

**Independent Oversight
Special Review of**



**Workplace Exposure
Monitoring**

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Office of Environment, Safety and Health Evaluations
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Abbreviations Used in This Report

AIHA	<i>American Industrial Hygiene Association</i>
BAWR	<i>Beryllium-associated Worker Registry</i>
CFR	<i>Code of Federal Regulations</i>
DOE	<i>U.S. Department of Energy</i>
DOEHRS	<i>Defense Occupational & Environmental Health Readiness System</i>
EM	<i>Environmental Management</i>
HASS	<i>Hazard Assessment and Sampling System</i>
HSS	<i>Office of Health, Safety and Security</i>
NNSA	<i>National Nuclear Security Administration</i>
OSHA	<i>Occupational Safety and Health Administration</i>
PPE	<i>Personal Protective Equipment</i>
TLV	<i>Threshold Limiting Value</i>
VOC	<i>Volatile Organic Compound</i>

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Executive Summary

Workers at U.S. Department of Energy (DOE) sites have a fundamental right to a safe and healthy workplace. Furthermore, DOE owes it to its workers to ensure that hazardous materials and operations are controlled and monitored in the various workspaces across each of its sites so that workers are protected from health hazards, such as toxic chemicals, excessive noise, and ergonomic stressors. While these rights and responsibilities have been established in DOE orders for some time, they are further emphasized and codified in the provisions of 10 CFR 851.

10 CFR 851, *Worker Safety and Health Program Rule*, and its predecessor directive, DOE Order 440.1A, *Worker Protection Management for Federal and Contractor Employees*, established the requirements for line management to ensure that non-radiological workplace exposures are identified, assessed and/or monitored, and documented for all workplace hazards. Worker exposures to chemical, physical, biological, or ergonomic hazards are to be assessed through the conduct of an exposure assessment and, as appropriate, workplace monitoring (including personal, area, wipe, and bulk sampling), biological monitoring, and observations. Monitoring results must be formally recorded, and documentation should include the tasks and locations where monitoring occurred, identification of workers monitored or represented by the monitoring, and identification of the sampling methods and durations, control measures in place during monitoring (including the use of personal protective equipment), and any other factors that could have affected sampling results. In addition, 10 CFR 851 requires initial or baseline surveys and periodic resurveys and/or exposure monitoring, as appropriate, of all work areas and operations to identify and evaluate potential worker health risks.

The Office of Health, Safety and Security's Office of Independent Oversight recently completed a series of reviews that evaluated non-radiological workplace exposure assessments and monitoring programs at eight sites, beginning in January 2006. These reviews identified a number of positive aspects and noteworthy practices, such as the development of robust exposure-monitoring computer databases for the recording, tracking, and trending of workplace exposures. Each of the DOE sites that were reviewed had established a work control process for the identification of workplace hazards. As a result, each of these sites had identified, assessed, and documented a wide variety of workplace hazards, a number of which could potentially result in worker exposures. For those workplace exposures for which workplace monitoring was performed, the monitoring records were generally consistent with the basic expectations of 10 CFR 851. All of the sites reviewed routinely use accredited laboratories for sample analysis as required by 10 CFR 851, and the workplace exposure assessment and monitoring programs are implemented by experienced and knowledgeable industrial hygienists.

However, much remains to be accomplished in the area of workplace exposure assessments and monitoring before full implementation of the requirements and expectations of 10 CFR 851 can be achieved across the DOE complex. At the time of this review, several sites lacked realistic implementation plans to develop the procedures, policies, and guidance needed to implement the workplace exposure and monitoring requirements of 10 CFR 851. At each site, the inspection team noted a number of workplace exposures that had not been adequately identified, analyzed, monitored, and/or documented. None of the sites had completed 10 CFR 851 baseline exposure surveys of all of their work activities, and several sites had already acknowledged

this gap in their Worker Safety and Health Plan submittals to DOE. In some cases, the sites lack sufficient industrial hygiene resources to implement an effective workplace exposure program, and in other cases, the results of exposure assessments have not been incorporated into work control documents. Work performed by subcontractors often lacks an assessment of worker exposures. Some exposure records contain errors and omissions or lack a defensible technical basis to support the assumptions or conclusions stated in the record. Rarely have sites attempted to base their exposure assessment monitoring programs on confidence levels to ensure that the occupational exposure limits are not being exceeded, and performance metrics have not been established to ensure that such criteria are measured and trended. Feedback and improvement processes at the DOE sites typically exclude workplace exposure assessments and monitoring from routine oversight.

