

**Independent Oversight
Special Review of**



Construction Safety and Health Programs

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Office of Independent Oversight
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Abbreviations Used in This Report

ACGIH	<i>American Conference of Governmental Industrial Hygienists</i>
CFR	<i>Code of Federal Regulations</i>
DOE	<i>U.S. Department of Energy</i>
EM	<i>Office of Environmental Management</i>
ES&H	<i>Environment, Safety, and Health</i>
HSS	<i>Office of Health, Safety and Security</i>
NFPA	<i>National Fire Protection Association</i>
NNSA	<i>National Nuclear Security Administration</i>
OSHA	<i>Occupational Safety and Health Administration</i>
PPE	<i>Personal Protective Equipment</i>
SC	<i>Office of Science</i>
SLAC	<i>Stanford Linear Accelerator Center</i>

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Executive Summary

Construction work involves a number of inherent hazards and the number of injuries and illnesses related to construction is high relative to other work areas within the U.S. Department of Energy (DOE). Therefore, the DOE Chief, Health, Safety and Security Officer identified construction safety as a focus area for Office of Independent Oversight environment, safety, and health inspections.

This special review of construction safety was performed by the Office of Independent Oversight, within the Office of Health, Safety and Security (HSS), to provide feedback to DOE line management and contractors on the effectiveness of line organizations at DOE sites in implementing construction safety requirements. The special review is based upon data collected during scheduled Independent Oversight inspections at nine DOE sites over the past three years.

Most construction subcontractors have established work control processes that address the core functions of integrated safety management. The quality and effectiveness of these processes varies but has improved significantly since the DOE safety management system policy was issued over ten years ago. In addition, at each evaluated site, steps have been taken to improve these processes, and noteworthy practices were identified in the construction safety programs at some sites. For example, the Idaho Cleanup Project contractor at Idaho National Laboratory has established technical response teams to effectively and promptly assist supervisors and foremen in determining a course of action when unanticipated work conditions occur.

However, further improvements are needed in work control processes to ensure that construction workers are consistently informed of hazards and that appropriate controls are established to mitigate these hazards. The need for improved work control processes is most apparent for health hazards associated with exposures to hazardous materials and noise. Weaknesses were also noted in the implementation of safety controls for a number of important aspects of construction safety, including pre-job briefings, hazard identification and analysis, industrial hygiene support at the construction workplace, noise protection, electrical safety, penetrations and excavations, fire protection, occupational medicine, and work planning. Most of the unsafe and non-compliant work practices observed during Independent Oversight inspections occurred because workers were unaware of the hazards and/or the controls associated with their assigned work. In addition, some unsafe work practices occurred when workers failed to comply with clearly established requirements (e.g., requirements for personal protective equipment).

Although the need for improvement varies from site to site, most work control processes and their implementation can be improved with respect to identification and control of health hazards and implementation of Title 10 of the Federal Code of Regulations, Part 851, Worker safety and Health Program. Therefore, DOE line management further enhances oversight of prime contractors' construction safety programs and subcontractor construction safety programs and implementation. In addition, specific recommendations for DOE sites resulting from this Independent Oversight review include:

- Emphasizing safety requirements that are unique to DOE sites during pre-bid and pre-construction meetings with construction subcontractors.
- Strengthening contractual health and safety provisions in construction subcontracts.
- Reviewing subcontractor health and safety plans more carefully to ensure that they meet the requirements of 10 CFR 851.
- Enhancing monitoring, review, and evaluation of subcontractor construction safety programs and implementation.
- Strengthening processes for involvement of subject matter experts in the planning of construction work.
- Ensuring that construction subcontractors effectively implement the occupational medicine requirements of 10 CFR 851.
- Increasing the effectiveness of pre-job briefings conducted by construction subcontractors.
- Strengthening the control of noise exposure hazards.
- Enhancing electrical safety by addressing problems related to contacting electrical conductors during excavations and wall penetrations.
- Improving fire safety by ensuring that construction subcontracts and/or approved fire safety plans clearly identify the organization responsible for issuing hot work permits and reference applicable National Fire Protection Association (NFPA) requirements.

