard analysis processes evolve and improve in accordance with the continuous improvement philosophy.

E.2.3 Core Function #3 – Develop and Implement Hazard Controls

Safety standards and requirements are identified and agreed upon, controls to prevent/mitigate hazards are identified, the safety envelope is established, and controls are implemented.

Institutional and Facility-Level Hazard Controls

LLNL provides comprehensive controls for generic and laboratory-wide hazards through the LLNL ES&H Manual. Overall, the manual is informative, easy to read, and accurate. It addresses physical hazard control (e.g., lockout/tagout [LO/TO], confined space, and excavation), the IWS program, procedure development and use, laser safety, and the use of safety equipment. Institutional programs that support the requirements of the ES&H Manual and that are designed to provide hazard controls are also generally acceptable. For example, the LLNL internal dosimetry program is fundamentally sound, has a well-documented technical basis, and is consistent with DOE expectations and good industrial practices. Other institutional-wide programs that were reviewed by the OA team that effectively control hazards include pressure safety, chemical safety, hearing conservation, and the beryllium protection program.

At the facility level, SARs for nuclear facilities, SADs for accelerators, and hazards analysis reports for hazardous and/or radiological facilities establish operating envelopes and hazard controls. These facility-level hazard controls are implemented through FSPs and, in some cases, OSPs. For the hazards that were appropriately identified and analyzed, the facility-level and generic hazard controls were appropriately defined. Buildings such as 131 High Bay, 132N, 191, 235, 332, and the 612 Complex have FSPs and OSPs in place that, in most cases, provide appropriate requirements for workers. For example, the FSP for the Buildings 235/241 complex describes the activities requiring OSPs and requires IWSs for all work not commonly performed by the public. For some large activities, one or more facility-level IWSs cover the major equipment operations and maintenance. For example, the 4 MeV accelerator system in Building 235 is covered by three separate IWSs that refer to the appropriate OSPs for specific controls. The OSPs provide the operations and maintenance hazard controls resulting from the accelerator SAD. In general, the controls provided in facility-level documents are comprehensive and envelope most activities observed by the OA team.

In Building 332, the authorization basis has defined several technical safety requirement (TSR) surveillance requirements. A structured and controlled set of surveillance procedures is in place to satisfy the different surveillance requirements. The operations group issues the appropriate controlled procedure at the start of each surveillance. This process has ensured that the correct procedure is used when performing a surveillance. In general, the surveillance procedures are well written and provide the necessary detail for the workers. However, several surveillance procedures were not current with the required triennial review. This deficiency is known by operations and corrective actions are being taken. During the review, no surveillances in Building 332 were found to be past due.

Activity-Level Hazard Controls

At the activity level, engineering and administrative controls are the primary mechanisms for hazard control. Administrative controls for most hazards were well documented and identified by IWSs, FSPs, OSPs, work procedures, and/or work permits. LLNL ES&H teams effectively assist operations and facility personnel during work planning to assure that all applicable controls for hazards are identified and appropriately tailored to the work activity before the authorization of work. For example, the controls in the IWS for laser spectroscopy of DAC samples in Building 235 were adequate for the identified hazards. The Chemistry and Materials Science Directorate uses a customized version of the IWS that tracks all changes, retains a historical record of those changes, and requires a review of changes to be acknowledged by a formal automated process. In addition, OSPs governing work reviewed in Building 235 were well written and provided adequate administrative controls for the hazards. In another example, the hazardous waste management (HWM) procedure for performing lab pack operations (DIS-110) is technically accurate, provides adequate guidelines for performing laboratory pack operations, and includes appropriate actions to be taken during abnormal situations. Health and safety requirements, such as personal protective equipment (PPE), cautions, and warnings, are appropriately addressed. In Building 332, air sampling for radioactive contamination is effectively implemented. Daily and weekly air samples are collected in most areas where plutonium is stored or handled and are used as a retrospective means of confirming the airborne concentrations in the various areas of on a routine basis. Sampling results are reviewed regularly, and elevated readings are flagged by the system and investigated by the health physicist.

Hazard communications were generally effective and provided appropriate hazard information to workers and affected personnel in laboratories and working spaces. For example:

- All LLNL organizations require that all workers within the organization receive beryllium awareness training, although few workers are exposed to beryllium through their work activities.

- Laboratory rooms are well organized, and hazard identification signs are conspicuously posted on each laboratory door in Buildings 132N and 235. The hazard identification signs were generally accurate, although several noise postings were either not current in the Building 131 High Bay, or not sufficiently addressed in an IWS.

- In Building 131 High Bay, the chemical activities IWS provides a useful description of the health hazards associated with chemical usage typically encountered in the High Bay, such as spray painting, chemical cleaning, and adhesive and bonding operations.

Where possible, engineering controls are used (rather than administrative controls and PPE). In addition to the administrative controls, engineering controls were robust and effective in most cases. For example:

- Hazard control processes at the Chemistry and Materials Science Directorate for chemistry operations in Building 132N are effective, including application of engineering controls more stringent than those normally seen in other DOE laboratories. For example, each laboratory door has a cipher lock system that allows access only by individuals authorized by the laboratory supervisor. Similarly, facility access to the Building 131 High Bay is controlled through a key card system that requires approval by the facility manager prior to entry. Fume hoods in Building 132N have variable airflow controllers, so that regardless of the sash height, the proper flow rate is automatically maintained.

- Engineered controls for the hazards in Buildings 235 and 191 are well implemented and comprehensive. For example, multiple interlocks for lasers and the accelerator in Building 235 provided redundant protection against inadvertent exposures. In the Building 235 plutonium sample preparation room, extensive engineering controls provided multiple barriers for confinement of contaminants during glovebox operations. In Building 191, to prevent personnel access to explosive testing areas during tests, interlocks and run-safe buttons are installed, routinely tested, and used when required.

- The Building 332 passive air sampling network is well designed, provides broad coverage, and is implemented with detection sensitivity sufficient to confirm the expected low magnitude of airborne activity concentrations during the sampling period.

Although effective controls for most hazards were developed and implemented, the OA team identified weaknesses in fire protection testing and maintenance. Specifically, there are significant deficiencies with PM, testing, and documentation for the Building 191 fire alarm and mitigation systems. The National Fire Protection Association (NFPA) 72 standard requires an annual test of the entire fire protection system and quarterly and semiannual testing of the specific elements in the system. For this building, the fire protection system includes fire alarm, wet fire sprinkler, and deluge systems. These systems have quarterly, semiannual, and annual PM test requirements. Of these three systems, only the wet fire sprinkler system has received satisfactory PM.

- At the time of the OA inspection, the fire alarm system has been only partially tested since June 1999. Some fire alarm system PM (quarterly, semiannual, and annual) since that time was either partially completed or not performed, and PM results and deficiencies were not well documented.

- The deluge system has not been fully tested since May 2000. No fire deluge system PM (quarterly, semiannual, and annual) since that time had been completed at the time of the inspection, although a PM was attempted but not completed in May 2002. The NFPA 25 standard requires an annual test of the entire system and additional quarterly and semiannual testing of the specified elements of the system. In addition, the following problems exist with the maintenance and testing of the deluge system.

  – The tests completed in June 1999 and May 2000 were not performed in accordance with the PM procedure, which required a major portion of the test to be done on direct current (DC) power. This portion of the 1999 and 2000 tests could not be successfully performed on DC power and were instead done on alternating current (AC) power. A deficiency report to investigate the problem with the DC power was issued following the May 2000 test; however, no investigation was performed. Following a May 2002 test, LLNL initiated a revision of the procedure directing performance of the test using AC power. Facility personnel reviewed the procedure, and the revised procedure was issued for implementation following completion of the OA onsite activities.

  – The PM procedures require replacement of the fire protection solenoid valves and relays every 10 years. The May 2000 PM generated a work request to replace these devices because they were over 10 years old; however, they had not been replaced at the time of this OA inspection.

- Contrary to the requirements of NFPA 25 and recommendations of NFPA 72, PM implementing procedures for Building 191 do not compare the completed test results with the original and previous results. Additionally, these procedures do not contain acceptance criteria for the majority of the fire protection PM. The DOE Writer's Guide for Technical Procedures (DOE-STD-1029-92) establishes DOE expectations for procedures and specifies use of acceptance criteria. Such criteria would significantly aid in implementation of the requirements of NFPA 25 and recommendations of NFPA

72 and in determining system operability. These criteria could also be used to compare the completed test results with the original and previous results to identify trends and predict possible failures before they occur.

- The SAR for Building 191 credits a deluge fire suppression system, a smoke exhaust system, and a wall mounted pressure-relief vent for mitigating fire in the propellant area. LLNL staff stated that the opening used for the smoke exhaust system is also a pressure-relief vent; however, no documentation was made available to show that this vent is adequately sized to provide the pressure relief discussed in the SAR.