To enhance workplace exposure monitoring, the Office of Health, Safety and Security should consider providing additional guidance and assistance to DOE line organizations that will assist in the development, implementation, and monitoring of workplace exposure assessment programs. Line management should develop initiatives that focus on:

- The development of guidance that defines the mechanisms for performing workplace exposure assessments and methods for monitoring that ensure compliance with 10 CFR 851
- Methods to provide consistent and uniform implementation of the workplace exposure assessment and monitoring programs
- The integration of workplace exposure monitoring programs into established feedback and improvement processes.

1 Introduction

From January 2006 through June 2007, the U.S. Department of Energy (DOE) Office of Independent Oversight, within the Office of Health, Safety and Security (HSS), evaluated the effectiveness of DOE's workplace monitoring programs for non-radiological hazards at eight sites (shown in Table 1) as part of regularly scheduled inspections. These reviews focused on site programs for ensuring that workers are protected in accordance with the requirements of 10 CFR 851 and/or DOE Order 440.1A (which preceded 10 CFR 851). This report summarizes the observations, insights, and lessons learned from these reviews.

Table 1. Workplace Exposure Monitoring Evaluation Sites

Safety Management Inspection Site	Headquarters Program Office
Savannah River Site	Environmental Management (EM)
Sandia National Laboratories	National Nuclear Security Administration (NNSA)
Nevada Test Site	NNSA
Idaho National Laboratory	Nuclear Energy
Idaho Cleanup Project	EM
Oak Ridge National Laboratory (Cleanup)	EM
Stanford Linear Accelerator Complex	Science
Fluor Hanford Waste Stabilization Project	EM

Longstanding requirements for non-radiological workplace monitoring were incorporated in the September 1995 issuance of DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*. In February 2006, the requirements of DOE Order 440.1A were incorporated into 10 CFR 851, *Worker Safety and Health Program*, which became effective for all DOE sites in May 2007. During this review, seven of the sites were under the requirements of DOE Order 440.1A while transitioning to 10 CFR 851, and one site was evaluated after the 10 CFR 851 rule became enforceable in May 2007. When the rule became effective, DOE Order 440.1A was rescinded and DOE Order 440.1B was issued. DOE Order 440.1B contains similar requirements to the rule but applies only to Federal organizations and employees; contractor organizations are covered only by the rule. In either case, the requirements for workplace monitoring have remained basically unchanged since 1995.

10 CFR 851, *Worker Safety and Health Program Rule*, requires contractors to “assess worker exposures to chemical, physical, biological, or safety workplace hazards through appropriate workplace monitoring”

[10 CFR 851.21(a)(1)]. 10 CFR 851 further establishes additional requirements of a workplace monitoring program, including:

- Documented assessments for chemical, physical, biological, and safety workplace hazards using recognized exposure assessment and testing methodologies and certified laboratories [10 CFR 851.21(a)(2)]
- Recording of observations and testing/monitoring results [10 CFR 851.21(a)(3)]
- Initial or baseline surveys and periodic resurveys and/or exposure monitoring, as appropriate, of all work areas or operations to identify and evaluate potential worker health risks [10 CFR 851 Appendix A.6(a)].

These high-level requirements define the fundamental elements of a program for assessing workplace exposures, which often requires workplace monitoring. Further guidance on the expectations for development and implementation of DOE-compliant workplace exposure programs is provided in the following documents:

