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

Focused Review of the

River Protection Project

July 2001

OVERSIGHT

Table of Contents

Abbreviations Used in This Report

AJHA	Automated Job Hazards Analysis
ALARA	As Low As Reasonably Achievable
CHG	CH2M HILL Hanford Group, Inc.
DOE	U.S. Department of Energy
ES&H	Environment, Safety, and Health
EWP	Enhanced Work Planning
HEPA	High Efficiency Particulate Air
ISM	Integrated Safety Management
ORP	Office of River Protection
RL	Richland Operations Office

Executive Summary

EVALUATION:	Office of Environment, Safety and Health (ES&H) Oversight Focused Review
SITE:	River Protection Project
DATES:	April-July 2001

Scope

The Office of Environment, Safety and Health (ES&H) Oversight performed a focused review of the River Protection Project from April through July 2001. The review was initially scheduled at the request of the Assistant Secretary for Environmental Management in response to safety concerns raised by a former member of the Hanford Tank Advisory Panel Subcommittee on Safety and Health. The primary purpose of the review was to evaluate U.S. Department of Energy (DOE) and contractor line management implementation of integrated safety management in order to: (1) provide feedback to the site on the effectiveness of its implementation of the five core functions of integrated safety management, (2) evaluate the functionality of an essential safety system, and (3) follow up on a 1996 safety management evaluation conducted by the Office of ES&H Oversight.

The River Protection Project has two major functions. The first function is construction of a new tank waste remediation system, which will be constructed by Bechtel National. The second function, which is performed by CH2M HILL Hanford Group, Inc. (CHG), is storage and interim stabilization activities to remove liquid wastes from single-shell tanks, as well as to reduce such hazards as flammable hydrogen gas buildup. This review did not include construction activities associated with the waste remediation system. The major focus of the review was the adequacy of the Office of River Protection (ORP) and CHG implementation of the five core functions of integrated safety management. The review also included an essential system review of the Aging Waste Facility primary tank ventilation system to verify that safety-significant systems are functional. The overall evaluation focused on those site organizations directly responsible for the day-to-day operation of the 200 Area East and West Tank Farms: DOE line management, the CHG management team, and applicable subcontractors.

Background

Creation of the ORP approximately two years ago established clear line management responsibility for the nearly 54 million gallons of highly radioactive and toxic wastes stored in both single-shell and double-shell tanks. Of note was the recent removal of Tank 101-SY from the "watch list."[1] This tank was a significant concern for several years due to the buildup of hydrogen below the crust layer and periodic "burping" or release of hydrogen, presenting a significant potential for an internal explosion or deflagration. After a series of dilutions and removals from the tank, the River Protection Project is preparing to return the tank to service for staging waste transfers between East and West Tank Farms in support of future vitrification operations.

In June 2000, the DOE Richland Operations Office declared that integrated safety management was fully implemented at the River Protection Project. Subsequent comprehensive self-assessments conducted by both CHG and ORP identified a number of areas where integrated safety management programs and performance were deficient. Line management has initiated a significant effort to analyze the deficiencies and to develop and implement corrective actions. These actions include changes in the CHG organizational structure and in key ORP and CHG management personnel. New personnel in critical positions, such as the ORP Manager; the ORP Assistant Manager for Environment, Safety, Health, and Quality; the CHG Senior Vice President of Environment, Safety, Health, and Quality; and the

1 The "watch list" was created in response to Public Law 101-510, *Department of Defense Authorization Act, 1991*. This law "directs the Secretary to identify single-shell and double-shell waste tanks at the Hanford Reservation that may have a serious potential for release of high-level waste due to uncontrolled increases in temperature or pressure, to monitor such tanks, and to prepare a report on the safety actions taken with respect to such tanks."

CHG Director of Quality Assurance, have directed reevaluations of various integrated safety management processes and performance, and changes in certain roles and responsibilities.

Results

Despite recent changes and improvements, some significant deficiencies remain in implementation of integrated safety management at both the activity and facility level. Problems related to work control, conduct of operations, procedure development and use, operator training and qualification, engineering analysis, assessment and corrective action management, and ORP oversight of CHG operations were identified. In many cases, these problems resulted from a lack of rigor, particularly in analyses.

Work control systems and implementing processes for the five core functions of integrated safety management are not yet fully effective. Several cases were identified where hazards to the workers, such as noise, lifting and rigging, elevated work, and radiation hazards, were not adequately characterized and analyzed as part of the job hazards analysis and work planning processes. In other cases, controls identified in job hazards analyses were not clearly integrated in work instructions, resulting in failures to adequately implement controls at the working level. These problems relate to a lack of systematic mechanisms to ensure that hazards analyses are consistently tailored to specific jobs and that identified hazard controls are appropriately integrated into work packages and instructions.

Problems with personnel training, qualification, and proficiency also contribute to deficiencies in integrated safety management implementation. Line management does not always ensure that workers are adequately trained in specific job hazards and controls prior to performing work. Training requirements are not clearly identified in work documents. The large number of operators certified as watch standers for various tank farm operations, although beneficial in some areas, results in limited individual watch-standing time, affecting operator proficiency for safety-significant systems. No formal program for industrial hygiene technician qualification and continuing training has been in place since 1995.

Although the Aging Waste Facility primary tank ventilation system was capable of performing most of its safety-related functions, one essential function had been overridden for about two months—the interlock between the stack continuous air monitor and the primary ventilation fans. The interlock function is designed to detect a failure of the system's high efficiency particulate air filters and shut down the ventilation system on high stack activity to prevent unfiltered releases to the environment. In response to historical problems with continuous air monitor interlock reliability, CHG installed a high efficiency particulate air filter differential pressure instrument with the intention of replacing the continuous air monitor interlock. ORP approved a one-year demonstration of the differential pressure interlock with the condition that the continuous air monitor interlock remain operable. ORP was unaware that the continuous air monitor interlock was bypassed . Differences between ORP's expectations and written direction allowed CHG to operate with the interlock disabled, and CHG did not restore the continuous air monitor to service in a timely manner. Consequently, the system continued to operate in an inadequately analyzed condition. Following discussion with the review team, ORP issued an additional direction letter to the contractor on May 10, 2001, which clarified ORP's original intent and should correct the problem. Deficiencies in engineering analysis demonstrated a lack of rigor and a failure to adequately justify assumptions in certain analyses that suggested uncertainty about the conservatism of some controls.

The CHG self-assessment programs (i.e., management observation and the senior management oversight programs) provide for frequent, documented management interactions with the workforce and monitoring of the workplace and work activities. These and other feedback and improvement mechanisms are identifying and correcting performance deficiencies. While these processes have significant potential, they are not well defined, and performance has been inconsistent and not fully effective. Many identified program and performance deficiencies have not been properly categorized and captured by the corrective action management program or formally tracked to resolution. Corrective actions do not consistently or fully address root causes to prevent recurrence. The recent independent performance evaluation conducted by CHG was an aggressive, comprehensive, self-critical assessment and identified weaknesses similar to those identified in this focused review. CHG management intends to rigorously develop and implement effective corrective actions in response to these weaknesses.

ORP oversight of CHG has not been rigorous or fully effective. Facility Representatives' roles and responsibilities have been detailed in a set of formal procedures. Contractor performance monitoring by the Facility Representatives has identified, documented, and formally communicated program and performance deficiencies. However, ORP has not consistently held CHG accountable for systemic performance deficiencies. Oversight by other program personnel and subject matter experts has been limited and informal. ORP does not have formal systems for office directives, self-assessments, or tracking issues and commitments. Contractor ES&H performance deficiencies identified by ORP are not formally analyzed to identify precursors or adverse trends. The ORP Assistant Manager for Safety and Quality has recently increased and augmented personnel and has planned organizational changes that, if implemented, should remove organizational barriers between the Facility Representatives and subject matter experts. Significant management attention has recently focused on the development of procedures and processes for assessments, directives/procedures, and corrective action management.

Conclusions

Following Phase I and Phase II verification reviews and an ORP integrated safety management system assessment in May 2000, ORP and CHG declared integrated safety management fully implemented in June 2000. While the programmatic foundation may be in place, this Office of ES&H Oversight focused review, a December 2000 CHG assessment, and continuing occurrences indicate that weaknesses persist in the safety culture and the implementation of integrated safety management core functions. On May 17, 2001, the ORP Manager issued a letter of concern to the contractor based upon events and near-misses, flowdown of safety requirements, authorization basis issues and violations, quality issues, Facility Representative findings, Price-Anderson Amendments Act enforcement actions, self-assessment findings, and preliminary results from this focused review. In that letter, the ORP Manager stated that "The systematic programmatic weaknesses revealed through these events cut across programs such as work control, work planning, hazard identification and control, authorization basis, critiques, root cause, lessons learned, safety oversight, procedures, etc. We are concerned that there is not an effectively managed safety net to span the gap of risk while improvements can be made."

The Office of ES&H Oversight recognizes that safety culture change and the implementation of integrated safety management can take time and is a continuing process. Despite the CHG independent performance evaluation and improvement initiatives, such as the management observation and senior management oversight (senior supervisory watch) programs, many of the same weaknesses still exist. In establishing compensatory measures and long-term improvements in safety culture and integrated safety management implementation, ORP and CHG should consider reaching out to other DOE sites that have successfully overcome similar challenges in changing safety culture and implementing integrated safety management. Unique and innovative programs, such as behavioral safety (peer feedback), disciplined operations, work control and safety committees, and lessons-learned initiatives, have been very effective in driving safety culture change and the acceptance and implementation of integrated safety management. In the interim, ORP and CHG should take maximum advantage of such existing controls as systematic work planning and control, procedure use and adherence, senior management oversight, and safety and hazards analysis to identify and control the numerous hazards associated with tank farm operations.

OVERVIEW OF SAFETY ISSUES

1. The CHG work planning and control system does not ensure that all hazards are adequately identified and analyzed and that appropriate controls are tailored to the work performed as required by DOE Policy 450.4, *Safety Management System*.

2. Deficiencies in CHG procedure development and use are adversely impacting implementation of integrated safety management as required by DOE Policy 450.4, *Safety Management System*.

3. Inadequate rigor in CHG engineering analyses, calculations, and the unreviewed safety question process resulted in the reduction of safety margin or in unreviewed conditions contrary to DOE Order 5480.21, *Unreviewed Safety Questions*; DOE Order 5480.22, *Technical Safety Requirements*; and DOE Order 5480.23, *Safety Analysis Reports.*

4. Some CHG personnel are not trained and qualified to perform assigned responsibilities in hazardous environments, as required by DOE Policy 450.4, *Safety Management System*, increasing the risk of adverse exposures.

5. CHG feedback and improvement processes are not sufficiently established or implemented to effectively drive continuous improvement or prevent recurrence of ES&H program and performance deficiencies as required by DOE Policy 450.5, *Line Environment, Safety, and Health Oversight*.

6. ORP line management has not established and implemented management systems that ensure effective oversight of contractor safety programs and performance as required by DOE Policy 450.5, *Line Environment, Safety, and Health Oversight*.

1.0 Introduction

The U.S. Department of Energy (DOE) Office of Environment, Safety and Health (ES&H) Oversight, within the Office of Environment, Safety and Health, conducted a focused safety management review of the River Protection Project from April through July 2001. The major focus of the review was on the adequacy of the site's implementation of the five core functions of integrated safety management (ISM). A selected essential system important to the protection of workers, the public, and the environment was also examined in order to verify the application of the core function elements to systems important to safety. This focused review was conducted in response to a request from the Assistant Secretary for Environmental Management, who had concerns regarding the effectiveness of ES&H programs, and as a follow-up to the Office of ES&H Oversight's 1996 safety management evaluation.

The review included observations of work activities and operations, facility walk-throughs, interviews, document reviews, and examination of safety management program elements. The overall evaluation focused on those site organizations directly responsible for the day-to-day operation of the 200 Area East and West Tank Farms: Office of River Protection (ORP) line management, the CH2M HILL Hanford Group, Inc. (CHG) management team, and applicable subcontractors. Figure 1 provides a simplified version of the ORP and CHG organizational structures.

The Office of Environment, Safety and Health Oversight examined implementation of the five core functions and conducted an essential systems review.

Since 1944, highly radioactive waste from the chemical processing of irradiated reactor fuel has been stored in underground storage tanks and in capsules at the Hanford Site. Approximately 54 million gallons of caustic liquid, salt cake, and sludge are currently stored in 177 underground storage tanks in 18 tank farms and in 1,933 cesium and strontium capsules. The tanks and capsules represent about 60 percent (by volume) of the nation's radioactive waste and 80 percent (by radioactivity) of the Hanford Site's radioactive waste resulting from nuclear weapons development. The Hanford tank farms are one of two Defense Nuclear Facilities Safety Board 95-2 priority facilities at Hanford.

During the mid-1990s, management of the Hanford tank farms was included as part of the Tank Waste Remediation System program. In 1996, that program was incorporated into the scope of the Richland Operations Office (RL) and the Project Hanford Management Contract, which was managed and operated by Fluor Daniel Hanford, Inc. The Lockheed Martin Hanford Company served as the major Fluor Daniel Hanford Inc. subcontractor. In December 1998, the DOE established ORP as directed by the Congress in Section 3139 of the *Strom Thurmond National Defense Authorization Act for Fiscal Year 1999* to execute and manage the River Protection Project.

The mission of the River Protection Project, which encompasses all programmatic activities formerly conducted under the Tank Waste Remediation System program, is to store, retrieve, treat, and dispose of the highly radioactive Hanford Site waste in a safe, environmentally sound, and cost-effective manner. In support of this mission, ORP established two prime contractors that are responsible for executing the assigned project work scope – a tank farm contractor and a waste treatment contractor. In October 1999, Lockheed Martin Hanford Company was established as the prime tank farm contractor to ORP. In December 1999, CHG assumed the ORP prime contract following the sale of the Lockheed Martin Hanford Company to CHG. CHG is responsible for tank waste storage, waste retrieval, interim storage of high-level immobilized waste, disposal of low-activity waste, and waste feed delivery to the waste treatment contractor. Bechtel National is the waste treatment contractor responsible for design, construction, and commissioning of the Hanford Tank Waste Treatment and Immobilization Plant.

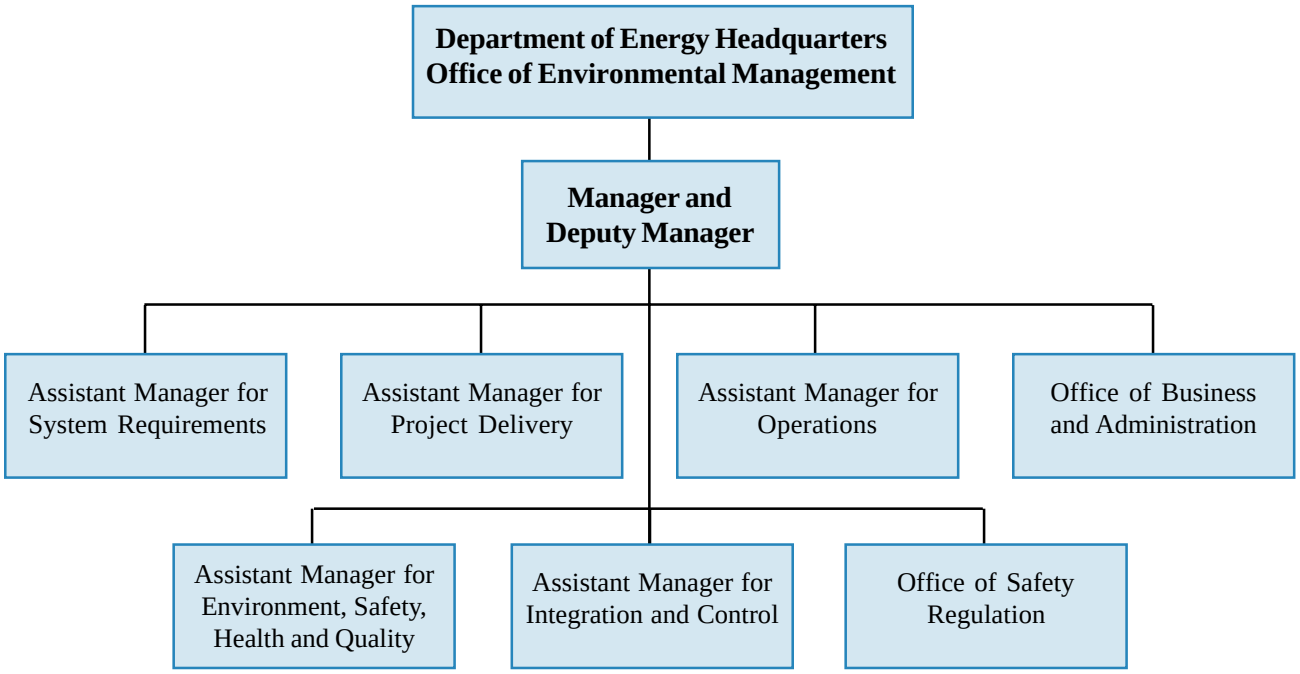


Figure 1. Simplified Organization Charts for ORP and CHG

OVERVIEW OF THE RIVER PROTECTION PROJECT

SITE: The River Protection Project, located at the Hanford Site, includes 149 single-shell and 28 double-shell tanks located in the 200 East and West Areas containing high-level radioactive wastes, and 1,933 cesium and strontium capsules located at the Waste Encapsulation Storage Facility. The overall effort will involve remediating 190 million curies contained in 54 million gallons of liquid in the tanks and 143 million curies contained in the capsules.