Based on the fire protection PM deficiencies, documented testing at the time of the inspection did not provide reasonable assurance that the fire alarm and mitigation systems in Building 191 were capable of performing their protective functions. Although completion of required maintenance and testing may address this concern in the short term, fundamental changes and improvements to the maintenance and testing program are necessary to provide a reasonable assurance over a long term. Because of the sitewide applicability of NFPA requirements, it is likely that similar deficiencies exist in other facilities.

Finding #2: LLNL is not performing some of the fire detection and mitigation system preventive maintenance actions that are required by the National Fire Protection Association and facility authorization basis documents.

The OA team also observed a few deficiencies in the areas of hazard communications, radiological controls, and planning and controlling some broad scope work. The following paragraphs provide more detail of these deficiencies.

Hazard communication training for workers is minimally provided via HS001, "New Safety Orientation." Although supervisors receive a supervisor course in hazard communications, the content of area-specific hazard communication training provided by supervisors is informal and not adequately documented.

For radiological work, Building 332 activities result in most of the collective dose at LLNL. While Building 332 continues to meet its established as-low-as-reasonably-achievable (ALARA) goals, formal activity-level ALARA reviews that meet the thresholds defined in the ES&H Manual were not being performed in Building 332. For example, several workstations in room 1378 include activities that meet the thresholds defined in the ES&H Manual. However, Building 332 personnel are not performing formal ALARA reviews, and the reasons for not performing ALARA reviews is not documented. Individual ALARA goals for workers are formally developed and routinely monitored and some informal ALARA discussions regarding higher dose work is conducted; however, systematic application of ALARA to individual work activities requiring formal review has not been demonstrated. For example, the possibility that additional shielding could be provided to further reduce doses in room 1378 has been recognized by ES&H team personnel but has not been documented in a formal ALARA review. Formal ALARA reviews would evaluate the range of engineering and administrative controls that could be applied to the work and would determine whether existing controls provide the maximum practical protection or should be further expanded.

LLNL's overall expectations for the development, use, format, and content of radiation work permits (RWPs) are not well defined, and site requirements (e.g., ES&H Manual) do not recognize that FSPs and OSPs can serve as RWPs. For example, most radiological work performed in Building 332 is conducted under an OSP and the FSP. These documents are the only controlling radiological work documents for a variety of radiological activities. The LLNL ES&H Manual, Document 2.2, recognizes a RWP requirement and refers to the ES&H Manual, Document 20.1, for details. However, Document 20.1

contains no details on RWPs or their required content and format, and does not specify a requirement that facilities use RWPs.

As radiological work control documents, the scope and span of control for work covered by the Building 332 FSP and OSPs are broad, resulting in nontask-specific information on radiological hazards and controls. The information is not always specifically tailored to individual types of work activities, each of which has a different set of hazards and controls. Therefore, workers are left responsible for determining the appropriate controls during the course of the day, rather than following a prescriptive designation based on the specific conditions for a particular activity. For example, requirements for wearing finger rings when working with kilogram quantities of plutonium are currently defined generically in the Building 332 FSP; however, the assessment of whether and when their work will require this control is left up to the worker. The worker is not required to document the evaluation of the condition on a formal activity-by-activity basis by selecting a predefined specific RWP before performing work, as is consistent with DOE radiological control guidance. Similarly, while OSPs provide task-specific work breakdown descriptions, hazards and controls are not defined in a similar manner, but are discussed more generally in separate sections, resulting in some conditional controls left to the discretion of the worker. However, although the OA team identified a few instances of improper radiological controls work practices in Building 332 (see Core Function #4), the identified deficiencies did not lead to a significant performance issue.

Although generic and specific IWSs for most work clearly identified and correctly linked the appropriate control with an identified hazard, generic IWS forms for Plant Engineering were not specific enough to provide adequate hazard controls for all job activities performed under the IWS. In Plant Engineering's generic IWSs for roofing, carpentry, and electrical work, the scopes of work are excessively broad, resulting in controls rarely being tailored to the specific work activity in the IWS. Instead, the crafts personnel must determine what work is being done, what hazards from the broad list might apply to that particular work, and what controls would mitigate and control those hazards, without the benefit of preplanned input from work planners, supervisors, and line ES&H personnel. Many of the generic IWSs reference back to the ES&H Manual, OSHA, and other upper-tier and regulatory documents. Thus, the generic IWS is not a tailoring or implementing document at the working level. For example, in a number of IWSs the hazard controls were very broadly stated, such as "other generic IWSs may apply," "Electrical Safety Program," or "OSHA Part 1926," rather than listing the specific controls for a job task or subtask. For much work performed under a generic IWS, another implementing document that further defines the controls is needed.

In some cases, blanket IWSs used in the Building 131 High Bay did not identify specific hazard controls because the hazard was not adequately identified or characterized (see Core Function #2). For example, hearing protection controls for environmental test operations in the High Bay were not documented on the IWS, since the noise levels had not been characterized. In addition, some hazardous chemicals and cryogens were not identified in blanket IWSs, and therefore protective clothing was not addressed.

Plant Engineering typically uses ES&H assessment forms (bridging documents) to merge the hazard controls defined by the Plant Engineering IWSs to facility IWSs. While this mechanism serves to minimize the number of work-specific IWSs generated for low-hazard jobs, several problems are evident with the governing document for the forms and the implementation of the forms. The Plant Maintenance Management Systems Manual governs use of the forms; however, the instructions are not sufficiently detailed to correctly and consistently complete the forms. For example, the manual refers to the five ES&H screening questions on the forms, but does not provide complete actions to take based on the answers to those questions. Consequently, several problems with the hazard controls were apparent during observed work activities. For example, the forms do not always specify what craft generic IWSs apply to the work, leaving it to the crafts person to determine what controls apply to the specific work; the decision to notify the FPOC is not always consistent for similar work activities; some work has been released prior to the FPOC or responsible individual completing the screening questions on the bridging document; and in some cases, the bridging document did not identify all hazards or controls, such as the requirements for a LO/TO.

Occasionally, bridging documents are used by organizations other than Plant Engineering in support of programmatic work, and some of these also had deficiencies. For example, the Manufacturing and Materials Engineering Division Machine Tool Services Group has a "bridging document" for using a generic machine tool servicing IWS for machine tools in the Building 131 High Bay. In this example, there are no instructions that describe the intended use, approval, and limitations for the bridging document. In addition, the bridging document had been approved for a period of one year, although the FSP that was referenced in the bridging document had already been revised twice, without any indication that workers using the bridging document had been informed of the changes.

Summary. Processes and procedures for the development and implementation of hazard controls are established. Implementation of engineering controls, administrative controls, and PPE for facilities and buildings work activities that were reviewed was generally effective. In many cases, engineering controls were more rigorous than those normally found at DOE sites, providing an added measure of protection to workers.

However, the OA team identified significant deficiencies in implementation of fire protection testing and maintenance that require management attention. In addition, some deficiencies were also identified in the performance of formal ALARA reviews, and planning and controlling some broad scope work. Some of these deficiencies were previously recognized by OAK and LLNL and were encompassed within the scope of ongoing or planned enhancements to LLNL ISM programs (e.g., enhancing facility manager training and tools).

Although IWS is an effective framework for analyzing hazards, and hazard controls have been adequately identified and effectively implemented for the majority of work reviewed by the team, improvements are needed in some aspects of hazard identification and analysis processes and implementation. In addition, the identified deficiencies in fire protection testing and maintenance require timely attention and improvement, including an analysis of the extent of condition at other LLNL facilities.

E.2.4 Core Function #4 – Perform Work Within Controls

Readiness is confirmed and work is performed safely.

Plant Engineering initiated and has implemented a behavioral-based safety program that has significantly reduced the number of at-risk behaviors for the groups participating. The program is also implemented for some functions within the Laboratory Services Directorate in Plant Engineering and Business Services. Employees run the formal program, with support from management. Participating employees perform weekly peer reviews using a checklist to identify performance that is questionable or unsafe. Employees hold monthly meetings to review performance results, trending, and specific behavioral areas, to determine root causes, and to discuss ways to make their work area safer. The program has resulted in measurable reductions in at-risk behavior in several areas. Within Plant Engineering, traffic safety and the use of PPE are two of the areas that were greatly improved.

