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Office of Security and Safety Performance Assurance
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Independent Oversight Lessons Learned Report

Environment, Safety, and Health Evaluations

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OVERSIGHT

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Abbreviations Used in This Report

AJHA	Automated Job Hazards Analysis
ALARA	As Low As Reasonably Achievable
ATR	Advanced Test Reactor
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
EH	Office of Environment, Safety and Health
EM	Office of Environmental Management
EMS	Environmental Management System
ES&H	Environment, Safety, and Health
ESF	Essential System Functionality
FR	Facility Representative
ISM	Integrated Safety Management
NE	Office of Nuclear Energy, Science and Technology
NNSA	National Nuclear Security Administration
OA	Office of Independent Oversight and Performance Assurance
OA-40	Office of Environment, Safety and Health Evaluations
OSHA	Occupational Safety and Health Administration
PAAA	Price-Anderson Amendments Act
PPE	Personal Protective Equipment
SC	Office of Science
S/CI	Suspect/Counterfeit Item
SME	Subject Matter Expert
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question

FOREWORD

Since 1984, the Office of Independent Oversight and Performance Assurance (OA) and its predecessor offices within the U.S. Department of Energy (DOE) have been responsible for evaluating programs of national significance and reporting on their status to the Secretary of Energy, senior Department management, and Congress. This independent internal oversight function is unique in the executive branch of the government and, over the years, has led to notable improvements in safeguards and security; cyber security; environment, safety, and health; and emergency management programs. OA is part of the Secretary of Energy's Office of Security and Safety Performance Assurance.

Last year, OA issued a compilation of lessons learned in environment, safety, and health in a report entitled *Independent Oversight Lessons Learned Report: Environment, Safety, and Health Evaluations*, which provided feedback on the results of our inspection activities conducted in 2002, including common areas of effective performance and opportunities for improvement. This year we have updated our information to reflect data from our inspections conducted January 2003 through December 2003. During this time, OA conducted inspections of environment, safety, and health programs at five DOE sites, spanning the range of Departmental missions involving the National Nuclear Security Administration, the Office of Environmental Management, the Office of Science, and the Office of Nuclear Energy, Science and Technology. OA also conducted a special study of the Department's control of suspect and counterfeit items.

The OA inspections during 2003 indicate that most aspects of the Department's integrated safety management system policy have been effectively implemented and have resulted in work hazards being identified and controlled such that work is being performed safely. Furthermore, DOE environmental protection programs continue to be well implemented and improving with the adoption of integrated safety management principles to minimize and control wastes and protect the environment. However, improvements are needed in DOE sites' implementation of two key components of integrated safety management. First, identification and implementation of hazard controls need improvement, particularly the rigor of working within established controls. Second, attention is needed in DOE line management oversight and contractor feedback and improvement programs. In addition, OA found significant weaknesses in the design of safety systems at several sites that could have rendered the systems unable to perform their safety function for some design basis accidents, indicating a need for improvement in the rigor and attention to detail of the design and design review processes for safety systems.

OA will continue to evaluate safety management programs and focus on such areas as the identification and implementation of hazard controls, design of safety systems, and feedback and improvement processes, where weaknesses continue to be identified. In addition to evaluating program performance, we will assess ongoing line management oversight activities at the site, field office, and Headquarters levels. We also will continue to periodically step back and review the results of our evaluations to ascertain the status of DOE sites' integrated safety management implementation and to identify lessons learned to help facilitate improvements. New actions OA is undertaking in 2004 include the identification of noteworthy practices on the OA web site and the evaluation of several cross-cutting issues during site evaluations, such as legacy hazards management, the establishment of system engineer programs, and controls for preventing inadvertent hazardous energy penetrations during work activities. By these means, we will continue to fulfill our mission of promoting improvement in environment, safety, and health programs at the Department of Energy.

1.0 Introduction

The Office of Independent Oversight and Performance Assurance (OA) Office of Environment, Safety and Health Evaluations (OA-40) is responsible for evaluating and reporting on environment, safety, and health (ES&H) performance throughout the U.S. Department of Energy (DOE) complex. OA is part of the Secretary of Energy's Office of Security and Safety Performance Assurance.

This report summarizes the observations and insights that resulted from OA inspection activities conducted from January 2003 through December 2003. OA-40 performs ES&H management inspections as its primary mechanism for evaluating and reporting on ES&H performance. These inspections evaluate selected aspects of DOE site integrated safety management (ISM) programs, with a focus on implementation of ISM, and DOE contractor and line management performance. The five sites inspected by OA during the reporting period are listed in Table 1. The table also identifies the DOE program office that has primary management responsibility for each site—the National Nuclear Security Administration (NNSA), the Office of Environmental Management (EM), the Office of Science (SC), or the Office of Nuclear Energy, Science and Technology (NE). All five inspections included an evaluation of safety management systems and programs, based on observation of work activities involving hazards. During some inspections, OA also conducted a detailed engineering review of the condition and performance of a sample of essential safety systems that are relied upon to protect site workers, the public, and the environment. Any ES&H performance deficiencies identified during OA-40's review of work activities or essential systems were evaluated to determine whether weaknesses in management systems contributed to the deficiencies, to ensure identification of the underlying causes as well as the symptoms.

OA also conducted a special study of the Department's control of suspect and counterfeit items (S/CIs) that included evaluations of implementation of Department controls at the seven sites identified in Table 2. Some common issues identified during this special study are included in this report. Details of the special study can be found in an OA report on this topic, *Independent Oversight Special Study of the Department of Energy's Management of Suspect/Counterfeit Items*, issued in August 2003.

The remainder of this report is organized as follows. Section 2 provides a summary of OA-40's

Table 1. Sites Inspected by OA-40 During the Reporting Period

SAFETY MANAGEMENT INSPECTION SITE	HEADQUARTERS PROGRAM OFFICE(S)
Sandia National Laboratories	NNSA
Y-12 National Security Complex (Y-12)	NNSA
East Tennessee Technology Park	EM
Idaho National Engineering and Environmental Laboratory (INEEL)	EM and NE[1]
Pacific Northwest National Laboratory	SC

[1] The OA inspection included some INEEL facilities for which EM had line management responsibility and some for which NE had programmatic responsibility. At the time of the inspection, the Idaho Operations Office and INEEL were undergoing reorganizations to align management responsibilities with current and future missions.

key observations, based on the results of the recent inspections. Section 3 provides OA-40's conclusions and briefly discusses the priorities for future OA-40 inspections. Appendix A provides additional details on OA's analysis of ISM programs, including opportunities for improvement.

Table 2. Sites Inspected by OA-40 as Part of the 2003 Special Study on Suspect/Counterfeit Item Controls

SUSPECT/COUNTERFEIT ITEM CONTROLS INSPECTION SITE	HEADQUARTERS PROGRAM OFFICE
Savannah River Site	NNSA/EM
Pantex Plant	NNSA
Hanford Site	EM
River Protection Project	EM
Oak Ridge National Laboratory	SC
Kansas City Plant	NNSA
Los Alamos National Laboratory	NNSA

2.0 Results

The results of the past year's inspection activities are summarized in Table 3 (see page 5), which shows the distribution of ratings for the five ES&H inspections performed during this reporting period. As seen in Table 3, approximately 60 percent of the ratings are Effective Performance. Only one element at two sites was rated Significant Weakness. These ratings are generally consistent with last year's ratings.

The generally high ratings assigned to the ISM guiding principles (over 90 percent are rated Effective Performance) highlight the progress that DOE has made on its institutional programs. Although included as part of the core function reviews and not rated separately, environmental protection programs were generally effective at all inspected sites.

However, the ratings for the core functions and essential systems indicate a continued need for further improvements in implementing ISM core functions and ensuring that essential systems can perform their safety functions. Particular attention is needed in ISM Core Functions #3 and #4 (which address hazard controls and performing work within controls), where more than half of the sites' performance was rated as Needs Improvement, and in the design of essential safety systems, where all systems evaluated were rated as Needs Improvement or Significant Weakness. Finally, the ratings for the feedback and continuous improvement core function (ISM Core Function #5) indicated a need for improvement at four of the five inspected sites.

The following six observations are based on an analysis of the results of the five ES&H inspections and the S/CI special study performed during this reporting period. They identify conditions that are evident at most of the sites that OA inspected. The first two observations address aspects of DOE ISM programs that are generally effective, although some specific aspects could be further improved. The third observation provides a brief summary of the results of the S/CI special study. The last three observations address aspects of ISM that, in general, require improvement. Site-specific results and recommendations are contained in individual inspection reports, which can be found on OA's web page (http://www.oa.doe.gov).