MISSION: Store, retrieve, treat, and dispose of the highly radioactive Hanford Site waste in a safe, environmentally sound, and cost-effective manner. Tank waste cleanup is essential for protecting the Columbia River, Columbia River communities, and the economic future of the region.

SITE MANAGEMENT: The Office of River Protection (ORP) is responsible for day-to-day oversight of River Protection Project activities. CH2M Hill Hanford Group (CHG) is responsible for tank waste storage, waste retrieval, interim storage of immobilized high-level waste, disposal of immobilized low-activity waste, and waste feed delivery to the River Protection Project waste treatment contractor. Bechtel National is responsible for design, construction, and commissioning of the Hanford Tank Waste Treatment and Immobilization Plant.

INTEGRATED SAFETY MANAGEMENT IMPLEMENTATION: DOE conducted an integrated safety management (ISM) Phase I verification of the Tank Waste Remediation System in October 1998. This review concluded that the Richland Operations Office (RL) should direct the contractor to proceed with ISM Phase II, and that comments from the Phase I review should be incorporated into the Phase II implementation plan. DOE conducted a Phase II review of the River Protection Project in August 1999 and concluded that the ISM system was implemented, with further enhancements needed in the areas of hazard controls and the feedback and improvement system. In June 2000, RL declared that ISM was fully implemented at the River Protection Project. In December 2000, both CHG and ORP conducted comprehensive self-assessments, which identified a number of areas where ISM programs and performance were deficient.

In addition to the major organizational changes in the formation of the ORP and the contractor transition from Lockheed Martin Hanford Company to CHG, there have been other recent significant changes in organization and key personnel. In August 2000, a new manager was assigned to the ORP. Also, in August and September 2000, CHG made additional changes in organizational roles and responsibilities, including transition to the Project Delivery System. CHG also appointed a new Senior Vice President for Environment, Safety, Health and Quality and a new Director of Quality Assurance. Additional personnel assignments and new responsibility designations for various management systems have occurred in recent months (e.g., ORP Assistant Manager for Environment, Safety, Health, and Quality). Programs affected by these changes include assessments, employee concerns, Price-Anderson Amendments Act, construction safety, and a realignment of the reporting requirements for the ES&H staff. These changes in management, personnel, and organizational responsibilities have prompted reevaluations of various ISM processes and performance and a number of performance improvement initiatives. Comprehensive self-assessments conducted by both CHG and ORP in December 2000 identified a number of areas where ISM programs and performance were deficient, and line management has initiated a significant effort to analyze these deficiencies and to develop and implement corrective actions.

The Office of ES&H Oversight has also conducted a number of assessments of Hanford Site tank farm activities (i.e., of the River Protection Project and its predecessor, the Tank Waste Remediation System), beginning with a 1996 safety management evaluation and including two other evaluations that involved River Protection Project operations. In May 1999, the Office of ES&H Oversight examined the site's radiation protection program as part of a complex-wide assessment of radiation protection programs. In December 2000, the Office of ES&H Oversight performed an inspection of the modification of Hanford tank farm ventilation controls. A summary of previous Office of ES&H Oversight evaluations is provided on the next page.

Section 2.0 of this report includes an assessment of line management's implementation of the five core

functions of ISM at the River Protection Project. Section 3.0 contains an assessment of the effectiveness of selected River Protection Project essential systems. Section 4.0 describes the Safety Issues identified from this focused review, which are summarized in Appendix A. In addition, Appendix A lists issues from the 1996 safety management evaluation and provides the Office of ES&H Oversight's comparison to the current issues. Further details on the evaluation process and team composition are provided in Appendix B.

Summary of Results of Previous ES&H Oversight Evaluations at the Hanford Site and the River Protection Project

Independent Oversight Evaluation of the ES&H Programs at the Hanford Site, April 1996. The purpose of this evaluation was to determine how well DOE and contractor line management had implemented safety management and ES&H programs at the Hanford Site (including the Tank Waste Remediation System – the predecessor of the River Protection Project). This evaluation concluded that safety management at the Hanford Site was in need of improvement in many areas. Initiatives under way within RL and its contractors had the potential for significantly improving ES&H performance, but would succeed only if increased management attention and presence were brought to bear to assure sitewide acceptance and sustained implementation. RL needed to be more engaged in the management and oversight of ES&H performance, and more involved in monitoring ES&H performance through onsite observations and more direct involvement in safety management. Both DOE and its contractors needed to be more aggressive in achieving disciplined operations and work controls, as well as ensuring consistent accountability for ES&H performance at every level of management, supervision, and staff. Increased management presence in the field by both RL and contractors was essential to achieving these objectives. In addition, more aggressive safety management should have been accompanied by improved self-assessment capabilities to facilitate early identification of problems and reduce the excessive reliance on external inspections and findings. Systems for prioritizing and implementing corrective actions needed improvement.

Independent Oversight Assessment of Radiation Protection Programs Within the Department of Energy, May 1999. This assessment was performed to determine whether radiation protection program requirements were being effectively implemented at DOE sites and whether DOE was providing effective direction and oversight to contractors that implement radiation protection programs. The Hanford Site was one of five sites evaluated; at the Hanford Site, the evaluation scope included the River Protection Project, C Reactor, and N-Basin. The Hanford Site summary indicated a number of positive attributes and improvement areas, as well as one issue. The issue indicated that neither Fluor Daniel Hanford nor the environmental restoration contractor was effectively managing all aspects of the radiation protection assessment program to ensure completion of the 10 CFR 835.102 requirements. Among the 11 positive attributes were: (1) radiation protection performance indicators were being effectively used; (2) both the prime contractor and the environmental restoration contractor had significantly increased the number of radiation protection staff with certifications/technical degrees; and (3) RL had significantly upgraded their overall radiation protection knowledge base with the addition of five Senior Radiological Control Technical Advisors. Among the 12 improvement areas were: (1) River Protection Project radiation protection managers and supervisors were spending only a small amount of time in the field; (2) the environmental restoration contractor did not have a system to formally track radiological deficiencies not meeting DOE Order 232.1 thresholds; and (3) conflicting information was noted related to area access, personal protective equipment, and limiting conditions on multiple tank farm characterization project radiation work permits.

Inspection Report on the Modification of Hanford Tank Farm Ventilation System Controls, December 2000. The purpose of this recent inspection was to evaluate a proposed design modification to the River Protection Project ventilation system that was intended to enhance the reliability and efficiency of the exhaust controls. The ES&H Oversight team identified two positive attributes in the approach taken by ORP and its contractor, CHG. Steps had been taken to improve the reliability of the continuous air monitor systems, such as upgrading to a newer model and using more reliable components. Additionally, a conservative approach was being taken by using both the differential pressure and the continuous air monitor systems for an initial one-year trial period. The team also determined that the analysis of the proposed modification was not sufficient to demonstrate that the modified system would promptly detect and mitigate a release of airborne radioactivity. The proposed design modification (i.e., the differential pressure control) provided only an indirect indicator of exhaust gas quality. It had not been demonstrated that the design changes would provide the same level of assurance as a continuous air monitor interlock, which provides a direct measure of air quality and radiation levels regardless of the failure mode of the high efficiency particulate air filter. Observations made during the review of the design and supporting analysis included: (1) the differential pressure sensor controls' ability to fulfill the safety function requirement had not been demonstrated under all credible accident conditions; (2) the technical basis for the differential pressure control set points had not been established; and (3) potential failure modes of the continuous air monitors had not been fully analyzed and addressed.

2.0 Evaluation of the Core Functions

DOE Policy 450.4, *Safety Management System*, defines the five core functions of ISM 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 2, to systematically integrate safety into the management of work practices at the institutional, facility, project, and activity level. This review focused on work being performed at the 200 East and 200 West Tank Farms, and the operation of the Aging Waste Facility primary tank ventilation system. A range of operational, maintenance, and construction activities were examined at these facilities. The following sections summarize the River Protection Project's performance in the five core functions.

2.1 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.

A well-defined scope of work is critical to the success of an ISM system. It is the foundation of the budget formulation and allocation process and sets the stage for the rigor and depth of work-related hazard identification and analysis.

The mission of the River Protection Project has been established to address the environmental challenges of Hanford's legacy waste in accordance with regulatory commitments. The River Protection Project Management Plan details the strategic, management, and technical

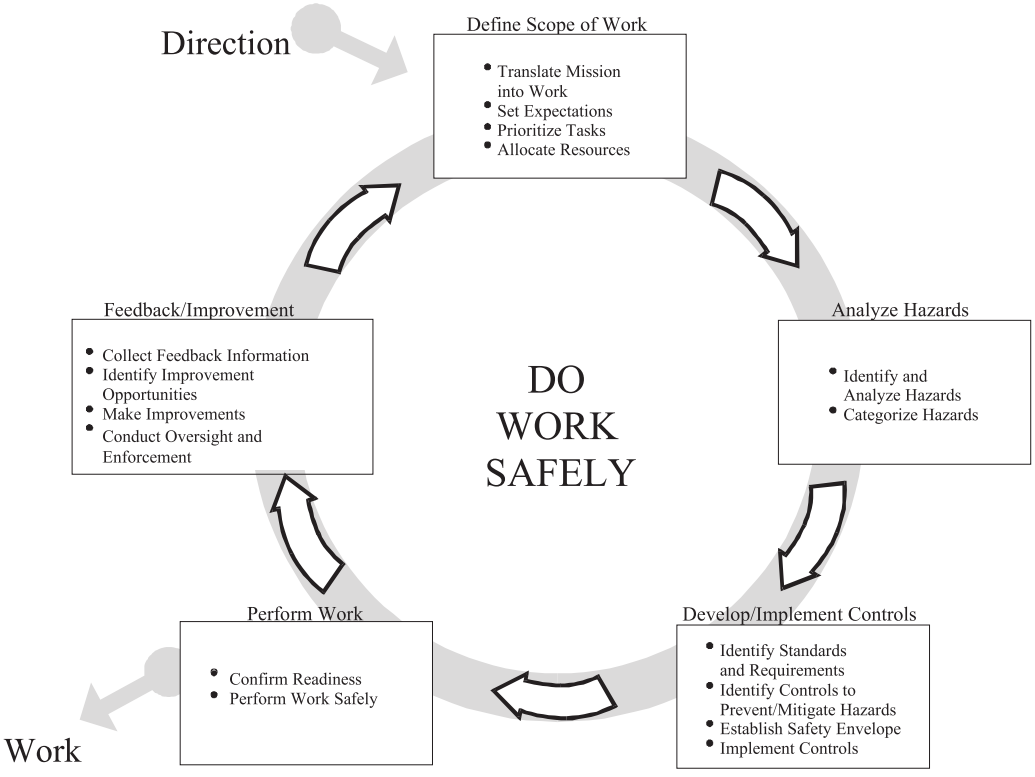


Figure 2. Core Functions of Integrated Safety Management

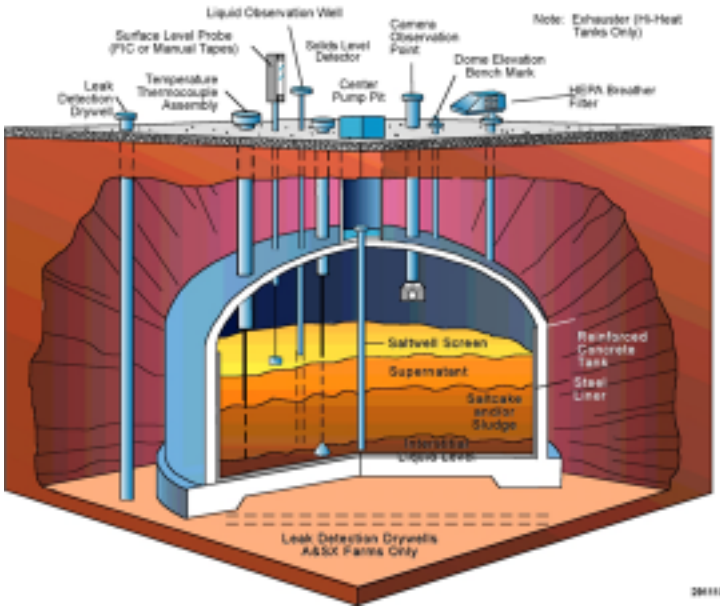
approaches that form the overall management strategy to address the mission, including cost considerations. It describes the work to be accomplished and defines how the complete scope of work is captured. The plan provides a work breakdown structure that divides work into manageable pieces with identified beginning and end points. The plan also provides top-level logistics and an overall schedule that reflects the best strategy for achieving short-term and long-term waste stabilization. For example, the plan describes interim stabilization of the old single-shell tanks by transferring the pumpable liquid waste to the newer double-shell tanks. The plan provides an acceptable macroscopic translation of the mission into work expectations and priorities.

Activity-level work at the tank farms is generally well defined.

Activity-level work at the tank farms is generally well defined. Work is characterized as one of three categories of planning (routine, planning required, and enhanced planning required) depending on the safety class of the system, operational requirements, the complexity of the activity, the frequency of the activity, and the hazards involved. With few exceptions, work packages and technical procedures are appropriately categorized for planning purposes and clearly define the scope, boundaries, prerequisites, and initial conditions for work activities. Routine operations and maintenance procedures have been established. The work scope does not change for many of the tank farm jobs, leading to a clear understanding of the work scope for those tasks. Work packages for maintenance and construction activities contain adequate descriptions of the scope of work to be performed, and planning tools such as the Waste Planning Checklist assist planners in further describing the scope of work. Most work scope documents provide the details necessary to define the required level of hazard analysis. For project work such as salt well pumping, project plans have evolved into procedures that specifically define the scope and location of work.

Workers are provided the opportunity to participate in work definition during the work planning process. For larger or unique jobs requiring enhanced planning, the enhanced work planning (EWP) process is used to plan the work. This process requires subject matter experts and worker participation on a planning team, which provides a mechanism for workers to provide input to the work package from its initial development.

Prioritization and scheduling of work by management are generally appropriate. Schedules are developed for both near-term and long-term work activities. Resource allocation and scheduling conflicts are resolved early during daily scheduling meetings, plan-of-the-week meetings, and monthly CHG-wide integrated schedule meetings. In some cases, priorities for work on safety systems are not appropriately assigned. For example, CHG has not placed a high priority on repair of the Aging Waste Facility primary tank ventilation system continuous air monitor interlock, a credited safety function. This may be partly due to ORP not clearly communicating their intent regarding the differential pressure. As a result, the interlock has been in bypass for about two months and has not been capable of performing its credited safety function. (See Section 3.0 for further details.)



Single-Shell Tank

Summary

A process is in place to properly prioritize and plan work. In general, project work scopes, work packages, system boundaries, and technical procedures adequately define and document the scope and specification of the work activities. With few exceptions, projects and work activities are effectively planned, prioritized, and scheduled. Although performance is generally effective, exceptions documented in the essential

systems review indicate the need for continued attention by management to ensure that the appropriate level of attention is placed on prioritization of safety-related system maintenance.

