Office of Environment, Safety and Health Oversight
Environment, Safety and Health

Focused Safety Management Evaluation of the

Oak Ridge National Laboratory

August 2001

ISM

Integrated Safety Management

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Abbreviations Used in This Report

ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazards Analysis
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
ATLC	Atomic Trades and Labor Council
BIO	Basis for Interim Operation
CFR	Code of Federal Regulations
COG	Cell Off-Gas
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
DP	Differential Pressure
EH-2	Office of Environment, Safety and Health Oversight
ES&H	Environment, Safety, and Health
ESH&Q	Environment, Safety, Health and Quality
FY	Fiscal Year
HCSA	Hot Cell Support Area

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OVERSIGHT

Executive Summary

EVALUATION:	Office of Environment, Safety and Health Oversight Focused Safety Management Evaluation
SITE:	Oak Ridge National Laboratory
DATES:	May-July 2001

Scope

The Department of Energy (DOE) Office of Environment, Safety and Health Oversight (EH-2), within the Office of Environment, Safety and Health, evaluated the integrated safety management (ISM) system at the Oak Ridge National Laboratory (ORNL). The responsible management elements for ORNL are the DOE Headquarters Office of Science (SC); the DOE Headquarters Office of Nuclear Energy, Science and Technology; the DOE Oak Ridge Operations Office (ORO); and the management and operations contractor – University of Tennessee-Battelle (UT-Battelle). The evaluation focused on the activities conducted within the Chemical Technology, Metals and Ceramics, and Plant and Equipment Divisions. This evaluation also included a functional review of the safety-class ventilation systems at a category 2 nuclear facility within the Radiochemical Engineering Development Center (REDC).

Background

UT-Battelle assumed responsibility for operating ORNL in April 2000. Some UT-Battelle managers have significant experience in operating DOE laboratories and transitioning to a rigorous and formal ISM program. ORO was instrumental in selecting a contractor that had this experience and in establishing performance measures related to ISM implementation in the new contract.

Before the contractor transition, ORNL had undergone an April 1999 Phase I ISM verification and a January-March 2000 Phase II ISM verification review. After a second, limited-scope Phase II verification review in August-September 2000, ORO declared that ISM was implemented on September 29, 2000. However, UT-Battelle assessments during and after the transition determined that the ISM program needed substantial improvement. Consequently, ORNL is in the midst of a major effort to enhance its ISM program. UT-Battelle established a number of major initiatives to address deficiencies that they self-identified in their internal assessments of current and historical operational practices. These initiatives include the establishment of the Standards Based Management System (SBMS) and a landlord-tenant model for facility management. When fully implemented, the SBMS is designed to provide the policy, standards, and procedures for conduct of work at the Laboratory. The landlord-tenant model provides for a single organization to focus on operations and maintenance of facilities while allowing the research organizations to focus on research.

As part of the contractor transition, ORO has increased its emphasis on partnering with the contractor and encouraging cooperative approaches to problem solving. ORO and SC have also recognized that the aging facility and equipment infrastructure is a growing concern and have recently allocated additional funding to facility and infrastructure upgrades. SC, ORO, and ORNL are working together and with other government and commercial organizations, such as the State of Tennessee, to establish funding for newer research facilities that would attract new businesses and allow phase-out of aging facilities.

Results

The new initiatives to strengthen ISM are generally appropriate and, when fully implemented, provide a good framework for an effective safety management program. Significant progress has been made in a number of areas as part of the new initiatives. ES&H specialists have been deployed to ORNL facilities, and improvements in facility-level ES&H support were evident. ORNL has improved management of hazardous chemicals through a systematic chemical safety management program. The process for identifying the appropriate set of external requirements and incorporating these requirements into institutional processes has been strengthened. The newly formed ORNL independent oversight organization has conducted some well-designed reviews since its inception, and the lessons-learned program has been improved.

ORNL senior managers recognize the need to establish a formal and rigorous ISM program, and to establish clear responsibilities and accountability for safety within all levels of ORNL line management. The new contractor senior management team has experience at other DOE laboratories that have successfully implemented ISM. The ORNL Leadership Team, consisting of the ORNL senior managers and chaired by the ORNL Director, is proactively and visibly involved in major decisions related to safety management and ES&H resource allocations.

The ORNL initiatives to improve safety management are in various stages of development and/or the early stages of implementation. Many corrective actions were ongoing at the time of the evaluation and numerous others were planned. However, some of the plans lacked sufficient detail and milestones to ensure effective and timely implementation. In addition, senior managers displayed a good understanding of the strategic vision for the improved ISM program, but most lower-tier managers and workers did not demonstrate a detailed understanding of ISM or the changes in historical practices needed to transition to a rigorous standards-based approach to safety management. ORNL has not yet developed adequate plans for addressing the significant challenges associated with transitioning to a standards-based approach in the numerous ORNL divisions, which historically have often operated with informal and undocumented approaches to hazards analysis and work control.

Although improvements are being made, the current programs and practices for work planning and control are not sufficiently rigorous to meet DOE expectations for an effective ISM program. Deficiencies were identified in the three ORNL Divisions that were reviewed:

- The review of operations at three nuclear hot cell facilities within the Chemical Technology and the Metals and Ceramics Divisions revealed that procedural quality, use, and adherence were inadequate. For example, operators removed highly radioactive materials from a hot cell without referencing procedures and omitted procedurally required steps.

- Although the work observed by the review team was performed in accordance with good industrial safety work practices and the Metals and Ceramics Division has maintained a good safety record, the Division's research and development activities did not have an adequate process for work planning and control. Processes for analyzing hazards and for developing and implementing controls were often informal and undocumented. Line management responsibility for safety was not clearly established and accepted, and there was excessive reliance on safety professionals to perform environment, safety, and health functions.

- For maintenance activities conducted by the Plant and Equipment Division and activities conducted by their subcontractors, the processes for planning and controlling maintenance activities were not consistently implemented and lacked clear standards or criteria for acceptable performance. For example, criteria were not adequate for involving environment, safety, and health subject matter experts or workers in the identification of some hazards and controls.

EH-2 also reviewed safety-class ventilation systems at the REDC nuclear category 2 hot cell facility to independently assess their operability and reliability. These systems are essential to the protection of workers, the public, and the environment, and provide a defense-in-depth control that is an essential element of ISM. However, the material condition of these safety-class ventilation systems is degraded, with many key components operating beyond their design lifetime. Many deficient conditions were longstanding, and workarounds had been incorporated into operating procedures. For example, procedures state that an aging damper may need "manual agitation" to close it and a steel rod is provided to the operators to use in striking the damper body; this workaround exacerbates the deteriorating condition of the damper. Other workarounds were also incorporated into procedures or operating practices, such as flexible joints and ducts that were repaired many times with tape to prevent air leakage. Many of the procedures for operating safety class ventilation systems contained unclear requirements, and operators did not consistently use procedures. Deficiencies were also evident in systems operations, in surveillance testing, and in applying the unreviewed safety question determination process.

In addition, the configuration management program for the safety-class ventilation systems has significant weaknesses. Modifications were not implemented consistent with safety-class requirements; system drawings were not updated to reflect modifications; and labeling was inadequate. Effective configuration management is fundamental to ensuring reliable operations in routine and accident conditions.

SC and ORO have effectively implemented some of their safety management responsibilities, such as maintaining the directives management system. ORO has transitioned to the limited oversight role defined in DOE Policy 450.5. However, ORO needs to focus on ensuring that ORNL establishes the requisite robust, rigorous, and credible self-assessment program.

Six Safety Issues were identified, as presented in Table ES-1. Although based on the review of the deficiencies evident in selected facilities, the Safety Issues need to be evaluated by UT-Battelle and ORO for sitewide applicability.

Conclusions

ORNL management recognizes that the current safety management systems need to be improved. While much work remains to be accomplished, the improvement initiatives, such as SBMS and the facility management model, are generally appropriate mechanisms for implementing ISM. However, additional management attention is needed in several important areas to ensure that a fully effective ISM program is established and sustained:

- Increasing involvement by lower-tier managers and supervisors, particularly in the research and development divisions, to ensure effective and timely implementation of effective work planning and control and other ORNL initiatives.

- Strengthening institutional policies, especially for work planning and control and procedural use and adherence, to ensure that expectations are clearly defined, that requirements flow down to the activity level, and that requirements are enforced across all ORNL divisions.

- Emphasizing communications that ensure that workers and supervisors understand and accept rigorous and formal approaches to safety, consistent with the DOE ISM policy.

- Ensuring that plans to develop and implement ORNL initiatives, particularly in the areas of work planning and control and procedural adherence, have sufficient detail and interim milestones to ensure successful and timely implementation at the facility and activity level.

- Establishing initiatives to improve procedures and procedural adherence at nuclear facilities and across ORNL.

- Systematically addressing the material condition and configuration management of safety-related systems to ensure continued operation within the authorization basis and address aging and deteriorating components.

In addition, in accordance with their emphasis on partnering with the contractor, ORO needs to work with the contractor to ensure that expectations for ISM are clearly communicated throughout the ORNL organization. ORO also needs to enhance its line management oversight efforts with a particular focus on ensuring that an effective contractor self-assessment program is implemented. ORO and SC also need to further emphasize infrastructure and preventive maintenance improvements to ensure that safety-related systems are adequately maintained.

Office of Science, the Office of Nuclear Energy, Science and Technology, ORO, and ORNL management were responsive in initiating near term actions to address deficiencies identified during this evaluation. For example, actions to address configuration management and procedural concerns are underway.

Table ES-1. Safety Issues

DOE Order 414.1A, *Quality Assurance*, establishes a process for addressing and tracking Safety Issues identified by independent oversight evaluations. The DOE Office of Science, as the lead program secretarial office, is required to develop a corrective action plan to address the Safety Issues identified during this EH-2 focused safety management evaluation.

- Environment, safety, and health roles and responsibilities for line management within the research and development divisions are not adequately defined and understood as required by DOE Policy 450.4, *Safety Management System*.

- The Metals and Ceramics Division work planning and control processes for R&D activities are not well defined or documented. Additionally, there are weaknesses in sitewide procedures for identifying and analyzing hazards, stop work policies, and work control processes for maintenance work.

- Numerous ORNL division-level procedures are not adequately developed and/or used to support effective implementation of ISM as required by DOE Policy 450.4.

- Configuration management at REDC is informal and ineffective, and it is not being implemented as required by 10 CFR 830.120 and the Building 7920 safety analysis report and technical safety requirements administrative controls.

- UT-Battelle's feedback and improvement processes are not adequately defined or implemented to effect consistent, continuous improvement as specified in DOE Policy 450.4, *Safety Management System Policy*, and DOE Policy 450.5, *Line Environment, Safety and Health Oversight.*

- ORO and its Oak Ridge National Laboratory Site Office have not established and implemented an effective and efficient oversight program as specified in DOE Policy 450.5, *Line Environment, Safety and Health Oversight*, and ORO Manual 220, *Oak Ridge Operations Appraisal Manual.*

1.0 Introduction

The U.S. Department of Energy (DOE), Office of Environment, Safety and Health Oversight (EH-2) conducted a focused safety management evaluation at the Oak Ridge National Laboratory (ORNL) during May-July 2001. EH-2 is the organization within the DOE Office of Environment, Safety and Health with responsibility for performing independent oversight of environment, safety, and health (ES&H) policies and programs across DOE sites.

The purpose of the evaluation was to determine how effectively DOE and contractor line management have implemented integrated safety management (ISM) at ORNL. A focused safety management[1] evaluation encompasses the line management organizations responsible for ORNL, from the lead program secretarial office to the DOE operations office, the operating contractor and its subcontractors, site users, and ultimately to the workers at selected facilities (see Figure 1). EH-2 evaluates site performance against the objective, principles, and core functions for ISM systems described in DOE Policy 450.4, *Safety Management System Policy* (see Figure 2).

The DOE Office of Science (SC) is the lead program secretarial office for ORNL. SC provides programmatic direction and funding for most research and development (R&D), facility infrastructure activities, and ES&H program implementation at ORNL. The Office of Nuclear Energy, Science and Technology (NE) provides programmatic direction for certain ORNL facilities and has responsibilities for certain aspects of operations at ORNL nuclear facilities, such as the High Flux Isotope Reactor, in accordance with a memorandum of agreement with SC. ORNL receives operational direction from the Oak Ridge National Laboratory Site Office (OSO), which is the DOE office with operational responsibility for ORNL. OSO reports to the Oak Ridge Operations Office (ORO). ORO provides specialized technical support to OSO in ES&H-related areas when requested by OSO.

The management and operations contractor for ORNL is University of Tennessee-Battelle (UT-Battelle), which is a partnership between the University of Tennessee and Battelle Memorial Institute. The UT-Battelle team assumed responsibility for operating ORNL in April 2000 and is responsible for R&D programs, site operations, maintenance of site infrastructure, environmental management, and waste management.

Before the contractor transition, ORNL had undergone an April 1999 Phase I ISM verification and a January-March 2000 Phase II ISM verification review. After a second, limited-scope Phase II verification review in August-September 2000, ORO declared that ISM was implemented on September 29, 2000. However, UT-Battelle assessments during and after the transition determined that the ISM program needed substantial improvement. UT-Battelle has initiated efforts to plan for and to implement major revisions and enhancements to the ISM program. Although they are in the early stages of this effort, UT-Battelle requested that EH-2 conduct the evaluation at this time rather than delay it until their planned enhancements were complete. UT-Battelle indicated that an independent review of the current ISM program and UT-Battelle's preliminary plans to enhance the program would benefit the site by identifying aspects of the plans that need revision or further enhancement. Consequently, EH-2 evaluated UT-Battelle plans and initiatives, as well as the current status of ISM programs at selected facilities.

This focused safety management evaluation of ORNL focused on the effectiveness of SC, NE, ORO, UT-Battelle, and selected subcontractors in implementing the objective, guiding principles, and core functions of ISM. Specifically, the EH-2 team evaluated the institutional processes that apply to all ORNL activities and the application of ISM in the following selected ORNL divisions, facilities, and work activities:

[1] Safety management refers to those programs that ensure that an acceptable level of protection of the public, workers, and environment is maintained throughout the life of a facility or operation. The term "safety," when used in the context of safety management, specifically includes all aspects of environment, safety, and health.

- **Chemical Technology Division**. Operations and maintenance, at the Radiochemical Engineering Development Center (REDC) and Radioisotope Development Laboratory were reviewed. A functional inspection of the safety-class ventilation systems at Building 7920 of the REDC was performed.

- **Metals and Ceramics Division**. Research and development, operations, and maintenance activities were reviewed.

- **Plant and Equipment Division**. Maintenance activities were reviewed, with a focus on maintenance activities within the other divisions (i.e., Chemical Technology Division and Metals and Ceramics Division) reviewed on this evaluation.

These facilities were selected to enable an evaluation of the application of ISM at facilities with different missions (e.g., R&D), including observation of work planning and control processes as they are actually implemented at ORNL. In addition, the EH-2 team was able to observe work performed by subcontractors.

As a major area of emphasis for the focused safety management evaluation, the EH-2 team conducted a functional review of the safety-class ventilation system at Building 7920 of the REDC. The functional review included a detailed walkdown and review of design, maintenance, testing, operations, and configuration management to determine whether engineered systems can reliably perform their designated safety-related functions. The reviews are supportive of DOE efforts to address Defense Nuclear Facilities Safety Board Recommendation 2000-2, *Configuration Management, Vital Safety Systems*. The results of the review of essential systems are summarized under Guiding Principle #6, *Hazard Controls Tailored to the Work Being Performed*, and discussed in detail in Appendix A.

In this report, the effectiveness of UT-Battelle in implementing the ISM guiding principles is discussed in Section 2. UT-Battelle effectiveness in implementing the core functions is summarized in Section 2 and discussed in more detail in Appendix B. Section 3 discusses the effectiveness of DOE line management—SC as the lead program secretarial office, and ORO as the responsible field element—in implementing their ISM responsibilities. Section 4 presents the ratings. Appendix C summarizes issues for corrective action. Appendix D describes the evaluation process and the EH-2 team composition.

OVERVIEW OF OAK RIDGE NATIONAL LABORATORY

MISSION: ORNL's mission is basic and applied research in support of DOE and government programs. Originally established in 1943 as part of the Manhattan Project, the site's original mission involved pioneering methods to produce and separate plutonium. ORNL currently performs research in a wide variety of areas, including neutron science, carbon management, high performance computing, complex biological systems, and materials science.

LOCATION: ORNL covers 58 square miles in eastern Tennessee, about 15 miles northwest of Knoxville, Tennessee.

MAJOR FACILITIES: Major facilities include the Spallation Neutron Source, the High Flux Isotope Reactor, the Center for Computational Science, the Holifield Radioactive Ion Beam Facility, the Mouse Genetics Research Facility, the High Temperature Materials Laboratory, the Oak Ridge National Environmental Research Park, the Building Technology Center, the Radiochemical Engineering Development Center, and the Surface Modification and Characterization Research Center.

STAFFING AND BUDGET: ORNL employs about 3,800 people. In addition, several thousand guest researchers use ORNL facilities each year. Projected fiscal year 2001 funding for the site is about $870 million. The DOE Office of Science is the site landlord and provides the majority of the ORNL funding. The Office of Nuclear Energy, Science and Technology provides programmatic direction for certain ORNL facilities. As a multi-program laboratory, ORNL also receives funding from several other DOE offices, including the DOE Office of Energy Efficiency and Renewable Energy. ORNL performs R&D activities for various non-DOE organizations and commercial industries under the DOE work-for-others program. The projected 2001 funding includes about $86 million under the work-for-others program.

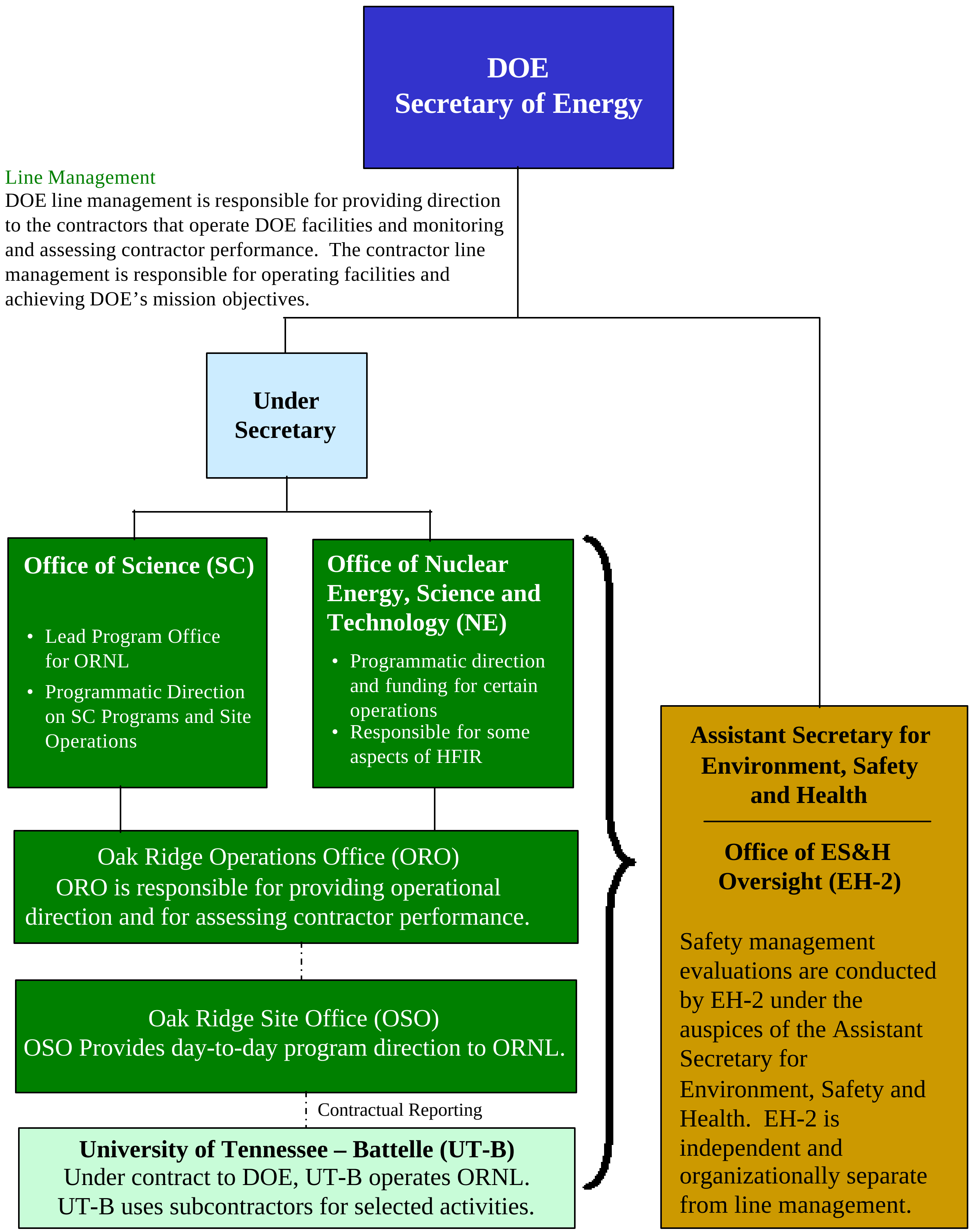


Figure 1. Organizations with Responsibilities at Oak Ridge National Laboratory (ORNL)

Component 1
Objective

Systematically integrate safety into work practices at all levels

Component 2
Guiding Principles

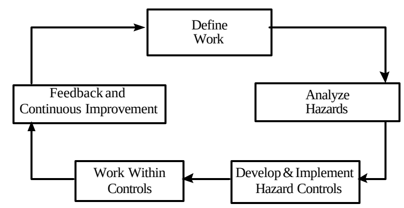
Fundamental policies that guide Department and contractor actions, from development of safety directives to performance of work

Component 3
Core Functions

Structure to perform work with rigor commensurate with hazards

integrate safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment. This is to be accomplished through effective integration of safety management into all facets of work planning and execution. In other words, the overall management of safety functions and activities becomes an integral part of mission accomplishment.

1. Line Management Responsibility for Safety
2. Clear Roles and Responsibilities
3. Balanced Priorities
4. Competence Commensurate with Responsibilities
5. Identification of Safety Standards and Requirements
6. Hazard Controls Tailored to Work Being Performed
7. Operations Authorization



The objective, guiding principles, and core functions of safety management shall be used consistently in implementing safety management throughout the DOE complex.

The mechanisms, responsibilities, and implementation components are established for all work and will vary based on the nature and hazard of the work being performed.

Systems defining how functions

Component 5
Responsibilities

Defined and documented responsibilities and approval process commensurate with hazards

Component 6
Implementation

Figure 2. Components of DOE's Integrated Safety Management System

2.0 Integrated Safety Management Program

The overall effectiveness of ISM relies on sound institutional processes and effective implementation at the facility and work activity level. This section discusses each of the seven guiding principles of safety management, focusing primarily on organizational and institutional processes. This section also includes a summary-level description of the evaluation of the core functions of safety management. Appendix B provides more detailed information on the five core functions, focusing on facility- and activity-level processes.

Background. This EH-2 evaluation took place while UT-Battelle was in the process of planning and implementing major revisions and enhancements to the ISM program. These include the Standards Based Management System (SBMS) and the facility management model. SBMS is intended to provide a comprehensive system for identifying applicable standards and requirements; incorporating them into ORNL institutional documents; and flowing those requirements down to working level procedures. The facility management model is intended to define the framework for various organizations (e.g., R&D and maintenance organizations) to conduct work activities in ORNL facilities under a common work control system. As part of the model, facility use agreements will be developed that will better define controls, work boundaries, and interfaces between the facility management organization and tenants. ORNL piloted the concept at the Building 4500 complex and plans implementation for the site before the end of the year, excluding nuclear facilities. UT-Battelle has also initiated various other efforts to improve ES&H programs and enhance ISM, such as establishing self-assessment programs.

These initiatives are in various stages of development, and some are in the early stages of implementation. As UT-Battelle took over the contract in April 2000, they developed a transition plan and a "gap analysis," which recognized that ORNL was relying on practices that do not meet current DOE expectations for ISM. For example, ORNL used a "people-based" approach to safety management rather than the standards-based approach required by DOE's ISM policy. A people-based approach relies largely on experienced people and individual competence and initiative. With a people-based approach, workers (e.g., maintenance personnel, operators, scientists, and engineers) must be capable of recognizing and controlling hazards and must know when to seek assistance from ES&H professionals. As historically implemented at ORNL, many communications about hazards were informal, many work activities were conducted without procedures, policies were not documented or were not mandatory, safety functions were often performed by ES&H organizations with limited line management involvement, and the numerous individual divisions/directorates at ORNL had significant authority to establish procedures for their divisions.

These longstanding practices were often viewed as adequate and appropriate by many ORNL managers and staff. ORNL has a relatively good safety record when compared to industrial averages for measures such as lost workdays (although higher than most other DOE laboratories). Most ORO assessments indicated that ORNL safety performance was adequate, and the ISM verification reviews indicated that an adequate ISM program had been established. The ORNL people-based work control process often worked adequately because of the relatively stable and experienced workforce. For example, the Metals and Ceramics Division has less than 3 percent turnover annually, and most workers have worked within the division for over a decade and are knowledgeable of each other's work practices. Communication of work scope and hazards among researchers and support organizations such as environment, safety, health, and quality (ESH&Q) and maintenance personnel was often informal but usually effective.

As a result, many ORNL managers under the previous contractor believed that their program was adequate and was meeting DOE expectations for ISM. Therefore, they did not take aggressive and proactive actions to fully understand and adapt to evolving DOE expectations for a rigorous and formal standards-based approach to safety management. Although the ISM program was established and approved by ORO, it did not adequately address DOE ISM requirements. For example, many ORNL institutional policies and processes were inadequate, and some line managers relied excessively on ES&H professionals to perform safety functions. Also, each division established its own ISM program, which generally do not meet DOE requirements for formality and rigor. Safety management at ORNL was also hindered by aging facilities and equipment, which had been allowed to degrade over time.

When UT-Battelle took over the contract, senior managers brought to ORNL by UT-Battelle had experience at other DOE laboratories and facilities, and thus recognized that ORNL's historical practices were not consistent with DOE expectations for a fully effective ISM program. Also, ORNL's historically informal work practices cannot be relied on in the future because of several factors (e.g., the aging workforce, the anticipated turnover of personnel, and the need to have traceable records of work activities). UT-Battelle performed various assessments and reviews, which generally were effective in characterizing the status of the current ISM program and the numerous deficiencies.

As discussed throughout this section, the EH-2 team examined the current ORNL ISM and ES&H programs to determine their effectiveness and compliance with DOE ISM policy. However, recognizing that many of the current processes are evolving or will be superseded as SBMS is implemented, the EH-2 team also examined plans for improvement with a focus on identifying areas that need additional management attention. As discussed throughout this report, additional attention is needed to address deficiencies that were not fully recognized by UT-Battelle (e.g., configuration management). Also, UT-Battelle needs to ensure that the implementation plans recognize and address the considerable challenges associated with transitioning a workforce to a formalized and rigorous safety management program and addressing numerous legacy deficiencies in aging equipment and historically poorly documented work practices.

Aerial View of ORNL

2.1 Line Management Responsibility for Safety

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

Organizations that have effective safety management programs place responsibility for safety with line management. Accordingly, line management must ensure that the safety management program includes safety policies and goals that are clearly articulated and communicated, and that workers are fully involved in safety issues and take appropriate action in the face of hazards encountered during normal and emergency conditions.

Policies, Expectations, and Leadership

The Laboratory Agenda as described in the ORNL Institutional Plan is the mechanism by which UT-Battelle's Leadership Team intends to accomplish its vision of "simultaneous excellence in science and technology; laboratory operations and ES&H; and community service." The Agenda outlines a framework for long-term initiatives, mid-term critical outcomes, and near-term actions. Three interrelated, near-term, ES&H-related actions are designed to:

- Demonstrate continual improvement in ES&H performance by building on the ORNL ISM program
  - Redesign the ORNL approach to facility operations
  - Deploy an integrated set of standards-based management systems.

During the last several years, ORNL management has focused on establishing the ISM program. The ISM verification process started under the former ORNL contractor. The Phase II ISM verification was initiated during the former contract and continued after contract turnover to UT-Battelle in April 2000. Although the verification did not result in a formal report, six of the divisions received less than satisfactory ratings. A follow-up Phase II verification assessment for the Chemical Technology and Plant and Equipment Divisions, which had received the lowest ratings in the earlier Phase II verification review, was performed in August-September 2000. ORO declared that ISM was implemented at ORNL in September 2000.

To support the Phase II ISM verification, UT-Battelle demonstrated leadership by performing detailed assessments of operations in the Chemical Technology Division and the Plant Equipment Division. These reviews and other assessments identified and documented numerous "ISM gaps." Follow-up UT-Battelle analyses of the gaps led to three major institutional issues: (1) weaknesses in work control policy and implementation; (2) inadequate definition of assignments and training; and (3) lack of a systematic approach to feedback and improvement. Responsibility for addressing these issues was assigned to the Director of the ORNL ESH&Q organization, and they were subsequently entered into the tracking system with a September 2001 milestone for closure. Other ISM gaps were assigned to the Chemical Technology and Plant and Equipment Divisions and entered into the ORNL tracking system. Division records indicate that many actions designed to address the gaps have been completed.

UT-Battelle has recently revised its ISM program description document. Many elements of ISM and requirements for closing the gaps identified in ISM verification assessments have been incorporated into implementation of SBMS and the facility operations model initiatives. When fully implemented, the SBMS systems and other planned initiatives have the potential to:

- Allow separation of R&D activities from maintenance and housekeeping tasks
- Enhance facility management infrastructure and expertise
- Take better advantage of subject matter experts deployed from support organizations
- Better delineate facility and activity safety boundaries
- Through SBMS, lead to a more disciplined approach for dealing with requirements and performing work
- Provide a documented and formalized system for developing and implementing policies and procedures.

Considering the significant deficiencies in the current ISM program identified by the UT-Battelle gap analysis and the additional significant deficiencies identified during this EH-2 evaluation (as discussed throughout this report), timely and effective implementation of the UT-Battelle initiatives is essential. UT-Battelle senior management has a good strategic vision for the ORNL work environment. Their implementation approach recognizes that top-down leadership is needed for establishing the policies, roles, and responsibilities, and the higher-tier programs and processes, and for extending the programs through the organization to the working level.