1 Introduction

Construction work involves a number of inherent hazards, such as falls from elevated work areas; pinch, crush, and entanglement hazards associated with machinery; electrical shocks; pressurized systems; burns; exposure to chemicals; and various other hazards. In addition, the hazards in a particular workplace may be difficult to characterize because of uncertainties about past use of facilities and grounds, particularly for demolition and construction in facilities undergoing decontamination and decommissioning. Further, hazards may change on a daily basis as new construction tasks begin and work conditions change. Injury and illness rates show that construction is one of the more dangerous types of work; only about six percent of the U.S. work force is engaged in construction, but 20 percent of work-related fatalities occur in the construction industry. The number of injuries and illnesses related to construction is also high relative to other work areas within the U.S. Department of Energy (DOE). Therefore, the DOE Chief, Health, Safety and Security Officer identified construction safety as a focus area for Office of Independent Oversight environment, safety, and health (ES&H) inspections. This special review of construction safety was performed by the Office of Independent Oversight, within the Office of Health, Safety and Security (HSS), to provide feedback to DOE line management and contractors on the effectiveness of line organizations at DOE sites in implementing construction safety requirements.

This special review is based on data collected over the past three years (covering the timeframe from late 2005 to early 2008) during scheduled inspections performed by Independent Oversight's Office of Environment, Safety and Health Evaluations, at the nine DOE sites listed in Table 1. The table also identifies the DOE program office that has primary management responsibility for each site.

Table 1. Inspected Sites

SITE (Date of Inspection)	Headquarters Program Office
Brookhaven National Laboratory (November 2007)	Office of Science (SC)
Idaho Cleanup Project (August 2007)	Office of Environmental Management (EM)
Lawrence Livermore National Laboratory (May 2007)	National Nuclear Security Administration (NNSA)
Oak Ridge National Laboratory - Environmental Management program activities (June 2006)	EM
Pantex Plant (February 2005)	NNSA
Sandia National Laboratories (April 2008)	NNSA
Savannah River Site (February 2006)	EM and NNSA
Stanford Linear Accelerator Center (January 2007)	SC
Y-12 Plant (September 2005)	NNSA

Significant construction was under way at each of these sites during the time of data collection: existing facilities were being renovated; old, unneeded facilities were being removed; and new facilities were being constructed to reduce operating expenses and enhance mission capabilities. Some of this work was performed by DOE prime contractors, but most was subcontracted. At some sites, a dedicated, subcontracted craft workforce is maintained on site to provide full-time support for routine maintenance and construction. At other sites, such work is normally subcontracted to offsite firms. All of the prime contractors in this sample subcontracted large construction projects, such as construction of new buildings, to outside construction companies.

DOE safety and health program requirements for construction activities are established in 10 CFR 851, *Worker Safety and Health Program Rule*, which became enforceable in 2007. This rule replaces a similar set of requirements that were included in DOE Order 440.1A, *Worker Protection Management for Federal and Contractor Employees*. DOE sites are also required to apply the integrated safety management policy in DOE Policy 450.4, *Safety Management System Policy*, to construction activities and to flow down these requirements to subcontractors through provisions in construction contracts. This report provides an assessment of the extent to which these requirements have been effectively implemented for construction work at DOE sites.

Because of integrated safety management and the DOE management focus on reducing injuries and illness, DOE has experienced a general downward trend in injury and illness rates over the past ten years. The most recent available injury and illness rates – as measured by the total recordable case rate and the days away from work due to restriction or job transfer rate – show that DOE rates are less than one third that of the industry averages for the private sector.¹ Nevertheless, the injury and illness rates at DOE sites for construction are still considerably higher for construction than for most other activities, and a significant portion of the accidents at DOE involve construction activities. Therefore, a continued focus on enhancing construction safety by DOE line management and Independent Oversight is warranted.

Sections 2 and 3 of this report identify best practices and weaknesses, respectively. Section 4 provides Independent Oversight's overall observations about DOE site effectiveness in implementing construction safety programs. Section 5 identifies recommendations for site prime contractors and DOE site offices to improve construction safety.

The weaknesses identified in this report are not necessarily evident at every site that was evaluated and may not apply to some DOE sites that were not specifically evaluated. However, the weaknesses were noted with sufficient frequency to represent a generic concern across DOE and therefore warrant consideration and attention at all DOE sites. Similarly, the opportunities for improvement, which consider the generic weaknesses, should be evaluated for applicability at all DOE sites.