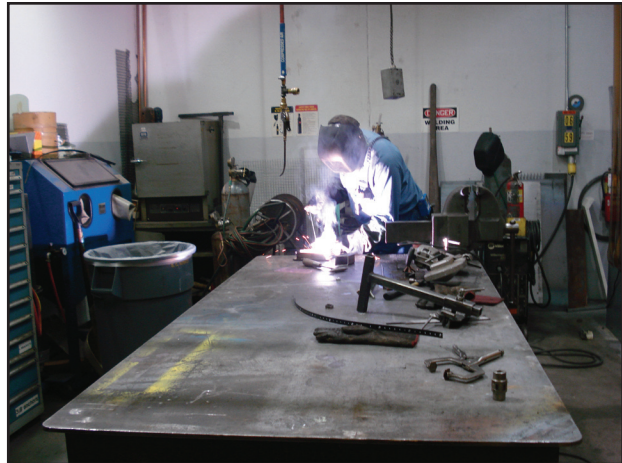
- DOE Guide 440.1-8, *Implementation Guide for use with 10 CFR Part 851, Worker Safety and Health Program*
- DOE Guide 440.1-3, *Occupational Exposure Assessment*, March 1998
- DOE-STD-6005-2001, *Industrial Hygiene Practices*, April 2001
- Mulhausen, JR and Damiano, J, *A Strategy for Assessing and Managing Occupational Exposures*, American Industrial Hygiene Association (AIHA) Press, Fairfax, VA, [2006. Third Edition]
- Occupational Safety and Health Administration (OSHA) Technical Manual, TED 01-00-015
- National Institute for Occupational Safety and Health, *NIOSH Manual of Analytical Methods*.

By the 1990s, it was evident within the field of industrial hygiene that OSHA's expanded health protection standards would only be available for a few hazardous materials. The professional consensus on occupational exposure assessment evolved away from a focus solely on compliance with OSHA standards to a generic approach based on risk management principles. The AIHA issued the first edition of *A Strategy for Assessing Occupational Exposures* in 1991. The second edition, renamed *A Strategy for Assessing and Managing Occupational Exposures*, was published in 1998, and the third edition was published



Monitoring a worker's exposure to noise during a machining operation

in 2006. These books expanded upon the methods OSHA inspectors use to prove that a workplace is out of compliance and thus are useful to employers in ensuring that exposures are adequately controlled. This approach includes logic similar to statistical process control to assure that enough work shifts are monitored to keep the probability of uncontrolled exposures at an acceptably low level. High-order mandatory DOE policies do not specify methods. The non-mandatory DOE Guide 440.1-8, DOE Guide 440.1-3, and DOE-STD-6005-2001 reference and endorse the use of the AIHA strategy as a best method; there is a consensus in the field that it is a standard for good practice of industrial hygiene.



Typical worker exposure to welding fumes

During 2006 and 2007, the DOE Office of Independent Oversight evaluated the workplace exposure assessment and monitoring programs of the sites listed in Table 1 based on the aforementioned regulatory criteria and guidance documents. Independent Oversight's site-specific evaluations were performed in conjunction with regularly scheduled Independent Oversight inspections of environment, safety, and health programs at each of these sites.

This report summarizes the key insights about the performance of workplace exposure monitoring programs at these sites. Sections 2 and 3 present DOE-wide positive attributes and weaknesses, respectively. Section 4 presents Independent Oversight's overall assessment of the effectiveness of workplace exposure monitoring programs. Section 5 presents a set of opportunities for DOE sites to consider.

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.

2 Positive Attributes

Each of the evaluated sites has established processes for identifying and evaluating workplace hazards. Each site has implemented mechanisms, such as an activity-level hazard analysis or job hazard analyses process, to identify and document workplace hazards. In most cases, the activity-level hazard analysis process is the primary mechanism for identifying potential workplace exposures. Each site has also identified and/or developed a worker exposure assessment process to perform both a qualitative and quantitative analysis of workplace exposures, although there is considerable variation in the maturity of these processes. Considerable efforts have been implemented to identify, analyze, and document some of the most prevalent and higher-risk workplace exposure hazards, such as asbestos and beryllium.