In the past year, UT-Battelle has made good progress in several important areas:

- The UT-Battelle Leadership Team, consisting of Level I managers and chaired by the ORNL Director, is proactively and visibly involved in most major decisions.
- Key members of the management team have experience in implementation and use of SBMS and the facility/tenant model from their work at other DOE laboratories (e.g., Pacific Northwest National Laboratory and Brookhaven National Laboratory) that have successfully implemented those programs.
- Support organizations have received considerable attention and resources, and have deployed many subject matter experts to support field activities.
- As a result of a sitewide initiative to reduce hazards, ORNL has made good progress in improving the management of chemicals within the Laboratory.
- In the environmental area, ORNL is focusing on potential deficiencies identified during the contract transition, as well as more recent deficiencies discovered during the High Flux Isotope Reactor reviews, and is performing a detailed review of facility environmental vulnerabilities.

- Various ORNL divisions have made progress in addressing ISM gaps and enhancing ES&H programs. Although deficiencies remain in their formal ISM program, the Metals and Ceramics Division has a good safety record, is operating according to good industrial safety practices, and has improved internal communications on safety. Also, the Chemical Technology Division has devoted considerable effort to completing actions to close concerns identified in the ORNL gap analysis.

The cultural factors associated with a transition to a standards-based approach to safety management will require proactive and sustained involvement by the upper management within the research infrastructure. Although the strategic vision is appropriate, implementation of the SBMS, facility operations model, and other initiatives will be complicated by cultural factors (i.e., resistance to changing longstanding approaches to safety management). Traditionally, R&D work and related support activities (e.g., equipment setup and maintenance) are controlled at the division level based on individual researcher's expertise and work habits. Consequently, implementation of SBMS and the new facility operations model, and utilization of these systems at the task level, constitute a departure from the past and current practices within ORNL. Interviews with division managers and observation of how work is performed indicate that this effort will continue to present a major challenge to the UT-Battelle support organizations charged with defining, planning, implementing, and communicating these systems to operating divisions.

In addition to cultural factors, ORNL plans for improvement initiatives are not always sufficiently developed and detailed to ensure that implementation will be timely and effective. Some of the schedules are not realistic and do not adequately consider the challenges associated with implementing major changes at over 30 semi-autonomous ORNL divisions and driving the changes down through several layers of management to the working level. In addition, the current plans do not provide for sufficient participation by researchers, adequate communications, interim milestones, and timely feedback. Specific areas of concern include:

- Many major milestones are scheduled for completion on or about September 2001. However, ORNL has not been successful in communicating expectations for the systems, the portions that will be implemented in each division/facility, and the expected rigor and formality of work processes. Also, ORNL has not adequately communicated the implications of the changes in safety management approaches to the working levels in each division/facility. ORNL senior managers recognize that they are not going to meet their September 2001 SBMS goal to implement work planning and control, and will need to allow more time for communications to and feedback from the divisions.

- There is no effective communication or detailed and clear understanding of how the new systems will work, and what influence these systems will have on how work is approved and performed. Researchers have had limited participation in defining SBMS subject areas. Many of the research management and staff expressed their impression that improvement initiatives are about "maintenance or housekeeping" and will not significantly affect the way work is done. The limited involvement and ownership of safety management by some line managers (below Level I managers) in the research division contribute to the communication weaknesses. ORNL management indicated that they recognize this weakness and are increasing their emphasis on improving the interactions with the R&D divisions. Also, the ISM verification process provided an overly optimistic assessment of the status of ISM implementation and gave incorrect feedback to the line organizations about the status and effectiveness of ISM.

- Weaknesses in work planning and control persist. The importance of line management ownership for work planning and control has not been clearly communicated and is not yet being effectively implemented. This situation is a major flaw in the ISM implementation strategy, and the failure to effectively establish line management ownership for safety is a significant concern given that the DOE ISM policy has been established for more than five years.

- As a major element of SBMS, the UT-Battelle management team is currently involved in the definition of a new work control process. A preliminary management system description for this activity was recently developed and placed on the SBMS web site. There is a strong commitment to complete this task by September 2001. However, considerable details need to be worked out before this new process is ready for approval and implementation within ORNL. In addition, successful accomplishment of this task requires broad involvement and extensive interactions with ORNL divisions. Division managers interviewed, however, did not have sufficient knowledge and understanding of the details of the new process as currently developed, and were not anticipating an impending change in how they are operating.

Overall, senior managers at UT-Battelle have directed much of their leadership and energy to enhancing ISM by adding SBMS and a new facility operations model at ORNL on an accelerated schedule. Believing that this approach would lead to timely changes and would address recognized problems, ORNL management has not devoted sufficient attention to implementation at the division level and to correcting identified deficiencies. Considering possible extension of SBMS schedules, additional and timely attention is needed in a number of areas, including a lack of clear ownership of ES&H responsibilities, inadequate procedures, insufficient procedural use and adherence, inadequate work control mechanisms, and deficient configuration management.

Worker Empowerment

Workers at ORNL contribute to ES&H enhancements through a number of established mechanisms, such as various safety committees and multiple processes for addressing employee concerns and suggestions. Workers are generally involved in work planning and control processes. However, institutional and divisional work control procedures do not specify worker involvement to the extent expected by ISM.

The ORNL policy and procedure for "Stop Work and Restart Work" clearly empowers the workers to stop work when faced with an "imminent danger." The procedure also identifies alternative avenues for resolution of lesser hazards. Atomic Trades and Labor Council (ATLC) union representatives confirmed that ORNL workers have exercised their stop work authority and have generally achieved resolving lesser safety hazards through the available alternatives. However, as discussed in Safety Issue #2 and Appendix B, there are weaknesses in the policy and procedure.

ORNL workers have multiple avenues for expressing ES&H concerns, both formally and informally. They can bring their concerns to their supervisors, members of line management, and ES&H Division representatives. They can also pursue resolution of their concerns through a web page designated for ES&H questions, various safety committees, and the ORNL or DOE employee concerns programs. Both ORNL and DOE prohibit retribution against employees, subcontractors, and guests for raising concerns. To alleviate potential fear of retaliation, many of these avenues can be used confidentially or anonymously. Workers are made aware of these opportunities to address their concerns and their stop-work right and responsibility through the ORNL Employee Handbook, initial orientation and training, web sites, posters, bulletins, and various safety- and work-related meetings.

ATLC representatives expressed general satisfaction with the resolution of concerns processed through the DOE employee concerns program. They also indicated that workers were sometimes reluctant to press their safety concerns, reportedly because of past examples of intimidation, such as threats of layoff or loss of subcontracts. The EH-2 team found no recent, specific examples of such intimidation. However, the workers' perception that management's response to raising safety issues might be punitive was identified by UT-Battelle during their 1999 ORNL contractor transition review. Efforts to address worker-level concerns, build trust, and improve the safety of the work environment are contained in the partnership initiative under development between ATLC and ORNL.

External Stakeholder Involvement

ORNL, in coordination with ORO, other contractors at the Oak Ridge Reservation, and government organizations, supports a robust set of venues for external stakeholder involvement in ES&H decisions, with principal focus on environmental and human health issues. These venues include the Oak Ridge Site Specific Advisory Board, the Oak Ridge Reservation Local Oversight Committee and Citizens Advisory Panel, the Roane County Environmental Review Board, the Community Reuse Organization of East Tennessee, the Coalition for a Healthy Environment, Friends of Oak Ridge National Laboratory, the Tennessee Department of Environment and Conservation's DOE-Oversight Division, and DOE-sponsored public meetings and comment periods on a broad range of ES&H issues. Recommendations that result from these activities are carefully considered for incorporation in final decisions on the issues reviewed.

Summary of Guiding Principle #1. ORNL has adequate programs for addressing worker concerns and involving stakeholders in decisions. ORNL management has devoted considerable attention and resources to addressing the recognized deficiencies in the current ISM program. Their major initiatives, such as SBMS and the facility operations model, are appropriate and provide a good strategic vision for the ISM program. In the past year, UT-Battelle has made significant progress in certain areas, established a top-down approach to implementing the needed improvements, and demonstrated leadership and involvement in safety management.

However, implementation plans for the ORNL strategic vision needs improvement. ORNL management need to devote additional attention to developing sufficiently detailed implementation plans to ensure that their strategic vision will be realized. They also need to address the significant challenges associated with implementation of the SBMS, the facility operations model, and other initiatives across the ORNL divisions and with communicating the changes to the research organizations. Recognizing that their SBMS schedule will be extended, additional attention is needed to address weaknesses in work control processes, procedure development and use, and configuration management on a more timely basis.

2.2 Clear Roles, Responsibilities, and Authorities

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

Organizations that have effective safety management programs place responsibility, authority, and accountability for safety with line managers. Accordingly, line management must ensure that the program includes well-defined roles, responsibilities, and processes for ensuring that management is accountable for safety performance.

Leadership Team

The Leadership Team, chaired by the ORNL Director, has clear line responsibility for ORNL strategic goals and has assigned appropriate roles to Level I managers to meet these goals. UT-Battelle has also devoted considerable effort to formally implementing its roles, responsibilities, authorities, and accountability (R2A2) process for management and staff. Although the R2A2 process is not expected to be fully operational until the end of fiscal year (FY) 2001, ORNL is already realizing some benefits of the system. R2A2 profiles for ten positions, including the Laboratory Director, vice presidents, associate laboratory directors, and directors of institutional support organizations, are currently in final review and approval by UT-Battelle management. Review of these documents indicates that ES&H requirements have been appropriately included. The expectations developed for Level I managers are currently being used to define corresponding R2A2s for lower-level positions within the organization.

When fully implemented at all levels of the organization, the R2A2 process will benefit ORNL by establishing relationships among various roles and positions. It will also link individuals' roles and responsibilities to corporate goals and processes defined in SBMS management systems, subject area descriptions, and procedures.

ESH&Q Support Organizations

UT-Battelle has devoted considerable effort to strengthening the ESH&Q support organizations. As a result of these efforts, the roles and responsibilities of positions and individuals within the ESH&Q organizations, including the deployed staff, are well defined. Roles and responsibilities of ESH&Q managers and staff have also been appropriately documented in a number of sources, including individual position descriptions, the ISM system description, procedures, and SBMS management system descriptions and subject area programs.

UT-Battelle is replacing the existing position descriptions with the Performance and Development System, a modern web-based system for staff performance management and compensation. Within this system, the "Annual Results Plans" summarize employees' performance expectations for the year and have been developed by the employees and reviewed and approved by their supervisors, and are the bases for annual performance reviews. ES&H requirements in these plans are appropriate, and the employees have a good understanding of what they need to accomplish to meet their goals.

The respective roles and responsibilities of the ESH&Q and R&D organizations have not been adequately coordinated to ensure effective implementation of ES&H goals and initiatives within research organizations:

- The corporate ESH&Q organization has been assigned the lead responsibility for closing the ISM gaps and for facilitating the definition and implementation of SBMS system. As noted in the SBMS plan, these tasks, especially SBMS definition and implementation, require significant coordination with R&D divisions. However, in practice, the interfaces between ESH&Q and R&D divisions for implementation of the new initiatives are not adequately understood and characterized. As a result, roles and responsibilities for the level of coordination necessary to implement important elements of SBMS, such as R&D work control and planning systems, are not clearly delineated, understood, or assigned.

- A number of divisions within the ESH&Q organization are currently preparing memoranda of understanding with R&D divisions they support. Lack of a process to consolidate this effort and insufficient participation by upper management of R&D organizations (e.g., associate laboratory directors) is hindering this important effort.

Maintenance Organizations

The Plant and Equipment Division provides maintenance support to all ORNL divisions. Roles and responsibilities of Plant and Equipment Division managers and staff are defined in their position descriptions. In addition to position descriptions, the Performance and Development System is used for performance management and compensation. Annual Results Plans for the Plant and Equipment Division Director and department heads (i.e., work center managers) include appropriate requirements for ES&H and ISM.

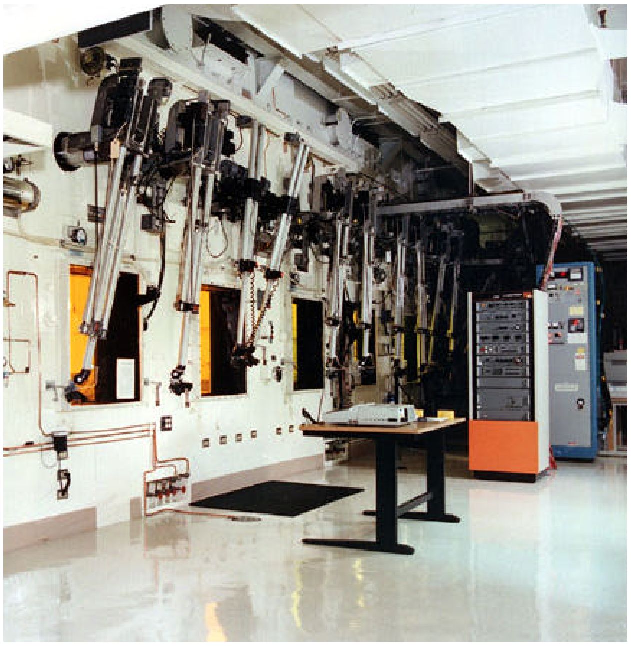
Plant and Equipment Division procedures identify the roles and responsibilities of organizations requesting the work and various Plant and Equipment Division positions, such as planners and supervisors. Work requests appropriately identify responsibilities for involving the workers and obtaining appropriate technical expertise for such functions as job hazards evaluations. The Plant and Equipment Division procedures are not, however, used uniformly across all ORNL organizations.

Memoranda of understanding are used to document the respective responsibilities and interfaces between the Plant and Equipment Division and R&D divisions/organizations. The responsibilities and interfaces, however, have evolved historically and vary significantly from organization to organization. One of the institutional gaps identified during UT-Battelle self-assessment identifies a "lack of understanding of safety-related responsibilities and processes" for interface between Plant and Equipment Division craft support and nuclear facilities. The actions proposed to close this gap included a series of meetings between Plant and Equipment Division personnel and nuclear facility managers, and updates to the memoranda of understanding. However, the memoranda of understanding continue to display weaknesses in definition of safety-related roles, responsibilities, and interfaces.

UT-Battelle is preparing for a major reorganization to implement the new facility operations model, which is based on facility/tenant use agreements. Responsibilities for definition and implementation of this model have been appropriately assigned to Facility Operations, with a September 2001 milestone for implementation. The Facility Operations organization has recently completed a pilot project of the facility/tenant use agreement model and has made progress towards implementation. As a result of these efforts, a set of comprehensive roles, responsibilities, and qualification requirements for a number of positions (e.g., facility managers) have been defined and are being used to recruit qualified individuals.

R&D/Operations Organizations

ORNL divisions perform a wide variety of R&D activities, ranging from benchtop research to hot cell operations. In addition to this very broad scope of R&D activities, each ORNL division, including the Metals and Ceramics and Chemical Technology Divisions, uses a division-specific approach for performing work and implementing ISM. These divisions each have dedicated ES&H support organizations and individuals in safety-related positions,



Hot Cell at ORNL

such as Division Safety Officers and Division Radiological Protection Officers. These personnel, augmented by staff from institutional ESH&Q organizations, provide ES&H support to principal investigators for research projects and to facility managers when requested. Position descriptions and annual measures of performance for division and section managers within the Chemical Technology and Metals and Ceramics Divisions appropriately incorporate ES&H roles and responsibilities. In addition, roles and responsibilities of nuclear facility managers are appropriately documented in facility operating policies and requirements.

One Safety Issue was identified under Guiding Principle #2, addressing inadequate definition and understanding of line management roles and responsibilities for ES&H. Although primarily based on the review of the Metals and Ceramics Division, the Safety Issue needs to be assessed by ORO and UT-Battelle for sitewide applicability.

Safety Issue #1: ES&H roles and responsibilities for line management within the R&D divisions are not adequately defined and understood as required by DOE Policy 450.4, *Safety Management System.*

Although various initiatives are under way, such as R2A2 and SBMS, the ES&H roles and responsibilities of line managers within R&D divisions are currently not well defined or understood. Some of the group leaders and principal investigators in the Metals and Ceramics Division did not display a good understanding of their safety-related responsibilities and were not actively involved in implementation of a number of safety programs in their workplaces. Specific concerns identified in the roles and responsibilities of line managers in the Metals and Ceramics Division include:

- Some group leaders and principal investigators have relied excessively on ES&H personnel to perform safety functions, such as development and maintenance of new work reviews, which should be performed by group leaders. Some of these group leaders did not recognize their ownership of these documents and indicated that completion and maintenance of safety records was an ES&H organizational responsibility rather than a line management responsibility.

- Most group leaders interviewed were unaware of roles and responsibilities that were assigned to them by the division management and documented in the Metals and Ceramics Division Chemical Hygiene Plan.

- Many group leaders have not implemented their responsibility for maintaining up-to-date Laboratory Safety Summaries, which are the primary tool for identifying and communicating hazards, and authorizing work. Failure to maintain the summaries is a deficiency in the implementation of ISM requirements.

- Some Metals and Ceramics Division group leaders were unaware of equipment operability requirements for safety equipment (e.g., fume hoods, safety showers, and chain hoists) in their work areas, contributing to instances where equipment was operated after the inspection date had lapsed.

- Responsibility for storage and labeling of chemicals was not clearly recognized and assigned in some laboratories. Some group leaders were unaware of the extent of the chemical hazards within their laboratories.

- Contrary to the requirement of Metals and Ceramics ISM System Program Plan, job descriptions for group leaders do not specifically and clearly define their responsibility for safety.

- There is no job description for principal investigators, although personnel in this position must perform various ES&H responsibilities.

- There is no formal requirement for line managers of R&D work to brief their personnel on hazards and controls before a job starts, or to conduct a post-job review. Also, there are few written requirements for involving ES&H professionals and workers in planning the work or improving work performance through lessons learned.

The ISM gap analysis identified weaknesses in roles and responsibilities for the Chemical Technology Division that were similar to those identified in the Metals and Ceramics Division. The similarity of the deficiencies in the two organizations indicates that roles and responsibilities for R&D line managers constitute a sitewide concern that warrants timely management attention.

Summary of Guiding Principle #2. UT-Battelle has identified weaknesses in the roles and responsibilities area on several occasions. Processes to correct the identified weaknesses, such as R2A2, have been established and are ongoing. Overall, however, roles and responsibilities need improvement. ORNL and ORO need to focus on establishment of a robust process for assigning roles and responsibilities and for holding individuals and organizations accountable for safety performance. Particular attention is needed to address the poor flowdown of requirements (see Guiding Principle #5) to the activity level and the prevailing culture in the R&D divisions, which historically tolerated informality and did not promote a standards-based approach to safety management.

2.3 Competence Commensurate With Responsibilities

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

A fully functioning safety management system has workers and managers who are technically competent to perform their jobs and who are appropriately educated and knowledgeable of the hazards associated with site operations. Management must assure that effective training programs are in place and that sufficient qualified staff are available. Workers must have the technical capability to respond to workplace hazards.

Staffing and Qualifications

ORNL has many experienced, well educated, and well trained personnel throughout facility management, operations, ES&H, and R&D divisions. In general, ORNL personnel have extensive experience; the average age of the staff is about 50, and most of the individuals in facility management and ES&H positions have worked at ORNL for more than 10 years. The experience and relative stability of the ORNL staff have contributed to safety as ORNL has historically operated with a "people-based" approach to work planning and control.

However, as discussed elsewhere in this report, the people-based approach is not consistent with DOE expectations for ISM. UT-Battelle is in the early stages of a transition to a standards-based approach to safety management. This transition is particularly important at ORNL because there have been and will continue to be increases in staff turnover and the associated loss of corporate memory. Significant staff reductions in the past few years have resulted in the loss of some experienced personnel and the realignment of positions. The recognition that increasing numbers of key ORNL staff will be approaching retirement age has challenged ORNL to pursue initiatives that are designed to attract and retain laboratory personnel for its ongoing R&D mission (e.g., plans to hire about 250 new personnel this year, including 100 new positions for the Spallation Neutron Project). The expected turnover of personnel will negate some of the historical safety benefits associated with a stable, experienced workforce, and will increase the importance of the transition to the ISM standards-based approach to safety management. The increasingly large numbers of visiting researchers and students at ORNL also highlight the need for rigorous and formal safety management approaches that do not rely exclusively on the capability and initiative of individuals.

Although staffing levels have been decreasing for the past several years, including areas such as ESH&Q and R&D, ORNL has retained sufficient numbers of qualified staff to effectively perform ES&H-related functions. ORNL senior management considered ES&H needs during the staff reductions and determined that the remaining ESH&Q employees provided a staffing level consistent with the safety mission and functions of ORNL.

In some areas, however, safety-related functions are not being consistently performed in accordance with UT-Battelle expectations because staff are not assigned to the functions. Some divisions have chosen not to fill the Division Safety Officer positions or have assigned that role to minimally qualified individuals. The Plant and Equipment Division has eliminated the Division Training Manager position, and the Chemical Technology Division has reduced the number of Division Training Officers from five to two. The full effect of these reductions has not yet been formally analyzed or addressed by ORNL, and there is a backlog of work for some safety-related functions, such as procedure development, training development, and record keeping. The failure to update training programs and procedures could create ESH&Q concerns because training programs or procedures may not include current safety requirements or all activities that may have safety significance.

ORNL personnel generally have the education, experience, and qualifications consistent with their positions. Human resource specialists are assigned to each directorate to help ensure that job postings, position descriptions, promotions, and all employment activities focus on identifying and considering the qualifications necessary for every position. ESH&Q standards are identified as a core competency for all ORNL employees. The following concerns, however, were identified by the EH-2 evaluation team:

- **Two positions, Division Safety Officer and the Non Nuclear Facility Manager, had no formal qualification requirements.** These two positions should have basic ES&H qualifications to effectively recognize hazards and take appropriate actions to resolve safety concerns. This deficiency was identified in an ISM self-assessment.

- **In some cases, management has established a requirement that individuals be qualified, but has not established an effective qualification program.** For example, Metals and Ceramics Division management established a requirement that equipment operators be qualified to operate machinery. However, the qualification program is not well defined (see Core Function #3 in Appendix B).

- **The qualifications and training needed by individuals performing work activities cannot be readily identified in many cases.** Although currently lacking at ORNL (see Safety Issue #2), an effective work planning and control process is a prerequisite to identifying the needed competencies, skills, qualifications, and training to perform work activities. For example, in the absence of effective work control processes, the work scope is not well defined and thus is it not possible to determine what training and qualifications (e.g., scaffold training, confined space training) would be required for a specific job.

Training Programs

At the institutional level, the training program is well defined. The SBMS Management System Description for Training and Qualification clearly establishes the purpose, responsibilities, and operation of the ORNL institutional training system. Managers within the ESH&Q Division develop institutional training standards, manage the data management system, provide core training requirements, and communicate

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training information and guidance for the Laboratory. The data management system contains the institutional training matrix that links specific job positions to mandated training requirements. The data management system also alerts employees and their managers to the need to renew training/qualifications and identifies available training courses. The data management system maintains a complete and readily retrievable institutional training record for each employee.

The responsibility for ensuring individual employee training and qualifications ultimately rests with the division and office directors. The divisions reviewed during this EH-2 evaluation effectively captured and monitored individual employee institutional training requirements. For example, the Metals and Ceramics Division updates all employees' training and qualification records at least every two years. A formalized orientation program is in place for most guests and visitors to determine their training needs for site access or other institutional requirements. Also, the divisions have agreements to cover situations where employees from one division need to access areas in another division that may have special precautions or training requirements. These agreements are being updated.

In most instances, the individuals who were interviewed or observed performing work by the EH-2 team had training, skills, and qualifications appropriate to their responsibilities. However, weaknesses in facility-specific training programs were evident in some job-specific and employee-specific activities. As discussed previously under this guiding principle, a significant concern is that the work planning and control processes are not currently adequate and do not provide a good foundation for identifying training requirements. Therefore, it is difficult for supervisors to determine precisely what training and qualification requirements are needed for the job. Thus, supervisors are not always able to fulfill their responsibility for ensuring that personnel are trained and qualified for their assigned work activities. Other specific concerns include:

- Training for specific hazards or processes is often informal and not well documented.

- A training and qualification program for equipment operators in the Metals and Ceramics Division has not been established, although only "qualified operators" are permitted to operate certain research-related equipment. Typically, an operator becomes qualified after being mentored by a "knowledgeable" operator and reaching a level of personal comfort when operating the equipment unassisted. Operations, safety, and emergency shutdown performance expectations are not defined, measured, reviewed, or approved by line management. ES&H staff are typically not involved in defining safety training requirements for qualifying operators, and there is no assurance that poor work practices will not be passed on to new operators. A few laboratories use check sheets that indicate specific capabilities required for individuals to operate equipment unsupervised. However, these were developed informally without review by ES&H or approval by management.

- The current data management system does not incorporate some training records (i.e., records in an older data collection system that did not transfer to the new system) and is not designed to easily accommodate data generated at the facility-specific level. Therefore, some training records are not available in the current system to managers and supervisors that need it to verify qualifications for work activities.

- There are few provisions for ensuring that supervisors effectively perform or document their responsibilities for training individuals when new hazards are introduced to a work area.

- Orientation information and assessment of training requirements for guests and visitors are inconsistently applied across the site. While the Metals and Ceramics Division and Chemical Technology Division have orientation materials for visitors, some programs (e.g., M-Plus) did not have a formalized orientation process.

- Deficiencies in procedures and procedure adherence (see Safety Issue #3) contribute to the observed deficiencies in training programs. Two of the three divisions reviewed did not follow division-level procedures that encompassed training programs and thus their training did not meet division requirements. For example, in the Metals and Ceramics Division, ad hoc job- or facility-specific training is provided by safety professionals; however, lessons plans and documentation (required by the training procedure) of this training were not retained.

- A construction subcontractor, who was fulfilling the safety officer role, had not been adequately trained to properly monitor hazards of work site conditions for heat stress and noise.

Although progress to date has been limited, ORNL personnel indicate that the development of the SBMS training program and related subject area documents will address the process that all divisions use to formalize job-specific training and qualification programs. The training program subject area documents currently under development do not address facility-specific and individual subject area training and record keeping, and no milestones have been set for their completion.

Summary of Guiding Principle #3. ORNL has many well trained, educated, and highly experienced personnel. Many aspects of the current training and qualification programs are effective. While the experienced and stable workforce has historically contributed to safety, recent staff reductions have required managers and employees to assume additional responsibilities and seek training in expanded roles. Staff turnover is increasing the importance of the transition to a standards-based approach to safety management. Currently, institutional training programs are generally well established and implemented.

However, division-level training and qualification programs need improvement to meet DOE ISM expectations. The current programs are hindered by deficiencies in work planning and control, and in procedure use and adherence. Many ORNL initiatives, such as SBMS, are intended to address deficiencies in training. ORNL needs to ensure that draft subject area documents address all division-level training weaknesses and have clear milestones for completion.

2.4 Balanced Priorities

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

A well-performing organization has a management system that identifies, analyzes, and prioritizes risks posed by the hazards inherent in the work to be performed. The system must also establish priorities to mitigate those risks. The priorities are used to request, allocate, and apply resources to meet safety goals, program goals and objectives, and operational needs.

Set Expectations and Provide for Integration

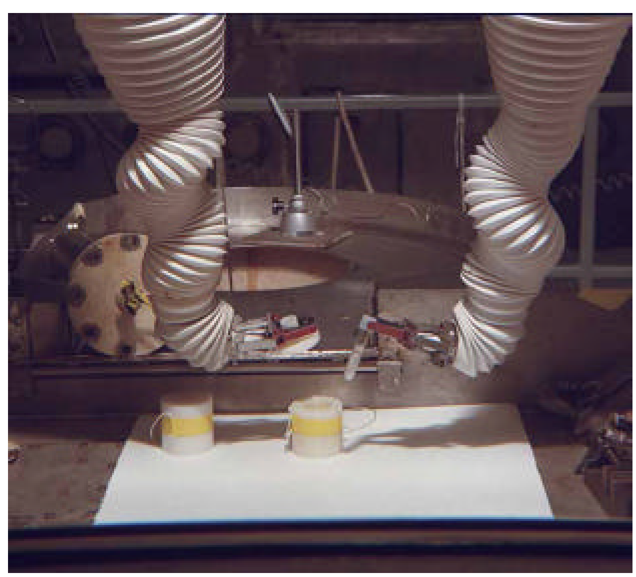
As part of their effort to improve ES&H at ORNL, UT-Battelle recognizes that they need to clearly convey performance expectations and integrate provisions for meeting these expectations into ORNL management systems. ES&H expectations have been included in a Laboratory Agenda that defines strategic objectives to be met, as well as initiatives and commitments for meeting each objective. These objectives, initiatives, and commitments are aligned with DOE expectations, which are defined in the Laboratory Agenda as critical outcomes.

One of the ORNL strategic objectives, "Excellence in Laboratory Operations and ES&H," focuses on ES&H. It includes three subordinate initiatives: (1) facilities modernization, (2) maximizing research effectiveness, and (3) enhanced operational discipline. The first two initiatives are intended primarily to promote improvement of ORNL research by making capital improvements to ORNL facilities and reducing the cost of performing research and operations. The third initiative addresses ES&H and is supported by commitments to improve ES&H through ISM, deploy SBMS, and upgrade the ORNL infrastructure. These commitments are appropriate and, if met, should improve ES&H performance.

ES&H has been given appropriate priority in the UT-Battelle performance fee evaluation process. UT-Battelle and OSO have established the FY 2001 UT-Battelle Performance Evaluation Plan to assess performance against each of the ORNL Strategic Objectives and to base the performance fee on the results. A total fee of $6,860,000 is available in FY 2001. Ten percent of this amount, or $686,000, is allocated to the "enhanced operational discipline" initiative.

Translate Mission into Work

To effectively translate the UT-Battelle Laboratory Agenda into work, tasks must be developed, responsibilities assigned, schedules established, and performance monitored. Project management plans provide an effective mechanism for implementing



Hot Cell Operations

Agenda commitments. An ISM project management plan assigns responsibilities and establishes completion dates for correction of deficiencies and closure of gaps identified by the OSO and UT-Battelle. The plan also includes a provision for conducting a review of program effectiveness after the deficiencies and gaps have been addressed. Satisfactory implementation of this project management plan should improve ES&H by providing the ORNL staff with an appropriate set of processes and procedures. However, effective leadership will be required to achieve acceptance and implementation of these processes and procedures by ORNL staff.