Rating: Green

2.2 Core Function #2 - Analyze the Hazards

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

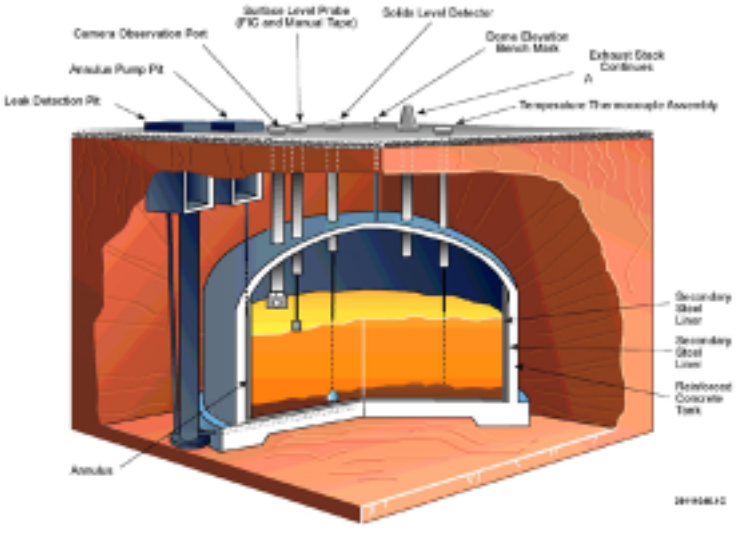
To conduct work safely, line management must ensure that structured processes exist and are implemented sitewide to identify and analyze work hazards consistent with the complexity of the work activity and the significance of the risks. The level of line management involvement in reviewing and approving hazards analyses should be commensurate with the complexity of the work and the hazards involved.

Hazard identification, analysis, and categorization processes at the tank farms are defined at the institutional level and implemented at the facility and activity level.

Hazard identification, analysis, and categorization processes at the tank farms are defined at the institutional level and implemented at the facility and activity level. At the facility level, hazards are identified and analyzed, and risks are classified through the hazard and accident analysis process, which in turn determines the type of formal safety analysis to be performed, the facility hazard classification, and the required hazard baseline documentation. For industrial facilities at the tank farms (e.g., shops, laboratories, and warehouses), a hazard baseline is completed. For nuclear facilities at the tank farms, the results of hazards analyses associated with facility construction, modification, operation, and decontamination and decommissioning are documented in the Tank Farms Final Safety Analysis Report. The review team assessed the adequacy of the nuclear facility hazard analysis process by performing an essential system review of the Aging Waste Facility primary tank ventilation system (see Section 3.0). Weaknesses in the hazards analyses performed on the Aging Waste Facility tanks were identified with respect to non-conservative assumptions in the tank structural analysis and analysis of scenarios involving high efficiency particulate air (HEPA) filter failure. Additional details about these weaknesses are provided in Section 3.0.

For specific work activities, line and safety personnel jointly review planned work, identify radioactive and chemical material inventories, identify potential hazards, and develop a facility safety baseline. Workers are made aware of these hazards through mechanisms defined in the Tank Farm Health and Safety Plan, administrative procedures (safety, environmental, and radiological procedures), and communications from line management. Hazards associated with maintenance, operations, and construction work are identified through employee job task analyses and the tank farms' work control system. The rigor or level of hazards analysis required is consistent with the level of work planning as described in Section 2.1.

To identify and analyze hazards at the activity level, CHG uses the computer-based automated job hazards analysis (AJHA) process. In many cases, broad classes of work activities are covered by a single or "standing" AJHA. Fluor Federal Services, the construction subcontractor to CHG, uses a separate job safety analysis to identify and analyze hazards associated with construction-related activities. The AJHA process has significant potential to aid planners and line managers in the identification and analysis of work hazards. However, in a number of cases, the AJHA process did not result in job-specific hazards that were clearly identified and linked to the work activity, or



Double-Shell Tank

communicated to workers. Similar concerns were identified in Fluor Federal Services job safety analyses. The December 2000 CHG independent performance evaluation also identified that in the work execution process, craft workers did not adequately recognize some hazards. CHG is evaluating mechanisms for improving the identification of job-specific hazards and their linkage to controls specified in work packages (e.g., computer-based work control systems), but none of these improvement mechanisms has been fully implemented. Although the CHG work control procedure requires workers to read AJHAs, some workers have not done so, particularly with standing AJHAs. Job-specific hazards are not clearly identified in work packages, and there is no requirement to document that standing AJHAs are read and understood. CHG management expectations, as described in the ISM System Description, the work control procedure, and the pre-job briefing procedure, are that job-specific hazards and controls identified in AJHAs will be communicated to workers through pre-job briefings. The pre-job briefing procedure, however, does not provide sufficient guidance in linking hazards and controls from the AJHA to the work activity, does not apply a graded approach to pre-job briefings, does not communicate training requirements, and does not verify that job-specific hazards and controls are understood by workers. Unlike the work planning process, which is tailored to the hazards, there is limited guidance in developing pre-job briefings consistent with the magnitude of the hazards. An independent baseline evaluation conducted by CHG in February 2001 also identified that improvement was needed in the pre-job briefing process (see Section 2.5).

The enhanced work planning process is effective for medium- and high-hazard work activities.

The EWP process is an effective hazard identification and analysis system for medium- and high-hazard work activities. The EWP process involves the input of multiple disciplines and workers in identifying and analyzing hazards. Most applicable job hazards were identified and analyzed in the EWP sessions and subsequent job walkdowns. For example, the EWP session for a work package to clean, prepare, and paint the AW-B valve pit was well attended by craft workers, subject matter experts, and work planners. CHG Environmental Services staff were typically well represented at EWP sessions, and ensured that planned work was meeting environmental compliance and waste management requirements.

The review team observed a number of radiological and industrial hazards that were not adequately identified, analyzed, or documented in an AJHA or job safety analysis. For example:

- CHG has not identified the potential for beta radiation doses to the lens of the eye for some work activities. This hazard was not included in the "as low as reasonably achievable" (ALARA) management worksheets, the radiation work permits, or the pre-job briefings for W-314 valve pit work. The Fluor Federal Services construction work package and job-specific job safety analysis did not identify this hazard.

- CHG Radiation Work Permit IS-329 Revision 001 erroneously identified in the data field "Radiation Emitted" that alpha, beta, and gamma were not a hazard (i.e., all boxes for "Alpha, Beta, Gamma and Neutron" were left unchecked). This contradicted information elsewhere in the radiation work permit, which indicated the potential for "MFP" (mixed fission products) and specified controls for alpha and beta/gamma activity.

- For ultrasonic testing of the 151 AZ Condensate Tank, the potential stored-energy hazard associated with the pressure wash (e.g., potential line whip hazard) was not adequately identified, analyzed, and documented in the work package or communicated to workers.

- Several potential unanalyzed noise hazards were identified. For example, a potential noise hazard (alarm bell) was observed during a continuous air monitor function test. Instrument technicians working in the vicinity of the continuous air monitor attempted to dampen the noise levels by covering the bell with their hands. Although the potential noise hazard was identified in the work package, it was not sufficiently analyzed by industrial hygiene personnel or discussed during the pre-job briefing. The work package did not require the use of hearing protection, and none was observed. In addition, noise hazards associated with operation of soil compactors during construction activities at the AZ tank farm have not been sufficiently analyzed or characterized. Workers operating the soil

compactors were not wearing hearing protection, although this operation could exceed the threshold limit value for noise.

- Fluor Federal Services has not identified, analyzed, or documented the ergonomic hazards of using extension tools and remote impact wrenches at the 241-AW-B Tank construction project.

Summary

Processes exist to identify, analyze, and document hazards, but the implementation of these processes is evolving and they are not mature. At the facility level, some analyses and supporting calculations, the results of which are documented in the Tank Farms Final Safety Analysis Report, provide an incorrect, incomplete, or non-conservative technical basis. At the work activity level, the work control systems implemented by both CHG and Fluor Federal Services, and the AJHA or job safety analysis processes, identify most potential hazards. The EWP process is an effective hazard identification and analysis tool that involves workers, planners, line management, and safety professionals. For some medium-hazard and most routine work, hazards specific to a current work activity are not clearly distinguished from a comprehensive list of all potential hazards typically documented in a standing AJHA. In addition, based on a limited sampling, the review team identified a number of hazards that were not sufficiently identified, analyzed, or documented, indicating that additional rigor is needed. Increased management attention is warranted to ensure that all hazards are appropriately identified and analyzed.

Rating: Yellow

2.3 Core Function #3 - Develop and Implement Hazard Controls

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

Hazard controls include engineering controls (e.g., buildings, enclosures, safety systems, ventilation systems, controls, and instrumentation), personal protective equipment (e.g., protective clothing and respirators), and administrative measures (e.g., limits, safety requirements embedded in procedures, warning signs, and training). The established levels of controls must be adequate to protect workers, the public, and the environment from all hazards associated with work activities.

CH2M HILL Hanford Group, Inc. (CHG) has programs that develop and implement hazard controls at the institutional, facility, and activity levels.

CHG has established and implemented programs for developing and implementing hazard controls at the institutional, facility, and activity levels. Standards and requirements for these programs are identified by CHG through the Tank Waste Remediation System standards/requirements identification document and approved by ORP. A sampling of health and safety requirements indicates that most requirements have been identified and incorporated into the standards/requirements identification document in a timely manner, with the exception of DOE Order 440.1, *Worker Safety and Health Protection*. Although DOE Order 440.1 was included in the DOE contract with CHG in 1999, incorporation of this Order into the standards/requirements identification document, and subsequent revisions to CHG safety and health programs and procedures and CHG subcontracts, is only now being processed. Revision of the standards/requirements identification document to incorporate changes in Federal

Tank Construction, 1984

regulations in a timely manner is required by Section 4.2 of the River Protection Project Authorization Agreement (CHG-5980, June 2000).

At the institutional and facility level, the requirements and controls necessary for safe, environmentally sound operations and for protection of the workers, the public, and the environment are specified in the authorization agreement. The authorization basis, which includes the final safety analysis report and technical safety requirements, is an integral element of the authorization agreement. The review team assessed the adequacy of controls described in the final safety analysis report by performing an essential system review of the Aging Waste Facility primary tank ventilation system. A number of concerns were identified in the development and implementation of controls for this system. These included ventilation system differential pressure set points that did not provide the same margin of safety previously provided by the continuous air monitor interlock, errors in valve and breaker control lineup sheets, and fire protection controls that were not implemented in accordance with the fire hazards analysis. Weaknesses were also identified in the unreviewed safety question screening process. Additional details about these concerns are provided in Section 3.0.

At the activity level, worker protection is provided through engineering, administrative, and personal protection controls and a procedure-based work control system. Controls for hazards are developed during the work planning process and incorporated into the governing work control documents (e.g., work procedures and permits, radiation work permits, and confined space permits). Although the work control system provides a mechanism for identifying hazard controls for construction, operations, and maintenance work activities, the review team identified a number of implementation deficiencies.

The work control process for construction, operations, and maintenance work activities is summarized in the ISM system description and described in Section 7.1, Volume V, and other sections of the HNF-IP-0842, *Hanford Administrative Procedures and Management Manual.* Additional guidance is included in the "production control desk instructions." These documents contain a number of weaknesses with respect to the preparation of work packages. For example, some terms and guidance that are fundamental to implementing the work control process (e.g., skill-of-the-craft) are not defined. Although a checklist is used for work release, this checklist has not been formalized in the work control process, and the review team observed some discrepancies in work control packages. For example, the work package for core sampling of the S112 Tank was issued with both incomplete and expired waste checklists. No CHG individual or organization is assigned responsibility for the work control program, leading to some confusion in the maintenance and revision of program documents. The CHG double-shell tank group has recently taken the lead for the site to assess the work control process and implement changes that should benefit the entire CHG organization.

Although controls are identified through the automated job hazards analysis process, controls are not always clearly translated into work documents.

Through the AJHA process, controls are identified for inclusion in work packages and work instructions. Those controls are not always clearly translated into work documents. For example, the review team observed that some controls identified in AJHAs for maintenance and operations work, and job safety analyses for construction projects, were not effectively integrated into work steps. The use of computer-based work control systems has had only limited success in tailoring controls identified in AJHAs to job-specific work activity. When creating a new AJHA, the use of archived AJHAs without appropriate review has resulted in the incorporation of some incorrect or outdated safety requirements. Furthermore, the AJHA procedure does not adequately define the use and limitations of the standing AJHA process and its application to non-routine work. Standing AJHAs are typically so generic that it is difficult to identify the hazards that apply to a specific work activity. As described in the previous section, CHG work control requirements have not been effective in ensuring that workers are familiar with job-specific controls identified in standing AJHAs.

The CHG process does not ensure that workers are adequately trained in job-specific hazards and controls before they perform work. Worker training requirements are not clearly identified in the AJHA or in work packages via work prerequisites or job steps. AJHAs that identify a training requirement often do not specify the method of training (i.e., briefing, on-the-job training, or formal classroom instruction) or reference a training course by name or course number. The

absence of such information has led to some confusion, expressed by line managers. CHG work planners are not required to list training requirements in work packages, and line managers seldom review worker-training requirements for applicability to specific job hazards. (An exception is the recent changes in some sitewide training programs, such as lockout and tagout.) Typically, training requirements are not addressed in pre-job briefings, and some workers had not received sufficient training for all potential job hazards (e.g., chemicals and scaffolding use). Some employee job task analyses do not identify all the training requirements for a specific work activity to which the employee has been assigned (e.g., heat stress training).

CHG radiological controls established for work packages across the various tank farms organizations are implemented through the CHG radiation work permit process. Radiation work permits are augmented by ALARA management worksheets and formal ALARA reviews where required. These mechanisms are supported by formal procedures and guidance documentation. A staff of radiological engineers, dedicated to work planning, has improved the quality and content of radiation work permits. These individuals support radiological work planning for each of their respective tank farms' project radiological control organizations. Although CHG has implemented comprehensive procedures and guidance for the conduct of radiological work, the application of this guidance and differing expectations have resulted in varying levels of worker adherence to good radiological conduct of operations principles. For example, workers were not informed of an administrative control included in an ALARA management worksheet for the radiation work permit covering a pressure test. The administrative control for low-dose waiting area(s) to be used for personnel not directly involved in all work activities was neither addressed in the pre-job briefing nor indicated by the on-scene radiological control technician. The reliance on radiological field instruments alone for measuring removable contamination levels on surfaces and equipment has also limited the ability of CHG to fully analyze and trend contamination buildup. Radiation survey reports record less-than-detectable values for alpha or beta contamination, based on the minimum sensitivity of the field instruments used to count the samples. Counting these same samples in a field laboratory would improve the detection sensitivity and allow trending of data that cannot be obtained by field instruments alone.

Several procedures and administrative controls were inadequately written or conflicted with other controls, resulting in permit violations or potentially unsafe practices.

Several procedures and administrative controls were inadequately written or conflicted with other administrative controls and procedures, resulting in permit violations or potentially unsafe practices. For example, during a small water tank fill at U-109 tank, the procedure required filling the tank by looking at the level or until the tank overflowed. The operators performed the procedure as written, and approximately one gallon of well water overflowed to the ground. According to the operators, the accepted practice is to verify that the tank is full by observing water running out of the overflow. This practice violates a State of Washington discharge permit. A previous permit violation occurred from overflowing the dilution water tank (a much larger quantity overflow), and a desk instruction had been issued to prevent this practice.

Inside a Tank in B Farm

The lessons learned from the earlier event were not applied to similar work activities. In another example, the Shift Office Command & Control Center maintains a current list of all tanks with industrial hygiene monitoring requirements for flammables and chemicals (i.e., the Tank Farm Air Monitoring Zone List). The list is used to establish personal protective equipment requirements for workers entering a work zone. This list contradicts similar requirements in the Health and Safety Plan, which has not been updated to reflect the new requirements and controls. In another example, roles and responsibilities for Shift Managers responding to a dust storm were not clearly stated in administrative procedures or standing orders.