Workplace monitoring record keeping is typically performed in accordance with the requirements of 10 CFR 851, and some noteworthy record keeping systems have been developed. 10 CFR 851 requires a record of observations, testing, and monitoring results. Appropriate monitoring methods and equipment are used to conduct workplace monitoring (e.g., direct reading instruments, personal breathing zone samplers). Monitoring results are formally recorded in electronic databases and include the data required by 10 CFR 851, such as monitoring location, identification of workers and activity monitored, and sampling methods. Although recording of workplace monitoring data is consistent with the basic requirements of 10 CFR 851 at most sites evaluated, there is considerable variation in the sophistication of exposure record keeping systems among the sites. Some of the smaller DOE sites rely on spreadsheets to document and track workplace exposures. Several other sites have developed and implemented sophisticated computer-based exposure monitoring and record keeping systems. For example, the Hazard Assessment and Sampling System (HASS), currently in use by the two prime contractors at the Idaho National Laboratory, was developed to meet the exposure assessment guidance provided by the AIHA that is referenced in the DOE guidance documents. The HASS is user-friendly, is robust in its scope and capabilities, and is routinely used by Idaho National Laboratory industrial hygienists. A second noteworthy exposure assessment database is the Defense Occupational & Environmental Health Readiness System (DOEHRS), which was developed in conjunction with the Department of Defense and is used at the Nevada Test Site. The DOEHRS database is also being integrated with a historical worker exposure database that includes over one million health hazard employee records for



Worker wearing personal breathing zone air sampler

Nevada Test Site workers and spans the time from the commencement of operations at the site to the present. The database contains four terabytes of data, searchable at a rate of one gigabyte per second.

All of the DOE sites that were evaluated rely on accredited laboratories to analyze workplace monitoring samples. 10 CFR 851 requires the “use of accredited and certified” laboratories. Most of the sites that were evaluated maintain onsite analytical laboratories that are accredited by the AIHA in one or more analytical procedures (e.g., metal and solvents). These sites decided to maintain an onsite laboratory analysis capability for two reasons: (1) they need to accommodate a large number of samples (e.g., beryllium or asbestos samples) and/or laboratory response capability in order to support site production activities; and (2) many of the sites must analyze samples that could be radiologically contaminated, and thus cannot be processed at a commercial lab. However, in all cases the onsite laboratory capabilities are augmented by contracts with commercial analytical labs. The Waste Sampling Characterization Facility Analytical Laboratory, used by the Fluor Hanford Waste Stabilization Project (as well as the Hanford Tank Farms), is one example of effective use of an onsite analytical laboratory. As a result of the wide spectrum of complex workplace hazards at Hanford, the Waste Sampling Characterization Facility lab has developed considerable analytical processes and equipment capability to analyze for the 800-plus hazardous chemicals that are present in the Tank Farms and associated waste streams.

The industrial hygiene staffs responsible for the design and implementation of the workplace monitoring programs at the evaluated sites are knowledgeable and experienced in workplace exposure monitoring for non-radiological hazards. Workplace monitoring programs are being designed and implemented by experienced industrial hygienists and by trained and qualified industrial hygiene technicians. The industrial hygiene staff at each of the sites reviewed consists of experienced, knowledgeable, and certified industrial hygienists, many of whom have a broad commercial, DOE, and/or defense background and a detailed understanding of workplace exposure monitoring processes. In addition, most of the industrial hygiene technicians who provide critical monitoring data are experienced, trained, and methodical in exposure data gathering and record-keeping.

3

Weaknesses

Several sites that were reviewed lack sufficient procedures or guidance to effectively implement the workplace monitoring requirements of 10 CFR 851 or DOE Order 440.1A. As discussed in the introductory section, high-order mandatory DOE policies do not specify methods for program implementation. Therefore, it is incumbent upon each site to develop procedures and guidance for implementation that incorporate the guidance expectations and tailor the requirements for the particular site. Of the eight sites reviewed, one site did not have policies or procedures for performing workplace exposure assessments or for implementing the workplace monitoring requirements of 10 CFR 851 or DOE Order 440.1A. At another site, the exposure monitoring program was described in fewer than two pages in the contractor’s health and safety manual, and required initial exposure monitoring “unless recent objective data can demonstrate conclusively that no employee will be exposed to chemical or physical hazards.” However, there was no guidance for defining “objective data” or performing the exposure assessment. One laboratory had developed a draft exposure assessment program, but it lacked any details about an exposure monitoring strategy. One site had identified a lack of resources as an impediment to the development of workplace monitoring policies and procedures. Two of the eight sites, with the approval of the local DOE office, did not incorporate DOE Order 440.1A requirements for workplace monitoring into their contracts until after September 2006, although the DOE requirements had been in place since March 1998. As a result, policies and procedures for workplace monitoring were only in the process of being developed at the time of the Independent Oversight inspection.

