Independent Oversight
Inspection of
Environment, Safety,
and Health Programs
at the

Idaho National Laboratory Advanced Test Reactor

June 2005

Office of Independent Oversight and Performance Assurance
Office of Security and Safety Performance Assurance
Office of the Secretary of Energy

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Abbreviations Used in This Report

AC	Alternating Current
AIF	Assessment Input Form
ALARA	As Low As Reasonably Achievable
ASME	American Society for Mechanical Engineering
ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance
CATS	Corrective Action Tracking System
CFR	Code of Federal Regulations
CY	Calendar Year
DBR	Design Basis Reconstitution
DC	Direct Current
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
ECP	Emergency Coolant Pump
EFIS	Emergency Flow Initiation System
EH	Office of Environment, Safety and Health
EH-23	Office of Facility Authorization Bases
ES&H	Environment, Safety, and Health

(Continued on inside back cover.)

OVERSIGHT

1.0 Introduction

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) conducted an inspection of environment, safety, and health (ES&H) programs at the DOE Idaho National Laboratory (INL) Advanced Test Reactor (ATR) during May and June 2005. The inspection was performed by the OA Office of Environment, Safety and Health Evaluations. OA reports to the Director of the Office of Security and Safety Performance Assurance, who reports directly to the Secretary of Energy.

Within DOE, the Office of Nuclear Energy, Science and Technology (NE) has line management responsibility for INL. NE provides programmatic direction and funding for research and development, facility infrastructure activities, and ES&H program implementation for INL, including the ATR. ATR also performs work for and receives funding from other DOE program offices and other government and industry organizations. At the site level, the Idaho Operations Office (ID) has line management responsibility for ATR and reports to NE.

Under contract to DOE, INL (including ATR) is managed and operated by Battelle Energy Alliance (BEA). BEA was awarded the management and operating contract for INL in November 2004 and assumed responsibility for INL operations in February 2005 after a three-month transition period. BEA is owned by the Battelle Memorial Institute, and the BEA team members include BWXT Services Inc., the Washington Group International, the Electric Power Research Institute, and the Massachusetts Institute of Technology. Although the prime contractor has changed, the majority of the managers and staff at ATR have been retained and most have considerable experience working at ATR.

At the time of this OA inspection, a significant transition was ongoing within INL and ID. The transition changes include: the division of the Idaho Complex into INL, under NE, and the Idaho Cleanup Project, under the DOE Headquarters Office of Environmental Management; a new prime contractor and contract for management of the INL; the transfer of the former Argonne West facilities, now called the Materials and Fuels Complex, to a part of the INL, and transfer of DOE line management responsibility for Argonne West to ID; the transition of contractor personnel, organization, and processes; and several recent reorganizations in ID, including a change in the management and reporting line for the Facility Representative program. As a result of these changes, many ID feedback and improvement processes are in transition to reflect the new organizations and responsibilities. Because of these major changes in organization and operations, many ID and INL institutional processes were undergoing significant revision at the time of the inspection to reflect the new organizations and interfaces.

The primary mission of ATR is to study the effects of radiation on materials; its primary user is the Naval Nuclear Propulsion Program. However, ATR is a multipurpose facility that has several other government, commercial, and foreign users, and it produces rare and valuable medical and industrial isotopes.

ATR Facility

ATR activities involve various hazards that need to be effectively controlled. These hazards include reactor accidents, external radiation, radiological contamination, hazardous chemicals, and various physical hazards associated with facility operations (e.g., machine operations, high-voltage electrical equipment, pressurized systems, and noise). Radioactive materials are present in various forms and quantities at ATR.

The purpose of this OA inspection was to assess the effectiveness of ES&H programs at ATR as implemented by BEA under the direction of ID. OA used a selective sampling approach to evaluate a representative sample of activities at ATR, including its management systems, operations, maintenance, and engineered safety systems. Specifically, the sampling approach was used to evaluate:

- ATR implementation of the core functions of integrated safety management (ISM) for selected maintenance and operations activities, including radiation protection controls that are applied during these activities. OA focused primarily on implementation of ISM at the facility and activity/ task levels.

- ID and BEA feedback and continuous improvement systems, as applied to ATR.

In addition, OA reviewed two other areas to determine the status of programs of interest to DOE management:

- Essential safety systems, with primary emphasis on evaluating the adequacy of INL's Design Basis Reconstitution (DBR) effort, which is an ATR initiative for validating the ATR safety basis and functionality of safety systems, structures, and components. The review of essential safety systems was performed to provide DOE management with information about the status of the extensive DBR program at ATR and to identify potential improvements in this program. Because the purpose of the essential system functionality review was to provide a status update, this portion of the review was not rated.