1. Most aspects of the Department's ISM system policy have been effectively implemented and have resulted in work hazards and controls being identified such that work can be performed safely. However, some specific weaknesses were identified in several areas at some sites. At all sites, planning processes for programmatic work were generally well established, and mechanisms were in place to provide the necessary framework for identifying hazards and developing hazard controls. Project engineers, workers, and ES&H professionals were integrated into the planning process and in most cases provided good support for effective hazard identification and control. Improvements in maintenance programs were evident, and maintenance organizations are demonstrating a better understanding and more effective implementation of ISM. Line organizations, maintenance managers, supervisors, and workers generally utilized the ISM core functional elements effectively to evaluate and conduct work activities safely. DOE injury rates and lost workdays continue to be below the industry average.

Most sites had some specific weaknesses in some ISM elements, including: (1) worker exposure assessments and surveys associated with routine recurring craft activities, such as painting, welding, and carpentry work activities; (2) implementation of some skill-of-the-craft work activities; and (3) work scopes for a number of construction and decontamination and decommissioning projects being performed by subcontractors. In addition, most sites had weaknesses in the identification of some hazards and, more often, in the effective implementation of hazard controls that had been identified. (See observation #4 below.)

2. DOE sites have effectively utilized ISM principles to identify and control waste generation and disposal. Most sites evaluated during 2003 had enhanced their processes for identifying and controlling waste generation and disposal. These enhanced processes were usually directly linked to the sites' ISM program for work

activities or utilized ISM principles. All sites evaluated had made good progress toward effectively implementing DOE Order 450.1, *Environment Protection Program*, requirements for establishing environmental management systems and pollution prevention programs ahead of the December 2005 implementation deadline.

At some of the sites, OA found that the level of detail of environmental work scopes could be improved to better identify environmental risks. Furthermore, at some sites, improvements are needed in administrative controls, utilization of environmental expertise to select disposal paths, and analysis of waste streams.

3. All of the evaluated DOE sites were knowledgeable of S/CI issues and concerns and had implemented elements of S/CI programs into the site services, plant engineering, and maintenance organizations. However, some DOE-wide programmatic and site-specific weaknesses were identified. DOE S/CI policies and guidance set out many elements of an effective S/CI process, and some sites have effectively integrated S/CI prevention provisions into site procurement and maintenance programs. These provisions included procuring critical items only from qualified vendors and performing rigorous receipt inspections. However, DOE Headquarters' S/CI communication and information exchange processes lack sufficient rigor to ensure effective dissemination of information and tracking of needed actions. Further, DOE site contracts and implementing procedures have not always ensured that appropriate requirements are established for control of S/CIs. A particular concern was that subcontractors have not always established controls for S/CIs. In addition, S/CI training programs do not always encompass all appropriate personnel, or training has not been provided at the appropriate frequency.

4. Some sites have not identified and rigorously implemented all of their hazards analysis and control requirements. In many cases, contractors did not rigorously follow or implement existing management directives or program requirements called out in site-level documents, resulting in some hazard controls not being identified or incorporated into working-level documents. For example, a continuing common problem at some sites involves the lack of complete identification of institutional standards and safety requirements in working-level documents to be used by the workers, such as specific personal protective equipment for chemical work. As a result, the definition of controls was ambiguous, leaving the decisions on the use of specific types of personal protective equipment to the discretion of the worker, who may not have sufficient training and experience to make a conservative decision.

5. Processes and performance for safety management feedback and continuous improvement, including DOE line management oversight, continue to mature and improve; however, the quality of self-assessments needs improvement, and issues management problems persist. In many cases, line management has strengthened assessment and oversight programs and methods for monitoring and measuring the adequacy of implementation of safety management systems. Benefits have resulted from the application of behavior-based safety observation programs, and from efforts toward certification to international standards. However, continuous improvement and prevention of adverse conditions, events, and injuries are impeded by continuing weaknesses in conducting effective self-assessments and in issues management programs, especially the lack of rigor in evaluating deficiencies for causal factors and extent of condition and in establishing and maintaining effective recurrence controls. In addition, site lessons-learned evaluations lack the rigor and formality needed to determine local applicability to support formal and specific preventive actions.

6. While the essential systems that were reviewed were generally well maintained and operated, significant design flaws at several sites could have prevented the systems from performing their intended safety function. Most of the systems that were evaluated were in good material condition, and operators were well trained and knowledgeable of the systems. However, design deficiencies were identified in several areas, including insufficient analysis of: (1) critical design factors that establish the conditions under which the system must operate, (2) the impact of natural phenomena on system operability, and (3) actual/as-built safety system response under accident conditions.

Table 3. Areas and Ratings for ES&H Inspections

Areas for ES&H Inspections in 2003	Number of Sites			Effective Performance			Needs Improvement			Significant Weakness		
	NNSA	EM/NE	SC	NNSA	EM/NE	SC	NNSA	EM/NE	SC	NNSA	EM/NE	SC
Safety Management System Ratings												
GP#1 - Line Management Responsibility for Safety	1			1								
GP#2 - Clear Roles and Responsibilities	2	2	1	2	2	1						
GP#3 - Competence Commensurate with Responsibility	1			1								
GP#4 - Balanced Priorities												
GP#5 - Identified Safety Standards and Requirements	2	2	1	2	1	1		1				
Feedback and Improvement												
CF#5 - Feedback and Improvement	2	2	1	1			1	2	1			
Work Activities, Facility Operations, and Maintenance												
CF#1 - Define the Work	2	2	1	2	2	1						
CF#2 - Analyze the Hazards	2	2	1	1	2	1	1					
CF#3 - Develop and Implement Controls	2	2	1	1			1	2	1			
CF#4 - Work Within Controls	2	2	1	1		1	1	2				
Essential Systems												
Design and Configuration Management	2	1	1				2				1	1
Surveillance and Testing	2	1	1	1		1	1		1			
Maintenance	2	1	1	1		1	1		1			
Operations	2	1	1	2	1	1						

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3.0 Conclusions

At the sites evaluated in 2003, most aspects of ISM systems were mature and effectively implemented. Most work activities observed by OA had been thoroughly evaluated to identify hazards and needed controls and were performed safely. Furthermore, OA found environmental programs to be generally effective and to have improved in the establishment of centralized systems for controlling wastes.

However, some aspects of ISM need improvement. First, implementation of hazard controls (ISM Core Functions #3 and #4) needs improvement, particularly the rigor of working within the established controls to ensure worker safety. Second, feedback and improvement programs (ISM Core Function #5), including DOE line management oversight and contractor feedback and improvement programs, require improvement to ensure that deficiencies are self-identified and corrected in a timely manner. In addition, OA found significant weaknesses in the design of safety systems at several sites. Although the systems were generally well maintained and operated, the design flaws could have rendered systems unable to perform their safety function for some design basis accidents.

Because most elements of ISM have been well defined and established, OA focuses its evaluations on the review of specific work activities, from planning to actual work in the field; this has proven to be the most effective way to provide value-added feedback on the effectiveness of ISM implementation at the activity level. OA will continue to perform these reviews. In addition, because the feedback and continuous improvement element of ISM has not been well established or implemented, OA will continue to focus on the adequacy of both processes and implementation in this area. Particular emphasis will be placed on DOE line management and contractor efforts to develop and implement effective self-assessment and corrective action processes. OA also will continue to review the functionality of selected essential safety systems, especially the design, surveillance, and testing of these systems. Finally, during site visits, OA plans to focus on several cross-cutting issues, such as legacy hazards management, implementation of the unreviewed safety question process, establishment of system engineer programs, and controls for preventing inadvertent hazardous energy penetrations during work activities.

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APPENDIX A
ISM PROGRAM RESULTS

During the past year, the Office of Independent Oversight and Performance Assurance (OA) Office of Environment, Safety and Health Evaluations (OA-40), primarily focused on selected aspects of integrated safety management (ISM) programs, including:

- Guiding Principle #2, Roles and Responsibilities
- Guiding Principle #5, Requirements Management
- Core Function #5, Feedback and Improvement
- Programmatic Work[1, 2]
- Maintenance[1]
- Subcontractor Activities[1]
- Environmental Protection[1]
- Essential System Functionality (ESF).

These areas were selected based on a review of the past performance of U.S. Department of Energy (DOE) sites; the status of ISM implementation; and other commitments, such as implementation plans for Defense Nuclear Facilities Safety Board (DNFSB) recommendations. The first five areas were reviewed on all recent inspections. The last three were reviewed at selected sites, depending on site-specific factors. This appendix discusses each of these areas, including positive attributes, opportunities for improvement, and conclusions. For each area, OA identifies aspects of ISM that will be emphasized on future OA inspections.

The opportunities for improvement noted in this appendix are provided for DOE Headquarters, DOE site organizations', and site contractors' consideration for applicability. OA found these opportunities for improvement to be generally applicable to sites evaluated in 2003, and believes that they may have broad applicability across the DOE complex, and that they may be useful in improving environment, safety and health (ES&H) programs.

[1] OA evaluated implementation of ISM Core Functions #1 through #4 (i.e., define work, analyze hazards, develop and implement controls, and work within controls) for each of these activities.

[2] Refers to work, such as research or stockpile activities, performed to accomplish a programmatic mission.