At some sites, workplace exposures have not been sufficiently analyzed and/or documented for some facilities and/or work activities to meet the initial baseline survey or periodic resurvey requirements of 10 CFR 851. Appendix A.6(a) of 10 CFR 851 requires initial or baseline surveys and periodic resurveys and/or exposure monitoring, as appropriate, of all work areas or operations to identify and evaluate potential worker health risks. At most of the eight sites surveyed, self-assessments and 10 CFR 851 gap analyses identified that they had not completed a comprehensive baseline exposure monitoring as required by 10 CFR 851 and self-identified non-compliances with 10 CFR 851. For these sites, exceptions to 10 CFR 851 have been formally entered into the Non-compliance Tracking System. In some cases, few baseline exposure assessments have been completed. At one site, only about ten percent of an estimated 800 required exposure assessments were complete at the time of the Independent Oversight evaluation. Several sites had not determined the number of exposure assessments that would be required to meet the baseline survey requirements of 10 CFR 851 and therefore were uncertain of the magnitude of this task, the resources required, or the time required to achieve compliance.

The non-radiological exposure assessment process is often not sufficiently linked to the work control process, so some workplace exposures have not been assessed. Both 10 CFR 851 and DOE Policy 450.4, *DOE Safety Management System Policy*, require that hazards associated with the work are identified, analyzed, and categorized. Typically, this hazard analysis process and resulting hazard controls are documented—for example, in a work package or research plan. For chemical, biological, and ergonomic hazards, the exposure assessment is often the mechanism used to analyze hazards in the work control process. However, the

exposure assessment process and the work control process are often poorly linked. At every site reviewed, numerous non-radiological exposures had not been assessed. In some cases, the work control hazard analysis process does not have sufficient “triggers” to ensure that industrial hygienists are sufficiently involved in the assessment of workplace exposures. As a result, workplace exposures have been missed. Other examples indicated that changing work practices and/or changes in the facility or equipment had not triggered a review or update of the exposure assessment. Most sites have not yet established a relative risk for workplace exposures or a monitoring frequency based on risk. Only one of the eight sites has a mechanism for determining how much sampling is needed to ensure that workers can be 95 percent confident that only 5 percent of the workplace exposures will be above the exposure limits, as recommended by the AIHA strategy. In some cases, line managers do not recognize potential worker exposure hazards and/or have not involved industrial hygiene in the assessment of some potential exposure hazards. The most common workplace exposures that have not been sufficiently analyzed and/or documented include:



Monitoring a worker's exposure to airborne metals during a high-speed drilling operation

- Machine shop exposure hazards, including exposures from drilling, sawing, grinding, sand/beam blasting, and welding
- Cutting, machining, and soldering lead
- Legacy hazards from past use of lead, asbestos, beryllium, and mercury at some sites; such analysis is needed to determine worker exposures to such hazards when performing routine maintenance in legacy hazard areas
- Exposure hazards associated with work performed by subcontractors
- Exposure hazards associated with “skill-of-the-craft” work activities, which are often considered to be “low hazard” and are not reviewed by industrial hygiene to determine whether an exposure assessment is warranted
- Construction and maintenance exposure hazards, which are typically varied and transient in nature (e.g., noise from cutting, sawing, or paint spraying) and are often missed in the exposure assessment program.

Workplace exposures have not been assessed at a frequency consistent with the potential risk to workers. In fact, the workplace exposure review found that only one of the eight DOE sites surveyed had established a mechanism for ensuring that sufficient monitoring and sampling was completed to provide 95 percent confidence that exposure limits are not exceeded, as suggested by the AIHA strategy. Furthermore, in some cases exposure assessment records are not maintained. One site indicated that fewer than ten percent of the exposure evaluations are documented. Another site identified in a self-assessment that “industrial hygiene

survey reports are backing up and are not being processed and filed promptly.” In several instances, site personnel and/or site self-assessments attributed these deficiencies to insufficient industrial hygiene resources.

