Inspection of
Environment, Safety,
and Health Programs
at the

Stanford Linear Accelerator Center

January 2007

Office of Independent Oversight
Office of Health, Safety and Security
Office of the Secretary of Energy

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Abbreviations Used in This Report

AHA	Area Hazards Analysis
CAIRS	Computerized Accident/Incident Reporting System
CATS	Corrective Action Tracking System
CEF	Conventional and Experimental Facilities Department
CFR	Code of Federal Regulations
CY	Calendar Year
DART	Days Away and Restricted Time
DOE	U.S. Department of Energy
EMS	Environmental Management System
ES&H	Environment, Safety, and Health
FRAM	Functions, Responsibilities, and Authorities Manual
FY	Fiscal Year
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
ISEMS	Integrated Safety and Environmental Management System
ISM	Integrated Safety Management
JHAM	Job Hazards Analysis and Mitigation
JSA	Job Safety Analysis
LCLS	LINAC Coherent Light Source
LINAC	Linear Accelerator
MFD	Mechanical Fabrication Department

(Continued on inside back cover)

OVERSIGHT

1.0 Introduction

The U.S. Department of Energy (DOE) Office of Independent Oversight, within the Office of Health, Safety and Security, conducted an inspection of environment, safety, and health (ES&H) programs at the DOE Stanford Linear Accelerator Center (SLAC) during October and November 2006. The inspection was performed by Independent Oversight's Office of Environment, Safety and Health Evaluations.

The DOE Office of Science (SC) provides funding for and has Headquarters line management responsibility for SLAC. At the site level, the Manager of the Stanford Site Office (SSO) has DOE line management responsibility for SLAC activities. Under a contract to DOE, Stanford University manages and operates SLAC. SLAC uses subcontractors for certain activities, such as construction.

SLAC is a research and development (R&D) laboratory established in 1962 at Stanford University in Menlo Park, California. Its mission is to design, construct, and operate state-of-the-art accelerators and related experimental facilities for use in high-energy physics and synchrotron radiation research. The SLAC activities involve various potential hazards that need to be effectively controlled. These hazards include exposure to radiation, hazardous chemicals, and various physical hazards associated with accelerator facility operations and maintenance and associated construction-like activities (e.g., heavy equipment operation, trenching and excavating, electrical hazards, heat and cold stress, elevated work, hoisting and rigging, and noise).

The purpose of this Independent Oversight inspection was to assess the effectiveness of ES&H programs at SLAC as implemented by SLAC, SSO, and SC. Independent Oversight evaluated a representative sample of activities, including:

- Implementation of the core functions of integrated safety management (ISM) for selected facilities and activities, focusing on work planning and control systems at the

Research Yard at SLAC

activity and facility level and their application to the following organizations and activities:

- o Stanford Synchrotron Radiation Laboratory (SSRL) experimental work and accelerator operations

- o SLAC Operations Directorate production support, R&D projects, and facility and experimental support maintenance activities

- o Construction project activities including the Linear Accelerator (LINAC) Coherent Light Source (LCLS) construction project within the SLAC LCLS Directorate, and selected other construction projects managed by the Conventional and Experimental Facilities Department (CEF) within the SLAC Operations Directorate

- SC, SSO, and SLAC feedback and continuous improvement systems

- SC, SSO, and SLAC effectiveness in managing and implementing selected aspects of the ES&H program that Independent Oversight has identified as focus areas, including environmental management system (EMS) implementation and workplace monitoring of non-radiological hazards. Although these topics are not individually rated, the results of focus area reviews are integrated with or considered in the evaluation of ISM core functions.

Sections 2 and 3 discuss the key positive attributes and weaknesses identified during this review. Section 4 provides a summary assessment of the effectiveness of the major ISM elements that were reviewed. Section 5 provides Independent Oversight's conclusions regarding the overall effectiveness of SC, SSO, and SLAC management of ES&H programs, and Section 6 presents the ratings assigned during this review. Appendix A provides supplemental information, including team composition, and Appendix B identifies the specific findings that require corrective action and follow-up.

Three technical appendices (C through E) contain detailed results of the Independent Oversight review. Appendix C provides the results of the review of the application of the first four core functions of ISM for work activities. Appendix D presents the results of the review of feedback and continuous improvement processes and management systems. Appendix E presents the results of the review of safety management for the other selected focus areas. For each of these areas, Independent Oversight identified opportunities for improvement for consideration by SC, SSO, and SLAC management. The opportunities for improvement are listed at the end of each appendix so that they can be considered in context of the status of the areas reviewed.

2.0 Positive Attributes

Some positive attributes were identified in ES&H programs, including certain aspects of actions to improve electrical safety in response to a Type A electrical accident in 2004.

SSRL has a formal, documented, stringent experiment proposal review process that effectively integrates safety. The process applies to all users of the experimental equipment (e.g., the photon beam) and is documented in a set of procedures that are readily available to users and based on the particular type of beam line requested and the identified potential hazards. The experiment proposals effectively define the scope of the experiments, and the process requires users to include descriptions of all hazardous materials, equipment, or processes being proposed. The SSRL Safety Office reviews each experiment proposal and formally flags each proposal with any safety concerns. Each subsequent cycle in the process of actually gaining beam time gets a safety office review to analyze for hazards and develop or approve appropriate hazard controls. Formal processes include hazard forms for each identified hazard submitted by users (and required for each additional hazard identified during the proposal review process) and a safety checklist documenting required controls for each scheduled experiment. For ease of understanding, SSRL has documented the process in a detailed flowchart.

Aerial View of SLAC

Overall, SSRL sets an excellent example of safety integration into the experiment proposal review process.

SLAC has taken significant steps to strengthen electrical safety and to achieve compliance with electrical safety standards. The identification of personal protective equipment (PPE) requirements for work on electrical panels has been particularly noteworthy. Arc-flash calculations have been performed for electrical panels across the site, and each panel has been clearly marked to identify electric shock and arc-flash hazards and to specify required PPE. Electrical work plans that identify tasks, hazards, and controls associated with lockout/tagouts have been developed and are used by SLAC electricians performing lockout/tagouts. SLAC lockout/tagout training has been improved and made available to subcontractors.

SSRL has developed and implemented extensive engineering and administrative controls for accelerator and beam line radiological hazards. Radiological hazards are extensively controlled through engineered components and systems, such as shield walls, personnel protection interlock systems, and hutch interlock systems. To ensure that the engineering controls remain valid and to verify appropriate configuration control of the engineered safety systems, SSRL effectively implements and maintains a suite of administrative controls, such as radiation safety work control forms, beam authorization sheets, and beam line authorizations. For users, SSRL develops safety checklists during the experiment review process that are used by the duty operator to ensure that established controls are implemented before users are given the key to a beam line or experiment beam hutch.

SSO operational awareness and assessments of major construction projects have been thorough and generally effective. SSO safety engineers prepare oversight plans to describe how SSO will provide safety oversight of assigned projects, and coordinate these plans with the respective SSO Federal Project Director and SLAC counterparts. SSO is appropriately involved in review of key construction project documents (e.g., safety plans, excavation and shoring plans, rigging/lift plans) and attends meetings at contractor job sites to monitor project activities. SSO has performed meaningful reviews of construction subcontractor safety plans and walkthroughs of construction project job sites and has identified a number of appropriate findings and observations. Also, SSO safety engineers are planning to conduct a surveillance of the SLAC utility location process in response to multiple strikes of utilities on construction projects.

3.0 Weaknesses

Although some aspects of ES&H management are adequate, there are weaknesses in most aspects of activity hazards analysis and controls and feedback and improvement.

SLAC does not have an adequate work planning and control system. While some SLAC organizations formally define work scopes for quality or operational reasons, SLAC has not established a formal, structured, and comprehensive process (or coordinated set of processes) to ensure that the scope of work is clearly defined for all work at SLAC so that hazards can be systematically identified and the appropriate controls assured. The primary activity-level hazards analysis and control tools used at SLAC – the job hazards analysis and mitigation (JHAM) and area hazards analysis (AHA) – do not have sufficient institutional (i.e., sitewide) guidance for their content, use, and maintenance to ensure adequate and consistent implementation by line organizations. Work authorization processes, including ensuring readiness to perform work, are not well defined, resulting in some work being performed that was not well planned or clearly authorized. As a result of inadequately defined work, hazards, and controls, some ES&H requirements have not been met, and some unsafe work conditions were observed.

SSO and SLAC do not have effective requirement management systems, resulting in many requirements that are not identified, communicated to the workforce, and/or effectively implemented. SSO has not established a structured process for ensuring that new or modified ES&H directives are incorporated into the contract in a timely manner and effectively implemented. SLAC has not established effective mechanisms for identifying all safety requirements or a reliable hierarchy of documents (policies, programs, procedures, training plans, etc.) and structured document control system (review, approval, and change control) to establish implementing processes and clearly and consistently communicate these to personnel. In addition, SLAC has not established an adequate process for ensuring that applicable requirements are imposed on subcontractors. The lack of SSO and SLAC systems for managing requirements is a systemic weakness and contributes to deficiencies in implementation of ES&H requirements.

A Shop Area with Equipment with Incorrect Radioactive Material Labels

SLAC has not implemented certain radiation protection requirements with sufficient rigor to ensure adequate radiological control in accordance with institutional and DOE expectations. Radiological control requirements are generally well defined in the SLAC *Radiation Control Manual;* however, deficiencies were identified in the application of required radiological controls. Implementation of some program elements lacks sufficient formality to ensure effectiveness. Radiological work authorizations are not always used when required, and controls are not always specified, postings and boundary controls are deficient in some areas, and the program lacks procedures and technical bases for certain field methods and performance. A lack of rigor in following and understanding institutional and DOE requirements in these areas has resulted in radiological safety controls that fall short of meeting DOE and institutional expectations. These concerns were not previously identified by contractor self-assessments or DOE site office oversight.

SC, SSO, and SLAC feedback and continuous improvement programs have systemic deficiencies and are not sufficient to

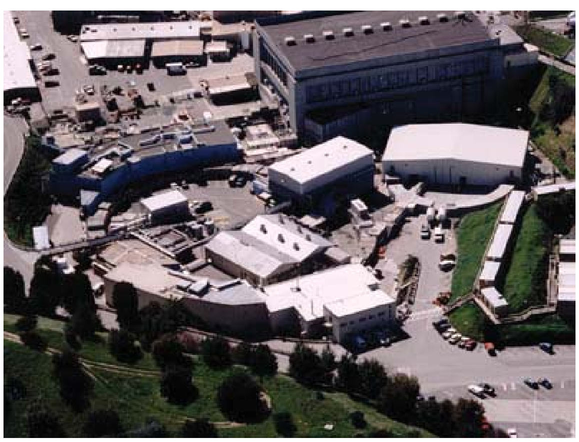
identify deficiencies and drive improvements in SLAC ES&H programs. Because of weaknesses in most aspects of its contractor assurance program, SLAC is not sufficiently effective in identifying and correcting deficiencies in ES&H programs. The SLAC assessment program lacks sufficient depth, rigor, and focus on performance. Investigations of injuries and illnesses and operational incidents and events and safety issues from assessments routinely have not adequately identified or addressed root causes or established appropriate recurrence controls. SSO has not been sufficiently involved and focused on evaluating contractor performance to ensure that system deficiencies in SLAC work planning and control, requirements management, and feedback and improvement systems are identified and addressed. SC has not ensured that SSO performs adequate oversight of the contractor and incorporates safety requirements into the contract and Work Smart standards

4.0 Summary Assessment

The following paragraphs provide a summary assessment of the SC, SSO, and SLAC activities that Independent Oversight evaluated during this inspection. Additional details relevant to the evaluated organizations are included in the technical appendices of this report.

Work Planning and Control

With some exceptions (e.g., SSRL experimental review process), SLAC does not have an adequate work planning and control process. In addition, SSO has not established a structured process for ensuring that new or modified ES&H directives are incorporated into the contract in a timely manner and effectively implemented. Further, SLAC has not established an adequate requirements management process. There are systemic deficiencies in the informal requirements management mechanisms at all levels: the contractual level, the institutional level, the facility level, and the activity/task level. Collectively, the deficiencies in the SSO and SLAC requirements management process and the SLAC work planning and control process indicate that SLAC relies more on an expert-based approach to safety than on the ISM principle of clear standards and requirements.



Aerial View of Beam Storage Ring at SSRL

SSRL. In most cases, SSRL experimental and operational work is well defined, hazards are generally well analyzed, and appropriate engineering and administrative controls have been established. The Third Generation Stanford Positron Electron Asymmetric Ring (SPEAR3) safety assessment document provides an extensive facility-level hazards analysis for the ring and associated equipment. SLAC does not have a DOE authorization basis for the facility photon hazards; SSO and SLAC management attention is needed to address this concern. Most other aspects of hazards analyses at SSRL are adequate. Formal processes are in place to verify readiness, and the observed work was performed safely and in accordance with established controls. Although most applications of the JHAM and AHA processes are adequate, in a few cases, the tasks in JHAMs are too broadly defined to accurately and completely support identification of task-specific hazards. In such cases, these deficiencies caused some hazards to be missed, resulting in incomplete hazard controls.

Operations Directorate. Work within the Operations Directorate presents the widest variety of hazards within SLAC and the largest population exposed to hazards. Some work activities are well defined in written procedures and test plans. Many workplace hazards in the Operations Directorate have been identified in JHAMs and AHAs and have been adequately analyzed and evaluated through such mechanisms as safety permits, exposure assessments, and procedures for structured tasks. Most engineering controls (i.e., beam access controls and shielding) are effective in controlling radiological hazards, and SLAC has continually improved systems (e.g., intranet) to ensure that ES&H requirements, procedures, JHAMs, and exposure assessments are readily available to workers. Overall, many hazards and controls were identified in JHAMs, AHAs, and safety permits, and the SLAC Operations Directorate has an experienced and well-qualified workforce.

However, much remains to be done before the SLAC Integrated Safety and Environmental Management System (ISEMS) process can fully meet the requirements of DOE Policy 450.4, *DOE Safety Management System Policy*. Much of the work within the Operations Directorate, including maintenance, production support, and research, relies on informal mechanisms such as verbal direction, drawings, memoranda, and notes. These and existing SLAC ISEMS tools (JHAMs, AHAS) do not always provide sufficient definition of work scope and tasks to ensure that activity-specific hazards are identified, properly analyzed, evaluated, and controlled. Furthermore, the site ISEMS system description and implementing guidance lack relevant detail on site requirements for work scope definition at the activity level, and this lack of systematic definition of work scope can be directly correlated to many of the observed deficiencies in other core functions of ISM. Likewise, while the JHAM and AHA tools can provide a useful framework for hazards analysis, institutional expectations for their proper development, use, and synergy are lacking, and line management has not effectively applied these tools in describing, linking, and tailoring hazards and controls to individual work activities. There were a number of examples where task-specific hazards were not sufficiently identified and/or analyzed so that appropriate controls could be implemented. As a result, some hazards and controls were missed, and work was performed outside of the expected controls. The design of the SLAC radiation protection program, while generally sound, has certain radiological controls that are not well defined and are informally implemented.

Problems in requirements management and specification of controls have resulted in work activities being performed outside the bounds of safety requirements, or the safety requirements being unclear because they were not identified. Similarly, since there are no formal mechanisms and expectations for ensuring readiness to perform work and ensuring that all controls are in place, some work was performed without the required controls and had to be halted for additional planning, In some cases, workers did not follow established requirements or perform according to expectations, in part because of management acceptance of informality in the work control process, which places too much reliance on workers (who have varying levels of ES&H expertise and training) to recognize, analyze, and control hazards at the time of work (i.e., an expert-based approach that is not consistent with ISM).

Construction. SLAC has established the essential elements of an effective work planning and control process for construction. If properly implemented, the process used by the LCLS construction contractor is consistent with DOE ISM policy. The job safety analysis process, supplemented with pre-job briefings, is appropriate for other subcontracted construction

Construction Activities

projects. The JHAM process used for minor construction is useful for ensuring that workers are qualified for the range of hazards they may encounter, but would be of greater value for work planning and control if it were supplemented with more job-specific hazards analysis and control. The AHA is an appropriate mechanism for identifying area-related hazards and controls, but the work control process does not require AHAs to be kept up to date. Although each of the methods used for hazards analysis and control is generally appropriate, implementation has not been fully effective. Some hazards are not fully analyzed, and applicable controls are not always identified. Expectations need to be better documented in procedures, reinforced through training, and more rigorously implemented in order to achieve improvement in performance.

Feedback and Improvement Systems

SC. SC is making progress in defining its Headquarters management systems and processes, and is actively involved in safety at its sites. However, progress has been slow, and many management system processes and supporting procedures have yet to be defined. In addition, SC has overall line management responsibility for ensuring the effectiveness of SSO line management oversight programs and the SLAC contractor assurance system, but there are significant deficiencies in these programs. Further, although SC's efforts to provide a leadership role in driving improvements in total recordable case (TRC) and days away and restricted time (DART) rate performance at its sites have resulted in a general overall improving performance trend in worker safety performance at SLAC, SC has not taken sufficient action to ensure that SLAC injury and illness and occurrence investigation processes are effective and that SSO performs sufficient oversight of SLAC investigations. The newly appointed SC Chief Operations Officer is aware of the current weaknesses in SC, SSO, and SLAC feedback and improvement processes. While SC has some plans to address recognized weaknesses, increased SC management attention is essential. SC needs to devote particular attention to ensuring that SSO and SLAC take a more comprehensive and balanced approach to establishing ES&H goals and priorities, applying their ES&H resources, and focusing their assessment and oversight efforts. SC's leadership has been successful in focusing SSO and SLAC on worker safety performance to include close monitoring and ongoing efforts to improve "lagging" indicators (i.e., measuring the number of undesired events that have already occurred) of worker safety performance (e.g., TRC and DART). SSO and SLAC have devoted particular attention to addressing some of the most frequent categories of worker injuries (e.g., slips, trips, and falls). In addition, the 2004 Type A accident and associated management attention led to additional focus on and improvements in various aspects of electrical safety (e.g., lockout/tagout and arc flash protection). However, SC needs to ensure that SSO and SLAC management is more proactive and adopts a broader perspective to managing the various types of hazards and risks at SLAC. For example, more emphasis is needed on ensuring that management systems (e.g., requirements management, work control processes, feedback and improvement processes) are effective. SSO and SLAC also need to devote more attention to monitoring and evaluating "leading" indicators (i.e., events that do not cause an injury but that constitute a "close call" or "near miss"). Proactive management efforts to ensure effective systems and to evaluate leading indicators are essential for preventing future accidents and events and recurrences of past problems, and for achieving the desired further reductions in worker injury and illnesses.

SSO. In the past two years, SSO has made some progress in strengthening its programs and processes for oversight of the contractor. SSO has appropriately used SC's Integrated Support Center services to provide subject matter expertise to support SSO assessments and surveillances. SSO has made progress in strengthening ES&H staffing, and most SSO ES&H personnel demonstrated an adequate understanding of their general ES&H roles, responsibilities, and authorities. Notwithstanding the recent progress, most of the processes are new and have not yet fully matured or been implemented. In addition, a number of key management systems and processes have yet to be defined to ensure that SSO has a functional line management oversight program. Some SSO staff did not sufficiently understand key mechanisms and practices used to ensure the effective implementation of requirements management systems processes. SSO has not yet established a training and qualification program for personnel assigned ES&H oversight responsibilities. While progress is being made, a number of weaknesses in issues management and corrective action processes still remain. SSO has not placed sufficient management attention and priority on ensuring that DOE employee concerns program requirements are effectively implemented. Overall, the SSO program is not sufficiently effective and warrants significant and timely management attention to address systemic deficiencies.

SLAC. SLAC has identified and described the various elements of feedback and improvement mechanisms. Recent improvements include strengthening of assessment, incident management, and lessons learned programs; establishing a new action tracking tool; and improving the feedback and improvement elements of the ES&H Manual. Assessment activities are performed, and in some cases, issues are identified, deficiencies are corrected, investigations are conducted and actions taken when injuries and events occur, events are reported, safety concerns are addressed, and lessons learned are identified and applied.

However, each of the feedback and continuous improvement program elements evaluated by Independent Oversight reflected significant weaknesses that hinder establishment of an effective assurance system. Roles, responsibilities, authorities, management expectations, requirements, and detailed process steps have not been adequately defined or established in consolidated, controlled documents that facilitate effective implementation. Communication of these requirements and processes to individuals responsible for implementation has been insufficient. Implementation of feedback and continuous improvement program elements has not been rigorous or well documented, and processes lack control and oversight mechanisms to provide real-time performance feedback. The expectations for self-assessment are not challenging and do not adequately monitor and validate performance through structured and rigorous work observation and safety program and management system implementation, including documentation and records of safety activities.

Significant weaknesses in the management of safety issues cut across all feedback and improvement areas. Investigations and corrective actions consistently focus on mitigating specific circumstances or deficiencies without sufficient identification of causes and identification and implementation of recurrence controls. Corrective actions often lack sufficient specificity to facilitate appropriate implementation and formal tracking, verification of completion, and validation of effectiveness. The SLAC feedback and improvement processes have not been effective enough to identify and correct the significant deficiencies noted in such areas as work planning and control and requirements management.

Focus Areas

EMS and pollution prevention program. SSO has approved the EMS for SLAC and continues to work closely on support and oversight to ensure that the contractor meets the requirements of DOE Order 450.1, *Environmental Protection Program*. SLAC has an approved EMS that integrates environmental requirements into the site's ISM system. However, some environmental controls are not adequately specified in AHA and JHAM processes. In addition, some guidance documents have only been recently updated, and many new provisions are in the initial stages of implementation. There are also some instances in which program documents are not comprehensive or EMS environmental aspects are not adequately integrated with other SLAC planning and tracking documents. SLAC has set general expectations for line organizations for pollution prevention/waste minimization activities using general employee training, but some support documents have not been updated.

An Unlabeled Waste Accumulation Area

Workplace monitoring of non-radiological hazards. The SLAC industrial hygienist has been aggressive in evaluating workplace exposures to non-radiological hazards when requested by line management, as evidenced by the number of exposure assessments performed and documented during the past few years. Exposure monitoring reports are readily accessible to line managers through the SLAC intranet, and the SLAC industrial hygienist has been diligent in responding to line managers' requests for exposure assessments. However, much remains to be done. Exposure assessment policy documents are minimal; exposure assessment requirements identified in DOE Order 440.1A have yet to be evaluated and fully implemented; and SLAC is not positioned to meet the exposure assessment requirements of the new Worker Safety and Health Program Rule (10 CFR 851) when they go into effect in February 2007. Line management has missed some opportunities for notification of industrial hygiene for the conduct of exposure assessments, and has not adequately integrated industrial hygiene recommendations into work documents. Limited staffing (e.g., only one full-time and one part-time industrial hygienist for the site) has resulted in lack of maintenance for exposure assessment programs (such as baseline hazards analysis).

5.0 Conclusions

Since the 2004 Type A electrical accident, SSO and SLAC have made improvements in many aspects of ES&H programs. However, the deficiencies in the SSO and SLAC requirements management process and the SLAC work planning and control process indicate a significant, continuing reliance on an expert-based approach to safety at SLAC, rather than the ISM principle of clear standards and requirements. As indicated in the 2004 Type A accident investigation report and other recent reviews, and as confirmed by this inspection, some accidents and events at SLAC are at least partially attributable to inadequate work planning and control and inadequate identification and communication of ES&H requirements. The SLAC EMS and workplace monitoring programs also need attention and improvement. SC, SSO, and SLAC feedback and improvement processes have not been sufficient to identify and correct the deficiencies in ES&H programs.

SC, SSO, and SLAC management need to take timely and aggressive actions to reduce the likelihood of additional accidents and events. The ISM program at SLAC is significantly less mature and rigorous than those at other DOE sites (including other SC laboratories); significant benefit could be realized through collaboration with other sites and taking advantage of their lessons learned while establishing ISM mechanisms. Areas of particular priority and emphasis for SLAC should include:

- Establishing a comprehensive and effective requirements management system

- Establishing a work planning and control system

- Performing a gap analysis against applicable requirements to identify and prioritize areas of noncompliance and weakness

- Enhancing the contractor assurance system, with particular emphasis on performance based assessments and rigorous issues management processes.

SSO should closely monitor SLAC's efforts and take actions to improve its systems and line management oversight of SLAC. SLAC program deficiencies are particularly evident in the areas where SSO has not performed adequate line management oversight, such as requirements management, accelerator safety bases, work planning and control, and contractor assurance. Wherever possible, SSO should seek assistance from the Integrated Service Center and other DOE site offices that have addressed and resolved similar problems to those that SSO is now facing. In addition, SC should take a larger role in monitoring SSO and SLAC performance and should facilitate efforts to provide assistance and support to SSO and SLAC and to ensure that lessons learned at various SC sites are applied across all SC sites to improve safety performance.

6.0 Ratings

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

Work Planning and Control

ACTIVITY	CORE FUNCTION RATINGS			
	Core Function #1 – Define the Scope of Work	**Core Function #2 – Analyze the Hazards**	**Core Function #3 – Identify and Implement Controls**	**Core Function #4 – Perform Work Within Controls**
SSRL Experimental Work and Accelerator Operations	Effective Performance	Needs Improvement	Effective Performance	Effective Performance
Operations Directorate Support, Maintenance, and R&D	Significant Weakness	Needs Improvement	Significant Weakness	Needs Improvement
Construction	Effective Performance	Needs Improvement	Needs Improvement	Needs Improvement

Feedback and Continuous Improvement - Core Function #5

SC and SSO Feedback and Continuous Improvement Processes ....SIGNIFICANT WEAKNESS
SLAC Feedback and Continuous Improvement Processes.............................. SIGNIFICANT WEAKNESS

APPENDIX A
SUPPLEMENTAL INFORMATION

A.1 Dates of Review

Planning Visit	October 16 – 19, 2006
Onsite Inspection Visit	October 30 – November 9, 2006
Report Validation and Closeout	November 28 – 30, 2006

A.2 Review Team Composition

A.2.1 Management

Glenn S. Podonsky, Chief, Office of Health, Safety and Security
Michael A. Kilpatrick, Deputy Chief for Operations, Office of Health, Safety and Security
Bradley Peterson, Director, Office of Independent Oversight
Thomas Staker, Acting Director, Office of Environment, Safety and Health Evaluations

A.2.2 Quality Review Board

Michael Kilpatrick	Bradley Peterson	
Dean Hickman	Robert Nelson	Bill Sanders

A.2.3 Review Team

Thomas Staker, Team Leader

Vic Crawford	Robert Freeman	Robert Compton	Al Gibson
Joe Lischinsky	Jim Lockridge	Ed Stafford	Mario Vigliani

A.2.4 Administrative Support

Keiana Scott	Tom Davis

A.3 Ratings

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

- **Significant Weakness (Red):** Indicates senior management needs to immediately focus attention and resources necessary to resolve management system or programmatic weaknesses identified. A significant weakness rating would normally reflect a number of significant findings identified within a management system or program that degrade its overall effectiveness and/or that are longstanding deficiencies that have not been adequately addressed. A significant weakness rating would, in most cases, warrant immediate action and compensatory measures as appropriate.