- ID and BEA effectiveness in managing and implementing selected aspects of the ES&H program that OA has identified as focus areas, including hoisting and rigging, safety systems oversight, and corrective action management. OA selects focus areas—areas that warrant increased attention across the DOE complex—based on a review of operating events and inspection results. Although these topics are not rated, the results of focus area reviews are considered in the evaluation of ISM core functions.

Sections 2 and 3 provide a discussion of the key positive attributes and weaknesses identified during this review. Section 4 provides a summary assessment of the effectiveness of the major ISM elements that were reviewed. Section 5 provides OA's conclusions regarding the overall effectiveness of ID and BEA management of the ES&H programs, and Section 6 presents the ratings assigned during this review.

Appendix A provides supplemental information, including team composition, and Appendix B identifies the specific findings that require corrective action and follow-up. Appendix C provides the results of the review of the application of the core functions of ISM for ATR work activities. Appendix D presents the results of the review of ID and BEA feedback and continuous improvement processes and management systems. Appendix E presents the results of the review of essential safety system functionality, and Appendix F presents the results of the review of safety management of the selected focus areas. For each of these areas, OA identified opportunities for improvement for consideration by DOE and contractor management. The opportunities for improvement are listed at the end of each appendix so that they can be considered in context of the status of the areas reviewed.

2.0 Positive Attributes

Several positive attributes were identified in ES&H implementation during operations and maintenance activities at ATR. In addition, the DBR effort is contributing to improvements in the safety basis.

Reactor Technology Complex

The process for ATR operations procedure development, review, approval, use, and modification provides a comprehensive system to ensure that technically accurate procedures with appropriate ES&H controls are provided to and appropriately used by operators. The procedure review process requires a hazards analysis and associated job safety analysis for all new and revised procedures. A hazard evaluation group made up of applicable safety professionals and workers reviews and walks down the procedures. The rigorous development process has resulted in operations procedures that are generally high quality and technically accurate. Overall, the quality of the procedures is a strength, and when problems are identified, operations management takes appropriate actions to promptly address the deficiencies. ATR follows a program for strict adherence to procedures, and operators perform proceduralized activities with rigor appropriate for a Category 1 nuclear facility.

ATR's use of the integrated work control process defined in Standard (STD)-101, *Integrated Work Control Process*, represents an effective and mature implementation of ISM for maintenance activities. Planners, supervisors, and workers are all familiar with the requirements of this standard, and they work together to plan and complete work safely. By following the process, planners produce work packages that contain the information necessary for craftspeople to complete the assigned task. Hazards and controls are appropriately tailored and integrated into the work package. Procedures are included where necessary, and are written in a stepwise manner. Changes to work orders and procedures are formally controlled and approved before work progresses.

ATR's implementation of most INL radiological control program requirements is robust, mature, and effective. ATR has a strong radiation protection program and effectively uses the powerful Radiological Control Information Management System (RCIMS) database management program to manage radiation work permits, control entry into radiological areas, and track personnel and task-specific doses. The system tracks all individual entries on radiation work permits, requires workers to review specific personal protective equipment requirements and contamination/dose/dose rate limits, grants or rejects entry based on predefined criteria (e.g., radiation worker training status or cumulative dose), and

ATR Vessel Head

allows preparation of a variety of reports (e.g., providing information about the effectiveness of work planning and radiological controls). Radiological control personnel closely monitor individual entries on radiation work permits, consistently perform appropriate radiological surveys to obtain current radiological survey data, and ensure that workers review and understand the radiological conditions prior to performing work. In addition, all entries into posted high-radiation areas are further controlled with a supplemental, documented pre-job briefing that specifically addresses radiological control requirements.

BEA's conduct of the DBR effort for the first two systems reflected a critical, questioning attitude and safety culture and has resulted in some important safety improvements. INL has identified over 60 discrepancies ("gaps") in the design basis for the first two systems reviewed. The identification of the gaps demonstrated a willingness and ability to critically evaluate the safety analysis report and supporting analysis, question assumptions, and formally identify discrepancies so that they could be addressed. Some of the gaps that were identified constitute important weaknesses that would impact the ability of the safety systems to adequately perform their safety function during certain design basis accident sequences. For example, the impact of degraded voltage on direct current pumps had not been adequately considered for a loss-of-power event; testing of the emergency cooling pumps was not adequate to ensure operability; and emergency operating procedures did not provide properly sequenced actions in case of a loss of heat sink. INL made some important changes to address these weaknesses, including revising emergency operating procedures and training its operators.