ORNL also has a project management plan for SBMS, but it lacks sufficient detail, milestones, and provisions to ensure an effective transition from a "people-based" to a "standards-based" management system. As discussed under Guiding Principle #5, the SBMS plan does not provide sufficient criteria or direction to assure that subject area documents, internal operating procedures, and administrative processes will be developed when needed. The SBMS plan lacks sufficient provisions for monitoring and assessing the effectiveness of implementation.

Although ORNL has a commitment to enhance operational discipline by upgrading the ORNL infrastructure, this commitment does not have a formal project management plan. Emerging deficiencies in the material condition of nuclear facilities have been managed on an ad hoc basis. The funding allocated for maintenance of nuclear facilities at ORNL has historically not been sufficient, as evidenced by the degraded material condition. Repairs necessary for compliance have been made, and some equipment has been upgraded to improve reliability, but funding has not been sufficient to fully address degradation of nuclear facilities due to aging equipment. The need for repair is not always documented, and, when documented, funding is often not provided. Maintenance activities often focus on short-term, minimal solutions to immediate problems. Non-critical ventilation maintenance actions are being deferred, resulting in degradation of the overall material condition of the safety-related ventilation systems.

A recent assessment report issued by the UT-Battelle Office of Independent Oversight recommends: "Laboratory management needs to consider assigning higher priority to requests for funds to replace aging equipment that is critical to safe operation in nuclear and radiological facilities." No action has been taken or planned in response to this recommendation.

Initiatives for the enhanced operational discipline objective do not include provisions that specifically address procedural compliance. The EH-2 team observed a casual approach toward this important element of operational discipline in ORNL nuclear facilities. The SBMS may promote some improvement in procedural compliance as the quality of procedures improves and as roles and responsibilities are more clearly defined. However, such improvements will take considerable time. Further, sustained management commitment is needed to achieve the desired level of operational discipline, particularly when the workforce is not accustomed to the degree of rigor and formality in operations expected under the DOE ISM system.

Project Prioritization and Resource Management Systems

Processes for identifying and prioritizing needs and for allocating resources are important at ORNL in the balancing of mission and ES&H priorities because expenditures in these areas compete for the same limited resources. The EH-2 team reviewed application of these processes to determine whether ES&H factors are appropriately considered in funding decisions, such as decisions to reduce ES&H staffing and modernize facilities.

A structured process for assessing the risk associated with infrastructure needs has been established. A Risk Ranking Board of five senior managers has been chartered "to develop a consistent and integrated approach to commitment of resources among activities that compete for resources in short supply." The Board uses a process for assigning risk scores based on consideration of impacts related to public safety and health, site personnel safety and health, compliance, mission, cost, and environmental protection. The Board then computes the risk reduction that may occur in each of these categories and integrates these risks into a single risk score. The Board's scoring model assigns high weights to safety and environmental categories. The Board ranks proposed work based on risk scores and presents the ranked list to the UT-Battelle Leadership Team for funding decisions. This process provides a mechanism for focusing the attention of senior managers on the risks and benefits of competing priorities. Although the resulting risk assessments are inherently subjective, they provide valuable assistance to the Leadership Team in making informed funding decisions. The risk-ranking process could be enhanced by more fully documenting the bases for scores, limiting the use of informal communications (e.g., e-mail as a substitute for Board meetings), issuing meeting minutes, and defining the process in a formal procedure.

The Leadership Team implements this process by considering safety and environmental impacts in decisions regarding infrastructure funding. The Leadership Team periodically reviews risk-ranked listings of proposed work from the Risk Ranking Board and makes any adjustments in the priorities that they believe to be appropriate. During FY 2001, the Board adjusted the score for about one third of the proposals it reviewed, in most cases to increase scores of mission-related work to a level above the funding thresholds. Such changes are to be expected in view of the lower weights given to certain activities in the risk-ranking model.

UT-Battelle has made infrastructure funding decisions with adequate involvement of the OSO. After review and approval by the Leadership Team, the list is submitted to the OSO, which reviews the prioritized list, makes any adjustments in the priorities that it believes are appropriate, and returns the list to UT-Battelle with a letter granting or withholding authorization for expenditure of funds. Although the process is appropriate, the failure to document some of the deficient conditions, as discussed below, hinders the overall effectiveness of the process because the information provided to management does not reflect all degraded conditions.

Facility management can request additional funding by submitting activity data sheets describing the need and justification for this funding. Additional funding may be provided to address needs that are judged most important to the mission and/or safety. All adjustments to priorities, and the bases for these adjustments, are recorded on activity data sheets. Similarly, changes to authorized expenditures require approval by the Leadership Team and authorization by the OSO. However, expenditures are not always consistent with risk-ranking data on activity data sheets. This inconsistency occurs when unforeseen circumstances cause delays in authorized work.

Overall implementation of the process for identifying infrastructure needs has not been fully effective because deficient facility conditions have not been well documented in maintenance work requests. Systems have been established to manage facility maintenance backlogs based on priorities assigned to maintenance work requests. However, deficiencies in material condition, such as those observed by facility users and identified by periodic condition assessment surveys, are often not documented on maintenance work requests. In some facilities, personnel do not generate work requests until a decision to do the work has been made because of a common belief that there are no funds to do the work. Furthermore, activity data sheets for identified needs are not always prepared because of a belief that the money will not be provided. Similarly, some activity data sheets do not clearly describe deficient conditions, and some do not include adequate assessments of safety impacts. There is no formal procedure that provides instructions, criteria, or responsibilities for preparing activity data sheets, and some facility personnel are not familiar with this funding process.

The process for prioritizing overhead expenditures for core functional areas is less structured and more subjective than the one used for prioritizing infrastructure expenditures. The Risk Ranking Board reviews and scores proposed overhead expenditures for core functional areas, such as radiological control and nuclear criticality safety. However, information about the impact of funding changes in these areas is not sufficient to assign meaningful scores. Thus, the assigned scores provide limited benefit to the Leadership Team for determining the level of funding for core functional areas, nor are they of value for ranking the relative risks associated with core functional area and infrastructure overhead expenditures. The Leadership Team makes overhead allocation decisions for core functional areas based upon budget proposals from the division level.

Existing management systems at ORNL do not assure appropriate consideration of safety during initial planning of research activities. This initial planning should formally be required to include an analysis of whether the activities can be safely accomplished within the facilities. Principal investigators and program managers indicated that ES&H is fully considered as part of initial planning for research projects and programs. They also indicated that work under consideration, including work requested by DOE, is reviewed to assure that it can be accomplished safely and that such reviews have caused some work to be denied. However, reviews are not required by procedures or process and are not documented, and responsibility for performing the reviews is not clearly assigned. ORNL instruction, "Preparation of ORNL Programs and Budget Proposals," revised December 2000, implies a requirement for such reviews, as it requires that safety and health resource needs be assessed prior to proposing work and that fieldwork proposals include an explicit estimate and explanation of health and safety expenditures. This information has not been included on fieldwork proposals submitted to DOE this year. Headquarters program offices authorize approved research to begin by issuing guidance letters to UT-Battelle through the OSO. These letters do not normally address ES&H.

Summary of Guiding Principle #4. UT-Battelle has integrated ES&H into a Laboratory Agenda that is closely aligned with DOE expectations. The set of objectives, initiatives, and commitments defined in this Agenda is appropriate to meet DOE expectations for ES&H. However, project management plans do not include adequate details on implementation within the divisions. Also, plans to improve procedural compliance and ensure maintenance of infrastructure and aging ORNL facilities are not developed.

In general, ORNL has adequate processes for ensuring that management makes informed decisions when balancing safety priorities against operational and mission needs and allocating resources to ES&H programs. The processes are well defined and appropriately involve ORO and UT-Battelle management, including senior managers, and most have mechanisms for considering ES&H needs. Additional attention is needed to ensure that deficient facility conditions are fully documented so that management can make informed decisions based on accurate information.

2.5 Identification of Safety Standards and Requirements

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

An effective safety management system must include processes to identify, communicate, execute, and monitor all applicable DOE requirements and Federal, state, and local regulations. In addition, processes that provide change control and maintenance mechanisms for a given set of baseline requirements must be in place. Translating these requirements into policies, programs, and procedures; tailoring them to specific work activities; and effectively implementing them so as to protect workers, the public, and the environment are a necessary and integral part of an effective safety management system. These processes are closely related with processes to analyze and control hazards described under Guiding Principle #6.

Contractual Requirements

ORO and UT-Battelle have adequate processes for incorporating external (e.g., Federal and state) regulations and DOE directives into the ORNL contract. The ORO directive management system meets the requirements of DOE Order 251.1A, *Directives System*, and the associated DOE Manual. ORO Order 250 establishes clear processes and responsibilities for implementing the system. The ORNL contract references all requirements and is updated quarterly. Most ES&H requirements are contained in the work smart standards, which are developed and maintained in accordance with ORO Order 250 and DOE Manual 450.3-1, *Authorizing Use of the Necessary and Sufficient Process for Standards-Based Environment, Safety and Health Management*.

Although the processes are generally adequate, some safety-related DOE requirements are not incorporated into the current ORNL contract. As part of the work smart standards process in the past several years, ORO and the current and previous prime contractors decided that certain DOE requirements were not necessary because they were redundant to other Federal or state requirements. In some cases, these decisions resulted in a situation where there are no clear contractual requirements for systems/processes normally required at facilities with potentially hazardous materials and operations. Examples include:

- **DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities.*** This order was included in the ORNL High Flux Isotope Reactor work smart standard subset but was not included for ORNL Category 2 or 3 nuclear facilities. Category 2 and 3 nuclear facilities have not implemented alternative standards that provide for a comparable level of rigor in conduct of operations. DOE Order 5480.19 applies to all DOE facilities and provides for a graded approach in applying the order. The lack of a conduct of operations program contributed to the deficiencies in conduct of operations, procedures, and procedural adherence discussed throughout this report.

- **DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*.** Certain sections of DOE Order 440.1A are included in the ORNL work smart standards. However, some sections are not included, apparently because ORNL believes that equivalent requirements are contained in Occupational Safety and Health Administration (OSHA) requirements (29 CFR 1910 and selected parts of 29 CFR 1926). However, some safety and health elements applicable to DOE facilities are not adequately addressed in the Code of Federal Regulations (CFR) requirements. For example, DOE requirements for assessing and documenting worker baseline exposure to various hazard types and certain construction safety and industrial hygiene requirements are not covered in the current ORNL contract.

- **DOE Order 414.1A, *Quality Assurance*.** In 1996, ORO and the previous ORNL contractor determined that DOE Order 5700.6C, *Quality Assurance*, was not necessary. ORNL and the previous contractor also evaluated subsequent revisions to the DOE quality assurance orders (i.e., DOE Order 414.1, dated 11/24/98, and DOE Order 414.1A, dated 9/29/99) and determined not to include them in the work smart standards. The decision not to implement DOE Order 414.1A (or its predecessor orders) contributed to observed deficiencies in the ORNL assessment programs (as discussed under Core Function #5 in Appendix B), the poor quality of procedures and program documents, and incorrect quality level designations of safety system modifications (see Essential System Functional Review in Section 2.6).

The recent issuance of 10 CFR 830 Subpart A and Subpart B has prompted ORO and UT-Battelle to reconsider certain previous decisions. For example, DOE Order 460.1, *Packaging and Transportation Safety*, was historically not included in the work smart standards set but was reevaluated in February 2001 and incorporated into the ORNL contract in March 2001 primarily due to the issuance of Subparts A and B. The inclusion of this order fills a previous gap in the requirements (i.e., provisions for onsite transport of radioactive materials are now included in the contract). The DOE order on fire hazards analysis (DOE Order 420) was recently added to the contract (see Guiding Principle #6). Further, the issuance of Subparts A and B has prompted ORO and UT-Battelle to establish a team that is presently reevaluating the quality assurance order for possible inclusion in the work smart standard set.

In their gap analysis, UT-Battelle recognized that the requirements in the contract were incomplete and that decisions to omit all or portions of certain DOE orders required reevaluation. However, UT-Battelle is analyzing the impact of the omitted requirements and determining whether contract modifications are warranted (with the exception of the DOE requirements encompassed by the recent issuance of Subparts A and B).

The requirements of DOE Order 430.1A have not been adequately flowed down and implemented at the facility and activity level. Therefore, essential elements of maintenance management, including configuration management, equipment identification through a master equipment list, and management of maintenance backlogs, are not adequately implemented (see Appendix A and B). Also, the ORNL suspect and counterfeit parts program is not comprehensive.

Subcontracts

Flowdown of requirements to UT-Battelle subcontractors has been strengthened in the past year. Much of the improvement has occurred as a result of the corrective actions taken by ORO, OSO, and UT-Battelle in response to an August 2000 Type B accident at the Portsmouth Gaseous Diffusion Plant involving an individual working under a subcontract to ORNL. The corrective action plans developed by ORO and ORNL included immediate actions, such as implementing a rigorous review process for processing and approving requested subcontracts and revising the procedure governing the identification of ES&H requirements in service subcontracts.

With the recent improvements, the current processes are adequate to ensure that ES&H requirements are in subcontracts. Subcontracts reviewed during this EH-2 evaluation generally included appropriate ES&H requirements. However, as discussed in other sections of this report (e.g., Core Function #5), the oversight, assessment, and enforcement of the requirements are not consistently effective.

Translating Requirements into Procedures and Work Instructions

Although contractual requirements are specified and regularly updated, the current ORNL processes for translating requirements into procedures and work instructions at the site level and within all divisions are not consistently effective. There is currently no consistent sitewide implementation process for the flowdown of requirements from the contract to the activity-level implementing procedures as required by DOE Policy 450.3 and ORO Order 250.

In its transition plan, UT-Battelle recognized that the current requirements management processes are inadequate. UT-Battelle plans to address a wide range of deficiencies in requirements management and procedures by implementing the SBMS, a process-based approach that translates laws, orders, and regulatory requirements into useable procedures and guidelines to help personnel perform their assigned work safely and efficiently. As envisioned by UT-Battelle, SBMS will include a comprehensive system of management system descriptions, program descriptions, subject areas, procedures, and requirement decision records.

SBMS is a major area focus for UT-Battelle and is receiving significant management attention and resources. UT-Battelle has experience in establishing and implementing SBMS at other DOE laboratories and plans to apply lessons learned at other laboratories to ensure the successful implementation of SBMS at ORNL. UT-Battelle is taking a "top-down" approach to establishing SBMS by first focusing on the SBMS responsibilities, authorities, and upper-tier documents, such as management system descriptions. As the upper-tier documents are completed, UT-Battelle plans to focus on successively lower tiers of documents, with the goal of establishing and continually updating a comprehensive set of working-level procedures.

Since taking over the contract in April 2000, UT-Battelle has made significant progress in establishing the SBMS program and the upper-tier SBMS documents. Accomplishments to date include:

- Establishing the ORNL Requirements Manager position as the single control point for all directives
- Establishing roles and responsibilities for the SBMS program, including owners for each management system and subject area
- Implementing the directives management portion of SBMS
- Establishing processes for daily reviews of various information sources, such as the Federal Register and Consensus Standard Organizations Publications, to identify new or modified requirements
- Establishing procedures for the requirements management subject area to support the ORNL directives management program
- Issuing 18 policy statements
- Issuing 21 of 23 management system descriptions, with the remaining two scheduled for issuance in the near future.

Although progress has been made, ORNL is in the early stages of SBMS implementation and much work remains to complete the lower-tier documents. For example, only 6 of 165 subject area documents have been finalized, and none of the 8 facility use agreements has been issued. In addition, progress on ORNL-wide procedures and facility-specific procedures has been limited. Further, 385 requirement decision records, which will trace the flowdown and implementation of the contract requirements, cannot be completed until the other key elements are issued. Currently, some top-tier documents that have been issued establish requirements for which the lower-tier implementing procedures do not exist. This creates a situation where requirements are in force but are not being implemented.

The EH-2 review of UT-Battelle plans and actions to date indicates that the SBMS system has the potential to serve as an effective program for ensuring that contract requirements flow down through all levels to the implementing process or procedure. However, the ORNL SBMS implementation plan does not contain sufficient detail and lower-tier schedules to ensure that the SBMS implementation will be timely and effective. In addition, the implementation plan does not identify resources needed to accomplish the major efforts or analyze the critical paths and interfaces.

Further, the SBMS implementation does not adequately address the challenges associated with ensuring that SBMS is understood, accepted, and effectively implemented by about 30 separate and largely autonomous ORNL divisions and directorates. The implementation plan does not adequately address:

- The management challenges associated with transitioning to rigorous and formal processes, such as an effective work planning and control process, when most personnel, including R&D personnel, are not accustomed to working under a system of formal controls and rigorous procedures.

- The need to plan for training, communication, and worker involvement in the transition to a new system of procedures. Many of the workers interviewed by the EH-2 team had little or no knowledge of ISM or SBMS, indicating that significant effort will be needed to ensure that workers fully understand, accept, and implement the SBMS.

- The fact that some divisions, such as Metals and Ceramics, are using external requirements (as discussed in Section 2.6), some of which are less conservative than DOE requirements, and thus will require additional effort to transition to a uniform ORNL SBMS.

- Provisions for self-assessments and independent assessments of SBMS progress and products at various stages of development and implementation. Such feedback is needed to ensure that management expectations are being fulfilled and to ensure timely corrective actions if they are not.

- The need for clear and unambiguous expectations in program documents and procedures. Although recent documents are improved, they do not always provide clear and explicit instructions to personnel who must implement the procedures and requirements. For example, recent documents still include ambiguous instructions (e.g., statements that personnel "should" perform an action but no clear requirement that they must do so).

While SBMS has good potential, its current effectiveness is limited by the current lack of an effective work planning and control process at ORNL, as discussed under Safety Issue #2. SBMS relies on the concept of applying requirements to specific work activities. In the absence of an effective work control process, there is not sufficient assurance that the scope of work is adequately defined; that hazards are identified; that work is appropriately authorized; and that personnel work within established work scopes and controls. As a result, there is a significant likelihood that the requirements established through SBMS will not be sufficient because the work scopes and controls may be incomplete or because the work may be performed outside established boundaries.

Summary of Guiding Principle #5. The current ORNL processes for identifying and communicating standards and requirements need improvement to address numerous legacy deficiencies, such as the lack of an effective system for translating requirements into implementing procedures. ORNL recognizes that improvements are needed and has implemented several recent enhancements, such as improved processes for flowdown of requirements to subcontractors and improvements in the directives management process. Other important enhancements are under way through the SBMS initiative. However, ORNL and ORO need to ensure that plans for implementing SBMS contain sufficient detail to ensure timely and effective implementation with particular attention in the areas of lower-tier schedules, transition and communication plans, and the integration of the major ORNL initiatives.

2.6 Hazard Controls Tailored to Work Being Performed

GUIDING PRINCIPLE #6: Administrative and engineering controls to prevent and mitigate hazards shall be tailored to the work being performed and associated hazards.

To conduct work safely, line management must ensure that structured processes exist and are implemented sitewide to identify and analyze work hazards consistent with the complexity of the work activity and the significance of the risk. The appropriate engineering and administrative controls and personal protective equipment must be established and properly implemented to prevent or mitigate hazards identified before start of the work activity.

Institutional Level

ORNL institutional procedures are generally adequate in addressing the development and maintenance of safety analyses and facilitating consistent analysis and control of hazards at nuclear facilities. The institutional procedures typically require that safety analyses be developed and maintained based

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on applicable DOE standards and/or DOE orders for hazard identification, analysis, and control at the facility level. For example, procedure ORNL-FS-P01, *ORNL Unreviewed Safety Questions (USQ) for Nuclear Facilities*, is consistent with DOE Order 5480.21.

Comprehensive fire hazards analyses have not been developed and incorporated into the documented safety analysis for most ORNL nuclear facilities. Fire protection expectations are described in 10 CFR 830, which cites DOE Order 420.1. However, DOE Order 420.1 was not included in the ORNL contract until recently (April 2001), and ORNL was not contractually accountable for its implementation (see Guiding Principle #5).

Although institutional requirements specified in ORNL FS-P01 and ORNL-FS-P03, *ORNL Configuration Management for Nuclear Facilities*, are adequate, the flowdown of these requirements into facility maintenance procedures, which implement facility modifications and screening for USQ determinations, was not consistently effective in the ORNL divisions reviewed. As discussed later in this section and in Appendices A and B, these requirements are not being effectively implemented for REDC Building 7920 modifications to safety-class ventilation systems, and several instances of failure to perform USQ determinations were identified.

Facility-Level Hazards Analysis

ORNL is making progress in upgrading facility safety analysis reports (SARs) and technical safety requirements (TSRs) for approval by ORO. The original SAR upgrade program implementation plan identified nine Hazard Category 1, 2, and 3 nuclear facilities that needed SARs and TSRs. Those documents were prepared and submitted to ORO on schedule, and all but two have been approved. The facilities reviewed during this EH-2 evaluation have upgraded and approved SARs and TSRs or are operating under an approved basis for interim operation (BIO).

Progress is being made in accordance with approved implementation plans to ensure that ORNL safety basis documents fully meet DOE regulations contained in Subpart B of 10 CFR 830. ORNL is developing a Transportation Safety Document in accordance with DOE Order 460.1A, *Packaging and Transportation Safety*, to meet the intent of 10 CFR 830 Subpart B. ORNL is in the process of developing a detailed 10 CFR 830 Subpart B Implementation Project Plan to meet the April 2003 implementation milestone.

Activity-Level Hazards Analysis

Appendix B provides a detailed discussion of activity-level hazards analysis and controls in terms of the core functions of ISM. This section summarizes the most important findings and presents two Safety Issues related to procedure development and implementation, and site work planning and control processes.

ORNL hazards analysis and work planning processes are not always effective in ensuring that all work is adequately defined, all hazards are identified and analyzed, and necessary controls are established and implemented as required by DOE Policy 450.4, *Safety Management System*. Some of the major weaknesses identified in the UT-Battelle ISM gap analysis are:

- No fully implemented, standardized Laboratory-level work control policy or process
- Lack of established minimum requirements related to processes that implement ORNL-LM-006, *Work Control Policy*
- Lack of a consistent, ORNL-wide method for job hazard evaluation (JHE) process application and use
- Improvement needed in hazard identification and control process for research projects
- Insufficient worker participation in selection of hazard controls

- Lack of rigor in formal work control and implementation of JHE processes, and reliance on skill of the craft.

ORNL recognizes the need to strengthen hazards analysis and work planning and controls. As a result of the UT-Battelle gap analysis, work planning and control improvements have been identified as a critical need in the ORNL Institutional Plan. ORNL actions and initiatives, such as SBMS and the facility operations model, to address the previously identified weaknesses in work planning and control are in various stages of development and implementation. While some improvements have been made, progress in addressing many of the identified work planning and control deficiencies has been limited.

There are deficiencies in hazards analysis and work planning and control as implemented at the facility and activity levels in the divisions reviewed. For example, R&D personnel performed work, involving handling highly radioactive materials, that had not been adequately analyzed to ensure that radiation exposure was minimized in accordance with the DOE as-low-as-reasonably-achievable (ALARA) principle and that appropriate personal protective equipment was used. Further, procedures were not used when the work was performed, and few engineering or administrative controls were established.

Although ORNL has several ongoing initiatives that are intended to improve hazards analysis and control and work planning, the SBMS management descriptions and program descriptions for work control and procedure development and use do not effectively address all of the weaknesses identified in the ORNL ISM gap analysis. Further, the initiatives are not sufficiently developed to ensure that they can be effectively implemented across ORNL facilities. Specific areas of concern include:

- SBMS for R&D work control is in the formative stages of development, activities related to actual implementation in the field are not well defined; coordination between ESH&Q and the R&D divisions has not been sufficient; and the schedules for implementation are very ambitious and are not being met.

- Although the gap analysis identified that ORNL-LM-006, *Work Control Policy,* was not fully implemented and lacked mandated minimum requirements, the current version of the SBMS work control management description does not describe how work control at ORNL will function or the various elements of the different types of work, nor does it identify the minimum requirements for establishing the basis for subject areas within the management description.

- The current JHE program does not sufficiently identify minimum requirements, such as thresholds for ES&H or safety professional involvement, that will lead to effective identification and analysis of job hazards.

- Procedure use and adherence constitute a continued problem recognized by management. However, there was no specifically identified ISM gap or ongoing actions to strengthen procedure use and adherence. Ongoing programs, such as SBMS, are not always sufficiently developed and detailed to ensure that its implementation will adequately address procedure use and adherence.

Increased management attention is needed to ensure that SBMS management and program description documents clearly identify major elements of the program, describe the program, define subject areas, and establish minimum requirements for hazard identification and control processes across ORNL.

Two Safety Issues were identified in activity-level hazards analyses and controls: (1) inadequate work planning and control, and (2) deficiencies in procedure quality, use, and adherence. Although based on information gathered in the three divisions that were reviewed, both of these Safety Issues need to be evaluated for sitewide applicability.

Safety Issue #2. The Metals and Ceramics Division work planning and control processes for R&D activities are not well defined or documented. Additionally, there are weaknesses in sitewide procedures for identifying and analyzing hazards, stop-work policies, and work control processes for maintenance work.

The Metals and Ceramics Division relies too much on a "people-based" work planning process rather than a formally documented process as expected in a mature ISM program. Weaknesses include the following (additional related details and examples are discussed in Appendix B):

- There is no well-defined R&D work control process for implementing the five core functions of ISM.

Currently, research work is described through a variety of informal mechanisms that do not establish an adequate, documented foundation for determining the rigor and depth of required hazard identification and analysis, or the level of involvement of ES&H when defining the work.

- The existing R&D hazard identification and analysis processes (i.e., Laboratory Safety Summary and New Work ESH&Q Review forms) are ineffective. These forms are not controlled by procedure, and there are no instructions for their preparation, approval, and use. As a result, for a number of R&D work activities, the work was not sufficiently defined, hazards were not clearly identified, and appropriate controls were not specified.

- Existing processes do not address some R&D work activities, and the processes have not been tailored to address all R&D activities. For example, routine work with chemicals and replacement of furnace elements are not addressed by existing processes. Although hazards and some controls may have been informally identified, there is no record of the work activity, the potential hazards, or the agreed-upon controls.

- For non-nuclear facilities within the Metals and Ceramics Division, there is no clearly defined process for authorizing all work (including routine work) based on the ES&H risk of the activity. ISM requires work authorization processes to include both formally approving work and then verifying that facility conditions are appropriate just before work is started.

Sitewide work planning and control process and implementation weaknesses include deficiencies in sitewide procedures for identifying and analyzing hazards, deficiencies in establishing controls, deficiencies in stop-work procedures, and failure to rigorously follow and implement existing work control documents and procedures. Specific concerns include:

- The sitewide JHE program description mandates a set of requirements for implementation of a consistent sitewide program that results in the identification and analysis of all hazards for all work activities. However, the JHE process allows ORNL divisions to implement division-specific JHE procedures rather than using a consistent sitewide process. There are no instructions in the JHE program description or the division-level procedures that were reviewed for completing forms and checklists. The JHE program description states that forms and checklists serve only as guides, indicating that they may be optional, without any requirements that an equivalent process be used.

- Alternatives to the JHE process, such as the Problem Safety Summary used in the Chemical Technology Division and the New Work ESH&Q Review used in the Metals and Ceramics Division, do not clearly meet the intent of the JHE program description. For example, the alternative methods do not include clearly written specific thresholds for ES&H or safety professional involvement based on the risk of the work activity.

- There are no clear linkages or triggers for readiness review considerations within the work planning and control processes for modifications performed under maintenance job requests. Depending on the modification or installation, a readiness review may be required by DOE Order 425.1B, *Startup and Restart of Nuclear Facilities*.

- Consistent USQ screenings of work activities, required by DOE Order 5480.21 and the site USQ procedure, are not being completed because of deficiencies and inconsistencies in screening processes in the various work control procedures. Examples of failure to perform USQ screens were identified in the essential system functional review (see below and Appendix A).

- Ambiguity and insufficient mandatory reporting requirements in the site stop-work policy and procedure could result in unreported and undocumented "imminent danger" and unsafe work situations. For example, the ORO sitewide stop-work policy does not require mandatory reporting of unsafe conditions because it uses conditional language (i.e., "should" rather than "shall"). The ORNL program description for stop-work contains insufficient mandatory reporting requirements and could result in unreported and undocumented "imminent danger" and unsafe work conditions. The program description allows an immediately correctable imminent danger condition to be corrected without ES&H involvement or notification to division management (see Safety Issue #2).

- The personal job hazard evaluation card system is not being adequately implemented as required by the Plant and Equipment Division work control procedure. As a result, the defined scope of work for Plant and Equipment Division "blanket" tasks and other grade 4 (routine) work is not well specified and documented on either the maintenance job request or the personal JHE cards. There are also deficiencies in Plant and Equipment Division work control procedure and deficiencies in clearly specifying the equipment (e.g., equipment name and/or identification numbers) on work control documents within the divisions.

- REDC work packages revealed numerous failures to follow procedures (such as hazards present in the work area not being identified on the JHE) and other administrative deficiencies in the development and completion of work packages and supporting documentation.

As discussed in Appendix B, programmatic and implementation deficiencies in the site and division work control procedures have resulted in deficiencies in planning work, identifying and analyzing hazards, and implementing adequate controls.

Safety Issue #3: Numerous ORNL division-level procedures are not adequately developed and/or used to support effective implementation of ISM as required by DOE Policy 450.4.

ORNL does not have an adequate institutional policy and process for the development and use of procedures. As a result, the individual divisions and groups are free to establish their own expectations and practices, which vary in quality, detail, and implementation. These practices are not consistently effective. The divisions that were reviewed all had deficiencies in procedure development and/or use. These deficiencies contribute to many inadequacies in the quality of procedures. Many procedures do not adequately identify hazards and controls or communicate them to the personnel using the procedures. Further, there are no procedures for some R&D work and some work involving safety-class ventilation systems. When procedures exist, ORNL personnel often do not use them at the work site, and many ORNL personnel, including managers and supervisors, believe that procedures are not mandatory and may be modified or disregarded without formal review and approval. Longstanding management practices (which tolerate a lax attitude toward procedural use and compliance) and inadequate procedures (which contain ambiguous requirements) inappropriately reinforce the perception that procedures provide optional guidance rather than mandatory direction.