Guiding Principle #2: Roles and Responsibilities

Introduction

The DOE ISM system policy and associated guidance stress the importance of clear roles and responsibilities for DOE and site contractors in establishing and implementing a comprehensive ES&H program. DOE requires ES&H-related functions, responsibilities, and authorities to be clearly defined, communicated, understood, and implemented at all levels of DOE and contractor line management. To ensure appropriate implementation of assigned roles and responsibilities, DOE organizations and DOE contractors must have effective processes for holding DOE and contractor organizations and individual line and ES&H managers accountable for safety performance, including performance objectives and appraisal systems.

In the past year, all OA inspections of the guiding principles of safety management have reviewed the effectiveness of DOE and contractor organizations in establishing clear roles and responsibilities for ES&H performance. In these reviews, OA focused on the implementation of assigned responsibilities by DOE and contractor management, accountability systems, contractual performance measures, worker involvement, and processes for resolving safety concerns raised by workers.

In 2003, OA found that most roles and responsibilities were clearly defined for both DOE and contractor organizations and that DOE sites were making significant progress in implementing effective systems to hold organizations and senior managers accountable for ES&H performance. A rating of Effective Performance was assigned to each of the five sites that underwent ES&H management inspections. However, some improvements are warranted in defining roles and responsibilities for ES&H subject matter experts (SMEs) and communicating management expectations that productivity does not conflict with or take precedence over safety.

Positive Attributes

The interfaces between the DOE line management chain at Headquarters and the field elements have been clarified through recent reengineering and reorganization. The new organizational structures clarify lines of responsibilities and authorities for safe operations at the sites. For example, within the Office of Environmental Management (EM), the Office of the Chief Operating Officer has been delegated primary responsibilities for site operations, ISM, and ES&H oversight. EM site office managers report directly to the Office of the Chief Operating Officer and are empowered to ensure safety at their sites. Similar arrangements are in effect within the Office of Science and the National Nuclear Security Administration (NNSA). Although the recent reengineering and reorganization efforts clarify responsibilities, continued attention is needed to ensure that the field elements have the resources and expertise needed to implement their responsibilities effectively.

At most sites, contractor roles and responsibilities for work planning and control are clearly defined at the task level. At most sites OA evaluated in 2003, the work planning and control processes require the assignment of an individual who is then held responsible for end-to-end development as well as final execution of work packages. In addition to the facility managers' positions that authorize facility-level work, many sites have created such positions as Cognizant Space Manager, an individual who is responsible for all activities that occur within a laboratory space, to oversee task-level activities. The roles and responsibilities of these individuals are well defined and strongly supported by the upper management, and they have usually been given appropriate authority to perform their functions.

Opportunities for Improvement

DOE site offices need to better define the roles and responsibilities of SMEs who have ES&H responsibilities. Most DOE site offices inspected during the year were in the process of defining, documenting, and publishing ES&H implementation plans and other related documents to serve as procedures for SMEs' activities and their associated roles and responsibilities. These documents, when completed, are intended to better define certain organizational interfaces, such as the interfaces between Facility Representatives (FRs), ES&H SMEs, and program management staff. A well-defined interface is essential in the development of analysis capabilities for discovering and mitigating adverse ES&H trends.

Contractors' senior management should establish and clearly communicate their expectation for rigorous implementation of safety responsibilities. Although senior managers clearly demonstrate their commitment to safety, site management expectations for implementation of safety-significant functions and associated roles and responsibilities were not always sufficiently defined to ensure that work activities were performed safely. Contractor management has not always clearly communicated that they expect rigorous implementation of ISM and safe work practices, and that schedule pressures must not be allowed to degrade safety.

Conclusions

The implementation and maturation of ISM programs have resulted in significant improvements in the clarity of roles and responsibilities for ES&H across DOE sites. Although further improvements are warranted in a few areas, most roles and responsibilities are clearly defined for both DOE and contractor organizations. DOE sites are making significant progress in implementing effective systems for holding organizations and senior managers accountable for ES&H performance.

Guiding Principle #5: Requirements Management

Introduction

DOE Policy 450.4, *Integrated Safety Management System,* requires that hazards be evaluated before work is performed and that an agreed-upon set of safety standards be established to provide assurance that the public, the workers, and the environment are protected from adverse consequences. Effective implementation of this policy requires a systematic approach to requirements management, including systems for clearly defining applicable requirements and translating them to procedures, processes, and training. OA assessed the effectiveness of requirements management programs by observing work and reviewing documents to determine whether appropriate ES&H requirements were specified in contracts, and whether these requirements were

adequately conveyed through procedures, processes, and training to individuals performing hazardous work.

In 2003, OA found that ES&H requirements were effectively managed at most of the sites assessed. A rating of Effective Performance was assigned for four of the five sites that underwent ES&H management inspections, and performance at the fifth site was rated as Needs Improvement. However, the special study of the management of suspect/counterfeit items (S/CIs) at seven additional sites identified deficiencies in the area of requirements management that adversely impacted performance at some of these sites. Further, OA identified some specific DOE processes/ mechanisms that need improvement, such as: (1) flowdown of ES&H requirements applicable to the Federal staff, (2) requirements for maintenance of medical records, (3) use of industry standards, and (4) identification of changes in laws and standards.

Positive Attributes

At most sites, DOE has included all appropriate ES&H requirements in contracts. In general, DOE has included an appropriate set of safety requirements in management and operating contracts, has established processes for reviewing new and revised DOE directives for applicability, and has incorporated appropriate changes into contractual requirements. Most contracts contain appropriate ES&H requirements. However, in a few cases, contracts did not reflect the latest revisions of referenced DOE directives, and, as discussed further below, some contracts did not contain adequate requirements for the control of S/CIs.

Contractors have effectively flowed down ES&H requirements to the activity level, including to subcontractors, through implementing documents and training. In general, contractors have ensured that ES&H requirements are tailored and flowed down through company documents to the individuals responsible for implementing these requirements. The process that the Idaho National Engineering and Environmental Laboratory contractor uses has several noteworthy aspects that enhance its effectiveness, including the use of sitewide procedures to the extent practicable and formal processes for flowdown of new and revised laws and regulations into site procedures.

New environmental management system (EMS) requirements or equivalent industry standards have been incorporated into contracts and have been flowed down through site-specific documents to staff members responsible for implementation. DOE Order 450.1, *Environmental Protection Program*, which was issued in January 2003, provides requirements for incorporating EMS requirements into ISM systems. Proactive steps taken before this order was issued, and continuing efforts following issuance, produced adequate implementation at each site inspected this year. Each site had incorporated the order into the contract or had applied International Organization for Standardization (ISO) 14001 as an equivalent industry standard. Appropriate steps are being taken to achieve full compliance by December 31, 2005.

Opportunities for Improvement

DOE should establish processes for the flowdown of ES&H requirements applicable to Federal staff. NNSA Policy Letter NAP-5, *Policy Letter for Standards Management*, which was issued in October 2002, includes appropriate expectations for managing requirements applicable to Federal staff (e.g., Federal Employee Occupational Safety and Health program requirements, and requirements for implementing line management oversight functions). However, NNSA has not specified implementation milestones or completion dates for this policy and has not established the processes for managing requirements applicable to the Federal staff that will be necessary for full implementation of the NNSA policy. DOE has not established clear expectations in this area for non-NNSA sites. As a result, some requirements applicable to Federal employees have not been clearly assigned or implemented.

DOE site management should clarify requirements to ensure that all subcontractor occupational medical/health records are accessible, properly maintained, and preserved as required by current DOE directives and best business practices. Site procurement officials have allowed contractors and subcontractors to obtain occupational medical services from medical providers external to the DOE site without specific contractual stipulations concerning medical record content, quality, and access. This situation can hinder line management's ability to protect workers and to collect and store the needed medical information. For example, the absence of specific requirements in contracts may result in the loss of medical data needed for future epidemiological studies and worker compensation management. Pertinent health information collected from medical examinations of workers should be compiled and analyzed by medical providers to help

ascertain the quality and effectiveness of site safety programs and to identify any adverse health-related trends that may affect workers.

DOE site organizations should establish systematic processes for identifying changes in applicable laws, regulations, or industry standards. DOE relies primarily upon its contractors to identify applicable changes in laws, regulations, and industry standards and to propose appropriate contract revisions in these areas. Relying on contractors to perform these functions is appropriate to the extent that contractors maintain formal processes and sufficient documentation to support effective DOE oversight in this area. However, such processes are often informal, expert-based processes that contain few requirements for periodic reviews to confirm that applicable requirements remain necessary and sufficient. For example, contractors rely on their SMEs to maintain knowledge of current requirements in their assigned areas and to propose changes to contracts and implementing documents when appropriate. A more formal and systematic process is needed to assure that changes in applicable standards are identified and appropriate changes to contract requirements are made. DOE oversight of these programs has not been sufficiently comprehensive or rigorous.