The ATR senior supervisory watch program provides an effective management tool and assessment mechanism. This program broadens ATR management personnel's knowledge of systems and processes, site facilities, personnel, and the work of other organizations. It also helps improve the assessment and oversight skills of the managers and supervisors who participate in the program. The daily, full-shift presence of management in the field provides direct, independent management oversight of field activities and has led to the identification and resolution of safety problems in performance, process, and the plant physical condition. Another significant benefit of the senior supervisory watch program is the direct interaction and real-time feedback between workers and management.

3.0 Weaknesses

Although ATR has a generally effective ISM program and demonstrated a strong nuclear safety culture, a few weaknesses were identified in isolated aspects of work planning and the DBR. There also are weaknesses in feedback and improvement processes and their implementation.

INL has not ensured that clear and unambiguous requirements for confined spaces have been consistently and conservatively applied at ATR to minimize the risk to workers consistent with the intent of Occupational Safety and Health Administration (OSHA) regulations. The INL/ ATR procedures on confined spaces lack a description of requirements for or explanation of non-permit confined space entry safety reviews, and most ATR workers who were questioned could not define what the required safety review for a non-permit confined space encompasses. In addition, completed Confined Space Identification and Hazard Evaluation Forms are quite old in some cases, and the procedure does not require periodic review, either at a specified frequency or prior to use. Further, the ATR has incorrectly classified many confined spaces as not requiring permits. Incorrect classification of confined spaces could lead to important controls being missed.

ATR has not applied sufficient rigor in analyzing some radiological hazards associated with non-uniform radiation fields and glovebox failures. Although most aspects of radiation protection are effective, two systemic cases were observed in which insufficient analysis of the radiological hazards resulted in potentially inadequate radiological controls. First, the as-low-as-reasonably-achievable (ALARA) review did not adequately consider the potential for dose rates and doses to both the whole body and extremities that would require supplemental dosimetry for the work. Second, insufficient analysis of radiological hazards associated with glovebox work resulted in not implementing several ATR procedural requirements for radiological control. When these concerns were brought to their attention, facility management took appropriate action to follow requirements but did not take timely action to characterize the problems and enter the problems into the site corrective action tracking system database for timely review of reporting and Price-Anderson Amendments Act screening, root cause analysis, extent–of-condition reviews, and determination of needed corrective actions.

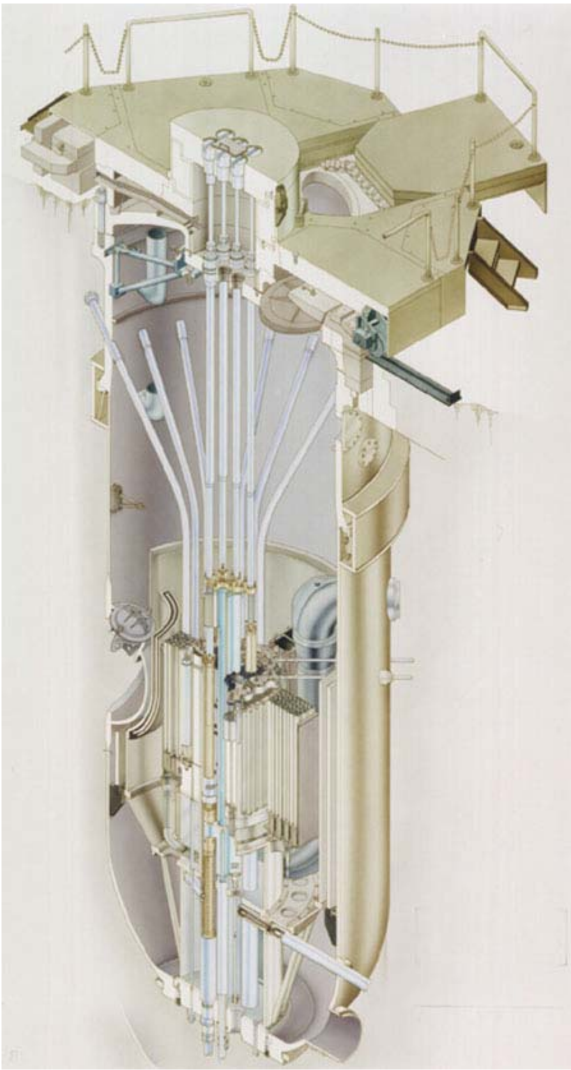
The DBR plan is not designed to provide a near-term, higher-level evaluation of safety systems' capability to perform their safety functions prior to an in-depth DBR; is not complete in its scope or adequately defined; and is not supported by sufficient and appropriate resources for effective implementation. The INL plan includes important elements for ensuring reconstituting the design basis for safety systems, but it has not been prioritized to provide for near-term evaluation of whether safety systems can perform their safety functions. The detailed, system-by-system approach is not timely; the plan has been under way for almost 18 months, and only two systems have had their design basis reconstituted. Further, the plan is missing some important elements, such as an evaluation of environmental qualification and quality assurance, that should be included in a DBR, and INL has not developed detailed implementation procedures or guidance for the plan. Finally, although INL established a team consisting of three senior-level and very qualified engineers, the team lacks the assessment experience needed to perform the most effective DBRs, and with its current resources, it has not kept up with schedules and is not positioned to complete the effort in a timely manner. INL has taken some initial steps to address these weaknesses.