The OA team observed maintenance, construction, programmatic, and research work that was performed safely and within established controls. All workers interviewed were aware of their stop-work responsibilities and authorities and indicated that they would not hesitate to stop work if they observed or were asked to perform questionable or unsafe work activities. During this inspection, the OA team observed that work was appropriately stopped when a safety issue was raised. The workers displayed a safety-conscious attitude and did not indicate concerns about intimidation or production pressures from management or supervisors that would inhibit them from exercising their stop-work authority. Although documented policies are in place and well understood, LLNL would benefit from having a stop-work procedure that provides supplemental instructions/guidance (e.g., covering management notification, and restart of stopped work) on implementing the LLNL stop-work policy.

The LLNL Plant Engineering organization uses a "maintenance window" concept to coordinate maintenance efforts on a building-by-building basis. According to this concept, Plant Engineering and line organizations mutually agree on a time period—a maintenance window—for each building. During this window, Plant Engineering performs PM, equipment-outage work, corrective maintenance, other minor repairs, and facility modifications. This concept allows maintenance to perform work efficiently, with minimal impacts on programmatic work, and to avoid frequent interruptions of programs throughout the year. Various organizations and technical disciplines coordinate efforts to perform tasks efficiently and with proper coordination of ES&H requirements. The program results in improved safety, reduced impact on programmatic facilities, and cost savings (estimated by LLNL as $1.7 million). Plant Engineering started the program in 1994, and it has matured into a formal program that is well respected by the LLNL programmatic directorates.

The processes for work approval and authorization of work just before actually performing the work are in place and effectively implemented across a wide range of facilities and organizations. The use of the IWS and Plant Engineering ES&H assessment form formalizes the process of determining that readiness to perform work is confirmed and documented.

Observation of numerous work activities in various programmatic facilities indicated that, with few exceptions, work was safely performed by highly skilled and experienced workers, and supervisors were using established controls and appropriate PPE based on job hazards. The work included programmatic and research, including maintenance on programmatic equipment. For example:

- In Bldg 235, most researchers and workers demonstrated a high regard for safe work practices and closely followed the work control and safety requirements specified in IWSs, OSPs, and facility procedures.

- Except for HEPA testing, surveillance testing and glovebox operations were appropriately conducted in Building 332 in accordance with approved procedures.

- Explosive test shots in Building 191 were carefully performed in accordance with approved test equipment firing procedures.

- Research activities in several 132N laboratory locations were appropriately conducted and employees were knowledgeable of controls in applicable IWSs.

- Workers in the HWM Department performed checks of incoming waste, daily inspection rounds, and laboratory pack operations safely, efficiently, and in accordance with HWM procedures. The workers displayed a strong commitment to safety, and donned appropriate PPE when required.

- The IWS and facility management controls in the Building 131 High Bay provided increased levels of assurance that work being performed was appropriately authorized through a number of work authorization levels.

Plant Engineering performs over 75,000 work requests each year (over 200 per day), of which about 48,000 are whiz tags. Work was being performed under whiz tags, preventive and corrective maintenance work orders, and small project job orders. The work observed included roofing, heating, ventilation, and air conditioning PM and repair, fan motor replacement, energized electrical troubleshooting, building modifications, office construction, excavation and paving, carpentry, paint shop operations, welding and cutting, and grounds keeping. Work was being performed safely with many strengths and few deficiencies. For example:

- Work crews were knowledgeable, experienced, had a good safety culture, and enjoyed working at LLNL. Several workers with experience outside LLNL expressed satisfaction that LLNL provided a safe working environment.

- Workers were very conscious of their responsibility to ensure authorization and concurrence was obtained before starting any work and to keep the FPOC informed of status. Communication between supervisors, workers, and the FPOCs was good.

- Strict adherence to appropriate PPE requirements was universal among workers, including proper use of hardhats, safety glasses, safety shoes, and electrical gloves for energized testing.

- Use of step and extension ladders and scaffolds was good, including required inspections, tying off ladders prior to use, proper placement of ladders, and safely transitioning between ladders and roofs.

- Housekeeping in facilities, buildings, and Plant Engineering shops was good. The paint storage, housekeeping, and cleanliness in the paint shop and satellite accumulation area were excellent.

Important elements of performing work safely and confirming readiness to perform work includes pre-job briefings, checking to ensure that building or facility conditions have not changed, and ensuring that personnel have been properly trained and are current in qualification. A sampling of workers' training records for various jobs indicated that all had current training. However, there were weaknesses in the IWS implementation that makes verification of required training difficult. It is not clear on IWS forms what training is required and what training is recommended because the applicable portion states required and recommended training, and many IWSs did not differentiate between the two. Additionally, the training that is needed to perform a task is often not directly specified, but is listed in other IWSs and requirements that are referenced in the IWS, making verification of training, using the information in the IWS, difficult.

Although most of the programmatic work was performed properly, the OA team identified a few instances of improper work practices and failure to follow procedures. These included:

- During observation of laser work in Building 235, a technician was wearing shorts, and both the technician and researcher were wearing short-sleeve shirts without lab coats. The OSP requires such protective clothing as long pants and long sleeves to reduce the potential for skin exposure.

- Workers in Building 332 did not consistently implement FSP, OSP, and health physics discipline action plan radiological requirements correctly. The observed shortcomings included frisking too fast on glovebox-mounted hand monitors, not wearing alarming dosimetry for work requiring it, wearing a finger ring on the outside of the glove, and incorrect response to high background on a glovebox contamination monitor that was not recognized and corrected. Radiological surveys conducted by LLNL health and safety technicians were also deficient in some areas, including failure to take swipes in response to elevated fixed contamination readings, lack of neutron surveys in some areas, incomplete and confusing completion of survey forms, and not always posting survey maps within required time intervals;

- In cases where suspected intakes of plutonium have been identified, internal dosimetry has not always attempted to obtain and utilize, if possible, the most sensitive follow-up bioassay methods to confirm the intake and quantify any resulting doses. As a result, some intakes with resulting exposures that fall well below regulatory and administrative dose limits (i.e., tens to 100 mrem range committed effective dose equivalent) may not be reported because the sensitivity of urine and lung data alone is not sufficient to confirm intakes and determine doses at this level of sensitivity. The internal dosimetry technical basis document early-decision criteria flowchart suggests initial follow-up fecal sampling in conjunction with urine and lung counts to assess all potential internal doses. In approximately 11 incidents in Building 332 during 2001 and early 2002, intakes were suspected based on workplace conditions. Urine and/or lung counts were performed, but initial fecal sampling was not requested in these cases. Fecal samples were later requested in two of the cases.

- Sealed source location and custodian changes that have occurred between the required semiannual inventory check have not been reported to materials management, as required by the ES&H Manual, and there is no formal procedure to directly implement this requirement for sealed source moves. As a result, the inventory listing does not always reflect current conditions, because changes in source storage locations and changes in responsible custodians will not been identified until the semiannual inventory is completed. However, a review of the latest sealed source inventory and leak test record completed in April 2002 shows all 339 individual sources were accounted for and leak tested.

- Some parts of the HEPA filter testing generic procedure in Building 332 were not followed. The penetrometer gain was not adjusted before testing the second HEPA bank, and the data was not recorded concurrent with performing the efficiency test on each individual filter within the bank. Other deficiencies with this work activity are discussed in Core Functions #2 and #3.

For Plant Engineering, there were some deficiencies and a few improper work practices, but no cases of imminent danger were identified for the work observed. The improper work practices should be used as lessons learned and applied to similar work practices across the site. The deficiencies included:

- During an air conditioning unit PM at Building 511, one of the craft personnel servicing the unit did not properly perform the LO/TO, and neither craft person attempted to start the unit and test the LO/TO before servicing, as required by both 29 CFR 1910.147 and the LLNL LO/TO procedure. One General Services Administration labor LO/TO in Building 151 was not installed in accordance with LO/TO requirements.

- For the Building 671 roofing work, the demarcation of the six-foot warning line from the unprotected edge of the roof was not installed on one side of the roof, as required by 29 CFR 1926.501. The ladder extension above the roof hatch did not meet the requirements of 29 CFR 1927(d)(3), and the roof access closet and ladders were partially obstructed by storage, which may delay access to the roof by firefighters.

- In the Building 511 carpentry shop, a worker was observed sawing melamine strips (Formica-like covered wood) with the blade guard raised, and the worker was not using a push stick to keep his fingers well clear of the blade, as required by 29 CFR 1926.304, which governs blade guard operation for table saws. The OA team observed several improper work practices during walkdowns and observation of work activities in the Building 511 central shop area. These included:

- Chemicals were stored in an inactive hood and in one active hood not designated for chemical storage.

- Paint was stored in a hood designated for vacuum oil.

- A hood designated for soldering was used for minor spray painting.

- Several machine grinders in use had evidence of aluminum grinding, grinding on the sides of the wheels, and improperly adjusted tool rests, contrary to OSHA requirements, and increasing the potential for worker injury.