DOE should ensure that requirements are consistently imposed for control of S/CIs. The requirements for control of S/CIs, specified in DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, were not included in two of seven contracts reviewed during the 2003 OA special study. Including these requirements is important because there are no equivalent laws, regulations, or industry standards in this area. Control of S/CIs was less effective at sites that did not adopt the requirements of DOE Order 440.1A. This matter is discussed in more detail in the August 2003 OA report, *Independent Oversight Special Study of the Department of Energy's Management of Suspect/ Counterfeit Items*.

Conclusions

Performance in the area of requirements management has continued to improve and is effective at most sites. Appropriate ES&H requirements have been included in most contracts, and these requirements have flowed down to the activity level, including to subcontractors, through implementing documents and training. Processes for reviewing new and revised DOE directives for applicability to site contractors have been generally effective, but processes for review of applicable laws, regulations, and industry standards need to be strengthened. In addition, improvements are needed in the flowdown of ES&H requirements to Federal staff, the incorporation of medical records requirements, and the incorporation of requirements for the control of S/CIs.

Core Function #5: Feedback and Continuous Improvement

Introduction

DOE and contractor feedback and improvement processes—the fifth core function of ISM—provide management with the assurance that the guiding principles and first four core functions of ISM have been adequately defined and effectively implemented. They also identify areas where improvements are needed. The OA-40 inspections of feedback and improvement processes included evaluations of the adequacy of DOE line management oversight, contractor feedback, and issues management systems. DOE line oversight elements that were evaluated included day-to-day operational awareness, assessments, and contract performance monitoring, including activities conducted by FRs, SMEs, and program personnel. Contractor elements that were evaluated included management self-assessments and independent assessments, the evaluation and resolution of identified program and performance deficiencies, and the application of lessons learned. Corrective action and issues management processes were evaluated, including the handling of employee safety concerns.

In 2003, OA found that DOE line management and contractors continued to make improvements in feedback and improvement mechanisms and processes and in the implementation of various processes. These improvements have resulted in safety program enhancements and have led to improvement in safety performance. Nonetheless, feedback and improvement programs at most sites continue to have important weaknesses, and OA rated this area as Needs Improvement at four of the five sites evaluated. The most frequently cited weakness, for both DOE and contractors, involved inadequacies in the effective evaluation and resolution of safety issues to prevent recurrence. DOE oversight deficiencies, inadequate contractor assessments, and weaknesses in employee concerns programs were also identified at multiple sites.

Positive Attributes

DOE FR programs have continued to improve and provide an effective means for overseeing the safety of day-to-day, activity-level operations at nuclear facilities. DOE site offices have established and communicated appropriate expectations to their FRs for day-to-day oversight of contractor activities. The roles and responsibilities of FRs are adequately defined and documented, and focus on in-the-facility oversight of work activities, including planning, hazards analysis and control, and conduct of operations. Effective tools have been developed for documenting and sharing FR observations and for validating whether contractors have taken appropriate actions to close out FRs' concerns.

DOE contractors have continued to build on established feedback and improvement processes. Several sites have established comprehensive, integrated assessment programs that encompass the essential elements of effective programs, including task- and program-level worker and management self-assessments, management system program reviews, and internal and external independent evaluations. Several sites have established vigorous and effective independent assessment programs that conduct comprehensive evaluations of both programs and performance, using established acceptance criteria. These programs provide senior management with valuable feedback on the adequacy of safety management programs and performance. Several sites use workshops and classroom training to enhance the assessment skills and techniques of the line personnel who are responsible for performing assessments.

Good practices for enhancing self-assessment were identified at several sites. One site was especially effective in having trainee teams conduct actual self-assessments of safety management processes and performance in their organizations, with mentoring and in-process self-critiques of the selection, scoping, planning, performance, and evaluation elements of the assessment process. Several sites have established rigorous routine safety inspection/ walkthrough processes that include SMEs, supervisors, managers, and workers. Behavior-based safety observation programs and construction safety team inspections have been effective in involving workers in recognizing and correcting unsafe behaviors and conditions.

Sites are increasingly utilizing data from feedback and improvement processes, such as assessments and inspections, issues management, employee concerns, and lessons learned, to establish metrics for routinely monitoring performance. The use of these metrics is often linked to contract performance monitoring and reflects greater use of these metrics by DOE as an oversight tool. Several sites are refining metrics to provide a more comprehensive assessment of performance, including use of a combination of qualitative and quantitative performance indicators.

Opportunities for Improvement

DOE and contractors should improve issues management programs so that they adequately capture and evaluate safety process and performance deficiencies and ensure that effective corrective actions are established and implemented to prevent recurrence. Issues management continues to be an area with frequent and substantive performance weaknesses. Many of the issues identified by the OA inspection team, for both DOE and contractors, have been previously identified, either through self-assessments or external reviews, but corrective actions have been ineffective in preventing recurrence. In many cases, not all deficiencies identified during inspections and assessment activities, especially from less formal reviews, are being rigorously addressed through formal issues management processes. Some sites continue to maintain numerous tracking systems without sufficient mechanisms to identify cross-cutting issues and to permit accurate determination of the overall level of safety performance. In many cases, issues are incorrectly or inconsistently categorized as to significance, and analysis to identify causes and extent of condition is not performed or is not performed adequately. In addition, some issues have been closed based only on a commitment to take action, without sufficient determination that actions were actually taken, or with no process for verification of effectiveness for significant issues.

DOE should ensure that their oversight and self-assessment programs are well designed and defined to provide effective oversight of contractors' ES&H performance and site office activities. Many of the DOE site offices evaluated in 2003 had not adequately defined their oversight programs to provide assurance that they would be effective. As discussed in the following paragraph, DOE programs have not been effective in identifying safety concerns or in overseeing corrective actions for

safety concerns identified by a contractor or other external organization. With the changing roles of Headquarters and site offices, it is particularly important to ensure that oversight is properly defined with clear roles and responsibilities. Several DOE site offices do not have sufficient processes for critically self-assessing the effectiveness of their own functions and programs.

Contractors need to improve the rigor of implementing their assessment programs in order to obtain useful feedback on the effectiveness of safety management processes and performance. Rigorous implementation of self-assessment programs remains problematic for several sites inspected by OA. Although generally adequate processes have been established, insufficient attention has been directed at ensuring the quality and effectiveness of line management assessment activities. In some cases, assessments performed by the line lack sufficient rigor, either in scope or execution, to provide valuable feedback on processes or performance. Although much assessment effort is often directed at inspection of physical conditions in the workplace, too little is directed at evaluating the effectiveness of processes that govern work activities and observing work activities to ensure that safety management requirements and expectations are being effectively implemented. Line personnel often could benefit from training or mentoring to strengthen assessment techniques and ensure that management expectations for assessments are understood. Weaknesses were also identified in assessment activities related to S/CI programs.

In addition, activity-level worker feedback assessment activities have not sufficiently matured. Although some sites have written expectations and procedures for conducting post-job reviews to identify lessons learned and develop recurrence controls, they are typically not rigorously implemented. Few post-job reviews are conducted, and little formal worker feedback is documented. When problems are identified, resolutions to prevent recurrence are not consistently implemented or documented. Other sites have not established processes for formally documenting feedback from workers or conducting formal post-job reviews for significant work activities.

Contractor programs related to injury and illness reviews, employee concerns, occurrence reporting, and Price-Anderson Amendments Act (PAAA) reviews need improvement. Of special concern are the weaknesses in evaluating of the conditions and causes for injury and illnesses that did not rise to the level of a reportable occurrence. Because these incidents resulted in actual physical injury or illness to workers, rather than the potential safety implications of most documented deficiencies, it is appropriate that these cases receive the most rigorous scrutiny. However, in a number of cases, causes were not identified or were incorrectly evaluated, and recurrence controls were not established. Documentation of the corrective actions taken was sometimes lacking. Many times the established issues management processes were not employed to manage the issues related to injuries and illnesses. The documentation of the evaluation and disposition of employee safety concerns was sometimes not sufficiently comprehensive or formal, and in some cases concerns or actions were prematurely closed without verification that the issues were fully and effectively addressed. In several cases, operational and safety-related events that met DOE's reportability requirements were not reported as required. In some cases, disposition of actions to address PAAA non-compliances were inadequately completed or improperly verified as closed when actions had not been implemented. Collective analysis of the issues identified by inspection and assessment activities for repetitive or systemic issues or adverse trends was limited at most sites, precluding timely preventive actions and focusing of resources to areas needing management attention.

Contactors should improve their lessons-learned programs by ensuring that externally generated lessons learned are rigorously evaluated and applied. Although all sites have established lessons-learned programs, both for internally identified lessons and for evaluating and applying lessons from events at other sites in the DOE complex, implementation is often insufficiently rigorous. Typically, contractors have been more effective in identifying and communicating lessons to be learned from incidents occurring on site than from events occurring at other DOE sites or industry. Formal processes have been improved at several sites, but a common weakness is a lack of rigor in the performance and documentation of reviews for local applicability. Frequently there is a lack of rigor in identifying specific actions to be taken to prevent the local occurrence of adverse events that are reported by others. Too often, the only actions that were taken were providing copies to selected parties for reading, without formal determination that existing processes and practices were adequate or whether site-specific, tailored preventive actions were warranted.