In some cases, standing orders are used in lieu of approved procedures, which is not their intent as described in DOE Order 5480.19 and in the CHG conduct of operations manual. Using standing orders instead of procedures circumvents the procedure development, review, validation, and revision process. Eight of the standing orders that were issued in 1999 contain requirements and operational instructions that should have been incorporated into procedures. For example, Standing Order TWO-99-08, Control of Contaminated Vegetation and Soil Specks, describes the remediation actions to take for these circumstances, provides these actions in procedure format, and has been revised three times. There is nothing to indicate that these actions are temporary in nature, making this an inappropriate use of a standing order. An independent assessment conducted by the CHG Facility Evaluation Board in 1998 also identified that most standing orders at the tank farms were not being adequately incorporated into procedures. Similar standing orders issued in 2000 and 2001 should have been issued as procedures. The resulting corrective actions failed to address the root cause and prevent recurrence.

Summary

CHG and its construction contractor, Fluor Federal Services, have established and implemented procedures for developing and implementing hazard controls at the institutional, facility, and activity levels. Most standards and requirements for these programs are adequately identified through the standards/requirements identification document process. The Tank Farms Final Safety Analysis Report addresses facility-level controls. An evaluation of such controls for the Aging Waste Tanks identified a number of deficiencies in the prescribed controls. At the activity level, work control processes have been established for operations, maintenance, and construction work. These work control processes do not effectively tailor the hazard controls for job-specific work activities, consistently communicate those controls to workers, or ensure that workers are trained in job-specific hazards before performing work. The review team observed a number of radiological and industrial control practices and several procedures and administrative controls that were contrary to site procedures, permits, and DOE orders. CHG has recently recognized a number of these deficiencies and is implementing changes in programs and procedures. The effectiveness of those changes remains to be determined. Increased management attention is warranted to ensure that appropriate controls are identified and implemented.

Rating: Yellow

2.4 Core Function #4 - Perform Work Within Controls

Readiness is confirmed and work is performed safely.

Safely performing work is the culmination of well defined and properly analyzed work with appropriate controls and supervisory oversight commensurate with the risk of the work activities performed. A rigorous process is necessary to confirm adequate preparation and readiness to begin work prior to authorizing work at the facility, project, or activity level. The formality of the process, the extent of documentation, and the level of approval should be based on the hazards and complexity of the work.

Institutional processes for authorizing work are effective.

Institutional processes for authorizing work are effective. At the facility level, readiness to perform work is adequately confirmed and authorized in accordance with established procedures. At the activity level, meetings are scheduled the day before the work begins to ensure that support personnel are ready and coordination issues are resolved. The evening shift work-release operations engineers review the work packages for final work release for the next day. The plan-of-the-day meeting on the day that the work is planned to begin is conducted by the morning work-

release operations engineer and provides a final verification that no conflicts exist.

Pre-job briefings provide a final check to ensure that hazards are controlled before work begins. Briefings observed by the review team for medium- and high-hazard work were generally well prepared and presented by the appropriate supervisors. For briefings involving larger numbers of people, audiovisual aids were used to ensure that information was clearly communicated. Workers actively participated in the briefings and asked pertinent questions. The effectiveness of pre-job briefings was sometimes limited by deficiencies in the pre-job briefing procedure (described in Section 2.3). For example, in observed pre-job briefings, the current training status of the workers for job-specific hazards was not verified as required.

Workers in Pit, January 2000

Operations activities were generally performed in accordance with applicable procedures, and construction and maintenance work was generally performed in accordance with the work instructions contained in the work package. Most workers adhered to the required controls, such as personal protective equipment and radiological barriers, established in the radiation work permit. Field supervisor presence and involvement at the work locations were evident. The field work supervisors ensured that applicable controls were in place and approvals were obtained. During the performance of work, supervisors actively monitored job progress to ensure conformance with the procedures and work packages and provided guidance and direction as needed.

Procedure use and compliance problems have been repeatedly identified by the Office of River Protection (ORP), the contractor, and previous Office of Environment, Safety and Health reviews.

Although much of the observed work was performed safely, procedure use and compliance problems have been repeatedly identified by ORP, the contractor, and previous Office of Environment, Safety and Health reviews. Some workers demonstrated poor practices and a lack of safety awareness around cranes and suspended loads. For example, workers were observed walking under a suspended load, walking under attached crane hooks and lifting rigs, and working under a crane boom with a load attached when other work areas were available. In one case, a scaffold ladder for routine access had been erected in a location directly under the routine path of a crane. Other unsafe practices were also observed. Heavy equipment (front-end loader) operations in close confines went unnoticed by workers walking near the equipment in the AY tank farm area. No spotter for the front-end loader was evident. An individual was observed leaning over the railing while positioning a suspended load from above, risking a potential fall from greater than six feet without the benefit of a safety harness. Some industrial hazard controls were also not implemented as required by work control documentation, procedures, or area postings. For example, a precaution in the procedure for operation of the S-242 Evaporator Air System requires operators to wear hearing protection in the vicinity of operating air compressors, but they did not.

Several deficiencies in conduct of operations and instances of failure to follow procedures were also apparent. At the Aging Waste Facility Monitoring & Control Station, operators had difficulty locating and using alarm response procedures, emergency procedures, and the ventilation system startup/cold start procedure. (See Section 3.0 for further details.) Status boards in both the Command & Control Center and the Aging Waste Facility Monitoring & Control Station were not kept up to date. Waste planning checklists had not been completed for some work packages as required by procedure.

Although CHG has comprehensive implementing procedures and guidance for the conduct of radiological

work, in some cases the application of this guidance by radiological control technicians and workers is deficient. Workers were observed performing exit monitoring with scan rates exceeding detection efficiency requirements. Radiological control technicians did not perform the analysis of large area wipes (field counts) in accordance with procedure. Recent radiological problem reports and management observation program reports identified improper boundary control practices, such as failure to follow postings or maintain contamination control. Workers were not informed of an administrative control included in an ALARA management worksheet for the radiation work permit for a pressure test job. The administrative control of low-dose waiting area(s) to be used for personnel not directly involved in all work activities was neither addressed in the pre-job briefing nor indicated as necessary by the on-scene radiological control technician. A worker was observed conducting hands-on work without the personal protective equipment required by the radiation work permit. The work package provided for a riser to be controlled as a small localized "Contamination Area" under the immediate control of the radiological control technician during the conduct of work. The lack of specificity in establishing the controlled area may have contributed to this deviation.

Several deficiencies in work performance reflected deficiencies in training and qualification programs.

Several deficiencies in work performance, such as the operator difficulties at the Aging Waste Facility Monitoring & Control Station, reflected deficiencies in training and qualification programs. The operators indicated that the current two days of classroom training was not sufficient to give them a high degree of confidence in performing these various procedures. Although large emergency drills are performed under the direction of the Shift Manager, a minimal number of smaller drills are conducted with operators in the Monitoring & Control Station control room. In addition, the large number of watch standers with multiple certifications results in limited watch-standing time. The minimum proficiency requirement of one shift per quarter does not ensure the proficiency necessary for operation of a safety system.

Industrial hygiene technicians were not fully cognizant of their responsibilities, the characteristics of the measured chemicals, and the operational characteristics of the their test instruments. CHG has not implemented a formal program for industrial hygiene technician qualification and continuing training. This program is required by 10 CFR 830.120, *Personnel Training and Qualification,* and DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*. CHG training also has not sufficiently addressed responsibilities for industrial hygiene technicians identified in the CHG *Safety and Health Program Description* (HNF-IP-0842, IX, Safety 1.1, Revision 3, April 21, 2000). As a result of this program deficiency, some of the approximately 20 industrial hygiene technicians lack knowledge and awareness of fundamental industrial hygiene principles and practices. For example, an industrial hygiene technician was unaware of the purpose of the response factors and calibration associated with an organic-vapor monitoring instrument. Another technician lacked the knowledge of basic material safety data sheet information on chemical products used and primary chemical constituents involved in monitoring confined-space painting operations. In response to the review team discussing this issue with management, CHG issued a new procedure on May 7, 2001 (*IH Technician Qualification Program Description*, HNF-IP-0842, III Training 10.15, Revision 0), which more clearly defines qualification expectations of industrial hygiene technicians.

Summary

While much of the work observed was authorized and performed using proper work practices and in accordance with the hazard controls contained in permits, work packages, and technical procedures, examples of unsafe practices, inadequate implementation of controls, and failure to follow procedures were evident in several disciplines. Some deficiencies resulted from inadequate training, although many were the result of a lack of rigor and attention to detail. These types of deficiencies adversely affect ISM implementation and could lead to undesired safety consequences. Increased management attention is warranted to ensure that work is safely performed within the established controls.

Rating: Yellow

2.5 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.

Continuous improvement in safety performance requires that line management establish formal mechanisms and processes for identifying, documenting, and evaluating ES&H-related deficiencies and for developing and implementing effective corrective actions to prevent recurrence. Feedback and improvement information can be captured, analyzed, and disseminated in many ways, but the participation and commitment of both the workforce and management are essential to continuous improvement. Lessons learned must be communicated and applied to future work activities, and corrective actions must be tracked and periodically verified as effective. Measures of safety performance need to be established, and line management must routinely monitor the implementation of feedback and improvement processes.

CHG Assessment Program

CHG has established processes for conducting management and independent assessments. Project and support organization managers direct and conduct self-assessments. Self-assessments are performed in functional areas, with routine, planned program and implementation assessments in the areas of radiological control, maintenance, operations, and environmental management. Assessment planning and performance in other safety and health areas, such as industrial safety, industrial hygiene, and construction safety, have been less structured. Tank farm managers also conduct numerous surveillances and limited-scope assessments each month through the senior management oversight program and the management observation program. These programs are effective in promoting personal interactions with workers and focusing management on direct observation of field conditions and work performance. All managers are expected to conduct multiple assessments each month and document their observations on a checklist. Managers' observations are summarized and tabulated in monthly reports. Some of the deficient conditions or performances are placed in the formal action tracking system, where they are screened for significance, assigned a causal code and a responsible owner, and tracked to resolution. Other unsatisfactory conditions, deemed less significant, are settled informally, and corrective actions are typically not documented or tracked to closure. Other assessment processes include standards/requirements identification document implementation assessments, radiological problem reports, periodic multi-functional team inspections, and construction safety inspections.

CHG has established processes for conducting management and independent assessments.

While these various assessment processes have identified ES&H and quality deficiencies resulting in corrective actions, weaknesses in the processes and in implementation have limited the program's effectiveness:

- The expectations, requirements, and processes for some assessment elements, including the management observation program (which comprises much of the management assessment effort at the tank farms, and in the facility evaluation program) are not delineated in implementing procedures.

- Implementation weaknesses in the areas of assessments and corrective action management indicate a need for more rigorous training for managers and supervisors. Training on these processes is not required as part of individual training matrixes. Although some training in these areas has been conducted, not all managers and supervisors participated, and much of the corrective action management system training was conducted almost two years ago. Instruction in assessment techniques could benefit managers participating in the management observation program.

- Other assessment procedures, such as those for radiological assessments and the senior management oversight program, do not provide linkage to or direct the use of the site's corrective action management program to process identified deficiencies.

- Implementation assessments for standards/ requirements identification documents are

Corrective Action Plan Meeting

conducted periodically for each requirement in the document. These assessments resulted in conclusions that were in direct conflict with other assessments. Specifically, numerous assessments conducted in 1999 and 2000 incorrectly concluded that all of the more than 1,200 requirements that are applicable to the tank farms in 20 functional areas were being implemented as required. During the same timeframe, other CHG and ORP assessments identified many non-compliances. The standards/requirements identification document assessments clearly did not meet the purpose stated in the governing procedure: to provide, on a continuing basis, confidence that conditions and activities adhere to requirements. Program owners in CHG and ORP, as well as oversight processes, have not recognized and resolved this contradiction.

- Management assessment reports have inconsistent formats. Many do not indicate who performed the review, lack any evidence of management review and approval, and are either undated or indicate only the month and year. Assessment findings are reported using a variety of descriptions that are not correlated to the deficiency descriptions in the site corrective action management procedure (i.e., numerical grades, unsatisfactory/satisfactory, unacceptable/acceptable, non-compliance/good/excellent), hindering consistent screening for inclusion in the corrective action management program.

- The CHG assessment program lacks clear institutional ownership. The assessment program procedure assigns various program roles and responsibilities to project Vice Presidents, Directors, and Managers, and the Senior Vice President for Environment, Safety, Health and Quality. However, ultimate responsibility for the effectiveness of the program is not clearly defined, contributing to inconsistencies and other weaknesses in assessment processes and in their implementation.

Inadequate implementation of the post-job review feedback process has been a longstanding weakness.

Worker assessments, in the form of post-job reviews, are required by procedure for all work activities governed by routine work requests, planned work from the Job Control System, and EWP tasks. While there have been a number of process improvements and, recently, an increase in the number of completed feedback forms, inadequate implementation of this feedback process has been a deficiency noted as far back as the ISM Phase II verification evaluation in July 1999. This problem has been repeatedly identified by subsequent internal and external assessments, but no effective corrective action has been taken. Post-job review forms are not being completed for preventive maintenance tasks, and feedback on routine work requests is rare. The mechanisms of the worker feedback processes, which are designed to ensure that the comments are reviewed, corrective actions are implemented, and information is provided to the originators, are poorly defined and inconsistently and inadequately applied among the projects. Management expectations and the benefits of providing this feedback have not been effectively communicated to workers and first line supervisors. Completed work packages are being accepted and archived without completion of the feedback information. Documentation of post-job reviews and comment resolutions on the intranet are being piloted in one project, but the new process has not been formalized in a procedure and its effectiveness has yet to be confirmed.

Independent assessments and surveillance monitoring are performed by the quality assurance organization, and independent teams have periodically conducted more extensive, multi-function team

assessments. In calendar year 2000, independent assessments were limited to quality assurance surveillances. In March 1998 and January 1999, independent Facility Evaluation Boards conducted comprehensive, multi-discipline performance assessments. In December 2000, an aggressive, comprehensive, self-critical assessment called the independent performance evaluation was conducted, addressing 16 functional areas. This independent performance evaluation identified numerous weaknesses in programs and performance in each of the functional areas, including many of the findings and observations made by this focused review team. The 103 weaknesses were analyzed and categorized into five major deficiency areas, and CHG management has initiated corrective action plans in each of these core areas and for individual deficiencies that were identified. Management has established a rigorous process for independently monitoring the development and implementation of these corrective action plans, with an expectation to perform another comprehensive performance evaluation early in calendar year 2002.

CHG Issue and Corrective Action Management Program

CHG has a formal process for evaluating conditions adverse to quality, safety, health, operability, or the environment and to manage the development and tracking of corrective actions. Deficiencies, defined as non-compliance with established requirements, that are captured by this process are risk ranked, evaluated for direct and root cause, and assigned to an owner for ensuring development and implementation of corrective actions. High risk-ranked deficiencies require a more rigorous root cause analysis, and completed corrective actions require independent verification by quality assurance personnel. A Deficiency Evaluation Group, composed of the deficiency owner, a corrective action management point of contact from the owner's organization, and a representative from the corrective action management organization, performs the evaluation. Although the CHG corrective action management program is generally effective in categorizing reported deficiencies and tracking corrective actions, in many cases corrective actions address only the symptoms instead of the root cause. In addition, many identified program and performance deficiencies have not been properly categorized for placement in the formal corrective action management program or formally tracked to resolution.

Although root cause categories are selected during evaluations of deficiencies and are reported in the site corrective action management system, there is no narrative to clarify or describe the rationale for the cause determination. Longstanding ISM performance deficiencies, such as failure to implement effective post-job reviews, have been subject to the corrective action management system several times, but have not been resolved. Resolution of ORP-identified deficiencies in the CHG lessons-learned program failed to fully consider and address an essential weakness, which is that the system's prime customers—planners and training personnel—cannot easily use system information.

A variety of rating systems and definitions are used in different assessments, resulting in inconsistent categorization and processing.

The threshold for entering an item into the formal corrective action management system is unclear and not consistently or conservatively applied by personnel who identify and review performance deficiencies. Many observations identified in management assessments meet the corrective action management program's definition of a deficiency and, thus, should be dealt with in accordance with that program, but they are not. Non-existent and unclear procedures, unclear roles and responsibilities, and fragmented assessment

Blowout Riser

program ownership have resulted in failure to properly manage and correct identified deficiencies. For instance, recent maintenance program assessments performed by the institutional owner were provided for disposition to project personnel responsible for maintenance implementation. The recipients assumed that the program owner would initiate dispositions. Similarly, unsatisfactory performance findings in management assessments performed by the implementing organizations were not included in monthly rollup reports of management assessments because it was assumed that the institutional owner would process those findings. As a result, at least half of the deficient conditions that were identified by both parties were not addressed. As described in the previous section, a variety of performance grading or deficiency rating systems and definitions are employed in different assessment processes, resulting in inconsistent deficiency categorization and resolution processing.