¹ CAIRS data for cost plus and lump sum construction contractors indicates a total recordable case rate (TRC) of 1.91 for DOE work in 2006. The TRC for US private industry was 5.8 for this same period. (<http://www.bls.gov/iif/oshwc/osh/os/ostb1757.pdf>)

2 Best Practices

The Idaho Cleanup Project contractor has noteworthy processes for supporting decontamination and decommissioning of the Reactor Technology Center and for verifying training qualifications. A technical response team was assigned daily to assist supervisors and foremen in determining a course of action when unanticipated work conditions occurred. The technical response team, which included members from project management, engineering, radiological control, environmental, and industrial hygiene, provided prompt involvement and integration of health and safety professionals in situations likely to involve new or changing hazards or controls. The technical response team visited each job site daily, remained on call throughout the day, and provided documented guidance. The Idaho Cleanup Project contractor also systematically confirmed training by comparing the training records of assigned workers with a list of training requirements generated by an automated job hazard analysis tool. Pre-job briefings for the Idaho Cleanup Project were especially well conducted; worker attendance and participation were good, and hazards and controls were thoroughly addressed.

Some sites have taken significant steps to strengthen electrical safety and to achieve compliance with electrical safety standards. For example, the Stanford Linear Accelerator Center (SLAC) has performed arc-flash calculations for electrical panels across the site, and each panel has been clearly marked to identify electric shock and arc-flash hazards and to specify required personal protective equipment (PPE). SLAC also improved lockout/tagout training and made it available to subcontractors. Other actions taken by DOE prime contractors to strengthen electrical safety included providing National Fire Protection Association (NFPA) 70E training to subcontractor electricians, requiring construction subcontractors to follow prime contractor lockout/tagout procedures, prime contractors performing the initial lockout/tagout on circuits to be worked by subcontractors, and involving electrical subject matter experts in the review of subcontractor lockout/tagout programs.

Sandia National Laboratories (SNL) has recently taken two initiatives to better control exposures to health hazards. The first initiative is the implementation of a Welding, Cutting, and Brazing Control Permit that contains exposure controls based upon exposure assessments by SNL industrial hygiene staff. Controls specified by these permits will reduce the potential for exposures to fumes containing hazardous materials such as lead, chromium, zinc, beryllium, and phosgene gas. The second initiative is the development of a library of exposure hazards and controls for commonly performed construction activities. The library will be used during pre-bid meetings with prospective construction subcontractors to better explain SNL expectations for controlling exposure hazards and will be used as a guide for preparation and review of contract-specific safety plans. These two initiatives are particularly valuable for construction work because construction subcontractors do not always have the expertise needed to identify and analyze some types of hazards.

The HSS Office of Health and Safety (HS-10) has developed guidance for occupational medicine compliance. DOE contractors at all levels (prime contractor and subcontractors) are responsible for ensuring that the occupational medicine requirements in 10 CFR 851 are met for construction work performed at DOE sites. The rule is applicable directly to any entity (including construction subcontractors) under contract to perform activities at a DOE site. In addition, DOE prime contracts include DEAR Clause 49CFR970.5204-2(h) which states that prime contractors are responsible for compliance with the ES&H requirements applicable to their contracts regardless of the performer of the work. The HSS Office of Health and Safety has developed updated guidance for implementation of occupational medicine requirements, available on the HSS website, hss.energy.gov, under the link for “10 CFR 851 Rule.” This guidance will be included in the occupational medicine section of DOE Guide 440.1-8, *Implementation Guide for Use with 10 CFR 851, Worker Safety and Health Program*.

3

Weaknesses

Inadequate work planning and communication contributed to a number of safety deficiencies and work delays. Examples include subcontractors who were required to participate in lockout/tagout but did not have approved lockout/tagout programs; aerial lifts that were not available when needed, leading to the use of less safe ladders to access elevated work locations; special ventilation that was not available when needed; subcontractors who needed respiratory protection but did not have respirators, training, or approved respiratory protection programs; and some of the other examples discussed in the weaknesses below. Several factors contributed to these deficiencies. First, in some cases, work planning processes did not sufficiently involve workers and subject matter experts in the identification and analysis of hazards. Inadequate hazard identification and analysis can often be traced to inadequate involvement of subject matter experts in work planning. Work control processes do not always include adequate criteria or “triggers” that prompt work planners to determine the need for subject matter expert involvement. Second, in some cases, worker involvement is not sufficient to ensure that workers help to identify and understand the hazards. Worker involvement is not always possible in the early stages of planning for construction work because such planning is sometimes performed by general subcontractors before lower-tier subcontractors are hired. In such cases, prime contractors do not always ensure that general subcontractors use worker and subject matter expertise in the planning stages and coordinate with lower-tier subcontractors as soon as practical. Third, pre-job briefings at some sites were not fully effective in communicating hazards to workers at the time of the job. The observed problems include infrequent briefings for jobs that were performed over periods of several days or weeks, poor attendance by workers, and lack of guidance or direction regarding the required content of briefings, resulting in inconsistent quality.