Conclusions

Processes for safety management feedback and continuous improvement, including oversight by DOE, continue to mature and improve. In many cases line management has strengthened assessment and oversight programs and methods for monitoring and measuring the adequacy of implementation of safety management systems. Some line managers have utilized innovative techniques in assessment training and effectively used regular meetings of feedback and improvement SMEs to improve processes and performance. Benefits have been achieved from the application of such processes as behavior-based safety observation programs. However, additional DOE and contractor line management attention is needed to ensure that assessment programs are effectively evaluating appropriate safety management processes, especially field performance. Continuous improvement and prevention of adverse conditions, events, and injuries are impeded by continuing weaknesses in issues management programs, especially the lack of rigor in evaluation of deficiencies for causal factors and extent of condition, and the establishment and maintenance of effective recurrence controls. Significant improvement is needed in the rigor and formality of lessons-learned evaluations for local applicability and in tailoring formal and specific preventive actions.

Programmatic Work

Introduction

For the purpose of this report, programmatic work refers to work conducted at each site that is directly related to accomplishment of the facility missions. Examples include production/process and manufacturing operations, decontamination and decommissioning (D&D) activities, and research and development work. In 2003, OA performed inspections at a diverse range of DOE facilities, including national laboratories, manufacturing institutions, research and development facilities, and environmental restoration sites. Specific work activities that were observed included experimental, research, and facility operations; material inspection, stabilization, repackaging, and removal activities; decontamination and demolition work; and infrastructure and mission support work performed by DOE contractors.

OA reviewed contractors' implementation of ISM Core Functions #1 through #4 (i.e., define work, analyze hazards, develop and implement controls, and work within controls) in performing programmatic work. OA found programmatic work to be well defined, and most hazards were appropriately analyzed. However, most sites had weaknesses in site-level planning processes for developing and implementing hazard controls and ensuring that work is performed within controls. While most work is being performed safely, analysis of inspection results indicates continuing concerns about the rigor of sites' implementation of programs for identifying and analyzing hazards, and instances where appropriate controls had not been identified and implemented.

Positive Attributes

At all sites, planning processes for programmatic work are generally well established, and mechanisms are in place to provide the necessary framework for identifying hazards and developing hazard controls. In general, work control processes were found to be comprehensive and to envelope the variety of programmatic tasks evaluated. Furthermore, sites have improved their job hazards analysis processes. For example, at Y-12, the new automated job hazards analysis (AJHA) system provides a comprehensive hazard question set and corresponding controls, as well as requirements for further actions needed to complete the hazard and control identification process. This system results in a more user-friendly and comprehensive hazards analysis, provides for involvement of the appropriate ES&H professionals, and fosters identification of more consistent controls in the final AJHA. At some sites, staff qualifications, education, and training in certain safety and health disciplines are notable.

Increased use of technical procedures at DOE sites is evident, either in a step-by-step fashion or for reference use. Most sites have extensive procedure development, review, and approval systems, resulting in high-quality technical procedures that provide the proper instructions for workers to safely perform programmatic activities. In general, hazards unique to the processes are effectively integrated into the technical procedures.

Contractors at some sites have developed innovative techniques for performing program work more safely and efficiently. For example, one contractor used vacuum excavators and air-powered lances to improve the safety and efficiency of D&D-related excavations in environments where

underground surveys are not precise and outdated facility drawings cannot be relied on to accurately characterize underground hazards. Another innovative hazard control used at several sites was an automated laboratory access control system that ensured that only qualified personnel were granted access to the laboratory.

Opportunities for Improvement

Contractor management, supervisors, and safety professionals should improve the rigor with which their hazard analysis and control requirements are implemented. In many cases, contractors do not rigorously follow or implement existing management directives or program requirements called out in site-level documents, so some hazard controls are not identified or incorporated into working-level documents. For example, a continuing common problem at some sites involves incomplete identification of institutional standards and safety requirements in work instructions, such as specific chemical personal protective equipment (PPE). As a result, the definition of controls is ambiguous and leaves the decisions on the specific type of PPE to use to the worker's discretion. In other cases, contractor work planning and control processes lack adequate mechanisms to ensure that controls identified in the hazard identification process are effectively integrated into work instructions before work is performed.

Several sites have not rigorously followed programmatic requirements in a manner that demonstrates or ensures compliance with all site-level and DOE radiological safety standards and requirements. For example, at one site, there were no documented radiological surveys in contaminated work areas, so the site did not meet site and regulatory requirements intended to ensure complete hazards analysis, adequacy of controls, and worker protection during work. At another site, the radiological work permit process was not implemented in a manner that ensured that all controls were clearly identified, documented, and understood by workers and ES&H professionals prior to performing work, as required by site requirements. Weaknesses were also identified at several sites in defining or implementing established radiological requirements in the areas of as-low-as-reasonably-achievable (ALARA) reviews, dosimetry, and radiological hazards analysis and posting. In most cases, these weaknesses resulted from a failure of responsible safety professionals to rigorously follow existing site-level and/or DOE requirements.

Conclusions

At the facilities that OA evaluated, contractor supervisors, technical and safety support personnel, and workers have effectively integrated safety into the work planning process, and major programmatic processes are generally executed effectively. In most cases, project planning mechanisms are effective in integrating project engineers, workers, and ES&H professionals into the planning process to identify hazards and establish appropriate controls for major work evolutions. However, additional rigor is needed in implementing established site-level planning processes and requirements to ensure that all hazard controls are properly identified and included in working-level documents. In addition, instances were identified where supervisors and safety professionals have allowed work to be performed in violation of established requirements or hazard controls, in part because of complacency by the supervisors and workers and an insufficiently safety-conscious approach to work. DOE and contractor line management needs to look for and correct such potential degradations in safe work practices as part of its self-assessments and in communications to workers.

Maintenance

Introduction

All OA ES&H inspections during this reporting period examined facility and infrastructure maintenance work activities. OA placed emphasis on maintenance because maintenance activities often involve a wide variety of potential hazards to workers. Further, OA's ongoing review of reportable events and near misses across the DOE complex indicates that a significant number of events occur during maintenance activities.

Maintenance activities at each DOE site involve significant workforces (typically from 300 to 900 workers) that perform a wide range of activities inside and outside of all facilities and buildings during all weather conditions. Because workers may maintain infrastructure and programmatic equipment and perform work in programmatic spaces, they can be exposed to hazards from both infrastructure maintenance and programmatic activities. Maintenance activities typically include work on roads and grounds, utilities (e.g., electrical, fire protection, steam, air, water, sanitary, and gas systems), vehicles, security detection and protection systems, programmatic equipment, and mission and facility system and equipment interfaces.

Maintenance work activities cross all organizational and facility boundaries and at some sites may involve different processes and procedures that are dependent on the organization or facility where the work is being performed. While most maintenance work is performed by DOE prime contractor personnel, some is performed by service contractors, equipment vendors, and subcontracted maintenance companies at a number of sites. Maintenance organizations also perform some "construction-like" work activities that involve hazards common to the building and construction trades.

Overall, recent OA-40 evaluations indicate that implementation of maintenance programs have continued to improve and that the core functions of ISM are being effectively implemented for moderate- and high-risk work activities. However, OA found that improvement is needed at most sites in the definition of work and documentation of job-specific and facility hazards for lower-risk (skill-of-the-craft) work activities. Although many of these activities involve lower risk, routine skill-of-the-craft work activities continue to cause a number of reportable events across the DOE complex and can result in serious injury or death. While most work is being performed safely, analysis of the inspection results indicates continuing concerns about workers not following procedures and not implementing requirements.

Positive Attributes

With few exceptions, maintenance work activities observed by the OA team at all sites were performed safely and in accordance with approved work packages. Hazards for most work activities were documented in work packages, were well controlled, and had been adequately communicated to both workers and other personnel who could access work areas. Maintenance workers at all sites were found to be experienced and knowledgeable of their assigned tasks, and exhibited a high regard for safety. The number and types of work activities were within a reasonable span of control for responsible supervisors and managers. Workers were generally knowledgeable of the guiding principles and the five core functions of safety management.

Maintenance work control organizations, programs, and procedures have continued to improve with better communication, implementation, and documentation of maintenance work activities. Most sites have defined categories of work, such as low-risk, planned, safety-related, and high-risk work (with well-defined thresholds for each category) and established, standardized work packages for each category. Many sites use known and tested commercial computerized maintenance management systems, such as Passport and Maximo or equivalent systems, resulting in more consistent maintenance work packages. Broad participation by most sites in DOE-wide maintenance meetings has increased site-to-site communication between maintenance and site services organizations across the DOE complex.