At a number of sites, recommendations from workplace exposure assessments performed by industrial hygienists have not been incorporated into work control documents. Once a workplace exposure assessment has been performed and documented, 10 CFR 851 requires that the results of the assessment must be recorded such that the results of the evaluations of workplace exposures and controls can provide management with essential feedback for improvement. However, at some sites surveyed, industrial hygiene exposure assessments and their recommendations are not sufficiently integrated with the work control process (e.g., work packages, job hazard analyses, operating procedures, or research or experimental work documents). At some sites, the exposure assessment records did not have sufficiently specific recommendations, conclusions, or details to be useful to line management, or were not provided to line managers in a timely manner. For example, at one site, breathing zone sampling on two workers identified a need for local ventilation. However, because the analysis and recommendations were not clearly documented in the exposure assessment, the local ventilation was not incorporated into work packages. At another site, facility managers and line managers were not familiar with the site’s exposure assessment program and did not know whether the hazard controls determined to be necessary as a result of the exposure assessments had been incorporated into work documents. In some cases, industrial hygienists have not followed up on exposure assessment recommendations to verify that their recommendations are implemented as expected.

Workplace exposure monitoring for work performed by subcontractors often does not have sufficient policies, procedures, and contractor support, monitoring, and assessment to ensure that the requirements of 10 CFR 851 are met. The scope and purpose of 10 CFR 851 clearly states that the rule applies to the conduct of contractor activities at DOE sites; a “contractor” is defined as “any entity under contract with DOE, or a subcontractor to such an entity at any tier.” However, most of the subcontractors surveyed during this assessment lack adequate exposure assessment procedures, monitoring, sampling equipment, and trained staff to meet the workplace requirements of 10 CFR 851. Some DOE prime contractors have supported the subcontractor workforce by reviewing and assessing the exposure monitoring program and/or conducting independent monitoring and sampling to supplement the subcontractors’ workplace monitoring. Typically, at the sites reviewed, subcontractors have been enveloped by the prime contractors’ 10 CFR 851 Worker Safety and Health Plan, and few subcontractors have submitted individual plans for approval by the local DOE office. However, few prime contractors have rolled down their workplace exposure monitoring procedures to their subcontractors, and rarely does the prime contractor perform workplace monitoring for subcontractor work activities (for a variety of reasons). A number of the subcontractors that were reviewed do not have exposure monitoring instrumentation, adequate procedures, or sufficient workplace monitoring knowledge. None of the evaluated subcontractors were knowledgeable of the 10 CFR 851 workplace monitoring requirements.

Some documented workplace exposure data contains errors or omissions that raise questions about the validity of the results. 10 CFR 851 and the associated DOE guidance documents on workplace monitoring methods are consistently clear on the importance of following accepted industry monitoring and sampling practices and maintaining detailed, accurate, and reproducible workplace monitoring records. However, the review of workplace monitoring methods, practices, and records conducted during this assessment identified a number of poor practices. For example, at one site, beryllium swipes and air samples were recorded with incorrect units, raising questions about the validity of many of the monitoring results. At another site, poor monitoring practices were observed in that the sampling media was on the ground instead of in the worker’s breathing zone, leading to questionable results. In another case, the sampling media was exposed prior to being affixed to the worker, yet the period of worker exposure included these results. In some cases, the monitoring records and/or regulatory exposure limits were not adjusted for extended work shifts (i.e., beyond an eight-hour shift), which is the preferred practice (although OSHA regulations do not require this adjustment

except for a very few hazards). In some cases, the personal protective equipment (PPE) documented on exposure assessment reports was inconsistent with the observed PPE practices.

Technical bases are often lacking to support conclusions about workplace exposure assessments. The implementation guide for 10 CFR 851 states that “records or whatever data is important to characterize the process and workplace safety and health hazards should be recorded, maintained and be retrievable.” However, at several sites during this assessment, assumptions with respect to sampling and monitoring were made without sufficient basis to characterize the process or workplace safety and health hazards. For example, when photo-ionization detectors are used to measure a combination of volatile organic compounds (VOCs), threshold limiting values (TLVs), in ppm, are often set without any documented basis relative to the mix of VOCs that is being monitored. In one example, the TLV set for a mix of VOCs at a waste retrieval facility could not be correlated to the actual gases being released. In a related concern, several sites have attempted to extrapolate the exposure data from one work activity to a different work activity in a different facility without a documented technical basis. For instance, at one site, the industrial hygienist concluded that the exposure data associated with grinding and scraping of lead paint in a machine shop was comparable to the exposure a worker would receive from sweeping lead-based paint chips in an abandoned building, but provided no technical basis for that conclusion.