- **Needs Improvement (Yellow):** Indicates a need for improvement and a significant increase in attention to a management system or program. This rating is anticipatory and provides an opportunity for line management to correct and improve performance before it results in a significant weakness.

- **Effective Performance (Green):** Indicates effective overall performance in a management system or program. There may be specific findings or deficiencies that require attention and resolution, but that do not degrade the overall effectiveness of the system or program.

APPENDIX B
SITE-SPECIFIC FINDINGS

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

FINDING STATEMENTS		PAGE
#C-1:	SLAC does not have an adequate system for managing requirements to ensure that they are current, accurate, communicated to, and understood at the working level, as required by DOE Policy 450.4, *Safety Management System Policy*.	18
#C-2:	SLAC has not sufficiently defined formal work planning and control processes, including work scope definition, walkdowns, pre-job briefings, subject matter expert involvement, and adequate implementing procedures for hazard analysis and control, to ensure that each of the core functions of integrated safety management are systematically used in planning and executing work, as required by DOE Policy 450.4, *Safety Management System Policy*.	18
#C-3:	SLAC has not performed a facility-level hazards assessment of the SSRL beam lines, beam line hutches, and experiment halls (areas associated with photon hazards) as required by DOE Order 420.2B, *Accelerator Safety*, and internal SLAC requirements addressing accelerator safety assessment documents.	20
#C-4:	SLAC has not implemented certain radiation protection requirements with sufficient rigor to ensure adequate radiological control in such areas as the use and content of radiological work authorizations, radiological postings and boundary controls, radiological control procedures, and technical basis.	31
#C-5:	SLAC has not adequately defined the involvement of subcontractors in lockout/tagout procedures, accepted subcontractor lockout/tagout programs, or subcontract terms and conditions, and lockout/tagouts have not always met the requirements of NFPA 70E.	36
#C-6:	SLAC has not confirmed readiness to perform subcontracted construction work managed by CEF with sufficient rigor, as required by DOE Order 450.4, *Safety Management System Policy*.	37
#D-1:	SC does not have a current, approved Headquarters Functions, Responsibilities, and Authorities Manual and does not have an adequate set of procedures to fully implement its quality assurance program and safety oversight activities, as required by DOE Policy 411.1, *Safety Management Functions, Responsibilities, and Authorities Policy*, DOE Order 414.1C, *Quality Assurance*, and DOE Order 226.1, *Implementation of DOE Oversight Policy*, respectively.	44
#D-2:	SSO does not have an approved site office Functions, Responsibilities, and Authorities Manual and does not have an adequate set of processes and procedures to govern a number of its safety oversight activities, including such important functions as requirements management and maintenance of accelerator safety basis documents as required by DOE Policy 411.1, *Safety Management Functions, Responsibilities, and Authorities Policy*; DOE Order 414.1C, *Quality Assurance*; DOE Policy 450.4, *Safety Management System Policy*; and DOE Order 420.2B, *Safety of Accelerator Facilities*.	46
#D-3:	SSO has not sufficiently established and implemented a fully effective line management oversight and self-assessment program, including a training and qualification program and processes for tracking and communicating ES&H issues to SLAC, that ensures that SSO and SLAC are implementing ISM as specified in the DOE Order 226.1, *Implementation of Department of Energy Oversight Policy*.	46

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

FINDING STATEMENTS		PAGE
#D-4:	SSO has not implemented the requirements of SSO Procedure SSO-ADM-06, *Employee Concerns Program*, in accordance with DOE Order 442.1A and DOE Order 226.1 expectations.	49
#D-5.	SLAC has not established a program of effective assessment and activity level feedback activities with sufficient scope and rigor to ensure that ES&H performance at all levels and in all organizations is consistently and accurately evaluated, as required by DOE Order 226.1, *Implementation of DOE Oversight Policy*.	51
#D-6.	SLAC has not established an effective issues management program that ensures that safety deficiencies are appropriately documented, rigorously categorized, and evaluated in a timely manner, with root causes and extent of condition accurately identified, and appropriate recurrence controls identified, as required by DOE Order 226.1, *Implementation of DOE Oversight Policy*.	53
#D-7.	SLAC has not established a rigorous and effective program for investigation of incidents, occurrences, and events, including occupational injuries and illnesses, to ensure that incident causes are identified and that appropriate and effective corrective and preventive actions are identified and implemented, as required by DOE Order 226.1, *Implementation of DOE Oversight Policy*.	55
#E-1.	SLAC has not developed procedures and programs for implementation of the exposure assessment requirements and does not perform baseline hazards assessments and periodic reassessments of work areas and activities based on risk, as required by DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees.*	72

APPENDIX C
WORK PLANNING AND CONTROL

C.1 Introduction

The U.S. Department of Energy (DOE) Office of Independent Oversight evaluated work planning and control processes and implementation of the core functions of integrated safety management (ISM) at the DOE Stanford Linear Accelerator Center (SLAC). The Independent Oversight review of the ISM core functions focused on environment, safety, and health (ES&H) programs and work planning and control systems at the following organizations and activities:

- Stanford Synchrotron Radiation Laboratory (SSRL) experimental work and accelerator operations (see Section C.2.1)
- SLAC Operations Directorate production support, maintenance and research and development (R&D) projects (see Section C.2.2)
- Construction project activities, including the Linear Accelerator (LINAC) Coherent Light Source (LCLS) construction project within the SLAC LCLS Directorate, and selected other construction projects managed by the Conventional and Experimental Facilities Department within the SLAC Operations Directorate (see Section C.2.3).

For each area, Independent Oversight reviewed implementation of the core functions of ISM (including activity-level feedback processes), observed ongoing operations, toured work areas, observed equipment operations, conducted technical discussions and interviews with managers and technical staff, reviewed interfaces with ES&H staff, and reviewed ES&H documentation (e.g., plant standards, permits, and safety analyses). The evaluation of activity-level feedback and improvement systems for SLAC is reflected in the evaluation of the feedback and improvement program, as discussed in Appendix D. In addition to evaluating the selected aspects of SLAC activities, Independent Oversight also evaluated the collective results of the application of the core functions to identify commonalities and to provide perspective on sitewide work control processes and the ISM system.

C.2 Results

The evaluation of the collective results identified two findings that indicate systemic deficiencies across a wide range of SLAC organizations, facilities, and activities. While there are some exceptions (e.g., SSRL experimental review process), Findings C-1 and C-2, below, were sufficiently prevalent across the range of SLAC activities reviewed by Independent Oversight to warrant attention at both the organizational and institutional level and corrective actions on a sitewide basis, including facilities and activities not reviewed during this inspection. These institutional-level findings are presented below for easy reference and are briefly discussed. The results section for each of the areas reviewed (subsections C.2.1 through C.2.3) includes references to the institutional findings, where applicable. The corrective action plans for the two institutional findings need to address both the institutional weaknesses and the specific weaknesses identified at each activity reviewed (as identified by the references to Findings C-1 and C-2), as well as evaluating the extent of the condition to determine whether similar conditions exist at facilities and activities not reviewed during this Independent Oversight inspection.

First, SLAC has not established an adequate process for managing identified safety requirements and establishing and maintaining a current base of requirements that includes a hierarchy of documents to communicate methods for implementation (policy, programs, procedures, training plan, etc.). As a result, institutional methods for implementing some requirements are not established and requirements are not always clearly communicated, resulting in over-reliance on informal mechanisms and insufficient knowledge and understanding of requirements. For example, National Fire Protection Association (NFPA) 70E and Occupational Safety and Health Administration (OSHA) regulations require that lockout/tagout procedures be audited annually for execution and completeness, including a work observation of at least one ongoing lockout/tagout; the SLAC lockout/tagout program has not been audited annually as required, and responsibilities for performing these audits are not clearly assigned through an implementing procedure or other mechanism. This lack of clear requirements contributes to a situation in which too much reliance is placed on individual workers to effectively identify and implement safety controls (i.e., an expert-based approach to safety), and there is insufficient management attention to ensuring full compliance with safety requirements. (Also see Appendix D and Finding D-2.)

FINDING #C-1: SLAC does not have an adequate system for managing requirements to ensure that they are current, accurate, communicated to, and understood at the working level, as required by DOE Policy 450.4, *Safety Management System Policy*.

Another systemic weakness at SLAC is the lack of an adequate work planning and control system. While some SLAC organizations formally define work scopes for quality or operational reasons, SLAC has not established a formal, structured, and comprehensive process (or coordinated set of processes) to ensure that the scope of work is clearly defined for all work at SLAC so that hazards can be systematically identified and the appropriate controls assured. The primary activity-level hazards analysis and control tools used at SLAC – the job hazards analyses, job hazards analyses and mitigation (JHAMs), and area hazards analyses (AHAs) – do not have sufficient institutional guidance for their content, use, and maintenance to ensure adequate and consistent implementation by line organizations. The JHAM and AHA are useful tools but do not constitute a work control process, and important elements are missing, such as formal requirements for ES&H subject matter expert involvement, walkdowns, work documents, and pre-job briefings. Work authorization processes, including work scope definition and readiness to perform work, are not well defined, resulting in some work being performed that was not well planned or clearly authorized. As a result of inadequately defined work, hazards, and controls, some ES&H requirements have not been met, and unsafe work conditions were observed.

FINDING #C-2: SLAC has not sufficiently defined formal work planning and control processes, including work scope definition, walkdowns, pre-job briefings, subject matter expert involvement, and adequate implementing procedures for hazards analysis and control, to ensure that each of the core functions of integrated safety management are systematically used in planning and executing work, as required by DOE Policy 450.5, *Safety Management System Policy*.

Collectively, the deficiencies in the Stanford Site Office (SSO) and SLAC requirements management process and the SLAC work planning and control process indicate that there is still a significant reliance at SLAC on an expert-based approach to safety, rather than the ISM principle of clear standards and requirements. As indicated in the 2004 Type A accident investigation report, other recent reviews, and this inspection, work planning and control is a significant weakness at SLAC.

C.2.1 SSRL Experimental Work and Accelerator Operations

SSRL is a national user facility that provides synchrotron radiation, a name given to x-rays or light (photons) produced by electrons circulating in a storage ring at nearly the speed of light. These extremely bright x-rays can be used to investigate various forms of matter ranging from objects of atomic and molecular size to man-made materials with unusual properties. The facility is roughly divided into two major operating areas. The first area is the particle side, consisting of a small linear accelerator, a booster ring, and the storage ring – the Third Generation Stanford Positron Electron Asymmetric Ring (SPEAR3). The second area is the photon side, consisting of the beam lines and associated experimental areas.

During this inspection, SSRL was returning from a maintenance outage, and ongoing activities included SPEAR3 and beam line startups and experiment setups in preparation for the arrival of facility users. Observed work activities included SPEAR3 startups, group lockouts, SPEAR3 and experiment floor duty operator activities, beam line authorization inspections and surveys, and program support activities, such as facility modifications and other facility work conducted by SSRL staff. The Independent Oversight team also reviewed the SSRL experimental review process and participated in SSRL user training. Because SSRL was not yet ready for users during most of the inspection, minimal experiments and associated experimental work activities were observed.

Core Function 1: Define Scope of Work

At SSRL, the scope of work is defined by several methods and depends on the type of work being performed. Experimental work is generally well defined in experiment proposals. Experiment proposals are required for staff scientists as well as visiting researchers. The proposals adequately describe the experiments, materials, and overall experimental approach in sufficient detail to permit effective hazard identification and analysis. The proposal review process requires experiment proposals to address potentially hazardous materials, processes, and equipment, thereby giving an advance notice of potential hazards to the SSRL Safety Office.

The scopes of work for maintenance or experimental setup in areas requiring access to beam lines or radiological interlock protected areas and activities are generally defined in approved work documents (such as work plans and procedures) that describe the work sufficiently to identify the most significant hazards. For example, configuration control requirements for protection systems generally require specific scope-of-work descriptions in work documents, such as the SSRL radiation safety work control forms. In most cases, scopes of work for routine activities are adequately described in the basic job steps contained in personnel's JHAM forms. Although not always tailored to specific activities, the basic job steps in the JHAMs for personnel at SSRL were sufficient to analyze observed hazards.

Although most JHAMs were adequate to define the scope of work, in a few cases the JHAM job steps and associated hazards and controls are too broad to provide meaningful, quantitative information to workers. For example, a JHAM for accelerator operators is in place, but is overly broad in some cases and does not cover all task-level controls (similar to problems seen in other SLAC organizations and facilities, as discussed in subsequent sections). An example of the job steps listed in that JHAM is "Work in design, construction and installation of accelerator modifications;" the potential hazards are listed as "Electric shock, cuts, fumes and burns from soldering, injury from using power tools;" and the controls and recommended actions are "Raise awareness, take appropriate training, inform others of when and where work is planned." These generic hazards and controls are not complete, provide little benefit to the operator, and are not tailored to the specific activities. In another example, the JHAM for the duty operator cites "Welding" as a basic job step, but the task is not further broken down sufficiently to allow adequate analysis of hazards for the different types of welding (e.g., gas or arc) or the different materials to be welded. Consequently, hazards such as chromium fumes or other welding fumes are not addressed. (See Findings C-1 and C-2.)

Core Function 1 Summary. In a few cases, tasks in JHAMs are too broad to accurately and completely identify task-specific hazards. However, in most cases, SSRL program work is well defined through experiment proposals, JHAMs, and other work documents.

Core Function 2: Analyze Hazards

Hazards for most operational and maintenance work at SSRL are adequately identified and analyzed. Because SSRL is a user facility, the influx of numerous offsite non-SSRL users to the facility in order to perform a variety of experiments presents a challenge to ensuring that all potential hazards introduced by those experiments are adequately identified and analyzed. To respond to this challenge, SSRL has a formal, documented, and stringent proposal review process that effectively integrates safety throughout the process. The process applies to all users of the beam, is documented in a set of procedures available online for users, and is based on the identified potential hazards. The experiment proposals effectively define the scope of the experiments, and the process requires users to include descriptions of all hazardous materials, equipment, or processes being proposed. The SSRL Safety Office reviews each experiment proposal and formally flags each proposal with any safety concerns. Each subsequent cycle in the process of actually gaining beam time gets a Safety Office review to analyze for hazards and develop or approve appropriate hazard controls. Formal processes include hazard forms for each hazard identified by users or during the proposal review process and a safety checklist for each scheduled experiment documenting the required controls. For ease of understanding, SSRL has documented the process in a detailed flowchart. Overall, SSRL sets a noteworthy example of safety being integrated into the proposal review process.

Although institutional deficiencies exist with the ISM process at SLAC (see Findings C-1 and C-2), SSRL has been effective in adequately identifying and analyzing most activity/task-level hazards through the JHAM and AHA processes. For example, lead hazards from machining operations and lead handling activities in an enclosure designed to improve lead housekeeping are adequately evaluated and addressed in the AHA and the workers' JHAMs.

At the facility level, hazards analysis for the SPEAR3 has been adequately performed and documented in an accelerator safety assessment document (SAD). The SPEAR3 SAD contains appropriate hazard and accident analysis inside the specific bounds of the facility.

Facility-level modifications to beam lines and a modification to install a bulk liquid nitrogen distribution system in the beam line area received extensive hazards analysis. The liquid nitrogen distribution system installation received an extensive hazards review. Shielding design and approval processes for new or modified beam lines are comprehensive and involve engineering design development in conjunction with radiation physics, review by the radiological control citizens committee, and approval by the radiation safety officer.

Although facility-level hazards analyses for the particle accelerator side of the facility and a facility-level modification are adequate, other aspects of the facility-level hazards analyses were deficient. The SSRL beam lines, beam line hutches, and experiment halls (areas associated with photon hazards) are part of the SSRL accelerator facility but are not covered by a SAD as required by DOE Order 420.2B, *Accelerator Safety*, and the SLAC guideline for operations addressing SADs. Specifically, DOE Order 420.2B requires that contractors develop and maintain a comprehensive SAD or separate SADs addressing hazards within the facility. The SPEAR3 Safety Final SAD is the existing authorization basis document; however, this document only covers the SPEAR3 linear accelerator, booster ring, and storage ring. According to SSRL management, "the agreement with the DOE for the SPEAR3 project was that the SPEAR3 SAD would be exclusive of photon beam lines and related systems." However, this agreement was not documented, and an exemption to DOE Order 420.2B has not been pursued by SLAC or SSO. As a result, SSRL does not have a consolidated authorization basis from DOE for the extensive radiation and other hazards presented by the beam lines. (Also see Finding D-2.)

FINDING #C-3: SLAC has not performed a facility-level hazards assessment of the SSRL beam lines, beam line hutches, and experiment halls (areas associated with photon hazards) as required by DOE Order 420.2B, *Accelerator Safety,* and internal SLAC requirements addressing accelerator safety assessment documents.

Core Function 2 Summary. SSRL experimental and operational hazards, along with hazards that could be introduced by facility modifications, are generally well analyzed. The SPEAR3 SAD provides an extensive facility-level hazards analysis for the SPEAR3 ring and associated equipment, facility modifications receive extensive safety reviews, and the JHAM and AHA processes provide adequate analyses of task-level hazards. Although most hazards analyses at SSRL are adequate, the lack of a consolidated hazards analysis and corresponding DOE authorization basis for the beam line portions of SSRL is a deficiency that needs increased management attention to ensure that this accelerator (as well as others on site) has an adequate facility-level hazards analysis.

Core Function 3: Develop and Implement Controls

For most radiological activities, SSRL has developed and implemented extensive engineering and administrative controls. Radiological hazards are extensively controlled through engineered components and systems, such as shield walls, personnel protection interlock systems, and hutch interlock systems. To ensure that the engineering controls are in place and effective, administrative controls, such as radiation safety work control forms, beam authorization sheets, and beam line authorizations, verify appropriate configuration control of the engineered safety systems. For users, safety checklists are developed to address hazards introduced by experiments and to ensure that appropriate controls are implemented.

In most cases, task-specific controls are adequately described in JHAMs, AHAs, postings, and other related controls. For example, lead and cryogen controls are listed in sufficient detail in technician JHAMS, AHAs, and work area postings to adequately protect workers, although in one isolated case, neither the workers' JHAM nor the AHA contained controls or instructions for work on an installed high efficiency particulate air (HEPA) filter in a lead work enclosure. Postings for required cryogenic personal protective equipment (PPE) at the liquid nitrogen fill station are comprehensive and tailored to specific activities. Required electrical PPE for breaker operations and work inside breaker compartments is explicitly listed on each individual breaker (see Section C.2.3 for further discussion on extensive electrical controls). However, as noted under Core Function #1, some tasks are not adequately defined, and there is insufficient assurance that controls for these tasks are always comprehensive and complete.

In general, SSRL staff personnel are experienced, well trained, and knowledgeable of SSRL systems and hazard controls. Staff ES&H training requirements are appropriate for observed work activities, and workers are current in their training. Workers are knowledgeable of the systems, activities, and associated requirements. SSRL provides an extensive training program to ensure that outside users are adequately trained on facility hazards.

At SSRL (and other areas at SLAC), several safety requirements for operation of powered industrial vehicles (forklifts) have not been adequately implemented in the field as required by the ES&H Manual. Deficiencies in this area indicate that senior SLAC management attention is needed at the institutional level to ensure that management expectations for field implementation of established safety controls are clearly and consistently implemented. (See Findings C-1 and C-2.)

Core Function 3 Summary. In most cases, SSRL has established the appropriate engineering and administrative controls commensurate with the hazards for which these controls are intended. While overall implementation of controls at SSRL is adequate, understanding and implementation of forklift controls at SSRL are not adequate.

Core Function 4: Perform Work Within Controls

SSRL has multiple systems to ensure that appropriate hazard controls are in place prior to work authorization. Radiation is one of the SSRL hazards that needs to be effectively addressed, and the facility uses a combination of administrative authorization processes, schedules, daily meetings, and SPEAR and duty operator authorizations to ensure that controls are in place. Readiness and authorization to perform experiments by visiting users are also rigorously controlled. Final readiness to perform the experiment includes required safety training for users, a signed safety agreement with users, and final formal authorization by an SSRL duty operator (issuance of a key to access the beam) after verifying that the safety checklist has been completed and implemented. Each time a user leaves the facility, the key is returned. Subsequent access to the key requires duty operator authorization.

In general, SSRL workers perform work safely and in accordance with controls. For observed work, workers followed JHAM and AHA controls, used the correct PPE, and performed radiation surveys as required. Operator response to an unexplained beam dump, group lockout for ring access, and ring refill were performed in accordance with appropriate procedures and controls. Duty operator activities, such as beam line authorization and radioactive source control, were performed in accordance with requirements. Duty operator and radiation control personnel effectively performed initial and verification radiological surveys in accordance with established requirements. Surveys were thorough, and survey techniques were appropriate. During radiation shield modifications involving lead cutting and handling, workers followed all established controls.

In general, SSRL beam line areas, satellite waste accumulation areas, and user chemical laboratories are clean and orderly. For example, the satellite waste accumulation areas had the standard SLAC posting listing the regulatory requirements, the containers were kept closed except when waste was added, the containers were properly labeled, and secondary containment was provided for liquid hazardous waste. Observed deficiencies in most SSRL areas were minor and included such items as one case of improperly secured compressed gas cylinders and a ladder stored within the 36-inch setback area in front of an electrical panel. Facility management promptly addressed these minor deficiencies.

Although most activities were performed in accordance with established controls, the Independent Oversight team observed two cases where activities were not being effectively performed in accordance with controls. In one case, a waste storage area was not maintained as required. The metal cabinet SSRL uses for a waste accumulation area was missing the appropriate warning and directional signs. In addition, expired fluorescent lamps had been placed on top of this unlabeled hazardous waste cabinet, indicating that the lamps were universal waste. However, the lamps were not protected from breakage as required, and the area was not specifically marked as a universal waste storage area. In the other case, forklift operations were not performed in accordance with all safety

requirements in the ES&H Manual. As discussed under Core Function #3 in Section C.2.2, workers, supervisors, and the person administering the SLAC proficiency examinations were not fully knowledgeable of the material in the ES&H Manual and consequently were not following several established safety requirements. (See Findings C-1 and C-2.)

Core Function 4 Summary. At SSRL, formal processes are in place to verify readiness, and work is generally performed safely and in accordance with established controls. The few observed non-compliances with ES&H Manual requirements were primarily attributable to lack of clear management expectations for those requirements. (See Finding C-1.)

C.2.2 SLAC Operations Directorate Production Support, Maintenance, and R&D Projects

The SLAC Operations Directorate is the largest of the SLAC directorates and comprises approximately two-thirds of the 1500-person SLAC organization. Work within the Operations Directorate reflects the widest variety of hazards within SLAC and the largest population exposed to hazards. Of the eleven departments or divisions within the Operations Directorate, the following six departments were sampled during this evaluation: Controls and Power Electronics, Mechanical Fabrication (MFD), Klystron/Microwave, Conventional and Experimental Facilities (CEF), Metrology, and Surface and Materials Sciences. The review of CEF focused on maintenance and research activities. CEF also manages the site construction section, which is addressed in Section C.2.3. These six departments were selected because they work with the most significant and varied hazards. The Operations Directorate also uses diverse work control mechanisms and has a number of different types of ongoing work (i.e., production, maintenance, research, and operations).

Core Function 1: Define Scope of Work

Within the Operations Directorate, the most structured and formal tasks are those that are performed in accordance with procedures. For a number of work activities in various departments within the Operations Directorate, the requirements for accuracy, precision, and quality assurance require that work be performed in accordance with industry standards, client requirements, and testing protocols. Typically, work that is performed according to a procedure has sufficient detail and scope definition so that hazards can be identified and analyzed. For example, metallurgical testing of copper coupons within the Surface and Materials Sciences Department is performed in accordance with specific American Society for Testing and Materials standards and departmental procedures that detail the work steps, equipment, and chemicals to be used in the analysis. A separate American Society for Testing and Materials standard provides guidance about laboratory safety standards to be employed. Similarly, most Klystron (which is a type of linear vacuum tube used in high power applications) testing activities performed in the Klystron/Microwave Department are detailed in written Klystron Test Notes that outline in detail how the specific tasks are to be performed, addressing the most prevalent hazards and controls.

However, much of the production work within the Operations Directorate is not performed by procedures and standards, but with a work order, one or more drawings, a bill of materials, and a JHAM, which is used to identify typical individual work tasks that one performs in the course of a year. Similarly, most maintenance work is minimally defined in service requests (typically a statement of the problem, such as "roof leak" or "trouble shoot loss of power"). These service requests are used for work performed by in-house crafts, preventive maintenance (sometimes, but not typically, in the form of a procedure), and deferred maintenance that results in generation of a service request. Most (roughly 90 percent) of the CEF maintenance work is performed through either service requests or preventive maintenance, which provide minimal work description or definition. Work packages typically only consist of a service request, AHA, and a worker's individual JHAM. This methodology relies heavily on an informal walkdown by maintenance line supervision to determine the scope of effort needed for the proposed work, and whether additional permits or non-routine JHAMs need to be developed. Individual scopes of work for some CEF operational response activities at fixed facilities or field locations typically are not documented in sufficient detail to allow activity-level hazards and controls to be readily identified by workers. CEF operational response to loss of critical systems typically occurs during off-shift or requires immediate response, putting it outside the normal service request process. These responses typically lose any benefit from the normal process of an informal walkdown by maintenance line supervision to determine the needed scope and additional permits or non-routine JHAMs. Operational responses typically rely solely on the worker's assessment of whether the proposed troubleshooting falls within work described in existing JHAMs, and provides little opportunity for subject matter expert input or review because of its requirement for immediate response. (See Finding C-2.)

While the JHAM is often the identified tool to provide task- and activity-specific work scope definition and hazards analysis, many JHAMs do not contain sufficiently detailed work scopes, or tasks and work steps that are tailored to a specific work activity, to allow hazards to be systematically identified and effectively analyzed, and controls implemented. Routine JHAMs are prepared and reviewed annually, and can be modified more frequently if hazards and controls change. However, JHAMs routinely do not incorporate non-static conditions, such as the work environment, the work process, or varying activity-based work steps. While line management has the option of preparing procedures or non-routine JHAMs to address these conditions, most work is governed by routine JHAMs, which often do not provide a sufficient description of the work to identify all the potential hazards. For example, one JHAM within the Klystron/ Microwave Department identified a work scope as "work in noisy areas," which does not sufficiently describe the work to characterize the specific noise hazard present, worker proximity to the noise, type of hearing protection required, if any, and whether industrial hygiene should conduct additional noise measurements. Similarly, "work with chemicals" is not a sufficient work description to describe the chemical hazard or the quantity, use, and disposal of the chemical, all of which have a bearing on the magnitude and consequences of the hazard and the determination of the most appropriate controls. In addition, a statement in the ES&H Manual (i.e., statement indicating that more than three non-routine JHAMs in an individual's file could indicate that a job is not properly scoped) could discourage development of needed non-routine JHAMs.