Several maintenance organizations have become more aligned and embedded with the major programmatic organizations, resulting in maintenance teams that are more knowledgeable and better trained to support critical infrastructure and mission elements. At several sites, the concept of using core teams composed of dedicated facility-specific maintenance personnel, ES&H personnel, facility and building managers, and building engineers has improved the coordination between programmatic and infrastructure work. Through such documents as memoranda of understanding and facility use agreements, the boundary interfaces and roles and responsibilities between maintenance and programmatic organizations have improved. Roles and responsibilities are clearer, and line management (e.g., facility managers and project managers) has more fully accepted the responsibility for safety and is using the safety organization and SMEs effectively to help fulfill that function.

All DOE site organizations are knowledgeable of S/CI issues and concerns and have implemented elements of S/CI programs into the site services, plant engineering, and maintenance organizations. At several sites, maintenance workers, procurement personnel, and quality assurance receipt inspectors identified suspect/counterfeit material in installed systems and in the procurement chain prior to parts being installed into systems. Maintenance workers at several sites carry badge-size cards with suspect bolt head-stamp information to aid in identifying suspect fasteners. S/CI considerations have been integrated into maintenance procurement and work package procedures at many of the sites. Most maintenance workers (and personnel in other applicable organizations) at all sites that OA reviewed had attended formal S/CI training.

Opportunities for Improvement

Contractor line management, maintenance supervisors, and safety personnel should improve worker exposure assessments and surveys associated with routine, recurring craft activities. Weaknesses continue to be identified in the area of worker exposure assessments and surveys associated with routine, recurring craft activities, such as painting, welding, and carpentry. Worker exposure assessments are required by both Occupational Safety and Health Administration (OSHA) regulations and by DOE Order 440.1A. OSHA 1910.132 requires employers to assess the workplace to determine whether hazards are present, or are likely to be present, that necessitate the use of PPE. It further requires a written certification that the required workplace hazards assessment has been performed. DOE Order 440.1A requires implementing a comprehensive and effective industrial hygiene program to reduce the risk of work-related disease or illness. This program includes initial or baseline surveys and periodic resurveys of all work areas or operations to identify and evaluate potential worker health risks. Identified deficiencies include lack of initial and periodic resurveys, not analyzing for the most limiting or damaging constituents, and not maintaining some elements of programs required by site procedures and upper-tier requirements. The OSHA requirement also includes provisions for review of both field and shop work areas; however, OA continues to identify readily observable safety deficiencies in such areas.

Improve the safe implementation of some skill-of-the-craft work activities. At all sites, deficiencies were identified in the implementation of some skill-of-the-craft work activities. Many sites use relatively simple work orders or job tickets for such activities. These mechanisms, carefully and properly completed, would form adequate ISM documentation of the scope, hazard, hazard controls, job completion, and feedback records. However, there is some degree of complacency in the rigor of implementing these mechanisms for routine, lower-risk work. As a result, work requests are being issued to the field without careful review by supervisors, with deficient or unbounded statements of work and missing hazards and hazard controls. Some of the deficiencies in hazard identification and hazard controls may not be adequately addressed by training or hazard reviews. Specific areas where improvement is needed include: work documents for troubleshooting activities do not always reflect a clear and bounded scope of work (sometimes simply restating the problem reported by work requestors), so that the expectations and limitations of the investigation of the problem are clear to the worker; supervisors/foremen do not always carefully review and sign the work documents before they are released to the craft for work; responsible craft do not perform a mini "worker hazard review" at the worksite and annotate any additional or incorrect hazards (task- or facility-specific) on the work document; the actual work performed is not always well documented on the work order; positive and negative feedback on work definition, hazards, and controls is not well documented in some cases; and completed work orders are not routinely reviewed to ensure that ISM elements and work control procedures are rigorously implemented.

Contractors should ensure that planned work requests are used for higher-risk or more complex work. All sites have identified some thresholds to define work that requires additional planning, and some give examples that either fall below or above the skill-of-the-craft threshold. However, several sites do not include clear thresholds (for items such as complexity, number or multiple types of craft involved, or coordination or supervision involved to safely complete the task) to help identify work requiring additional planning. As a result, some jobs that involved multiple trades or craft, multiple organizations (maintenance, operations, radiological controls, industrial hygiene, etc.), and multiple locations were inappropriately classified as skill-of-the craft. Each step or task of the job could be construed as skill-of-the-craft, but using a graded approach, the collective complexity and coordination were more appropriate for a fully planned work activity. Coordination and communication errors have resulted in a number of events across the DOE complex.

Conclusions

A continuing challenge for all DOE sites is to safely perform routine preventive and corrective maintenance activities with the appropriate level of craft instructions, hazard information, and controls consistent with ISM, DOE order requirements, and regulations. Improvements in maintenance programs were observed at all sites evaluated. There is a better understanding of ISM and the core functions by line organizations, maintenance managers, supervisors, and workers. For example, core functional elements are being used at several sites to evaluate work activities

and documentation. Work is being safely performed by maintenance organizations in most cases, and programs, procedures, and implementation have improved. However, continued management attention is required in recurring areas of concern, including workplace surveys and exposure assessments, skill-of-the-craft work documentation, and specificity of thresholds between skill-of-the-craft and planned work packages.

Subcontractors

Introduction

All DOE sites evaluated during 2003 used subcontractors to a varying extent. Most of the subcontracting work that OA observed involved construction, renovation, and D&D of aging facilities. Subcontractors were also integrated into a wide range of activities, including environmental support, service contractors assisting with maintenance, procurement, and vending services. Sites conducting research and development often rely on subcontractors to service and maintain equipment used in research activities.

Most subcontractors are contracted through the prime DOE site contractor, in which case the prime contractor assumes responsibility for defining the overall project work scope and generic ES&H requirements. Typically, the prime contractor also monitors and assesses the subcontractor's work activities through subcontractor technical representatives, project managers, and safety personnel. Frequently, subcontractors use other subcontractors to complete assigned work activities, and it is common to encounter several tiers of subcontractors performing work at a DOE site.

OA evaluated subcontractor work activities within the framework of ISM Core Functions #1 through #4 (i.e., define work, analyze hazards, develop and implement controls, and work within controls). In addition, OA focused on the flowdown of ES&H requirements to the subcontractor. Overall, recent OA inspections indicated that subcontractors are performing their work safely and, for the most part, in accordance with DOE and prime contractor requirements and expectations. However, the evaluation results also indicated that improvement is needed at most sites in the definition of work scopes for D&D activities, clear identification of all ES&H requirements in work documents, and rigorous adherence to work controls.

Positive Attributes

Planning and scheduling of subcontracted construction and D&D work is well coordinated, organized, and communicated through construction planning and scheduling meetings. Plan-of-the-day and plan-of-the-week meetings, which are conducted at most sites, enhance communication and coordination of work activities among subcontractors. Work scheduling meetings are well attended by subcontractor personnel and by construction project management and safety representatives. Frequent production, scheduling, and safety meetings address safety, work breakdown, coordination of subcontractors, and allocation of resources. For service contractor work, procedures for prioritization are in place at most sites and are appropriately used to prioritize work based on risk, mission, and the importance of systems and equipment being serviced or maintained. At most sites, mechanisms are also in place for subcontracted work to ensure readiness prior to commencement of work, such as pre-job or pre-shift briefings, readiness reviews, and kickoff meetings.

At most sites, formal processes have been implemented to ensure that applicable ES&H requirements flow down to subcontractors. The subcontracting process typically includes appropriate provisions for involvement of environment, safety, health, and quality SMEs in the planning, conduct, and reviewing of subcontracted activities. Most sites have developed detailed master specifications for subcontracted construction and D&D work. Because the specifications identify the pertinent Federal and state regulations, subcontractors are able to focus on a tailored set of ES&H requirements provided in the specifications. The ES&H specifications, which are typically prepared by the prime contractor, provide a mechanism for delineating the pertinent ES&H regulations. Several sites have developed ES&H handbooks to assist subcontractors in understanding the applicable ES&H regulations. Subcontractors are also required to develop health and safety plans that document the subcontractor's understanding of the applicable ES&H requirements, and define the subcontractor's programs for meeting those requirements. Subcontractors are often given the option of using their own health and safety plan or adopting the site prime contractor's plan. In general, the health and safety plans reviewed for construction and service subcontractors were well written, addressed applicable

ES&H functional areas, and were consistent with site and DOE requirements. As discussed below, a few exceptions were noted with respect to requirements that are unique to DOE sites, such as medical surveillance, chemical exposure control programs, and radiation protection programs. In addition, a few sites have established different, and less stringent, requirements for subcontractors than for the prime contractor performing the same or similar work.

In general, most hazards for work involving subcontractors are appropriately identified, analyzed, characterized, and documented. Project-level hazards are addressed through health and safety plans. Activity-level hazards are addressed through work packages and typically are documented in activity-level hazards analyses or job hazards analyses. At some sites, subcontractors use the same work control processes as the site maintenance organization, adding to the formality, safety, and consistency of subcontracted work activities. Subcontractors are increasingly using automated hazards analyses processes to identify and analyze hazards. When subcontractors encounter environmental hazards, such as in waste segregation or processing work, or in environmental sampling activities, they have generally been effective in identifying, characterizing, and documenting the hazard. Overall, subcontractors have addressed environmental hazards associated with waste streams from D&D and construction work effectively.