Many deficiencies that are not deemed significant enough to be input to the site corrective action management system are logged using a variety of methods, although formal tracking to closure is often not performed or is untimely. For example, more than 150 radiological control program management observation findings from calendar year 1999, and a similar number from calendar year 2000, are still identified as open. Databases of facility excellence program deficiencies indicate that many conditions identified in 1999 remain open. Resolution of deficiencies and follow-up items identified by health and safety inspectors at construction projects are not formally tracked to closure. Management observation program findings are noted as open or closed when reported and logged into a database, but management does not document or routinely monitor closure. Although many of these reported conditions and deficiencies might have been corrected, the documented records do not reflect that timely corrective actions were taken. The radiological control program performs periodic binning and analysis of radiological problem reports and management observation program findings. Other CHG groups, processes, or qualitative analyses rarely identify any adverse trends or systemic deficiencies. Further, there are no written procedures describing the processes or expectations for tracking, trending, or closing those findings that are entered into the site corrective action management system.

Deficiencies in corrective action management have been core issues in Facility Evaluation Board assessments of tank farms since 1995 and were identified in the recent independent performance evaluation. Deficient areas similar to those identified by this review team included: multiple tracking systems; corrective actions that were ineffective in addressing root causes; failure to conduct meaningful deficiency trending; failure to effectively correct, track, and trend management observation program findings; and deficiencies in performing standards/requirements identification document Phase II assessments. Although some specific deficiencies have been adequately addressed, previous corrective actions have not been effective in addressing systemic root causes and establishing fully effective assessment and corrective action management programs. Vigilant senior line management attention is needed to develop and implement corrective actions in these areas.

Lessons Learned and Other Continuous Improvement Processes

CHG disseminates lessons learned from both onsite and offsite events and work activities to key points of contact via e-mail and hard copy bulletins and to an intranet website. The assigned points of contact distribute lessons learned to affected persons. DOE "Red Alert" safety notices require a documented response to the site lessons-learned coordinator regarding applicability and any needed actions. Line managers actively participate in developing lessons learned from tank farm events and activities. Lessons learned on the website have been binned into various hazard, control, and work activity categories to help end-users locate pertinent material. Several circumstances inhibit the effectiveness of the lessons-learned program. Frequent end-users, such as planners and the training staff, cannot easily identify recent additions because listings in the website bins are not chronological and many entry titles are not descriptive—often limited to the occurrence number from an offsite event. Further, the website contains no search capabilities other than the categorical binning. Lessons learned from offsite sources are not evaluated for applicability or tailored to tank farm work. Applicability reviews, final dissemination populations and methods, and needed actions are not documented except for the few DOE "Red Alerts."

The CHG employee concerns program has undergone significant recent changes.

The CHG employee concerns program has undergone significant recent changes: responsibility has been transferred from Human Resources to the ES&H and Quality organization; a new procedure has been implemented; a new coordinator was named; and the employee concerns office was relocated from the city of Richland to a more accessible central tank farms location. The new coordinator has issued and distributed new information brochures describing the program and conducted get-acquainted meetings with workers, shop stewards, and management. A database tracks concerns from receipt to resolution. Approximately 20 employee concerns have been received to date in calendar year 2001, many related to ES&H. Actions to resolve employee concerns, monitor progress, and communicate with concerned individuals appeared to be timely and thorough.

Accident Prevention Councils meet monthly in each project, with ES&H and craft worker/operator participation. A President's Accident Prevention Council also meets monthly, during which senior management and trade workers communicate ES&H expectations and concerns. Safety concerns and initiatives are tracked individually by each group and, although the processes are informal, it appears that issues are followed to resolution.

CHG has established a voluntary protection program but has not yet attained "Star" status. A February 2001 independent baseline evaluation noted that 13 of 17 corrective actions resulting from a 1999 evaluation were open, and only one of four closed actions was completed on schedule. Areas noted as needing improvement in the baseline evaluation include management involvement, feedback on safety and health issues, roles and responsibilities, and the conduct of pre- and post-job reviews. An improvement plan has been developed, establishing 17 activities to address identified weaknesses.

ORP Oversight

ORP oversight of the tank farms has principally been composed of routine monitoring and periodic functional area assessments by Facility Representatives from the Tank Operations Division working for the Assistant Manager for Operations. Facility Representative oversight activities are delineated in a comprehensive set of written instructions. An annual schedule identifies planned surveillances and assessments. Concerns, findings, and observations identified during ORP monitoring and assessments are formally transmitted to CHG monthly, and a response is required for any concern or finding. The Assistant Manager for Operations is tracking the division's self-assessment and oversight findings to resolution in internal databases. The Facility Representative program is generally effective in identifying program and performance deficiencies and communicating them to CHG for resolution. Participation in ES&H oversight by ORP program elements and the Environment, Safety, Health and Quality organization has been very limited—typically as part of Facility Representative assessment activities.

Deficiencies in management systems, policies, and assessment processes have limited the effectiveness of ORP oversight of CHG.

Deficiencies in management systems, policies, and assessment processes have limited the effectiveness of ORP oversight of CHG. Aside from the Facility Representative instructions and to a limited extent the recently issued ORP Functions, Responsibilities and Authorities Manual, ORP does not have formal policies or procedures for conducting contractor oversight. There is no defined ORP self-assessment program, and only the Assistant Manager for Operations has conducted routine self-assessments. Because ORP has no central tracking system for issues and commitments, effective analysis and trending of deficiencies is hindered. ORP management has not established any formal policy or expectations for routine backshift oversight by Facility Representatives, and backshift performance monitoring is only performed for limited high-risk operations. In some cases, identified deficiencies have been under-classified or understated when presented to CHG. For instance, a recent assessment of the CHG lessons-learned program identified one finding, which required a CHG response, and four observations that did not. Although the finding noted that feedback on "Red Alert" action notices was not being documented as required by procedure, the observations identified the potentially more significant programmatic issue that lessons-learned information was not easily useable and as a result, some key end-users (work planners) rarely accessed the information. Similarly, significant unreviewed safety question program weaknesses identified in a recent ORP assessment were insufficiently characterized in the report to CHG. No

consistent or formal analysis or trending is performed for identified performance deficiencies. The fact that the Tank Operations Division has been operating under rotating acting directors for over a year may be contributing to performance weaknesses.

Many of the management system deficiencies discussed above are longstanding, known problems at ORP, and corrective actions have been initiated or are under development. In December 2000, ORP conducted a self-assessment of the implementation of ISM by ORP to follow up on corrective actions for deficiencies identified in the August 1999 Phase II ISM verification. This assessment identified continuing deficiencies in all ORP ISM performance objectives and provided 13 opportunities for improvement. Because of this self-assessment, an extensive effort is ongoing to evaluate various management system deficiencies and develop corrective action plans including short-term compensatory measures. Areas under review include assessments, directives, deficiency and corrective action tracking, configuration management, training and qualification, roles and responsibilities, and quality assurance. To support development and implementation of corrective actions, Environment, Safety, Health, and Quality organization staffing has been augmented with new hires, management specialists detailed from RL and other DOE sites, and additional contractor support. A draft staffing plan proposes a significant increase in staffing and reorganization of the Environment, Safety, Health and Quality organization to support implementation of the corrective actions and the new roles and responsibilities.

Summary

CHG has established processes that provide the basic elements needed for effective feedback and continuous improvement. Assessment programs are identifying performance deficiencies, which are being evaluated and addressed to drive continuous improvement. Most of these feedback and improvement processes have procedural or implementation weaknesses that limit their effectiveness. Management and worker assessment programs are not well defined, and performance has been inconsistent and not fully effective. Workers and supervisors are not being held accountable for providing feedback through post-job reviews as required by procedures and the ISM system. Deficiencies are not consistently categorized, processed, or tracked to closure. Corrective actions do not always fully address root causes and prevent recurrence. Lessons-learned information is not presented in a manner that promotes consistent and efficient use by planners and trainers. Unclear roles and responsibilities and lack of formal procedures for some assessment and corrective action processes hamper feedback and improvement.

ORP's Facility Representatives provide generally effective routine performance monitoring of the contractor in accordance with comprehensive procedures and clear roles and responsibilities. However, the contractor is not always held accountable for conducting effective analysis of performance deficiencies and implementing corrective actions. ES&H oversight by program and Environment, Safety, Health and Quality support staff is minimal. ORP lacks many management systems necessary to support effective oversight of contractor performance, including a self-assessment program, many implementing directives and a directives process, a corrective action and commitment tracking system, and a comprehensive contractor oversight program.

Recent self-assessments by CHG and ORP have identified many of the issues noted by the review team, and corrective actions have been initiated or are in development. Significant and sustained senior management oversight and support are needed to ensure that the resulting corrective actions are comprehensive, fully address root causes, and are rigorously implemented.

Rating: Yellow/Red

Ratings

Figure 3 presents the ratings for the five core functions.

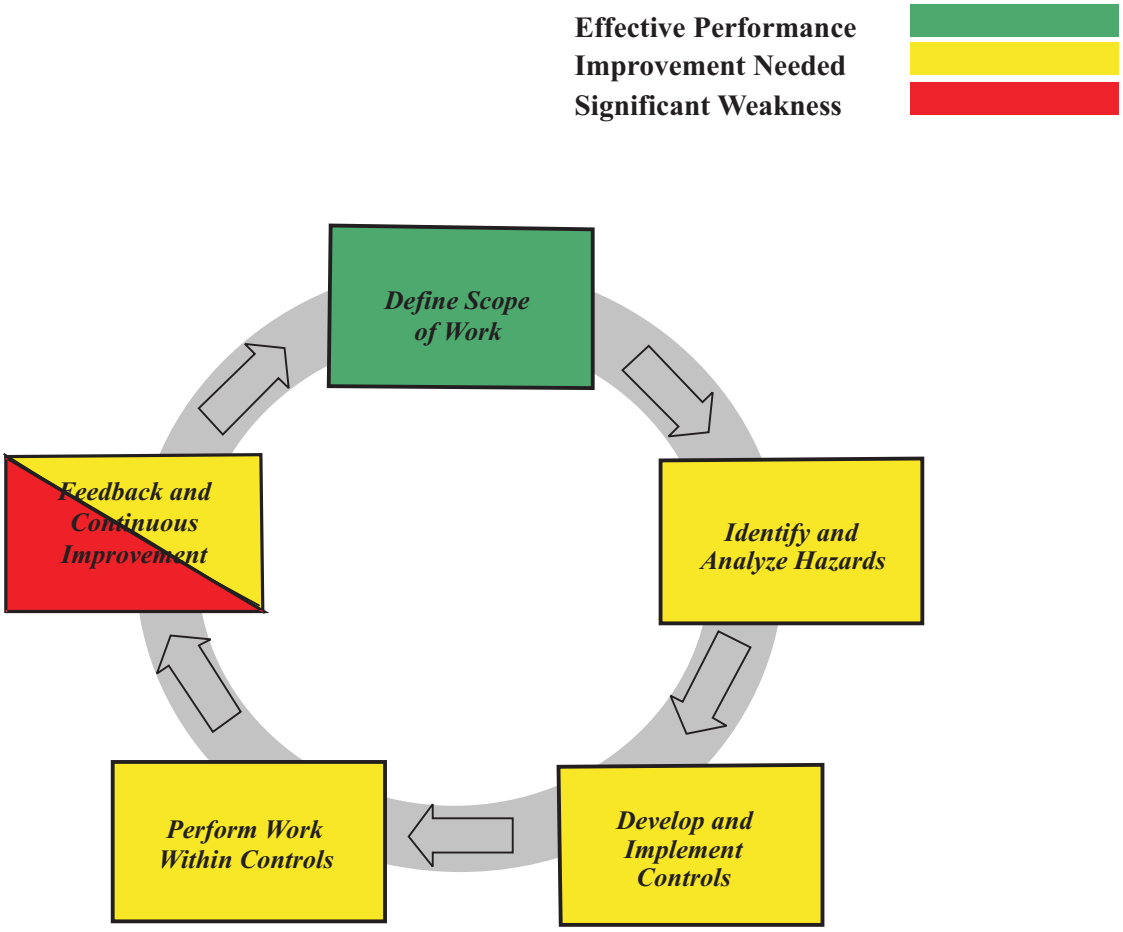


Figure 3. Core Function Ratings for the River Protection Project

3.0 Essential Systems Review

The purpose of an essential systems review is to evaluate the design, functionality, and operability of systems and subsystems essential to safe operation. An essential systems review examines all aspects of design, operations, maintenance, or modifications that could result in a system not being able to perform its safety function. This review determines whether the design, maintenance and modifications, operations, and training and qualifications keep the system functional within the safety envelope specified in the authorization basis and supporting documents. The review includes any changes in the system to ensure that unreviewed safety questions have been screened appropriately and that the appropriate evaluations, reviews, and approvals are in place. Configuration control and system drawings are reviewed to ensure that the installed system matches design drawings and that configuration control is documented and accurate.

The Aging Waste Facility primary tank ventilation system was selected for the essential systems review because the facility mission will continue for some time, the system is designated as a safety-class system (originally designed as safety-significant), and functionality is necessary to protect workers, the public, and the environment.

The Aging Waste Facility primary tank ventilation system was reviewed because the facility mission will continue and its functionality is necessary to protect workers, the public, and the environment.

The Aging Waste Facility is located in the 200 East Area in a complex of tank farms known as the 241-A tank farm complex. The Aging Waste

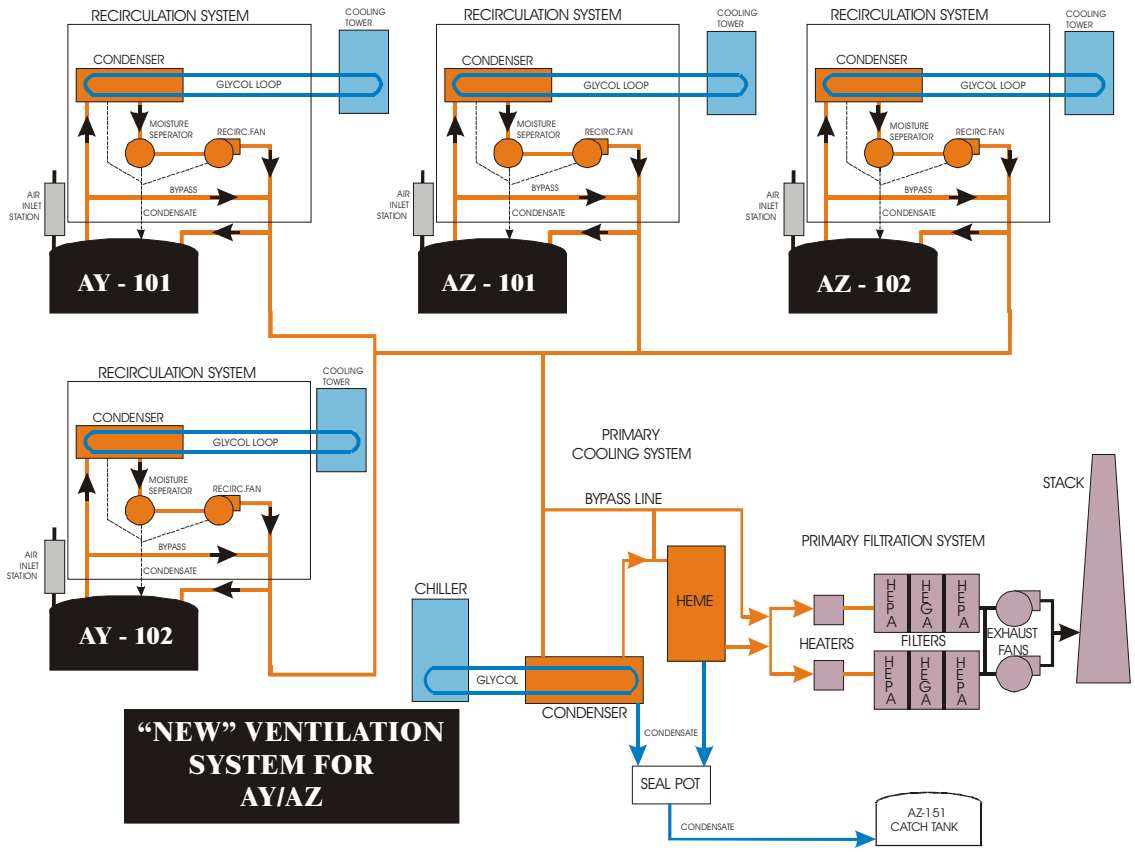


Figure 4. Simplified Diagram of Aging Waste Facility Primary Ventilation System

Facility, a Hazard Category 2 nuclear facility that provides underground tank storage of high-level radioactive waste, consists of four tanks requiring ventilation and HEPA filtration for confinement, cooling, and flammable gas mitigation. In addition to the four underground tanks, the Aging Waste Facility encompasses three other buildings that include the Monitoring & Control Station, the diesel generator/service building, and the ventilation building.