ORNL institutional policy on procedures consists of a guidance document—ORNL Conduct of Operations Guidance Document—but few mandatory requirements. Specific deficiencies in the approach taken to apply the guidance include:

- The current policies do not adequately specify minimum requirements for procedure development, use, and adherence. For example, there is no management commitment to procedural compliance.

- There are no minimum standards for independent review or validation and verification compliance, and no requirement to implement DOE standards for procedure development or conduct of operations principles.

- There is no effective institutional system to ensure that individual divisions adequately establish procedures and that institutional expectations are implemented at all levels of the organization.

Specific concerns with the procedure development processes in the divisions stem from the inadequate institutional policy:

- There are significant differences at the divisional and facility level in the procedure review and approval processes, and the various processes do not ensure adequate ES&H reviews in all cases. For example, the procedure review and approval process used for Buildings 7920 and 7930 permitted the approval of special operating procedures (one-time-use verification procedures) without safety professional review, even when chemical hazards were involved, as was the case in Building 7920. As a result, most operating procedures, especially for chemical processes at Building 7920, have not been reviewed for potential hazards by a safety professional, and many procedures lacked safety instructions in accordance with material safety data sheets (MSDSs) for chemicals or ORNL chemical handling guidance.

- REDC AP-1, *Policy and Procedure for Development, Writing, Review, Approval, Use and Document Control of Procedures,* does not provide detailed guidance on the verification and validation process, especially regarding the criteria for a satisfactory procedure. This shortcoming has contributed to a process for procedure verification and usage at REDC in Building 7920 that allows for many in-cell processing procedures to contain numerous redlines, cross-outs, major step deletions, and written additions. The number of handwritten changes makes the procedures confusing and increases the potential for operator error.

- Requirements for procedure development and use are not well defined or communicated within the Metals and Ceramics Division. Instructions have not been developed to clarify when standard operating procedures (SOPs) or guidelines (SOGs) are to be used. Although a Metals and Ceramics Division quality assurance (QA) standard has been issued concerning procedure requirements, it is not used consistently throughout the division.

Because of the inadequate processes for developing procedures, the quality of procedures varies considerably and some procedures are inadequate:

- As discussed in Appendix A, several procedures that apply to the procedure modification process at REDC do not provide specific guidance for that process. For example, configuration management procedures do not provide clear and concise directions on quality requirements and independent verification.

- Several TSR surveillance ventilation system procedures contain the statement, "If modifications to the procedure are required in the course of an operation, it is anticipated that the person(s) performing the work will respond appropriately according to their own judgment." This statement would allow procedure revisions without the appropriate controls required by 10 CFR 830.120 and DOE Order 5480.21. Such uncontrolled revisions and other practices are inconsistent with the requirements of the CFR and the DOE order but are permitted by the REDC procedure for developing, writing, reviewing, approving, using, and controlling procedures. In response to this observation, facility management indicated that they have revised these procedures to require mandatory compliance.

- REDC has no procedures addressing startup, normal operations and operating parameters, system shutdown, and valve and electrical lineups for the ventilation systems. Facility management relies on operator and supervisor knowledge, system familiarity, and training rather than approved standards.

- Procedural guidance for responding to upsets in safety-class ventilation systems at REDC are poorly written, are not user-friendly, contain multiple actions within individual steps, address multiple conditions or alarms without the benefit of a table of contents, and are generally not written in accordance with industry standards or DOE expectations delineated in DOE-STD-1029, "Writer's Guide for Technical Procedures." Although they affect safety-class systems, use of these procedures is not mandatory.

- When Metals and Ceramics Division personnel in Building 3025E removed highly radioactive materials from a hot cell, the associated radiological work permit (RWP) did not prescribe adequate personal protective equipment, monitoring, or tooling for ALARA considerations (i.e., leaded vinyl gloves, extremity dosimetry, and/or long-handle tooling).

There is no clear institutional policy that requires procedural use and adherence that flows down through the organization. As a result, ORNL personnel often do not use or follow existing procedures. Situations where procedures were not used or followed that could have impacted safety include:

- At REDC, operators did not display an adequate knowledge of alarm response and abnormal event response during simulated scenarios involving abnormal events with ventilation systems. None of the operators immediately referred to the guidance procedures for abnormal event response, and many of the operators did not respond as instructed by the guidance procedures for abnormal events. Operators indicated that they did not trust the abnormal event response and alarm response procedures and felt that the procedures could not help them in all situations.

- Procedural non-compliances contribute to configuration control problems. For example, out of the 17 reviewed modification packages, none addressed impacts on preventive maintenance and calibration, although procedures require these subjects to be addressed. Although required by procedure, the modification process is not used as a vehicle for implementing changes to preventive maintenance.

- Metals and Ceramics Division personnel removing highly radioactive materials from a hot cell did not use or follow procedures. The procedure was available but not used or referenced. The procedure checklist, which provides a signoff for each major step, was not used. As a result, activities were conducted out of sequence, and some were missed. Key steps that were omitted included the performance of radiological contamination smears and dose readings of the area. It was determined that the facility was not closely following the procedure because of confusion regarding the facility and division policy on verbatim use of procedures.

- The applicable procedure was not used at Building 3525 during receipt of a nuclear material shipment. Not all individuals performing this activity had been trained in accordance with the procedure.

- Many of the deficiencies noted in training and assessments throughout this EH-2 evaluation resulted from lack of adherence to existing procedures. While the current procedures have some deficiencies, their implementation would have precluded many of the observed deficiencies. For example, procedures require assessments to be performed, but line managers did not conduct the assessments.

These deficiencies adversely affect ISM implementation and could have undesired safety consequences. The ORO/ORNL decision not to include DOE Order 5840.19, *Conduct of Operations*, in the ORNL contract contributes to the observed deficiencies. ORNL is not required to follow that order and has not established a suitable alternative policy that provides mandatory institutional requirements for an effective conduct of operations program.

Essential System Functional Review

This section provides a summary of the results of the essential systems review, which is discussed further in Appendix A. The functional review of essential systems focused on four ventilation systems at the REDC Building 7920: (1) the Vessel Off-Gas (VOG) system, (2) the Cell Off-Gas (COG) system, (3) the Laboratory Area (LA) exhaust system, and (4) the Hot Cell Support Area (HCSA) exhaust system. These systems were selected because the facility mission will continue for some time, the systems are designated as safety class systems, and functionality is necessary to protect workers, the public, and the environment from radiological consequences during normal operations and following abnormal events or accidents. The results are divided into four areas: configuration control, maintenance, surveillance and testing, and operations

Configuration Management. Some aspects of configuration control were effectively implemented. For example, most unreviewed safety question determinations (USQDs) performed in support of REDC modification activities were comprehensive and adequately analyzed effects of modifications on the authorization basis. However, in general, configuration management at REDC is informal and ineffective, and it is not being implemented as set forth in 10 CFR 830.120 and the Building 7920 SAR and TSR administrative controls. Although configuration management requirements are provided in facility procedures, they are not being followed in many cases. Procedures are not providing clear and concise directions on quality requirements and independent verification. Neither independent design verification nor training of facility staff is being implemented as required by 10 CFR 830.120 and programs described in the SAR. Lack of personnel training coupled with weak procedural guidance contributed to the problems with the development and implementation of the facility modifications. Failure to provide a correct quality designation resulted in procurement of not-qualified or not-fully-qualified components, installation of these components outside of the QA requirements, and performance of work without the required independent verification. The consequences of an inadequate configuration management program include potential errors in all phases of safety system operations, an invalid basis for authorization documents, and resultant inadequate performance of future USQDs. If not addressed in a timely manner, this situation will continue to degrade and further increase the potential for operational errors and component failures.

A Safety Issue was identified during the essential system functional review in the area of configuration management. The Safety Issue was based on the systems reviewed at REDC. However, some aspects of the Safety Issue, such as deficiencies in drawings, may be applicable at other facilities at ORNL.

Safety Issue #4: Configuration management at REDC is informal and ineffective, and it is not being implemented as required by 10 CFR 830.120 and the Building 7920 SAR and TSR administrative controls.

The team identified numerous deficiencies with the current configuration of the Building 7920 safety-class ventilation systems relative to design documents, drawings, authorization basis documents, and recent modifications. Specific examples include:

- Recent upgrades of the safety class COG and VOG systems were incorrectly installed as non-safety modifications. Sixteen out of 17 recent modification packages on the COG and VOG exhaust systems were incorrectly designated as Quality Level III (i.e., little or no specific negative impact on safety). According to the REDC work request and a Radiochemical Technology Section (RTS) modification procedure (RTS-003), many of these packages should have been designated as Quality Level I. The incorrect designations resulted in procurement of not-qualified or not-fully-qualified components, installation of these components outside of the QA requirements, and completion of modifications to safety systems without the independent design reviews required by RTS-003. This does not meet the requirements of 10 CFR 830.120 or the programs described in the Building 7920 SAR.

- Training of the facility staff on the section-level procedure RTS-003 (used for functional design modifications) was not implemented at REDC as required by 10 CFR 830.120 and the programs described in the Building 7920 SAR. The facility could not locate records that the procedure training had been performed for personnel developing modification packages, and the facility staff indicated that they had not received any formal training on procedure RTS-003.

- Design documents for the safety-class heating, ventilation, and air conditioning (HVAC) systems do not reflect the as-built configuration, nor do they reflect recently implemented modifications. A probe located on Building 7920 roof used to provide a reference outdoor pressure was installed improperly, calling into question the operability of instruments receiving input from this probe, which includes instruments used to verify that building pressure remains within TSR limits. Failure to incorporate the recent modification changes into design basis documents further exacerbates the as-built configuration of the building. Lack of drawing control is evidenced by numerous uncontrolled pen-and-ink changes on the control room and document control drawings. Additionally, drawings in the control room are not the current revision.

- Appropriate USQ screenings and evaluations are not always initiated when required. When ORNL discovered several of the configuration discrepancies, USQ evaluations were not immediately initiated as required by DOE Order 5480.21. For example, no USQ was initiated when ORNL discovered that non-qualified COG fan motors and controllers were installed as part of a recent modification. USQ screenings or evaluations are required when discoveries are made that may have an effect on the authorization basis.

- Procedural non-compliance contributed to configuration control problems. For example, out of the 17 reviewed modification packages, none addressed procedurally required impact on preventive maintenance and calibration. Although required by procedure, discussions with the facility staff identified that the modification process is not used as a vehicle for implementing changes or additions to preventive maintenance or calibrations.

- Modification development and implementation procedures used for installation of modifications on the safety-class ventilation systems do not provide specific guidance for the modification process, particularly in the areas of quality level

Damaged Ventilation System Dampers

determinations and requirements for independent design review. In addition, specific QA standards and requirements for software application were not established or enforced.

Most of the deficiencies resulted from procedure deficiencies, failure to adhere to procedures, and a lack of training of facility personnel responsible for development of modification packages. An inadequate configuration management program has the potential to cause errors in all phases of safety system operations. Inadequate configuration management and control of modifications can invalidate authorization basis document conclusions and the results of future USQDs.

Maintenance. Maintenance activities focus primarily on short-term, minimal solutions of immediate problems. Consequently, the material condition of some of the ventilation systems and components has deteriorated. Although most ventilation failures directly affecting TSR-related items are promptly fixed, many ventilation maintenance actions are being deferred, resulting in degradation of the overall material condition of the safety-related ventilation systems. Deferring corrective maintenance and failing to implement results-oriented preventive maintenance on an aging (over 35 years old) ventilation system have negatively impacted its reliability. The degraded material condition of the ventilation systems is a direct indicator that the maintenance program needs immediate improvement. Although the system meets TSR requirements, system reliability and its potential impact on system operability have not been sufficiently analyzed. Continued degradation of the systems might impact their ability to meet safety functions. Managers at REDC generally have a good understanding of the weaknesses of the maintenance program and ventilation systems in Building 7920, and have actively requested funding and made maintenance proposals over an extended period of time (ten years).

Surveillance and Testing. The required surveillance and testing of safety- and TSR-related structures, systems, and components were being performed in a manner that assured that minimum requirements were being satisfied. However, some procedures and controls were not commensurate with their importance to safety, their reliability, or basic tenets of worker safety. These included a procedure specifying expected results that did not reflect the procedure's intended purpose and lack of reconciliation of deviations from expected test results. Overall, these observations indicated a need for increased discipline in all aspects of surveillance and testing, including the generation, review, approval, and revision of procedures, their execution, and the development of their acceptance criteria.

Operations. Ventilation systems are not operated in accordance with DOE or industry standards or expectations. Normal operational procedures for the ventilation systems do not exist, and operators do not use or trust existing procedures that provide guidance for response to alarms or abnormal events. Instead, the operators rely on their own system knowledge and familiarity (a people-based approach), which varies among operating shifts and might not reflect management expectations delineated in the procedures. Lack of standards-based operations increases the risk of human error and the vulnerability of safety systems during normal operations, abnormal events, and accident response. Significant management attention is needed to ensure that a standards-based approach to operations is implemented consistent with ISM and conduct of operations standards.

Summary of Guiding Principle #6. Although some deficiencies need to be addressed, ORNL is making adequate progress on SAR and TSR upgrades and has adequate institutional procedures for most aspects of safety analysis. ORNL recognizes the need to strengthen hazards analysis and work planning and controls. Major ongoing initiatives, such as SBMS, are intended to address recognized work planning and control weaknesses, and some improvements have been made. However, progress to date at the facility and activity level on SBMS implementation has been limited and the schedules in the implementation plan might be missed.

Current ORNL hazards analysis and work planning processes have significant weaknesses that warrant timely management attention. The processes are not always effective in ensuring that all work is adequately defined, all hazards are identified and analyzed, and necessary controls are established and implemented as required by ISM. In the divisions reviewed, there are significant deficiencies in work planning and control processes and implementation. Procedural quality, use, and adherence are also a significant weakness.

The reliability of safety-class REDC ventilation systems is degraded by weaknesses in implementation of configuration management, maintenance, surveillance and testing, and operations. Configuration management at REDC is informal and ineffective, and it is not being implemented as required, increasing the potential for operational errors and component failures. Maintenance activities focus on short-term, minimal solutions to immediate problems. Although most ventilation failures directly affecting the mission and TSR-related items are promptly fixed, many ventilation maintenance actions are being deferred, resulting in degradation of the overall material condition of the safety-related ventilation systems. Surveillance and testing of safety- and TSR-related structures, systems, and components were performed as required. However, increased discipline in all aspects of surveillance and testing is needed. Ventilation system operations lack procedures and do not meet DOE or industry standards or expectations.

Significant management attention is needed to ensure that a standards-based approach to safety management is implemented consistent with ISM and the conduct of operations principles. The SBMS management and program description documents need to clearly identify major elements of the program, describe the program, define subject areas, and establish minimum requirements for hazard identification and control processes across ORNL. Development and implementation of an effective, standardized work planning and control process is essential to making the needed improvements. A comprehensive and systematic assessment of the material condition of safety-related systems may facilitate the prioritization of needed upgrades. Management also needs to ensure that deficient conditions are corrected rather than tolerating workarounds in safety systems. Timely improvements in configuration management are also essential to ensure that safety systems operate reliably in routine and non-routine conditions.

2.7 Operations Authorization

GUIDING PRINCIPLE #7: The conditions and requirements to be satisfied for operations to be initiated and conducted shall be clearly established and agreed upon.

Line management must ensure that operations are authorized using established mechanisms for developing and maintaining authorization basis documentation that clearly delineates the terms and conditions for authorizing site, facility, or activity operations. DOE has the ultimate responsibility for ensuring that all operations at DOE facilities are reviewed and authorized at a level commensurate with the hazards and that work authorization processes are established by the contractor. DOE and the contractor must confirm readiness to implement safety controls before starting work, and ensure that DOE personnel, contractors, and subcontractors execute defined requirements in such a manner that workers, the public, and the environment are protected from adverse consequences.

Processes for Confirming Readiness to Perform Work

Established institutional processes are in place at ORNL to confirm startup and restart of nuclear facilities. An ORNL procedure, ORNL-QA-P08, Rev. 2, *ORNL Readiness Assessment*, delineates the requirements and processes for the startup and restart of ORNL Hazard Category 1, 2, and 3 nuclear facilities. However, the procedure does not reflect current DOE requirements contained in the ORNL work smart standards set (i.e., DOE Order 425.1B, *Startup and Restart of Nuclear Facilities*, and DOE-STD-3006-2000, "Planning and Conduct of Operational Readiness Reviews"). In addition, the flowdown of requirements and linkage to nuclear facility operations in division procedures, work planning and control, and project management processes for nuclear facility modifications are inadequate (as discussed under Guiding Principle #5).

All work planning and control processes for maintenance activities appropriately identified the individuals, such as a task leader or group leader for the particular work activity, who is responsible for ensuring that the work package is prepared properly in accordance with requirements. In most cases, the facility engineer, facility supervisor, or a designee confirms that the work activity has been appropriately analyzed, planned, and coordinated before the work is scheduled. Shift turnovers and plan-of-the-day meetings (some facilities use plan-of-the-next-day meetings) are the primary mechanisms for discussing, assigning, prioritizing, and verifying that facility conditions are correct prior to starting work. These processes were generally effective.

Most facilities that were reviewed do not use a formal written plan of the day/week as an authorizing document for upcoming work, but verbally authorize work at the plan-of-the-day meeting. However, the facility operation model being implemented in the Building 4500 complex includes implementation of a formal, written plan of the next day's scheduled major work activities. ORNL plans to extend this practice across the site.

ORNL has not established a sitewide work control program for maintenance. As a result, each ORNL division has established its own maintenance work control program. Of the three ORNL divisions evaluated, all included requirements for confirming readiness to perform maintenance and modification work packages. However, the specific requirements for ES&H review, approval, and pre-job briefings varied among the three work control processes. The differing requirements are not based on a graded approach to risk management, and some of the requirements lacked clear thresholds/criteria. For example, within the Chemical Technology Division (at both the REDC and Building 3047facilities), pre-job briefings were optional for maintenance and modification work activities, and procedures did not provide guidance/criteria for when pre-job briefings are required. Conversely, for the Plant and Equipment Division, pre-job briefings were required for all work except routine, low-risk jobs.

For research activities conducted in non-radiological facilities, there is no well-defined process for confirming readiness or authorizing work. The Metals and Ceramics Division ISM Program Plan identifies approved Laboratory Safety Summaries and New Work ESH&Q Reviews as authorizing work. However, some work is not covered by these processes, and a number of these summaries or reviews were not signed by ES&H and/or line management prior to performing work. Furthermore, since there are no adequate instructions or procedures for either the Laboratory Safety Summary or New Work ESH&Q Review processes, there are no clear management expectations on the use of these documents in authorizing work.

Processes and requirements have been established for the authorization of construction projects at each phase (i.e., Conceptual Design Phases I through IV) of a project in accordance with the standard operating procedures for line-item projects and capital-funded general plant projects. As part of the project execution phase, the project manager is required to develop and execute a project ES&H oversight plan addressing ES&H requirements and level of oversight before commencement of field work in accordance with ORNL's Project Environmental, Safety, and Health Oversight Plan, and Construction ES&H Requirements Identification and Oversight. The Construction Field Representative normally conducts pre-construction meetings prior to the start of field work. These meetings address work scope, specific job ES&H requirements, job and activity hazards analyses, and permits in accordance with ORNL procedures. Construction project turnover and acceptance requirements for the transfer of projects (i.e., buildings and systems) from the construction subcontractor to the facility manager are defined in an ORNL standard operating procedure.

Processes for Authorizing Work

As a result of an identified issue from the ORNL ISM gap analysis, an ORNL procedure (*ORNL Facility Safety Documentation Program*) was revised in December 2000 to incorporate requirements for the development, maintenance, and utilization of issued authorization agreements, pursuant to ORO Order 420, *Authorization Agreements*. The process specified by this procedure is consistent with DOE Guide 450.4-1, *Integrated Safety Management System Guide*. Authorization agreements currently exist for all Hazard Category 1 and 2 nuclear facilities and, with the exception of Building 7920, contain up-to-date references to safety basis documents. In April 2001, Building 7920 implemented revised SAR and TSR documents, which will need to be reflected in the next annual update to the Building 7920 authorization agreement.

Approval of authorized work is not always formally documented, and the rigor of work authorization processes varies across the various work control processes. Although shift turnovers and plan-of-the-next-day meetings are primary mechanisms for verifying facility conditions prior to starting work, neither REDC nor Building 3047 issues formally approved plan-of-the-day documents to authorize and communicate approved work activities for the day. Similarly, the list of approved operational tasks in some facilities is not formally documented. For REDC, approval authority for work release is designated in their work control procedure and requires Shift Supervisor approval/signature unless the work is determined not to affect facility operations. The work authorization/release process for Building 3047 is informal and largely based on verbal communications. For non-radiological facilities within the Metals and Ceramics Division, the process for authorizing work is not well defined, and the existing mechanisms have not been fully effective.

Performing Work

Observations of work and interviews indicated that ORNL managers, staff, and workers are dedicated, experienced, and knowledgeable in their respective disciplines and are committed to doing work safely. ORNL benefits from an experienced and stable workforce, most of whom have years of experience at ORNL.

During the EH-2 evaluation, limited work involving hazardous materials or conditions was ongoing at the facilities reviewed, and the sample of work activities observed was not sufficient to draw broad conclusions about performance of work. The limited amount of work observed was performed without incident, although controls were not adequately established in procedures and procedures were not always used. Workers (e.g., researchers and technicians) generally relied upon engineering controls and personal protective equipment, commensurate with the hazard. The presence and involvement of line management and ES&H in day-to-day operations and work activities were evident at most facilities.

Procedural adherence and use varied across ORNL facilities, but generally lacked the rigor and formality required of a mature ISM program. In Building 7920, normal operating procedures for the ventilation system do not exist, and operators do not use or trust existing procedures that provide guidance for responding to alarms or abnormal events. For some work activities observed in Metals and Ceramics Division Buildings 3025E and 3525, available procedures were not properly used. For research work, many of the controls were not sufficiently documented, and performance of work within established controls could not be confirmed.

Summary of Guiding Principle #7. Although some deficiencies are evident, ORNL has established processes to authorize facility operations and projects. Authorization agreements are adequate. Processes for authorizing work and confirming readiness just before the start of work are generally adequate for non-research activities, although formal documentation is sometimes lacking and the rigor of the process varies across divisions. Observations of work and interviews indicated that ORNL managers and staff are dedicated, experienced, and knowledgeable in their respective disciplines. The limited work observed was performed without incident, although procedural controls were not always established and implemented. The presence and involvement of line management and ES&H in the work activities were evident at most facilities.

However, some aspect of operations authorization need improvement. For research activities conducted in non-radiological facilities, the process for authorizing work is not well defined, and existing mechanisms are not fully effective. The requirements for procedures, and use of and adherence to procedures, varied across ORNL. Particular attention is needed to address the quality of procedures and lack of rigorous procedural compliance.

2.8 Summary Evaluation of the Core Functions

DOE Policy 450.4, *Safety Management System Policy*, defines the five core safety management functions that provide the necessary structure for any work activity that could affect the safety and health of the public, the workers, or the environment. The functions are applied as a continuous cycle, as shown in Figure 3, to systematically integrate safety into the management of work practices at the institutional, facility, project, and activity level for all work.

Because of the close relationship between the guiding principles and the core functions, some ORO and UT-Battelle institutional processes for implementing the core functions have been discussed under the applicable guiding principles. Within the framework of the core functions, the EH-2 evaluation of safety management at ORNL focused on the application of the core functions at the facility, project, and activity levels. The following paragraphs summarize ORNL performance with respect to the five core functions. Detailed results are presented in Appendix B.

Core Function #1 - Define the Scope of Work

For most maintenance and operations activities, ORNL has adequate processes for defining the scope of work and the work breakdown to allow identification

Figure 3. Core Functions of Safety Management

of hazards. Maintenance work control procedures consider the importance of the equipment and the risk of the work activity. For most operations activities, such as hot cell operations, procedures adequately define the scope of work. For R&D activities, work definition is provided by various mechanisms, such as New Work ESH&Q Reviews and informal meetings. However, these processes for work definition are not adequately documented or integrated into the Metals and Ceramics Division work control process. In some cases, these processes have not resulted in a description of work sufficient to identify the hazards or the required level of ES&H involvement.

Core Function #2 - Analyze the Hazards

The processes for analyzing hazards at ORNL are not consistently effective across the ORNL divisions reviewed. For maintenance, construction, and operations activities, there are processes in place, such as job hazards analyses and JHEs, for identifying and analyzing hazards. For some work activities, the application of these processes adequately identified and analyzed job hazards. However, the site job hazards analysis procedure has significant weaknesses that could result in missed hazards, and provides insufficient direction to ORNL divisions for developing division-level hazard control procedures. In addition, maintenance personnel did not always rigorously adhere to the JHE process, resulting in numerous administrative discrepancies and some hazards that were not adequately documented and analyzed. Further, the process for developing operating procedures does not provide for adequate involvement of ES&H personnel in analyzing hazards, resulting in deficiencies in analysis of hazardous materials such as liquid nitrogen and nitric acid.

Hazard identification and analysis processes for R&D work are less formal than for maintenance and operations work and rely on a knowledgeable workforce, effective hazard communications at all organizational levels, and an involved and proactive ES&H team. Within the Metals and Ceramics Division, these informal processes have often been effective in identifying and analyzing hazards associated with research work. However, the hazards identification and analysis processes are not well documented. These existing processes (i.e., Laboratory Safety Summaries and New Work ESH&Q Review) are not fully effective, and the informal processes rely excessively on individual initiative and the experience of individual research staff.

Core Function #3 - Develop and Implement Hazard Controls

As discussed under Guiding Principles #6 and #7, current ORNL current work control processes need significant improvement for all types of work activities (maintenance, operations, and R&D). The R&D work control processes are generally informal and fragmented, and they are not sufficiently defined and documented to meet DOE ISM requirements and expectations. Laboratory Safety Summaries and New Work ESH&Q Reviews do not adequately define and control research-related hazards. Some routine laboratory activities that involve potential hazards have few documented hazard controls or records. There are also many deficiencies in other hazard control processes and procedures, such as the stop-work policy and the Plant Equipment Division work control procedure. The deficiencies in processes and procedures contribute to deficiencies in implementing hazard controls at ORNL facilities in such areas as labeling of equipment, handling and storage of chemicals, ensuring that safety equipment (e.g., fume hoods) is appropriately designed and operational, establishing and verifying training and qualification requirements, and ensuring that personal protective equipment is appropriately used.

For many ORNL activities, particularly in R&D divisions, procedures are not developed or are not adequate. For some activities involving safety-related ventilation systems, operators did not have procedures. Guidelines for procedure development and use for R&D activities (QA-MC-5) lack sufficient detail and have not been consistently implemented within the Metals and Ceramics Division. Requirements for procedure development and use are not well defined or communicated. Many procedures do not adequately ensure that controls are identified and unambiguously communicated to personnel that must implement them. For example, REDC procedures for modification of safety-class ventilation systems do not clearly define requirements, contain items that are implemented at the users discretion. The inadequate procedures resulted in failures to perform safety-related functions such as independent reviews of modification designs in all 17 packages that were reviewed by the EH-2 team.

ORNL management recognizes that improvements are needed in work controls, hazards analysis, and hazard control. Implementation of SBMS and the facility management model are intended to address deficiencies in these areas. While these initiatives are generally appropriate and progress is being made, the SBMS and the facility management model are not sufficiently defined or developed to ensure that a work control process can be effectively implemented in the near future, particularly in R&D divisions.

Core Function #4 - Perform Work Within Controls

For certain operational activities, ORNL uses formal processes and checklists to verify that controls are in place. However, most maintenance and R&D activities do not have formal processes for verifying readiness to perform work. Similarly, the processes for authorizing work are generally informal and not well defined or documented. For maintenance and operations work, ORNL relies on plan-of-the-day meetings to verify readiness to perform work and authorize work to proceed. While providing some benefit, these informal practices do not provide full assurance that controls are adequate before work begins.

When procedures exist, personnel do not always use or adhere to them. ORNL personnel did not use or follow procedures when performing operations with radioactive materials. Operators did not use alarm and/or abnormal response guidance procedures in simulated scenarios and were not always knowledgeable of the response called for by those procedures. Operators indicated that they did not have confidence in the existing alarm response procedures and thus did not use them. In some instances, procedures contain workarounds because of the degraded condition of ventilation systems. For example, procedures call for "manual agitation" using a steel rod to close dampers and another procedure indicates that manual adjustments must be made to dampers because the controllers do not work.

For many work activities, ORNL lacks well-defined and enforced controls, which are a prerequisite to performing work within controls. As discussed throughout this report (see Core Functions #2 and #3 and Safety Issues #2 and #3), ORNL procedures, work planning and control processes, and hazards analysis mechanisms have significant deficiencies. These deficiencies result in work activities where the required controls are not well defined. Thus, the workers (operations personnel, maintenance personnel, and researchers) do not always have sufficient information and direction to clearly understand which controls must be implemented for each work activity. This situation is exacerbated by the inadequate management expectations for procedural compliance and insufficient line management ownership of safety management. Further, work is often performed with no procedures, and procedures are not always followed when they exist.

Although there are significant deficiencies in the processes, most ORNL workers demonstrated a safety-conscious approach in the limited work observed by the EH-2 team. Most workers are experienced and knowledgeable, and they understand the stop-work policy and indicated a willingness to apply it if safety concerns arose. However, workers are tolerant of inadequate procedures and workarounds.

Core Function #5 - Feedback and Continuous Improvement

At the institutional level, ORNL uses numerous mechanisms, such as quarterly and/or annual assessments, line manager self-assessments, and weekly ES&H facility walkdowns, to identify ES&H deficiencies and provide feedback for ES&H improvement. These mechanisms have identified ES&H deficiencies and resulted in improved ES&H programs in several areas (e.g., chemical safety).

However, assessment results and other feedback data are often informally and inconsistently generated, collected, documented, analyzed, and utilized to drive improvement in safety. Few assessments of work activities or ESH&Q programs are performed. Line management oversight by the subcontractor support organization, subcontract field representative, and a prime subcontractor did not ensure that all contract specifications for some ES&H areas were adequately implemented.