The potential for exposure to hazardous materials is not always adequately identified, analyzed, and controlled because of insufficient application of industrial hygiene expertise. Health hazards are often less apparent and less well understood by construction workers than are physical safety hazards. Identification and analysis of these hazards often require industrial hygiene expertise. Title 10 CFR 851 requires comprehensive industrial hygiene programs that are managed and implemented by professionally and technically qualified industrial hygienists. However, industrial hygiene expertise is often not available at the work sites. Small construction subcontractors typically do not have industrial hygiene expertise, and although large construction subcontractors often have industrial hygiene expertise in their corporate offices, such expertise is not always available at construction sites. DOE prime contractors sometimes provide industrial hygiene support to their subcontractors, but they often attempt to limit their liability for health effects by minimizing their involvement in hazard analysis and control and by assigning industrial hygiene responsibilities to their construction subcontractors. Factors such as these have contributed to common failures to identify and control a number of potential health hazards at DOE construction sites. For example, there have been numerous instances of failures to identify the health hazards associated with airborne crystalline silica (a known carcinogen), resulting in failure to require appropriate respiratory protection when performing operations such as sawing

bricks and concrete and sanding drywall. As another example, construction subcontractors have not always understood that a carcinogen, benzene, is present in asphalt fumes, so the exposure of roofers and pavers to these fumes has not always been adequately monitored and controlled. As a final example, exposures to hazardous materials in welding fumes, such as lead, chromium, zinc, beryllium, and phosgene gas, are not always properly identified, monitored, and controlled.

Material safety data sheets are not adequately used to identify hazards and controls for construction work for potentially hazardous and toxic materials. Material safety data sheets, which describe hazards and controls for potentially hazardous and toxic materials, are maintained at construction job sites as required by the Occupational Safety and Health Administration (OSHA) in 29 CFR 1926. However, construction subcontractors do not always evaluate the hazards identified in these documents and thus do not always prescribe appropriate controls. Some construction subcontractors expect workers to read material safety data sheets and follow specified controls, but most workers do not have the expertise needed to reliably determine the proper controls for a work activity based on reading material safety data sheets. Industrial hygiene expertise is often needed to assess the hazards and determine appropriate controls after considering such factors as the work conditions (e.g., ventilation), the amounts of hazardous material that are present, the duration of potential exposure, and the potential for conditions to change (e.g., high temperatures and direct sunlight could result in some volatile materials reaching a flash point or fire point and increasing the likelihood of an explosion or fire that could cause an injury or a higher exposure).

Noise exposures are not always adequately identified, analyzed, and controlled. Most DOE prime contractors require compliance with noise exposure limits established by the American Conference of Governmental Industrial Hygienists (ACGIH) for all work including construction work. The ACGIH noise exposure limit is significantly lower than the OSHA limit applicable at non-DOE construction sites. Construction subcontractors do not always understand this requirement and do not always perform sufficient noise measurements or exposure monitoring to ensure that the limit is met. Because the noise hazards are not always adequately analyzed during early construction planning, the instrumentation, PPE, postings, and monitoring expertise are not always available when needed at job sites.

Several DOE sites are not sufficiently familiar with and do not adequately implement certain electrical safety requirements of NFPA 70E, *Standard for Electrical Safety in the Workplace*. Although many sites have improved their overall electrical safety programs, certain requirements of NFPA 70E are not well understood and/or implemented at some sites. Compliance with this standard was not required at some DOE sites before 10 CFR 851 became enforceable in 2007. Thus, some prime contractors have little experience in implementing the NFPA 70E standard. Further, construction subcontractors are not typically required to meet this standard for non-DOE construction work, so they are not always familiar with it. The standard requires hazard analyses for both electric shock hazards and electric arc-flash hazards and specifies detailed requirements for PPE and for lockout/tagout of electrical circuits. However, many commercial electricians have little or no training on electric arc-flash hazards or the controls specified by NFPA 70E, and compliance deficiencies have been identified at most sites inspected by HSS. The most common deficiencies include failure to wear required PPE when verifying that circuits are de-energized, and failure to establish lockout/tagout procedures that meet the requirements of the standard. In some cases, construction subcontractor health and safety plans describe lockout/tagout programs that do not meet the requirements of NFPA 70E but were nevertheless approved by DOE prime contractors, indicating that the prime contractors are not sufficiently familiar with the standard and/or do not perform adequate reviews of the electrical safety aspects of the subcontractor plans. In addition, the control of hazards associated with contacting electrical conductors during excavations and wall penetrations also warrants continued attention. (See Independent Oversight lessons-learned report, *Electrical Safety During Excavations and Penetrations*, January 2005.)