Proper system operation prevents an unfiltered, unmonitored radioactive release to the environment.

Primary Ventilation System HEPA Filter Train

In normal operation, outside air is drawn into the tanks by the ventilation exhaust fans, and the flow through the tanks is controlled by the recirculation module outlet flow control valves. Recirculation modules for each tank provide additional cooling by recirculating air from the tank through a condenser and back to the tank. Air from the recirculation modules is directed via underground lines to the ventilation building, where it passes through a condenser, a high efficiency mist eliminator, a HEPA/charcoal filter/HEPA assembly, a ventilation fan, and radiation monitors, and then to the atmosphere through a monitored stack. Monitoring is accomplished through a continuous air monitor and a fixed airhead sampler. For redundancy, there is a second parallel filter train that can be started if the operating filter train fails. Proper system operation prevents an unfiltered, unmonitored radioactive release to the environment.

Operators who staff the Monitoring & Control Station control room, with direction provided by the tank farm Shift Manager, perform most activities at the Aging Waste Facility, including operator rounds. Monitoring & Control Station operators perform most control functions, such as valve and fan control, from remote monitoring and control consoles.

3.1 Engineering Design and Analysis

Selected engineering and design considerations were evaluated through a review of engineering drawings, calculations, authorization basis documentation, and interviews with engineering and nuclear licensing staff. The review team performed some independent calculations, such as HEPA filter failure flow scenarios, to examine and compare information from authorization basis documents and calculations. Hazards analysis information, including the fire hazards analysis, was reviewed to ensure that specified features and controls were implemented during project construction.

Although most of the assumptions for calculations and other design input information are correct for the installed material and equipment, the review team identified several weaknesses in the rigor and implementation of analysis, evaluation of design information, and development of controls to ensure that the design intent is met and that systems do not operate outside the conditions documented in the calculations.

Several weaknesses were identified in the rigor and implementation of analysis and controls.

One of the safety-significant protective features to prevent a radioactive release from the Aging Waste Facility primary tank ventilation system is the continuous air monitor interlock. The continuous air monitor is designed to continuously sample the tank exhaust stream for particulate radioactivity at the exhaust stack. For any filter failure or malfunction that would allow a radioactive release through the stack in excess of the continuous air monitor set point of less than or equal to 10,000 counts per minute, the continuous air monitor interlock shuts down the ventilation system, terminating

the release. The continuous air monitor has a history of spurious alarms, which led to unnecessary ventilation system interruption. These difficulties, combined with other unrelated continuous air monitor system failures in other tank farms, led CHG to consider a replacement system. To improve the reliability of filter train failure detection, CHG designed a new primary ventilation system shutdown scheme to replace the continuous air monitor interlock based on monitoring HEPA filter differential pressures. The new interlock was installed in parallel with the continuous air monitoring interlock and was undergoing a one-year evaluation.

HEPA Filter Differential Pressure Interlock. The newly installed safety-significant HEPA filter differential pressure interlock was not adequately analyzed or documented before being placed in service. These interlocks will not detect all credible HEPA filter failures, and this could allow uncontrolled radioactive releases to the environment. Consequently, they are not functionally adequate or equivalent to the continuous air monitor interlocks they were intended to replace.

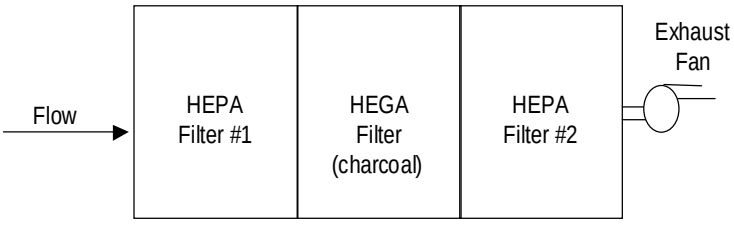
The system contains two parallel filter trains, each consisting of a HEPA filter, a high efficiency gas adsorber (or charcoal) filter, and a second HEPA filter. A simplified diagram of one filter train is shown in Figure 5. One function of the second HEPA filter is to capture potentially radioactive charcoal fines released from the high efficiency gas adsorber filter. Analysis by the review team and testing by an ORP subcontractor (NUCON) showed that this second filter could degrade to the point of bypassing the full ventilation flow without actuating the differential pressure interlock. Failure of the second HEPA filter would then pose the potential for uncontrolled release of the possibly radioactive charcoal fines. The second HEPA filter function and the resultant consequences of its failure were not fully recognized and analyzed by CHG. The review team's analysis also showed that degradation of the first HEPA filter, with up to 100 percent bypass, would also not actuate its interlock. Further, CHG did not recognize and factor into the analysis that the design function of the interlocks is applicable to both credible normal operating filter train degradations and to accident-induced failures. Causes of filter train degradation can include improper installation, damaged seals, or manufacturing defects.

Degraded filtration upstream of the charcoal filter for an extended period of time (but less than one year) may allow for waste loading to exceed the final safety analysis report assumption. As a result, the control of annual testing of HEPA filters combined with only the differential pressure interlock may not be adequate to protect against all credible HEPA filter failure/degradation scenarios; specifically, those partial failures associated with routine operations, rather than a complete failure associated with over-pressure or over-temperature accidents.

Therefore, the analysis and the documentation for this safety-significant modification were inadequate to demonstrate a valid technical basis. This concern was identified in less specific terms in the Office of ES&H Oversight's December 2000 report, *Inspection Report on the Modification of Hanford Tank Farm Ventilation System Controls*, and in the safety evaluation report on Addendum 3 to the tank farm safety analysis report.

Tank Structural Analysis. The AY/AZ tank structural analysis for vacuum conditions may be non-conservative. A structural analysis of the AY/AZ primary tanks (the inner shells of the double-shell tanks) determined the ability of the tanks to withstand all negative pressures associated with operation of the ventilation system. A single vacuum relief valve on each tank protects against excessive vacuum and would limit vacuum to minus 6.6 inches water gage. Normal operating vacuum is minus 1.0 to minus 3.0 inches water gage.

The AY/AZ tank structural analysis for vacuum conditions may be non-conservative.



HEPA - High Efficiency Particulate Air

HEGA - High Efficiency Gas Adsorber

Figure 5. Aging Waste Facility HEPA Filter Train

The structural analysis was based on American Society of Mechanical Engineers Code Case N-284-1, which addressed tank buckling due to vacuum. This code case required that the 2.0 factor of safety used for the local buckling failure mode be increased by 20 percent to 2.4 when analyzing a hypothetical, total collapse failure mode. The higher safety factor was not used in the analysis, based on the assumptions

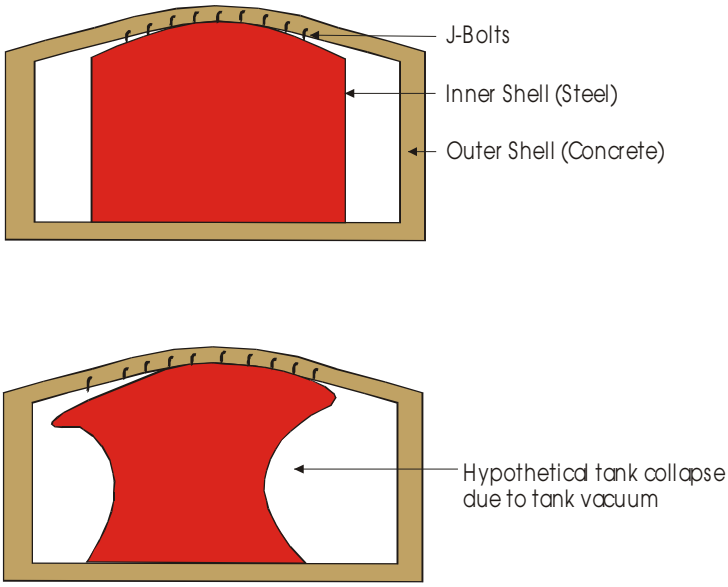


Figure 6. Schematic of Hypothetical Failure of J-Bolts

that only localized buckling would occur, since the primary tank walls were supported by the primary tank steel shell dome, which is supported by the secondary tank reinforced concrete dome through the connecting embedded J-bolts and risers. These assumptions were based on an undocumented additional assumption that the J-bolts would uniformly assume the load generated by the buckling tank sides. The review team identified that this last assumption was invalid. The load path would initially be only through the outer ring of J-bolts, because the primary tank dome would peel away from the underside of the concrete dome as a result of the downward pull of the buckling sides. Each succeeding inboard bolt circle could assume load only after the outboard bolts had failed, and thus the J-bolt failures would be progressive until there was complete detachment of the steel dome from the concrete dome. This could lead to the total collapse of the primary tank (see Figure 6). The J-bolts or their attachments were the unanalyzed potential weak link in the load path. Therefore, the 2.0 factor of safety used was non-conservative with respect to the Code requirements.

Preliminary analysis by CHG engineering personnel of the effects of this omission indicated that using the correct safety factor while holding the other analysis factors constant would generate an allowable tank vacuum of 0.0 inches water gage, which is unacceptable for operation. CHG engineering indicated that the analysis contained multiple conservative assumptions that, when removed, may compensate for this non-conservatism. Reanalysis, reduction in the allowable tank vacuum, and/or other measures may be required to remedy this concern. The normal operating vacuum range of the tank of minus 1.0 to 3.0 inches water gage is well below the minus 6.6 inches water gage limit. Additionally, current liquid levels in the tank provide hydrostatic pressure not credited in the calculation that would significantly increase the allowable vacuum as long as these levels are maintained. Therefore, there is no immediate threat to the tank. Deficiencies in the calculation should be evaluated to ensure that an adequate technical basis is maintained and appropriate limits are established.

The Aging Waste Facility tank inlet HEPA filters do not protect against all radiation releases as intended by design.

Tank Inlet HEPA Filters. The Aging Waste Facility tank inlet HEPA filters do not protect against radiation release for some tank pressurization events as intended by design. The Aging Waste Facility primary tank ventilation system normally operates with the exhaust fans providing flow through the tanks. The tank inlet valve operates automatically and throttles to maintain the tank at a slight vacuum of about minus 1.0 to minus 3.0 inches water gage to ensure that any air leakage is into, rather than out of, the tank in order to minimize releases of unfiltered radioactive materials.

Each inlet air station also contains a HEPA filter intended to prevent radioactive releases through this pathway for most tank pressurization events. There are two conditions that would prevent the HEPA filters from performing their intended function. First, during normal operation, the tank air inlet valves are throttled nearly closed on some tanks. Operators and engineering staff indicated that much of the required flow to the tanks was from leakage paths that bypassed the air inlet station (e.g., inter-tank sleeves and drains). For tank pressurization events, these bypass in-leakage paths would likely become out-leakage paths, bypassing the inlet air HEPA filter. With the inlet valves nearly or fully shut, the condition would be worse. Second, because of the design, tank pressurization events would cause the controls to sense high tank pressure and close the inlet valve, attempting to maintain negative tank pressure. This would further worsen the event by causing all of the out-leakage to bypass the inlet HEPA filter. Although a combination of operator action,

Inside a Waste Tank

administrative controls, indications, and alarms normally help in maintaining the tanks within allowable limits, the design intent of the HEPA inlet filters may not be met for some overpressurization scenarios. Quantitative analysis of this condition, and the potential consequences of unfiltered releases, should be part of the documented technical basis. Based on the potential deficiency, CHG initiated an unreviewed safety question.

Airlift Circulator Interlock. Deferred maintenance on the Aging Waste Facility airlift circulator interlock has resulted in engineered controls being replaced by administrative controls. The airlift circulators have the potential to create a positive pressure in the tanks, which is prohibited by the safety analysis report. The airlift circulators' flow capacity could cause the tank pressure to exceed the minimum vacuum limits on the tanks from outside air if the primary ventilation exhaust fans are not operating. This was recognized both in the design (engineered controls) and in operating procedures (administrative controls) when the system was installed. The interlock between the airlift circulators and the ventilation system would normally stop the circulators upon a loss of primary tank ventilation. The airlift circulator operating procedure likewise requires manual action to stop all airlift circulators upon a loss of tank ventilation as required by authorization basis Limiting Condition of Operation 3.2.1. This interlock has not been operational for some time (about 16 months). Authorization basis clarification 99-001 (January 1999) indicates that an engineering evaluation was in progress to determine the need to repair the interlock. The rationale was that under the assumed hydrogen release rates with the airlift circulators in operation (the limiting accident), 25 percent of the lower flammability limit would not conservatively be reached for at least seven days. The maintenance approach to essential systems should avoid replacing design safety functions (through a lack of corrective maintenance) with administrative controls, because such replacement could reduce the margin of safety for limiting accidents. Deferred maintenance becomes a temporary modification controlled by the design change process and should be evaluated as such. The airlift circulators are not currently in operation. Before using airlift circulators, CHG should restore the interlock.

HEPA Filter Dose Rate Limit. Non-conservative errors in the Aging Waste Facility HEPA filter analysis and calculation would allow slightly greater radioactive source terms to be available for release than initially analyzed. The hazards analyses for the Aging Waste Facility tank ventilation system addressed accidents that could result in failure of the HEPA and charcoal filters, which, if not mitigated, could release contained radioactive materials to the environment. The safety analysis report and technical safety requirements limit exposures from a filter failure by limiting the contact dose rate on the filter housing to less than 200 mrem/hour, thereby limiting the amount of radioactive material buildup available for release on the filter.

The review of calculations for the HEPA filter train identified two non-conservative errors that could allow exposures above those analyzed.

The review of calculations for the HEPA filter train identified two non-conservative errors that could allow exposures slightly above those analyzed. First, the analyses incorrectly assumed that the filter cartridge frames were made of aluminum; they are made of stainless steel. Second, the analyses did not account for the attenuation that would be caused by the stainless steel filter outer housing. Both factors could cause the actual radioactive burden of the filter to be greater, at the limiting dose rate, than what was calculated. After

Primary Ventilation Fan in Background; HEPA Filter Train in Foreground

discussions with the review team, the CHG engineering organization initiated revisions to the affected calculations. The normal loading of the HEPA filter under current operating practice is low (less than 10 mrem/hour) because filters are changed often, so the calculation deficiency did not result in an immediate safety concern. Re-analysis is necessary to adequately support the safety analysis technical basis. The technical basis for filter changeout needs to be established and documented.

Vacuum Relief Valve Instrument Uncertainty. The pre-operational tests of the Aging Waste Facility vacuum relief valves did not account for instrument uncertainty. The new Aging Waste Facility ventilation system modification included a new, larger vacuum relief valve for each tank. Pre-operational system testing included testing of the relief valves to verify their ability to prevent the tanks from exceeding the maximum analyzed vacuum of minus 6.6 inches water gage. The review team noted that instrument uncertainty had not been accounted for in the tests. Subsequently, engineering staff determined that the allowable tank vacuum would not be exceeded, even considering the instrument uncertainty. Therefore, although the deficiency requires correction, it was not considered an immediate safety concern.

The fire hazards analysis for the Aging Waste Facility system was comprehensive in addressing fire hazards, design considerations, and needed controls.

Fire Hazards Analysis. The fire hazards analysis for the Aging Waste Facility comprehensively addressed fire hazards, design considerations, and needed controls. Facility design with regard to fire hazards is robust for the low combustible loading of facilities. Firewalls separate redundant filter train rooms, and Aging Waste Facility buildings and rooms have sprinkler coverage. Although the 1996 fire hazards analysis had not been reviewed and updated within the required three-year period, discussions with the fire marshal indicated that a review and update were in progress. In the interim, ORP has directed CHG to review the adequacy of the fire hazards analysis and to identify any compensatory measures, if required, until the analysis is updated and integrated with the final safety analysis report.