- The different welding and soldering areas were not properly posted with burning permits. One area had a burning permit that was issued for an eight-year period.

- A welder performing cutting operations with a torch was not using the installed local ventilation to remove fumes. An OA team member identified that fumes were floating up under the welder's hood.

Plant Engineering took prompt action to correct most of these deficiencies as they were identified during the inspection. For example, Plant Engineering walked down all fume hoods, removed chemicals and spray paint, and reinstructed personnel on the proper use of hoods. All welding/soldering areas and burning permits were reviewed, and three areas with improper permits were reposted. Maintenance was performed on bench grinders, and one was taken out of service. The LO/TO deficiencies were corrected, and the personnel involved were instructed on proper LO/TO procedures. Action was taken to plan exposure assessments for the melamine cutting operations.

Summary. With some exceptions, Plant Engineering and programmatic work is being performed safely at LLNL. Most of the Plant Engineering and programmatic work are safely performed by skilled and experienced workers who take pride in their work. Stop-work authority and responsibility is well understood by supervisors and workers, and the attitude that safety comes first was evident. Management and worker support for behavioral safety programs has produced measurable results and has significantly reduced the number of at-risk behaviors for those participating. The deficiencies identified, while few, require timely corrective action and indicate that managers, supervisors, and workers need to be more vigilant, questioning, and detailed in their review and performance of work activities and associated documentation. LLNL management took prompt action to correct most identified deficiencies during the OA inspection.

E.3 CONCLUSIONS

There have been major improvements in the processes and procedures that control LLNL work activities since the most recent DOE Headquarters independent oversight safety management evaluation and subsequent implementation of ISM. The most significant was the sitewide approach to ISM through implementation of the IWS process. The IWS provides a single, consistent method for defining, analyzing, and authorizing work. The IWS defines the work, management chain, and hazards; contains and references controls; and certifies that controls are in place for the hazards associated with work activities. LLNL directorates have implemented IWS, which has resulted in improved safety and control of work activities.

The OA team's observations of a wide variety of different Plant Engineering, programmatic, and research work activities indicated that they were performed safely, with a relatively small number of deficiencies. All workers observed had a high degree of experience and knowledge and effectively applied those skills to their work activities. To improve safety performance, LLNL, OAK, and Plant Engineering management supported implementation of behavior safety programs for some Plant Engineering and Business Services functions. Where implemented, these programs have had measurable effects on safety behavior.

Notwithstanding the improvements, the rigor of ISM implementation among the directorates varied. The Chemistry and Materials Science Directorate's implementation of IWS is rigorous, and work activities are well specified and controlled in accordance with well-defined IWSs. The work activities for some other IWSs, particularly generic IWSs, were not well defined, creating difficulties in identifying and tailoring hazard controls to a specific work activity.

A significant deficiency was evident in the testing and maintenance of fire protection systems. Although LLNL had a general understanding of the need for improvements in this area, LLNL had not been timely and comprehensive in developing and implementing corrective actions. Thus some required testing and maintenance activities were not performed or were not adequate. Further, the IWS processes need some refinement (such as improvements in the area of generic IWSs), and formal ALARA reviews need to be performed.

Many of the deficiencies in the core functions and IWS implementation identified by the OA team were also identified in the FY 2001 operational awareness ISM review conducted by OAK, including instances of work that was defined too broadly, and controls that were not always tailored to the work being performed. Other deficiencies had been identified by individual LLNL organizations, and some corrective actions had been initiated.

Overall, LLNL has made major improvements and has established IWS as an effective process for identifying and controlling hazards. The IWS process is still evolving and maturing. The deficiencies identified on this inspection indicate a need for continued management attention to ensure continuous improvement.

E.4 RATINGS

The ratings of the first four core functions reflect the status of the reviewed elements of ISM programs elements within the Defense and Nuclear Technologies (Buildings 191 and 332), Chemistry and Materials Science (Buildings 132 and 235), Engineering (Building 131 High Bay), and Safety, Security, and Environmental Protection (sitewide environmental monitoring and waste management facilities/activities) Directorates.

Core Function #1 – Define the Scope of Work…………………………..EFFECTIVE PERFORMANCE
Core Function #2 – Analyze the Hazards………………………………..EFFECTIVE PERFORMANCE
Core Function #3 – Develop and Implement Hazard Controls………………...NEEDS IMPROVEMENT
Core Function #4 – Perform Work Within Controls……………………...EFFECTIVE PERFORMANCE

E.5 OPPORTUNITIES FOR IMPROVEMENT

This OA review identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive. Rather, they are intended to be reviewed and evaluated by the responsible DOE and laboratory line management and prioritized and modified as appropriate, in accordance with site-specific programmatic objectives.

1. **Improve implementation of generic IWS forms for Plant Engineering work to ensure adequate hazard controls for all job activities performed under the IWS. Ensure that each activity, task, or subtask is identified and provides a one-to-one relationship between the individual activities, the corresponding hazard(s) tailored to the specific activity, and the specific controls for those hazards.** Specific actions to consider include:

    - Develop guidance or instructions for filling out IWS forms, including requirements that all subtasks under a generic IWS be listed in sufficient detail to identify hazards.

    - Improve implementation of generic IWS forms to ensure adequate hazard controls for all job activities performed under the IWS.

    - Perform a critical review of all generic IWSs and revise them to fully define the scope of work and the limitations on the scope of work performed under an IWS.

    - Limit the use of generic IWSs to those that are absolutely necessary. Ensure that the specific work tasks are clearly defined and that there is a one-to-one correlation between the specific task, the hazards, and the required controls.

    - Minimize general references back to the ES&H Manual, OSHA, and other upper-tier and regulatory documents. Instead, tailor the generic IWS to be useful at the working level.

    - Clearly communicate expectations, monitor performance and progress, and hold managers and supervisors accountable for performance.

2. **Reevaluate examples of exceptions to the IWS process for work "commonly performed by the public."** Specific actions to consider include eliminating exclusions for welding or torch cutting of common metals, and working with fixed machine tools, such as lathes, mills, and drill presses.

3. **Ensure that work performed by research and test technicians in the setup and dismantlement of research activities and maintenance performed on test equipment is described in one or more IWSs.** Specific actions to consider include:

    - Review vendor operating and maintenance manuals and other work documents (such as test plans) to ensure that hazards and controls identified in these supplementary documents are evaluated by the ES&H team and line management and incorporated into the IWS, or referenced, as necessary.

    - When using existing generic IWSs to perform maintenance or repair activities on programmatic equipment, verify that hazards and controls for maintenance activities are identified and analyzed, and are adequately bounded by existing IWSs.

4. **Improve the rigor of analyzing, characterizing, and documenting industrial hygiene assessments conducted in support of work activities.** Specific actions to consider include:

    - Increase the amount of exposure monitoring, sampling, and documentation, including negative exposure assessments, consistent with the guidance provided in the DOE Industrial Hygiene

Standard, DOE-STD 6005-2001, and provided by the American Industrial Hygiene Association Exposure Assessment Strategies Committee ("A Strategy for Assessing and Managing Occupational Exposures, Second Edition").

- Summarize and/or reference the results of industrial hygiene hazard assessments in IWSs to the extent that the appropriate hazard control(s) can be identified.

- Improve and expand the LLNL computer-based exposure record retrieval system (STAR and IH Report Module), such that exposure records can be easily retrieved and sorted by individual, work group, work location, work type, or stressor (e.g., chemical, noise, and biohazard).

- Ensure that work activity hazard analyses evaluate all operational hazards (such as restricting egress of workers inside plenums), and document the results of such reviews in the IWS.

- Include the capability to record readouts from direct exposure measuring instruments in the LLNL computer-based exposure record retrieval system.

5. **The Hazards Control and Health Services Departments should continue to explore how their respective staff can cooperatively work to identify hazards, minimize risk, and promote worker safety and health.** Specific actions to consider include:

   - Continue to promote the integration of Health Services and Hazards Control into ES&H teams.

   - Identify mechanisms for medical, industrial hygiene and safety professionals to assist in identifying medical surveillance determinations.

   - Explore methods for involving medical staff in assisting the ES&H team in authorizing work.

   - Expand and improve the Health Services Department's access to employee exposure information.

6. **Improve the specificity and description of hazard controls in IWSs to ensure that the controls are clearly identified and can be consistently implemented.** Specific actions to consider include:

   - Continue to explore a user-friendly mechanism for the identification and verification of all applicable worker-training requirements, in lieu of cross-referencing training requirements in multiple IWSs. Ensure that required training is clearly distinguished from recommended training.