In some cases, the threshold for conducting an exposure assessment is too high and does not meet the intent of 10 CFR 851. At some sites, exposure assessments are conducted only if the potential worker exposures are expected to exceed the “action level” of the hazardous material (i.e., 50 percent of the permissible exposure limit or TLV). This practice is clearly inconsistent with the AIHA strategy, which suggests that most results in typical industrial hygiene monitoring data are about 10 percent of the exposure limit when the data demonstrates with 95 percent confidence that no more than 5 percent of the exposures exceed the limit. Because some sites lack exposure monitoring or exposure assessment strategies, the initiation of an exposure assessment is at the discretion of the industrial hygienist. At these sites, there are no uniform thresholds for conducting an exposure assessment, and actual practices vary widely. Based on an independent review, in a number of instances, exposure assessments should have been conducted but were not.

Site feedback and improvement processes rarely evaluate the adequacy of non-radiological workplace exposure monitoring programs and performance. DOE Policy 450.4, *Safety Management System Policy*, requires the gathering of feedback information as an opportunity for improving the definition and planning of work. Although all of the eight sites reviewed had implemented a variety of feedback and control mechanisms, such as self-assessments, few contractors include workplace exposure assessments or workplace monitoring as an element of the self-assessments that are performed by line managers. In addition, line managers seldom review the adequacy of exposure assessments during management walkarounds or management self-assessments. Some line managers have not assumed ownership for the control of workplace exposures and have delegated such responsibility to the safety and health staff. Only one of the eight sites evaluated included exposure assessments as a performance indicator relative to contract performance goals. DOE oversight of contractor exposure assessment programs has also been minimal at most of the sites evaluated. Some DOE site offices do not have an industrial hygienist on staff, contributing to the minimal oversight of workplace exposure monitoring programs. Only simple reports of individual measurement results are provided to line management and workers. Sites do not periodically analyze data in aggregate, summarize the results, draw inferences, and report indicators that can be used to identify priorities for workplace exposure reduction.

4 Overall Assessment

There are a number of positive aspects of DOE site performance in the area of workplace exposure monitoring. All of the eight evaluated sites were aware of the workplace exposure assessment requirements of 10 CFR 851 and its predecessor regulation, DOE Order 440.1A. However, two of the sites had only recently incorporated such requirements into their contracts, and the remaining sites were in the process of developing policies and procedures for implementing such requirements. In general, each of the evaluated sites has established a work control process for the identification of workplace hazards. As a result, these sites have identified, assessed, and documented a wide variety of workplace hazards, a number of which potentially could result in worker exposures. For those workplace exposures for which workplace monitoring was performed, the monitoring records are generally consistent with the basic expectations of 10 CFR 851. All of the sites that were reviewed use accredited laboratories for sample analysis as required by 10 CFR 851, and the workplace exposure assessment and monitoring programs are implemented by experienced and knowledgeable industrial hygienists.

However, much remains to be done in the area of workplace exposure assessments and monitoring at all of the sites to meet the requirements and expectations of 10 CFR 851. Several sites, at the time of the evaluation, did not have sufficient procedures, policies, or guidance to implement the workplace exposure and monitoring requirements of 10 CFR 851. At each site, the inspection team identified a number of workplace exposures that the site had not identified, analyzed, monitored, and/or documented. None of the sites have completed 10 CFR 851 baseline exposure surveys of all of their work activities, and several sites have already acknowledged this gap in their Worker Safety and Health Plan submittals to DOE. In some cases, the sites lack sufficient industrial hygiene resources to implement an effective workplace exposure program, and in other cases, the results of exposure assessments have not been incorporated into subsequent work control documents. Work performed by subcontractors often lacks an assessment of worker exposures. Some exposure records contain errors and omissions or lack a defensible technical basis to support the assumptions or conclusions stated in the record. Sites have rarely incorporated confidence levels into their exposure assessment monitoring programs to determine how well their exposures comply with occupational exposure limits, and performance metrics have not been implemented to ensure that such criteria are measured and trended. DOE and contractor feedback and improvement processes at DOE sites typically do not routinely evaluate workplace exposure assessments and monitoring. Finally, implementation plans to correct both non-compliance issues and corrective actions from external reviews lacked realistic goals to achieve full compliance.