Similarly, some departmental production activities (especially those production activities performed in other departmental facilities, such as the LINAC) do not have sufficient work scope task definition to ensure that activity-specific hazards, such as specific work locations (e.g., working in contaminated areas or at elevated heights), can be identified, properly analyzed and evaluated in relation to the task, and appropriately controlled. For example, component alignment activities performed by the Metrology Department within the LINAC facilities did not describe or communicate work scope on an unprotected elevated platform sufficiently to identify and implement required controls. (See Findings C-1 and C-2.)

Several of the Operations Directorate departments also conduct research activities, in which the outcome and the work process may not be well understood at the commencement of the research project. Research tasks present the greatest challenge for developing a formal work description from which hazards can be identified and the appropriate controls defined and implemented. Much of the process knowledge and work description resides with the experienced and knowledgeable experts who conduct the research. For these types of evolutions, the outcome of the activity and the process by which the work is to be performed are developed during the activity. Often the work description consists of conceptual design drawings, interoffice memoranda, and notes from design reviews, which are conducted periodically over the course of the research project. In later stages of the research project, some researchers will document a more detailed description of the project, including hazards and controls, as they prepare for a design review before the Safety Overview Committee or one or more of the SLAC Citizen Safety Committees.

However, this unstructured process of defining work is not sufficient to "clearly define the specific tasks that are to be accomplished as part of any given activity" as required by Chapter 2 of the SLAC ES&H Manual. Neither the SLAC ISM description nor the Operations Directorate ISM Plan provides any guidance or expectations on how research work should be defined. In a number of research activities, the combination of a line item schedule entry, a conceptual drawing, and one or more generic JHAMs for researchers participating in the project and/or AHA is not sufficient to describe the research activity so that all the hazards can be identified. Although research activities are performed by knowledgeable experts, the lack of a well defined scope limits the opportunity for ES&H subject matter experts, line management, and others to provide constructive input about hazards and controls. Furthermore, the lack of a well defined work scope may result in hazards being missed or not sufficiently analyzed, and inappropriate controls, as discussed in the following sections. (See Findings C-1 and C-2.)

Core Function 1 Summary. The most structured and best defined tasks within the Operations Directorate are those that are governed by written procedures. However, much work within the Operations Directorate, including production support and research, is not performed by procedures and relies primarily on informal mechanisms, such as verbal direction, drawings, memoranda, and notes. These and existing SLAC ISM mechanisms (JHAMs, AHAs) do not sufficiently describe the work scope and tasks to ensure that activity-specific hazards are identified, properly analyzed, evaluated, and controlled. Additionally, some work scopes for operational response activities are not described in sufficient detail to effectively analyze and control hazards, instead relying on the worker's assessment, sometimes without the benefit of input from supervisors or subject matter experts. The lack of sufficient details on site requirements for work scope definition at the activity level in the site ISM system description and implementing guidance and the lack of a systematic definition of work scope directly contribute to many of the observed deficiencies in other ISM core functions. Significant management attention is needed to address systemic weaknesses in the institutional expectations for work definition for the variety of production, research, and operations work conducted within the Operations Directorate.

Core Function 2: Analyze Hazards

Many workplace hazards in the Operations Directorate are identified in JHAMs and AHAs and are adequately analyzed and evaluated through such mechanisms as safety permits and exposure assessments. A number of possible hazards are typically identified in workers' JHAMs. Industrial hygiene has evaluated and documented a wide variety of workplace exposure hazards (e.g., asbestos, noise, beryllium, lead, chemicals). Some of the more significant hazards are also evaluated during the preparation of safety permits, plans, and procedures, such as lockout/tagout permits, hoisting and rigging lift plans, manufacturing procedures, confined space entry permits, radiation work permits (RWPs), excavation permits, and fall protection plans. For example, radiological hazards associated with Klystron Test Lab operations have been appropriately analyzed and documented in Klystron Test Notes and training materials. In addition, significant efforts were expended on analyzing radiological hazards and needed controls for beam dump removal work in the Beam Switchyard, which was one of the higher risk radiological jobs at the time of this Independent Oversight inspection. This analysis effort included various planning meetings, pre-job task dose estimates, and preparation of a job plan to identify high-dose activities and planned controls.

The SLAC AHA and JHAM are useful tools for hazards analysis; however, the JHAM and AHA are only tools and cannot substitute for a lack of a well defined and developed work control process. Further, institutional expectations for proper development, use, and synergy of the tools are not well defined, contributing to wide variations in content and quality. Most generic hazards associated with an individual's work are identified in his/her JHAM, although there is no process to formally identify and link the hazards identified in a JHAM to a specific work activity. In addition, there is no institutional guidance, requirements, or expectations for workers to read and be familiar with the contents of an AHA before performing work. Similarly, although the JHAM is the principal work authorization mechanism for work activities, according to the SLAC ISM description, there are no requirements to revise the JHAM before performing work activities if it fails to address certain hazards. Line management has generally not been consistent in the use of an AHA or JHAM for describing hazards and controls. One department within the Operations Directorate, for example, applies AHAs to specific equipment items instead of work areas, which is the AHA practice in most other departments. As discussed in Section C.2.3, construction project AHAs have not always been updated annually or when conditions change; similar concerns were noted in the Operations Directorate. (Also see Finding C-2.)

In some cases, task-specific hazards have not been sufficiently identified and/or analyzed so that appropriate controls can be implemented (see Finding C-2). Examples are as follows:

- Overhead hazards were not evaluated for Beam Switchyard work and were not identified in the AHA or JHAMs. A metal grated catwalk in the Beam Switchyard did not have toe boards, and workers approximately eight feet below were not wearing hard hats or head protection. During a work activity, a tool rolled off the catwalk and could have injured workers below.

- Potential chemical exposure hazards when working with potassium dichromate (a carcinogen) in the Surface and Materials Science metallographic lab have not been evaluated by Industrial Hygiene.

- Hazards associated with alignment work on a platform were not sufficiently addressed by the generic JHAM, which called out the possibility for work at elevated heights. Additional ES&H subject matter expert involvement was needed to ascertain the specific fall hazard and type of fall protection needed.

- In the Mechanical Fabrication Department Plating Shop, the JHAM for the plating specialist identified the chemical hazards associated with an enclosed degreaser, but failed to address the more significant chemical hazards associated with the open tank degreaser that was being prepared for use.

- While lead hazards were identified in Klystron Test Notes, they were not identified in some JHAMs covering Klystron Test Lab activities.

- Noise hazards were not identified in the accelerator tunnel AHA.

- No noise monitoring data was available for a trailer-mounted diesel 480 Volt generator located adjacent to ongoing maintenance work. The noise from this equipment could have exposed workers to noise levels greater than 85 dBA, but it was not included in the AHA as a hazard, nor was the equipment posted. Measurements conducted following an Independent Oversight team inquiry indicated noise levels in the low 90 dBA range against the side of the trailer. The AHA for this area did not mention this equipment and the associated noise potential, and the workers' JHAMs only generically address high noise areas (primarily only those known or posted within facilities).

- A Weld Shop was established by CEF in a modified intermodal steel container (building 4205). Although a hot work permit was issued by the Palo Alto Fire Department and the SLAC Fire Marshall, the requirements for a fire watch were not adequately communicated to or understood by the worker, who believed, based on an undocumented communication with the Fire Marshall, that he did not require a fire watch. The permit, however, explicitly required one. Additionally, there was no notification of industrial hygiene or industrial hygiene review of this facility to ensure appropriate ventilation.

- The SLAC Motor Pool (building 81) and the crane maintenance weld shop area did not receive adequate industrial hygiene review of hazards in the facilities. Additionally, there has been no documented exposure assessment for lead soldering or welding activities that could generate hexavalent chromium (e.g., before work on stainless steel) or monitoring motor pool chemical use and exposure potential.

- JHAMs and AHAs generally include waste generation as a hazard to be analyzed. However, the broad scope of the JHAMs is not adequate to identify specific hazards associated with waste generation. For example, a JHAM for the Heating, Ventilation, and Air Conditioning (HVAC) Shop listed all waste types under one entry that included hazardous waste, waste pesticides, and recovered Freon. This broad scope is not adequate to analyze the specific hazardous for these different waste streams.

- Noise surveys were not conducted to sufficiently characterize the potential for producing noise levels in excess of 85 dBA for a CEF maintenance subcontractor excavation to install hot water lines. Although hearing protection is required by job safety analyses (JSAs) for some activities as standard PPE, the actual noise levels were not measured, nor was assistance requested from SLAC subject matter experts. Following a discussion with the SLAC University Technical Representative, the operator was directed by his supervisor to wear double hearing protection (i.e., ear plugs with ear muffs); however, no additional evaluation was conducted.

Core Function 2 Summary. Many workplace hazards in the Operations Directorate are identified in JHAMs and AHAs and have been adequately analyzed and evaluated through such mechanisms as safety permits, exposure assessments, and procedures for structured tasks. However, while the JHAM and AHA forms are useful tools for hazards analysis, institutional expectations for their proper development, use, and synergy are lacking, and line management has not ensured the effective application of these tools in describing, linking, and tailoring hazards and controls to individual work activities. In a number of cases, task-specific hazards were not sufficiently identified and/or analyzed so that appropriate controls could be implemented. Furthermore, the hazards of some activities (e.g., motor pool lead and chemical use, weld shop, hoisting and rigging, lacking or incomplete AHAs) were not evaluated by subject matter experts so that appropriate controls could be ensured.

Core Function 3: Develop and Implement Controls

SLAC accelerator and support facilities appropriately rely heavily on engineering controls to mitigate potential exposures to personnel. Engineered controls, such as radiation shielding, beam access control systems, and atmospheric monitoring systems, are effective and comprehensive. Dose rates in most SLAC areas, including accelerator tunnels, are well characterized and controlled through effective shielding designs and placement. Access to these areas during operations is tightly controlled by a comprehensive key access system. Access controls, interlocks, and shielding design for both the accelerator tunnels and Accelerator Structure Test Area bunker in the Klystron/Microwave Department have been effective in minimizing radiation exposures to workers during work in and around these areas. Installed air monitoring systems for hydrogen cyanide in the MFD Plating Shop are extensive and effective in providing a monitoring and alarm capability for airborne concentrations of hazardous gases.

In addition to engineering controls, the Operations Directorate has implemented some effective administrative controls, including use of procedures, permits, and training, as well as PPE when necessary. The SLAC intranet is an example of a well designed administrative tool that provides useful and easy access for line managers, workers, and ES&H support staff to ES&H requirements, operations procedures, and hazards analyses. For example, ES&H requirements, procedures, locations of hazardous chemical storage cabinets, material safety data sheets (MSDSs), and exposure assessments are accessible through the ES&H and Industrial Hygiene home pages. Specific work procedures, test notes, JHAMs, and AHAs are available on most Operations Directorate home pages. Training reports, training histories, and training delinquencies for all workers are easily accessible with a variety of search options. SLAC also has a generally effective hazardous waste management program with some effective controls implemented at the point of generation. For example, the SLAC Hazardous Waste Management organization provides all labels and many containers to be used by generators. In addition, Hazardous Waste Management has developed standard waste profiles that simplify the grouping of compatible wastes for disposal.

However, in some cases, administrative controls lack sufficient design, structure, and rigor to be fully effective in serving their intended purpose. Examples are provided in the following paragraphs.

As discussed under Core Function 2, the principal mechanisms for identifying and implementing non-radiological controls during work are the JHAM and AHA, supplemented by safety permits as needed. While these tools can provide a useful framework for identifying hazard controls, institutional expectations and processes for the identification and application of appropriate controls to specific work activities are not well defined. In particular, there is limited guidance about expectations or processes for tailoring hazard controls to a specific work activity and requirements for appropriate subject matter expert involvement in work planning, resulting in generic and often inadequate specification of controls at the task level. While line management has other tools to address this problem (i.e., development of non-routine JHAMs), the institutional expectations and limitations on the use of routine versus non-routine JHAMs are not well delineated in implementing documents. For example, as discussed under Core Function 1, JHAM expectations for proper task and work step breakdown and methods for ensuring that hazards and controls properly bound individual work activities are undefined. Often, line managers have differing opinions on the purpose and use of these tools, ranging from raising safety awareness in the workplace to a serving as a formal mechanism for authorizing work. Institutional expectations are not supported by implementation guidance to ensure a consistent sitewide approach to the use of JHAMs and AHAs, specifically, and work control in general. Most work is accomplished under a routine JHAM and area AHA, and in many cases, these mechanisms are not sufficiently tailored to the work to adequately identify the specific controls needed to safely perform the work. (See Findings C-1 and C-2.) Examples are as follows:

- Some JHAMs identify chemical hazard controls as "use the appropriate PPE" but do not specify the PPE needed or any mechanism for determining the appropriate PPE.

- Workers in the MFD Plating Shop may be exposed to a number of acids, caustics, and cyanide baths, as stated in the JHAM for this work activity. Each of these potential chemical exposures may require different PPE. However, the controls and recommended actions in the JHAM are "PPE such as safety glasses, goggles, aprons, boots, gloves (hot gloves, rubber gloves, and electrical gloves)." In recent months, the department has recognized this shortcoming in not linking specific controls to identified hazards and is developing a job-specific PPE matrix that will assist workers in selecting the appropriate PPE.

- A JHAM in the Metrology Department identified a control to "use fall protection" when working at elevated heights, but failed to include other ES&H Manual requirements, such as a required fall protection plan and involvement by ES&H professionals.

- Controls for potential lead exposure in the Klystron Test Lab are not sufficiently addressed in JHAMs for workers handling lead. Although Test Notes identify lead and the need for gloves and hand washing, they do not address training requirements or a 30-minute time limit for operators who have not been through SLAC lead training. There is no mechanism to ensure that workers who handle lead, but are not required to complete the lead classroom training, have read and understood the minimum OSHA lead awareness requirements, as required by the Code of Federal Regulations (CFR) in 29 CFR 1910.1025.

- In general, there is no formal mechanism for consistently identifying training and medical surveillance requirements in JHAMs, although the Operations Directorate's ISM Plan and Chapters 1 and 24 of the ES&H Manual indicate that training requirements are to be verified before performing work. For lead brick machining performed in MFD, the lead training and medical surveillance requirements are not identified in workers' JHAMs or SLAC training assessments. Some departments choose not to include training requirements in JHAMs, relying solely on the SLAC training assessment to identify training requirements. However, the JHAM is the only approved work authorization mechanism, described in Chapter 1 of the SLAC ES&H Manual and the Operations Directorate ISM Plan, for verifying training before work is performed.

- A number of AHAs were not dated nor signed; thus, it is difficult for a worker to determine whether the AHA is current (i.e., has been reviewed during the past year).

- Some AHAs encompass such an extensive physical area that they provide limited value to workers in identifying specific hazards to which they may be exposed (e.g., the Generic Accelerator Tunnel AHA). In addition, it is not always clear from the AHA title whether the AHA covers a particular area (e.g., the Beam Switchyard is not specifically listed on the AHA).

- Chemical hazards are prevalent in many SLAC locations, but the chemical controls are only vaguely identified on many AHAs.

- Confined space entry requirements, although stipulated in the ES&H Manual and CEF's Manhole Entry Form (which is a type of confined space permit), do not establish an appropriate retrieval system for worker non-entry rescue in the event of the need for worker extraction. CEF electrical high voltage preventive maintenance line inspections are routinely conducted in manholes. These manhole entries are managed as permit-required confined space entries, workers are required to wear PPE including retrieval harness, and a tripod/hoist is required at the work site. However, workers made entries with no retrieval line attached. The line supervisor (who is also the competent individual) was unsure of the requirement for a retrieval line. The ES&H Manual states, "If feasible whenever an authorized entrant enters a permit space, retrieval systems will be used to facilitate non-entry rescue. Each entrant will use a full-body harness with a retrieval line attached. The other end of the line will be attached to a mechanical device or fixed point..." Omitting the need for a retrieval line indicates a fundamental misunderstanding of retrieval system operation and/or intent and places a worker at additional risk as a result of the potential delay in retrieval if an entry rescue is needed, because the complete retrieval system was not utilized.

- Confined space entry requirements for retrieval PPE were not adhered to during CEF electrical high voltage preventive maintenance line inspections conducted in manholes.

- The JHAMs for maintenance workers conducting HVAC compressor replacement used a one-ton rated "A" frame and chain fall hoist with slings and shackles; however, hazards associated with lifting (e.g., weight limits and ergonomic concerns) were not addressed. The JHAM does not require pre-job inspection of lifting fixtures and equipment as would be required by the ES&H Manual, methods for safe assembly and use of this equipment, etc. Many of these shortfalls can be attributed to inadequate initial definition of work (also see Core Function 1). Furthermore, neither the JHAM nor the AHA for this CEF HVAC compressor replacement addresses potential hazards or controls associated with working around or moving equipment over an unprotected 480 Volt power line running from a trailer-mounted diesel generator into building 2, also indicative of inadequate work definition (also see Core Function 1).

- Many individual JHAMs reference MSDSs as a control without sufficiently describing or analyzing the hazard or specifying which MSDS control measures workers are required to implement.

- Hot work at the SLAC motor pool (i.e., cutting, burning, welding, and grinding) was conducted without an approved hot work permit.

- Temporary stairs were constructed at interaction region-2 (IR-2) to address a concern noted earlier by the Independent Oversight team. (The team had observed that workers were required to transition from stairs to a three-tread step stool with no guard rails, and then onto a floor surface covered with cables, creating a fall and tripping hazard.) However, the temporary stairs were not constructed in accordance with provisions of OSHA 1910 or the temporary stair service provision of 29 CFR 1926.1052.

- The JHAM developed for hoisting and rigging activities for removing a hatch and moving equipment down into the hatch did not list most of the potential hazards associated with this work activity, nor did it provide any indication of controls or recommended actions. The JHAM developed for the riggers who routinely conduct this activity only lists one hazard (i.e., "equipment could fall on someone below"). Some of the hazards not included on the workers' JHAM are fall protection, noise, moving equipment, electrical overhead lines, fuels, heat/cold stress, and ergonomics. No AHA exists for this outside area, and no lift plan was used. The JHAM did not address those ambient hazards or other hazards in the work environment (e.g., heat stress, cold stress).

- Electrical panels, although posted keep clear within 36 inches, were obstructed at IR-2 building 620. Additionally, several posted fire extinguisher stations were not equipped with extinguishers.

Some engineering and administrative controls intended to minimize worker exposures to chemical hazards have not been sufficiently implemented. For example, local ventilation systems for chemical tanks in the Plating Shop are not periodically tested to ensure that ventilation flow rates are within the required flow rate ranges defined in the American Conference of Governmental Industrial Hygienists Ventilation Handbook. Chemical carcinogens in some laboratories and areas have not been identified in chemical inventories so that the requirements for chemical carcinogens as identified in Chapter 35, Chemical Carcinogens, of the ES&H Manual can be implemented (e.g., industrial hygiene monitoring, annual medical monitoring). Also, some chemical inventories do not accurately reflect the current chemicals in use or in process as required by Chapter 4, Hazard Communication, of the ES&H Manual. For example, perchloroethylene was not identified in the Plating Shop inventory, even though substantial quantities (i.e., 500 gallons) are required for operation of one of the degreasers. Although the new Unidox chemical inventory system identified the perchloroethylene, this system has not been implemented sitewide while awaiting the issuance of the new Hazardous Materials chapter of the ES&H Manual.

SLAC places a significant emphasis on worker experience and training in controlling hazards and identifying training needs for individual workers, through such processes as the SLAC training assessment and JHAM. These processes can be effective when implemented appropriately. However, a sampling of training records indicates that not all workers are up to date on their required training. For example, almost 25 percent of the hazardous waste generators are overdue for required hazardous waste training. Other examples of overdue safety and health training courses were identified in various Operations Directorate personnel. In a related concern, even if all personnel were current on required training, underlying deficiencies in the requirements management process have resulted in unclear or outdated training requirements. Most of the ES&H Manual will be substantially revised by the end of this year, resulting in some changes in training requirements that are not identified in the intranet training course catalogs. For example, the Lead chapter of the ES&H Manual (Chapter 20) was revised in November 2005. However, the new medical surveillance and training requirements are not reflected in the online training course catalog description for Course # 240 – Lead Safety Core. As a result, department managers who rely on this information when developing or revising SLAC training assessments could be misled into specifying the incorrect training and medical requirements for their workers. Similarly, changes in the ES&H Manual concerning forklift inspection criteria have not been incorporated into SLAC forklift training (see Findings C-1 and C-2).

In the radiological controls area, a variety of concerns in the application of administrative radiological controls were identified during this Independent Oversight inspection. While the design of the SLAC radiation protection program is generally sound, certain intended radiological controls are not well defined and are often informally implemented. A lack of rigor in following and understanding institutional and DOE requirements has resulted in some radiological safety controls that fall short of meeting DOE expectations in several areas, including use and content of radiological work authorizations, radiological postings and boundary controls, technical bases, and procedure use. SLAC requirements and DOE expectations are delineated in the SLAC Radiological Control Manual, the DOE Guide 441.1 series implementation guides, and DOE 1098-99, *DOE Radiological Control Standard*. Specific concerns are described in the following paragraphs.

First, written work authorizations are required by DOE regulations to control work in all radiological areas, including radiation areas, high radiation areas, contamination areas, high contamination areas, and airborne radioactivity areas. These written authorizations generally take the form of RWPs or technical work documents associated with jobs or experiments, as discussed in the SLAC Radiological Control Manual, DOE implementation guides, and the DOE Radiological Control Standard. However, fundamental deficiencies in the existence, development, and use of written radiological work authorizations may weaken the effectiveness of the as-low-as-reasonably-achievable principle. Specifically, SLAC Radiological Control has not ensured that the need for written work authorizations is properly described in the Radiation Control Manual and understood by line management, that written work authorizations such as RWPs or equivalent mechanisms are used to control all radiological work, and that when used, RWPs contain the necessary level of detail and clarity with respect to radiological controls (see Finding C-4).

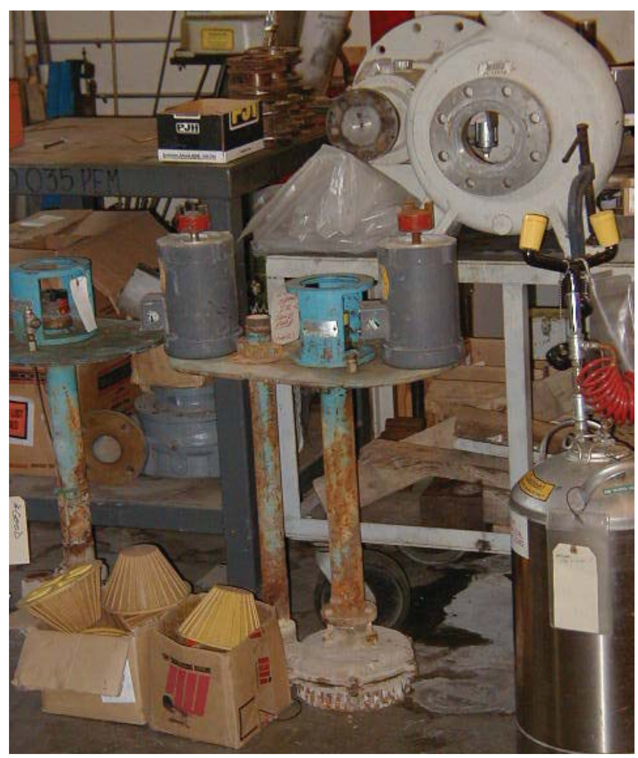
While the SLAC Radiological Control Manual clearly defines the need for RWPs in most radiological areas (high radiation areas, high contamination areas, etc.), it lacks sufficient clarity about the need for RWPs or other equivalent work authorizations for personnel entry and work in radiation areas. For example, Article 322.2 contains an allowance for general employee radiation training as the written work authorization for entry into a radiation area, which inherently conflicts with Article 322.9. The use of any training as a substitute for written work authorizations is less conservative than expected by the DOE Radiological Control Standard and DOE Guide 441.1-2 because training alone does not provide information on the specific work to be performed or the necessary controls. This practice was authorized by the local DOE site office, which approved the SLAC Radiological Control Manual and radiation protection program. Neither SLAC nor DOE requested a formal Headquarters interpretation of the practice by comparison to 10 CFR 835 requirements. Personnel routinely enter posted radiation areas for such activities as beam line authorization surveys and a variety of production support and maintenance work without an RWP or other written work authorization that delineates radiological conditions or needed controls. While worker JHAMs could constitute a written work authorization, this approach is not stipulated as part of the DOE Radiological Control Manual or JHAM process, and the radiological control organization is not involved in preparation or approval of JHAMs prepared by line organizations. Because they do not specify radiological conditions or specific activity controls, these documents do not meet SLAC or DOE requirements for written radiological work authorizations (see Finding C-4).

Another example of radiological work performed without an RWP or written work authorization resulted in spread of contamination and possibly uncharacterized internal worker exposures to thorium. Welding and grinding work with thoriated tungsten electrodes has been performed for an undetermined amount of time in building 26 without any RWP or other radiological work authorization, in conflict with SLAC Radiological Control Manual requirements. Based on an unexpected spread of contamination, a prohibition on thoriated welding electrode work was recently instituted for MFD and building 26. However, this corrective action did not address other areas across the site where these materials may be used. The magnitude and extent of thorium use at SLAC is not well known, particularly for subcontractors working at SLAC. Because thoriated welding electrodes contain up to several percent technologically-enhanced Th-232, these items present a radiological hazard and the potential exists for internal doses in excess of the bioassay monitoring threshold of 100 mrem, especially for workers performing grinding on the tips. This concern is documented in scientific literature, and MSDSs acknowledge the radiological hazard and possible need to control their use and intakes from a radiological and regulatory standpoint. At SLAC, some informal radiological controls, including periodic surveys and local ventilation, are used in building 26. However, RWPs were not in place, and no air sampling, bioassay (lung counting), or formal internal dose assessment were conducted to evaluate the potential exposure of welders from grinding and welding work. The SLAC internal dosimetry and air monitoring technical basis documents do not address thorium hazards. (See Finding C-4.)

RWPs are used to control radiological work in posted high radiation and/or contamination areas. Two jobs were observed during the inspection, and in these cases, the RWPs controlling access to and work in these areas were deficient. Specifically, the scope of work covered by RWPs was not always clear, and the RWPs did not provide sufficient information on specific radiological controls. For example, the routine RWP for the Beam Switchyard defines authorized work as "Routine entry into area after beam shutdown." This work scope does not specifically authorize or exclude hands-on work, although personnel were performing hands-on work under this RWP. The job-type RWP for positron vault magnet coil replacement addressed the allowed work scope, but controls were so generic that they could not be followed as written. For example, the controls "shielding to be installed," "HEPA vacuum," and "Tritium controls" were listed with no supporting detail or instruction for use. "Full set of protective clothing" did not adequately define the number of gloves to be worn. In practice, workers receive more detail on radiological controls in informal briefings and discussions with the Field Operations Manager and health physics technicians before and during the work. However, the RWPs contain insufficient detail to ensure that the intended radiological controls are implemented. (See Finding C-4.)