   - Enhance the sitewide hazard communication training program by developing additional hazard communication training courses, establishing refresher course requirements, and involving ES&H teams in tailoring individual hazard communication training requirements. Improve the mechanisms for documenting the requirements for hazard communication on IWS forms, and for verifying that required worker training has been completed.

7. **Increase emphasis on creating more specific radiological work control documentation, with a goal of minimizing conditional requirements that must be determined by the worker.** Specific actions to consider include:

   - Subdivide broad scope OSPs or provide specific hazard analysis and control definition for each discrete type of work in an effort to tailor the information to the specific work being performed.

- Conduct formal ALARA reviews of specific activities that contribute significantly to worker dose and include the results of such reviews directly into the OSPs.

8. **Increase attention to developing more detailed work instructions and additional technical basis documents to ensure health physics expectations are clearly delineated and that program objectives and capabilities are clearly defined**. Specific actions to consider include:

    - Evaluate the benefits of developing detailed work instructions for health and safety technicians to outline expectations for completing radiological survey forms, including appropriate data reporting in a consistent and standardized manner.

    - Evaluate other health physics areas where detailed work instructions may be beneficial, to clearly delineate expectations for fulfillment of assigned duties, such as in radiological work control documentation (e.g., FSPs, OSPs, and work permits), completion of formal ALARA reviews, and sealed source movement and transfers.

    - Consistent with DOE expectations and guidance, evaluate benefits of developing additional technical basis documents for the radiation protection program in the areas of air sampling and contamination control, where technical defensibility of methods, instrumentation, and implementation methods can be defined and demonstrated.

9. **Strengthen Plant Engineering work planning and control functions**. Specific actions to consider include:

    - Consider the use of an expediter/planner to improve the coordination between Plant Engineering and other facilities and to reduce delays and problems with work execution.

    - Implement a review of work requests to ensure that the scope of work is adequately defined and documented and that ES&H assessment documents are correct and consistent before work requests are issued as "ready to work."

    - Retrain central shops personnel on the requirements, proper use, maintenance, and storage for ventilation systems, such as hoods and local welding cones. Ensure that safety procedures for tools, such as grinders and table saws, are understood and followed.

    - Perform exposure assessments for such areas as the paint booths, and for the carpenter shop for milling of laminates.

10. **Continue increased management attention to strengthen authorization basis processes and program implementation.** Specific actions to consider include:

    - Provide more detailed local guidance for development of authorization basis documents for nuclear facilities, which extends the mutual understanding between LLNL and OAK regarding how the technical standard, DOE-STD-3009 (for meeting the requirements of 10 CFR 830), is to be interpreted and applied to LLNL's facility-specific circumstances. The guidance could further amplify the graded approach as well as cover such issues as the identification of defense-in-depth versus safety-significant safety features, or the development of administrative controls versus limiting conditions of operations, taking into account the given types, conditions, and operations of the facilities. Such guidance at the local level would complement the OAK/LLNL framework for the review and approval of authorization basis documents and increase the efficiency of the process.

- Define the role of the ES&H teams in the authorization basis process.

- Identify and track appropriate performance measures or indicators (a) to monitor effectiveness of the corrective actions taken to improve the authorization basis program (e.g., completeness, timeliness, and rework of documented safety analysis/TSR sections); and (b) to provide implementation status of the corrective actions (e.g., completion of the development and implementation of new authorization basis procedures and training).

- Perform periodic, comprehensive self-assessments of the authorization basis improvement program, as well as independent assessments as required by the authorization basis corrective action plan.

11. **Develop supplemental guidance to complement the stop-work policy.** Specific actions to consider include developing a procedure or instructions that delineate management expectations for implementing the stop-work policy and that address such items as requirements for management notifications and approval processes for restarting stopped work.

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APPENDIX F

Environmental Protection

F.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) evaluated the implementation of the core functions of integrated safety management (ISM) as they relate to environmental protection activities at Lawrence Livermore National Laboratory (LLNL). The purpose of the review was to evaluate the adequacy of LLNL management processes in analyzing and controlling potential environmental impacts relating to site operations and legacy hazards. LLNL has two major sites: the LLNL main site (referred to as the Livermore site) and Site 300. The LLNL main site, located in Livermore, California, encompasses approximately 800 acres. Site 300 occupies approximately 11 square miles, and is about 15 miles east of the LLNL main site.

In conducting this evaluation, the OA team reviewed the adequacy and implementation of site policies and procedures, and performed walkdowns of several operational facilities (Buildings 131 High Bay, 132N, 235, 612, and 514, and portions of site 300), waste storage locations, and environmental monitoring stations. The OA team interviewed LLNL and Oakland Operations Office (OAK) personnel, including personnel in OAK's Livermore Safety Oversight Division (LSOD) and Livermore Environmental Programs Division. The OA team held technical discussions with environmental protection subject matter experts and operating department personnel, and performed technical evaluations of site programs and activities in the areas of waste management, groundwater protection, radiological environmental monitoring, and liquid process effluent controls.

F.2 RESULTS

F.2.1 Core Function #1 - Define the Scope of Work

LLNL has effectively defined the scope of the site environmental protection responsibilities. LSOD, OAK, and LLNL staff and managers have evaluated mission activities and identified applicable environmental protection requirements. Applicable regulatory requirements were appropriately incorporated into the work smart standards (WSSs) for all environmental areas that were evaluated during this OA assessment. Consistent with the WSSs, OAK and LLNL have applied for and obtained environmental permits from state and county agencies that define the scope of authorized hazardous waste management activities and effluent discharges.

LLNL WSSs incorporate many appropriate DOE environmental protection order requirements (i.e., DOE Orders 5400.1, *General Environmental Protection Program,* 5400.5, *Radiation Protection of the Public and the Environment,* and 435.1, *Radioactive Waste Management*). In their analysis of requirements for incorporation into WSSs, LLNL appropriately tailored the requirements to the LLNL scope of work.

LLNL has effectively integrated many environmental protection considerations into the LLNL ISM system and established internal requirements and organizations to support line organizations in achieving management expectations. The LLNL Environment, Safety, and Health (ES&H) Manual defines LLNL ES&H policies and requirements, general worker responsibilities, and ISM expectations. The LLNL

Environmental Protection Department (EPD) provides expertise and guidance to help LLNL line organizations execute their environmental responsibilities. LLNL has established ES&H teams, which include EPD environmental analysts, to support research divisions. Additionally, EPD deploys waste management technicians to support waste generating organizations. In the areas evaluated, an appropriate level of environmental expertise was available to line organizations.

The scope of LLNL site environmental monitoring programs is consistent with DOE and regulatory expectations. The LLNL radiological environmental surveillance program is well developed and comprehensive. The air, water, and terrestrial groups within the EPD Operations and Regulatory Affairs Division conduct routine environmental surveillance of potentially affected environmental media annually, consistent with the provisions of DOE Order 5400.1, DOE Order 5400.5, and DOE environmental monitoring and surveillance guidance (DOE EH-0173T). The site groundwater protection program is also well defined for both the Livermore site and Site 300. The environmental monitoring plan, groundwater protection management program plan, environmental restoration project operable unit monitoring plans, and a series of compliance monitoring plans for specific waste units all contribute to an overall effectively planned groundwater monitoring program.

Although the environmental program and responsibilities are well defined, there are opportunities to enhance the institutional environmental protection systems through an evaluation of recently promulgated requirements in Executive Order 13148, *Greening the Government Through Leadership in Environmental Management*, and DOE Notice 450.5, *Assignment of Responsibilities for Executive Order 13148*. Specific areas for potential enhancements include updating LLNL environmental policies, establishing systems to set institutional environmental protection goals and strategies, and formalizing periodic review of accomplishments of established goals by senior management.

Overall, LLNL has established an environmental protection program appropriate to the scope of site operations. LLNL has also integrated many environmental protection management systems into the LLNL ISM system. Further enhancements to institutional policies and goals can be achieved through an evaluation of recently issued directives.

F.2.2 Core Function #2 - Analyze the Hazards

With few exceptions, LLNL has established effective mechanisms to evaluate environmental hazards posed by current operations and legacy conditions. Some aspects of these mechanisms were particularly effective:

- **LLNL has effectively analyzed potential releases of radionuclides from air emission sources**. Point source stack air sampling, diffuse, and ambient air monitoring programs have rigorous and well-documented technical basis documentation. Data quality objectives for these programs are well defined and appropriate for the expected low magnitude of emissions. Gross alpha and beta analyses of samples are used frequently to analyze trends, and appropriate isotopic analyses are routinely performed to quantify emissions and doses.

- **To ensure waste has been properly analyzed, LLNL has instituted a waste characterization program to identify constituents in the waste streams**. This program provides an effective means to determine the hazards and requirements associated with each waste container, so that compliant storage and appropriate disposal paths can be determined. As part of the quality control function, the site also has a Waste Characterization Officer, independent of the Hazardous Waste Management Division, who is responsible for ensuring the characterization program is effectively analyzing waste.