The review team identified two deficiencies associated with controls specified in the fire hazards analysis. First, to preclude a charcoal filter fire due to radioactive heat generation, a control limit of 200 mrem/hour measured at the charcoal filter housing was specified. This control limit has not been implemented; a 200-mrem/hour reading is taken on the HEPA filter housing but not on the charcoal filter housing. Second, the analysis specifies that the interconnecting duct between filter rooms A and B must have a two-hour fire wrap to match the fire rating of the wall. The interconnecting duct between the two rooms does not have fire wrap installed. Without equivalent protection, a single fire could provide a common-mode failure for both filter trains. Fire protection engineers indicated that the need for fire wrap was based on standard ducting, and the thick-wall stainless steel ducting may, upon analysis, have the equivalent two-hour fire rating. The installed configuration lacks a documented analysis.

Collectively, the deficiencies identified indicate a significant lack of rigor and discipline in engineering design and analysis (see Safety Issue 3 in Section 4.0).

3.2 Unreviewed Safety Question Process

Weaknesses were identified in unreviewed safety question screenings for changes in the Aging Waste Facility tank ventilation system, other equipment, and procedures. From an initial sample of 30 unreviewed safety question screenings for changes in this system between 1996 and 1998, two-thirds were screened

negative when unreviewed safety question determinations should have been performed. Three other procedure change screenings from that period were also screened as not requiring unreviewed safety question evaluations because of a narrow interpretation of procedures as described in the safety analysis report. This narrow interpretation that changes and procedures do not affect specific equipment or procedures called out in authorization basis documentation is contrary to DOE Order 5480.21. CHG also identified screening problems in 1998.

Consequently, the review team selected an additional ten unreviewed safety question screenings for 2001 to evaluate current practices. Of these, approximately half had been inappropriately screened. The deficiencies included narrow interpretations of whether changes affected the authorization basis equipment or procedures, inadequate information or technical justification for screening out changes, and screening questions that were answered "no" instead of "yes," which did not trigger the unreviewed safety question determination process. For example, although a procedure change was screened out because it did not apply to a test or experiment, the screening indicated that it was indeed a new test procedure and would result in draining some saline water into an Aging Waste Facility tank, causing a local waste-disturbing activity. In another example, a proposed modification that would replace tank inlet flow orifices with smaller orifices was screened out because the authorization basis document did not specify a minimum tank flow. The screening process did not consider that the change was a design modification to safety-significant equipment. Many unreviewed safety question screenings included performance of "mini-safety analyses" as a justification for not performing an unreviewed safety question determination.

Recurrence controls for continued weaknesses in the unreviewed safety question process have not been effective.

Because the unreviewed safety question process does not meet DOE Order 5480.21 requirements, changes in equipment or procedures could result in operation outside the approved safety envelope. The range of deficiencies indicates the need to reevaluate past and present unreviewed safety question screenings to ensure that the unreviewed safety question determinations that are required have been performed. The CHG Licensing Manager and Nuclear Safety Services Manager indicated that they had identified similar deficiencies during recent self-assessments. Recurrence controls for continued weaknesses in the unreviewed safety question process have not been effective.

Collectively, the deficiencies identified in the unreviewed safety question screenings and evaluations further reflect the lack of rigor and discipline in the engineering process (see Safety Issue 3 in Section 4.0).

3.3 Operations

ORP oversight of the approval process for HEPA filter differential pressure interlock operation, communication of operational intent to CHG, and oversight of implementation did not ensure that the HEPA filter differential pressure interlocks and the continuous air monitor interlock operated as ORP intended. ORP approved the HEPA filter differential pressure interlock for operation without an adequate technical basis. Although ORP recognized this in the safety evaluation report, it was determined that if the continuous air monitor interlock was inoperable, operation could shift to the differential pressure interlock and CHG could exit the continuous air monitor interlock Limiting Condition of Operation 3.1.4, thereby removing the need to immediately restore the continuous air monitor interlock to service. This decision was in partial conflict with the ORP direction to keep the continuous air monitor interlock operable. Exiting the limiting condition of operation removes the technical safety requirements to immediately restore the continuous air monitor to service, to perform alternate monitoring, and to perform surveillances as compensatory measures for loss of the continuous air monitor. As long as the HEPA differential pressure interlock system is operable, there is no limiting condition of operation driver in the technical safety requirements to require CHG to return the continuous air monitor to operable status. Confusion about the guidance is evident by the initiation of several CHG authorization basis clarification requests concerning HEPA differential pressure interlock Limiting Condition of Operation 3.1.8, continuous air monitor interlock Limiting Condition of Operation 3.1.4, and multiple ORP letters to CHG.

There were weaknesses in ORP oversight of actions directed by the safety evaluation report implementation.

There are also weaknesses in ORP oversight of actions directed by the safety evaluation report implementation. The continuous air monitor has been in bypass since February 27, 2001, due to spurious alarms, protracted maintenance, and deficiencies in the radiological control technician functional test procedure. ORP was unaware that the interlock had been in bypass for an extended period (see Section 2.5). Although ORP relies heavily on its Facility Representatives for awareness of ongoing activities, the Facility Representatives were unaware of the interpretation issues arising out of the final safety analysis report regarding the HEPA filter differential pressure and continuous air monitor interlock systems. As a result of discussions with the review team, ORP directed CHG, in a May 10, 2001, letter, to immediately restore provisions of the continuous air monitor interlock Limiting Condition of Operation 3.1.4, to maintain the interlock operable at all times, and to submit within 30 days an authorization basis amendment to reflect the change.

Material condition and housekeeping for the Aging Waste Facility rooms and equipment were very good, with the cleanliness of the diesel generator room being a minor exception. High winds caused excessive amounts of blown dirt and sand to enter the room through the open-air grating in the roof and to collect on top of the diesel fuel oil tank, diesel starting batteries, and diesel generator.

CHG reported an occurrence in 2000, resulting from a valve misalignment in the differential pressure interlock system. Although no valves were found out of position during this focused review, some valve and breaker/control switch lineup sheets for the Aging Waste Facility contain errors and do not adequately support documented configuration control. Procedure TO-060-350, addressing electrical lineup sheets, does not include two power panels (PP-3-241-AZ-701 and PP-16) that contain loads necessary for system operation. The lineup ensured that power was provided to the panels, but did not align breakers on those panels. A Monitoring & Control Station operator could not complete the valve alignment for the safety-significant HEPA filter differential pressure transmitter valves due to errors in the lineup sheet, unlabeled valves, and unapproved operator aids (pencil markings) depicting the "high" and "low" side of the transmitter on the valve block. Additionally, the valve lineup sheet did not list the differential pressure transmitter equalizing valves, which are critical to correct operation of the transmitter.

The calibration procedure for the HEPA differential pressure transmitters does not adequately control the inlet, outlet, and equalizing valves. Although operators indicated that operations personnel did not touch the transmitter valves, this was contrary to the instrument calibration procedure, which required operators to align the transmitter for maintenance and to return the transmitter to service following maintenance. Valve lineup sheets for an electrical hand switch lineup on the Monitoring & Control Station graphic screens are not well designed and are difficult to use. One operator tried to complete the graphic display alignment sheet in the field rather than at the Monitoring & Control Station control room due to confusion over valve locations on the lineup sheet.

A number of weaknesses in conduct of operations were identified at the Monitoring & Control Station related to watch standing, training, and proficiency in the use of procedures. These include:

- Several operators raised concerns about their limited training. Although on-the-job training lasted several months, formal training on graphic panels, systems, and equipment is lacking.

Monitoring & Control Station

- The large number of operators qualified on the Monitoring & Control Station limits individual watch-standing time and affects their ability to maintain proficiency.

- Other proficiency weaknesses included difficulty in completing a valve/electrical lineup due to unfamiliarity with locations of power panels, breakers, and valves. This lack of proficiency may be attributable in part to weaknesses in the operator qualification program, which does not include valve or breaker lineups as part of the normal qualification process.

- Although operators participate in major tank farm drills, drills involving evaluation and critique of control room actions are rare.

- Status boards are not up to date and contained errors, and configuration changes were not routinely marked on the composite diagram in the Monitoring & Control Station control room.

- Although several alarms occurred while the review team was on site, alarm response procedures were not used. Several alarms were not reported to the Shift Manager as required by procedures. The alarm response procedures are classified as "continuous" procedures and are required to be "in hand."

Aging Waste Facility procedures are not well integrated. Stand-alone procedures exist for the chillers, recirculation module, airlift circulators, and primary ventilation system. Generally, the system operates in an integrated manner where one procedure can affect another. Improving the links between the procedures could enhance operational effectiveness and reduce the potential for operator error.

3.4 Maintenance and Surveillance

A sampling of maintenance and calibration procedures indicated that preventive maintenance and calibrations are completed in accordance with formally approved procedures, and corrective maintenance is performed in accordance with approved work packages. The diesel generator monthly and yearly preventive maintenance procedure and the automatic bus transfer test procedures are detailed and contain appropriate prerequisites, precautions, and limitations. Facility Managers prioritize maintenance tasks within their facilities, and overall priority among facilities is adjusted during planning and scheduling meetings and through plan-of-the-day meetings. The maintenance backlog is manageable, at about 750 open work orders for the entire tank farm and 27 open work orders for the Aging Waste Facility. The two Priority 1 tasks for the Aging Waste Facility included repair of the ventilation building stack continuous air monitor and repair of a leaking chiller pump. There were about five open work orders for each of 1998, 1999, and 2000 and about 12 open work orders for 2001. Open work orders in 1998 and 1999 were Priority 3 or lower (i.e., Routine). In April 2001, the backlog increased slightly due to work stand-downs associated with lockout and tagout deficiencies. The CHG Maintenance Manager indicated that funding or personnel limitations did not contribute to the backlog.

Maintenance issues continue with the Eberline AMS-4 stack monitor continuous air monitor.

Reliability problems with the Eberline AMS-4 stack monitor continuous air monitor have existed since installation about four years ago. The review team noted that, unknown to ORP, the continuous air monitor interlock has been in bypass since February 27, 2001, due to frequent alarms or system problems that could

Aging Waste Facility Backup Diesel Generator

indicate software problems. Actions such as replacing electrical connectors and holding vendor meetings have occurred to isolate the cause. The continuous air monitor and associated interlock constitute the only real-time direct monitoring of a radioactive release resulting from HEPA filter train failure. Therefore, management needs to place a high priority on returning this safety-significant interlock function to service and keeping it operable. During this focused review, procedure problems further delayed a functional test of the continuous air monitor. The functional testing procedure had incorrect/missing steps for starting and stopping the vacuum pump in the correct sequence. Radiological control technicians have been using a deficient procedure for about two years. After the procedure was corrected, the continuous air monitor failed the functional test; the monitor and interlock functions remain inoperable.

Testing has not been adequate to assure full operability of the Aging Waste Facility diesel generator and all automatic starting logic.

Testing has not been adequate to assure full operability of the Aging Waste Facility diesel generator and all automatic starting logic. The safety-class Aging Waste Facility primary ventilation system should be powered from an equivalent safety-significant source, because failure of power would cause the safety-class ventilation system to fail. Neither the site feeder nor the diesel generator is classified as safety-significant, and diesel generator load testing and automatic starting logic testing have not been performed to ensure diesel generator availability. Further, there is no technical safety requirement or limiting condition of operation for return of the site feeder or the diesel generator to service in any specified timeframe. Previously, only monthly and annual preventive maintenance and run tests (not load tests) were performed. In response to a CHG senior management finding, CHG issued procedure TO-060-364, which includes requirements for an annual load test of the diesel generator and tests of automatic bus transfer switches that test the automatic starting logic. Management should expedite testing under the new procedure to ensure continuous operability of the diesel generator. The contractor and ORP have developed a technical basis for the adequacy of the current electrical power availability and reliability; however, because the site feeder and diesel in combination fulfill a safety-significant function for backup power to the safety-class primary ventilation fans, a limiting condition of operation for the loss of both power sources should be implemented.

3.5 Summary

Significant weaknesses were identified as part of the essential systems review, particularly in the areas of CHG engineering design and analysis (see Safety Issue 3 in Section 4.0). For ORP, weaknesses were identified in the approval of the HEPA filter differential pressure interlock before a documented technical basis was in place; communication of ORP expectations for operation of the HEPA filter differential pressure and continuous air monitor interlock to CHG; and oversight of authorization basis implementation. Weaknesses were identified for CHG in the rigor of engineering analysis and documentation; development of some safety analysis controls; the unreviewed safety question screening process; Monitoring & Control Station operator training and proficiency; and testing to ensure reliability of the Aging Waste Facility diesel generator and maintenance of the continuous air monitor interlock system in an operable condition. Some compensatory actions were taken during the review, such as initiating load testing of the diesel generator; performaing unreviewed safety question screenings on calculation deficiencies; and restoring the safety analysis report limiting condition of operation for the continuous air monitor interlock function.

4.0 Safety Issues

Line management is responsible for addressing Safety Issues in accordance with DOE Order 414.1A, *Quality Assurance*. The DOE Headquarters Office of Environmental Management, as the lead program secretarial office, is required to ensure that an adequate corrective action plan is developed. Six Safety Issues were identified during this focused review. For each Safety Issue, a summary discussion of the basis for the Safety Issue is provided. References to the specific portions of Sections 2.0 or 3.0 that provide more detailed examples are also indicated. Table A-1 in Appendix A provides page references to discussion of the particular issue in the body of the report.

Issue 1. The CHG work planning and control system does not ensure that all hazards are adequately identified and analyzed and that appropriate controls are tailored to the work performed as required by DOE Policy 450.4, *Safety Management System*.

Work planning weaknesses, including deficiencies in hazard analysis and control, were evident across a range of CHG activities performed by both CHG and their construction subcontractor. Rigorous hazard analysis, development of appropriate tailored controls, and adherence to the work control system and institutional safety requirements are essential to implementing ISM. Weaknesses in the CHG work control process are precursors to potentially more serious conditions that could challenge safety margins and impact workers and the environment (see Sections 2.2 and 2.3).

Some CHG project hazards have not been adequately identified, analyzed, or documented. Specific weaknesses (noted in detail in Section 2.2) include activities in which work packages did not adequately identify, analyze, or communicate potential hazards. Potential hazards associated with some work activities are not identified in the work packages. Monitoring conducted in support of some hazards analyses does not sufficiently analyze the hazard or address or communicate the risks to all potentially exposed workers. Additionally, some analytical methods used in support of hazards analysis lack the sensitivity to fully support analysis of the hazard potential.

AJHAs do not always clearly define and tailor hazard controls to the specific work activity and are not effectively integrated into the work instructions. Specific weaknesses included some hazards and controls identified in AJHAs and construction job safety analyses that were not coupled with the work steps where the hazards were encountered. Some AJHAs listed hazards that were not present in the work specified. In other instances, work packages did not identify specific safety hazards and/or establish appropriate hazard controls. Some standing AJHAs are so generic that it is difficult to identify which hazards are applicable to a work activity. Line management has not ensured that workers review and understand the hazards analyzed in the standing AJHA. Workers must examine various sections of a voluminous work package to obtain guidance on hazard controls when performing a work step, increasing the likelihood of performance errors. The pre-job briefing program is not fully developed and is not implemented in a graded approach to be consistent with the work control process. A single briefing may be judged sufficient for both routine, low-hazard work and high-hazard work performed under the EWP process.

Pre-Job Briefing

Issue 2. Deficiencies in CHG procedure development and use are adversely impacting implementation of integrated safety management as required by DOE Policy 450.4, *Safety Management System*. Consequently, senior management expectations for procedure compliance delineated in CHG policy and DOE Order 5480.19 are not being met.

CHG has adequate policy guidance on procedure development and use, but field management and supervision are not enforcing this guidance. The review team identified deficient procedures and ES&H practices with no procedures. In many cases, personnel failed to follow established safety requirements and procedures as required. Procedure problems included deficiencies in the AJHA procedure, the absence of procedures for industrial hygiene technician tasks, inadequate procedures for responding to dust and high wind conditions, an operations procedure containing technical errors in valve and electrical lineups for a safety system, an operations procedure allowing violation of a State of Washington discharge permit, no procedures for some CHG assessment processes, and system surveillance procedures that do not include the requirements necessary to ensure operability of the system (see Sections 2.3 and 3.4 for further details).