There are also weaknesses in radiological posting. Radiological posting and boundary control at SLAC are not fully implemented in accordance with institutional and DOE requirements and standards. For example, the wording on contamination area postings was universally not correct. "Contamination areas" are required by 10 CFR 835 to be posted with the specific words "contamination area." At SLAC, although institutional requirements stipulate the correct and required wording, the incorrect words "Contaminated Area" were printed on all postings. Similarly, the contamination area postings were also missing the SLAC-required entry control instruction "RWP required for Entry." The incorrect wording, while relatively minor by itself, is symptomatic of underlying deficiencies in the rigor of radiological controls at SLAC. (See Findings C-1, C-2, and C-4.)

In the Klystron Test Laboratory, radiation area postings were often inaccurate and poorly controlled. For example, some test stations were posted when



Pump Shop

there was no potential for radiation fields because the radiation generating devices were powered off. At some test stations, radiation area signs were hanging or strewn on the floor, boundary controls were missing, and the existence of a radiation hazard was not adequately specified. In the Klystron organization, operators are responsible for maintaining the postings, but their procedures do not address maintenance of postings, boundary control requirements, or down-posting requirements. A health physics technician assigned to perform bi-weekly routine radiological surveys and check status in this area did not notice or correct the posting deficiencies. Radiation area postings in other laboratory areas, such as the entry to PEP II Zone 8, had proper signage but lacked any form of boundary control (e.g., rope or chain) as required. In the Beam Switchyard area, a configuration change resulted in the RWP and sign-in sheets being moved inside a posted high radiation area, so that personnel had to enter the posted area before they could review and sign the RWP (see Finding C-4 and Core Function 4). In another area, pumps and motors with radioactive material tags were stored in an area not posted as a radiologically controlled area, as required.

Another radiological concern was that the technical basis for certain aspects of workplace monitoring and data quality has not been documented, and expectations for existing practices are not defined by procedure. SLAC performs removable contamination measurements by taking swipes and counting them on a Geiger-Mueller rate meter using 10 percent efficiency, but there is no documented technical basis describing the acceptability of this approach for meeting regulatory requirements for the isotopes of concern at SLAC. Field analysis of swipe samples may not be adequate for some isotopes, such as Fe-55, and more-sensitive techniques, such as low background counting with a fixed geometry, are not routinely used. Some survey results report data as less than the minimum detectable activity; however, the minimum detectable activity is not listed, and there is no documented method for calculating the minimum detectable activity for field analysis of swipes using a rate meter. Contamination survey records do not demonstrate that direct or fixed radiation measurements are routinely taken as needed to ascertain the potential presence of non-removable contamination, required under the DOE regulations, and there is no documented procedure or method for converting direct measurements using a small area probe to dpm/100cm^2 for comparison with regulatory requirements. (See Finding C-4.)

This concern was illustrated by a May 2006 contamination event involving a finding of radioactive contamination from thorium welding electrode grinding in an area posted as a "radiologically controlled area" but not as a "contamination area." SLAC deemed the event as not reportable to the DOE Occurrence Reporting and Processing System (ORPS), even though they had no suitable radiological data to justify their decision. The determination was non-conservative and questionable because the radiological surveys included only removable contamination measurements counted on a pancake Geiger-Mueller rate meter and did not assess the total contamination level, as would be required for comparison with ORPS criteria. As discussed in Appendix D, the corrective actions for this event did not address the extent of the condition or other entities outside the MFD department. (See Finding C-4 and Appendix D.)

Some of the problems noted above may be related to the fact that SLAC lacks field operations health physics implementing procedures and/or programmatic technical basis documentation in some areas needed to ensure compliance with applicable SLAC Radiation Control Manual and DOE requirements and expectations. The suite of SLAC Radiation Protection procedures is less comprehensive than intended by DOE implementation guides. According to DOE Guide 441.1-1A, *Management and Administration of Radiation Protection Programs,* written procedures should be developed and employed whenever worker health and safety are directly affected, when the expected outcome for the process or operation requires that a specific method be followed, and/or to document the approved method to implement specific processes or operations. SLAC has not fully assessed the adequacy of existing field operation procedures and technical basis documents against these provisions.

FINDING #C-4: SLAC has not implemented certain radiation protection requirements with sufficient rigor to ensure adequate radiological control in such areas as use and content of radiological work authorizations, radiological postings and boundary controls, radiological control procedures, and technical basis.

Core Function 3 Summary. Engineered controls at SLAC, such as radiation shielding, beam access control systems, and atmospheric monitoring systems, are effective and comprehensive. However, there are significant and systemic weaknesses in work authorization and identification and implementation of controls for Operations Directorate work activities. The JHAM serves as the principal work authorization and control mechanism but in many cases was not sufficiently tailored or developed to adequately identify the specific controls needed to safely perform the intended work. Radiological control requirements are generally well defined in the SLAC Radiation Control Manual; however, the implementation lacks rigor, and certain radiological controls are not implemented in accordance with requirements and DOE expectations. Radiological work authorizations are not always used and controls specified, postings and boundary controls are deficient in several areas, and the program lacks procedure and technical bases in some areas. Significant and timely management attention to work planning is needed to ensure that effective controls are established and all ES&H requirements are met.

Core Function 4: Perform Work Within Controls

The Independent Oversight team observed a variety of examples of safe work conduct during the review of the Operations Directorate, including many industrial-type activities where workers used appropriate PPE. The workforce is experienced and generally safety conscious, and is not hesitant to stop and revisit controls when safety questions arise. Operations in the central waste accumulation area were effective, including excellent housekeeping, neatly stored supplies, proper waste segregation, and well designed and maintained secondary systems to protect surfaces from hazardous chemicals in the event of a spill and keep non-compatibles separated. In both the central facility and various shops, secondary containments were well designed and maintained to protect the surfaces from hazardous chemicals in the event of a spill. Containers awaiting disposal were properly labeled and kept closed, and the required postings for hazardous waste management areas were in place.

As discussed under the previous core functions, the SLAC work control process is not always implemented in a manner that sufficiently defines the work scope, specific hazards, and needed controls. As a result, ensuring readiness to perform work is sometimes inadequate, particularly because there are no requirements or guidance, and few established processes for conducting readiness reviews (e.g., use of pre-job briefings and pre-work walkdowns) to ensure that the appropriate controls have been identified and appropriately implemented. For example, some workers went to their assigned work locations with approved JHAMs and began work without ensuring readiness to perform work. The failure to systematically ensure readiness to perform work through formal review of actual conditions, planned job steps, and needed controls resulted in stopping jobs in the Beam Switchyard and Positron Vault because of unanticipated conditions and inadequate specification of controls (see Finding #C-2).

The Independent Oversight team identified a number of examples where work was not performed in accordance with requirements or intended controls, including those stipulated in JHAMs, RWPs, and the ES&H Manual:

- A worker using a liquid nitrogen pumping Dewar did not wear a face shield as required by the JHAM.
- There was widespread lack of adherence to ES&H Manual requirements for pre-use inspections and requirements for powered trucks and forklifts.
- Personnel working in the Positron Vault did not follow specific RWP PPE requirements or question whether the requirements were correct.
- Workers demonstrated poor contamination control and frisking practices for contamination area work in the Beam Switchyard and Positron Vault.
- A worker required to don a full set of PPE did not use proper shoe covers and would have entered a contamination area with personal clothing exposed if not corrected on the spot by the Health Physics staff.
- Two individuals signed in on a job-type RWP on which they were not working, rather than on the general access RWP, indicating that they did not read the scope of work listed at the top of the RWP.
- An 800-pound steel component was lifted with a magnet lift that was past its required inspection date.

- A number of workers did not hesitate to cross a posted high radiation area boundary and walk 15 feet to sign in on an RWP. Although this specific area did not have dose rates in excess of 100 mrem/hr (and thus did not actually meet the criteria for a high radiation area), the area is posted and controlled as a high radiation area. Workers' complacency and disregard for safety postings violate requirements and could have resulted in unnecessary exposure to personnel.

- In the MFD Plating Shop, a raised section of a floor covering presented a tripping hazard that could have resulted in a worker being exposed to plating chemicals (strong acids and/or bases) within the tanks. Although a work order had been issued to fix the hazard, no interim corrective actions were implemented to mitigate the hazard, and the situation was not identified as a safety issue.

- Metrology workers performing alignment activities in the Beam Switchyard did not use fall protection when working on an unprotected elevated surface over four feet.

- During the CEF building 2 HVAC compressor replacement, workers did not use some PPE, such as hard hat, leather gloves, and/or safety glasses, when needed or as required in a worker's JHAM.

- A lockout/tagout was conducted by a CEF electrical maintenance worker to support SSRL subcontractor electrical troubleshooting in accordance with posted arc flash requirements. However, the actual requirements stipulated on the electrical work permit were more conservative than those posted at the work site, and the worker did not follow the more conservative electrical work permit requirements, such as hearing protection and use of a rubber mat, nor did the electrician note the discrepancy between the PPE posted at the electrical panel and the PPE listed in the electrical work permit.

- A worker secured a tag line to a ladder on which he was working while attempting to raise an "I" beam for assembling an A-frame hoist. The worker used the tag line to support the weight of the "I" beam while lifting, creating the potential hazards of the beam striking the worker, loss of ladder stability, ladder failure, or the beam causing the worker to fall from the ladder.

- One IR-2 worker was unaware that his assigned fire watch was to be maintained for 30 minutes following the performance of hot work (welding) according to the hot work permit. This individual cleared the area and moved the fire extinguisher to its stored location before the end of the half-hour interval. The worker was also unsure of the fire watch responsibilities.

- A fire watch required by the hot work permit was not established to provide coverage for a CEF maintenance subcontractor individual conducting metal burning.

Most of these cases indicate an accepted level of informality in work management at SLAC where requirements and controls are not clearly and systematically identified, linked to hazards, and verified prior to performing work. Consequently, management has established a system with the expectation that workers will compensate for systematic shortcomings by knowing and properly implementing all controls and requirements from the ES&H Manual at the time the work is to be performed—that is, there is over-reliance on an expert-based approach to safety that is not consistent with ISM. The current level of non-compliance with requirements indicates the need for additional management attention in this area. (See Findings C-1 and C-2.)

Core Function 4 Summary. The SLAC Operations Directorate has an experienced and well-qualified workforce that typically performs work safely and in accordance with requirements. However, problems in requirements management and specification of controls have resulted in work activities being performed outside the bounds of SLAC safety requirements. In some cases, the safety requirements were unclear or were not identified. As discussed under Core Function 2, there are also no formal mechanisms and expectations for ensuring readiness to perform work, such as pre-job briefing and walkdowns, to ensure that all controls are in place; consequently, some work was performed without the required controls in place and had to be halted for additional planning, In some cases, workers did not follow established requirements or perform according to expectations, in part because of management's acceptance of informality in the work control process and over-reliance on workers, who have varying levels of ES&H expertise and training.

C.2.3 Construction Activities

The Independent Oversight team reviewed processes and procedures and observed construction activities to assess the effectiveness of work planning and controls applied to SLAC construction work. The inspection included assessment of work activities and controls for three sub-tier subcontracted jobs associated with construction of the new LCLS, six subcontracted projects performed under the direction of the SLAC CEF, and two minor construction projects managed by CEF and performed by SLAC employees.

Core Function 1: Define Scope of Work

The SLAC ES&H Manual specifies appropriate requirements for identifying construction subcontractor tasks. The Manual requires that construction subcontractors identify tasks to be performed on JSAs before work begins, that University Technical Representatives review JSAs, and that subcontractor workers be briefed on the content of JSAs before work begins.

The scope of LCLS work is clearly defined by the general contractor in subcontracts. The general contractor's health and safety plan requires each task to be defined in writing before it is performed, and tasks were defined daily in written JSAs that were approved by the general contractor. Tasks were adequately addressed during daily pre-task briefings.

The scope of subcontracted construction work managed by CEF is also adequately described in contracts and in drawings and specifications that were available to workers at job sites. JSAs were prepared and adequately described specific job tasks, and pre-job briefings were conducted daily for the subcontracted jobs.

Some small construction projects are classified as minor construction and are performed by SLAC employees using a work control process that is similar to that used for maintenance. The scope of minor construction work was adequately defined in service requests for the two reviewed jobs, but the specific tasks were not identified in writing. Instead, all tasks that the worker might perform during the routine application of his/her trade were listed on a JHAM for each worker. Workers attended daily meetings to receive work assignments, but specific tasks associated with these assignments were not typically discussed. Thus, specific tasks to be performed as part of minor construction projects were not always clearly defined prior to the start of work. (See Finding C-2.)

Summary. The processes established for defining subcontracted work, including such work at LCLS, are adequate and were adequately implemented for most work reviewed during this inspection. The process for minor construction was implemented but did not always clearly identify and define job-specific tasks before the start of work. Nevertheless, most construction tasks are adequately defined in writing and in briefings before the work begins.

Core Function 2: Analyze Hazards

For LCLS, the construction general contractor has established and effectively implemented a process for identification of construction hazards that is consistent with the SLAC ES&H Manual and DOE ISM policy. Potential hazards are documented on JSAs and pre-task hazard recognition plans and are discussed with workers prior to the start of the workday.

SLAC typically relies on the LCLS construction contractor for industrial hygiene support to analyze hazards and identify controls for the construction project, but this contractor does not have an onsite certified industrial hygienist. Although the SLAC industrial hygienist oversees the LCLS construction contractor, SLAC has limited resources for overseeing industrial hygiene programs at construction projects (see Section E.2.2). As exposure hazards increase during future LCLS tunneling operations, contractor industrial hygiene programs will need increased management attention and internal oversight.

For other subcontracted work, the approach used for hazard identification and analysis is also appropriate, but some aspects of the process are not well documented and implementation is not consistently effective. SLAC procedures do not provide detailed expectations for the content of JSAs, and University Technical Representatives, who are assigned responsibility for reviewing JSAs, have not been trained in this area. Some work-related hazards and controls are not adequately addressed in JSAs prepared by construction subcontractors. For example, JSAs did not address hazards associated with the use of a laser leveling device used during remodeling of building 84, the potential exposure to crystalline silica during drywall demolition in building 40, the use of power-actuated tools to repair secondary containments under PEP II transformers, or exposure to welding fumes during replacement of K1A and K1B switchgear. In addition, the hazards described in MSDSs for epoxy coating materials and a solvent were not adequately evaluated or implemented before these materials were sprayed inside secondary containments beneath PEP II power transformers, and adequate controls were not established. (See Finding C-2.)

Hazard identification and analysis was generally adequate for the two minor construction jobs that were reviewed. The hazard identification and analysis process used for minor construction is similar to that used for maintenance except that the project manager uses a Minor Construction Project Sheet to ensure the involvement of appropriate subject matter experts in job planning. The AHA for one of the jobs (installing a camera on building 750) was appropriately modified to address elevated work hazards associated with this job. There was no applicable AHA for the other job (replacement of an equipment shed near Building 1701). Generic work-related hazards were included in routine JHAMs for both of the jobs. However, job-specific hazards were not addressed in the routine JHAMs and are not typically discussed during pre-job briefings. (See Finding C-2.)

The AHA process for identification and control of area-related hazards is not fully effective. There is no requirement to update AHAs and no requirement to read them before work activities. Procedures require AHAs to be reviewed annually and when conditions change but do not require the AHAs to be changed based on these reviews. In some cases, they have not been updated when conditions changed, and in other cases, they were not read by persons entering the areas. For example, the AHA applicable to secondary containments beneath PEP power transformers specifies hazards and controls that are applicable when the facility is operating; however, construction work was performed in this area while the facility was shut down, and the hazards and controls that apply to the shutdown status were not specified. The AHA identifies chemicals in chilled water and compressed gas as hazards, but construction workers in the area did not know whether or where these hazards existed. SLAC does not have a change control process that requires timely update of AHAs when facility conditions change. This AHA was not changed when the facility was shut down, and applicable hazards and controls were not included on the construction JSA. (See Finding C-2.)

Summary. The process established for identification and analysis of hazards associated with construction work is generally adequate. For the LCLS jobs that were inspected, the process was adequately implemented and potential hazards were adequately identified and analyzed. However, for other subcontracted construction work, implementation of the hazard identification and analysis process was not fully effective. Expectations for the content of JSAs have not been made clear to subcontractors or SLAC reviewers, and implementation of the established process (defined in the ES&H Manual) was not sufficiently rigorous. Hazard identification and analysis was generally adequate for the minor construction jobs that were reviewed. AHAs, as currently maintained, are of limited value for construction work because construction is often performed when facilities are shut down and AHAs typically address hazards associated with operating facilities.

Core Function 3: Develop and Implement Controls

The LCLS work control process includes appropriate measures for identifying applicable controls and informing workers of these controls. Controls have generally been adequate to mitigate the hazards encountered during construction. One exception was identified when a subcontracted electrician, who was not aware of the SLAC AHA process, entered the building without contacting building management and without proper radiation dosimetry. A radiological warning sign on the building door was not visible because the door was open. For the other LCLS jobs that were reviewed, appropriate controls were included in JSAs and pre-task plans, and controls were understood by workers.

Expectations for specifying controls in construction JSAs and JHAMs have not been clearly conveyed to the workforce, and controls are not always adequately addressed in these work control documents. Procedures for control of subcontracted and minor construction work lack sufficiently detailed instructions for identifying controls in JSAs and JHAMs, and construction project managers and University Technical Representatives have not been trained in this area. Some controls listed in these documents do not have sufficient specificity. For example: MSDSs are often referenced as controls without specifying which MSDS control measures are required; MSDS numbers are not normally referenced; the name or number of the required training courses are not typically specified, and the individuals who must have the training are not identified; a general reference to PPE (e.g., "wear appropriate PPE") is sometimes used without specifying the PPE that is required; the noise level at which hearing protection should be worn is not stated on JHAMs or JSAs; and fall protection is sometimes specified as a control without describing the type of fall protection that is required. (See Finding C-2.)

SLAC has taken significant steps to strengthen electrical safety and to achieve compliance with the electrical safety standards of NFPA 70E. The identification of PPE requirements on electrical panels has been particularly noteworthy. Arc-flash calculations have been performed for electrical panels across the site, and each panel has been clearly marked to identify electric shock and arc-flash hazards and to specify required PPE. Electrical work plans that identify tasks, hazards, and controls associated with lockout/tagouts have been developed and used by SLAC electricians performing lockout/tagouts. SLAC lockout/tagout training has been improved and made available to subcontractors.

Although progress has been made in strengthening the SLAC lockout/tagout program, the extent of construction subcontractor involvement in electrical lockout/tagouts performed by SLAC is not clearly defined in SLAC procedures, accepted subcontractor lockout/tagout programs, or subcontract terms and conditions. Contractor involvement has not always met expectations or requirements. For example:

- A lockout/tagout for remodeling office space in building 40 was performed by SLAC with the involvement of an electrical subcontractor. Workers employed by a different demolition contractor, who subsequently removed drywall, conduit, and electrical boxes, were not involved in the lockout/tagout as required by NFPA 70E, even though they could have been injured if the circuit were energized. The SLAC lock and tag program states that "No worker shall work on machines, equipment, or processes that have been locked and tagged out unless he/she has affixed his/her own red lock and tag." This requirement is not well understood or consistently implemented by SLAC employees or subcontractors.

- Subcontractor workers do not always isolate live electric circuits by applying a SLAC lockout/tagout, and the expectation that they do so is not specified in procedures. The only isolation at one of the subcontracted construction jobs inspected was a subcontractor lockout/tagout.

- The expectation for subcontractors to prepare and use electrical work plans for lockout/tagouts is not well defined. The pre-work hazards analysis form instructs subcontractors to submit electrical work plans, but these plans were not used on subcontracted construction jobs inspected by the team. Some of the electrical work plans prepared for use by SLAC electricians were not signed by subcontractors.

- Lockout/tagout was identified as a task in the JSA demolition and reconstruction of office spaces in building 84, but controls for this task were not adequately defined. The specified control was: "Trade programs with SLAC, training, qualified personnel." This statement does not define SLAC or subcontractor responsibilities.

- A lockout/tagout needed to protect workers in PEP II transformer secondary containments was not specified in the JSA for that work and was not performed. SLAC locked and tagged power to the transformers to provide protection for another job. The project manager thought that this lockout/tagout provided adequate protection because the other job was scheduled for completion after the secondary containment work. The workers in the containments did not participate in the lockout/tagout, and not all the circuits necessary to protect the workers in the secondary containment were deenergized. Reliance on a work schedule is not equivalent to the lockout required by NFPA 70E.

FINDING #C-5: SLAC has not adequately defined the involvement of subcontractors in lockout/tagout procedures, accepted subcontractor lockout/tagout programs, or subcontract terms and conditions, and lockout/tagouts have not always met the requirements of NFPA 70E.

SLAC has not imposed some worker safety requirements on its construction subcontractors. For example, SLAC Work Smart standards have not been tailored for LCLS construction or flowed down through the LCLS construction contract. Thus, important worker safety requirements in DOE Order 440.1A, such as American Conference of Governmental Industrial Hygienists threshold limit values, have not been imposed on the LCLS construction contractor. Additionally, SLAC has not flowed down the NFPA 70E lockout/tagout requirements to subcontractors (other than for the LCLS project). The judgment of need from the Type A investigation of the October 2004 arc-flash injury states "SLAC needs to enforce applicable OSHA standards and all sections of NFPA

70E." SLAC expects its subcontractors to comply with both NFPA 70E and 29 CFR 1910.147 lockout/tagout requirements, but has not included these requirements in the terms and conditions of contracts. The 29 CFR 1926 lockout/tagout requirements, which are applicable to construction contractors, are less detailed and less restrictive than those in 29 CFR 1910 and NFPA 70E. (See Finding C-1.)

Summary. The processes for establishing controls are generally adequate, and most controls were appropriate for the work reviewed during this inspection. However**,** expectations for specifying controls in work control documents, and the extent of subcontractor involvement in lockouts/tagouts, were not sufficiently defined in work control documents to ensure consistent and effective performance, and this area needs improvement.

Core Function 4: Perform Work Within Controls

SLAC has established and implemented appropriate processes for ensuring readiness to perform LCLS construction work**.** The SLAC contract administrator authorized the LCLS general contractor to proceed with construction based, in part, upon ES&H readiness reviews performed by SLAC ES&H and line organizations. In addition, each phase of work is authorized based upon review and approval of the applicable JSA by the construction general contractor.

For subcontracted construction work, the process for ensuring readiness to perform work is also adequate, but implementation has not been fully effective. SLAC procedures require line managers to ensure readiness to perform work before authorizing the work to begin. The process for ensuring that hazards are identified and controls are established includes SLAC review of several subcontractor documents, including preliminary work hazards analyses, JSAs, lockout/tagout procedures, and training records. These documents have not always been reviewed with sufficient rigor to identify deficiencies. For example:

- SLAC reviews of subcontractor JSAs were not effective in identifying the deficiencies discussed previously in this report.

- The preliminary work hazards analysis for drywall demolition and installation in building 84 incorrectly stated that there would be no need for breathing protection, no use of power or hand tools, and no exposure to non-ionizing radiation.

- The preliminary hazards analysis for PEP II secondary containment incorrectly indicated that there would be no need for lockout/tagout, breathing protection, or construction power.

- Some subcontractor lockout/tagout programs accepted by SLAC do not adequately address the lockout/tagout requirements of 29 CFR 1910 or NFPA 70E. For example, accepted programs did not address the following requirements and did not reference the source documents for:

  - Use of individual, simple, and complex lockout/tagouts as specified by shift [NFPA 70E, Section 120.2(D)].

  - Test each phase both phase-to-phase and phase-to-ground. Determine the voltage test instrument is operation satisfactorily before and after each test [NFPA 70E, Section 120.1(5)].

  - Release stored electric energy [1910.133(b)(2)(ii)].

  - Grounding phase conductors when there is a possibility of induced voltage [NFPA 70E, Section 120.1(6)].

- Section H of construction subcontract terms and conditions specifies training requirements for electrical subcontractors and requires that (effective April 2005) subcontractor safety training be validated to ensure SLAC equivalency and that University Technical Representatives complete SLAC training assessments for electrical subcontractor personnel. This validation requirement has not been included in SLAC procedures and is not being implemented.

FINDING #C-6: SLAC has not confirmed readiness to perform subcontracted construction work managed by CEF with sufficient rigor, as required by DOE Order 450.4, *Safety Management System Policy*.

The process for control of minor construction work is appropriate and was followed for construction work reviewed during this inspection. Readiness was ensured by line management review before the work was assigned**.** The project manager completed a CEF Minor Construction Project Sheet documenting that appropriate safety reviews had been completed before the work was authorized.

In general, work was accomplished in accordance with established controls when these controls were clearly identified in work control documents. However, some safety requirements that were not clearly specified in procedures or work control documents were not met. For example, when a subcontracted electrician was provided a JSA for lockout/tagout that required following the CEF electrical work plan, the worker wore a lower level of PPE than required (i.e., leather gloves, hard hat, safety glasses, and coveralls), which did not meet NFPA 70E, electrical work plan, or posted panel requirements.

Summary. SLAC has established appropriate processes to confirm the readiness to perform work. Implementation of these processes is adequate for LCLS and minor construction projects but lacked sufficient rigor for subcontracted projects managed by CEF. Work was executed in accordance with required controls when these controls were clearly defined in JSAs and JHAMs, but compliance was inconsistent when controls were not well defined.

C.3 Conclusions

While there are some exceptions (e.g., the SSRL experimental review process), SLAC does not have an adequate work planning and control process. In addition, SSO has not established a structured process for ensuring that new or modified ES&H directives are incorporated into the contract in a timely manner and effectively implemented. Further, SLAC has not established an adequate requirements management process. There are systemic deficiencies in the informal requirements management mechanisms at all levels: the contractual level, the institutional level, the facility level, and the activity/task level. Collectively, the deficiencies in the SSO and SLAC requirements management process and the SLAC work planning and control process indicate that there is still a significant reliance at SLAC on an expert-based approach to safety, rather than the ISM principle of clear standards and requirements and a rigorous and structured process for ensuring that ES&H requirements are met and that hazards are effectively identified, analyzed, and controlled.

SSRL. In most cases, SSRL program work is well defined through experiment proposals, JHAMs, and other work documents. Experimental and operational hazards, along with hazards that could be introduced by facility modifications, are generally well analyzed. The SPEAR3 SAD provides an extensive facility-level hazards analysis for the ring and associated equipment, facility modifications receive extensive safety reviews, and the JHAM and AHA forms provide adequate analyses of task-level hazards. SLAC does not have a DOE authorization basis for the facility photon hazards; SSO and SLAC management attention is needed to address this concern. Most other aspects of hazards analyses at SSRL are adequate. In most cases, SSRL has established the appropriate engineering and administrative controls commensurate with the hazards for which these controls are intended. At SSRL, formal processes are in place to verify readiness, and work is performed safely and in accordance with established controls. Although most applications of the JHAM and AHA processes are adequate, in a few cases the tasks in JHAMs are too broad to accurately and completely support identification of task-specific hazards. These deficiencies have carried forward to cause some hazards to be missed, and in these cases resulted in incomplete hazard controls. In another case, some established forklift safety controls were not adequately implemented and not followed by workers and supervisors.