5

Opportunities for Improvement

Site contractors, DOE program offices, DOE field offices, and Headquarters environment, safety, and health staff should review the following opportunities for applicability and action.

Office of Health, Safety and Security

1. **Provide guidance and assistance to the DOE line organizations in the development, implementation, and monitoring of workplace exposure assessment programs.** Such assistance should include:
 - Providing additional guidance and assistance in the development of workplace monitoring performance indicators to verify that field organizations conduct sufficient monitoring to demonstrate compliance with occupational exposure limits
 - Updating DOE guidance documents, such as DOE Guide 440.1-3, *Occupational Exposure Assessment*, and the DOE standard on industrial hygiene practices (DOE-STD-6005-2001), to provide current expectations for the development and implementation of workplace exposure monitoring consistent with the requirements of 10 CFR 851.
2. **Ensure that routine analyses of workplace exposure monitoring data is included in assessments of the Department's occupational health protection performance.** Computerizing exposure monitoring records and using better analytical software have made the routine collection, analysis, and dissemination of occupational exposure monitoring data feasible. Industrial hygiene data collected for risk management purposes can be aggregated for use in generating performance indicators. Use of industrial hygiene performance indicators locally and Department-wide could support the continual improvement of exposure monitoring and control programs.

DOE Line Organizations (Program Offices and Field Elements) and Site Contractors

1. **Develop policies and procedures that define the mechanisms for performing workplace exposure assessments and monitoring to ensure compliance with the requirements of 10 CFR 851.** Consideration should be given to:
 - Correlating the site's exposure assessment program to specific 10 CFR 851 requirements for workplace monitoring
 - Incorporating the exposure assessment and workplace monitoring principles and practices delineated in 10 CFR 851 guidance documents, such as DOE Guides 440.1-8 and 440.1-3, DOE-STD-6005-2001, and in particular the latest version of the AIHA *Strategy for Assessing and Managing Occupational Exposures*

- Establishing processes and expectations for performing and updating baseline workplace exposures including realistic corrective actions for both non-compliance issues and external reviews
- Developing thresholds for conducting and documenting workplace exposures
- Developing exposure assessment and monitoring frequencies based on risk.

2. Provide consistently effective implementation of the workplace exposure assessment and monitoring program. Consideration should be given to:

- Documenting exposure assessments for all work activities that pose a workplace exposure hazard in which monitoring data demonstrate with 95 percent confidence that more than 5 percent of exposures could exceed the occupational exposure limit
- Ensuring appropriate monitoring of workplace exposures for those work activities that are frequently excluded from such monitoring, such as machine shops, facility work in areas with known legacy hazards, work performed by subcontractors, and “skill-of-the-craft” work activities
- Ensuring that recommendations from workplace exposure assessments are effectively incorporated into work control documents
- Ensuring effective implementation of the exposure assessment program, including evaluation of the adequacy of industrial hygiene resources
- Providing sufficient documented technical bases in each workplace exposure assessment to justify exposure monitoring decisions, such that a third-party industrial hygienist could reach similar conclusions.

3. Integrate the workplace exposure monitoring program into established feedback and improvement processes. Consideration should be given to:

- Incorporating a routine review of the workplace exposure monitoring process into self-assessments and management walkarounds
- Establishing workplace monitoring performance metrics, including goals for continually reducing workplace exposures
- Verifying that the recommendations for workplace exposure assessments are available to line managers, the contents are understood, and recommendations are incorporated into work documents
- Routinely analyzing exposure monitoring data and summarizing it in reports that are disseminated to those who have a need to know the information, such as line managers, workers whose exposures are being assessed, and DOE site management.