Most subcontracted work is performed safely. Injury and illness rates for subcontractors generally are well below comparable construction and general industry rates in the commercial sector. At several sites, safety trends for subcontracted work are improving. Prime DOE contractor project managers, subcontractor technical representatives, and the contractor's ES&H staff perform extensive review and monitoring of subcontractor performance and have been effective in mentoring subcontractors to ensure compliance with ES&H requirements and expectations.

Opportunities for Improvement

Prime contractors should ensure that work scopes for construction and D&D projects are well defined such that hazards and hazard controls are identified and linked to specific work activities or construction phases. Work scopes for a number of construction and D&D projects being performed by subcontractors are not sufficiently defined to allow hazards and hazard controls to be identified and linked to specific work activities or construction phases. As a result, some hazards have not been sufficiently analyzed, or the appropriate engineering or administrative controls have not been implemented to mitigate the hazard. Most construction activities and D&D activities involve a variety of sequential work activities, multiple craft personnel, and project durations that extend over months or years. Because work activities are defined in a number of work documents, subcontractors performing construction and D&D work face challenges in adequately identifying, documenting, and communicating work scope or changes in work scope once the project has commenced. In some cases, hazards and controls were missed in subcontracted D&D activities because the scope of work was too broad to readily identify all the hazards. In other cases, hazards and controls were missed at subcontracted construction sites because the work scope did not address new hazards resulting from changes in work scope or from temporary modifications. In a few cases, generic work orders were not sufficiently tailored to the work activity such that hazards could be identified and analyzed and the appropriate control could be implemented.

Subcontractors should ensure that activity-level work documents clearly identify all ES&H requirements. Some subcontractor-generated, activity-level work documents (e.g., work packages and activity-level hazards analyses) contain ambiguous, conflicting, or inaccurate ES&H requirements. Although project-level ES&H requirements for subcontractors are generally well defined and documented in specifications and health and safety plans, in some cases at the work-activity level, hazard controls and inspection requirements were not identified in the work documents or were not implemented. In a few cases, safety permits used by subcontractors did not accurately reflect current workplace controls or locations. In other cases, ES&H requirements, such as the PPE specified in one type of work document used by subcontractors (e.g., activity hazard analyses), conflicted with other work documents (e.g., radiation work permits). Subcontractor work documents at several sites did not provide clear directions when the hazard control was required, or how the control should be implemented.

Subcontractor managers and supervisors should emphasize the need for rigorous adherence to procedures, postings, or other required controls. In some cases, subcontracted construction workers did not follow site safety procedures or requirements identified in construction work packages, or violated construction site postings and construction

barriers. D&D workers were observed on several occasions not following safety postings or the requirements in safety permits. In a few cases, subcontractors performed work without the appropriate training, licenses, or certifications.

DOE prime contractors should improve processes for ensuring that subcontractors have established and implemented sufficient controls for S/CIs. During the OA special study of the DOE's management of S/CIs, several sites did not have sufficient controls to ensure that procurement processes and equipment brought on site by subcontractors precluded the introduction and use of S/CIs. Most of the sites evaluated during this study did not adequately inform their subcontractors of S/CI requirements, verify that S/CI processes were being implemented by subcontracting organizations, or ensure that S/CI awareness training was provided to subcontractors. As a result, construction and service repair work performed by subcontractors may have been at increased risk of inadvertently using suspect or counterfeit materials.

Conclusions

Overall, subcontracted work activities have been successfully integrated into site work activities. Many subcontracted companies have improved their overall health and safety programs and reduced their injuries and illnesses as a result of working at DOE sites. Prime contractors perform extensive reviews of subcontractors' activities to ensure compliance with ES&H requirements and expectations. However, a number of challenges remain with subcontracted work activities, particularly with respect to the adequacy of work definition, tailoring and linking hazard controls to specific work activities, and following ES&H requirements documented in work packages, procedures, and work area postings.

Environmental Protection

Introduction

Environmental programs at DOE sites comprise a wide range of activities, from managing waste and monitoring emissions created by current operations, to remediating legacy contamination from past operations. Under Federal, state, and local environmental regulations, most aspects of these programs are subject to external monitoring, inspections, and enforcement actions. Environmental radiological protection concerns, under the Atomic Energy Act, are regulated solely by DOE. Because of the potential impact on the public and the environment, many environmental functions receive close scrutiny by regulators and the public.

Most environmental activities are performed by support organizations that monitor emissions; manage waste storage, treatment, and disposal facilities; conduct remediation of past contamination; and handle environmental compliance actions (e.g., obtaining permits and negotiating cleanup standards). Line operations personnel also have environmental protection responsibilities, including properly managing waste at the point of generation and ensuring that production activities do not adversely impact the public or the environment. At some sites, environmental functions are performed by subcontractors. DOE field offices provide line management oversight of prime contractor and subcontractor environmental functions.

OA inspections of environmental protection programs in the past year focused on hazardous, non-hazardous, and radioactive waste management. OA evaluated environmental protection activities within the framework of ISM Core Functions #1 through #4. In addition, OA evaluated actions by DOE sites in meeting requirements for implementing (by December 2005) an EMS as required by DOE Order 450.1, *Environmental Protection Program*, issued January 15, 2003. Overall, recent OA-40 evaluations indicated that DOE sites are protective of the environment and are effectively implementing DOE Order 450.1.

Positive Attributes

DOE sites have effectively integrated centralized hazardous, mixed, and radioactive waste management programs into their ISM programs. Most sites have incorporated waste management into their ISM processes so that work can be defined to support the identification, analysis, and proper control of waste generated during work activities. Most sites have expanded ISM processes to include waste management, and some utilize checklists and/or environmental expertise to analyze projects and activities to determine the need for controls for waste management in accordance with site and external requirements. These processes are consistent with new requirements specified in DOE Order 450.1. In addition, most sites that were evaluated had appropriately implemented the DOE Order 450.1 requirements and had either included the order in the contract or specified an appropriate international standard.

Most sites have implemented effective pollution prevention and waste management programs. Most sites have effective programs for analyzing operations and construction activities to determine pollution prevention/waste minimization opportunities; in fact, one site wrote a book on conducting pollution prevention opportunity assessments at DOE laboratories. Several sites have implemented tight controls to ensure that hazardous and radioactive wastes are not introduced into the sanitary waste stream. Generally sites have instituted effective guidance for controlling waste during construction, D&D, maintenance, operations, and research activities in order to meet site, DOE, and external regulatory requirements for hazardous and radioactive waste. In order to ensure effective waste management, many sites have deployed environmental and/or waste management expertise as a control into operations, facility support, and research organizations to provide direct support to waste generators. Overall, the waste management functions of waste generators in line organizations and waste management support organizations are performed in accordance with site and DOE requirements and in compliance with external regulations.

Opportunities for Improvement

Contractors should improve the rigor of implementation of waste management processes. In many work packages, the work scopes do not provide enough details to determine environmental risks, thus creating a reliance on informal exchanges between persons with environmental expertise and line operations. In addition, contractors should improve coordination and review of hazards analyses by impacted organizations, including waste management personnel and/or personnel with environmental expertise. Further, at several sites, administrative controls were not adequate; environmental expertise, although available, was not used; informal actions were taken to select disposal paths; and inappropriate pallets were utilized to store waste drums.

Conclusions

With the issuance of DOE Order 450.1, *Environmental Protection Program,* sites are continuing work to enhance EMS and to integrate waste management functions into ISM. Site programs for waste management have generally been effective, but further improvements are needed to ensure that detailed information on waste generation is incorporated into work planning and controls, administrative controls are followed, environmental expertise is utilized, and waste operations are performed in strict compliance with DOE and external requirements.

Essential System Functionality

Introduction

ESF reviews are highly technical, detailed engineering evaluations of selected essential systems at DOE sites. Essential systems include safety-class systems and other systems, such as fire protection, ventilation, and emergency electrical power, that prevent or mitigate the release of hazardous materials that could adversely affect the public, site workers, or the environment. The ESF reviews focus on design, configuration control, maintenance, surveillance and testing, and operation of essential systems. OA's ESF reviews are similar to and complement DOE and contractor line management reviews of vital safety systems performed in response to DNFSB Recommendation 2000-2, *Configuration Management, Vital Safety Systems*. However, OA reviews also evaluate the design of the system (e.g., design assumptions and analysis), the adequacy of certain aspects of documented safety analyses (DSAs) and technical safety requirements (TSRs), and implementation of the unreviewed safety question (USQ) process for nuclear facilities.