Deficiencies in feedback and improvement systems were also evident at the activity level. Worker/supervisor feedback and resolution of concerns at the activity level are not typically documented. Post-job briefing processes are weak and underutilized at the facilities that were evaluated. Many work activities have no documented post-job briefings, and when they are held, they result in few comments from workers or supervisors. Systems are not in place to track and provide corrective actions for post-job briefing comments. Some workers interviewed were not aware of employee concerns programs or other processes to identify suggestions for safety improvements. Line management analysis, tracking, and resolution of safety-related deficiencies are inconsistent and informal. The informality of feedback processes hinders the collective analysis of performance and the communication of lessons learned. Lessons learned were not effectively used to update procedures in some facilities. As a result, in one facility reviewed, the operators were not implementing new operational guidance that was based on lessons learned from a spill event.

ORNL management recognizes that feedback and improvement processes require improvement, and plans to use the SBMS initiative as the vehicle for improvement. In some areas, improvements are evident (e.g., informal feedback from R&D personnel has resulting in improvements to certain ES&H functions, and increased ES&H presence in the R&D facilities is evident). However, changes in policy and expectations related to feedback and improvement processes by ORNL management have resulted in less rigorous self-assessment and issues management at ORNL. Further, line management has clearly been given the responsibility and authority for self-assessments and issues management, but the required processes have not always been fully and effectively implemented, and accountability for effective implementation has been lacking.

One Safety Issue was identified under Core Function #5, addressing inadequate definition and implementation of feedback and improvement programs.

Safety Issue #5. UT-Battelle's feedback and improvement processes are not adequately defined or implemented to effect consistent, continuous improvement as specified in DOE Policy 450.4, *Safety Management System Policy*, and DOE Policy 450.5, *Line Environment, Safety and Health Oversight.*

Although improvements have been made and are ongoing, the current feedback and improvement programs lack rigor and do not lead to improvements in safety performance in many cases because of process and implementation weaknesses in assessments, issues management, and lessons learned.

UT-Battelle's assessment program has focused on the small number of ES&H elements in the performance evaluation plan, facility conditions inspections, and regulatory-driven reviews, without sufficient consideration of the many other ES&H program elements that need to be monitored:

- Assessments rarely involve evaluations of performance that are based on observation of work activities, the application of ISM principles and functions, or ES&H programs.

- In the process of implementing a Performance Based Management System, UT-Battelle has cut back on compliance-based assessment activities, but failed to compensate with appropriate performance-based assessments. An annual confined-space program review was not performed as required by site procedures and 29 CFR 1910.

- The construction contractor oversight procedure and individual oversight project plans for subcontracted electrical system and reservoir upgrade projects were not rigorously followed, and performance deficiencies were not adequately documented and tracked to resolution.

Weaknesses in assessment procedures hinder the evaluation and resolution of issues by affected organizations:

- Procedures for institutional assessments do not define detailed requirements for resolution of findings and do not provide linkage to the site's issues management procedure or tracking system.

- Requirements for documenting, analyzing, and dispositioning issues identified by division self-assessments are not clearly delineated in division procedures. In some cases, division-level implementing procedures did not exist or were out of date and did not reflect current institutional procedures and organizations. Many division-level assessment reports failed to adequately describe the scope, acceptance criteria, assignments, or results.

- Requirements, expectations, and process details for performing post-job reviews and addressing identified issues are poorly delineated in site procedures. As a result, worker self-assessments in the form of post-job reviews and the resolution of any concerns were not routinely documented or tracked.

Numerous deficiencies in the ORNL issues management program adversely impact the continuous improvement in safety performance. Some program and performance deficiencies are poorly defined in assessment reports and are not being consistently placed into the Laboratory Issue Database System or division-level tracking systems as required by ORNL procedures. Some sitewide issues are not being evaluated for significance and cause, and are not tracked to resolution:

- Institutional documents do not clearly communicate that formal issue management is a requirement and shall be implemented at all levels within ORNL.

- Division-specific and Laboratory-wide findings from ORNL Office of Independent Oversight assessments and some external assessments are not being placed in the Laboratory Issue Database System. Laboratory-wide issues thus have not been assigned owners responsible for significance and cause evaluations, development of corrective action plans, and verification of effective implementation.

- Institutional issues management documents do not clearly define or categorize issues and opportunities for improvement based on risk or significance (e.g., distinguish between recommendations and deficiencies that involve a violation of a procedure or requirements).

- Little formal analysis and trending are performed at the divisional or institutional levels to identify adverse trends or systemic and ORNL-wide issues.

- Some corrective actions have not been effective, have not been adequately verified before closure, and have not been sufficient to prevent recurrence. Various deficiencies were not resolved in a timely manner or the resolution did not address the full scope of the condition, including deficiencies in the ORNL feedback and corrective actions program identified as "key issues" in the ORNL gap analysis. ORNL failed to establish corrective actions that addressed all of the causes identified for two recent Price-Anderson Amendments Act non-compliance items on work control and issues management.

- Findings and concerns identified by ORO Facility Representatives are not input to the Laboratory Issue Database System until the formal report is received, up to six months after the issues were initially identified and verbally communicated to facility management. Therefore, some ORO-identified issues are not being prioritized, analyzed, and tracked to closure in a timely manner.

Many of the identified deficiencies result from a failure to adequately implement existing procedures. Others occur because the procedures and processes are not clearly defined in institutional requirements.

Summary Assessment of the Core Functions. Although some progress has been made, ORNL does not yet have effective processes in place for implementing the DOE core functions of safety management. The fragmented and deficient work control processes are not reliable mechanisms for ensuring that hazards are identified and appropriate controls are established. ORNL has promising initiatives, such as SBMS, that are intended to enhance implementation of ISM across ORNL. However, these initiatives are in various stages of development and need additional attention in such areas as procedural adherence. ORNL and ORO need to focus on the timely development and implementation of a comprehensive work control process and address the longstanding tolerance of inadequate procedures and inconsistent procedural use and adherence.

3.0 DOE Implementation of Integrated Safety Management Responsibilities

As discussed throughout Section 2, ORO is responsible for providing direction to its contractors and evaluating the effectiveness of contractor implementation of the ISM program at the ORNL site. This section provides additional information about the effectiveness of DOE line management in implementing their ISM responsibilities.

DOE Headquarters. Within SC, the Office of Basic Energy Sciences (SC-10) is responsible for providing programmatic direction to ORNL, including budget and scientific program formulation, budget preparation, and scientific research program activities. NE has line management responsible for safety and effectiveness of several facilities reviewed during this EH-2 evaluation, including REDC (7920, 7930) and Radioisotope Development Laboratories (3047). Coordination of line management responsibilities among SC, NE, and ORO for certain nuclear facilities was established in a 1999 memorandum of agreement.

SC has delegated responsibility for day-to-day programmatic direction and line oversight of ORNL to ORO. Correspondingly, SC's involvement in site operations is not frequent or routine, and SC does not normally assess safety performance. However, discussions with SC and NE personnel and review of policy documents indicate that these organizations have established clear expectations for safety.

SC provides much of the DOE funding for ORNL, and SC and ORO are actively involved in decisions about funding for ORNL. ES&H resources are not specifically addressed in the allocation of funds. ORNL is expected to allocate funding for most ES&H and infrastructure needs (with exceptions for line item upgrades) from its overhead budget and/or the general plant projects/ equipment budget.

As discussed in Section 2.4, the budget allocation processes generally enable DOE program offices, ORO, and ORNL management to make informed decisions, and ORO regularly participates in the risk prioritization process. However, some facilities and systems, including safety-related systems at ORNL, are not in good material condition, indicating that the allocated funding has either not been sufficient or has not been utilized efficiently over the lifetime of the systems. SC, ORO, and ORNL are dealing with the aging systems on a piecemeal basis, and have not developed a proactive plan to address them.

SC has recognized that aging facilities and equipment are a growing concern at ORNL and many other DOE laboratories. SC has recently allocated additional funds ($17 million) to new construction and equipment and facility upgrades at its laboratories. Additional attention is needed to ensure that SC has a detailed and comprehensive understanding of the material condition of safety-related systems and components so that a systematic approach to resolution can be implemented, and that resources can be allocated to the highest-priority safety concerns.

Oak Ridge Operations Office. In accordance with the ORO management approach, OSO has been delegated responsibility for most line management oversight functions involving ORNL. ORO provides specialized technical support when requested by OSO.

ORO senior management recognized that improvements were needed in the safety culture at ORNL. ORO was instrumental in the decision to select a new contractor with managers who have experience in implementing ISM and SBMS and dealing with the complex transition from a people-based approach to a rigorous and formal standards-based approach to safety. ORO also ensured that the contract included performance measures related to ES&H and ISM.

ORO and OSO have transitioned to the limited oversight role defined in DOE Policy 450.5. In accordance with direction from SC, ORO participated in a pilot program to transition to a limited oversight role in the mid-1990s and has continued it since that time. With the limited oversight approach, ORO and OSO perform fewer formal assessments and focus primarily on working with the contractor (including participation on contractor assessments and regular joint contractor/OSO facility walkdowns) to identify and resolve ES&H issues and concerns.

Although DOE Policy 450.5 allows a limited oversight role, one of the prerequisites is that the contractor establish a robust, rigorous, and credible self-assessment program. As discussed under Core Function #5 and Safety Issue #5, ORNL does not currently have a fully effective and mature self-assessment program. Consistent with SC expectations, ORO and OSO are committed to continuing the limited oversight role and are not positioned to revert to an oversight program that performs a comprehensive assessments of all safety programs on a regular basis. Consequently, ORO and OSO need to focus on ensuring that the ORNL contractors establish a robust, rigorous, and credible self-assessment program in a timely manner.

ORO and OSO have performed effectively in some areas. ORO has a good training program for its personnel and is improving and expanding its technical qualification program. The ORO directives management system is well organized and meets the applicable requirements of ORO and DOE orders. The ORO functions, responsibilities, and authorities manual defines the roles and responsibilities for line management and support organizations, including ES&H and ISM responsibilities. Some of these requirements are reflected in various ORO and OSO documents and procedures and OSO practices. ORO recently adopted a policy statement on public involvement that emphasizes identification and facilitation of meaningful opportunities for public involvement in DOE decisions impacting stakeholders and surrounding communities.

In some cases, ORO has used the budget allocation process to impact safety in a positive manner. For example, there are instances where ORO personnel increased the priority of a safety-related item during the budget reviews to ensure that it would be funded. However, aging systems and facilities and the degraded condition of safety-related systems indicate that the historical priority placed on infrastructure and preventive maintenance has not been sufficient. ORO, in conjunction with the contractor, are attempting to address the aging infrastructure through a strategic plan for upgrading R&D facilities. They have line item projects for new laboratories and are working to obtain funding for other new facilities through other sources, such as cooperative agreements with the State of Tennessee and commercial firms. If successful, these longer-term plans could enable current aging facilities to be phased out and dispositioned.

The ORO Phase II ISM verification communicated a positive characterization of the ISM program framework at ORNL. These characterizations were not supported by the more comprehensive review performed during this EH-2 focused safety management evaluation.

ORO Order 450.5, *ES&H Oversight Program*, defines the requirements and responsibilities for ORO oversight of ORNL and specifies development of an oversight program consistent with DOE Policy 450.5. Specified oversight program elements include operational awareness of contractor work activities; ensuring a robust, rigorous, and credible contractor self-assessment program; and the performance of appraisals of sufficient frequency and duration to confirm the contractor's safe performance of work and the effectiveness of the self-assessment program. However, other ORO policies (such as the ORO Mission Implementation Plan) and actual practices do not reflect DOE Policy 450.5. ORO does not evaluate safety and health programs in a prioritized, routine, and structured manner.

The OSO Facility Representative program includes five Facility Representatives for eight ORNL nuclear facilities. The program has formal procedures and an annual assessment plan that includes focus areas for surveillances. Findings from quarterly and semi-annual assessments are communicated in writing to UT-Battelle, and written responses are required for high-level concerns. Deficiencies noted during surveillances and day-to-day monitoring are initially communicated verbally to the contractor and tracked by individual Facility Representatives. Concerns are escalated to higher levels of management if appropriate resolution is not achieved at the lower levels. The Facility Representative program is generally implemented in accordance with the ORO manual. However, deficiencies in performance at the REDC (see Safety Issues #2, #3 and #4 and Appendices A and B) were either not identified or not corrected, and only ten concerns were formally identified to the contractor for resolution and formal response in calendar year 2000. Overall, the Facility Representative program has not been fully effective in facilitating correction of systemic deficiencies, such as the observed deficiencies in configuration management and operations of nuclear hot cell facilities. Increased attention is needed to ensure that Facility Representatives perform rigorous reviews and that their findings are formally communicated and tracked to resolution, and that corrective actions are verified to be effective.

For non-nuclear facilities, OSO conducts a variety of line oversight activities. For example, the OSO ES&H staff actively participate with UT-Battelle in weekly facility condition inspections, and program staff conduct some safety-related walkthroughs. OSO personnel also perform for-cause reviews and other event-related reviews, such as operational readiness reviews. However, there is insufficient documentation of routine surveillances or day-to-day monitoring activities. Also, there is insufficient observation of work activities and assessment of safety and health programs and ISM functional areas. Some observations are not formally reported to the contractor or tracked to resolution.

One Safety Issue was identified for ORO, addressing inadequate line management oversight of ES&H.

Safety Issue #6. ORO and OSO have not established and implemented an effective and efficient oversight program as specified in DOE Policy 450.5, *Line Environment, Safety and Health Oversight,* and ORO Manual 220, *Oak Ridge Operations Appraisal Manual.*

ORO and OSO are not effective in continuously and rigorously monitoring safety and health programs and performance; in identifying and correcing systemic deficiencies; or in holding the contractor accountable for performance deficiencies. Specific deficiencies include:

- **OSO has not implemented a planned, rigorous, and formal process for routinely monitoring contractor safety and health performance for ORNL's non-nuclear facilities.** The governing procedure (ORO 200, *Operational Awareness Program*) does not delineate a rigorous, documented line oversight process. There is insufficient documented assessment or monitoring of work activities, ISM implementation, or the adequacy of safety and health programs and their implementation. Excluding walkthrough facility condition inspections, safety and health concerns are only communicated to the contractor verbally or via email. While deficiencies have been identified and corrected through the ORO oversight program, many concerns are not documented in a manner that supports periodic performance reviews or tracking and trending.

- **OSO Facility Representative oversight of ORNL nuclear facilities has not been effective in identifying and correcting systemic deficiencies.** Reporting to the contractor is often not timely. Systemic programmatic and performance deficiencies in work planning, procedural adherence, and configuration management (see Safety Issues #2, #3, and #4) were not identified and corrected through Facility Reprentative reviews.

- **The ORO ISM verification reviews were not effective in identifying and correcting systemic deficiencies in the ORNL ISM program.** Numerous ISM program documents are still not established or adequate. In the Phase II implementation, ORO established too low a threshold of performance expectations for ISM program document adequacy, formality, and the level and effectiveness of implementation in many areas. The overly-positive characterization of the status of the ISM program contributed to the incorrect understanding of the ISM policy expectations exhibited by management and staff in various ORNL organizations.

- **ORO has not met the line management oversight requirements of DOE Policy 450.5, *Line Environment, Safety and Health Oversight,* or ORO Manual 220, *Oak Ridge Operations Appraisal Manual.*** DOE policy allows the transition to a limited oversight approach when the contractor has established an effective, robust, rigorous, and credible safety self-assessment program. However, the ORNL contractor does not yet have an adequate self-assessment program. In addition, ORO is not meeting the requirements of ORO Manual 220, which specifies that multidisciplinary team appraisals and functional appraisals are to be conducted. ORO has not performed the periodic appraisals of work performance and the contractor self-assessment program identified in the DOE Policy and the ORO Appraisal Manual since 1999, and is not conducting the specified functional appraisals.

Ongoing oversight activities by ORO and OSO have not been sufficiently robust to identify many of the ISM program and performance deficiencies identified by this EH-2 evaluation, establish rigorous expectations for ES&H performance, and ensure that UT-Battelle establishes and implements an effective ISM program.

Summary of DOE Implementation of ISM Responsibilities. SC and ORO have effectively implemented some of their safety management responsibilities, such as maintaining the directives management system and performing operational awareness activities. However, ORO has not effectively fulfilled all responsibilities delineated in ORO Order 450 (e.g., to establish and execute an effective contractor oversight program and effectively monitor contractor work activities) and does not have a structured, planned, routine, and formal oversight program that provides for regular and rigorous evaluation of ISM and safety and health program implementation.

Because ORO has transitioned to the limited oversight role defined in DOE Policy 450.5, ORO needs to focus on ensuring that ORNL establishes the requisite robust, rigorous, and credible ES&H self-assessment program. ORO also needs to focus on contractor efforts to implement a fully effective ISM program at ORNL, including implementation of SBMS and reviews of work activities in ORNL facilities to ensure that the requirements are understood and effectively implemented at the activity level by R&D personnel and support organizations. In accordance with their emphasis on partnering with the contractor, ORO needs to work with the contractor to ensure that expectations for ISM are clearly communicated throughout the ORNL organization. ORO and SC also need to further emphasize infrastructure and preventive maintenance improvements to ensure that safety-related systems are adequately maintained.

4.0 Integrated Safety Management Ratings

The purpose of the EH-2 ratings is to direct management attention to the areas that need improvement. At ORNL, the entire ISM program, including all seven guiding principles and all five core functions, are in transition. ORNL has self-identified significant weaknesses in the current ISM program and is developing and implementing plans to enhance and upgrade the entire ISM program. The ratings below are intended to provide line management with feedback on which areas require the most attention, considering the effectiveness of the current systems. However, the adequacy of plans to enhance ISM is also considered; areas where there are gaps in the plans or the plans are not sufficiently detailed to ensure effective implementation also warrant increased management attention.

The seven guiding principles and five core functions are interrelated and must be considered collectively with respect to their overall impact on ISM. In evaluating the overall effectiveness of the safety management system, the guiding principles provide the institutional framework for ISM, and the core functions provide an indication of whether the institutional processes are effective. Consequently, the overall rating reflects the evaluation of both the core functions and the guiding principles.

At ORNL, one of the seven guiding principles was evaluated as having effective performance (GREEN). Two of the guiding principles were evaluated as having effective performance in some areas but needing improvement and significant management attention in other areas (GREEN/YELLOW). Three guiding principles need improvement and significant management attention (YELLOW). One guiding principle has significant deficiencies in some areas and requires significant management attention in other areas (RED/YELLOW).

ORNL programs for implementation of the five core functions of ISM at the facility and activity level are still evolving and maturing and are not yet consistently effective. One of the core functions was evaluated as having effective performance in some areas but needing improvement and significant management attention in other areas (GREEN/YELLOW). Three of the core functions need improvement and significant management attention (YELLOW). One core function has significant deficiencies in some areas and requires significant management attention in other areas (RED/YELLOW).

Overall, while deficiencies are evident in the current ORNL ISM program, UT-Battelle management has a good understanding of the need to improve and is aware of many of the remaining weaknesses. Their ongoing or planned programs are designed to further enhance safety management and are generally appropriate. However, many of the plans are in the early stages of development and lack sufficient detail and milestones, and some of the deficiencies (e.g., configuration management and procedural quality and use) are not fully recognized by ORNL management and are not adequately addressed by the current plans and initiatives. Continued attention is needed to address the identified Safety Issues and ensure consistent implementation of work planning and feedback and improvement mechanisms. Particular attention is needed to ensure that line management ownership of safety is established and that procedure quality and adherence are improved in a timely manner.

The ratings are sumarized in Figure 4.

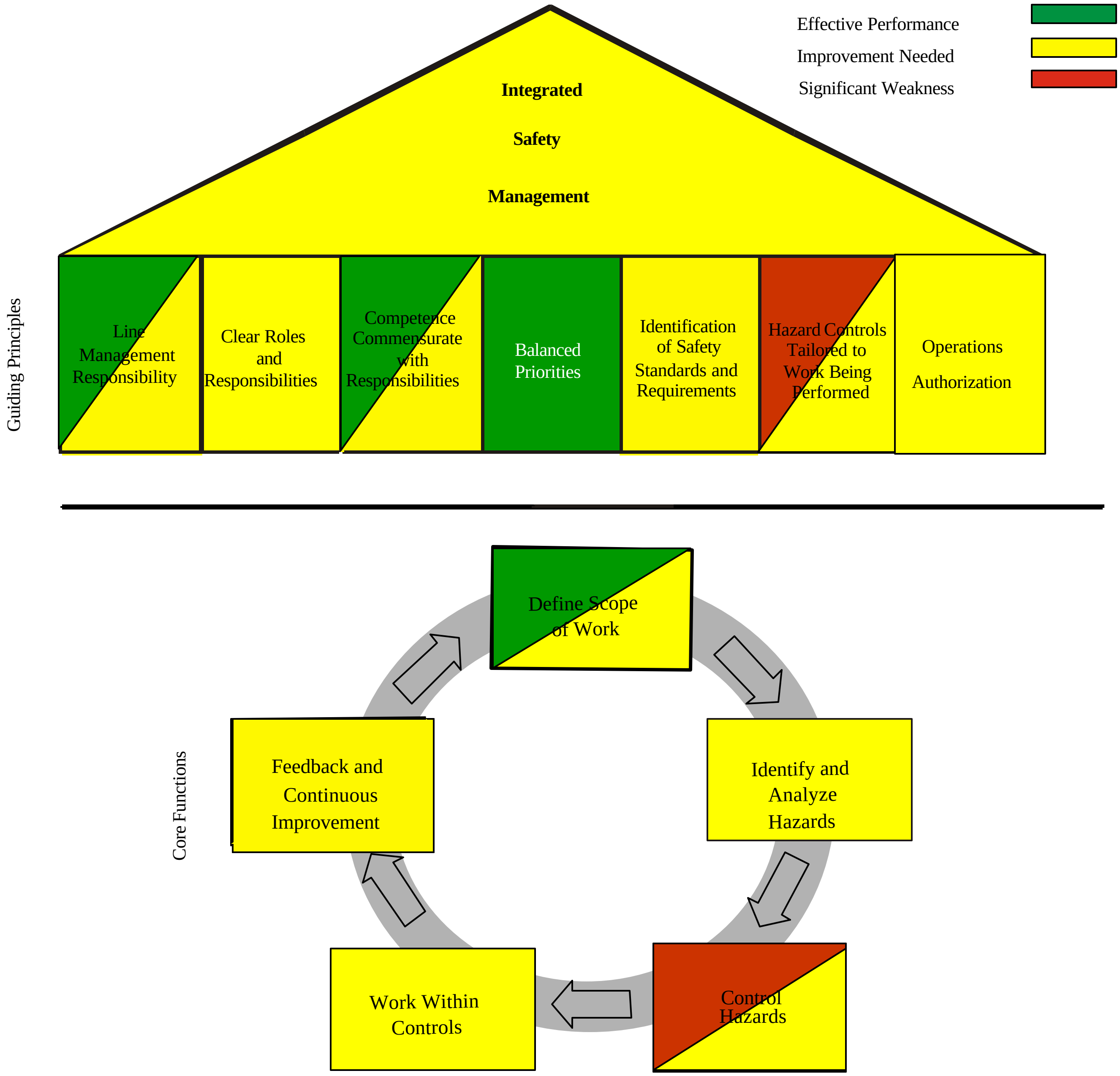

Figure 4. Ratings

APPENDIX A
ESSENTIAL SYSTEM FUNCTIONAL REVIEW

The purpose of an essential systems functional review is to evaluate the functionality and operability of systems and subsystems essential to safe operation. This Office of Environment, Safety and Health Oversight (EH-2) essential systems functional review examined aspects of modifications, maintenance, surveillance and testing, and operations and their impact on the systems' ability to perform their safety functions. This review evaluated whether the maintenance and modifications, operations, and training and qualifications are sufficient to keep the systems functional within the safety envelope specified in the authorization basis, including the technical safety requirements (TSRs). System modifications were also reviewed to ensure that the appropriate evaluations, reviews, and approvals were in place and that the modifications had been appropriately evaluated for Unreviewed Safety Questions (USQs). Configuration control and system drawings were reviewed to ensure that the installed systems match design drawings and that configuration control is documented and accurate. This EH-2 review did not specifically evaluate the adequacy of the current approved safety basis. The results of this review fell into four general categories: configuration control, maintenance, surveillance and testing, and operations.

System Overview

Four ventilation systems at Radiochemical Engineering Development Center (REDC) Building 7920 were selected for the essential systems functional review: the Vessel Off-Gas (VOG) system, the Cell Off-Gas (COG) system, the Laboratory Area (LA) exhaust system, and the Hot Cell Support Area (HCSA) exhaust system. These systems were selected because the facility mission will continue for some time, the systems are designated as safety-class, and functionality is necessary to protect workers, the public, and the environment from radiological consequences during normal operations and following abnormal events or accidents.

In addition to the non-safety ventilation supply and other ventilation systems, Building 7920 has two major ventilation areas designed for confinement of contamination during normal operations for worker safety and during accident conditions for worker and public safety. These ventilation areas require safety-class exhaust systems. The hot cells, cubicles, and tanks inside the hot cells, shielded caves, and gloveboxes are used for the primary confinement of large quantities of radioactive materials and the process operations. The safety-class VOG and COG systems are used to maintain the desired negative pressures and airflow pattern in the hot cell bank and to collect, purify, and discharge gaseous wastes through the plant stack. The VOG system includes necessary ducts and dampers, a scrubber to remove corrosive fumes, an iodine retention system, high efficiency particulate air (HEPA) filters, charcoal beds to remove iodine, and two 100-percent capacity redundant fans. The COG system includes necessary ducts and dampers, HEPA filters, and two 100-percent capacity redundant fans. In both systems, only the confinement boundary (including the ductwork and HEPA filters) and the active functions of the fans and motors are designated as safety-class.

The outer walls of areas adjacent to the hot cells, including the control room (the HCSA) and the radioactive materials laboratories and adjacent rooms (the LA), constitute the secondary confinement. The purge air from these areas is exhausted on the building roof through two separate collection and duct systems (the HCSA and LA exhaust systems), each with its own HEPA filters and exhaust fan system. The confinement boundary, including the ductwork and HEPA filters, and the active functions of the fans and motors are designated as safety-class.

A.1 Configuration Control

Some aspects of configuration control were effectively implemented. For example, most unreviewed safety question determinations (USQDs) performed in support of REDC modification activities were comprehensive and adequately analyzed the effects of modifications on the authorization basis. The USQD addressing the COG system upgrades was particularly comprehensive and provided a thorough review and analysis of the effects of modifications on the authorization basis. It also addressed interim system configurations during installation of the modifications.

However, the team found significant deficiencies in the area of configuration control. Most of the deficiencies were attributed to procedure deficiencies, procedure non-compliances, and insufficient training.

Modifications - The team selected 17 recent (1998 through 2001) modification work packages for the safety-related COG and VOG exhaust systems for review. The development, implementation, and configuration control of these packages were evaluated for adherence to the applicable REDC procedures. Numerous problems with the development and implementation of these modifications were identified.

VOG and COG Fans

Sixteen out of 17 packages were incorrectly designated as Quality Level III (i.e., little or no specific impact on safety). According to the REDC work request procedure, many of these packages should have been designated as Quality Level I. Only one package was correctly designated as Quality Level II. UT-Battelle could not locate any records indicating that training on the section-level procedure RTS-003 (used for design modification) had been performed for the personnel who developed the modification packages. Facility personnel indicated that they had not received any formal training on RTS-003. Training was provided on REDC AP/MP-5000, the REDC work control procedure.

An example of an incorrect Quality Level designation is replacement of the COG fans. These fans are safety-related, and the work package should have been designated as Quality Level I,s but was designated as Quality Level III. Additionally, the quality requirements in the purchase specifications for these fans were inadequate. Although these fans have active and passive (pressure boundary) safety-related functions, only the pressure boundary aspects were specified as safety related in the purchase specifications. Fan active functions (flow control and fan motors) did not have any safety-related requirements in the specifications. The facility staff stated that the procurement specification (approved on February 3, 1998) was based on the Revision 0 of the basis for interim operations (BIO) and did not take into consideration a change in the authorization basis (i.e., the BIO) for these fans. Revision 0 of the BIO, Section 2.5 stated that "COG and VOG fan operation is not relied as a mitigation factor in [process hazards analysis]." Revision 1 of the BIO, which was approved on January 23, 1998, included these fans in the description of the safety-related systems, structures, and components and deleted the phrase "not relied as a mitigation factor." Failure to incorporate the current facility authorization basis in the procurement specification is another example of inadequate configuration control.

The COG digital flow controller and the COG programmable logic controller (PLC) were purchased as non-safety-related and non-quality assurance components, although they perform functions that directly affect the safety-related function of the COG system. For example, the COG digital flow controller could send an erroneous signal to close the inlet vanes and, hence, impede the COG flow required to maintain TSR negative pressures. Similarly, the PLC could send an erroneous signal and trip the operating COG fan. In addition, the facility programmed the PLC (developed the software) without regard to Oak Ridge National Laboratory (ORNL) software development quality assurance (QA) guidance. Although the facility staff performed extensive testing of this controller, the programming and testing were not independently verified, and verification and validation required by the QA guidance were not performed. The facility staff indicated that they had no training on software QA requirements. In addition, requirements stated in the ORNL Software Quality Assurance Guide were not applied to this modification.

Because 16 of the packages were incorrectly performed as Quality Level III and not Quality Level II or I (i.e., safety-related), the contractor did not perform an independent design review as directed by the modification procedure (RTS-003). Additionally, the only correctly designated package was not subjected to the independent design review required by procedure.

As-Built Configuration - Design documents for the safety-related HVAC systems do not reflect the as-built configuration, nor do they reflect recently implemented modifications, as evidenced by the following examples:

- The COG duct access point (pitot-tube connection) had a hole about 2-1/2-inch diameter, "sealed" by a plastic bottle. (The hole was used to insert a video camera for liquid presence/source investigation). This hole was cut without invoking the modification process, and it was an undocumented change to the facility, which was not reflected on the plant drawings or addressed by a USQD. After facility personnel were notified of the problem, the hole was sealed. They issued an occurrence report to address the finding and performed a USQD on the as-found condition and another USQD to address the repair.