Operations Directorate. Work within the Operations Directorate represents the widest variety of hazards within SLAC and the largest population exposed to hazards. A number of work activities are well defined in written procedures and test plans. Many workplace hazards with the Operations Directorate have been identified in JHAMs and AHAs and have been adequately analyzed and evaluated through such mechanisms as safety permits, exposure assessments, and procedures for structured tasks. Most engineering controls (i.e., beam access controls and shielding) are effective in controlling radiological hazards, and SLAC has continually improved systems (e.g., intranet) to ensure that ES&H requirements, procedures, JHAMs, exposure assessments, etc. are readily available to workers. Overall, many hazards and controls are identified in JHAMs, AHAs, and safety permits, and the SLAC Operations Directorate has an experienced and well-qualified workforce that typically performs work safely and in accordance with requirements.

However, much remains to be done before the SLAC ISM system can fully meet the requirements of DOE Policy 450.4. Much of the work within the Operations Directorate, including production support and research, relies on informal mechanisms, such as verbal direction, drawings, memoranda and notes. These and existing SLAC ISEMS tools (JHAMs, AHAs) do not always provide sufficient work scope and task definition to ensure that activity-specific hazards are identified, properly analyzed, evaluated, and controlled. Furthermore, the site ISEMS system description and implementing guidance lack relevant detail on site requirements for work scope definition at the activity level, and this lack of systematic definition of work scope can be directly correlated to many of the observed deficiencies in other ISM core functions. Likewise, while the JHAM and AHA tools can provide a useful framework for hazards analysis; institutional expectations for their proper development, use, and synergy are lacking; and line management has not effectively applied these tools in describing, linking, and tailoring hazard identification and controls to individual work activities. In a number of cases, task-specific hazards were not sufficiently identified and/or analyzed so that appropriate controls could be implemented. As a result, some hazards and controls were missed, and work was performed outside of the expected controls. The design of the SLAC radiation protection program, while generally sound, has some radiological controls that are not well defined and are informally implemented. A lack of rigor in following and understanding institutional requirements has resulted in radiological safety controls that fall short of meeting DOE expectations and requirements in certain areas, such as use and content of radiological work authorizations, radiological postings and boundary controls, and procedure and technical basis documentation.

Problems in requirements management and specification of controls have resulted in work activities being performed outside the bounds of SLAC safety requirements, or the safety requirements were unclear or not identified. Similarly, because there are no formal mechanisms and expectations for ensuring readiness to perform work and to ensure that all controls are in place, some work was performed without required controls in place and had to be halted for additional planning, In some cases, workers did not follow established requirements or perform according to expectations, in part because of management's acceptance of informality in the work control process, which places too much reliance on workers (who have varying levels of ES&H expertise and training) to recognize, analyze, and control hazards at the time of work (i.e., an expert-based approach that is not consistent with ISM).

Construction. SLAC has established the essential elements of an effective work planning and control process for construction. If properly implemented, the process used by the LCLS construction contractor is consistent with DOE ISM policy. The JSA process, supplemented with pre-job briefings, is appropriate for other subcontracted construction projects. The JHAM process used for minor construction is useful for ensuring that workers are qualified for the range of hazards they may encounter, but would be of greater value for work planning and control if it were supplemented with more job-specific hazards analysis and control. The AHA is an appropriate process for identifying area-related hazards and controls but is not kept up to date. Although each of the methods used for hazards analysis and control is generally appropriate, implementation has not been fully effective. Some hazards are not fully analyzed, and applicable controls are not always identified. Expectations need to be better documented in procedures, reinforced through training, and more rigorously implemented in order to achieve improvement in performance.

C.4 Ratings

ACTIVITY	CORE FUNCTION RATINGS			
	Core Function #1 – Define the Scope of Work	**Core Function #2 – Analyze the Hazards**	**Core Function #3 – Identify and Implement Controls**	**Core Function #4 – Perform Work Within Controls**
SSRL Experimental Work and Accelerator Operations	Effective Performance	Needs Improvement	Effective Performance	Effective Performance
Operations Directorate Support, Maintenance, and R&D	Significant Weakness	Needs Improvement	Significant Weakness	Needs Improvement
Construction	Effective Performance	Needs Improvement	Needs Improvement	Needs Improvement

C.5 Opportunities For Improvement

This Independent Oversight inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management, and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

SC and SSO

1. **Ensure that input and guidance from DOE sites/laboratories that have established effective ISM systems are sought and used as appropriate to enhance work planning and control and requirements management programs at SLAC**. Lead, coordinate, and/or facilitate such efforts as needed.

SLAC – Institutional and Operations Directorate (applies sitewide)

1. **Consider importing and adapting a standards-based management system from a national laboratory to start efforts to develop a requirements management system.**

2. **Review DOE Order 440.1A requirements to identify gaps and develop an implementation plan for addressing non-compliances. Use this plan to provide a baseline for meeting the requirements of the new Worker Safety and Health Program Rule (10 CFR 851).**

3. **At the institutional and directorate levels, develop work control processes that address the wide variety of production, operations, maintenance, and research work performed within the Operations Directorate.** Specific actions to consider include:

   - Revise SLAC ISEMS system descriptions and roadmap to more specifically delineate how each of the core functions is to be implemented through the SLAC work control process. Provide clear expectations and processes for how to define the work scope so that hazards can be identified and analyzed.

   - Revise ES&H Manual Chapter 2 to include more specific requirements and guidelines for proper implementation of JHAM and AHA tools, including additional emphasis on ensuring adequate work scope definition and use of non-routine JHAMs.

   - Increase the emphasis on improving the quality of JHAMs and AHAs so that identified controls are sufficiently concise, tailored, linked to specific hazards, and integrated into procedures and work instructions. Develop processes by which activity-level hazards can be identified and analyzed, and the appropriate controls can be tailored and linked to these hazards.

- Consider establishing an institutional definition of "skill-of-the-craft work" and the conditions under which such skill-based work may be accomplished without need for formal activity-level hazards analysis.

- Establish a risk-based approach to work control in which the extent of the work description, hazards analysis, involvement of subject matter experts, and the safety review process is commensurate with the degree of risk to workers, the public, and the environment.

- Define clear expectations for integrating training requirements into work control documents, such as JHAMS, AHAs, and procedures.

- Identify requirements and criteria for ensuring readiness, such as pre-job briefings and walkdowns, to ensure that the appropriate controls are in place and verified prior to performing work.

- Consider developing a separate research work control process with different tools that implement each core function in a manner that better accommodates the diverse and continually evolving nature of R&D work. Visit other DOE laboratories to gain perspective on the types of research work control processes being used throughout the DOE complex.

- Identify requirements and criteria for ensuring subject matter expert review of new activities or areas, to ensure that the appropriate controls are in place and verified prior to performing work. Develop hard triggers for subject matter expert review of facility activities that could introduce new or additional hazards requiring exposure assessment.

4. **Increase the rigor associated with implementation of radiological controls at SLAC consistent with DOE and SLAC institutional expectations.** Specific actions to consider include:

- Revise the Radcon manual to more closely align with the DOE Radcon Standard to delineate the required use of written work authorizations, such as RWPs, to control all radiological work.

- Develop and use general RWPs to control entry into and routine work in those radiological areas that have stable and well characterized radiological conditions.

- Improve the quality and content of RWPs by increasing the level of specificity and detail provided. Eliminate generic and ambiguous control statements. Controls should be sufficiently concise and descriptive so the intent is clear and the controls can be implemented without additional verbal direction. Consider revising the RWP procedure to add a checklist of questions for line management to ensure that specific jobs steps and tasks for support personnel are clearly understood.

- Conduct an extent-of-condition review on the use of thoriated welding electrodes at SLAC and ensure that this work is governed by appropriate radiological control authorizations that specify controls, including air sampling, radiological PPE, and boundary and contamination controls. Revise SLAC technical basis documentation to address thorium concerns.

- Determine the root causes of deficiencies in postings and boundary controls. Retrain individuals and consider developing a procedure for radiological posting. Add a module to Radworker training to address expectations for boundary control and worker requirements for entry into radiological areas, including written authorizations prior to entry.

- Ensure that there is an appropriate documented technical basis for performance of routine health physics tasks, such as field analysis of swipes and calculation of instrument minimum detactable activities. Conduct a review of existing health physics job tasks and evaluate against training materials and DOE Guide 441.1-1A criteria to determine additional procedure and technical basis needs.

- Develop additional procedures to guide health physics activities where worker health and safety could be affected or where the expected outcome for the process or operation requires that a specific method be followed.

Additional procedures should be considered for radiological posting and boundary control, radiological workplace monitoring and surveys, and analysis of swipe samples.

SLAC - SSRL

1. **Establish a comprehensive SAD that includes all aspects of SSRL operations**. Establish definitive schedules for hazards analysis and completion of portions of the SAD related to beam lines and other areas not currently covered by the SPEAR3 SAD.

2. **Ensure that all activity-level tasks are defined sufficiently to permit adequate hazards analyses**. Establish systematic reviews of randomly selected individual activities on a periodic basis to ensure that tasks are adequately defined.

SLAC - Construction

1. **Enhance processes applied to LCLS construction projects.** Specific actions to consider include:

   - Establish a process to ensure that LCLS subcontractors are adequately informed of area hazards associated with planned work. Consider incorporating applicable AHA hazards and controls in construction JSAs.

   - Revise the LCLS construction contract to incorporate applicable requirements from SLAC Work Smart standards.

2. **Enhance processes applied to CEF-managed construction projects.** Specific actions to consider include:

   - Establish a process to better define job-specific tasks for minor construction jobs. Consider using the JSA process for minor construction projects.

   - Include a discussion of job-specific tasks, hazards, and controls as part of pre-job briefings for minor construction projects.

   - Establish detailed written procedural requirements for the content of JSAs. Include these requirements in the terms and conditions of construction subcontracts, and train project managers and University Technical Representatives on them.

   - Establish a process to ensure appropriate involvement of subject matter experts in the review of MSDSs and in the selection of applicable hazards and controls to be included in JSAs.

   - Establish a more effective process for informing construction workers of area hazards and controls. Consider requiring an update of AHAs when the facility operational status changes and adding the hazards and controls associated with shutdown conditions. Also consider incorporating applicable AHA requirements into JSAs for subcontracted construction.

   - Modify the terms and conditions of construction subcontracts to require full compliance with NFPA 70E. Modify site procedures and construction subcontracts to clearly define expectations for subcontractor involvement in SLAC lockout/tagouts. Include these expectations in training for SLAC electricians, project managers, and University Technical Representatives.

   - Increase the rigor of reviews of subcontractor submittals, including preliminary work hazards analyses, lockout/tagout programs, and subcontractor training. Develop procedures for review of these documents, and train reviewers on procedural requirements.

APPENDIX D
FEEDBACK AND CONTINUOUS IMPROVEMENT (CORE FUNCTION #5)

D.1 Introduction

The U.S. Department of Energy (DOE) Office of Independent Oversight evaluated DOE Federal and contractor feedback and improvement processes at the Stanford Linear Accelerator Center (SLAC). The Independent Oversight team examined three aspects of feedback and improvement programs as applied to SLAC environment, safety, and health (ES&H) programs:

- The Office of Science (SC) line management oversight processes, including the employee concerns program, assessments, and issues management as applied to SLAC (see Section D.2.1)
- The Stanford Site Office (SSO) line management oversight processes, including assessments, self-assessments, the Facility Representative program, and issues management (see Section D.2.2)
- SLAC contractor feedback and improvement processes, such as the contractor assurance system assessments, corrective action and issues management, injury and illness investigation and prevention, lessons learned, the employee concerns program, and activity-level feedback processes such as post-job reviews (see Section D.2.3).

Independent Oversight interviewed SC, SSO, and SLAC personnel and reviewed various integrated safety management (ISM) and ES&H program documents and assessment reports.

D.2 Results

D.2.1 SC Line Management Oversight

Within SC, the Environment, Safety and Health Division (SC-31.1), reports through the Associate Director for Laboratory Policy and Infrastructure (SC-31) to the Chief Operating Officer (SC-3). This Division provides independent advice to the Under Secretary of Science, the Principal Deputy Director (SC-2) and the Chief Operating Officer on ES&H issues, including ISM; develops SC-specific policies related to ES&H; and ensures their effective and consistent implementation across the SC complex.

SC officially announced the standup of a restructured organization in March 2005, following a two-and-half-year re-engineering effort under the OneSC Project. The restructured organization incorporates a realignment of line management functions to the SC site offices and the establishment of an SC Integrated Support Center to support SC site offices in such areas as ES&H expertise, assessment assistance, and human resource support services. As part of the re-engineering effort, SC re-evaluated SC Headquarters management systems and processes, and established a new process called the SC Management System. The SC Management System provides a framework for defining SC operating and business processes, describes how SC operates, translates requirements into information for staff implementation, and defines the roles, responsibilities, accountabilities and authorities of program and staff organization as they pertain to the management system. The SC Management System is based on the standards-based management system approach that has been successfully implemented by a number of SC national laboratories.

As part of SC Management System initiative, SC recently developed several key ES&H program description documents, including Line Management Oversight for Implementing DOE Order 226.1. This program description provides an adequate framework and approach for SC line management oversight and clearly defines key line manager responsibilities and mechanisms for program implementation. The program description requires site offices to develop annual performance plans and perform other functions, such as developing and maintaining a three-year site office integrated oversight plan/schedule and conducting annual self-assessments against annual performance plan objectives and milestones. In addition, SC has also recently approved its Headquarters quality assurance program.

SC continues to monitor established performance indicators across SC laboratories, in particular total recordable cases (TRC) and days away/restricted/

transferred from job (DART) rates across SC laboratories. This management focus has contributed to a generally improving trend in performance indicators at SC laboratories. In a number of cases, the Under Secretary for Science has been personally involved in follow-up of occurrences and negative safety performance trends at SC laboratories. For example, the Under Secretary for Science issued a memorandum to the SLAC Laboratory Director calling attention to the declining safety performance in Laboratory TRC and DART rates and requesting SLAC to develop strategies and corrective actions to address this concern. However, SC attention also needs to be placed more on leading indicators of worker safety performance, such as lower-threshold events not reportable through the Occurrence Reporting and Processing System (ORPS) and investigation of "close calls," near misses, and injury and illnesses, rather than the current emphasis on lagging indicators (e.g., ORPS reportable events), to achieve further progress in improving worker safety performance.

Although SC is making progress in defining its Headquarters management systems and processes through the OneSC Project initiative, progress has been slow, and many management system processes and supporting procedures (e.g., subject areas, program descriptions) have yet to be defined. For example, a number of management system processes required to fully implement SC line management responsibilities for the SC Line Management Oversight for Implementing DOE Order 226.1 program description and the SC Headquarters quality assurance program have not yet been fully established. Furthermore, SC has not yet fully defined and formally established its Functions, Responsibilities and Authorities Manual (FRAM) as required by DOE Policy 411.1, *Safety Management Functions, Authorities, and Responsibilities Policy*. In discussions with Independent Oversight, the newly appointed SC Chief Operations Officer indicated that SC had not placed sufficient management priority and attention on its processes and the communication of its expectations to site offices in the past. He also indicated that one of his highest priorities was to take steps to increase senior management attention and accountability, re-invigorate efforts to clarify SC expectations, and complete the development of the SC Management System initiative.

FINDING #D-1: SC does not have a current, approved Headquarters Functions, Responsibilities, and Authorities Manual and does not have an adequate set of procedures to fully implement its quality assurance program and safety oversight activities, as required by DOE Policy 411.1, *Safety Management Functions, Responsibilities, and Authorities Policy*, DOE Order 414.1C, *Quality Assurance*, and DOE Order 226.1, *Implementation of DOE Oversight Policy*, respectively.

Although SC efforts to provide a leadership role in driving improvements in TRC and DART rate performance at its sites have contributed to a general overall improving trend in worker safety performance at SLAC, further progress in achieving current and future worker safety performance within SC is hindered by weaknesses in SLAC injury and illness investigation processes and lack of sufficient SSO oversight in this area. As discussed later in this appendix, weaknesses in these areas limit further progress in improving safety performance and reducing injury and illness rates.

SC has overall line management responsibility for ensuring the effectiveness of SSO line management oversight programs and the SLAC contractor assurance system. SC senior managers understand their safety management roles and responsibilities and are aware of continued deficiencies in various aspects of SSO's oversight program. SC recognizes the need to strengthen SSO management systems and resources. SSO has made use of Integrated Support Center services to provide subject matter expertise for the conduct of assessments/surveillances. However, SSO has not sufficiently utilized Integrated Support Center services to help develop site office management systems and processes so that SSO's limited site office staff can focus on operational awareness activities. In addition, SC's ES&H Division has not yet played a significant and visible role to support SSO in facilitating needed improvements in site office operations, which is one of its assigned office functions. Furthermore, current performance measures identified in the SSO Fiscal Year (FY) 2007 Annual Performance Plan are too generic, and do not provide sufficient detail to effectively monitor and drive necessary improvements in site office operational performance.

As discussed in Section D.2.2 and D.2.3, the significant deficiencies in SSO line management oversight programs and the SLAC contractor assurance system hinder the establishment and maintenance of effective ES&H programs at SLAC. Many of the issues and concerns identified during this Independent Oversight inspection are similar to those identified during a previous inspection at Argonne National Laboratory, but SC's communication of lessons learned to address such similar concerns at other SC laboratory sites has not been fully effective. Increased SC involvement in SSO improvement initiatives is essential to ensure accountability for correcting recognized and longstanding deficiencies in SSO oversight programs, including those identified by the 2004 Type A accident investigation.

D.2.2 SSO Line Management Oversight

SSO has 11 full-time equivalents, including 4.5 full-time equivalents focused on ES&H. The SSO Manager recently transferred to another DOE organization, and the SC Berkley Site Office Manager has been appointed in the interim until a new SSO manager is appointed.

Roles, Responsibilities, Authorities, and Accountability. SSO has made some progress in strengthening its site office programs and processes for oversight of the contractor. SSO established an Annual Performance Plan for FY 2007 in accordance with SC's guidance, updated their ES&H Management Plan to better define overall ES&H program elements and responsibilities, and recently (July 2006) developed its first Quality Assurance Plan in accordance with DOE Order 414.1C quality assurance requirements. SSO also recently (October 10, 2006) issued their Contract Management Plan, which outlines how SSO will manage the DOE-Stanford contract. The Contract Management Plan includes a detailed list of deliverables that SLAC is required to provide per the contract clauses and DOE directives. This list will need to be updated to reflect the additional submittals required by 10 CFR 851 for the health and safety program, but it provides a useful roadmap and checklist for tracking of SLAC ES&H deliverables.

Notwithstanding the recent progress, most of the processes are new and have not yet fully matured or been implemented. In addition, a number of key management systems and processes have yet to be defined to ensure that SSO has a fully functional line management oversight program:

- SSO has not yet developed internal management systems and processes and established interface protocols with the contractor for managing requirements and ensuring that applicable requirements are in the contract and the Work Smart standards set. This deficiency has contributed to process and implementation deficiencies in SLAC ES&H programs in such areas as quality assurance, contractor assurance systems, and worker health and safety. (See Appendix C and Section D.2.3.)

- Some implementing mechanisms referenced in the approved SSO quality assurance program (e.g., training and qualification, document control, assessments, and accident investigations) have not yet been formalized, approved, and implemented.

- SSO has not established processes and procedures to ensure that accelerator safety basis documents are periodically reviewed and properly maintained, including the establishment of appropriate processes for notification of significant changes requiring DOE/SSO review. Similar deficiencies were identified during the October 2005 SLAC ISM re-verification review and a June 2006 SC ISM assist visit (i.e., a review requested by SSO and performed with the support of the Integrated Service Center subject matter experts). The deficiencies in SSO processes for review and approval of safety documents contributed to deficiencies in managing the safety basis at the Stanford Synchrotron Radiation Laboratory (SSRL). (Also see Finding C-3.)

- SSO does not have an approved site office FRAM, as required by DOE Policy 411.1, *Safety Management Functions, Responsibilities, and Authorities Policy.*

Most SSO personnel who were interviewed demonstrated an adequate understanding of their general ES&H roles, responsibilities, and authorities. However, a number of SSO staff did not fully understand the key mechanisms and practices needed to ensure the effective implementation of requirements management systems processes. SSO personnel were generally unfamiliar with standard practices and mechanisms (e.g., gap analyses, implementation plans) for ensuring that appropriate actions are taken when directives/requirements are placed into contracts.

For example, DOE Order 226.1 was incorporated into the DOE-Stanford contract in October 2005, but SSO did not formally request SLAC to develop a gap analysis and implementation plan to define the actions needed to fully implement the requirements. As a general rule, SSO does not formally request a gap analysis and implementation plan from SLAC for new directives unless the directive specifically requires it or SC provides direction to do so. Lack of a well defined requirements management system process and interface protocols with the laboratory has contributed to concerns about progress in and/or effective implementation of the worker safety requirements of DOE Order 440.1A during this Independent Oversight inspection (also see Appendices C and E). The absence of an SSO FRAM and inadequate procedures contribute to the weaknesses in assignment and staff understanding of ES&H responsibilities.

FINDING #D-2: SSO does not have an approved site office Functions, Responsibilities, and Authorities Manual and does not have an adequate set of processes and procedures to govern a number of its safety oversight activities, including such important functions as requirements management and maintenance of accelerator safety basis documents as required by DOE Policy 411.1, *Safety Management Functions, Responsibilities, and Authorities Policy*; DOE Order 414.1C, *Quality Assurance*; DOE Policy 450.4, *Safety Management System Policy;* and DOE Order 420.2B, *Safety of Accelerator Facilities*.

Staffing and Training/Qualification Program. SSO has made progress in strengthening ES&H staffing. With the recent new ES&H hire, the total ES&H staffing has increased to 4.5 full-time equivalents; at the time of the 2004 Type A accident, SSO had only one ES&H safety engineer. SSO safety engineers and project managers have adequate technical backgrounds and related job experience for areas to which they have been assigned for oversight of the contractor. For example, project managers assigned to oversee major construction projects are qualified as Federal Project Directors, and personnel in the ES&H safety group have relevant prior experience in overseeing major construction projects, environmental regulation, laser safety, and fire protection.

SSO has not yet established a training and qualification program for personnel assigned ES&H oversight responsibilities, as required by DOE Order 226.1. The lack of a formal training and qualification program was identified in the October 2005 ISM re-verification review. SSO recognizes the need for a training and qualification program/procedures and has initiated some actions. Training and qualification is included on the SSO list of management system description documents to be developed. SSO has had discussions with other site offices and the Integrated Service Center to identify opportunities to import and adapt existing training and qualification and Facility Representative programs to SSO needs. However, SSO has not yet formally evaluated the need for establishing a Facility Representative program, in accordance with DOE Manual 426.1-1, *Federal Technical Capability Manual*, and DOE-STD-1063, *Facility Representatives*, which requires field elements with hazardous facilities (nuclear and non-nuclear) to evaluate each hazardous facility to determine an appropriate level of Facility Representative coverage. Further, SSO has not yet developed a core set of training requirements that are applicable to all ES&H staff (e.g., assessment and causal analysis training).

FINDING #D-3: SSO has not sufficiently established and implemented a fully effective line management oversight and self-assessment program, including a training and qualification program and processes for tracking and communicating ES&H issues to SLAC, that ensures that SSO and SLAC are implementing ISM as specified in the DOE Order 226.1, *Implementation of Department of Energy Oversight Policy.*

Operational Awareness and Assessment Program. Although much work still remains, SSO is making progress in establishing the framework for its operational awareness program to meet the requirements of DOE Order 226.1. An operational awareness program description document has been established and approved that adequately defines the overall functions to be performed by SSO, including SSO line management responsibilities for oversight of SLAC's ISM program. SSO has established procedures that adequately define some of the needed assessment processes and protocols (e.g., surveillances, walkthroughs, focused and functional area reviews). SSO also established its first three-year assessment schedule of planned oversight activities, in accordance with SC guidance and direction, and identified an appropriate set of planned assessments, including such areas as hoisting and rigging, emergency response, fire protection, electrical safety, radiation protection, and construction safety. SSO is coordinating with the Integrated Support Center to obtain required resources to support implementation of the planned schedule.

Although the SSO surveillance and walkthrough program has been adequately defined in an SSO procedure, SSO has not yet developed an annual surveillance/walkthrough plan for approval by the SSO Manager in accordance with an SSO procedure (SSO-OA-07). SSO management has not established expectations for walkthroughs by SSO staff and, with the exception of ES&H personnel, SSO personnel (senior managers, project managers) have not documented walkthroughs. In addition, no surveillances (reviews of actual work performance of the contractor) were documented, although a surveillance of the SLAC utility location process is being planned. The lack of a defined frequency for surveillances and walkthroughs was identified as an area for improvement in the October 2005 review of SLAC's ISM system. SSO is currently working on establishing a facility walkthrough schedule by November 30, 2006.

SSO operational awareness and assessments of major construction projects have been thorough and generally effective. SSO safety engineers prepare oversight plans to describe how SSO will provide safety oversight of assigned projects and coordinates these plans with the respective SSO Federal Project Director and SLAC counterparts. SSO is appropriately involved in review of key construction project documents (e.g., safety plans, excavation and shoring plans, rigging/lift plans) and attends meetings at the contractor job site to monitor project activities. SSO has performed meaningful reviews of construction subcontractor safety plans and walkthroughs of construction project job sites and has identified a number of appropriate findings and observations. Also, SSO safety engineers are planning to conduct a surveillance of the SLAC utility location process in response to the multiple recent strikes of utilities by construction projects.

SSO, with support from the Integrated Support Center, has provided adequate oversight of implementation of the SLAC environmental management system, in accordance with DOE Order 450.1, *Environmental Protection Program*. SSO conducted a three-day assessment of the SLAC environmental management system using subject matter expertise from the Integrated Support Center in November 2005, and determined that SLAC met DOE expectations. The SSO team identified areas for improvement, formally provided them to SLAC, and is performing appropriate follow-up.

Although adequate in a few areas (major construction projects and environmental management system, as discussed above), SSO operational awareness activities have not been sufficiently comprehensive for other facilities and site operations, including small construction projects. Except for large construction projects, few ES&H walkthroughs were documented in the applicable tracking system (i.e., the SMART dBase) and, as discussed above, no surveillances have been documented. To date, only a limited number of functional area/focused reviews have been conducted for SLAC. During FY 2006, the only such reviews performed by SSO were two focused area audits (construction safety/quality assurance and security), an environmental management system validation review, and a lockout/tagout surveillance/audit. In FY 2005, SLAC did not conduct focused/functional reviews because they focused on monitoring of SLAC restart activities after the Type A accident investigation and resulting shutdown of certain activities at SLAC. Further, SSO operational awareness activities are not sufficiently focused on SLAC feedback and improvement processes, including the injury and illness reporting program, corrective action management processes, and self-assessment processes. Also, SSO has not provided sufficient oversight to ensure that the DOE accelerator order (DOE Order 420.2B) is effectively implemented at SLAC. (See Finding #D-3.)