Problems identified during recent Independent Oversight activities include inadequate training on the use of instrumentation for locating buried utilities, unclear assignment of responsibilities for locating buried utilities at construction sites, and insufficient procedural controls for drywall penetrations.

Fire safety hazards are not always identified and adequately controlled for construction work. Some of the fire safety problems were caused by program deficiencies and some by the failure to follow established requirements. Hot work permits are typically required when work involves welding, burning, or other open-flame activities, but the requirements specified on these permits are not always followed. For example, combustible materials are not always removed from work areas as required by hot work permits; hot work permits are not always required for spark-producing activities, such as metal sawing and grinding; and individuals who are assigned fire watch duties are not always trained in the use of fire extinguishers. Further, contract requirements do not always clearly specify whether construction subcontractors are to issue their own hot work permits or obtain them from prime contractors. A number of deficiencies were observed in the operation of tar kettles used for melting asphalt roofing materials. Examples include a tar kettle operated at temperatures in excess of specified limits, an inoperable kettle thermometer, a fire watch who was assigned distracting duties, and an insufficient number of fire extinguishers near a kettle. Sites do not always meet requirements for controls (as specified in NFPA 1, Uniform Fire Code, 2003 Edition, Section 16.7, and NFPA 241, Standard for Safeguarding Construction, Alteration and Demolition, 2004 Edition, Section 5.1.3.1) and the material safety data sheets for asphalt roofing materials.

The occupational medicine requirements specified in 10 CFR 851 have not been effectively evaluated and implemented by construction subcontractors. Implementation of these requirements for short-term subcontractors of all types has been a challenge across the DOE Complex. At the time of this special review, some sites had not developed definitive plans or schedules for applying these requirements to construction subcontractors.

4

Overall Assessment

DOE construction subcontractors are required by contract to establish and use formal, systematic, work control processes for planning and performing work safely. These processes are required to include mechanisms for implementing the core functions of integrated safety management as set forth in the DOE safety management system policy. The five core functions address defining work, analyzing hazards, establishing controls, performing work within controls, and providing feedback to support continuous improvement of the work control process.

In most cases, appropriate requirements have been included in the terms and conditions of the majority of construction subcontracts. Most construction subcontractors have established work control processes that address the core functions. The quality and effectiveness of these processes vary but have improved significantly since the DOE safety management system policy was issued over ten years ago. In addition, at each evaluated site, steps have been taken to improve the process. For example, at Lawrence Livermore and SNL (sites that were inspected twice during the assessment period), work control documents that provide instructions to construction workers had been significantly strengthened to better define tasks, hazards, and controls associated with the assigned work.

In many cases, appropriate controls for the mitigation of identified hazards are established through the site or subcontractor work control processes, and site processes are sufficient to ensure that applicable controls are identified and that construction workers are informed about applicable controls. Applicable health and safety requirements that are specified in regulations and contracts, and identified by subject matter experts, are often effectively conveyed to workers through work control documents, postings, and briefings. Mechanisms for conveying these requirements include pre-construction briefings; worker training; work control documents, such as drawings, specifications, and job hazard analyses; and pre-job briefings for workers by their supervisors.

In general, if specific safety requirements are communicated to workers, and if management establishes a clear expectation for compliance, workers follow the requirements and perform work safely. Workers understand their right to stop work that they believe to be unsafe, and they exercise this right when appropriate. Work was appropriately stopped at several sites during HSS inspections.

However, further improvements are needed in work control processes to ensure that workers are consistently informed of hazards and that appropriate controls are established to mitigate those hazards. The need for improved work control processes is most apparent for health hazards associated with exposures to hazardous materials and noise. (See Section 3.)