- An indicator light taped to the side of the Ventilation Control Panel in the control room indicates the status of the interlock between the COG flow switch and the Building 7920 ventilation system supply and exhaust fans. This light was used during the implementation of the COG exhaust modification to establish the setpoint value without tripping the building supply and exhaust fans. Since operators determined that the indicator light was useful, the light was retained after the modification was complete. The light was left in place without invoking the modification process and was an undocumented change to the facility, which was not reflected on the plant drawings or addressed by a USQD.

- The facility design drawings do not represent the as-built configuration. This is a chronic condition; many modifications have been made in the 37 years of facility operations, and few are reflected in design drawings. This condition is exacerbated by failure to incorporate the recent modification changes. Lack of drawing control is evident by numerous uncontrolled pen and ink changes on the Control Room and Document Control drawings. Additionally, drawings in the Control Room are not the current revision.

- The TSRs require that the HCSA and LA pressures be maintained at least 0.1 inch of water lower than the outdoor pressure to prevent out-leakage. A probe located on the building roof provides the reference outdoor pressure. Two discrepancies exist between the as-designed and as-built configurations. First, the drawings required the probe to be three feet above the roof; it was actually only 27 inches above the roof. Second, the probe design calls for two horizontal, parallel, circular, flat, metal plates, 3/64-inch apart, with the sensing line penetrating the upper plate at its center. In the actual installation, the plates were nearly touching on one side. These discrepancies call into question the operability of the instruments receiving input from this probe, including instruments used to verify that the building pressure remains within TSR limits.

Procedural Compliance - Procedural non-compliances contribute to configuration control problems. For example, out of the 17 modification packages that were reviewed, none addressed the impact on preventive maintenance and calibration as required by procedures. Although required by procedure, the facility does not use the modification process as a vehicle for implementing changes or additions to preventive maintenance activities or calibrations. Consequently, the preventive maintenance recommendations provided in the vendor manual for the new COG fan motor have not been incorporated into the REDC preventive maintenance schedule. As another example, the facility modification procedure requires that the procedural impacts of modifications be addressed; however, the facility abnormal response procedure was not revised to reflect the modification that changed the indicating device for loss of HSCA and/or loss of LA flow to backdraft damper position proximity switches.

Procedure Adequacy – Several procedures applying to the modification process at REDC were used for modifications on the safety-class ventilation systems. ORNL Procedure ORNL-FS-P03, Revision 2, entitled "ORNL Configuration Management for Nuclear Facilities," controls the implementation aspects of configuration management. The Chemical Technology Division's Administrative Control Procedure RTS-003, Revision 6, entitled "Engineering Support Work System," controls the modification development aspects. REDC Administrative Procedure REDC AP/MT 5000, Revision 5, entitled "Maintenance Implementation and Work," controls work implementation, including the modification process. ORNL Software Quality Assurance Guide OQS-QA-G09, Revision 0 controls software modifications. These modification development and implementation procedures do not provide sufficient guidance for the modification process, as evidenced by the following examples:

- REDC AP/MT 5000 provides the following definition of the QUALITY LEVEL: "Level (category) I activities are characterized by high or significant risk of negative impact on safety, environment, public relations, program resources, etc. Level (category) III activities have little or no significant negative impact. Level (category) II activities are those that are not categorized as either III or I." This definition lacks precision and clear guidance and allows for inappropriate interpretations. Furthermore, because it lacks any reference to safety-related classification of components, it allows for quality level determination without any regard to the component's safety classification. This ambiguity contributed to the erroneous quality levels in 16 of 17 reviewed modification packages.

- The Documentation Checklist in RTS-003 leaves the user to decide whether independent design review verification is required ("Normally required for Design Category Tasks"). No guidance is provided for determining what is "normal" or when the independent design review is required. Consequently, none of the 17 packages received an independent design review.

- The ORNL Software Quality Assurance (OQS-QA-G09) is a guide, not a procedure. Consequently, specific quality standards are not established or enforced.

A.2 Maintenance

For the safety-class ventilation systems, REDC generally performs sufficient corrective maintenance, preventive maintenance, and post-maintenance testing to maintain TSR operability of safety systems and to continue program work. However, in most cases, ventilation system predictive maintenance or maintenance necessary for system reliability is not performed. Other than the COG fans and associated dampers (which were replaced in 1999), the material condition of observed portions of the safety-related and non-safety ventilation system components (including active components) are minimally acceptable for normal operations. Some equipment is beyond its life expectancy, and many components such as dampers and flexible joints are in disrepair, as evidenced by the following examples:

- Flexible joints in the safety-class ductwork of the HCSA and LA ventilation system are in extremely poor condition. The holes and tears are covered by numerous layers of duct tape. Some of the tape has also degraded, requiring more layers of tape to prevent air leakage.

Flexible Joints Repaired With Duct Tape

- VOG maintenance dampers for the control damper upstream of the fan have disintegrated. They were replaced, but the same type of isolation dampers for the suction side of the fans were not inspected for similar conditions. Portions of these dampers could be pulled into the safety-class VOG fans, if they disintegrate.

- The safety-class HEPA filter banks in the LA and HCSA exhaust systems have exceeded their maximum service life (i.e., ten years from date of manufacture), as specified in the April 2001 ORNL HEPA filter replacement criteria. The LA and HCSA exhaust system HEPA filters were installed in May 1991, and their manufacture date is unknown. Although ORNL committed to ORO to replace these filters no later than September 2003, this project has not yet been funded.

- External environmental conditions and aging have resulted in faded, illegible, or missing labels on many of the ventilation system components.

- Many of these maintenance deficiencies have existed for years. Although general material conditions are documented in condition assessment surveys, specific equipment deficiencies are not documented in maintenance work requests unless funding is available. This situation results in an erroneous indication that there is maintenance backlog and does not allow for effective prioritization of specific maintenance deficiencies.

Several methods of dealing with poor material condition are documented as workarounds in procedures; the required corrective maintenance has not been performed, and the underlying problems have not been resolved. Deferring such corrective maintenance for years has adversely impacted the material condition of the ventilation systems. Examples of these procedure workarounds were evident in the procedure providing guidance for abnormal event response and alarm response:

- VOG backdraft dampers do not fully close as designed, so procedures call for aiding the valves in shutting. For example, a procedure step addressing diagnosis of poor vacuum in the VOG system scrubber states, "Backflow preventers must be closed (may have to be aided)." Fully closing these dampers involves manual agitation to maintain required system flow; operators have staged a steel rod at the dampers for this purpose. Dents and missing paint on these dampers are evidence of the result of this particular workaround.

Damaged Backdraft Damper

- A step in the procedure regarding checking operation of the VOG system pressure control valve states, "There is a history of sticking, air supply lines breaking, and linkage coming loose." Plant and Equipment Division or REDC management has not performed a root cause analysis of these failures or otherwise tracked them for trending. This damper actively controls VOG system flow during normal operations and following an accident.

- One procedure step addressing the degraded LA system air supply dampers states, "These may require occasional adjustments of the set points of the controllers (behind panel MB-4) and/or more likely require manual movement of the dampers since most do not work from their controllers (PDC-31 and PDC-34 respectively)."

- A procedure step addressing diagnosis of failure of the COG flow instrumentation states, "Currently there is no history to suggest a particular reoccurring failure is likely, but the instrument air supply to the stack pad is somewhat tenuous." In the same procedure, a step addressing diagnosis of the cause of a low HCSA vacuum alarm states, "Historically the (PDS-32) switch has been found to drift between calibrations."

Although some corrective maintenance is performed, many deficiencies exist. For example, a significant portion of the HVAC systems is inaccessible, and much of it has never been inspected or is only inspected as a result of a failure (such as the leaky COG joint inspected earlier this year). Other examples of deficiencies in the corrective maintenance program include:

- Failure tracking of ventilation systems, structures, and components, which was performed until 1999 (REDC Maintenance Database), did not include sufficient documentation to support meaningful trending and analysis, and has been abandoned for almost two years.

- In the 1960s, acid carryover from the VOG scrubber damaged the system. At that time, the facility used patches to repair holes in the ducting and the VOG fan casings . However, these patches and other portions of the system subject to the same conditions have not been routinely inspected.

- Calibrations of non-TSR ventilation system instruments are not kept up to date (approximately 25 percent of the instruments are overdue).

- The facility procured replacement VOG system fans over five years ago. They have not been installed.

- A comprehensive Master Equipment List (MEL) for the ventilation systems of Building 7920, which is to include manufacturer or vendor name, model and serial number, and other pertinent data, was not available. A draft 1994 list, "Development of

Plant and Equipment Division's Master Equipment List: Building 7920," lacked sufficient detail and did not match and was not superseded by a 2000 list, "REDC Building 7920 Safety-Class, Safety-Significant, and Defense in Depth Configuration Items." Lack of a detailed, up-to-date MEL for the ventilation systems violates the intent of DOE Order 430.1A, *Life Cycle Management* and hinders effective trending, tracking, and maintenance of equipment.

In April 2000, the facility issued a Price-Anderson Amendments Act noncompliance report against the Quality Assurance Rule (10 CFR 830.120) addressing lack of an upgrade program to address facility aging. As one of the corrective actions, an Enhanced Preventive Maintenance Program Proposal addressing the upgrade of aging (end of life cycle) systems, structures, and components was developed in September 2000. Also, ORNL identified the need for upgrading equipment as early as 1991; however, these upgrades have remained largely unfunded, with some exceptions (COG system fans and associated dampers were upgraded in 1999).

A.3 Surveillance and Testing

A sampling of surveillance and testing procedures, practices, and test results for the facility indicated that they generally provided adequate assurance that TSR requirements were being met. For example, ventilation and off-gas HEPA filter efficiency testing was being performed in accordance with established requirements, and TSR surveillance roundsheets were being performed daily and in each shift in accordance with the TSRs and applicable procedures. Other testing reviewed included off-gas and ventilation systems' differential pressure (DP) monitoring, building exhaust systems' stack velocity testing, and functional tests and calibrations of instruments and alarms.

In a few instances, however, the ORNL procedures, practices, and supporting analyses did not provide full assurance that all aspects of the facility's safety and non-safety structures, systems, and components were capable of performing their design function as evidenced by the following problems.

Building DP Limits May Not Account for Uncertainties – The TSRs require that the HCSA and LA pressures be maintained at least 0.1 inch water gage (w.g.) lower than the outdoor pressure. However, because of the uncertainties associated with the building outside environment and the instrumentation used for measuring the building DP, the TSR building DP limit could be unknowingly violated.

The accident analyses of the mitigated consequences were based on all of the Building 7920 releases being through the various ventilation systems, with no direct building leakage as a result of the confinement areas being maintained at negative pressure with respect to the outside environment. Releases through the ventilation systems were mitigated by several factors, including HEPA filters and elevated release points. Therefore, any factors that might nullify the building negative pressure could allow direct, unfiltered, ground-level leakage to the environment, which could significantly increase the accident consequences. Two factors, one environmental and the other involving instrumentation, could compromise the building negative pressure.

First, the 0.1-inch w.g. building TSR negative DP limit does not take into account wind effects on the buildings, which can cause localized lowering of outside pressures. This situation is inconsistent with practices at other facilities requiring leakage control, which are typically in the 0.25-inch w.g. DP range to account for wind effects and uncertainties for most weather conditions that could credibly be assumed coincident with an accident. In response to this concern, ORNL, applying an American National Standards Institute (ANSI) standard on wind effects, calculated that winds above 17 mph could completely nullify the TSR 0.1-inch w.g. DP limit on the roof and sides of the building parallel to the wind direction. In addition, such calculations contain variables and uncertainties, both positive and negative, due to geometry discontinuities, wind direction variables, etc., which are not addressed in the ANSI standard. (During normal operation, Building 7920 DPs are maintained in the 0.3-inch w.g. range.)

The second factor involves the outdoor pressure sensing probe design (in addition to the installation concerns discussed in Section A.1). The probe is located on the building roof, one of the areas that would experience the most wind-induced pressure reductions. Because of this location, the probe should sense the lowest building outdoor pressure if the above-described uncertainties were neglected. Therefore, controlling the building DP based on this indication would ensure that it was negative at all locations. However, the probe design may indicate higher-than-actual pressure due to another wind effect.

The probe design consists of two horizontal, circular, flat, parallel, metal plates, 3/64-inch apart, the upper plate 16 inches in diameter, and the lower plate 8 inches in diameter, with the sensing line penetrating the upper plate at its center and pointing downward. This design was intended to make the probe omnidirectional and not subject to ram pressure effects on the sensing tube. However, wind entering the space between the plates is significantly slowed because the plates are close together. Since static pressure is inversely proportional to the square of the velocity, the static pressure at the center sensing point would be higher than the actual outdoor static pressure. Therefore, under windy conditions, this device would provide non-conservative pressure signals (i.e., the indicated pressure would be higher than the actual pressure). Although the difference would be small in absolute terms, it could be large relative to the very small DP limit of 0.1-inch w.g. Thus, the original design calls into question the operability of the instruments receiving input from this probe, which includes instruments used to verify that building pressure remains within TSR limits.

HCSA and LA Exhaust Systems Stack Velocity Testing – The HCSA and LA exhaust systems' stack velocity test acceptance criteria basis calculation contained minor non-conservatisms. These two systems are required by the TSRs to maintain the pressure of their respective areas at least 0.1 inches w.g. lower than the outdoors by exhaust fans on the building roof. Each exhaust system contains two fans with a common suction and separate exhaust stacks. Normally, one fan in each system is operating, with the other in standby. The systems' flows are through HEPA filters to remove any potentially radioactive particles, and they are directed upward through exhaust stacks 14 feet above the top of the roof to achieve the required release elevation for accident conditions.

The TSRs require that the exhaust velocity be at least 32.8 feet per second to provide the required mixing height to meet accident offsite exposure limits. Two minor non-conservatisms in the stack velocity acceptance criteria supporting calculation are:

- The calculation accounted for the standby fans' actual backdraft dampers back-leakage, which reduced the required system flows to achieve the 32.8 feet per second stack velocity. However, any subsequent damper replacement or other factor that would reduce the back-leakage would also reduce the exit velocity, thereby rendering the acceptance criteria non-conservative. ORNL's informal review of this concern showed that the additional accident exposure consequences would be minimal.
- Each fan contains a 2-inch casing drain that was not accounted for in the calculation. These drains allow a small portion of the flow to exit at roof elevation, bypassing the stacks. Only two accident consequences would result: it would allow the bypassed flow to be released at a lower elevation than was credited in the calculation. The ORNL USQD of this calculation error showed that the additional accident exposure consequences would be minimal and that the discovery did not constitute a USQ.

Diesel Generator/Building Exhaust Fan Testing – The standby diesel generator/Building 7920 exhaust fans' interlock test procedure is inadequate. This procedure was written to test the standby diesel generator and its automatic load sequencing, as well as the Building 7920 exhaust systems' low-flow interlocks for starting the standby fans upon loss of flow through the operating fans. Although both functions are non-safety, they are important to reliable normal operation of the facility's ventilation systems.

Although the procedure contains no acceptance criteria, it contains expected "nominal values" for the diesel generator load sequence timing after a simulated loss of normal power and for timing the building exhaust fans swap-over. The sequencer timing measurements are intended to demonstrate that the intervals between sequenced loads onto the diesel generator are adequate to prevent overloading, nominally 8 seconds. However, the nominal values specified would not necessarily provide that assurance, for two reasons. First, specifying a nominal instead of a minimum timing value, which was the critical parameter, results in no controls to prevent a minimum value from being violated. Second, the procedure provides nominal values of the total time for each device from the loading sequence start. The observed values could be substantially different from the nominal values because of tolerance buildup. As a result, these numbers do not give an accurate picture of the times between equipment starts in the sequence, which is the actual parameter that needs to be verified. An example of this tolerance buildup was demonstrated in a test performed on June 4, 2001, when the sequencer times differed from the nominal values by as much as 20 percent. No explanation was provided for the differences in the completed procedure.

Similarly, the fan swap-over timing values are intended to prevent the standby fans from being bypassed in the load sequence if the swap-over takes too long. However, in the test performed on June 4, 2000, one of the fans took over 50 percent longer than the specified nominal timing range, and no explanation or notation was provided in the procedure.

HEPA Filter Efficiency Testing - The HEPA filter efficiency testing procedure for this facility is a generic procedure used for all HEPA filter testing on site. It contains a general requirement that downstream sampling ports for single-point sampling be greater than or equal to 10 duct diameters from the filter to ensure uniform sample mixing. Only the VOG system configuration meets this criterion in this facility. However, for the other systems, the non-uniform hardware geometry downstream of the filters and other hardware factors, such as intermediate fans, tends to induce significantly higher turbulence than straight duct flow. Therefore, ORNL judged that these factors compensate for not having the required separation. Although the EH-2 team agrees with the rationale for allowing these exceptions, the procedure is written without this explanation and is less than optimum, because strict compliance cannot be achieved.

A.4 Operations

Process operators operate the Building 7920 ventilation systems in addition to performing process operations. The operators monitor the ventilation systems, perform system realignments when necessary, perform some surveillance tests, and respond to alarms and abnormal conditions within the systems.

Inadequate Procedural Controls and Compliance – Safety-related procedural controls were not commensurate with the procedures' importance to safety, as illustrated by the following examples:

- Several TSR surveillance procedures contain the statement, "If modifications to the procedure are required in the course of an operation, it is anticipated that the person(s) performing the work will respond appropriately according to their own judgment." This statement would allow procedure revisions without the appropriate controls required by 10 CFR 830.120 and DOE Order 5480.21. The REDC procedure for developing, writing, reviewing, approving, using, and controlling procedures allowed such uncontrolled revisions and other practices inconsistent with the requirements of the Code of Federal Regulations (CFR) and the DOE order.

- There are no procedures addressing startup, normal operations and normal operating parameters, system shutdown, and valve and electrical lineups for the ventilation systems. Facility management relies on operator and supervisor knowledge and system familiarity in lieu of approved standards.

- Most of the procedural guidance for response to upsets in the ventilation systems is contained in two procedures: REDC 7920/TSR 002, "Guidance for Troubleshooting and Corrective Actions in Response to Facility Alarms Associated With Equipment Addressed by the Building 7920 Technical Safety Requirements," and REDC 7920/TSR 003, "Guidance for Responding to and Correcting Abnormal Conditions Associated With Equipment Addressed by the Building 7920 Technical Safety Requirements." These procedures are poorly written, are not user-friendly, contain multiple actions within individual steps, address multiple conditions or alarms without the benefit of a table of contents, and are generally not written in accordance with industry standards or DOE expectations delineated in DOE-STD-1029, "Writer's Guide for Technical Procedures." Each of these procedures is designated as a "non-verification administrative procedure for general use," which the REDC procedure on procedures indicates are not mandatory.

- Loss of non-safety-related supply fans for the HCSA and LA ventilation systems leads to high negative pressure in the Building 7920. The facility staff indicated that operators mitigate this condition by opening building doors to the outside. Although not addressed by facility procedures, facility management considers this action routine, as evidenced by interviews and directions documented in REDC Work Request # 7925. The work plan for this modification directed control room personnel to take necessary actions during installation to stay within the TSR limiting conditions of operation, including propping open building doors. ORNL personnel acknowledged that the "propped open door" configuration was an unanalyzed condition with respect to accident consequences. To prevent entering this configuration in the future, facility management issued a Shift Instruction stating, "If a situation should arise at Building 7920 where it's necessary to prop open any of the outside doors inside the Buffer Area in order to maintain the proper building differential pressures then we should suspend all hot cell and glovebox operations in Building 7920." The use of "should" categorizes this instruction as guidance rather than a requirement, and the use of a Shift Instruction does not ensure that this guidance will be a permanent change to plant operations. In addition, the contractor did not perform a USQD to address the existing practice of propping the doors open for operating or shutdown conditions.

Operators are generally knowledgeable of the ventilation system design, and rely on their knowledge and system familiarity to operate systems and respond to abnormal events. However, during simulated scenarios, operators did not demonstrate a working knowledge of the procedures for responding to alarms and abnormal events, and there were notable differences between shifts in operators' familiarity with system operation. None of the operators immediately referred to procedures for abnormal event response, and during the scenarios, all of the shifts missed responses called for in the abnormal event response procedure. Operators indicated that they did not trust the abnormal event response and alarm response procedures, and felt that the procedures could not help them in all situations. Differences in system familiarity and proficiency between shifts could be attributable to the current schedule of rotating ventilation equipment. Equipment in redundant ventilation trains is swapped on a two-week cycle, and the operator shift schedule is on a four-week cycle. Because of this schedule, two of the four shifts never see these evolutions.

APPENDIX B
CORE FUNCTIONS OF SAFETY MANAGEMENT

The effectiveness of implementation of the integrated safety management (ISM) core functions was evaluated through a sampling of ORNL work control processes. Work activities at ORNL are diverse and include construction, maintenance, engineering, operations, and research and development. A sampling of a several work control processes and work activities within the Plant and Equipment, Chemical Technology, and Metals and Ceramics Divisions was conducted to determine the effectiveness of implementation of the core functions within these divisions.

Maintenance work is performed throughout all ORNL Divisions by Plant and Equipment personnel according to various work control procedures. Research and development (R&D) work conducted within the Metals and Ceramics Division consist of short- and long-term metals and ceramic research projects of varying degrees of hazards, routine laboratory work (much of which is performed in fume hoods), research equipment maintenance and repair, and infrastructure support, including facility maintenance and renovations. Most work is conducted by resident researchers and supporting staff. However, external users also perform a routine amount of work and resident time within the facilities is typically a few days to a few weeks. Operations work at ORNL nuclear facilities is addressed in the site work control program descriptions, and procedures and authorization basis documents that are unique to each nuclear facility. Operational work activities in ORNL nuclear facilities reviewed (Buildings 7920, 7930, 3047, 3025E, and 3525) included radiological hot cell operations, hazardous chemical handling and operations, and nuclear facility process operations.

B.1 Core Function #1 - Define the Scope of Work

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

Maintenance and Construction. Maintenance, construction, and modification work at ORNL is generally well defined. Construction work, including project and subcontracted work, is well defined through project execution plans, project work plans, and contract specifications. For example, the contract specifications for the electrical upgrade and reservoir work were comprehensive and clearly defined work and safety requirements for subcontractors. Requirements for lower-tier construction subcontractors were equally detailed. For the subcontractor electrical upgrade work, the large tasks had adequate work breakdown structures that subdivided the major tasks into smaller, better-defined, and more manageable tasks. Specific work statements and requirements of the contract properly bounded the defined work.

Work, other than routine work, was adequately defined in maintenance job requests (MJRs) or equivalent division-specific work documents. For the work reviewed, the grading and prioritization of work were appropriate and considered both the importance of the equipment involved and the need for the work based on risk and mission.

The EH-2 team identified weaknesses in the processes for clearly identifying the work, associated equipment, and components; ensuring appropriate prioritization of new and backlog work; and verifying that proper boundaries are established for organizations and facilities, as discussed below.

The scope of low-risk "blanket" work activities for Plant and Equipment are not well defined, documented, and retained as part of the work control process. For Grade 4 work, blanket maintenance job requests are written to cover a variety of new and repetitive routine work activities in support of the various divisional operations and mission. Examples of such maintenance job requests include requests entitled "electrical support for high bay," and "pipe fitter support for high bay." Individual tasks performed under the blanket maintenance job requests are verbally given to craft workers and are, by procedure, not listed on a maintenance job request. The craft workers then fill out a formatted three-by-five card, called a "personal job hazard evaluation (JHE)," that lists the job scope, specific job hazards, the controls, and post-job feedback. The personal JHE cards are not maintained once the job is complete, so there is no history of the defined work. The concept behind the personal JHE for low-risk work is good. It empowers the craft workers to review the specific job, write down specific work hazards, and identify controls that should mitigate the hazards. However, the EH-2 team found inconsistent implementation of the personal JHE system. A review of about 500 personal JHE cards indicated numerous cases where the scope, work description, equipment specification, or locations were not adequately defined to determine the hazards and implement controls. For some work, such as "electrical support for high bay," the work was not adequately defined and could have been a higher risk grade, but was not identified for a management-level review. Acceptance of personal JHEs by craft workers was not universal, and management was not performing rigorous reviews that ensured the requirements were properly implemented.

A MEL or an equivalent list is not up-to-date and not used for all work to facilitate the definition of work and unique identification of equipment and components. However, the Plant and Equipment Division understands the importance of unique equipment and component identifiers in reducing error and uses the portions of the MEL that are available. Plant and Equipment proposed implementing the system sitewide several years ago, but it never came about, due to funding restraints. The list in use uniquely identifies most equipment that the Plant and Equipment Division is responsible for; however, other divisions, such as Chemical Technology and Metals and Ceramics, do not always use unique equipment nomenclature or identification numbers for all equipment on work documents. Inconsistent identification of equipment can cause errors and complicates tracking, trending, and maintaining equipment history; planning for similar work activities; and obtaining lessons-learned information. This is particularly important for safety-class and safety-significant TSR equipment. The life cycle asset management order, DOE Order 430.1A, requires, for operation and maintenance, identification, inventory, and a configuration management process for physical assets.

Although ORNL facilities are aging (many facilities over 50 years old), the maintenance backlog is minimal and is being artificially kept at a low level. The evaluation revealed that divisions and facilities were generally not preparing maintenance or modification requests for items they perceived would not be funded. Consequently, the backlog was not characteristic of the true condition of facilities as documented in facility condition assessment surveys. Review of condition assessment survey information for selected facilities indicated material condition deficiencies in safety-class, safety-significant, and non-safety systems, some of which could affect worker and facility safety. However, there are no site procedures for implementing or maintaining the condition assessment surveys up-to-date. The September 2000 Predictive Maintenance Proposal for REDC also indicates significant long-term deficiencies in numerous safety system in Buildings 7920 and 7930. DOE Order 430.1A requires periodic assessment of the condition of physical assets in the maintenance program. It further requires the management of backlogs associated with maintenance, repair, and capital improvements, and a method for prioritizing infrastructure requirements. The maintenance program provides the first level of grading, prioritization, and backlog generation upon which to base higher-level prioritization, such as the activity data sheets. ORNL has this backlog management capability in the maintenance work control system, but has not elected to use it to fully implement the requirements of DOE Order 430.1A.

Overall, maintenance work activities are generally well defined, but there are deficiencies in the clear definition of lower-risk work using the personal JHE cards. Deficiencies in identifying systems, equipment, and components on some work requests could contribute to performance errors in the field. Backlog management and the prioritization of maintenance backlog is not adequately addressed in the work control process.

Research and Development. Research work within the Metals and Ceramics Division is described through a variety of mechanisms, including formal and informal research proposals, technical papers and presentations, interoffice memoranda, New Work ESH&Q Review forms, and other informal mechanisms (e.g., staff meetings). However, there is no well-documented mechanism for defining work scope in the R&D work control process. Although the Metals and Ceramics ISM System Program Plan includes a work definition section, this section of the plan focuses more on divisional administrative functions (staff meetings, position descriptions, etc.) than on processes for defining research work. In lieu of a documented work control process, researchers, technologists, and the environment, safety, and health (ES&H) staff have relied on good communications (verbal and interoffice memoranda) to establish definitions of work for identifying and analyzing the associated hazards. Researchers are expected to contact ES&H when defining new work that has substantial hazards where they lack familiarity with the hazards and controls, or the regulations that govern those hazards. Because ES&H staff have a proactive presence in the field, they have identified work activities where their involvement is necessary and beneficial.

Substantial new work within the Metals and Ceramics Division requires the preparation of a New Work ESH&Q Review form. However, the work definition elements of the New Work ESH&Q Review process are inadequate in several aspects. For example, for a number of New Work ES&H Review forms, the work was not sufficiently defined on the form in order to identify the hazards. Additionally, there are no instructions for completing, reviewing, or approving the form. The Metals and Ceramics Division conducts a significant amount of research work that researchers consider to be similar to ongoing work, and therefore to be exempt from the New Work Review process. There is no documented guidance for defining what is "substantial" or "new" work. Furthermore, the New Work ESH&Q Review does not typically include setup and/or disassembly of research equipment in the work definition. As a result, hazards associated with these activities may not be identified, analyzed, or properly controlled. For a number of proposed new work activities, there are no defined processes or minimum thresholds for involving ES&H when defining the work. For example, although ES&H considerations may be discussed during the preparation of field work proposals, there are no documented thresholds for involving ES&H when defining the work, and records do not indicate ES&H involvement. The Metals and Ceramics ISM plan indicates that new work proposals "may" be reviewed by ESH&Q, but provides no ES&H review thresholds. Similarly, proposal documents (e.g., High Temperature Material laboratory, Shared Research Equipment User Program, and Metals Processing Laboratory User Center) do not address initial ES&H review requirements. Metals and Ceramics Division personnel stated that a proposal section containing ES&H requirements was eliminated at the request of SC in order to streamline the process by reducing paperwork.

Operations. In the facilities reviewed by the team, the operational activities (such as work performed by procedures and routine operator rounds to maintain the authorization basis) are generally well defined. Most day-to-day operations in nuclear facilities, such as Buildings 7920, 7930, 3047, 3025E, and 3525, are not unique and are within the authorization basis documents for those facilities. With some exceptions (see Appendix A), operations procedures have been established to cover many operations and have clearly defined work scopes.

One common activity for these facilities is the movement of highly radioactive material in and out of the hot cells by using specially designed casks and, when necessary, special hoisting and rigging procedures. Operations procedures were in place at these facilities for cask movement activities, and these procedures had clearly defined work scopes.

B.2 Core Function #2 - Analyze the Hazards

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

Institutional. The dominant hazards within Metals and Ceramics and Chemical Technology Divisions' facilities are identified, analyzed, and documented in authorization basis document for nuclear facilities and other hazards assessments for radiological and industrial facilities. Nuclear facilities have more comprehensive and formal hazards analysis documents, such as safety analysis reports (SARs). These documents generally provide adequate identification and analysis of the dominant hazards associated with operations, processes, and facility infrastructure maintenance and modifications.

Generally, hazards are being identified and analyzed for most work activities. However, weaknesses in implementation and fragmentation of the work control processes across many divisional and facility boundaries have resulted in some hazards being missed, as discussed below and in other sections of this report. There is a lack of rigor in documentation and an over-reliance on people-based systems, rather than formal systems, to analyze hazards and control some work. In some cases, common hazards are not well documented; it is assumed that the experienced workforce with good historical knowledge will ensure safety during work activities. While for the most part this may be true, exceptions increase the risk and could lead to injuries.