- **LLNL performs effective testing of sinks and drains as part of the waste characterization program to identify potential pathways for the release of contaminates to the environment**. LLNL performs dye testing of sinks and drains to determine discharge points, and smoke testing of sewer lines to identify hidden connections. These tests provide additional assurance that industrial and sanitary waste piping system is properly connected to the appropriate retention tank and sewer system.

- **The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) monitoring programs at the Livermore site and Site 300 are effective and efficient**. The Livermore site and Site 300 each have about 500 groundwater monitoring wells, which were installed as a result of CERCLA investigations of source areas. These wells are used to track plumes. In the process of the investigations, wells have been placed down gradient of the facilities that were suspected sources of releases or had the potential for releases. The extensive data collected from wells are used to optimize groundwater remediation systems at the Livermore site. At Site 300, some plume conditions are still under investigation, and data from wells are used to evaluate threats to water supplies and track plumes, as well as for remediation system optimization.

- **LLNL has an effective groundwater compliance monitoring program**. The compliance monitoring program, designed and implemented primarily for post-closure monitoring of waste units, is effective. Compliance monitoring is conducted at both sites on a fixed schedule and includes both detection monitoring (to detect new releases) and corrective action monitoring (to monitor identified plumes of contaminants).

Although most aspects of environmental hazards have been effectively analyzed, some hazards posed by current operations have not been fully analyzed to determine potential groundwater impacts. LLNL has not performed a systematic analysis of contaminant release pathways from operational industrial facilities to identify any vulnerabilities and determine whether additional surveillance locations are needed (e.g., using an existing environmental restoration well or the installation of new wells). At both sites, LLNL's groundwater surveillance programs consist primarily of wells located in known areas of groundwater contamination that was previously identified by the restoration program.

LLNL maintains a large volume (over 10,000 drum equivalents) of transuranic waste, low-level waste, and mixed waste in storage. Much of this was generated before the late 1990s. As discussed in Appendix C under Guiding Principle #4, LLNL has not achieved significant reductions of legacy waste, and budget uncertainties need to be resolved. OAK and LLNL recognized that LLNL was not in a position to meet DOE expectations for timely shipments of some low-level waste and mixed wastes for offsite treatment or disposal. Consequently, OAK and LLNL did not incorporate the one-year storage limit for radiological waste (per DOE Manual 435.1 chapter IV, paragraph N2) in WSSs. Additionally, budget limitations have required LLNL to defer treatment of newly generated mixed waste and extend milestones for waste on the LLNL site treatment plan. In some cases, disposal options for these wastes exist (e.g., commercial vendors), but the options are costly and entail administrative burdens.

LLNL has a process for prioritizing legacy wastes for disposal, in which wastes with regulatory drivers are given the highest priority for disposal. However, limited progress is being made in addressing some types of wastes. LLNL has some higher-hazard wastes that have been in storage since the late 1980s and that are not a current high priority for disposal. Examples include:

- **Pyrophoric depleted uranium**. Area 514-3 (Treatment Storage Disposal Facility) contains approximately 125 55-gallon drums that contain pyrophoric depleted uranium machine turnings stored under coolant and/or machining oils. Building 612-100 contains approximately 75 drums of similar materials. The drums are not marked as pyrophoric (only required for transport), and there are no other indications of the potential hazards associated with the material. The receipt dates for the drums into the waste management facility ranged from the late 1980s to the late 1990s. Similar wastes were previously shipped to offsite locations for treatment and disposal. Currently, private sector treatment and disposal is available for the majority of these wastes, either through direct oxidization or cement encapsulation. Both treatment methods would render these wastes non-pyrophoric. The potential impacts of an initiating event (e.g., forklift puncture, handling accident, chip dry-out due to coolant loss, or leak) involving these drums could be significant. The storage area in Building 612-100 is within a portion of the facility where many waste treatment activities are carried out and others are proposed (e.g., drum crushing, decontamination booth, and high efficiency particulate air [HEPA] filter analysis). Increased traffic in this area resulting from such additional activities could increase the likelihood of an initiating event.

- **Radioactive and hazardous materials**. Building 614-1103 has a storage cell where flammable materials are stored. This cell contains several drums of uranium metal parts marked as pyrophoric and labeled as both flammable and radioactive; one-gallon paint cans of uranium hydride marked in a similar fashion; drums of lithium metal; and several drums of titanium sponge contaminated with tritium.

In some cases, the higher-hazard wastes are difficult or costly to address (e.g., treatment methods have not been developed for some types of waste). However, additional management attention is needed to analyze the current prioritization process for disposal of legacy wastes and to fully consider the potential risks to the environment and workers. The current contractual performance measures provide incentives based solely on the volume of waste disposed, with no consideration of the hazards to workers or the environment. As a result, the contractor has incentives to address the high-volume, low-hazard (easier to treat) waste first, and has few incentives to address the higher-hazard, low-volume (more costly to address) wastes. Higher-hazard wastes may languish for years because of low prioritization and lack of funding.

Overall, LLNL has established effective mechanisms to evaluate environmental hazards posed by most current operations and legacy conditions. Several of the mechanisms were particularly effective, including air monitoring, compliance-driven groundwater monitoring, CERCLA monitoring, and analysis of waste streams, drains, and sinks. However, additional analysis is needed to determine needs for additional monitoring of groundwater around certain operational facilities. In addition, the current LLNL strategies for prioritizing and funding legacy waste disposal efforts does not provide for sufficient consideration of the relative hazards posed by waste inventories.

F.2.3 Core Function #3 – Develop and Implement Hazard Controls

In most cases, waste management operations are adequately controlled by administrative requirements and/or engineered controls. The ES&H Manual provisions on waste management requirements provide an effective presentation of requirements and responsibilities for waste management activities. The Manual is written for LLNL waste generators, providing a question and answer format to walk the generator through the requirements for proper waste management, including responsibilities. Additional guidance is then provided in the provisions for management of satellite and waste accumulation areas. The Manual references the WSSs and other references, including external and LLNL guides. Although an effective control, the ES&H Manual does not reflect the current DOE order for radioactive waste (i.e., DOE Order 435.1).

Although DOE Order 435.1 was issued in 1999 and has been incorporated into the LLNL WSSs, the site's implementation plan for DOE Order 435.1 does not require the ES&H Manual (which is currently being revised) to reflect the new requirements until August 2002. In addition, a recent change in the interpretation of satellite accumulation storage requirements was not reflected in the Manual.

LLNL has established appropriate administrative and engineering controls for monitoring and controlling groundwater contamination from legacy sources. The LLNL Environmental Restoration Program has established effective groundwater monitoring systems for the legacy waste areas at the Livermore main site. Through a comprehensive long-term investigative program, LLNL has continuously improved the understanding of the subsurface at the main site, resulting in the optimization of remedial systems. LLNL has established effective engineering controls to arrest groundwater plume migration at both the Livermore main site and Site 300. For instance, the Livermore Site Project has 19 active groundwater treatment facilities and 2 unsaturated zone treatment facilities. A series of portable treatment units have been constructed at the Livermore site in order to optimize contaminant mass removal. At Site 300, there are 11 groundwater and 3 unsaturated zone treatment systems.

LLNL has devoted substantial resources to establishing engineering and administrative controls for effluent waste systems to characterize and control releases of hazardous or radioactive materials into the environment. With few exceptions, these controls are effective. In the early 1990s, LLNL completed three projects designed to reduce the potential impact from inappropriate release of hazardous or radioactive waste to the City of Livermore sewage treatment system (i.e., upgrading the retention tank systems at facilities, relining sewer lines, and building diversion tanks at the site boundary to hold the sewer flow if monitoring indicated release of hazardous or radioactive waste). Since that time, LLNL has continued to line the main sewer trunk lines and operate the diversion tank system. The diversion system at the site boundary has the capacity to hold about a day of flow in 11 aboveground tanks if monitoring indicates a release of hazardous or radioactive waste. This system uses pH, real-time radioactivity, and real-time metal monitoring to automatically divert sewer flow to holding tanks. The monitoring systems, diversion pumps, piping, and tank farm were being effectively maintained.

The OA team reviewed the facility retention tank upgrades at Chemistry and Materials Science Building 235 to provide insights on the effectiveness of the tank upgrade project. The tanks at this facility incorporate appropriate design features. For example, the tanks use a double wall sump with a leak alarm to capture sinks discharges and drains from the building. The retention tank system was being inspected weekly, and records were being maintained. The secondary containment for the aboveground tanks was observed by the OA team to be in need of repair. LLNL took prompt action to initiate repairs.