Procedure use and compliance deficiencies included failure to follow industrial safety requirements around crane loads and heavy equipment, failure to follow radiological control procedures and radiation work permit requirements, failure to follow operations procedures (including annunciator response and emergency operating procedures), failure to maintain status boards as required, failure to follow waste planning procedures, use of standing orders in lieu of procedures, failure to follow post-job review requirements, and evidence of workarounds for deficient procedures (see Sections 2.4 and 3.3 for further details). These problems result from a lack of rigor and attention to detail in the conduct of operations. These deficiencies adversely affect ISM implementation and could cause undesired safety consequences.

Issue 3. Inadequate rigor in CHG engineering analyses, calculations, and the unreviewed safety question process resulted in the reduction of safety margin or in unreviewed conditions contrary to DOE Order 5480.21, *Unreviewed Safety Questions*; DOE Order 5480.22, *Technical Safety Requirements*; and DOE Order 5480.23, *Safety Analysis Reports*.

As detailed in Section 3.1, the review team identified several cases where the lack of rigor in the performance of analyses and the development of technical bases led to reduced or indeterminate safety margins for safety-class or safety-significant equipment, or caused unreviewed conditions to exist. These included the failure to identify all of the high efficiency gas adsorber (charcoal) filter hazards and inadequate analysis of the HEPA filter differential pressure interlock system; failure to accurately identify the Aging Waste Facility primary tank structural failure mode, which resulted in a non-conservative assumption in the structural analysis; a tank ventilation system inlet station design that would not provide the intended filtration for tank pressurization events; failure to properly account for shielding factors in the HEPA filter failure radiation release analyses; and failure to account for instrument uncertainty in the tank vacuum relief valve pre-operational test.

The review team also identified (see Section 3.2) that implementation of the unreviewed safety question process from at least 1996 through 2001 has been inadequate to ensure that all unreviewed safety question screenings and evaluations have been performed as required. Many unreviewed safety question evaluations for changes in safety-class and safety-significant systems, structures, components, and procedures were not performed because of inadequate screenings. Some screenings did not contain adequate technical justifications for screening changes out of the unreviewed safety question process; had incorrect answers to screening questions; or attempted to perform safety evaluations within the screenings as justification for not doing an unreviewed safety question determination. Recurring deficiencies in the unreviewed safety question process indicate a significant weakness in an important design process requiring prompt management attention.

Issue 4. Some CHG personnel are not trained and qualified to perform assigned responsibilities in hazardous environments, as required by DOE Policy 450.4, *Safety Management System*, increasing the risk of adverse exposures.

The large number of operators certified as watch standers (several with multiple certifications) for various tank farm operations results in limited individual watch-standing time, affecting operator proficiency for safety-significant systems. At the Monitoring & Control Station for the Aging Waste Facility primary ventilation

system, review team members observed conduct of operations weaknesses in watch standing and proficiency in the use of procedures during walkdowns, valve alignments, interviews, and observation of activities (see Section 3.3).

During maintenance, operations, and construction work activities, line management does not ensure that workers are adequately trained in specific job hazards and controls before performing work. Training requirements are not clearly identified in the work package pre-job briefing checklist, job safety analysis (for construction), AJHA, specific work prerequisites, or job steps. Worker training requirements were not addressed in pre-job briefings by line management for maintenance, operations, and construction work observed by the team. The CHG training organization has implemented several systems to verify worker training, but CHG has not evaluated the effectiveness of integrating these systems into the job control system for use by line management (see Section 2.3).

No formal program for industrial hygiene technician qualification and continuing training has been in place since 1995. During maintenance and construction work activities, the review team observed that some industrial hygiene technicians lack knowledge of fundamental industrial hygiene principles and practices for performing effective hazard monitoring. This longstanding program deficiency was corrected during the investigation by management issuing an industrial hygiene Technician Qualification Card, Guide, and Program Description, effective May 7, 2001, with a six-month period to complete the program (see Section 2.4).

Issue 5. CHG feedback and improvement processes are not sufficiently established or implemented to effectively drive continuous improvement or prevent recurrence of ES&H program and performance deficiencies as required by DOE Policy 450.5, *Line Environment, Safety, and Health Oversight.*

Key assessment processes, such as the management observation program and other management assessments, are not adequately and formally delineated to ensure that roles and responsibilities are clear, reports contain essential information, and findings are rigorously managed to resolution. Many assessment findings are not consistently or conservatively documented and evaluated, and effective corrective actions are not developed, implemented, and tracked to closure. Many worker post-job reviews are not completed as required by procedure to support continuous improvement of work documents. Lessons-learned information is not presented in a format to facilitate and encourage use by work planners and as part of training (see examples and details in Section 2.5).

Issue 6. ORP line management has not established and implemented management systems that ensure effective oversight of contractor safety programs and performance as required by DOE Policy 450.5, *Line Environment, Safety, and Health Oversight.*

A comprehensive contractor oversight process that integrates all ORP organizations, including ES&H and Quality, has not been established. Furthermore, monitoring and assessment by organizations other than the Tank Operations Division has been minimal. Deficiency and commitment tracking systems are fragmented and informal, hindering trending and senior management awareness of issue status. ORP has not consistently identified systemic deficiencies and held CHG accountable for performance deficiencies. No formal self-assessment process exists to provide management information on the adequacy of line oversight programs and performance and provide a framework for continuous improvement. ORP oversight of CHG failed to identify conflicting information in standards/requirements identification document assessments and other CHG and ORP assessment results.

There were weaknesses in the ORP approval process for authorization of the installation and operation of the HEPA filter differential pressure interlock as an alternative to the continuous air monitor interlock before a documented technical basis was in place. There were also weaknesses in communicating ORP expectations for system operation to CHG. ORP did not adequately perform oversight of authorization basis implementation and the actions directed by the safety evaluation report. ORP was unaware that the continuous air monitor interlock had been in bypass for nearly two months, leaving the HEPA filter differential pressure interlock as the only interlock (see specific examples and additional details discussed in Sections 2.5 and 3.0).

APPENDIX A
ISSUES FOR CORRECTIVE ACTION AND FOLLOW-UP

Line management is responsible for correcting deficiencies and addressing weaknesses identified during Office of ES&H Oversight reviews. Following each review, line management prepares a corrective action plan. The Office of ES&H Oversight follows up on significant Safety Issues as part of a multifaceted follow-up program involving follow-up reviews and tracking of Safety Issues.

This appendix summarizes the significant Safety Issues identified in this focused review of the River Protection Project. The Safety Issues identified in Table A-1 will be formally tracked in accordance with the DOE plan developed in response to DOE Order 414.1A, *Quality Assurance*, which addresses follow-up of Office of ES&H Oversight findings. ORP and CHG need to address these Safety Issues in the corrective action plan.

During a focused review, the Office of ES&H Oversight team may identify isolated weaknesses and/or minor deficiencies in otherwise effective programs. Although the site needs to correct such weaknesses and deficiencies, the Office of ES&H Oversight does not include every identified weakness in the formal tracking system. All weaknesses and deficiencies are considered as part of the Office of ES&H Oversight follow-up program when evaluating safety management performance and planning future ES&H Oversight evaluation and follow-up activities.

Table A-2 provides a list of legacy issues identified during the 1996 Office of ES&H Oversight safety management evaluation of the Hanford Site, which relate to operation of the tank farms. Each issue is followed by a comparison to the Safety Issues raised in this report.

Table A-1. Safety Issues Identified in Focused Review

IDENTIFIER	ISSUE STATEMENT	REFER TO PAGES
RPP-FR-01-01	The CHG work planning and control system does not ensure that all hazards are adequately identified and analyzed and that appropriate controls are tailored to the work performed as required by DOE Policy 450.4, *Safety Management System*.	36
RPP-FR-01-02	Deficiencies in CHG procedure development and use are adversely impacting implementation of integrated safety management as required by DOE Policy 450.4, *Safety Management System*.	37
RPP-FR-01-03	Inadequate rigor in CHG engineering analyses, calculations, and the unreviewed safety question process resulted in the reduction of safety margin or in unreviewed conditions contrary to DOE Order 5480.21, *Unreviewed Safety Questions*; DOE Order 5480.22, *Technical Safety Requirements*; and DOE Order 5480.23, *Safety Analysis Reports*.	37
RPP-FR-01-04	Some CHG personnel are not trained and qualified to perform assigned responsibilities in hazardous environments, as required by DOE Policy 450.4, *Safety Management System*, increasing the risk of adverse exposures.	37-38
RPP-FR-01-05	CHG feedback and improvement processes are not sufficiently established or implemented to effectively drive continuous improvement or prevent recurrence of ES&H program and performance deficiencies as required by DOE Policy 450.5, *Line Environment, Safety, and Health Oversight*.	38
RPP-FR-01-06	ORP line management has not established and implemented management systems that ensure effective oversight of contractor safety programs and performance as required by DOE Policy 450.5, *Line Environment, Safety, and Health Oversight*.	38

Table A-2. Legacy Issue Status

LEGACY ISSUE NUMBER	PREVIOUS ISSUE STATEMENT AND COMPARISON TO CURRENT ISSUES
HS-04/01/1996-0001-I	Lack of effective RL Oversight of Occupational Health Program—RL management of the Hanford Site occupational health program lacks effective direction. Occupation health surveillances are not consistently applied and are not always related to workplace hazards. The absence of RL performance of line management assessment prevents validation of the effectiveness of the occupational health program sitewide. Not evaluated as part of the current review.
HS-04/01/1996-0002-I	Weaknesses in RL and Fluor Daniel Hanford Procedures Quality, Validation and Adherence—Both RL and contractor Westinghouse Hanford Company (now Fluor Daniel Hanford) management have not established an environment where the importance of complying with approved procedures is universally understood. Procedure non-compliance is due to a number of factors, including: poorly written or inadequately validated procedures, lack of acceptance or verbatim adherence to procedures by operating personnel, a level of mistrust in procedures due to known deficiencies in the field, and a verification and validation process that does not always ensure that the correct procedures reach the field. Although applicable to the previous management structure under RL and the previous contractor, similar problems were identified during the current review. See new Safety Issue 2.
HS-04/01/1996-0003-I	Deficiencies in DOE and Fluor Daniel Hanford Implementation of Requirements Management System—The absence of clear DOE Headquarters and RL direction to identify applicable safety management requirements—especially regarding modifications of DOE orders—has led to an inconsistent understanding of what safety requirements are applicable. There is not a comprehensive understanding of the standards/requirements identification documents process. The Westinghouse Hanford Company (now Fluor Daniel Hanford) standards/requirements identification documents have not captured all applicable requirements and have not been independently evaluated. A sampling of health and safety requirements indicates that most requirements have been identified and incorporated into the standards/requirements identification documents in a timely manner, with the exception of DOE Order 440.1, *Worker Safety and Health Protection*. Although DOE Order 440.1 was included in the DOE contract with CHG in 1999, incorporation of the Order into the standards/requirements identification documents, subsequent revisions of CHG safety and health programs and procedures, and CHG subcontracts is only now being processed. Deficiencies were identified in the conduct of required implementation assessments and oversight by ORP. See new Safety Issue 2 and Section 2.0.
HS-04/01/1996-0004-I	Deficiencies in DOE and Fluor Daniel Hanford Implementation of Authorization Basis System—Authorization basis documents for many Hanford Site facilities—notably Plutonium Finishing Plant, B Plant/Waste Encapsulation Storage Facility, and tank farms that are operated by Westinghouse Hanford Company (now Fluor Daniel Hanford)—do not reflect current site hazards, conditions, or activities. DOE (Office of Environmental Management, Office of Defense Programs, and RL) has not provided timely reviews of documents. RL has not established the policies and standards for the safety authorization

Table A-2. Legacy Issue Status (Continued)

LEGACY ISSUE NUMBER	PREVIOUS ISSUE STATEMENT AND COMPARISON TO CURRENT ISSUES
HS-04/01/1996-0004-I (Continued)	management infrastructure. Westinghouse Hanford Company's (now Fluor Daniel Hanford's) safety authorization basis has limited worker safety hazards analysis. Improvements are needed in implementing the unreviewed safety question process and controlling operational safety requirements. The tank farms are now covered by a DOE-approved safety analysis report that meets the requirements of DOE Order 5480.23, DOE-approved technical safety requirements that meet the requirements of DOE Order 5480.22, and an unreviewed safety question process that generally meets the requirements of DOE Order 5480.21. Some problems were noted with regard to DOE oversight of implementation of the safety analysis report, technical safety requirements, and the unreviewed safety question process. See new Safety Issue 3.
HS-04/01/1996-0005-I	Weaknesses in RL and Fluor Daniel Hanford Radiological Work Planning Processes—Weaknesses exist in Westinghouse Hanford Company (now Fluor Daniel Hanford) radiological work planning and in procedural compliance. RL is not providing the necessary radiological control program direction, and RL has neither developed nor implemented an effective process to evaluate contractor radiological control performance. Some deficiencies were noted regarding radiological control practices during fieldwork. See new Safety Issue 1.
HS-04/01/1996-0006-I	Deficiencies in RL and Fluor Daniel Hanford Programs to Monitor and Assess Safety Management Performance—An integrated approach to comprehensive monitoring and assessment of safety management performance has not been institutionalized at the Hanford Site. There is a general lack of direct participation by RL and contractor line management in monitoring, assessing, and verifying the effectiveness of field activities. Assessment programs are not being aggressively used to track, analyze, trend, and improve safety management performance. Performance indicators are used to varying degrees and with varying levels of success by Hanford Site contractor organizations. While this issue was applicable to the previous management structure under RL and the previous prime contractor, similar deficiencies exist within ORP and CHG. See new Safety Issues 5 and 6.
HS-04/01/1996-0007-I	Weaknesses in RL and Fluor Daniel Hanford Implementation of Corrective Action Management Program—The identification and correction of adverse safety management conditions are not effectively managed at the Hanford Site. RL has not clearly communicated to site contractors the expectations for processing and closing DOE-identified adverse conditions; corrective action management systems lack formality and have not been maintained as site missions, organizations, and management processes have evolved; the process for ranking the risk associated with adverse conditions lacks rigor and is applied inconsistently across site facilities; and corrective action management systems have not had sufficient oversight by RL or contractors (Westinghouse Hanford Company, which is now Fluor Daniel Hanford). While this issue was applicable to the previous management structure under RL and the previous prime contractor, similar deficiencies exist within ORP and CHG. See new Safety Issues 5 and 6.

This page intentionally left blank.

APPENDIX B
TEAM COMPOSITION

The evaluation was conducted according to formal protocols and procedures, including an Appraisal Process Guide, which provides the general procedures used by the Office of ES&H Oversight for conducting inspections and reviews, and the Focused Review Evaluation Plan, which outlines the scope and conduct of the review process. Planning sessions were conducted to ensure that all team members were informed of the review objectives, procedures, and methods. The planning process considered previously-identified weaknesses, current River Protection Project activities, and ORP and CHG management initiatives. The evaluation team collected data through interviews, document reviews, walkdowns, observation of activities, and performance testing. Interviews were conducted with ORP personnel and contractor managers, technical staff, and hourly workers.

This Office of ES&H Oversight focused review provides an examination of the five core functions of the ISM program, which are essential to effective work planning, an evaluation of the functionality of selected essential systems, and an assessment of line management feedback and improvement processes.

Team Composition

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

Deputy Assistant Secretary for ES&H Oversight

S. David Stadler, Ph.D.

Associate Deputy Assistant Secretary for ES&H Oversight – Operations

Raymond Hardwick

Office of ES&H Evaluations

Patricia Worthington, Ph.D., Director
Thomas Staker, Deputy Director

Team Leader

Bradley Davy

Core Functions Review

Ching-San Huang
Ronald Stolberg
Joseph Lischinsky
James Lockridge
Edward Stafford

Essential Systems Review

Michael Gilroy
Mark Good
Donald Prevatte

Line Management Oversight

Robert Compton

Communications and Support

Sandra Pate
Robert McCallum
Kathy Moore
Marcia Taylor

Quality Review Board

S. David Stadler, Ph.D.
Raymond Hardwick
Patricia Worthington, Ph.D.
Thomas Staker