Some divisions use their work control processes/procedures to perform new installations and modification to facilities. Depending on the modification or installation, a readiness reviews may be required by DOE Order 425.1B, *Startup and Restart of Nuclear Facilities*. However, there are no clear linkages or triggers for readiness review considerations within the work planning and control processes for modifications performed under maintenance job requests.

Because modifications, maintenance, and R&D within nuclear facilities are controlled by a variety of work control processes and procedures in different facilities, the procedures address the USQ differently and sometimes incorrectly. This discrepancy leads to an inconsistent application of the USQ screening process for maintenance and some modification work. The Plant and Equipment work planning and control procedure does not require screening of all maintenance and modification activities for USQs. Therefore, it is assumed that if work activity affecting safety-class or safety-significant equipment were performed, the facility would be relied upon to recognize when a USQ screening should be performed as part of the planning process. The REDC USQ screening process in the job-planning checklist does not meet requirement of ORNL institutional procedure ORNL-FS-01 in that it uses a different set of screening questions. The Radiochemical Technology Section of the Chemical Technology Division work planning and control process for USQ screening is consistent with the institutional procedure and with the DOE order and guidance. For R&D work conducted in Metals and Ceramics division non-nuclear and nuclear facilities, there are no clear linkages or triggers in the research work control process for USQ considerations for new experiments. However, the New Work ESH&Q Review Process does ask whether there is an introduction of added radioisotopes or greater than 100 pounds of highly toxic materials to the facility, implying a potential for exceeding the facility authorization basis. All site work control processes should mandate consistent USQ screening of proposed activities, as required by DOE Order 5480.21, *Unreviewed Safety Questions*, and the site USQ procedure.

The sitewide JHE procedure contains weaknesses that could result in hazards not being identified and analyzed, and has promoted inconsistent implementation of the JHE process within the divisions and across the site. The following are examples of problems with the JHE procedure:

- The JHE program does not identify and mandate a set of requirements for implementation of a consistent sitewide JHE process that results in the identification and analysis of all hazards for all work.

- Alternatives to the JHE process, such as the Problem Safety Summary used in the Chemical Technology Division and the New Work ESH&Q Review used in the Metals and Ceramics Division, do not clearly meet the intent of the JHE program description. For example, the alternative methods do not include clearly written specific thresholds for ES&H or safety professional involvement based on the risk of the work activity.

- The JHE procedure allows divisions to implement division-specific JHE procedures rather than using a consistent sitewide process that is well known to all workers. This is particularly important because Plant and Equipment and ES&H personnel, radiological control technicians, and others may work or move from building to building.

- There are no instructions in the JHE program description or division-level procedures for completing some forms referenced in the procedure, such as the problem summary form and the proposed new work form. The procedure states that forms and checklists serve only as guides, indicating that they may be optional, and there is no requirement that an equivalent process be used.

- The procedure states that “it is intended” that front line workers will participate in the process. The ISM process *requires* worker involvement. The JHE process should indicate the level of worker involvement and the process for achieving that involvement.

- The Medical Department is not included in the review or approval of JHE forms. This is especially important in work, research, and experiments associated with humans or with pathogens or other hazards that could present medical-related risks.

The Operations Services and Support Division management and staff recognized that the JHE process had weaknesses. However, these deficiencies have existed for several years and should have been corrected as a part of ISM Phase I and II program development and implementation.

Maintenance and Construction. At REDC, the JHE and work packages identified most hazards associated with maintenance work. However, there are some exceptions. For some packages, there was a lack of rigor in fully identifying and analyzing hazards. The JHE for an April 2001 maintenance job request to refurbish the transfer area cubicle window identified no potential hazards other than manual and mechanical lifting, pinch points, and radiological exposures. Although the JHE is required to identify all hazards for the specific job activity, other documents in or referenced by the work package identified a number of hazards not identified in the JHE. A review of the manufacturer product information in the work package and material safety data sheet (MSDS) information identified several additional hazards. Although a number of potential exposure hazards were associated with the work activity, there was no review of or concurrence in the work package by an industrial hygienist. The standing radiological work permit (RWP) was not tailored to the radiological controls required. Although personnel were informed of the hazards during the pre-job briefing, the following hazards were not identified on the JHE as required by procedure:

- The potential for dielectric discharge during dry assembly (from the manufacturer bulletin)
- The potential lead hazard from removing and cleaning components
- Hazards associated with pressure testing the window after reinstallation
- Potential hazard from oxides used to polish the lead oxide glass.

In another REDC work activity, inadequate analysis of hazards at resulted in personnel clothes contamination. A May 30, 2001, radiological event report described a contamination event for an employee working in the Building 7920 air plenum housing. The report documented that the workers pants had been contaminated with alpha radiation. The pre-job survey detected only activity thought to be radon. Radiological control technicians performed the survey only by frisking; no swipes for removable contamination were taken and no RWP was issued for the work. Because the plenum serves general ventilation and laboratory hoods in Building 7920 and was at a point prior to exhaust air entering the HEPA filter bank, contamination was likely and should have been expected.

For ORNL Engineering Division subcontracted construction work, some hazards that could be encountered during work activities were not identified and analyzed in activity hazards analyses prepared by second- and third-tier subcontractors and reviewed by the ORNL subcontractor support organization. For example, the potential for silica dust exposure while removing concrete was not identified the electrical systems upgrade and Reservoir #1 upgrade jobs. Although wet sawing may have been invoked as a dust control measure, neither the hazard nor the control is documented. No baseline air monitoring was planned for this potential silica hazard, and there was no apparent review of lessons learned from similar silica exposures across the DOE complex. Additionally, the potential for lead exposure during removal of old, painted conduit was not identified or analyzed for the electrical systems upgrade. The work scope and the hazard identification and analysis documents did not indicate that lead-containing materials were considered, and were not present in the work activity.

Research and Development. Much of the hazard identification and analysis process for R&D work within the Metals and Ceramics Division is conducted informally, with considerable reliance on an experienced workforce knowledgeable of hazards in their workplaces, an involved ES&H team, and effective communications throughout the organization. Principal investigators, group leads, and research technologists identify and analyze hazards, usually with the assistance of members of the ES&H team dedicated to supporting the division. Most hazards appear to be identified and sufficiently analyzed, although the documentation might not exist to support some hazards analyses. Worker exposures to noise, chemicals, and non-ionizing radiation hazards are routinely analyzed, and records are maintained. Frequent exposure monitoring is encouraged, and those services are provided by the Operations Services and Support Division at no cost to the ORNL divisions. However, there are few formal hazard identification, screening, and analysis processes other than the Laboratory Safety Summary and the Proposed New Work ESH&Q Review, which are described in the following paragraphs.

A number of weaknesses were identified with the implementation of the Laboratory Safety Summaries, which are intended to list the hazards and controls associated with ongoing experiments within one or more laboratory rooms, and are posted on the laboratory doors. However, there is limited guidance for the preparation, approval, and use of the Laboratory Safety Summaries, and their use and maintenance is unclear and inconsistent. One principal investigator commented that the purpose of the Laboratory Safety Summaries was primarily for auditors, and not to aid researchers in hazard identification. When viewed collectively, the deficiencies in the Laboratory Safety Summaries indicate a number of fundamental concerns, and they have not always served as an effective tool for identifying or analyzing hazards or documenting hazard controls. Some Laboratory Safety Summaries did not identify all the hazards in their respective laboratories. For example, employees in Laboratory B54 use a considerable amount of bare lead as weights. The Laboratory Safety Summary for this area does not address the uses of lead or the associated hazards and controls. Another Laboratory Safety Summary indicated that there were no carcinogens in the lab. However, a container was located in the lab with the precaution “carcinogen” written on the container. A number of Laboratory Safety Summaries were not kept up to date, and did not reflect current laboratory conditions or hazards. The Metals and Ceramics Division Chemical Hygiene Plan for each laboratory within the division requires an up-to-date Laboratory Safety Summary. A similar concern about updating Laboratory Safety Summaries for the Chemical Technology Division was previously identified by ORNL during the ISM gap analyses, but the concern was not extended to other divisions. Several Laboratory Safety Summaries had handwritten additions and deletions of hazards and controls, with no indication of who performed the change and why. Since there are no instructions for approval or updating of Laboratory Safety Summaries, it is not clear whether they are approved for use even if some signatures are missing, or whether they should be reviewed again based on handwritten additions or deletions. Some Laboratory Safety Summaries were approved by group leaders who no longer had responsibility for those laboratories. Many Laboratory Safety Summaries attempted to address multiple hazards associated with a number of concurrent research activities within a laboratory, but were too generic or confusing to adequately aid the researcher in identifying specific hazards for an individual experiment.

The New Work ESH&Q Review serves as the hazard identification and analysis tool for new research work, in a similar fashion as the Laboratory Summaries for existing laboratory activities. For the Metals and Ceramics Division, the New Work ESH&Q Review is intended to fulfill the function of the JHE as required by ORNL JHE program description. However, the current New Work ESH&Q Review is also inadequately implemented. For example, there are no instructions, procedures, or guidance for the preparation, approval, and use of the New Work ESH&Q Review, and its use and maintenance are inconsistent throughout division facilities. Use of the New ESH&Q Work Review revealed several unique concerns. For example, the process is typically conducted at the beginning of a project, but the review is apparently not maintained, revised, or updated throughout the life of the project, even as hazards change. In some cases, as the work changes and new hazards are introduced, a New Work ESH&Q Review is not initiated, nor is the initial New Work ESH&Q Review form updated and revised. This results primarily from the lack of clear direction in the ORNL JHE program description concerning updating JHEs for changing work conditions. Likewise, there is no clear guidance for a graded approach to implementing the New Work ESH&Q Review based on the safety and health risk of the work activity. Another concern is that some line managers have not assumed responsibility for the New Work ESH&Q Review process. ES&H routinely prepares and retains these documents on behalf of some line managers. A number of group leaders and principal investigators did not have a copy of their New Work ESH&Q Review forms, nor could they retrieve a copy. In a few cases, ES&H was perceived to be responsible for “safety forms.” A related concern is that New Work ESH&Q Review forms and the supporting documentation are not easily retrievable, if at all. Several New Work ESH&Q Review forms were incomplete and did not contain all the signatures designated on the form, although the research work had commenced. Additionally, a concern identified in the previous section of this evaluation was that hazards associated with some R&D project setup and disassembly were not identified and analyzed through the New Work ESH&Q Review Process or any other formal hazard identification process.

Although both the Metals and Ceramics ISM Plan and Work Control Process Description stress the importance of a graded approach to hazard identification and analysis, existing documentation within the Metals and Ceramics Division does not describe how to implement such a graded approach for research work. The work control process does not distinguish between low, moderate, or high-risk activities, or have a mechanism to tailor R&D hazards analyses accordingly. Although “significant” hazards require a greater level of analysis, there is no definition of what is “significant.” There are no clear documented guidelines for a graded involvement of management or ES&H in the preparation, review, or approval of hazards analyses. Furthermore, since there is no lesser form of hazards analysis than the New Work ESH&Q Review Process (i.e., a job hazards analysis), there is no mechanism for identifying and documenting hazards associated with routine laboratory work activities other than the Laboratory Safety Summaries, which are generally ineffective.

Operations. As discussed under Guiding Principle #6, there were significant differences in the approved operations procedure review and approval process among the reviewed facilities. For example, one procedure applied to Buildings 3025E and 3525, another to Building 3047, and yet another to Buildings 7920 and 7930. The procedure review and approval process used for Building 7920 and 7930 was the least prescriptive regarding the new procedure review process. For example:

- The Building 7920 Chemical Makeup Area nitric acid mixing procedure allows sparging of the nitric acid solution outside the fume hood. This is not in accordance with the MSDS for nitric acid or the Chemical Technology Division chemical hygiene plan. (The sparging operation for a nitric acid solution was observed being performed outside a fume hood.)

- In Building 7920 Chemical Makeup Area, the chemical operating procedures do not require the use of goggles when handling hazardous liquid chemicals. The procedures states that operators are expected to use standard laboratory practices and precautions when handling chemicals. In addition, the training provided to operators did not include the use of chemical splash goggles. However, the training covered the use of face shields and safety glasses. The Chemical Technology Division Chemical Hygiene Plan (ORNL/CF-01/12) and Chemical Laboratory Safe Practices (ORNL Laboratory Standard Program Description (ORNL-SH-P13) Appendix A) require the use of goggles, rather than safety glasses, when handling certain liquid chemicals.

- The Building 7920 Chemical Makeup Area operating procedure for oxalate makeup of reagent solutions (HC-OP-0803-R02) is used when handling oxalic acid. The MSDS for oxalic acid indicates that the substance is toxic. No evaluation of operating procedure adequacy or operator performance, and no airborne sampling by industrial hygiene, have been conducted to determine the extent of the chemical hazards when using this chemical.

During facility walkdowns, the team identified several hazards that were not adequately analyzed by the current safety documentation:

- At Building 3525, a 9,900 pound capacity liquid nitrogen tank is installed outside the east wall and is piped into the building. The potential cryogenic hazards associated with the relatively large amount of liquid nitrogen are not addressed in facility operating procedures. General cryogenic hazards are addressed in the Metals and Ceramic Division laboratory hazards personal protective equipment training and chemical hygiene plan.

- At Building 3025E, a large number of solid lead bricks were stored in the attached Butler Building. The lead had formed some white oxide on exposed surfaces, creating a potential dust exposure hazard if disturbed. The ORNL lead program requires a JHE for workspaces containing lead. This has not been completed.

- At Building 7920, no USQ screen was conducted following the discovery of a release path for I-131 (diffusion of molecular iodine through the manipulator boot material) during normal operations for some target campaigns. The site maintained that this was not an accident scenario release, and that the contamination hazard evaluation in the hazards analysis bounds this discovery. The frequency of this type of release cited in the SAR is not bounded and therefore a screen should have been conducted. Routine air samples failed to detect I-131 releases into the control room at Building 7920, and hazards analyses conducted before September 2000 had not identified this potential.

- At Building 7920 in the Chemical Makeup Area a large quantity of nitric acid is stored. In the Drum Room there are several large containers (55-gallon drum size) of chemicals being used and stored. A documented review had not been completed for these chemical practices. The Chemical Technology Chemical Hygiene Plan is applicable to these spaces but has not been implemented for Building 7920 chemical processing activities. For the practices not covered by operations procedures, hazards analyses were not completed in accordance with the Chemical Hygiene Plan Problem Safety Summary, JHE, or other documentation.

B.3 Core Function #3 - Develop and Implement Hazard Controls

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

Institutional. Empowering workers to stop work when hazards are recognized is an integral element in the work control process and performing all work safely. All workers must understand their responsibility to stop work when told of an unsafe condition, and not restart work until the unsafe condition is corrected or resolved by supervisors or management.

Although workers interviewed understood their stop-work authority and responsibility, there are numerous weaknesses in the stop-work program that could result in the lack of notification to management of "imminent danger" situations, missed opportunities for lessons learned important to safe work, lack of documentation for near-miss situations, and failure to identify reportable events. The weaknesses include:

- The newly signed Oak Ridge Operations Office (ORO) *Stop Work/Suspend Work Responsibility* policy states that employees "should" report unsafe activities and "should" notify affected workers and the supervisor, rather than "shall." That, in effect, puts in place an approved management policy by DOE, all site contractors, and the union that reporting unsafe conditions is not mandatory, but optional.

- The stop-work procedure (Program Description) allows "imminent danger" situations that are immediately correctable to be addressed by normal supervisory procedures, potentially bypassing full notification, documentation, and consideration of near-miss and Occurrence Reporting and Processing System (ORPS) reporting requirements.

- For immediately correctable imminent-danger situations, the procedure gives the supervisor full responsibility for corrective action without any requirement for Division Safety Officer, ES&H, QA, or section or division manager verification. The supervisor in charge of the unsafe work may have a perceived or actual conflict of interest.

- The Division Safety Officer, Environmental Protection Officer, and Radiation Control Officer respond to formal "stop-work orders," but the procedure does not mandate a response to immediately correctable imminent dangers by ES&H or safety personnel. Therefore, details and facts associated with imminent danger situations may be lost.

- The procedure only refers to the ORPS procedure if the hazard has already caused an injury. ORPS reporting is required for near misses or violations of Occupational Safety and Health Administration (OSHA) regulations causing imminent danger situations, whether immediately correctable or not.

Maintainence and Construction. The Plant and Equipment Division performs most infrastructure, facility, and support work using both dedicated and deployed personnel. Although some work within nuclear facilities is performed under facility-specific work procedures, most Plant and Equipment work is performed under the Plant and Equipment work control procedure. While this procedure provides a sound basis for the work control program, there are several procedure and implementation weaknesses:

- The scope of the procedure does not clearly state when maintenance work requires the use of the Plant and Equipment work control procedure, or when divisional-level procedures are acceptable.

- The Plant and Equipment work control process and JHE program description do not require clearly documenting the defined scope of work for individual blanket work activities either on the blanket work MJR or the personal JHE cards. The supervisor verbally gives the job to the craft workers, who in turn document the scope of the job on the personal JHE card. Review of about 500 JHE cards for blanket work indicated varying levels of details and completeness, as discussed in Core Function #1 above.

- The personal JHE cards that indicate the blanket and dispatch work tasks are destroyed after the job is complete, leaving no record of the specific work task, the hazards involved, or the work completed. The procedure requires retention of JHEs for blanket work, but is not clear as to whether it applies to both formal and personal JHEs.

- The procedure does not clearly indicate the revision, field change, and approval process for the different types of work with graduated levels of revision approval based on the risk of the work activity.

- The procedure intermixes terminology for operations type work and maintenance type work. Day-to-day operations driven by approved procedures and shift routines should not be performed under a maintenance work procedure. The procedure requires a JHE for operations work, whereas the hazard identification, analysis, and controls should be built into the approved procedure; a JHE should thus be unnecessary. Programmed maintenance procedures may require a supplemental JHE depending on the location and the environment where they are performed.

- The procedure notes that a hard copy of the MJR "may be used" during execution of work rather than requiring that it must be used. A hard copy should always be used to ensure that craft workers select the correct equipment and location, and that they have the job scope (limitations and boundaries) and instructions at the job site.

- The procedure requires that all procedures relevant to blanket work be reviewed annually with craft workers. This is not being done because it is impossible to determine which procedures are relevant, because neither the individual work tasks completed nor the procedures used are documented.

A sampling of REDC work packages identified numerous failures to follow procedures and other administrative deficiencies in the development and completion of work packages and supporting documentation. Work packages on different dates for identical air compressor maintenance had different requirements for notifying the Building 7920 control room before lockout/tagout of the compressor and upon return to service. On numerous work packages, some hazards were not checked on the JHE but were present in the work activity, as evidenced by a lockout/tagout (lockout/tagout not checked) and RWP (radiation hazard not checked). These errors appeared to be caused by inattention when completing the JHE. Some boxes either were not checked or were wrongly checked in work packages. For tracking, trending, and machinery history considerations, the REDC work control procedure requires entering all completed work requests in a database. However, about 80 percent of the recent maintenance job requests have not been entered due to a staffing change, and the responsibility has not been reassigned.

Although most radiological work had appropriate controls, there is an overreliance on generic "standing" RWPs when job-specific RWPs should be used in accordance with ISM. For example, at REDC, RWP 8094 covers work described as "general and routine," and is used for about 90 percent of the day-to-day radiological work. The JHE for a specific work activity prescribed additional controls for adding radiation shielding and radiological control technician job coverage, which should have triggered development of a job-specific RWP. However, the work was performed without revising the standing RWP to add the additional controls. Therefore, the standing RWP did not address all radiological hazards and associated controls for the job.

ORNL does not have a work planners' guide for site or facility maintenance, which would aid work planners, promote consistency across several work control systems, and better support implementation of the facility management model and Standards Based Management System (SBMS). Plant and Equipment developed a work planners' guide with the implementation of DOE Order 4330.4B, *Maintenance Management*. However, because the maintenance order is not part of the work smart standards, the planners guide is out of date and not being used. Therefore, there is no single reference to assist planners in planning work packages that must meet a multitude of work control, radiation protection, environmental, facility, and OSHA requirements.

ORNL has institutional procedures to guide the acquisition and control of construction subcontractors on site. The contract specifications and referenced documents provide the requirement basis for most construction subcontractor work. However, controls for service subcontractors, vendors, technical representatives, and other outside organizations that perform work within facilities are not well specified in division work control procedures; these organizations and their work could affect the operation of the facility and equipment. Equipment vendors might perform work with some hazards and be working outside the established work control program and requirements. For example, copy machine technicians typically perform adjustments and maintenance on energized 240V AC machines and may be working "on or near" energized electrical equipment without the knowledge of the site or facility, the benefit of a JHE, or verification that they have received adequate training.

During review of electrical system and reservoir upgrade work, the EH-2 team identified deficiencies in development, implementation, and documentation of controls associated with second- and third-tier subcontracted construction work. During a discussion of job site hazards with the supervisor who was fulfilling the role of safety officer, it was apparent the supervisor lacked adequate training and knowledge to evaluate potential noise and heat stress exposures as required in the contract specifications and subcontractor's activity hazards analysis (AHA). OSHA Standard 29 CFR 1926.52 and associated measurement method (5 dB doubling rate) for noise were incorrectly applied to employee exposures and incorrectly stated in the AHA prepared by the subcontractor. The construction specifications for that job, and the work smart standards, require the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limiting value for noise and a more conservative measurement method using a 3 dB doubling rate. Monitoring for noise at this job site was not documented as indicated in the ACGIH threshold limiting value for a hearing conservation program. For heat stress, the supervisor was not aware of the ACGIH heat stress monitoring requirements (i.e., wet bulb globe thermometer measurement) and was incorrectly using a combination dry bulb thermometer and relative humidity measurement. The lockout/tagout language in the AHA is confusing and could cause misunderstanding about who is responsible for lockout/tagout. The AHA used boilerplate language and the term "Company" and "Contractor" rather than the specific name of the organization.

While controls for most job hazards are developed, there are significant deficiencies in the processes and implementation. These deficiencies have resulted in controls not being developed or implemented for some hazards. In several cases, the JHEs and work control packages have errors or omissions, indicating laxness in following procedures and implementing requirements. Because of the number of errors, controls may not always be appropriate for the hazards.

Research and Development. Requirements for non-nuclear research activities conducted within the Metals and Ceramics Division are identified in Appendix E of the contract and in the ORNL industrial safety work smart standards. Since this division's work control process is minimally documented, the process for rolling out institutional ES&H requirements into division research activities is not well defined, and some institutional ES&H requirements are not being adequately implemented by line management (e.g., the JHE process). Included in the work smart standards for this division are the ACGIH threshold limit values. However, these values have not been fully incorporated into exposure monitoring activities for noise and chemicals in Metals and Ceramics facilities and the division's chemical hygiene plan.

At the activity level, many hazard controls are identified, communicated, and implemented by researchers, technologists, group leaders, and the ES&H staff on an informal and collaborative basis. Controls appear to be adequate for the research activities observed by the EH-2 team, although the documentation and management of those controls are not well established. The primary mechanism for identification and documentation of hazard controls is either the New Work ESH&Q Review process or the Laboratory Safety Summaries, which are supplemented by personal protective equipment training. However, as indicated in the previous section, no procedures govern these processes, and documented controls are either inadequately defined as to their application and hazard, or not defined at all. For example, a number of Laboratory Safety Summaries define the hazard control as personal protective equipment, but fail to identify the acceptable type (rubber gloves, chemical apron, chemical face shield, etc.). Furthermore, since a number of chemicals are used for multiple research projects within a laboratory, it is not clear to which activity this requirement is directed. Several Laboratory Safety Summaries and ESH&Q Review Forms did not list any controls for the identified hazards. Few of these forms identified the required ES&H training for the hazards listed.

Overall, there is no formal, documented process for the identification and implementation of hazard controls for R&D work, since the Metals and Ceramics work control process for research work is not well defined or documented (see Safety Issue #2). The Metals and Ceramics Division work control process is fragmented. Elements of the process are described in a three-page policy statement ("Materials and Ceramics

Practices Concerning Control of Experimental Activities"), the division's ISM system program plan, the chemical hygiene plan, a work control memorandum, and ORNL procedures on work control and JHEs, as applicable. The extent of the applicability of ORNL work control policy (which has not been updated since the former contract) and the ORNL JHE to R&D activities is not clear. Collectively, these work control documents are not linked to work control process for R&D. Individually, these documents do not adequately describe a research work control process. For example, the division ISM system program plan is insufficient as a R&D work control description, in that the plan does not address types of work performed in the division or address research work processes. Both the Laboratory Safety Summaries and the New Work ES&H Reviews, which are the division's formal mechanism for implementing the ISM core functions, have a number of deficiencies (as detailed in the preceding paragraphs). Typical ISM work control elements, such as pre- and post-job reviews, work activity walkdowns, a graded approach to hazards analyses, and involvement of ES&H or line management or their R&D counterparts, have not been defined or incorporated into the division work control process. Furthermore, since these documents are not centrally stored, it is difficult to assemble the work documents (or "Work Package") for an ongoing R&D activity (work definition, hazards analysis and controls, training requirements, safety permits, work authorization, etc.). Some work documents are kept by a number of individuals, with some controls conveyed verbally or by interoffice memorandum.

There are a number of routine laboratory work activities performed by technologists and some researchers for which the work activity and associated hazards and controls are not recorded through the New Work ESH&Q Review process or in a Laboratory Safety Summary. For example, technologists routinely replace furnace filters with assistance from Plant and Equipment Division. This work activity has been analyzed by research technologists, with the assistance of ES&H. Potential hazards were identified (e.g., nuisance dust, lifting, electrical and slippery surfaces), and controls were established (e.g., dust masks, lockout/tagout, housekeeping, and Tyvek coveralls). However, there is no documented record of this work activity, the potential hazards, or the required controls. Although the Laboratory Safety Summary is intended for this purpose, it is often too generic to identify the controls for a specific work activity. This approach is typical of a number of routine laboratory work activities that involve potential hazards and required controls, yet there is no record of the activity or controls. Other examples include chemical mixing in fume hoods, withdrawal of extruded metals from furnaces, and pouring of liquid nitrogen at elevated heights. Furthermore, the Metals and Ceramics work control process does not clarify the type of work that would require a documented hazards analysis and controls, when work can be performed as "skill of the craft," or a definition of skill of the craft as it applies to research work. Many chemical operations within DOE and industry have process instructions for chemical handling, fume hood operations, and repetitive laboratory practices to ensure safety and consistency.

Hazard awareness training delivered by the ES&H staff to researchers, technologists, and external users was generally exceptional. For example, the Metals and Ceramics Division has developed special awareness training materials for hazards associated with advanced materials that are not provided by ORNL site training programs (e.g., hydrogen fluoride handling, nanofibers). The division has also developed and implemented comprehensive pollution prevention and ergonomics programs, as well as an ESH&Q orientation program for new workers. The High Temperature Materials laboratory user program has a process that assures that new users are sufficiently briefed on their facility responsibilities, as well as specific ES&H responsibilities and the locations of safety equipment. The Shared Research Equipment User program uses a similar process to ensure that new users are qualified to conduct work. The Metals Processing Laboratory User Center external user program does not have a formal process to assure that new users are aware of ES&H requirements and responsibilities; however, a principal investigator accompanies each user and performs tasks posing a hazard potential.

Requirements for procedure development and use are not well defined or communicated within the Metals and Ceramics Division. Some guidance for the use of standard operating procedures (SOPs) and guidelines (SOGs) was presented in a recent division staff meeting, but the guidance has not been formalized or integrated with other divisional or ORNL policies and instructions on procedures. Although a divisional QA standard was issued in 1995 concerning procedure requirements, the standard is not consistently used throughout the division. Several SOGs posted in the vicinity of research equipment consisted of only informal, unapproved rules-of-thumb. For example, a single page instruction for an x-ray diffraction unit in Laboratory L113, entitled "High Temperature X-Ray Diffraction Power-up/Power-down Procedure," contains four lines of instruction, two for power-up and two for power-down. There is a statement following the two power-up instructions that states, "the order of the power-up must be followed in that order, otherwise dire things will happen." However, the precaution does not precede the power-up instructions, nor does it indicate what "dire things" may happen.

A number of chemicals within the Metals and Ceramics facilities are not adequately controlled or consistently labeled. Although most of the laboratory chemicals are included in the ORNL Hazardous Material Inventory System (HMIS), some have not been kept current. For example, the chemical inventory for Building 4508, Laboratory 242 is not updated; the chemicals have been depleted, and the inventory lists some chemicals that are no longer in the area. Ordering and receipt of some chemicals bypasses the ORNL chemical procurement system, such as chemical samples provided directly by vendors to researchers. Furthermore, since chemicals are assigned to individuals and not areas, chemical control areas overlap, and it is often difficult to identify chemical ownership in any specific laboratory or room. The purpose of the chemical inventory system and the requirements for updating chemical inventories were unclear to some group leaders. However, all personnel acknowledged that it was easy to obtain a chemical listed on the inventory, but extremely difficult to have one removed. Chemical labeling requirements were also unclear to those interviewed by the EH-2 team. For example, the High Temperature Materials Laboratory briefing sheet for users indicates that the National Fire Protection Association (NFPA) "diamond" is the method used to label chemicals and communicate hazards. However, by ORNL procedure, chemicals with an original manufacturer's label are not required to display the NFPA diamond. In addition, guidance is also lacking for labeling containers as carcinogenic, acutely toxic, or a reproductive hazard.

Operations. At the institutional and facility levels, the requirements and controls necessary for safe, environmentally sound operations and the protection of the workers, the public, and the environment are specified in the ORNL SBMS, individual facility safety analyses, and operating procedures. Facility-specific authorization bases include the respective SARs and TSRs. In general, the EH-2 team found that facility supervisors, operators, and chemical technicians demonstrated thorough knowledge of facility systems. Facility operators were observed properly completing their round sheets to verify facility condition in Buildings 7920, 3047, 3525, and 3025E. Observations of control room activities, including shift turnover and authorization of activities in Buildings 7920 and 3525, were found to be satisfactory.