SSO assessments of SLAC ISM implementation have not been performed with sufficient depth and rigor in some areas and did not adequately characterize a number of assessment results as significant weaknesses that require SLAC management attention and action. Although a June 2006 ISM assist visit conducted by the SC Integrated Service Center appropriately identified that SLAC did not comply with DOE Order 440.1A non-radiological workplace monitoring requirements, many other significant weaknesses in SLAC's implementation of ISM were characterized as observations or recommendations rather than findings in such areas as corrective action/issues management process, lessons-learned processes, reviews of accelerator safety-related documents, and reviews of directives and Work Smart standards (see Section D.2.3). In addition, ISM assessments (ISM re-validation review 2005, and assist visit 2006) were not performed with sufficient depth and focus on work performance in some areas to adequately characterize to status of implementation of SLAC work control processes. For example, these assessments reviewed but did not identify deficiencies in Conventional and Experimental Facilities Department (CEF)/maintenance work control processes, inadequate processes for area hazards analysis (AHA) implementation, and deficiencies in certain aspects of radiation protection programs (see Appendix C). (See Finding #D-3.)

Self-Assessment. SSO has drafted a guide for self-assessment and recently conducted both a self-assessment, and several independent external assessments (ISM re-validation review 2005, and June 2006 assist visit) have been conducted that evaluated SSO operations. For example, the SSO October 2006 self-assessment of the SSO ES&H program generally provided a status evaluation of the management systems and processes for the site office and identified a number of actions that need to be addressed, such as establishing a formal document control system, identifying items for senior site office management review/tracking, evaluating the need for a formal Facility Representative program, implementing a walkthrough schedule, and completing development of remaining site office procedures. The results of this self-assessment were consistent with the most recent June 2006 assist visit.

While recent internal self-assessment and external assessments of SSO operations have provided an adequate evaluation of the status of previously identified weaknesses in some SSO safety oversight programs, they did not focus sufficiently on the effectiveness and implementation of existing SSO management systems and processes, such as employee concerns program and assessment processes. The current draft SSO guide for self-assessment does not provide sufficient guidance and direction for assessing the effectiveness of SSO management systems and processes (e.g., standard operating procedures). In addition, assessments have not sufficiently focused on identifying and resolving barriers to implementation and needed process improvements. SSO is developing the necessary management systems and processes, but has not yet conducted a formal gap analysis to determine all of the necessary management systems and processes that are needed and does not have a comprehensive implementation plan to identify needed actions (including self-assessment and independent assessment activities) with priorities, clear assignments, milestones, and resources needed to adequately manage improvement initiatives. The lack of a formally detailed and documented site office FRAM contributes to this deficiency.

Issues Management and Corrective Action. Although much work remains, SSO has taken positive steps to establish a corrective action and issues management process. SSO recently developed a site office operating procedure (SSO-OA-09) to define the process for issues tracking, follow-up, and reporting. SSO has also established an automated system (i.e., SMART dBase) for documenting operational awareness activities. SMART is used effectively for tracking and follow-up of corrective actions in response to walkthroughs, and follow-up of corrective action is evident.

SSO is evaluating trends and taking actions to improve safety performance for construction projects and electrical events. For example, SSO identified a number of repetitive construction safety violations at the KAVLI construction site that resulted in the SSO safety engineer initiating a number of stop-work actions. SSO also conducted an effectiveness review of the SLAC actions taken to address the Type A electrical event accident investigation and has appropriately required SLAC to take additional actions to address concerns about subcontractors' implementation of electrical safety requirements. In addition, SSO issued memoranda to SLAC addressing SLAC's inadequate oversight of the KAVLI construction project and a number of electrical events that involved SLAC contractors' cutting of energized cables and conduit; in both cases, SSO appropriately directed SLAC to address the concerns.

While progress is being made, a number of weaknesses in issues management and corrective action processes still remain (see Finding #D-3):

- SSO has not yet clearly defined and/or consistently implemented a standardized process for formally communicating results from SSO operational awareness activities (including activities conducted by the Integrated Support Center) to the contractor. For example, the construction/quality assurance assessment and the lockout/tagout surveillance were not formally issued to the contractor for review and action. Because assessment reports are not always formally transmitted to SLAC, SSO does not communicate its expectations for formal causal analysis and review of corrective action plans before their implementation. Several lockout/tagout deficiencies had not been adequately addressed at SLAC (see Appendix C).

- The SSO surveillance and walkthrough procedure (SSO-OA-07) does not direct/set expectations that findings/concerns requiring corrective action be entered into the SLAC corrective action tracking system for tracking and/or trending. Results of walkthroughs are typically provided directly to the SLAC counterparts for action, with no expectation for findings to be entered into the SLAC corrective action tracking system.

- SSO has not yet adequately defined and/or implemented a standardized process to formally track the results of SSO operational awareness activities (including activities conducted by the Integrated Support Center). SSO does not consistently enter the results of assessments conducted by the Integrated Support Center into the SMART database. In addition, actions taken by SSO to verify effective review and closure of contractor corrective actions for occurrences are not captured in the SMART database, as required by a SSO procedure (SSO-OA-04).

- SSO has not always placed sufficient priority and attention on verifying the adequacy and quality of investigations of events/incidents to ensure that the significance, causes, generic implications, corrective action implementation, and closeout are sufficiently addressed. Formal effectiveness reviews/evaluations of completed corrective actions have been identified by both SSO and SLAC as a weakness/gap requiring improvement (see Section D.2.3).

- SSO has not conducted adequate oversight of the SLAC corrective action tracking system and has not yet resolved the longstanding issue of establishing protocols for access to SLAC's tracking system so that it can monitor issue status and SLAC performance.

Employee Concerns Program. SSO has issued a standard operating procedure (dated August 2005) that establishes an adequate framework for the implementation of the DOE employee concerns program, in accordance with DOE Order 442.1A, *DOE Employee Concerns Program*, and DOE Order 226.1. However, SSO has not placed sufficient management attention and priority on ensuring that the procedure's requirements are effectively implemented. SSO has not assigned a person to be responsible (e.g., appointing an Employee Concerns Manager) for program implementation and has not provided training for staff personnel who are assigned responsibilities for employee concerns program implementation. In addition, SSO has not ensured appropriate posting of employee concerns program and hotline information within SLAC to ensure that site employees are aware of the DOE employee concerns program and their rights and responsibilities to report concerns through this process. Further, SSO has not assessed SLAC's employee concerns program to ensure conformance to DOE Order 442.1A and DOE Order 226.1 expectations.

FINDING #D-4: SSO has not implemented the requirements of SSO Procedure SSO-ADM-06, *Employee Concerns Program,* in accordance with DOE Order 442.1A and DOE Order 226.1 expectations.

D.2.3 SLAC Feedback and Improvement Programs

In the past 18 months, SLAC ISM feedback and improvement programs have undergone several assessments and ISM verification reviews, some of which were performed by external organizations. Based on these assessments, SLAC has taken several steps to strengthen the tools, content, and processes of these programs. These include establishing a new and improved institutional corrective action tracking tool in October 2005, forming an independent Office of Assurance in March 2006, issuing a substantial revision to the ES&H Manual chapter on line management assessments in July 2006, and issuing an Assurance Program Description document in September 2006.

Assessments. Requirements for conducting assessment activities at SLAC are identified in a variety of documents that address line management self-assessments, ES&H program reviews, independent assessments, and senior management walkthroughs. In addition, safety assessment activities are performed by Stanford University, and various inspection and surveillance activities are the responsibilities of certain workers, building managers, and personnel responsible for workspaces. In July 2006 SLAC replaced Chapter 33 of the ES&H Manual, which defined the overall SLAC self-assessment program, with a new Chapter 33 detailing specific self-assessment activities for line management. The new chapter identifies three types of line management ES&H assessment activities: annual formal management walkthroughs of all occupied workspaces, compliance assessments consisting of workspace inspections and triennial reviews of all written procedures describing active work processes, and an annual directorate ES&H self-assessment and report.

In addition, seven designated senior managers are required to conduct monthly walkthroughs of areas with significant potential hazards as delineated in a "Director's Procedure." This requirement was the result of corrective action for a judgment of need from the 2004 Type A accident investigation report. The Building Managers Manual also identifies annual workspace inspections and weekly eyewash station inspections and testing to be performed by building managers. The Integrated Safety and Environmental Management System (ISEMS) Program Description, last revised in September 2006, requires ES&H program managers, safety officers, and ES&H subject matter experts outside the ES&H Division to perform program reviews on a triennial basis. These assessments can be conducted as a self-assessment, as an internal independent assessment led by the Office of Assurance, or as a peer review by subject matter experts from other DOE national laboratories. The ISEMS Program Description also describes an annual institutional self-assessment that summarizes ES&H performance based on the results of all forms of assessments at SLAC and to report performance against the contract performance measures.

Independent assessment functions conducted at SLAC are described in various documents including the SLAC Assurance Program Description, issued in September 2006, and the SLAC ISEMS Program Description. The Assurance Program Description assigns the Office of Assurance to validate line self-assessment results, validate the closure of issues put into the Corrective Action Tracking System (CATS), and lead or arrange for independent reviews of ES&H programs. Program reviews in approximately 20 functional areas have been scheduled for the next three fiscal years. Two internal independent program reviews were conducted in June and July 2006 for the ES&H training and emergency management programs. The ISEMS and Assurance program descriptions also identify twice-yearly external assessments conducted by the ES&H Advisory Committee of the SLAC Policy Committee, which reports to the Stanford University President, to review aspects of ES&H at SLAC. This committee conducted assessments in November 2005 and March 2006 that addressed a variety of ES&H topics, and nine issues from the March 2006 report have been entered into CATS and are being tracked to resolution. The ISEMS Program Description also specifies that the Office of Assurance will conduct annual compliance assessments to ES&H standards and other requirements in the Work Smart Standards set. Discussions with responsible personnel indicate that these assessments are only intended to be an independent physical condition inspection to verify the adequacy of inspections performed by line managers, ES&H staff, and building managers.

Notwithstanding the recent strengthening of line management assessment activities, there are a number of weaknesses in the SLAC ES&H assessment program. The requirements to conduct assessments are inconsistently specified and fragmented between various documents, and roles, responsibilities, and authorities are not sufficiently defined in procedures. The SLAC assessment programs do not sufficiently emphasize implementation and performance-based assessment:

- Requirements to conduct program reviews are only identified in the ISEMS program description document, not in the Assurance Program description document. Although 20 of these program reviews have been selected and scheduled, the basis for selecting these programs is not sufficiently specified. The draft document cited by SLAC personnel as the source of programs to be evaluated lists over 50 programs. However, some key programmatic areas that are either not identified as safety programs or not scheduled for review include lead, asbestos, cryogenics, and beryllium programs and management systems such as assessments, issues management, lessons learned, injury and illness investigations, occurrence reporting, and employee concerns.

- The two independent program reviews that were conducted in 2006 identified opportunities for improvement but did not evaluate implementation of requirements (e.g., observation of work), quality of documentation (i.e., reports, records, and procedures) or compliance with defined requirements. Program reviews are specifically defined as excluding assessment of line implementation, and there are no requirements for line management to conduct structured self-assessments of the adequacy or quality of implementation of safety program requirements for their hazardous activities or for management systems, such as self-assessment, issues management, work control, or lessons learned. Although Chapter 33 of the ES&H Manual states that the purpose of the line-management-led ES&H compliance assessments (workplace conditions and work procedures) is to assess how well the line organization "adheres to its own procedures," these inspections and reviews provide only a very limited assessment of compliance with procedures or safety programs. Line managers are only required to document one walkthrough per year, and these walkthroughs are not required to be planned or focused on performance or compliance. The expectations and requirements for the scope and intent of the procedures compliance assessments are also insufficiently defined.

- There are no division, directorate, or institutional-level mechanisms for controls and oversight to ensure that building manager inspections are performed as required. In addition, there is a conflict between documents on the responsibility for eyewash station inspection and testing between the ES&H Manual and the Building Managers Program Manual. Eyewash inspection requirements in the Building Managers Manual are also not clearly defined in that this manual specifies that "essential" eyewashes must be flushed weekly, without defining the term "essential," and how inspections are to be documented is unspecified. Further, implementation of these requirements has been inadequate; the Independent Oversight team noted numerous eyewash stations that had not been inspected and tested weekly as required.

- The Director's Procedure for senior management walkthroughs provides inadequate direction for managing findings. The management of findings is addressed in a limited, but process-specific manner, including stopping work for "significant" findings and reporting of "concerns, observations, or at risk behaviors that are believed to be significant" to the Laboratory Director. There is no reference to the use of the SLAC action tracking system tool (CATS).

- Recently issued directorate ISEMS "self-assessments" for the nine-month period ending June 30, 2006, were primarily summary descriptions of various measures and activities. They provided no additional assessment or analysis and resulted in no conclusions or findings.

Many of the above-listed weaknesses and deficiencies in process details are exacerbated by the lack of a SLAC procedure and document control management system. (See Findings C-1 and C-2.)

FINDING #D-5. SLAC has not established a program of effective assessment and activity-level feedback activities with sufficient scope and rigor to ensure that ES&H performance at all levels and in all organizations is consistently and accurately evaluated, as required by DOE Order 226.1, *Implementation of DOE Oversight Policy*.

Management of Safety Issues. The ISEMS and Assurance Program Descriptions describe CATS as the SLAC comprehensive issues management system to track issues, deficiencies, follow-up actions, and opportunities for improvement from all forms of assessment. CATS was established in October 2005 to replace a previous institutional action tracking tool, replace multiple tracking systems maintained by line organizations, and provide a central repository to facilitate monitoring performance and trending. Deficiencies that are not corrected on the spot are required to be entered into CATS. CATS is a web-based system that facilitates use by the line and provides value to supervision and management. At the time of this inspection, over 500 issues had been logged into CATS from approximately 50 assessments, including some open issues from earlier assessments. A user's manual for CATS provides some guidance on classifying issues and entering and manipulating data, the ISEMS Program Description discusses some attributes of issues management, and the requirement for using CATS for tracking correction of safety issues is referred to in various SLAC documents.

Although CATS is a useful tool for tracking corrective actions for safety issues, SLAC has not established a formal issues management process or procedure that comprehensively describes the roles, responsibilities, and authorities and process steps for managing safety issues. There are inconsistencies and inaccuracies in the CATS users manual, important elements of effective issues management processes are not in place, and data entry into CATS has been inconsistent and improper. Further, management of issues at SLAC almost always focuses on mitigating the specific circumstances or deficiency without sufficient identification and implementation of recurrence controls. Examples of weaknesses and deficiencies in the management process for safety issues at SLAC include:

- At the time of this Independent Oversight inspection, a superseded version of the CATS user's manual was posted on the CATS website that reflected inconsistencies with actual practice, including hazard level designations. The latest revision of the manual was subsequently posted to the web site and a revision control process put in place.

- The CATS tracking tool does not address essential elements of issues management, such as extent of condition or causes.

- The basis for input to CATS is assessments, not issues, fostering an attitude that only deficiencies identified by formal assessment efforts need be actively managed in the institutional system.

- Each "issue" gets one CATS entry but there is only one set of fields for associated corrective actions. More complex issues, especially ORPS or Price-Anderson Amendments Act issues, that are now required to be tracked in CATS may have many corrective actions, with different responsible individuals and action due dates.

- The "Hazard Level" classification is insufficiently addressed in the CATS users' guidance and is inconsistently and incorrectly recorded for many issues now documented in CATS. Many issues that are deficiencies have been categorized as "Level 0," designated in the user's manual as a best practice, defined as "an activity or procedure that has produced outstanding results." No classification level is specified for the recommendations or opportunities for improvement that constitute many of the items tracked in CATS. However, there is no uniform definition or consistent use of terminology for describing issues in either assessments or corrective action programs at SLAC, which can impede the consistent and appropriate application of the graded approach to management of issues.

- The use of the "description" and "corrective action" fields are inadequately defined in the user's manual and are incorrectly completed in the CATS database. Typically, the description of the issue is either not identified or is placed in the corrective action field. In many cases, the corrective actions are listed in the "description" field.

- Specified corrective actions often lack sufficient clarity or specificity and are often stated as an objective, without specifying methods for accomplishing the improvement, verifying effectiveness, or institutionalizing the methods to ensure continued performance. Actions often do not adequately provide adequate recurrence controls.

- SLAC has no defined process or protocol for managing issues from SSO (e.g., who is responsible for identifying and entering issues into CATS, or who is responsible for responding to SSO concerns).

- Most SLAC organizations have not consistently used CATS to track the resolution of safety deficiencies. Before the new compliance workspace inspections conducted in the last month, safety inspection walkdown deficiencies were not tracked in either local tracking systems or CATS in FY 2005 or 2006. Eight findings from an Oak Ridge assessment of lockout/tagout issued in May 2006 were not in CATS. Directorate management and personnel expressed a reluctance to use CATS based on their experience with previous tracking systems; this situation indicates that communication of management expectations and system function for the new tool may have been insufficient.

- Although individual abatement actions have been taken for all but one of the approximately 2000 individual findings identified during the February 2004 Occupational Safety and Health Administration (OSHA) assessment, the collective set of issues (with the exception of electrical safety issues) was not formally analyzed for extent of condition, and recurrence controls were not identified as part of the abatement process. The importance of an analysis for extent of condition in this case is more significant because the accelerator was operating during the inspection, limiting the inspectors' access in many areas. Although a significant number of deficiencies related to OSHA requirements were identified during this inspection, no formal evaluation of the processes, quality, or effectiveness of building manager and line management walkthroughs was conducted. Large numbers of electrical safety, hoisting and rigging, and procedure and personal protective equipment adherence issues were identified during the OSHA inspection (areas that continue to be problematic at SLAC).

Additional deficiencies in the management of safety issues are discussed in the following sections on occupational injury and illness investigations and occurrence/incident reporting.

FINDING #D-6. SLAC has not established an effective issues management program that ensures that safety deficiencies are appropriately documented, rigorously categorized, and evaluated in a timely manner, with root causes and extent of condition accurately identified, and appropriate recurrence controls identified, as required by DOE Order 226.1, *Implementation of DOE Oversight Policy*.

Injury and Illness Investigation and Prevention. SLAC's record for OSHA TRC and DART rates have generally reflected an improving trend over the past five years and are near the average for SC sites. However, these rates have been on an uptrend since the third quarter of 2005, prompting requests for corrective action from the Under Secretary for Science in December 2005 and again in July 2006.

One of SLAC's major actions to respond to these concerns was Laboratory-wide injury prevention talks conducted in May 2006 within each work group. These discussions included presentation of basic materials on safety and communication of recent performance data, management expectations, and safety tips. Subsequent discussions with workers focused on identifying suggestions for decreasing the chance of injury when performing their work tasks. Ideas resulting from these talks were summarized and published in the site online newsletter. Some sitewide actions were initiated and are currently under review by the Operating Safety Committee, including the establishment of lifting limits.

Reporting and management requirements for occupational injuries and illnesses are described in various documents, primarily as part of ES&H Manual Chapter 28, Incident Investigation. Other requirements and process steps are contained in ES&H Manual Chapter 3, Medical, a Workers' Compensation Procedures Manual, and ES&H and Human Resources intranet sites. Information on these websites includes checklists, forms, and various tools titled as guidelines, procedures, requirements, and flowcharts. The September 2006 revision to Chapter 28 of the ES&H Manual significantly strengthened the expectations and processes for incident investigation, including the management of occupational injuries and illnesses.

Occupational injuries and illnesses are investigated using a graded approach based on severity. For all injuries and illnesses, workers document the accident on a form (the SU-17 form) provided to the worker by the Medical department at the time they are treated or when they notify Medical of offsite treatment. The worker's supervisor documents an initial investigation of what happened, why it happened, and what actions were and remain to be taken on the back of this form. The Medical department makes the determination of OSHA recordability and communicates the classification to the workers' compensation administrator in Human Resources, either verbally, by electronic mail, or by marking side one of the SU-17 form. The workers' compensation administrator is responsible for recording and reporting injuries in accordance with the DOE Computerized Accident/Incident Reporting System (CAIRS) and OSHA reporting requirements. For most injuries and illnesses classified as first aid cases by the Medical department, no further investigation is performed. The incident investigation program manager in the ES&H Division identifies first-aid cases that require further investigation based on the potential lesson-learned value of the circumstances. All OSHA recordable injuries and illnesses are subjected to further investigation by a trained person designated as a "competent incident investigator."

Although SLAC has recently made significant improvements in its processes for managing occupational injuries and illnesses, these processes continue to reflect unclear, undefined, or inappropriate process steps and requirements. Further, although injuries and illnesses are documented and investigated by supervisors and incident investigators, many injury and illness investigations, conducted both before and after process improvements, are not sufficiently rigorous to address work control and ISM elements and accurately identify causes. In addition, corrective actions often do not adequately address causes, extent of condition, or recurrence controls. Examples of occupational injury and illness process and control deficiencies include:

- The roles, responsibilities, authorities, and process steps for managing occupational injuries and illnesses are fragmented, incomplete, and inconsistent. For example, ES&H Manual Chapter 28 does not specify actions to take when ES&H deems that additional investigation of first aid cases is warranted; there is no assignment of responsibility for reporting to CAIRS; entering action items into CATS is not specified in the attachment describing investigation requirements; and there are numerous discrepancies in the various attached procedures for first aid and recordable injury investigations. Process steps specify that corrective actions are to be put into CATS before they have been approved and do not specify authorities for signing and approving investigation reports; these steps are not consistently performed (also see Finding C-1).

- There are inadequate process steps, formality, and controls for the determination of OSHA recordability. The ES&H Manual chapter does not adequately specify the responsibility for making the recordability decision, stating that the "severity" of the injury is to be determined by Medical or the fire department, depending on circumstances. The documents describing first aid and OSHA recordable investigations referenced in the ES&H Manual specifies that Medical makes the "initial" determination, but does not identify the methods for documenting this determination or any subsequent approval or review. The processes for coordination between the workers' compensation administrator in Human Resources and the clinic doctor are not adequately defined or implemented, and communication on classification is often informal. No clinic visit reports that identify the treatment given, which determine the recordability of an injury/illness, are provided to the CAIRS/workers' compensation administrator to allow confirmation of data being input to CAIRS. Notifications of subsequent visits to Medical by injured or exposed workers are also not reported to the CAIRS administrator by the Medical department unless they determine that the subsequent treatment meets OSHA requirements for recordability.

- The controls and instructions for documenting the "competent investigator" investigations are inadequate. The instructions for completing the incident investigation form do not address all blocks on the form, including treatment given, signatures by investigators and approvers, final management review, event type, and cause coding. The designation of the location of the accident and the organization of the injured worker or of the work area is not clearly defined or annotated on the completed reports.

- Communication of essential injury and illness investigation information between the Medical department and the ES&H Division has been inadequate. Although the ES&H Manual notification requirements specify that the Medical department must notify the ES&H Division incident investigation program manager of first-aid injuries, it is silent on recordable injuries. The ES&H Division is responsible for ensuring that additional investigations are performed for all OSHA recordable injuries/illnesses and selected first-aid cases, but until late October 2006, the portion of the SU-17 forms (i.e., "side 2") that contained the supervisors investigation details needed to make those decisions were not provided to ES&H Division personnel.

- There are no requirements for any line management or support organization to review or approve the completed SU-17 form verifying the accuracy of the information or the adequacy of the causal analysis or corrective/preventive actions identified by the supervisor.

- Although the incident investigation form requires documenting whether a job hazards analysis and mitigation (JHAM) was applicable to the work being performed and requires obtaining a copy, there is no requirement to perform any evaluation of this information.

- Determining the extent of conditions that may have caused the injury or illness in order to establish appropriate recurrence controls is not required by the various documents governing injury and illness investigations.

Independent Oversight's review of a sample of occupational injury and illness case files revealed that investigation and management of occupational injuries and illnesses were inadequate to identify and address root causes to prevent recurrence. Causal analyses on the accident investigation reports completed by supervisors and by certified incident investigators were often inadequate. Most of the investigations failed to address work control and issues management elements of ISM in determining the causes of the injury or illness. Specifically, investigation reports did not identify whether the JHAM, AHA, or other work documents adequately identified hazards and controls and did not identify the worker's training status. The determination of the extent of condition was not addressed in any of the cases reviewed. Causal analyses frequently failed to accurately identify root causes. The investigator's determination of needed actions was also frequently inadequate. Specified corrective actions typically addressed only the affected employee or the location where the incident occurred, rather than the processes that failed, and did not provide adequate recurrence controls by addressing root causes or the extent of the condition. In many cases, the causal analysis checklist blocks were not marked on the extended investigation forms. Incident investigation reports often had no signatures from the injured worker or the supervisor, and none of the forms that were reviewed had a signed management review block.

An example illustrating these deficiencies was a May 2006 first-aid case where a worker was exposed to carbon monoxide. As described by the worker on the SU-17 form, he had responded to a carbon monoxide alarm in a room adjacent to where he was working and noted that the monitor was reading 279 parts per million (ppm). It took him almost ten minutes to reset the alarm, at which point it was still "reading high." He then returned to the room where he had been working and noted that the carbon monoxide monitor in that room was reading 112 ppm. The worker subsequently experienced symptoms (a severe headache, nausea, and numbness of the tongue) and reported to Medical. The supervisor's investigation report on the SU-17 form indicated that the exposure event occurred because someone had left a car running outside the building near the air conditioning inlet and the carbon monoxide was sucked into three rooms, including the rooms where the employee had been working and where he responded to the alarm. The supervisor's report indicated, in the block entitled "what should have been done," that carbon monoxide monitors had been installed in these two rooms (but not an adjacent third room), that the monitoring system and alarm had potentially saved a life, that the car should not have been left running for 30 minutes, and that the car should be smog checked. The supervisor noted that in the corrective action block that no corrective action was to be taken, reiterating that the site had anticipated having carbon monoxide in the room from outside traffic and had installed an alarm system that functioned properly and possibly saved a life. The SU-17 accident report failed to address the worker's lack of recognition of the significant danger of carbon monoxide and his inappropriate response to the carbon monoxide alarm (i.e., entering a room with an alarm, attempting to reset an alarm with a reading over the National Institute for Occupational Safety and Health ceiling level of 200 ppm, and returning to another room subject to induction of carbon monoxide rather than evacuating). Further, the report did not address whether the other two workers noted in the area and other workers were evacuated, why the monitor in the room where the exposed worker was working did not alarm with a reading over four times the OSHA threshold limit value of 25 ppm for eight hours (i.e., was it set properly?), the inadequacy of previous corrective actions to install monitors rather than relocate the air conditioning intake or restrict parking in the area, or why no monitor and alarm were installed in a third room. The report identified no actions to prevent a repeat of this event.

A more formal line management investigation of this event also failed to address the inappropriate worker response to the event, the unmonitored room, the monitor setting or failure to alarm in the worker's room, or the inadequate original controls for this known hazard. The incident report identified three corrective actions, including installing a sign for drivers to turn cars off, evaluating all air conditioning intakes near buildings, and counseling the driver. However, the only action taken was counseling the driver; the other corrective actions have not been addressed and are not being tracked. Industrial hygiene personnel were not involved in evaluating this event. This report was not identified as a close call and was not reported through the ORPS Facility Manager process for consideration of reportability to DOE.