Appropriate mechanisms for conveying requirements to workers have been established at most sites, but implementation has not been consistently effective. Most of the unsafe and non-compliant work practices observed during HSS inspections occurred because workers were unaware of the hazards and/or the controls associated with their assigned work, often because of deficiencies in various aspects of site processes (see Section 3). In some cases, sites do not have sufficient processes to ensure that workers receive the required safety training and/or meet qualification requirements before beginning a work activity.

A few unsafe work practices occurred when workers failed to comply with clearly established requirements. Examples include not following OSHA ladder safety requirements, not protecting workers from falling objects, not following fire safety requirements specified on hot work permits, and not wearing the PPE specified in work control documents. Some of the causes of non-compliance include forgetting to wear required PPE and shortcutting requirements in an effort to complete work activities on schedule. In many cases, DOE prime contractors' supervisory oversight monitoring of construction subcontractor work activities has not been sufficient to identify and correct common and persistent weaknesses in implementing safety and health requirements and controls. In a few cases, subcontractor and prime contractor supervisors, subject matter experts, and management contributed to non-compliances by failing to establish clear expectations for strict compliance and by tolerating non-compliant behaviors.

Some of the instances of deficient safety performance can be attributed to construction subcontractors' insufficient understanding of DOE requirements. In some cases, 10 CFR 851 establishes requirements for DOE subcontractors that did not apply to subcontractors under the predecessor directive (DOE Order 440.1A), and the subcontractors were not accustomed to implementing those requirements. For example, some construction subcontractors have not yet fully implemented occupational medicine requirements, in part because those requirements were not applied to subcontractors under DOE Order 440.1A but are now mandatory under 10 CFR 851. Additionally, some construction subcontractors, particularly smaller and lower-tier subcontractors, have limited experience at DOE sites and are not always familiar with the health and safety program requirements of 10 CFR 851, which sometimes are more stringent than the OSHA requirements with which they are more familiar. (For example, 10 CFR 851 imposes the requirement to prepare an activity hazard analysis for each separately definable construction activity.) Prime contractors have not always ensured (e.g., during pre-construction meetings) that subcontractors are sufficiently informed of all applicable 10 CFR 851 requirements.

Some DOE site offices have devoted significant attention and oversight resources to construction safety, and this attention has contributed to improvements in construction safety. Other site offices have relied almost entirely upon prime contractors and their subcontractors to monitor the safety of construction work. Oversight of construction health and safety by DOE site offices is needed and is appropriate because DOE is responsible for health and safety at their sites regardless of the organization (e.g., prime contractor or subcontractor at any tier) that performs the work. DOE attention and oversight are most needed to assess the effectiveness of controls for health hazards and compliance with ES&H requirements that are unique to work at DOE sites, with particular emphasis on work performed by contractors with little prior DOE work experience.

5

Recommendations

Opportunities for improvement for specific sites were provided to the responsible DOE and contractor managers during ES&H inspections at the sites. The following recommendations are based on Independent Oversight's review of the collective results and trends identified during ES&H inspections in the past three years. Therefore, DOE line management (program offices and site offices) and contractor management should consider the following opportunities for improvement for applicability and, as appropriate, action.

DOE Line Management

1. **Ensure adequate oversight of prime contractors' construction safety programs and subcontractor construction safety programs and implementation.** Evaluate and adjust the coverage and application of resources to construction activities to ensure that the level of attention is commensurate with the hazards associated with this work. Ensure that health expertise (e.g., industrial hygienists) is applied to review construction safety to complement safety specialists. Perform reviews of prime contractors' construction safety organizations, including their efforts to address the weaknesses and opportunities for improvement identified in this report. Develop contract performance measures and incentives that address construction safety, including measures that address site-specific weaknesses and the weaknesses and opportunities for improvement identified in this report.

DOE Sites (DOE Line Management and Prime Contractors)

1. **Emphasize safety requirements that are unique to DOE sites during pre-bid and pre-construction meetings with construction subcontractors.** Ensure that subcontractors understand expectations for implementing ES&H requirements that are included in the prime contractor's Worker Health and Safety Plan that may be unique to DOE work. Thoroughly discuss requirements and expectations for activities such as application of ACGIH threshold limit values, NFPA lockout/tagout requirements, and 10 CFR 851 construction and industrial hygiene requirements that may differ from requirements applicable to non-DOE work.
2. **Strengthen contractual health and safety provisions in construction subcontracts.** Include clear and specific requirements in the terms and conditions of construction subcontracts to ensure that health hazards are identified and evaluated, adequate controls are applied, and exposures are monitored when appropriate. If there is no assurance that subcontractors have the plans and resources necessary to meet these requirements, apply the prime contractor industrial hygiene programs to subcontracted construction work and provide industrial hygiene support. Revise contracts to require that subcontractors verify and maintain records at DOE sites to demonstrate that their workers have the training necessary for safely performing assigned tasks.