Controls for liquid effluents going into piping systems at Chemistry and Materials Science Building 235 are comprehensive and include both administrative controls (e.g., postings, procedural guidance, and laboratory policies) and engineering controls (e.g., floor drains plugged, laboratory sinks connected to tank retention system, and liquid waste collection containers at the point of generation). Radioactive and hazardous wastes are primarily collected and accumulated at the place of generation and are managed appropriately pending transfer to waste management for treatment and/or storage or disposal. Sampling for potential radiological constituents include gross alpha, beta, and tritium. Additional analysis (gamma spectrascopy and determination of concentration for thorium, uranium, plutonium, and americium) is performed if gross counting triggers are exceeded or activities or incidents occur within the facility.

Current discharges from tank retention systems are controlled by procedure WGMG-WD-AR and Table 7-4 of the Environmental Management Plan, which limits individual discharges. For example, gross alpha activity is limited to 0.3 uCi/1000 L (300 pCi/L). DOE's Derived Concentration Guide for Pu-239 contained in DOE Order 5400.5 is 30 pCi/L. The site assumes a 10-fold dilution factor prior to discharges leaving the site. Administrative controls are included in procedure WGMG-WD-AR to ensure that the sampling and sequence of retention tank discharges are controlled to meet these limits. Liquid effluent samples are collected continuously for analytical measurements and provide data for the sample of record. Real-time monitoring for radionuclides of concern is provided via gamma spectral analysis. However, the set points for diversion to the onsite holding tank system for alpha and beta emitters are qualitatively set at five times background, primarily because of counting method limitations and the desire to avoid spurious alarms. Under some upset conditions, releases above administrative limits might not be detected by the monitoring system because of the limitations of the instrument sensitivity.

Continuous stack sampling is conducted for each stack at those facilities that have the potential to emit radionuclides that could result in an effective dose equivalent of greater than 0.1 mrem, as required by 40 CFR 61. The OA team evaluated one such stack, located in Building 235, Room 1130. In this laboratory, a transuranic glovebox and hood are filtered by HEPA filtration, based on LLNL potential to emit calculations. The OA team expressed a concern that the sampling train, as constructed, did not appear to be isokinetic as required (there were several hard piped right angles, which typically result in line deposition losses, to accommodate bringing the air stream back to where the filter holder was located). Following this observation, an LLNL subject matter expert confirmed that the system was not constructed as designed. LLNL developed a work order to correct the obvious deficiencies and to take additional measurements to ensure American National Standards Institute (ANSI) standard requirements were met.

LLNL performs maintenance and surveillance actions to maintain its numerous waste containers. With the exception of a small number of administrative violations, LLNL meets regulatory requirements for waste storage. LLNL's inventory does not currently represent a significant risk to the public or the environment. However, waste at LLNL is not stored in optimal conditions; it is stored outdoors, resulting in (1) degradation of storage drums and boxes, and (2) occupational hazards. DOE has invested significant resources in a new facility, the Decontamination and Waste Treatment Facility (DWTF), which is constructed but not yet operational. As discussed in Appendix C, OAK has decided to designate DWTF as a Hazard Category 2 hazard facility, which entails additional controls and has delayed opening the facility. However, this facility will not completely resolve outdoor waste issues, even when it is operational, because of capacity limitations.

Most wastes are stored in approved storage containers (e.g., drums that are designed to contain the materials and prevent releases). For some wastes, additional engineering controls (e.g., tarps, and metal or plastic pallets) were established to protect drums that were stored outside from weather and ground contact. However, for other wastes, additional engineering controls were not established to protect waste storage containers from exposure to such environmental conditions as rain, sunlight, and thermal variations. Many low-level waste and "California combined" (i.e., radioactive waste combined with materials that California regulations define as hazardous such as petroleum waste) waste containers are stored outside, unprotected from the elements. Containers with microgram quantities of plutonium, americium, uranium, and cesium, as well as other isotopes, were observed in outside storage. Although storage modes are not always optimal, no cases of leaking drums or situations that presented imminent danger of a leak were observed.

Container painting, overpacking and relabeling efforts are performed by LLNL to maintain the integrity of the drums. However, these measures have not been fully successful in keeping drums and labels in proper condition. The absence of engineered structures for storage of some waste has resulted in containers with visible surface rust. Some drums were observed to be in significantly degraded condition and would not meet Nevada Test Site waste acceptance criteria for container integrity. Numerous containers had faded labels as a result of UV exposure; although still readable, their longevity is questionable. The LLNL program to maintain the conditions of drums and containers in the waste management complex (e.g., repainting or spot painting of metal containers and overpack of drums) was last implemented about one year ago. Although additional attention is needed, no instances of leaking drums or imminent danger situations were observed.

Waste container integrity degradation problems that are associated with the outside storage of wastes at the LLNL 612 Complex contribute to unnecessary increases in waste disposal volume. A few drums, estimated by the site to be about six per year, require overpack as a result of drum integrity concerns. The OA team observed several 85-gallon overpacks, which were utilized for degraded 55-gallon drums, and a 110-gallon overpack, which was used for a degraded 85-gallon overpack. Storage practices leading to these activities are not fully consistent with as-low-as-reasonably-achievable (ALARA) and waste minimization principles.

U.S. Government Executive orders and DOE and LLNL policies require the use of pollution prevention and/or waste minimization efforts to reduce utilization of natural resources and eliminate the generation of waste products. LLNL has historically made significant progress in achieving cost-effective reductions of wastes through pollution prevention and waste minimization initiatives. Several LLNL organizations have active programs and have continued to make significant progress. For example, the Defense Nuclear Technology Directorate is recognized within LLNL for its efforts to integrate pollution prevention into the performance of work activities, resulting in the minimization of problematic waste streams. Significant levels of grassroots efforts continue to contribute to the identification and implementation of prevention activities. Several recent facility construction projects have proactively incorporated pollution prevention. For example, the National Ignition Facility integrated pollution prevention efforts into early facility design efforts and maintains a facility-specific pollution prevention program. OAK continues to focus on some aspects of pollution prevention and maintains a pollution prevention award and recognition program for sites under their jurisdiction. OAK has worked with LLNL to establish a contractual performance measure for pollution prevention at LLNL.

While the pollution program has many positive attributes and significant progress has occurred, the LLNL pollution prevention program is not currently receiving a high level of management attention or resources. For example:

- LLNL management has not updated the site policies to incorporate DOE pollution prevention expectations consistent with DOE Order 5400.1 requirements. The current LLNL policy was established in 1991 and addresses only waste minimization.

- LLNL has not effectively integrated pollution prevention expectations into the LLNL ISM system for planning and controlling work activities and projects. In addition, LLNL does not have a formal mechanism to coordinate pollution prevention efforts across the site. The LLNL Waste Minimization Steering Committee has not met for several years.

- LLNL does not have a documented implementation strategy for achieving the Secretary of Energy's 1999 pollution prevention goals and is not currently on track to achieve these expectations in some areas. LLNL analyzed major waste streams and developed a funding proposal in 2001 for projects that would contribute to meeting many of the DOE goals; however, there have been no decisions on the funding proposal, and many of the projects are not being pursued.

- LLNL research and support organizations (operating primarily with Office of Defense funding) have few financial incentives to invest in pollution prevention projects because funding for all waste disposal activities comes from the DOE Headquarters Office of Environmental Management (EM). Thus, there are fewer incentives to establish goals and promote waste reduction efforts that could result in savings for EM.

- LLNL does not have a current pollution prevention plan that meets DOE Order 5400.1 requirements or a clearly defined employee awareness program for pollution prevention to ensure that all site employees understand expectations and contribute to established goals. Although LLNL sponsors some awareness activities (e.g., recycling posters and news articles), LLNL has not conducted pollution prevention awareness training for employees. Also, LLNL does not have an awards program that systematically identifies and recognizes pollution prevention successes and awareness activities. LLNL's most proactive awareness activity, Earth Expo, was canceled this year (2002).

There has been no formal flowdown of LLNL program requirements for the implementation of environmental ALARA to the LLNL line organizations. Following an OAK revision to the LLNL contract performance objectives in 1999, LLNL developed and issued an Environmental ALARA Program Plan. However, that plan has not been implemented through formal inclusion in the ES&H Manual (there is a placeholder in the Manual for future inclusion of environmental ALARA requirements/guidance, but currently no information is provided). Although the site developed a draft document for inclusion in the ES&H Manual in early 2001, it has not been incorporated to date. Without a mechanism to implement the LLNL Environmental ALARA Program Plan, there is little assurance that people conducting LLNL projects are aware of their responsibilities regarding environmental ALARA considerations. Furthermore, although the opportunities for application of quantitative environmental ALARA reductions may not be significant at LLNL, qualitative reduction opportunities are available and the line organizations could benefit from the guidance in the environmental ALARA plan.