FINDING #D-7. SLAC has not established a rigorous and effective program for investigation of incidents, occurrences, and events, including occupational injuries and illnesses, to ensure that incident causes are identified and that appropriate and effective corrective and preventive actions are identified and implemented, as required by DOE Order 226.1, *Implementation of DOE Oversight Policy*.

Occurrence Investigation and Reporting. SLAC's incident investigation processes also address events reportable to ORPS. Requirements, including roles, responsibilities, authorities, and process steps for managing potentially reportable events, are contained in a variety of documents, including ES&H Manual Chapter 28 and documents located on an Operations Directorate occurrence reporting program website, such as a Workbook for Occurrence Reporting. Other sources of requirements include desk instructions for ORPS program managers and staff, an unsigned set of "Guidelines for Findings of Investigative Reports" last revised in August 2005, various unsigned and uncontrolled procedures for notifying DOE of events, and recently issued Operations Directorate documents defining the ORPS program manager's role and summarizing the ORPS process. Before the September 2006 issuance of revised Chapter 28, there were few process instructions or requirements in the ES&H Manual for occurrence reporting. Chapter 28 now requires classification of events by the ORPS Facility Manager, investigation of reportable events by ORPS incident investigators, tracking of corrective actions in CATS, and documentation of the events in a log maintained by the ORPS Facility Manager's office. This log lists all events reported through the ORPS Facility Manager's office whether subsequently determined to be reportable or not, and includes corrective actions and the scheduled and actual completion dates. SLAC appropriately emphasizes lower-threshold, non-ORPS-reportable events with a program for reporting and investigation of "close calls" and near misses described in the revised ES&H Manual Chapter 28. These incidents are reported, logged by the ES&H Division in a database for trending and tracking, and formally investigated, with identification of causes and corrective and preventive actions.

Deficiencies, similar to those described above for injury and illness investigation and reports, impede the occurrence reporting program's effectiveness. Processes are informal and poorly defined, and implementation is inadequate and inconsistent (see Finding C-1). Incident and occurrence reporting process deficiencies include the following examples (see Finding D-7):

- Process steps used by SLAC to manage events that may be reportable through ORPS are fragmented in various documents, mostly uncontrolled, including website instructions/guidance, historical precedence, and verbal management expectations. The Workbook for Occurrence Reporting, which consists of excerpts from DOE Manual 231.1 with three inserted references to attached SLAC internal initial notification processes and forms, does not provide process steps for managing reportable occurrences. Action steps for ORPS management in ES&H Manual Chapter 28 on incident investigation are insufficiently detailed and are interspersed throughout many other actions for non-ORPS incidents that are administered by others.

- The delegation of responsibility for conducting investigations of some non-ORPS-reportable events is not documented, and subsequent monitoring and oversight of the investigations by the ORPS program manager or SLAC ORPS Facility Manager are insufficient. Some non-ORPS-reportable investigation reports were not on file in the ORPS program manager's institutional records. ORPS program quality reviews of the adequacy of investigation reports or corrective action plans are not documented and lack sufficient rigor to ensure adequacy. Tracking of corrective actions and tracking methods for incidents reported through the ORPS Facility Manager process and determined to be not reportable have also been delegated to the line or support organization conducting the investigation. No actions were identified or tracked on the occurrence report log for 6 of 11 reportable occurrences (all ORPS significance category 4) and 11 of 15 non-reportable events in calendar year (CY) 2005 and CY 2006. There are no requirements to verify completion of corrective actions by ORPS program personnel or to validate their effectiveness. Although evaluations likely were conducted and corrective actions were identified and acted upon, the ORPS program lacks the needed structure (i.e., formality, consistent requirements, clearly defined process action steps, and clear roles, responsibilities, and authorities) and controls (i.e., records, quality reviews, action verification and validation) to ensure that requirements and management expectations are met and that similar events are prevented through effective recurrence controls.

- The distinction between reporting incidents through the ORPS Facility Manager process or through the "close calls/near misses" report to ES&H is not clear, and the two processes are not consistently used as specified in SLAC documents. For instance, three of six 2006 events reported through the ORPS Facility Manager process were determined to be non-reportable events that met the SLAC definition of a close call, but they were not logged or evaluated through that program. Likewise, several events were tracked on the close-call log, including falling metal ceiling panels and support brackets in the Plating Shop in 2005 and a scissor lift dropped from a forklift in 2006. There was no formal documentation of an evaluation for ORPS reportability.

- A variety of methods are used to document ORPS investigations, including two forms that have different fields and data/investigation elements. One form, from ES&H Manual Chapter 28, is referenced and typically used by ES&H-directed investigations, and the other, for reportable ORPS events, is provided as a template on the ORPS webpage. In some cases, neither form is used.

The Independent Oversight team reviewed a sample of records for 2005 and 2006 events that had been screened for ORPS reportability and identified the following deficiencies (see Finding D-7):

- Investigation reports did not evaluate the extent of condition; inadequately described or evaluated work conditions, especially with regard to work planning elements of ISM; and did not accurately or completely identify causes. Corrective actions focused on addressing direct causes, did not include sufficient recurrence controls, and often lacked specificity on methods for accomplishing actions and objectives.

- Objective evidence of completed actions was not consistently obtained or retained by the ORPS program management system.

- Several recent events appear to have met the reporting requirements of DOE Manual 231.1 but were not reported to ORPS. Examples include a June 2005 event where heavy metal ceiling panels fell in the building 25 Plating Shop, the carbon monoxide exposure discussed above, and a May 2006 penetration of pressurized fire protection line without proper lockout/tagout. These events appear to meet the requirement for reporting as management concerns or issues under Group 10, for a near miss where no barrier or only one barrier prevented an event from being a reportable occurrence. The latter two events should have received heightened management concern, considering the previous electrical safety and lockout/tagout issues and corrective actions. In addition, an inadequate response to radiological monitoring for the thoriated welding electrode contamination event in May 2006 may have precluded an appropriate determination of whether reporting requirements were met. (See Appendix C.)

The investigation of the ORPS reported accidental natural gas line penetration discovered during the removal of a subcontractor canopy tent stake in August 2005 exemplifies these implementation weaknesses. This investigation did not include sufficient analysis of root and contributing causes, and it provided incomplete and unspecific corrective actions and inadequate recurrence controls. The investigation report for this reportable event was not on file in the ORPS program manager's files, and the occurrence reporting log was annotated "Internal investigation will be completed—no further investigation required by the Facility Manager." No corrective actions were identified or tracked in the log. The report failed to identify a specific root cause, and the findings and corrective actions lacked sufficient specificity. For instance, for a finding on the failure to follow procedures, the action was that "In all instances a physical utility line survey is to be performed, and known utilities marked, prior to initiating excavation." However, this was already a requirement and was specified on the excavation permit issued for the tent installation. For a finding on a failure to check or monitor the activity, the action was that "The University Technical Representative should be required to be present when the high-risk activities of tent stake driving is performed in the future." These are objectives rather than actions and do not identify how the objectives are to be achieved.

Examples of implementation weaknesses/deficiencies noted in a sample of 2005 and 2006 close call/near miss investigation reports included the following (see Finding D-7):

- Close call investigations inadequately addressed such elements as extent of condition, root causes, and ISM elements. Recurrence controls and corrective actions were often insufficiently defined and not formally tracked to resolution. Each of a sample of 12 items listed in the close call tracking log exhibited one or more of these deficiencies. For example, the analysis of an event where metal ceiling panels and a support bracket fell in the Plating Shop did not address the lack of untimely and inadequate resolution of previous failed ceiling panels three years earlier. The analysis did not address the failure to provide a formal structural engineering evaluation on structural adequacy for continued operation after the previous event, compensatory measures for working under these panels, or the extended delays in repairing the failing ceiling panels. Also not adequately evaluated were the rationale for and adequacy of a decision, made by facility management one month before the latest ceiling panels fell, to require workers in this room to wear hard hats.

- For some items on the close-call log, no investigation reports or any additional information regarding corrective or preventive actions could be located. Such items included a 50-gallon acid spill and a case where a vehicle gas tank was punctured by an employee.

Operating Experience/Lessons Learned. The SLAC lessons-learned program has recently undergone significant overhaul and strengthening. The processes and expectations for lessons learned are contained on a SLAC intranet webpage that has links to current SLAC lessons learned, the DOE lessons-learned website, selected DOE lessons learned that may be applicable to SLAC, and postings of selected lessons learned from outside the DOE complex. The SLAC lessons-learned database is a user-friendly source of local and complex-wide lessons learned. External lessons learned are screened at the institutional level and distributed. Internal lessons learned are generated, disseminated, and posted to the SLAC lessons-learned website by the SLAC lessons-learned program manager, and lessons are incorporated into work activities. The Operations Directorate publishes a summary of lessons learned from directorate recordable injuries each quarter and the ORPS Program Manager publishes a summary of DOE-wide ORPS reports semi-annually and sends it to supervisors, managers, and ES&H coordinators. Independent Oversight observations of work documents, safety committee meetings, and various documents reflect the review and application of lessons learned. An extensive post-modification safety review was performed after 2004 upgrade work on BaBar, and lessons learned from that review were incorporated into the current major project modification effort.

Although lessons learned are being identified, disseminated, and applied, the implementation of the program lacks sufficient rigor and documentation to demonstrate the extent or adequacy of screening, evaluation, and application of pertinent lessons learned. There is no requirement for documentation of applicability and technical reviews by functional area subject matter experts at the institutional level and by line organizations, and no evidence of actions deemed necessary and actions taken. Although much useful information and process steps are provided on the lessons-learned intranet website, there is no formal, controlled SLAC procedure delineating the requirements, expectations, and process steps for implementing the lessons-learned program, and there are no directorate, division, or department-level implementing procedures or instructions. Further, the postings of lessons learned to the SLAC website has been limited. Eleven internal lessons were posted in CY 2004, three in CY 2005, and six to date in CY 2006. Only nine lessons from other DOE sites have been posted since December 2005. Sharing of SLAC lessons learned with the rest of the DOE complex through submittal to the DOE database has also been limited, with two posted in 2004 and one each in 2005 and 2006. In addition, there was no evidence of review, dissemination, or action for recent DOE operating experience documents that identify hazards and events that exist or could occur at SLAC. For example, Safety Bulletins during 2006 on natural gas line breaks and hexavalent chromium exposures from welding, an October 2005 Safety Alert on untested compressed gas cylinders, and Special Operations Reports on electrical safety in August 2006 and Laser Safety in 2005 were not posted to the lessons-learned website. However, many DOE Operating Experience summaries and the Special Operations Report on Electrical Safety have been forwarded to all ES&H coordinators and selected managers.

Employee Concerns. Numerous means are provided for SLAC workers to communicate safety concerns and obtain resolution. Available methods include a hotline maintained by the ES&H Division, the ES&H Service/Support Desk phone line, ES&H functional area subject matter experts, and the Human Resources Department. Service/Support Desk calls, which include requests for routine ES&H services, are logged onto an intranet-based database for identifying dispositions. An intranet website describes these means to express worker concerns. Concerns reported to the ES&H hotline and the Service/Support Desk appear to receive timely and appropriate attention. Concerns may also be addressed to the Operating Safety Committee and to the Local Safety Committee (discussed in the following section).

Independent Oversight's review indicates no evidence that resolutions for concerns were significantly deficient or that concerned individuals were not treated fairly or were discouraged or unsatisfied with the resolutions. However, employee concerns processes are not well defined or established in controlled documents, and the documentation of the details of the concerns, analysis/investigation, and disposition does not show consistent and sufficient formality and rigor. Human Resources instructions are limited to uncontrolled checklists and higher-level Stanford University policies and procedures. There are no expectations for collecting or recording supporting documentation or case file contents, granting and maintaining anonymity or confidentiality, communicating final resolution to the concerned individual, or transferring or referring concerns from SSO or associated protocols and processes. The responsibilities for managing all elements of concerns made or directed to Human Resources are not adequately defined in that technical aspects are referred to and managed by other organizations, with no overall control and oversight by Human Resources, and the associated documentation is fragmented. The ES&H Division hotline records and Service/Support Desk logs do not always fully describe the concerns or adequately reflect final resolutions.

Other Feedback and Improvement Processes. Various peer reviews and over a dozen active, chartered safety-related committees provide additional avenues for communication and feedback among researchers, workers, management and ES&H subject matter experts that result in safety improvements for conditions, processes, and activities for SLAC projects and operations. "Citizen" committees are formed around specific technical areas, such as earthquake safety, electrical safety, and hoisting and rigging. A Safety Overview Committee, consisting of the chairs of the technical committees, meets to review new projects to determine the specific technical committees that must conduct more detailed reviews of safety elements of the projects.

Institutional committees include the Operating Safety Committee, the ES&H Coordinating Council, and local safety committees. The Operating Safety Committee, made up of representatives from all directorates and various ES&H subject matter experts, identifies, analyzes, and proposes solutions to all hazardous situations except for issues addressed by specific technical-area citizen committees. In addition, any employee can bring safety matters to the attention of the committee for evaluation and resolution. This committee also serves to augment ordinary line-management communication channels between ES&H and workers through the promotion of various safety awareness programs and presentations. The ES&H Coordinating Council, composed of senior managers from each directorate, formulates and recommends, to the Director, Laboratory policies with regard to ES&H and continually reviews the status of the ES&H program in the Laboratory to keep the associate directors informed. For example, revisions to the ES&H Manual are reviewed and approved by this council. The Local Safety Committee, with bargaining unit members and SLAC management, meets monthly to address various safety issues identified by the union, new ES&H requirements (such as revisions to the ES&H Manual), and injuries to bargaining unit workers.

SLAC Activity-Level Feedback and Improvement Processes. Activity-level feedback and improvement processes (e.g., pre-job briefs, post-job briefs, and plan-of-the-day meetings) are an important part of a work planning and control process. However, as discussed in Appendix C, SLAC does not have a structured work planning and control process and thus lacks an adequate set of activity-level feedback and improvement processes defined in their work control process. In the absence of an adequate institutional process, establishment and implementation of feedback and improvement mechanisms at the activity level are largely left to the discretion of lower-tier organizations (e.g., directorates, divisions, groups) and individual managers. Management for all of the organizations has set high-level expectations for collecting input from workers and work activities, and some formal or informal feedback activities have been performed by all of the organizations. However, these organizations have not established a structured system, with defined responsibilities, documented processes, criteria, and frequencies for various activities, or fully effective mechanisms for collecting activity-level feedback. As discussed in the following paragraphs, the activity-level feedback mechanisms for the SLAC organizations reviewed on this Independent Oversight inspection have been established and implemented with varying levels of rigor. (See Findings C-1, C-2, and D-5.)

SSRL has several feedback and improvement activities at the activity level for users and for other work in the facility (e.g., End of Run Summary Form for users, safety discussions, and management walkthroughs) and has used these processes to make improvements. For example, the Beam Line Program Manager and the Duty Operator are required to tour the experimental floor, stopping at each beam line to solicit questions, comments, complaints, and/or compliments from experimenters. These mechanisms ensure supervisor awareness and have a positive effect on facility safety and operation. However, overall activity-level continuous feedback and improvement effectiveness is limited by a lack of a comprehensive feedback and improvement system for specific activities, lack of specific expectations, and little documentation and trending. (See Findings C-1, C-2, and D-5.)

The Operations Directorate sets high-level expectations for activity-level feedback and improvement in its ISM Plan and CEF Conduct of Operations Manual for such activities as debriefings at the end of a job or project to apply lessons learned and regular and frequent staff meetings. However, for the most part, there are no defined responsibilities, no established frequencies, and no formal mechanisms to ensure that these activities are performed, and there are no requirements for documenting, tracking, or trending results. For CEF construction projects, a number of generally effective activity-level feedback processes are in place (e.g., debriefs at the end of subcontracted project). Issues and lessons learned are documented, and those that apply to ES&H have been appropriately addressed. However, these processes have identified few ES&H issues or lessons learned, did not identify the problems identified by the Independent Oversight team, and some aspects of the processes are not well documented. (See Findings C-1, C-2, and D-5.)

For construction activities at the LINAC Coherent Light Source, an extensive set of safety inspections is performed by the construction general contractor (safety and line managers) and SLAC (safety staff and University Technical Representatives). The frequency and scope are adequately defined and appropriate to identify ES&H deficiencies, and processes are in place to document deficiencies. Because construction work had been in progress for only about a month at the time of this inspection, there is limited performance data at this time. No formal process has been established for tracking corrective actions or analyzing recorded observations, and there is no formal process for post-job reviews to identify or apply lessons learned. (See Findings C-1, C-2, and D-5.)

D.3 Conclusions

SC. SC is making progress in defining its Headquarters management systems and processes and is actively involved in safety at SLAC and its other sites. However, progress has been slow, and many management system programs and supporting procedures have yet to be defined. In addition, SC has overall line management responsibility for ensuring the effectiveness of SSO line management oversight programs and the SLAC contractor assurance system, but there are significant deficiencies in these programs. Further, although SC efforts to provide a leadership role in driving improvements in TRC and DART rate performance at its sites have resulted in a general overall improving performance trend in worker safety performance at SLAC, SC has not taken sufficient action to ensure that SLAC injury and illness investigation processes are effective and that SSO performs sufficient oversight of SLAC injury and illness investigations. The newly appointed SC Chief Operations Officer is aware of the current weaknesses in SC, SSO, and SLAC feedback and improvement processes. While SC has some plans to address recognized weaknesses, increased SC attention is essential. SC needs to devote particular attention to ensuring that SSO and SLAC take a more comprehensive and balanced approach to establishing ES&H goals and priorities, applying their ES&H resources, and focusing their assessment and oversight efforts. SC's leadership has been successful in focusing SSO and SLAC on worker safety performance to include close monitoring and ongoing efforts to improve "lagging" indicators (i.e., measuring the number of undesired events that have already occurred) of worker safety performance (e.g., TRC and DART). SSO and SLAC have devoted particular attention to addressing some of the most frequent categories of worker injuries (e.g., slips, trips, and falls). In addition, the 2004 Type A accident and associated management attention led to additional focus on and improvements in various aspects of electrical safety (e.g., lockout/tagout and arc flash protection). However, SC needs to ensure that SSO and SLAC management is more proactive and adopts a broader perspective for managing the various types of hazards and risks at SLAC. For example, more emphasis is needed on ensuring that management systems (e.g., requirements management, work control processes, feedback and improvement processes) are effective. SSO and SLAC also need to devote more attention to monitoring and evaluating "leading" indicators (i.e., events that do not cause an injury but that constitute a "close call" or "near miss"). Proactive management efforts to ensure effective systems and to evaluate leading indicators is essential to preventing future accidents and events and recurrences of past problems, and for achieving the desired further reductions in worker injury and illnesses.

SSO. In the past two years, SSO has made some progress in strengthening its site office programs and processes for oversight of the contractor. In a few cases, SSO has appropriately used SC's Integrated Support Center services to provide subject matter expertise to support SSO assessments and surveillances. SSO has made progress in strengthening ES&H staffing, and most SSO ES&H personnel demonstrated an adequate understanding of their general ES&H roles, responsibilities, and authorities. Notwithstanding the recent progress, most of the processes are new and have not yet fully matured or been implemented. In addition, a number of key management systems and processes have yet to be defined to ensure that SSO has a functional line management oversight program, contributing to weaknesses in implementation of ES&H programs at SLAC. Some SSO staff did not understand key mechanisms and practices for ensuring the effective implementation of requirements management systems processes. In addition, a number of weaknesses in issues management and corrective action processes still remain. SSO has not placed sufficient management attention and priority on ensuring that DOE employee concerns program requirements are effectively implemented. Overall, the SSO program is not yet effective and warrants significant and timely management attention to address systemic deficiencies.

SLAC. SLAC has identified, described, and implemented various feedback and improvement mechanisms. Recent improvements include strengthening the assessment, incident management, and lessons-learned programs; establishing a new action tracking tool; and improving the feedback and improvement elements of the ES&H Manual. Assessment activities are performed, and in some cases issues are identified, deficiencies are corrected, investigations are conducted and actions taken when injuries and events occur, events are reported, safety concerns are addressed, and lessons learned are identified and applied.

However, each of the feedback and continuous improvement program elements evaluated by Independent Oversight reflected significant weaknesses that hinder an effective assurance system. Roles, responsibilities, authorities, management expectations, requirements, and detailed process steps have not been adequately defined or established in consolidated, controlled documents that facilitate effective implementation. Communication of these requirements and processes to individuals responsible for implementation has been insufficient. Implementation of feedback and continuous improvement program elements has not been rigorous or well documented, and processes lack control and oversight mechanisms to provide real-time performance feedback. The expectations for self-assessment are not challenging and do not adequately monitor and validate performance through structured and rigorous work observation and safety program and management system implementation, including documentation and records of safety activities. Significant weaknesses in the management of safety issues cut across all feedback and improvement areas. Investigations and corrective actions consistently focused on mitigating the specific circumstances or deficiency without sufficient identification of causes and identification and implementation of recurrence controls. Corrective actions often lack sufficient specificity to facilitate appropriate implementation, and formal tracking, verification of completion, and validation of effectiveness are lacking. The SLAC feedback and improvement processes have not been sufficiently effective to identify and correct the significant deficiencies in such areas as work planning and control and requirements management.

D.4 Ratings

SC and SSO Feedback and Continuous Improvement Processes................................SIGNIFICANT WEAKNESS
SLAC Feedback and Continuous Improvement Processes..SIGNIFICANT WEAKNESS

D.5 Opportunities for Improvement

This Independent Oversight inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

SC

1. **Increase SC management attention to and priority on establishing the SC Headquarters FRAM, and expedite the development of required management systems and processes and implementing mechanisms.** When established, perform a gap analysis of the SC FRAM by comparison to management systems, program descriptions, subject areas etc., under development in the SC Management System initiative to identify procedure and process gaps and enhancements to ongoing procedure upgrades.

2. **Strengthen SC Headquarters involvement in ensuring that SSO addresses identified deficiencies; provide or arrange for external technical and management support to provide external perspectives; help establish and implement site office management systems and processes; and provide needed skills on an interim basis while SSO establishes its site office processes.** Specific actions to consider include:

   - Provide on an interim basis selected dedicated resources from the Integrated Support Center, other SC site offices, and/or SC Headquarters to augment SSO staff support in key areas requiring priority and attention.

   - Coordinate the development of the SSO FRAM with SC Headquarters FRAM development efforts currently being led by the Integrated Support Center.

   - Establish a site office manager peer review process where outside experts (e.g., previous and current SC senior Headquarters managers and site office managers) visit SSO on a recurring basis to monitor and provide external perspectives on site office operations.

   - Require ES&H Division (SC-31.1), Integrated Support Center, and/or other SC site office staff participation in scheduled SSO internal self-assessments to provide independent perspectives on SSO internal processes and to facilitate the transfer of lessons learned from other SC Headquarters and site office operations.

   - Increase SC Headquarters involvement in monitoring SSO progress and holding SSO accountable for correcting recognized deficiencies in its oversight programs. Consider renegotiating or revising the current FY 2007 Annual Performance Plan to include more definitive performance measures and milestones that are targeted on areas requiring priority and attention.

3. **Strengthen SC management attention to and priority on ensuring that lessons learned in site office performance are appropriately addressed throughout the SC complex.** Specific actions to consider include:

   - Re-evaluate SC actions taken in response to the Argonne National Laboratory Independent Oversight inspection in May 2005 and this Independent Oversight inspection to determine lessons learned and identify any additional actions needed to ensure that similar deficiencies do not exist at other SC site offices.

   - Formally require SC site offices to periodically review the results of Independent Oversight inspections and other external reviews (e.g., Inspector General, Government Accountability Office) conducted at SC laboratory sites as part of site office self-assessment processes, and report back results and actions taken as part of SC Annual Performance Plans and Assessment Reports, in accordance with the SC Line Management Oversight Program Description document.

SSO

1. **Develop a comprehensive implementation plan that addresses all of the needed actions to fully address all SSO management systems and processes required to ensure that a framework for continuous improvement is established.** To this end, near term priorities should consider:

   - Develop a high-quality site office FRAM that provides the foundation and basis for development of SSO management systems and processes.

   - Expedite the development of internal management systems and processes and establish interface protocols with the contractor for managing requirements and ensuring that applicable requirements are in the contract and the Work Smart standards set.

   - Develop a comprehensive oversight plan and approach to near-term priorities that include focusing on evaluating and improving SLAC requirements management processes, including monitoring effectiveness of implementation of SLAC ES&H Manual Revisions; SLAC work planning and control implementation; and effectiveness of the contractor's assurance system.

   - Re-evaluate of use of Integrated Support Center services to focus priority support on developing site office management systems and processes in order to minimize the impact on SSO's limited resources for performing operational awareness activities.

2. **Increase SSO management priority and attention to establishing a site office FRAM.** Specific actions to consider include:

   - Use approved FRAMs from other DOE site offices, including the National Nuclear Security Administration, as models to create an SSO-specific FRAM (adapting as appropriate) in order to save time and capitalize on lessons learned from other DOE organizations.

   - Ensure that the SSO FRAM clearly identifies all delegated functions and authorities given to SSO and clearly assigns organizational and individual responsibilities for their accomplishment, including organizational interfaces (e.g., SC Headquarters, SC Integrated Support Center, and SSO group leaders). Ensure that the SSO FRAM addresses oversight requirements (e.g., products and actions) that need to be performed.

   - When available, perform a gap analysis of the SSO FRAM by comparison to existing SSO management systems and processes to identify procedure and process gaps and enhancements to ongoing procedure upgrades.

3. **Strengthen SSO performance and management involvement in line management oversight activities.** Specific actions to consider include:

   - Set minimum expectations/goals for the number of formal walkthroughs and surveillances of work activities to be performed in a given time period. Set up internal tracking and reporting mechanisms to track completion of completed operational awareness activities to established goals.

   - Target scheduling of SSO operational awareness activities, including functional area assessments performed by the Integrated Support Center for SSO, to verify effective flowdown of ES&H requirements from SLAC ES&H Manual revisions. Ensure that all functional area reviews include a sample of appropriate contractor corrective actions for follow-up and evaluation of effectiveness, and evaluation of the Laboratory's self-assessment program as an integral part of the scope of the area being reviewed.

   - Formally schedule SSO direct observation of selected Laboratory self-assessments (e.g., management assessments), with formal SSO reports developed and issued to the Laboratory critiquing the rigor, depth, breath of the Laboratory's self-assessment.

   - Increase the rigor and effectiveness of functional area review activities by establishing expectations for development and supervisory/ SSO review of formal written evaluation plans as part of the functional area review process. Ensure that all operational awareness activities, to the maximum extent possible, specifically address observation of actual work as part of assessment activities.

4. **Strengthen SSO processes and oversight activities for formal documentation, communication, and tracking resolution of SLAC performance deficiencies identified through SSO operational awareness activities.** Specific actions to consider include:

   - Ensure that expectations for documenting and reporting SSO activities for verification and closure of effectiveness of Laboratory actions to address ORPS and deficiencies/findings from *all* operational awareness activities are clearly and consistently established in SSO procedures, and captured in tracking systems so that they are readily identifiable and retrievable.