However, some areas of conduct of operations were found to need improvement. The major area needing improvement was procedure development and use. For example, the procedure validation process used at Building 3047 was deficient. The validation check sheet completed for the latest secondary containment test procedure revision specifically requires a review of equipment labeling. The test procedure contained several equipment labeling errors. The reviewer failed to note any labeling deficiencies on the validation form. Furthermore, the documentation to be provided following a validation is unclear. The procedure validation check sheet does not require the user to document what type of validation was performed (i.e., tabletop, field), and when a partial validation is performed it does not require a description of what parts of the procedure were validated. This information is needed in order to understand the thoroughness of the validation.

Problems in procedure verification and usage were observed at REDC. For example, in Building 7920, many operating procedures contain numerous redlines, crossouts, and major procedure step deletions and written additions. Good conduct of operations practices indicate that extensive handwritten changes make a procedure confusing and increase the potential for operator mistakes when performing operations. In addition, the REDC procedure on procedures, AP-1, "Policy and Procedure for Development, Writing, Review, Approval, Use and Document Control of Procedure," does not require ES&H staff review when chemical hazards are involved. This has resulted in poor procedures in the Chemical Makeup Area, as discussed under Core Function #2.

Also, problems were observed in the Instrumentation and Controls Division verification and validation process. In Building 7920, the J-Plug High Radiation Alarm Surveillance and Testing procedure contains an incorrect TSR setpoint. The J-plug area gamma radiation monitor and TSR alarm setpoint in the procedure is 150 mR/h. The correct TSR alarm setpoint is 100 mR/h. The procedure does not alert the operator to a TSR violation of the alarm setpoint if it is above 100 mR/h. A review of completed surveillance test data revealed no cases where the TSR limit was exceeded. In accordance with the Instrumentation and Controls Division procedure for procedure writing, the test procedure went through several validation reviews that identified and corrected many deficiencies. However, the checks required to complete a validation were not defined (e.g., verify equipment labeling, verify set points, and verify hazards). Problems were also identified with operators' knowledge and use of alarm and abnormal event response procedures (see Appendix A).

Numerous round sheet deficiencies were observed by the team. For example, the round sheet for Building 3047 was found to contain an administrative range for facility pressure gages that was misleading. The round sheet for Building 3025E was found to have deficiencies in the labeling for Cell #3 DP (the label was damaged and unreadable) and the continuous air monitor instruments (the labels were handwritten). Cell Filter DP reading specifications were stated as operable when a number (inches of water) would be appropriate. Many unlisted outside areas were inspected, but deficiencies found in the outside areas were not listed.

Several facility-level procedural requirements for REDC were not well defined. For example, the periodic review of operator aids in Building 7920 was not defined and had not been completed since 1999. The yearly training required by the Chemical Hygiene Plan on site-specific hazards is past due for a number of workers in Buildings 7920 and 7930.

Several deficiencies were noted in implementation of controls in the Chemical Makeup Room in Building 7920. Chemical technicians are permitted to work alone in the Chemical Makeup Room. The EH-2 team found this practice questionable, given the potential for a spill and the fact that the room is cluttered with equipment, valve and tank islands, and stored chemicals. A worker working would find it difficult to get to a safety shower or eyewash station (these are poorly located) in an emergency. The laboratory hood in the Chemical Makeup Room was past its inspection date (the hood was inspected following the team's observation). In addition, the size of the hood opening did not permit easy access when removing large graduated cylinders, thereby increasing the potential for a chemical spill. Many equipment, component, and valve labeling deficiencies were also identified in the Chemical Makeup Room. For example, poly tube jumpers used to make tank-to-tank connections are not clearly and uniquely labeled at both ends, potentially leading to chemical transfer errors. This was a contributing cause of a spill accident in 1994.

In Building 3025E, the MSDS binder in the Specimen Preparation Laboratory was out of date. This Laboratory does not have access to a computer to obtain current MSDS(s) to compensate for the outdated MSDS binder. The team observed an unlabeled drum of oil in the utility area, and paint that had been stored for many months in the Gamma Source Room. The housekeeping in 3025E Butler Building was very poor. Residual zinc bromide sludge is stored in the Butler Building; three drum liners were in poor condition, and several drums containing hazardous chemicals (zinc bromide and mineral oil) were unlabeled.

The team further observed radiological controls that were not tailored to the work being conducted. During the conduct of MET-IMET-SOP-19, Introduction/ removal of materials through cell roof port cells 1, 2, 3 and 6 at 3025E Irradiated Materials Examination & Testing Facility, the EH-2 team observed inappropriate radiological controls, personal protective equipment and extremity monitoring. Work was conducted under standing RWP 3025-8427, which was not tailored to the workplace hazards. Actual radiation levels emitted from samples were not consistent with anticipated conditions listed in the RWP. The RWP did not cite additional personal protective equipment, monitoring, or tooling for as-low-as-reasonably-achievable (ALARA) considerations (i.e., leaded vinyl gloves, extremity dosimetry, and/or long handle tooling was not included in the RWP). However, this practice was not in keeping with ALARA principles. The site conducted an evaluation following the team's observation and concluded that extremity monitoring was not required. Furthermore, the operating procedure or RWP had no guidelines or limits to prevent the practice. Additionally, it is unknown what previous sample activity levels may have been, and no true time-motion study during actual operations has been conducted.

In Building 3525, the team observed work conducted under the post-mortem examination of High Flux Isotope Reactor metal fuel experiment 10J in the hot cell procedure, DP-ETD-20977-10J. The procedure details the steps necessary to isolate various joints and assemblies and perform tests in an attempt to find the areas that failed during operation in the High Flux Isotope Reactor (HFIR) core. This procedure does not meet the procedure format and review requirements of Metals and Ceramics QA program documents (M&C QA-5 or QAP-X-MC-HC-01). The procedure does not have a signoff to indicate that it was reviewed to ensure that adequate precautions or concerns are defined and mitigated as required. The procedure omitted a "Responsibilities" section, where personal training and qualifications requirements would be addressed, and the required "Environmental, Safety, & Health Concerns" section, where appropriate ES&H precautions would normally be documented. The Metals and Ceramics Division New Work ES&Q Review for this activity did not provide controls for the hazards that were identified. The section of the form for further description of ES&H hazards and controls was left blank, as was the response to "Are all people involved with this work aware of the hazards and controls?"

B.4 Core Function #4 - Perform Work Within Controls

Readiness is confirmed and work is performed safely.

Maintenance and Construction. Observation of work and interviews indicated that ORNL workers are dedicated, experienced, and knowledgeable in their respective disciplines and are committed to doing work safely. ORNL benefits from an experienced and stable workforce. In addition:

- The REDC task leaders were very knowledgeable and experienced in REDC operations, systems, and equipment, facilitating the implementation of the work control program.
- The use of dedicated Plant and Equipment crews for selected facilities, especially some nuclear facilities, results in highly knowledgeable crews and effective support of facility operations.
- Plant and Equipment workers clearly understand their responsibilities for not affecting facility operations and systems, and have developed a good working relationship with facility operations personnel. The use of dedicated Plant and Equipment personnel working closely with facility personnel promotes close cooperation between program and support functions within facilities.

Plant and Equipment maintenance work in Building 5500 involving painting, patching holes, and replacing ceiling tiles was observed. The work had appropriate ES&H involvement (industrial hygiene) to sample the ceiling tile for asbestos, and the workers were properly trained and performed the work safely.

During the evaluation period, few maintenance activities were in progress at the selected facilities. Therefore, the sample of maintenance work activities observed was not sufficient to draw solid conclusions, even though most work observed was performed without incident. The number of programmatic weaknesses and implementation deficiencies in facility work control systems, however, places the site at some potential risk for missing hazards and controls that may affect safe work. For example, the team observed work at REDC in the Building 7930 North valve pit. According to the maintenance job request, this work was in an obstructed, non-permitted confined space requiring an RWP and personal protective equipment. Though a pre-job briefing was performed, the maintenance work request did not require a pre-briefing, even though the job involved several hazards. The REDC work control program allows jobs to be performed without pre-job briefings. Review of numerous work packages at REDC indicates that pre-job briefings were not required for many work activities where hazards are present.

Part of performing work safely is confirming readiness to perform work. Neither REDC nor B3047 uses formal, approved plan-of-the-day documents that show work that is authorized for the day. Both have plan-of-the-day meetings and talk about the work. REDC requires a shift supervisor work release signature unless the work is determined not to affect facility operations. The practice at B3047 is less formal. Work confirmation also includes ensuring that workers have proper training and that job-specific hazards have been communicated to them.

The EH-2 team observed construction work at two projects during the evaluation period. Tennessee Associate Electric, an ORNL subcontractor, was installing new electrical conduit in the Building 4509 Substation. Both the subcontractor supervisor and an ORNL field representative were present at the job site. The workers performed the work without incident. The second project observed was G&S Construction Company workers on the water reservoir #1 upgrade project installing a water main and replacing concrete supports for the pipe. The G&S supervisor and Engineering ORNL construction field representative were present at the job site. Workers again performed the work without incident. Review of the AHA, however, identified a number of deficiencies as discussed in Core Function 3.

Research and Development. For non-radiological facilities, there is no well-defined process for consistently authorizing and commencing the variety of research work performed within the Metals and Ceramics Division. For some research work, the approval of funding and the establishment of a budget constitute the only apparent authorization required to begin work. When funding is assured, the assumption is that work can commence. The division work control policy indicates that the proposed new work form "affirms operational approval by both ESH&Q and management," yet work that is not considered to be "new" does not require this process. The division ISM program plan indicates that the most basic work authorization document used by the division is the Laboratory Safety Summary. However, these summaries contain a number of inaccuracies and deficiencies as previously described, and routine laboratory work is not addressed in the Laboratory Safety Summaries. Typically, readiness to perform work can be confirmed and authorized in accordance with established procedures. However, research work is rarely performed in the division through established procedures. At the activity level, scheduling meetings (e.g., plan-of-the-day or -week meetings) typically provide another mechanism for planning and authorizing work and resolving resource conflicts. However, such meetings, or their research corollaries, have not been effective for scheduling short- or long-duration research work.

Work observed by the review team was performed in accordance with good industrial safety work practices, and the Metals and Ceramics Division has maintained a good safety record. Work appeared to be performed within established controls; however, since many controls are not sufficiently documented and most work is not performed with procedures, this ISM attribute could not be verified. Furthermore, the number of programmatic weaknesses and implementation deficiencies in research work control systems places the division at some potential risk for missing hazards and controls that might affect safe work. Pre-job (or pre-experimental) briefings typically provide a final check to ensure that hazards are controlled, conditions are safe, and people are aware of the hazards before starting work. However, there is no research corollary to the pre-job briefing within this division. In general, workers rely upon engineering controls (fume hoods), when necessary, and personal protective equipment that was commensurate with the hazard. The presence and involvement of principal investigators, group leaders, and ES&H in the laboratories were evident. During the performance of work, line managers actively monitored work progress and provided guidance and direction as needed.

Operations. Readiness to perform operations was, in general, adequately verified and authorized prior to starting a new operation. In particular, the shift turnover at Building 7920 and plan-of-the-day meetings at Buildings 3047, 3025E, and 3525 were effective in discussing, assigning, and verifying facility conditions prior to starting operational tasks to be performed for the day. However, in some of the facilities, the list of approved operational tasks was not formally documented and distributed to the workers and operators involved with the tasks, as recommended by the conduct of operations guidelines. In the facilities that operate only during the day shift, the operators satisfactorily completed their round sheets before the facility managers or supervisors authorized operations in the facility. The round sheets included readings verifying that facility conditions satisfied the authorization basis. Some of the observed operations were preceded by pre-job briefs. The observed briefs were thorough and presented by the appropriate supervisors. Workers and operators actively participated in the briefs, and asked insightful questions. The operators were well trained and knowledgeable about hot cell systems and equipment.

In many facilities, the team observed inconsistencies in the use of eye protection (safety glasses, side shields and goggles) as personal protective equipment when conducting work or operations. In some buildings (e.g., Building 7920), safety glasses and face shields were worn in lieu of chemical goggles as required by the chemical hygiene plan. Postings for safety glasses are unclear in other facilities (e.g., Building 3025E). The lack of an ORNL policy on the use of side shields with safety glasses has resulted in confusion on the appropriate eye protection in many cases.

One of the major aspects of performing operations within controls is to actively use procedures specifically written for the proposed operation. During the review in Chemical Technology Division Buildings 3047 and 7920, the operators used procedures, as required by facility requirements. In both facilities, improvement is needed in fulfilling the procedure usage requirements, as shown by the following examples:

- In Building 3047, operators closely followed the applicable procedures when they conducted the surveillance on the secondary containment system. The test went smoothly except that the facility announcement made at the start of the test was not received throughout the facility. The two operators staged in different locations did not report this anomaly to the operator controlling the procedure, who was located in the main hot cell control area. The procedure was continued without the facility announcement warning those present of the start of the secondary containment test.

- In the Chemical Makeup Room of Building 7920, the chemical technicians were observed following procedures to dilute nitric acid and to add this solution to a tank in the hot cells. However, when the technician performed the nitric acid dilution procedure (HC-OP-0701-R01), a note regarding chemical safety was not implemented. After the nitric acid is diluted with water, the procedure requires the mixture to be sparged. A note concerning the sparging states that all sparging vapors are to be directed to the hood. Because the container was too large for the hood, the sparging took place with the container on the floor below the hood. The technician did not take any action to direct the vapors to the hood and did not stop and request guidance from his supervisor on how to comply with the safety note. In this case, the note was not clear on how the operator would direct the vapors to the hood.

In Metal and Ceramics Division Buildings 3025E and 3525, procedure usage was less than adequate, as explained in the following examples:

- During the review, the operators in Building 3025E removed material from the cell roof port in accordance with procedure MET-IMET-SOP-19. Individuals performing the work did not refer to the procedure, although it was available in the field. The procedure contains a checklist that provides a signoff for each major step. Because the checklist was not utilized, activities were conducted out of sequence with the checklist, and some activities were missed. Key steps that were omitted included the performance of radiological contamination smears and dose readings of the area. If the radiological survey indicated high contamination for the area, decontamination efforts would have been performed. It was determined that the facility was not closely following procedure because of confusion regarding the facility and division policy on verbatim use of procedures.

- During the review at Building 3525, the operators received a nuclear material shipment. This activity is controlled by procedure MET-IFEL-OP-17 (Revision 2, dated December 15, 1995, last reviewed for accuracy in August 2000). The procedure was not utilized during the performance of the task. It was not available at the job site but was available in the facility. In addition, the procedure contained a list of employees designated as trained and authorized to perform the procedure. That portion of the procedure was last updated in December 1995. The radiological control technician who performed surveys during the receipt of the cask and tasked to perform job steps within the procedure was not identified in the procedure as being trained to the procedure. This technician did attend the pre-job brief, and the pre-job brief was not documented.

B.5 Core Function #5 - Provide Feedback and Continuous Improvement

Feedback information on the adequacy of controls is gathered, opportunities for improving the definition and planning of work are identified and implemented, line and independent oversight is conducted, and, if necessary, regulatory enforcement actions occur.

Feedback and improvement processes are evolving at ORNL as the Performance Based Management System (PBMS) is being developed and implemented as part of the laboratory's transition to SBMS. PBMS is intended to link the organizational vision, plans, and mission and business strategies to performance evaluation plans, assessments and oversight, evaluation of performance data, and implementation of lessons learned and performance improvement. The performance evaluation plans include some elements related to ES&H and provide the annual performance measures established by ORO and ORNL to provide the bases for performance fee determination. PBMS-related documents issued to date are mostly at the institutional level. Implementing procedures to provide process details at the directorate and division levels do not currently exist and have not yet been factored into project plans and schedules.

The phased implementation process for the PBMS programs and subject areas has resulted, and will result, in upper-level directives being issued before implementing procedures are issued. In some cases, this results in discontinuity in the flowdown of administrative requirements and thus procedural non-compliance at the operating level.

Assessment Programs. ORNL site documents clearly indicate that self-assessment is an essential element of ORNL safety management and improvement. Each ORNL division is required by ORNL-QA-P03, *ORNL Self-Assessment Program*, to establish a formal annual self-assessment plan and schedule. The quality of the FY 2001 ORNL division assessment plans varies, but generally the assessments are being performed as planned and scheduled and include a variety of self-assessment activities. In addition, the Quality Engineering and Inspection group performs required routine inspections of pressure vessels, fixed ladders, hoisting and rigging equipment, lifts and cranes, and many other site equipment items. ES&H subject matter experts from the Operations Support and Services Division conduct assessments, including radiation protection program reviews required by 10 CFR 835 and fire hazard assessments. A significant effort was made in the past year to evaluate the site's implementation of the chemical safety management program. This effort included self-assessments, an independent assessment by the Laboratory's Office of Independent Oversight, and an assessment by ORO.

A major element of the self-assessment program for ORNL's non-nuclear facilities is the operational awareness program – a joint effort involving UT-Battelle and ORO Oak Ridge National Laboratory Site Office. Teams of ES&H subject matter experts, often accompanied by division staff and management, conduct weekly facility ES&H inspections. Under this program, most non-nuclear facilities are inspected at intervals of 15 months or less. Deficiencies are documented, corrected immediately if possible, and communicated to facility management for tracking and correction.

Self-assessments performed in June 2000 of the implementation of ISM in the Plant and Equipment and Chemical Technology Divisions identified numerous gaps requiring correction. To close similar gaps in other divisions, division managers across ORNL are actively involved in the planning and execution of self-assessments. Divisions and/or directorates prepare annual summary self-evaluation reports, which are rolled up into a site level report for input to the performance evaluation plan fee determination process. Several positive initiative were noted in the Plant and Equipment Division, including the recent development of a self-assessment database called the self-assessment tracking system and managers performing documented, unscheduled observations of work activities.

The ORNL Office of Independent Oversight, formed when UT-Battelle assumed the contract in early calendar year 2000, has conducted approximately 12 independent assessments and special studies addressing areas such as the chemical safety management program, conduct of operations, the authorization basis process, offsite contractor oversight (in response to an event), and a review of operational awareness program observations. These assessments are generally well planned, documented, and thorough, and they identify numerous opportunities for improvement.

Although many assessments have been performed, weaknesses in the planning and performance of those assessments detract from their effectiveness:

- Divisions do not have a rigorous process for identifying areas that require evaluation or determining the frequency of assessments based on risk and facility-specific circumstances.

- Other than assessments based on external drivers or events, ES&H programs are not being evaluated on a planned and periodic basis, and there is little evaluation of work activities.

- Records indicate that more extensive program reviews were being performed in 1999 by the line divisions and the ES&H support division.

- While the facility condition inspections of the operational awareness program are effective in identifying and correcting safety concerns in the workplace, the program does provide comprehensive awareness of operations including assessments of work activities, personnel performance, or ES&H-related products or documentation.

- The PBMS has focused division self-assessment programs primarily on evaluating the specific and limited-scope elements of the performance evaluation plan rather than the broad range of ES&H program elements and ISM processes.

The approach taken to performing assessments and documenting results often lacks rigor:

- Procedures and assessment reports do not clearly define terms used to describe deficient conditions and performance or establish requirements and expectations for resolution. Unsatisfactory conditions or performance are variously and inconsistently described as weaknesses, opportunities for improvement, observations, recommendations, vulnerabilities; in some cases they are not given any specific identification. This lack of clarity was cited by a number of persons as causing problems in dispositioning issues.

- Self-assessment and ORNL Office of Independent Oversight reports typically do not specify any expectation or requirement for responsible parties to place issues and corrective actions into auditable tracking systems, and do not refer to the ORNL Laboratory Issue Database System.

- ORNL-QA-P03 does not clearly identify a requirement for tracking issues and corrective actions, and does not refer to the Laboratory Issue Database System or the ORNL issues management procedure. As a result, site tracking systems and formal closure processes for deficiencies are under utilized.

- Many division-level assessments lack rigor in documentation of scope, criteria, assignments, and results. For example, the self-assessment procedure in the Chemical Technology Division is out of date and reflects the previous contractor's program and procedures.

Management needs to develop controls to ensure that the continuing evolution to a purchased services model for ES&H expertise permits and encourages ES&H program owners to monitor, assess, and report on customer and ORNL performance in a forthright and rigorous manner.

Worker self-assessments in the form of post-job reviews mostly consist of informal and undocumented daily supervisors meetings with work crews. These meetings provide no documentation of any problems recurrence controls and little feedback to the worker on resolution of identified problems. Requirements for post-job reviews and resolving identified concerns are not well defined in the site work control policy, the ISM description, or divisional work control procedures.

Issues Management/Deficiency Tracking and Trending. Site procedure ORNL-QA-P04, *ORNL Issues Management Program*, describes the current ORNL system for processing and tracking events or conditions adverse or potentially adverse to safety, health, operations, quality, security, or the environment, or for improvement opportunities in the Laboratory Issue Database System. Although the Laboratory Issue Database System is used effectively for some issues related to ISM verification, the Price-Anderson Amendments Act, and ORPS, the system is used sporadically for most other issues. However, it applies only to issues from external assessments, internal independent assessments, Price-Anderson Amendments Act non-compliance, and occurrences. Managers are given the discretion to apply this process to self-assessment findings, but it is rarely used. ORNL divisions have a variety of internal computer-based and manual tracking mechanisms for self-identified issues, but division tracking is also sporadic. Numerous deficiencies in ORNL's issues management program adversely impact the continuous improvement in safety performance:

- Division procedures also do not provide sufficient detail on the expectations and minimum requirements for documenting, evaluating, and resolving internally identified issues. Site procedures and assessment reports do not adequately categorize the significance of performance deficiencies or distinguish between opportunities for improvement and deficiencies involving violations of regulations or procedures. These ambiguities hinder the consistent and effective evaluation and management of assessment findings. Division-level procedures and instructions do not exist, are not current, or are inadequate in addressing required actions.

- Many deficiencies resulting from both internal and external sources are not being properly and formally evaluated, documented, and resolved by line management. Risk/significance determinations are not routinely performed except for events and issues. Resolutions are often not documented, and there is little followup by issue originators. Findings from ORNL Office of Independent Oversight assessments and the October 2000 UT-Battelle Corporate Independent Assessment have not been entered and tracked in the Laboratory Issue Database System as required by procedure. Although many of these issues are sitewide or multi-divisional, procedures and reports do not clearly identify owners for these issues. The failure to formally capture deficiencies in tracking systems also hinders the ability to identify systemic deficiencies and adverse trends.

- There is little formal analysis or trending done for program and performance deficiencies to identify adverse trends and systemic issues, or to focus future assessment activities. The number of disparate systems makes it difficult to identify laboratory-wide or systemic deficiencies.

- A number of deficiencies were identified in recent ORNL corrective action plans and action closure processes. Corrective actions for two recent Price-Anderson Amendments Act non-compliances regarding work control and issues management failed to address all of the causes identified by the root cause analysis. In addition, the evidence file was inadequate, statements of completion of corrective actions were incorrect, and closure verifications for corrective actions in response to judgments of need from the November 2000 Type B investigation (fixed ladder injury) were insufficient.

- Many external and internal evaluations, including the ISM verifications, identified deficiencies in the ORNL issues management program, but corrective actions have not been effective and the deficiencies have been closed without adequate validation of effectiveness.

The site has an ongoing initiative to address issues management program deficiencies, but the draft plan and actions to date do not fully address the weaknesses noted above. The improvement initiative does not recognize or address fundamental program weaknesses, including the failure to follow issue management procedures, inadequate institutional and division-level procedures, and the lack of consistency and rigor in program implementation.

Lessons-Learned Program. The UT-Battelle lessons-learned program, although evolving, has a generally sound process in place. Institutional-level subject area descriptions and procedures have been recently issued. External event information is reviewed by the Laboratory Lessons-Learned Coordinator and subject matter experts as deemed necessary, and lessons learned are developed and distributed to division managers and staff. A comprehensive and useable web site provides ready access to lessons-learned documents and aids in preparing new lessons learned. DOE Alerts and certain high-risk lessons learned are disseminated with actions and required responses to the Laboratory Lessons-Learned Coordinator. However, a limited sample of lessons-learned documentation revealed that not all responsible parties had responded as required, nor were they held accountable for compliance.

Implementation weaknesses have limited the effectiveness of the lessons-learned program. The review and application of lessons-learned information by planners and training was poorly delineated in the former institutional procedure, and details on how the new lessons-learned process will be implemented have not been delineated in division-level procedures. Utilization of lessons-learned information by planners and training staff is inconsistent and typically undocumented. Few internal lessons learned are generated and shared with other ORNL organizations, although the lessons learned that have been developed are well written and comprehensive.

Subcontractor Oversight. The construction oversight procedure and individual project oversight plans for the electrical systems and reservoir upgrade jobs were not rigorously followed by the Engineering Division’s construction oversight organization. Procedure ENG-051 requires the Project Manager and the Subcontractor Support Group for Health & Safety to verify compliance with subcontract ES&H requirements and approving the subcontractor’s program. However, the subcontractor’s program had deficiencies in requirements and responsibilities for noise and heat stress, lead, and lockout/tagout (see Core Function #3).

Engineering Management’s subcontractor performance assessment, corrective action tracking, and feedback programs generally lack definition, written procedures, and formal methods for communication of deficiencies to the subcontractors. In addition, OSHA violations and other safety deficiencies described on the Subcontractor Support Group field observation report are not being properly identified as violations or deficiencies. Because the collective review of findings from these reports are the basis for subcontractor performance evaluations, failure to correctly identify deficiencies negates the benefits of the feedback mechanism.

Of the 15 oversight reports for the reservoir upgrade project, only one listed the deficiencies as findings or specified corrective actions. However, several of those reports identified OSHA 29 CFR 1926 violations that had potential to injure workers. The violations included no backup alarm on a road grader, improper ladder use, driving over electrical cords, improperly adjusted fall arrest system, and no fall arrest system when operating an aerial lift.

The oversight procedure does not adequately address the details of trending and tracking, extraction of lessons-learned information, use of the assessment form, communication of findings to the subcontractor, and closure of corrective actions. The field observation reports are discussed verbally with the subcontractor, but a written report is not generally provided. Generally, no lessons-learned reports from identified OSHA deficiencies are communicated to other subcontractors.

APPENDIX C
ISSUES FOR CORRECTIVE ACTION AND FOLLOW-UP

Line management is responsible for correcting deficiencies and addressing weaknesses identified by EH-2 reviews. Following each review, line management prepares a corrective action plan. EH-2 follows up on significant issues as part of a multifaceted follow-up program that involves follow-up reviews and tracking of individual issues.

This appendix summarizes the significant issues identified in this focused safety management evaluation of ORNL. The issues identified in Table C.1 will be formally tracked in accordance with the DOE Order 414.1A, *Quality Assurance*, which addresses follow-up of independent oversight findings. ORO and UT-Battelle need to specifically address these issues in the corrective action plan.

Table C-1. Issues Identified in the EH-2 Focused Safety Management Evaluation

IDENTIFIER	ISSUE STATEMENT	REFER TO SECTION
ORNL-FSME-01-01	Environment, safety, and health roles and responsibilities for line management within the research and development divisions are not adequately defined and understood as required by DOE Policy 450.4, Safety Management System.	2.2
ORNL-FSME-01-02	The Metals and Ceramics Division work planning and control processes for R&D activities are not well defined or documented. Additionally, there are weaknesses in sitewide procedures for identifying and analyzing hazards, stop-work policies, and work control processes for maintenance work.	2.6
ORNL-FSME-01-03	Numerous ORNL division-level procedures are not adequately developed and/or used to support effective implementation of ISM as required by DOE Policy 450.4.	2.6
ORNL-FSME-01-04	Configuration management at REDC is informal and ineffective, and it is not being implemented as required by 10 CFR 830.120 and the Building 7920 safety analysis report and technical safety requirements administrative controls.	2.6
ORNL-FSME-01-05	UT-Battelle's feedback and improvement processes are not adequately defined or implemented to effect consistent, continuous improvement as specified in DOE Policy 450.4, *Safety Management System Policy*, and DOE Policy 450.5, *Line Environment, Safety and Health Oversight.*	2.8
ORNL-FSME-01-06	ORO and its Oak Ridge National Laboratory Site Office have not established and implemented an effective and efficient oversight program as specified in DOE Policy 450.5, *Line Environment, Safety and Health Oversight*, and ORO Manual 220, *Oak Ridge Operations Appraisal Manual.*	3.0

APPENDIX D
EVALUATION PROCESS AND TEAM COMPOSITION

The evaluation was conducted according to formal protocols and procedures, including an Appraisal Process Guide, which provides the general procedures used by EH-2 for conducting inspections and reviews, and the Focused Integrated Safety Management Evaluation Plan, which outlines the scope and conduct of the evaluation process. The planning process considered previously identified weaknesses, current ORNL activities, and SC, ORO, and UT-Battelle management initiatives. The evaluation team collected data through interviews, document reviews, walkdowns, and observation of activities. Interviews were conducted with DOE Headquarters, ORO, and contractor managers, technical staff, hourly workers, and union representatives.

Team Composition

The team membership, composition, and responsibilities are as follows:

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Abbreviations Used in This Report (Cont'd)

HEPA	High Efficiency Particulate Air
HMIS	Hazardous Material Inventory System
HVAC	Heating, Ventilation, and Air Conditioning
ISM	Integrated Safety Management
JHE	Job Hazard Evaluation
LA	Laboratory Area
MEL	Master Equipment List
MJR	Maintenance Job Request
MSDS	Material Safety Data Sheet
NE	Office of Nuclear Energy, Science and Technology
NFPA	National Fire Protection Association
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations Office
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
OSO	ORO Oak Ridge National Laboratory Site Office
PBMS	Project Based Management System
PLC	Programmable Logic Controller
QA	Quality Assurance
R2A2	Roles, Responsibilities, Authorities, and Accountability
R&D	Research and Development
REDC	Radiochemical Engineering Development Center
RTS	Radiology Technology Section
RWP	Radiological Work Permit
SAR	Safety Analysis Report
SBMS	Standards Based Management System
SC	Office of Science
SC-10	Office of Basic Energy Sciences
SOG	Standard Operating Guideline
SOP	Standard Operating Procedure
S/RID	Standards/Requirements Identification Document
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question
USQD	Unreviewed Safety Question Determination
UT-Battelle	University of Tennessee - Battelle Memorial Institute
VOG	Vessel Off-Gas
w.g	Water Gage