3. **Review subcontractor health and safety plans more carefully to ensure that they meet the requirements of 10 CFR 851.** Focus on plans to implement the construction requirements in 10 CFR 851, Appendix A, Section 1; the industrial hygiene requirements in 10 CFR 851, Appendix A, Section 6; and the lockout/tagout requirements of NFPA 70E. Consider developing review plans to facilitate such reviews.
4. **Enhance monitoring, review, and evaluation of subcontractor construction safety programs and implementation.** Ensure that frequent reviews are performed by the prime contractor construction safety organization and that occasional reviews are performed by internal audit organizations. Assign higher priority to the monitoring of construction work performed by subcontractors that have limited DOE work experience and/or limited safety and health expertise. Ensure that health aspects are regularly reviewed and that industrial hygienists participate to complement the efforts of safety specialists.
5. **Strengthen processes for involvement of subject matter experts in the planning of construction work.** Include criteria or “triggers” in work planning processes to aid planners in identifying the need for subject matter expert involvement in hazard identification and analysis. Ensure that suitable expertise (e.g., industrial hygienists) is applied to identify and analyze health hazards that may not be readily apparent to construction workers.
6. **Ensure that construction subcontractors effectively implement the occupational medicine requirements of 10 CFR 851.** Because some subcontractors have not effectively implemented medical surveillance requirements, increase attention on effective implementation to include developing schedules and milestones to address implementation deficiencies and issues as soon as feasible. Include detailed occupational medicine requirements in the terms and conditions of construction subcontracts and, to the extent necessary, provide the medical services and other support needed by these subcontractors to meet these requirements. Consider reviewing approaches that have been used at some DOE sites, such as Brookhaven National Laboratory and the Hanford Site, to identify lessons learned and successful practices that could be modified and adapted at other sites.
7. **Increase the effectiveness of pre-job briefings conducted by construction subcontractors.** Consider requiring more frequent (e.g., daily) pre-job briefings and encouraging greater worker participation. Consider providing guidance and/or requirements on briefing content and worker participation to ensure that pre-job briefings are effective in ensuring that controls are communicated and understood by workers and that workers have an opportunity to ask questions and provide feedback. Evaluate work control processes, recognizing that some construction workers indicated that they gain and retain more information from such briefings than they do from reading procedures and other work control documents.
8. **Strengthen the control of noise exposure hazards.** Ensure compliance with the ACGIH noise exposure limit by better explaining the requirements to meet both the ACGIH threshold limit values and the 10 CFR 851 exposure monitoring requirements during pre-construction meetings. Ensure that noise hazards are evaluated during construction by performing noise measurements and noise exposure assessments. Require construction subcontractors to have calibrated noise monitoring instrumentation available at construction sites. Consider the application of conservative controls, such as requiring hearing protection whenever a power tool is used or whenever decontamination and decommissioning work is performed. Consider providing the subcontractor workforce with laminated cards specifying the noise levels expected from use of various power tools.

9. **Enhance electrical safety by addressing problems related to contacting electrical conductors during excavations and wall penetrations.** Provide commercially available training on the use of utility-locating instrumentation. Clearly identify the organizational responsibilities for locating utilities and the requirements for procedures and permits in construction documents. Establish procedures to specify PPE and work practices for drywall penetrations. Use commercially available power tools that stop automatically when metal is contacted during floor and wall penetrations. Consider the guidance in DOE-HDBK-1092-2004, Electrical Safety, Section 11. Consider adapting the lessons learned from electrical excavations and penetrations to other utilities, such as gas lines, as applicable.
10. **Improve fire safety by ensuring that construction subcontracts and/or approved fire safety plans clearly identify the organization responsible for issuing hot work permits and reference applicable NFPA requirements.** Include fire safety requirements and expectations in pre-construction briefings for construction subcontractors. Ensure that DOE prime contractor construction personnel/auditors monitor and review roofing work, with emphasis on known problem areas (e.g., tar kettles), and devote increased attention to small roofing contractors that may have limited knowledge of NFPA requirements and DOE safety practices and expectations.