Overall, LLNL has established adequate controls for most environmental hazards reviewed by the OA team. LLNL has also devoted significant resources to enhancing controls of waste streams. Some isolated deficiencies were identified in monitoring practices, such as the Building 235, Room 1130, glovebox air effluent sampling system. Improvements are needed in controls for legacy wastes, including inspection and mitigation of weathered containers, and the development of a prioritization system for treatment and disposal based upon potential worker and environmental impacts. Additional management attention is needed for the LLNL pollution prevention program to ensure that appropriate policies, implementation strategies, and awareness efforts are being implemented consistent with DOE expectations. Although further improvements are warranted, the identified deficiencies do not currently pose a significant hazard to workers, the public, or the environment.

F.2.4 Core Function #4 – Perform Work Within Controls

With few exceptions, waste generating activities and waste management activities at the central storage facilities were performed in accordance with established requirements and controls. Hazardous waste management activities in Buildings 131 High Bay and 235 were implemented consistent with LLNL requirements for the management of satellite accumulation areas. OA's review of several research and development activities within the Chemistry and Materials Science Directorate (Building 132 North) indicates that environmental hazards were appropriately bounded by the integrated work sheets (IWSs), the designated Environmental Analyst reviewed applicable IWSs, hazardous waste containers were appropriately managed, and laboratory sinks were appropriately labeled to prohibit disposal of chemicals. The central waste management facilities were clean, secondary containment systems were being maintained, access was controlled, and aisle spacing was within limits.

Although most aspects of the groundwater monitoring programs at both the Livermore site and Site 300 are effectively implemented, OA's field observations of LLNL sampling of monitoring wells indicates that improvement is needed in equipment and supervision of sampling techniques. OA observed implementation of both of the two primary methods for sampling monitoring wells at the Livermore site (i.e., the Easy Pump Method and the standard method of continuous flow sampling after purging three well volumes of groundwater). With both methods, leakage from equipment occurred, resulting in some spillage on the ground. In addition, communication between field technicians and the Site Sampling Coordinator was not always timely and clear.

Overall, LLNL is performing environmental work activities consistent with established requirements and controls. While improvements in sampling processes are warranted, the environmental activities observed by the OA team were effectively implemented with a high regard for environmental compliance.

F.3 CONCLUSION

Overall, the LLNL ISM system effectively incorporates environmental protection considerations. Appropriate requirements for environmental programs have been incorporated in the WSSs and LLNL manuals. LLNL has established organizations with clear responsibilities to implement defined environmental protection functions and has appropriate levels of staff expertise for areas evaluated. With few exceptions, the environmental hazards posed by the LLNL facilities that were reviewed have been appropriately analyzed, and LLNL has applied appropriate administrative and engineering controls to address environmental hazards.

While effective environmental protection programs have been established, some aspects warrant additional management attention and further improvement. The LLNL pollution prevention program, which has historically been strong, is not well integrated into the LLNL ISM system for planning and controlling work activities and projects. LLNL has not fully analyzed operational facilities to determine the need for additional groundwater surveillance monitoring. Sampling processes and techniques were not well developed and formalized. In addition, LLNL has made limited progress in addressing legacy hazards. The current processes for prioritizing waste disposal activities are not based on risks to workers and the environment. Progress in legacy waste disposal is hindered by funding limitations.

Although further improvements are warranted in a few areas, most aspects of the systems for analyzing and controlling environmental hazards are effectively established and implemented. OAK and LLNL management were previously aware of the areas needing improvement through their operational awareness activities and had initiated actions in some cases (e.g., seeking additional funding for waste disposal activities).

F.4 RATING

Environmental Protection ....…………..EFFECTIVE PERFORMANCE

F.5 OPPORTUNITIES FOR IMPROVEMENT

This OA review identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive. Rather, they are intended to be reviewed and evaluated by the responsible DOE and contractor line management and prioritized and modified as appropriate, in accordance with site-specific programmatic objectives.

LLNL

1. **Strengthen LLNL institutional environmental management systems within the ISM program, consistent with Executive Order 13148 and DOE Notice 450.5**. Specific actions to consider include:

- Update site policies and plans to incorporate environmental management expectations consistent with DOE Order 5400.1 requirements and Executive Order 13148.

- Establish laboratory environmental protection goals and objectives in the context of the most significant environmental challenges.

- Develop and obtain senior management approval of actions to achieve goal and objectives.

- Institute periodic senior management review of accomplishments against expectations.

- Continue to monitor the progress of the proposed new DOE environmental management order (DOE Order 450.1 - DRAFT) to ensure that LLNL environmental policies and programs consider updates and revisions to DOE's expectations as the current requirements in DOE Orders 5400.1 and 5400.5 are incorporated into the proposed new order.

2. **Strengthen the pollution prevention program.** Specific actions to consider include:

   - Develop a formal action plan with assigned responsibilities, milestones, and accurate resource allocations for achieving the Secretary of Energy's 1999 pollution prevention goals.

   - Establish LLNL-wide efforts to pursue pollution prevention initiatives, and set goals for reducing generation of waste that require long-term storage.

   - Develop a mechanism for coordinating pollution prevention efforts across LLNL through the establishment of a committee.

   - Establish financial incentives for investment in pollution prevention projects.

   - Establish requirements in the ES&H Manual that promote waste reduction efforts in generating operations.

   - Develop a formal pollution prevention employee awareness program including such features as standard publications, posters, Web-based training, and Earth Expo.

   - Integrate pollution prevention expectations into the ISM system to include criteria for reviewing work activities or projects for pollution prevention opportunities.

3. **Implement a structured environmental ALARA program.** Specific actions to consider include:

   - Apply the ALARA process to all facilities and activities that have the potential to release radioactive materials to the environment, regardless of the magnitude of the dose.

   - Provide formal informational and procedural instructions to line organizations to ensure awareness of their responsibilities for environmental ALARA considerations.

   - Conduct programmatic ALARA reviews, including consideration of alternatives that could further reduce doses and potential environmental radiological impacts.

   - Include environmental ALARA guidance in the ES&H Manual.

4. **Conduct a review of all stacks on site with effluent sampling trains that are required by the National Emissions Standards for Hazardous Air Pollutants (NESHAPS).** Specific actions to consider include:

   - Assess existing stack sampling designs and evaluate against ANSI standard requirements for probe design, probe placement, line losses, and isokinetic status.

   - Evaluate currently operational and future stacks requiring NESHAPS sampling against the draft ANSI standard as a best management practice.

5. **Formally evaluate environmental groundwater vulnerabilities from operating facilities, and use the results to determine whether groundwater surveillance monitoring network needs to be expanded.** Specific actions to consider include:

   - Systematically analyze potential release pathways from operating industrial facilities and document the results in a vulnerability analysis report.

   - Revise and expand the groundwater surveillance monitoring well network based on the results of the vulnerability analysis. This may include new wells or utilization of existing environmental restoration wells near areas of identified vulnerabilities.

   - Document the groundwater surveillance monitoring network in a plan that provides a similar level of detail and rigor as the existing compliance monitoring plans and corrective action monitoring plans.

6. **Update the ES&H Manual and waste acceptance criteria to reflect current requirements.** Specific actions to consider include:

   - Ensure that the ES&H Manual, Volume III, Document 36.1, is updated as required by the site implementation plan for DOE Order 435.1 by replacing DOE Order 5820.2A requirements with the requirements of DOE Order 435.1 and DOE Manual 435.1-1, as incorporated in the WSS.

   - Revise the ES&H Manual, Volume III, Document 36.3, to reflect revisions in the time limits for storing full hazardous waste containers in satellite accumulation areas.

   - Update the 1997 Waste Acceptance Criteria to reflect requirements for offsite disposal of waste (e.g., Waste Isolation Pilot Plant, Nevada Test Site).

7. **Consider risk to the workers and the environment as a weighting factor in waste disposal determinations.** Specific actions to consider include:

   - Develop a formal process for determining waste disposal priorities that includes a risk factor based on the potential impact to workers and the environment.

   - Identify and move high-risk waste containers to locations where potential impacts to workers, facilities, and other stored materials are minimized.

   - Provide additional posting to indicate the need for additional caution when working in storage areas where higher-risk waste is stored.

8. Enhance management of legacy waste pending disposal. Specific actions to consider include:

- Ensure the integrity of the drum or container is maintained consistent with the acceptance requirements of the organization (DOE or private vendor) that will receive the material for ultimate disposal.

- Ensure that effective systems are in place to periodically assess the readability of labeling on the containers or drums.