   - Re-evaluate all informal and formal existing reporting mechanisms within SSO and SLAC, and ensure that performance information is appropriately captured and effectively and formally communicated to both SSO and SLAC management.

   - Ensure that interface protocols with the Laboratory are clearly defined and integrated into SSO procedures and processes to formally communicate operational awareness activity results, and to request root causes analysis and corrective action plans for significant performance concerns. Resolve the longstanding issue concerning access to CATS. Develop a mechanism for routinely reporting and updating SSO management on the status of actions regarding operational awareness activities.

   - Develop a checklist for SSO staff to use when reviewing corrective action plan submittals and incident investigations that address key elements of issues management (e.g., extent of condition, root cause analysis) to ensure the consistency, quality, and completeness of SSO staff reviews.

SLAC

1. **Strengthen the self-assessment program to ensure that safety programs, processes, and performance are being appropriately and rigorously evaluated.** Specific actions to consider include:

   - Establish a program owner for the SLAC self-assessment program with the management support and formal responsibility and authority to monitor effective implementation.

   - Develop formal process documents that establish roles, responsibilities, and authorities and step-by-step instructions on implementing self-assessment activities. Preferably, this would be one procedure that integrates all elements of self-assessment: line, program, independent, and institutional management assessments.

   - Strengthen line self-assessment programs by requiring formal, scheduled, periodic assessments of internal processes and performance in safety functional areas and management systems implementation. Assessment area selection and frequency should be based on a graded analysis of such factors as the type of activities performed, the hazards involved, past performance, and management discretion.

   - Expand the scope of ES&H program reviews to evaluate implementation. Reinforce the ownership responsibilities for ES&H programs by ensuring that program reviews are led by the program owner even if teams or external parties are used to conduct the assessments.

   - Increase the rigor and formality of assessment activities. Where practical, formally plan assessments by identifying requirements and establishing lines of inquiry. Focus the self-assessment elements on performance and implementation against requirements—both internal (e.g., site procedures and management expectations) and external (e.g., DOE and regulatory entities). Assessments should focus on evaluating the quality and rigor of what is being done, as well as compliance with requirements.

- Develop mandatory training on self-assessment processes and on the tools and techniques of effective assessment. Consider engaging proven, effective, external expertise to provide training and mentoring. Ensure that trainers and training materials demonstrate effectiveness.

- Establish requirements and mechanisms within assessing organizations to review and approve the quality and content of self-assessments. Establish a formal assessment review/grading function by the institutional assessment program owner to provide feedback on the quality of assessments.

- Prioritize the use of the resources of the Office of Assurance. Consider redirecting efforts and resources from conducting verifications of physical condition inspections to conducting performance-based assessments of ES&H programs or management systems. Reflect performance related to OSHA violations and the adequacy of physical condition inspections in an analysis of data for repetitive findings or identified during senior management and line management walkthroughs.

- Conduct focused, independent management system implementation reviews.

2. **Strengthen the issues management process and implementation to ensure the consistent capture, classification, analysis, and management of safety deficiencies to effective resolution.** Specific actions to consider include:

   - Develop a comprehensive procedure that details the full scope of a program for the management of all safety issues identified at SLAC, including the process steps for implementation. Ensure that this program includes such elements as consistent and well defined categories of issues (e.g., findings and observations), documentation and tracking regardless of the source, risk ranking, determining extent of condition, a graded causal analysis of all issues, development of effective corrective actions and recurrence controls, tracking to closure with formal change controls, verification of completion, risk-based validation of effectiveness, and trend analysis of issues and data.

   - Clarify current requirements to require corrective actions to be completed within specific time periods, depending on hazard levels, to ensure that actions are prompt and timely and include an analysis of hazards, risks, and resources. Address the use of compensatory measures for delayed actions.

   - Add a classification category in CATS for recommendations or opportunities for improvement.

   - Conduct training and communicate clear management expectations for full implementation of the issues management program. Include specific training and guidance on extent of condition, causal analysis, and development of corrective/preventive actions.

   - Establish responsibilities and authorities for oversight of issues management program implementation at the institutional level and within line and support organizations. Establish mechanisms for management review and approval and for monitoring and improvement of the quality of issues management documentation, at least until effective implementation has been established.

   - Conduct focused, independent management system implementation reviews.

3. **Strengthen the occupational injury and exposure investigation and reporting processes and implementation to ensure that potential precursor events are thoroughly documented and analyzed, with causes determined and appropriate preventive actions identified and implemented.** Specific actions to consider include:

   - Develop a comprehensive procedure that details the full scope of a program for the management of occupational injuries and illnesses that addresses the roles, responsibilities, authorities, and process action steps for all organizations to implement the program.

- Review and revise as appropriate the information in and referenced by ES&H Manual Chapter 28 for clarity and accuracy. Include a mechanism to document the ES&H incident investigation program manager's decisions for conducting "formal" investigations of first-aid cases.

- Establish a more formal mechanism for communicating and documenting the occurrence, treatment details, and OSHA recordability classification of occupational injuries to the CAIRS administrator and the ES&H incident investigation program manager. Include a process and mechanism for documenting and communicating return visits of first-aid cases to address possible OSHA recordability classification changes.

- Review and revise as necessary the SU-17 and "formal" incident investigation forms and associated instructions to ensure complete, clear, and accurate information. Provide guidance, instructions, and appropriate fields to evaluate the adequacy of work control processes and the elements of ISM as they may have contributed to the incident.

- Provide classroom training/workshops for all supervisors and managers on causal analysis and investigation techniques and tools. Expand the certified supervisor's training to include responsibilities and expectations for completing the investigation part of the SU-17 form.

- Review and strengthen the training and qualification process for "competent incident investigators" to ensure that injury and illness investigations are effective in accurately identifying root and contributing causes and establishing appropriate and effective corrective actions and recurrence controls.

- Establish a mechanism to ensure that corrective and preventive actions are approved by management, formally tracked to completion, and verified to be effective on a graded and sampling basis.

- Establish responsibilities and authorities for oversight of injury and illness investigation program implementation at the institutional level and within line and support organizations. Establish mechanisms for management review and approval of investigation reports and for institutional monitoring, feedback, and quality improvement of investigations and corrective and preventive actions.

- Conduct focused, independent management system implementation reviews.

4. **Strengthen the incident investigation and occurrence reporting program to ensure consistent and rigorous identification, categorization, and investigation of incidents and events and development of corrective and preventive actions**. Specific actions to consider include:

    - Develop a comprehensive procedure that details the full scope of a program for the management of reportable occurrences that addresses the roles, responsibilities, authorities, and process action steps for all organizations to implement the program. Resolve any conflicts or confusion about the processes and responsibilities for reporting, documentation, investigation, and management of "close calls" and near misses.

    - Establish a process for conducting formal critiques as a tool for gathering facts in support of incident and event investigations.

    - Combine the ES&H Manual's incident investigation form and the ORPS investigation form into one, with appropriate fields to address all types of events.

    - Review and strengthen the training and qualification process for ORPS incident investigators to ensure that event investigations are effective in accurately identifying root and contributing causes and establishing appropriate and effective corrective actions and recurrence controls.

    - Establish formal responsibilities and authorities for oversight of incident and occurrence investigation implementation at the institutional level and within line and support organizations. Establish mechanisms for management review and approval of investigation reports and for institutional monitoring, feedback, and quality improvement of investigations and corrective and preventive actions.

- Conduct focused, independent management system implementation reviews.

5. **Increase the rigor and formality of management of the employee concerns program.** Specific actions to consider include:

   - Develop comprehensive procedures for managing employee concerns in both the ES&H organization and Human Resources that address the roles, responsibilities, authorities, and process action steps for all organizations to implement the program. Establish defined requirements and process elements, such as the minimum levels of documentation for closure, contents of Human Resources program case files, objective evidence, interfaces with organizations assisting in investigations and with SSO, confidentiality, and communication of disposition to concerned individuals.
   - Conduct program self-assessments and focused, independent management system implementation reviews.

6. **Increase the rigor and formality of management of the lessons-learned program.** Specific actions to consider include:

   - Develop a formal process that delineates the roles, responsibilities, authorities, and process action steps to implement the SLAC lessons-learned program.
   - Establish a formal means to document and track subject matter expert and field organization evaluations of applicability and needed actions for external and internally generated lessons learned.
   - Conduct focused, independent management system implementation reviews.

APPENDIX E
MANAGEMENT OF SELECTED FOCUS AREAS

E.1 Introduction

The U.S. Department of Energy (DOE) Office of Independent Oversight inspection of environment, safety, and health (ES&H) programs at the Stanford Linear Accelerator Center (SLAC) included an evaluation of the effectiveness of the Office of Science (SC), Stanford Site Office (SSO), and SLAC in managing selected focus areas.

Based on previous DOE-wide assessment results, Independent Oversight identified a number of focus areas that warrant increased management attention because of performance problems at several sites. During the planning phase of each inspection, Independent Oversight selects applicable focus areas for review based on the site mission, activities, and past ES&H performance. In addition to providing feedback to SC, SSO, and SLAC, Independent Oversight uses the results of the review of the focus areas to gain DOE-wide perspectives on the effectiveness of DOE policy and programs. Such information is periodically analyzed and disseminated to appropriate DOE program offices, sites, and policy organizations.

The focus areas selected for the review of environmental management program activities at SLAC and discussed in this appendix are:

- Implementation of the site environmental management system (EMS) and pollution prevention programs (see Section E.2.1)

- Workplace monitoring of non-radiological hazards (see Section E.2.2).

The focus areas are not rated separately, but results of the review of the focus areas are considered in the evaluation of integrated safety management (ISM) elements in Appendices C and D, where applicable.

E.2 Results

E.2.1 Environmental Management System and Pollution Prevention Program

An executive order and DOE Order 450.1, *Environmental Protection Program*, required DOE sites to implement an EMS by December 31, 2005. Independent Oversight selected the EMS as a focus area for 2006 to provide feedback to DOE management on the effectiveness of implementation of the new EMS program by line organizations at DOE sites across the complex. For SLAC environmental management program activities, Independent Oversight evaluated the SSO program management and oversight for EMS activities, and the SLAC environmental compliance program and implementation of EMS at selected activities involved with operations, research, maintenance, and construction.

SSO. SSO has validated that SLAC's EMS meets the requirements of DOE Order 450.1. To evaluate the EMS, SSO reviewed the results of an Environmental Protection Agency Region IX review (requested by SLAC), and SSO conducted a review with the support of subject matter experts from the SC Integrated Service Center. With this information, SSO certified to SC in December 2005 that SLAC had established an EMS, as required.

As part of the validation and certification process, in January 2006 SSO requested updates from SLAC on five areas requiring improvements. For example, one improvement was to update the University Technical Representative training manual to include EMS and incorporate pollution prevention into SLAC construction and services contracts. These areas are consistent with concerns that were identified during this Independent Oversight inspection. The five areas are being adequately tracked by SSO. SSO has designated a competent staff member to serve as the lead for EMS; this individual is actively engaged with SLAC environmental management and staff to ensure that the concerns are addressed.

SLAC. SLAC has established an institutional EMS within their ISM program and received certification from SSO. To establish an EMS, SLAC used a committee that included both line and environmental protection staff members, which resulted in an EMS that is accepted and supported by the line and environmental support organizations. To facilitate continued implementation, an EMS coordinator position was established within the Environmental Protection Department. As part of EMS and as required by DOE Order 450.1, the committee identified and risk-ranked significant environmental aspects. In addressing the ten currently identified “significant aspects,” SLAC has developed an environmental management program for each aspect that assigns a responsible person, states the objective and target, provides a strategy for achieving the object, and defines actions to achieve the object with target dates.

Although environmental management programs have been developed, most actions are in the early stage of implementation, and those actions are not comprehensive. For example, the program, *Significant Aspect for Industrial and Hazardous Waste Generation, Management, Transportation and Disposal,* which addresses pollution prevention, does not include the ongoing improvement in University Technical Representative training (i.e., including pollution prevention by subcontractors). This Independent Oversight inspection identified instances where a subcontractor performed work that involved use of heavy construction equipment and aerosol paint cans. However, the hazards associated with waste from these activities were not analyzed, so the potential for generation of oily rags from minor work on equipment, oil-contaminated soil from equipment leaks, and used aerosol cans was not identified until after work began. As a result, pollution prevention actions, such as use of drip pans and a non-aerosol marking system to reduce or eliminate hazardous waste generation, were not considered. Furthermore, the recently released ES&H Manual Chapter 42, Subcontractor Construction Safety, does not include pollution prevention or provide a reference to the ES&H Manual Chapter on pollution prevention.

In another example, for the program *Significant Aspect for Soil and Groundwater Contamination*, the objective established by the environmental management program was incomplete in that it only addressed meeting the requirements of the Regional Water Quality Control Board Order for historical spills and releases. DOE guidance for performing environmental aspects requires a comprehensive analysis that accounts for all sources of release and contamination, assesses impacts of operations and activities, and is kept up-to-date. However, this Independent Oversight inspection identified instances in which actions were pending or required to protect soil and groundwater due to the potential release of transformer oil and plating chemicals that were not addressed in the environmental management program for the significant aspect. In the first instance, an ES&H/Infrastructure Plan Information System Activity Data Sheet, first developed in 1998, requests funding to comply with Federal and state requirements to correct inadequate secondary containments for polychlorinated biphenyl (PCB)-contaminated transformers. These projects to ensure adequate secondary containment are ongoing. In the second instance, a 1997 safety analysis document for metal finishing operations showed that the main shop area does not have adequate spill containment and states that a deluge system will be used to dilute spills. However, the 2002 condition assessment (required by DOE Order 430.1B, *Real Property Asset Management*) for the Plating Shop does not address this deficiency in secondary containment.

To integrate the EMS into ISM, SLAC developed the Integrated Safety and Environmental Management System Description document, which was intended to describe the program to ensure that environment functions and activities are an integral part of SLAC’s mission and are implemented as a part of the ISM system. However, as discussed Appendices C and D, deficiencies in work planning and control hinder effective implementation. Therefore the EMS (the SLAC comprehensive program to ensure environmental compliance) has not been effectively implemented. For example, this Independent Oversight inspection identified many job hazards analyses and mitigation (JHAMs) and are hazards analyses (AHAs) that provide only general instructions, such as instructions to “Dispose of waste properly.” Such general instructions are not sufficient to ensure effective control of environmental hazards. Also, the JHAMs and AHAs rely on training, such as “completion of course #105,” which addresses hazardous waste generator training; however, approximately one-fourth of the personnel designated as hazardous waste generators are overdue for this course. In addition, although waste accumulation areas are included in the SLAC Consolidated Chemical Contingency Plan to meet state regulatory requirements for contingency plans at waste areas, those responsible for these areas have not been trained on this requirement. (See Finding C-1.)

SLAC has established a pollution prevention/waste minimization (P2/WM) program and has assigned a part-time P2 coordinator. The P2 coordinator guides and monitors a program that includes recycling of paper, aluminum cans, universal waste lamps/batteries, empty aerosol cans, and uncontaminated metals. In addition, P2/WM program guidance is included in general employee training, and actions are in process to improve the SLAC chemical purchases program so that it explicitly addresses P2/WM. Although the coordinator operates an effective recycling program, some program documents have not been updated or do not reflect EMS information. For example, the 1995 ES&H Manual Chapter 22, Waste Minimization and Pollution Prevention, does not reflect the EMS driven pollution goals. In addition, pollution prevention opportunity assessments, which are used to analyze opportunities to reduce waste, have decreased and are not sufficiently used to identify opportunities to minimize waste.

Summary. SSO has approved the EMS for SLAC and continues to work closely on support and oversight to ensure that the contractor meets DOE Order 450.1 requirements. SLAC has an approved EMS that integrates environmental requirements into the site's ISM system. However, some environmental controls are not adequately specified in AHA and JHAM processes. In addition, some guidance documents have only been recently updated, and many new provisions are in the initial stages of implementation. In some instances, program documents are not comprehensive or EMS environmental aspects are not adequately integrated with other SLAC planning and tracking documents. SLAC has set general expectations for line organizations for P2/WM activities using general employee training, but some support documents have not been updated.

E.2.2 Workplace Monitoring of Non-Radiological Hazards

DOE Order 440.1A, *Worker Protection Management for Federal and Contractor Employees*, establishes requirements for line management to ensure that workplace monitoring has been effectively implemented for Federal and contractor workers, including subcontractors. Worker exposures to chemical, physical, biological, or ergonomic hazards are to be assessed through appropriate workplace monitoring (including personal, area, wipe, and bulk sampling), biological monitoring, and observations. Monitoring of results must be formally recorded, and documentation should include the tasks and locations where monitoring occurred, identification of workers monitored or represented by the monitoring, and identification of the sampling methods and durations, the control measures in place during monitoring (including the use of personal protective equipment), and any other factors that may have affected sampling results.

During this inspection, the Independent Oversight team reviewed a number of work activities associated with construction, maintenance, production support, and research in which workers could be exposed to chemical, physical, and ergonomic hazards. In addition, the Independent Oversight team reviewed the current state of the SLAC non-radiological worker exposure program as defined in procedures, instructions, and various presentations.

Program Development. Elements of the SLAC exposure assessment program are described in a draft revision to Chapter 5 of the SLAC ES&H Manual (i.e., Industrial Hygiene) and several attachments. When finalized and issued, these documents provide a basic, initial framework for workplace monitoring program expectations at SLAC and address such topics as requirements for performing baseline industrial hygiene surveys and periodic resurveys of work areas, surveying and monitoring, content of exposure assessment reports, and service and calibration of industrial hygiene equipment. However, the draft Chapter 5 does not provide the details of an exposure monitoring strategy and has not yet been issued. The current Chapter 5 (issued August 1995) does not address workplace monitoring processes or expectations.

Although the current workplace monitoring program policies and procedures are minimal and under development, the SLAC exposure assessment program has been effective in evaluating and controlling workplace exposures to non-radiological hazards when exposure assessment needs are identified by line managers. During the past five years, a significant number of exposure assessments have been conducted to address noise, asbestos, beryllium, and chemical hazards. These assessments are well written, augmented with photographs, and readily accessible to line management through the industrial hygiene web page. Recently, asbestos inspections were completed for all SLAC buildings, with the exception of some of the inter-modal buildings (e.g., trailers). Asbestos inspection results are detailed, well documented, and easily retrievable. For the most part, the SLAC industrial hygienist has been effective in the evaluation and control of workplace exposure hazards when those hazards are identified by line management and Industrial Hygiene assistance is requested, although much remains to be done.

Although DOE Order 440.1A was approved in March 1998, SSO did not incorporate its requirements, including exposure monitoring requirements, into the SLAC contract until early 2006. Consequently, there is no comprehensive exposure monitoring baseline for the entire site. Additionally, these requirements have yet to be incorporated into the SLAC Work Smart standards and fully integrated into SLAC policies and program documents. To date, a formal implementation plan for DOE Order 440.1A and a gap analysis comparing the current exposure assessment program to the requirements of DOE 440.1A have not been required by SSO or developed by SLAC. The current ES&H Manual chapter of industrial hygiene (Chapter 5) does not reference DOE Order 440.1A. Although the new draft industrial hygiene chapter references DOE Order 440.1A , the exposure assessment strategy is not sufficiently documented to demonstrate that it incorporates recognized exposure methodologies as required by DOE Order 440.1A (e.g., *Implementation Guide for Use with DOE 440.1, Occupational Exposure Assessment*, and the American Industrial Hygiene Association publication, *A Strategy for Occupational Exposure Assessment*). Furthermore, without a comprehensive implementation plan for DOE Order 440.1A and gap analysis, SLAC lacks an adequate framework and baseline program for effectively implementing the requirements of the new Worker Safety and Health Program Rule (10 CFR 851), when SLAC enters the implementation phase of this new rule. (See Findings C-1 and D-2.)

Program Implementation. The workplace monitoring program is currently limited in scope and does not fully meet the requirements of DOE Order 440.1A, as previously discussed. Its primary activity is reacting to critical exposure assessment needs identified by line management. In a November 2005 report, the SLAC ES&H Advisory Committee stated: "due to a lack of sufficient manpower, industrial hygiene survey reports and other workplace monitoring documents are backing up, and are not being processed and filed promptly." The same report also determined that with only one industrial hygienist to cover 1300 SLAC employees, the ratio of industrial hygiene support to employees is lower than at other comparable DOE laboratories. The conclusions of the Advisory Committee are consistent with the Independent Oversight team observations. Currently, the SLAC industrial hygiene program is staffed by one full-time industrial hygienist and a part-time contractor; SLAC is in the process of hiring a certified industrial hygienist and an industrial hygienist. Although the addition of the part-time contractor support has reduced the back-log of exposure assessment reports, work activity support continues to be limited to reactively addressing critical needs. Currently, identification and assessment of exposure assessment opportunities through ongoing reviews of AHAs, JHAMs, and chemical inventories, and ongoing facility walkdowns are not sufficient to identify and analyze potential worker exposure hazards. In addition, procedures and programs for implementation of the exposure assessment requirements of DOE Order 440.1A and 10 CFR 851 have not been developed to address such requirements as proactive baseline hazards assessments and periodic reassessments of work areas and activities.

In some cases, line managers have not been effective in identifying, prioritizing, and communicating potential exposure hazards to Industrial Hygiene. Some line managers have not recognized potential exposure hazards and/or have not involved Industrial Hygiene in the assessment of some potential exposure hazards. As a result, during this inspection, the Independent Oversight team identified a number of workplace exposures that had not previously been identified, analyzed, and/or documented, as illustrated by the following examples:

- The potential for exposure to hexavalent chromium in welding fumes within the Klystron Tube shop was not included in the weld fume exposure assessment conducted for this shop.

- Welding in an unventilated steel intermodal container (Building 4205) was not addressed.

- The potential for exposure to potassium dichromate vapors (a carcinogen) in the Surface and Materials Science Metallographic lab was not identified by line management or evaluated by Industrial Hygiene as required by Chapter 35 of the ES&H Manual, Chemical Carcinogens.

- Several potential high noise exposures were identified but were not evaluated (e.g., maintenance work near the 480 Volt diesel generators near building 2, jack hammering by maintenance workers near Building 50, linear accelerator tunnel).

FINDING #E-1. SLAC has not developed procedures and programs for implementing the exposure assessment requirements and does not perform baseline hazards assessments and periodic reassessments of work areas and activities based on risk, as required by DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees.*

Summary. The SLAC industrial hygienist has been aggressive in evaluating workplace exposures to non-radiological hazards when requested by line management, as evidenced by the number of exposure assessments performed and documented during the past few years. Exposure monitoring reports are readily accessible to line managers through the SLAC intranet, and the SLAC industrial hygienist has been diligent in responding to line managers' requests for exposure assessments. However, much remains to be done. Exposure assessment policy documents are minimal, and the exposure assessment requirements identified in DOE Order 440.1A and 10 CFR 851 have yet to be evaluated and fully implemented. Line management has missed some opportunities to notify Industrial Hygiene to conduct exposure assessments, and has not adequately integrated industrial hygiene recommendations into work documents. Limited staffing has resulted in some proactive exposure assessment programs (such as baseline hazard analysis) not being fully developed, and a number of potential workplace exposures that were identified by the Independent Oversight team had not been identified, analyzed, and/or documented.

E.3 Conclusions

The SLAC EMS and workplace monitoring programs need attention and improvement. SLAC has implemented an EMS that has been certified by SSO as required. While many aspects of the EMS are adequately implemented, some aspects are not sufficiently defined, and there are deficiencies in processes and controls. SLAC is performing a significant number of workplace monitoring activities in a reactive mode in response to line management requests. However, the overall workplace monitoring program is limited in scope, does not meet current DOE requirements, and is not structured to meet the upcoming workplace monitoring requirements of the Worker Safety and Health Program Rule. Increased SLAC and SSO management attention is needed to achieve and sustain effective implementation of the EMS and workplace monitoring program.

E.4 Opportunities for Improvement

This Independent Oversight inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

SLAC – Environmental

1. **Ensure that significant environmental aspects are integrated into line function programs and functions.** Specific actions to consider include:

   - Ensure that University Technical Representative training includes pollution prevention by subcontractors.

   - Ensure that ES&H Manual Chapter 42 and/or the ES&H Manual chapters on waste management and pollution prevention appropriately address environmental requirements that are applicable to subcontractors.

   - On a broader level, ensure that program documents include appropriate cross references to environmental requirements and programs.

   - Expand environmental management programs to address all related concerns for that topical area and ensure they are coordinated with other planning and tracking documents.

2. **Ensure that environmental programs are effectively implemented as the identified work planning and control deficiencies are corrected.** Specific actions to consider include:

- Review controls for hazardous waste at the point of generation to ensure adequacy, e.g., in JHAMs and AHA guidance.

- Ensure that all hazardous waste generators are current on required training.

- Consider additional training for persons responsible for waste accumulation areas, including details on contingency planning.

3. **Evaluate the effectiveness of the P2 program in identifying waste reduction and recycling opportunities.** Specific actions to consider include:

   - Determine whether the number of planned P2 assessments is adequate to identify opportunities to reduce waste through substitutions, process changes, and recycling.

   - Ensure that documents that address P2 issues are updated to reflect current information about EMS goals, aspects, and requirements.

SLAC – Workplace Monitoring

1. **Roll down the DOE Order 440.1A requirements for exposure assessments and workplace monitoring into SLAC policies and procedures.** Specific actions to consider include:

   - Revise the SLAC Work Smart standards to reflect the addition of DOE Order 440.1A to the SLAC contract.

   - Perform a gap analysis and implementation plan for DOE Order 440.1A.

   - Assess the industrial hygiene resources needed to effectively implement the requirements of DOE Order 440.1A.

   - Develop industrial hygiene policies and programs for the implementation of DOE Order 440.1A based on recognized exposure assessment methodologies.

   - Develop a plan to meet the upcoming requirements of the new Worker Safety and Health Program Rule (10 CFR 851).

2. **Implement an exposure assessment and workplace monitoring program that is compliant with DOE Order 440.1 and 10CFR 851.** Specific actions to consider include:

   - Conduct baseline exposure assessments and perform periodic reassessments based on risk.

   - Perform and document exposure assessments based on recognized exposure assessment methodologies.

   - Develop a computer-based exposure assessment data management system for tracking, trending, and accessing industrial hygiene exposure monitoring records.

   - Develop guidance for line managers for involving Industrial Hygiene in the review of work control documents (JHAMs, AHA, etc.), and establish thresholds for when to request Industrial Hygiene assistance in performing exposure assessments.

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Abbreviations Used in This Report (Continued)

MSDS	Material Safety Data Sheet
NFPA	National Fire Protection Association
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
P2/WM	Pollution Prevention/Waste Minimization
PPE	Personal Protective Equipment
R&D	Research and Development
RWP	Radiation Work Permit
SAD	Safety Assessment Document
SC	DOE Office of Science
SLAC	Stanford Linear Accelerator Center
SPEAR3	Third Generation Stanford Positron Electron Asymmetric Ring
SSO	Stanford Site Office
SSRL	Stanford Synchrotron Radiation Laboratory
TRC	Total Recordable Case