During this reporting period, OA performed ESF reviews of seven systems at four sites: two fire protection systems, a toxic gas storage system, a criticality accident alarm system, an emergency firewater injection system, a reactor primary coolant pump shutoff system, and a confinement ventilation system. OA also reviewed DOE complex-wide efforts to improve safety bases, safety system oversight, and configuration management.

OA found that essential systems were being generally well maintained and operated. However, significant design flaws were found at several sites that could have prevented the systems from performing their intended safety function. OA rated operations for all systems reviewed as Effective Performance; maintenance and surveillance and testing were rated as Effective Performance for half of the systems and Needs Improvement for the other half of the systems; and design and configuration management was rated

as either Needs Improvement or Significant Weakness for all but one of the systems reviewed. An analysis of the findings and weaknesses indicated that a lack of attention to detail in establishing the system design and associated surveillance and test requirements was a primary cause of the observed weaknesses.

Positive Attributes

DOE took significant steps in 2003 to increase its confidence that safety systems will effectively perform their safety functions. DOE has expended a significant effort over the last two years to review and revise almost all of its over 200 hazardous nuclear facility safety basis documents by the April 2003 deadline, as required by an April 2001 revision to 10 CFR 830. In addition, DOE completed a number of efforts to implement commitments made in response to DNFSB Recommendation 2000-2 to enhance reliability of essential systems. These included (1) completion of "phase II" system assessments for the most hazardous facilities and establishing programs for continuing phase II-like assessments on other safety systems, (2) taking initial steps to establish a system engineer program for safety systems modeled after similar programs in the commercial nuclear industry, and (3) updating the DOE handbook for ventilation systems. These efforts have improved the confidence that essential system safety functions are properly defined and that safety systems will appropriately operate if called upon.

System operators demonstrate a high degree of competence, training programs are effective, and operation instructions and procedures appropriately support system operations. In general, management at the facilities that were evaluated has established effective programs for preparing operators to operate the safety systems under normal, upset, and emergency conditions. Training and qualification programs are formally documented, and the operations and maintenance personnel who were interviewed demonstrated good understanding of system design and operations. The training program at the Advanced Test Reactor (ATR) is particularly effective; it utilizes a reactor simulator to train operation crews and includes performance evaluations of operating crews working as a team. ATR management has allocated resources to staff five operating crews to allow time for training off-shift crews.

Furthermore, operating procedures for the systems that were reviewed are generally clear and provided effective direction. Operations personnel demonstrated during walkdowns of systems and procedures that they had in-depth knowledge of systems and could effectively implement procedures.

Safety systems were found to be in good material condition, with minimal maintenance backlog and up-to-date surveillances. In general, the systems that were reviewed are in good physical condition. Facility management has appropriately prioritized maintenance on the safety systems, and therefore corrective maintenance backlogs are very low. The efforts of and collaboration between maintenance engineers, system engineers, and maintenance technicians in the preparation for maintenance activities on the criticality accident alarm system at Y-12 were particularly effective. These preparations included a detailed review of documents, and trial runs at a mockup of the system. In addition, Y-12 has established an effective system for monitoring the operability of the criticality alarm system, which includes monitors displaying system status in a continuously manned central control room and in the maintenance shop.

Opportunities for Improvement

DOE and contractors should improve the degree of rigor, level of technical justification, and attention to detail in the design and review of safety systems. For several of the systems reviewed, OA identified significant system design deficiencies that could have resulted in the systems not being able to fulfill their safety functions. Areas of deficiency included: (1) inadequate consideration of critical design factors that established the conditions under which the system must operate, (2) inadequate analysis of the impact of natural phenomena on system operability, and (3) inadequate analysis of safety system response.

A number of instances were identified where critical design factors were not adequately analyzed. For example, a high efficiency particulate air (HEPA) filter loading during design basis accident was not appropriately analyzed to ensure the structural integrity of the filter and to ensure that the heating, ventilation, and air conditioning (HVAC) system was capable of maintaining negative confinement pressure with supply fans running. In other examples, the worst-case reactor accident conditions were not analyzed (surge tank vent line break would cause a more rapid depressurization than the evaluated water line break), and the gas bunker design pressure was below calculated accident blast pressure.

In several instances, natural phenomena were not adequately analyzed. As examples: seismic analysis of fire protection and reactor water makeup piping was not adequate; the impact of non-seismic equipment located in the vicinity (e.g., above) of essential equipment was not evaluated; snow/ice loads on facility blowout panels were not evaluated; wind-induced negative pressures on the outside of the building were not considered in analysis, resulting in inadequate building differential pressures for the confinement system; and essential power supplies were not protected against flooding.

In a few cases, safety system operations were not adequately analyzed. For example, at one site, the extent and impact of a severely degraded net positive suction head during system operation and the potential for air induction into reactor during an accident due to tank vortexing or from dry piping were not analyzed.

The number and technical significance of these deficiencies indicate that the depth, level of rigor, and attention to detail in technical reviews performed on typical essential systems—at the initial design stages, during subsequent reviews of updated DSAs, and in system assessments such as facility evaluation board reviews—have not been adequate. Improvements are needed in both initial design and subsequent system reviews to ensure that systems will actually perform their safety function for the spectrum of accidents that have been postulated. Management should ensure that appropriate resources are allocated and that technically qualified personnel are assigned to perform rigorous design reviews.

Contractors should rigorously implement configuration management requirements to ensure that safety systems will continue to be capable of performing their safety functions. Current configuration management requirements set expectations for rigorous configuration management. However, many of the safety systems that were reviewed did not meet these expectations for a number of reasons—the primary reason being poor documentation of the safety and design basis for older systems. Some of the systems reviewed were over 20 years old, had various pedigrees of safety bases and other design documents, and had undergone many design changes. Specific problem areas included: system drawings were not kept current, information supporting design analysis was not maintained, and vendor manuals were not maintained. These weaknesses reduce the assurance that the system will operate as designed, and they increase the likelihood of an error during system design changes and routine system operation and maintenance (e.g., system lineup, lockout, and equipment procurement). Although many sites have taken actions to address this issue, further attention is needed, with particular attention to facilities that may be nearing the end of their mission.

The Office of Environment, Safety and Health (EH) should revise the USQ guidance to be consistent with 10 CFR 830 requirements. The USQ process, along with other tools, assures that the authorization basis is kept valid and current. 10 CFR 830 required all contractors to have DOE-approved USQ procedures and processes in place by April 10, 2003. In every facility reviewed, OA found that the contractor and the DOE approval organization had made good-faith efforts to meet this requirement and to follow the site-specific procedures and processes they had put in place. However, OA discovered numerous non-compliances with 10 CFR 830, resulting from site-specific procedures that did not fully comply with the CFR requirements. In many cases, the non-compliances were attributable to the contractors following certain inappropriate guidance contained in DOE Guide 424.1-1, *DOE Guide For Use In Addressing Unreviewed Safety Question Requirements*.

Although DOE Guide 424.1-1 contains excellent guidance on many points concerning USQ processes, some specific areas are ambiguous, incorrect, incomplete, or contrary to the CFR requirements. For example, the CFR requires that a USQ determination be performed for a "temporary or permanent change in the procedures as described in the documented safety analysis," which would include maintenance procedures associated with safety systems, structures, and components described in the DSA. The guide, on the other hand, cited changes to maintenance procedures as a "categorical exclusion"; that is, such changes would, as a category, *not* require a USQ determination. EH (the guide's author) has agreed to make the necessary changes. However, it should be recognized that until the guide is changed and the resultant procedural changes are made, some procedures in the DOE complex might be non-conservative.

Contractors should ensure that safety systems' surveillance procedures include all surveillances required by safety analysis and are sufficient to ensure system operability. The sites that OA evaluated have established a set of system surveillance and testing requirements that appropriately test most of the system functions. However, many specific weaknesses were identified that result in reduced assurance that the system would function when

needed. Specific examples include: errors in TSR setpoints for critical operating parameters (e.g., water level) due, in part, to lack of rigor in performing setpoint calculations, including failure to follow established procedures; test acceptance flow criterion less than the flow analyzed in the safety analysis report; backup air supply testing not including a test for system leakage that could render the system inoperable; invalid TSR interpretations (e.g., that operating criteria specified in surveillance requirements needed to be met only at the time of the surveillance); industry standard surveillances not included in surveillance procedures; and TSRs not addressing critical safety limits and system performance parameters.

Conclusions

The systems that OA reviewed were generally well maintained and tested to support continued operability. Operators were very knowledgeable of system operations, were supported by effective procedures, and demonstrated the capability to effectively operate the systems under normal and emergency conditions. However, some systems have significant design deficiencies that could prevent them from performing their essential functions under accident conditions. Further, some systems do not have a complete set of surveillances that address all appropriate industry standards and test all of the system safety functions. Weaknesses also exist in some USQ programs because of poor guidance in some areas of the DOE USQ Guide.

DOE has made programmatic improvements that should improve the reliability of the systems, and these improvements are currently being institutionalized. However, these programmatic improvements need to be enhanced to include a rigorous engineering review of safety system designs.

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