BEA has not adequately defined its processes for resolving engineering deficiencies identified during the DBR effort to ensure formal, appropriate, and timely evaluations of their impact on plant operation. As part of its DBR, BEA has identified numerous engineering deficiencies ("gaps") whose resolution will strengthen the ATR safety basis. However, because BEA does not have a detailed procedure for gap analysis and resolution, there has been significant delays (months) and inconsistencies in processing the gaps through the formal unreviewed safety question (USQ) process. As a result, potentially important safety issues have not always been promptly addressed, and actions required by the USQ process to place the facility in a safe condition and to formally notify DOE have been delayed. Furthermore, the INL USQ process has several deficiencies that can also delay the evaluation of deficiencies and reporting to DOE, and the BEA USQ procedure, which was approved by ID, is not fully consistent with the intent of 10 CFR 830.203 and associated DOE guidance. Incorrect guidance, provided by ID, on certain aspects of the USQ procedure contributed to these deficiencies.

BEA has not consistently and rigorously implemented their formal corrective action management program at the ATR. Although many ES&H issues identified as part of assessment activities, operational events, or plant and equipment failures are properly documented and addressed, in many instances ATR personnel manage the evaluation and resolution of ES&H issues outside of the formal BEA corrective action program. This practice bypasses the documentation of many evaluations and decision points, structured development and documentation of action plans, and tracking and verification of corrective actions. In some cases, identified safety issues are not consistently and accurately screened or documented in accordance with the INL corrective action management system requirements, and in others, issues management details are documented only after management decisions and actions have been taken. Further, BEA has not identified the inadequacy of these action plans, and these actions and issues were incorrectly verified as being satisfactorily completed. As a result, the issues were inappropriately closed in the DOE Corrective Action Tracking System and the associated Occurrence Reporting and Processing System and Price-Anderson Amendments Act non-compliance tracking system reports, and in the associated deficiency report in the Issue Communication and Resolution Environment (ICARE) system.

4.0 Summary Assessment

The following paragraphs provide a summary assessment of the ID and ATR activities that were evaluated by OA during this inspection. Additional details relevant to the evaluated organizations are included in the technical appendices of this report.



ATR Vessel and Internals

ISM Core Function Implementation

Implementation of the ISM core functions at ATR is generally effective for both maintenance and operations. Engineered controls are used extensively and appropriately where feasible. Personal protective equipment and administrative controls are implemented effectively, with few exceptions. ATR has a mature system of detailed procedures that clearly define safety controls for most hazards, and ATR personnel demonstrated a safety conscious approach to performing work, including rigorous adherence to procedures. Although generally effective, additional management attention is needed in a few aspects of radiation protection, correction of fire alarm deficiencies, and implementation of confined space requirements.

Maintenance

ISM implementation for maintenance work at ATR is effective and mature. STD-101 is the primary mechanism for implementation of ISM at INL. The STD-101 process for developing, reviewing, and approving maintenance work has been in place for several years. Supervisors, planners, and craft personnel are all familiar with the requirements, and they work together to ensure that work is performed safely. All work observed during this assessment was conducted by qualified personnel in accordance with approved procedures. Personnel responsible for planning and performing maintenance work demonstrated a firm culture of nuclear safety. The scope of work for maintenance work within ATR is clearly defined and sufficiently detailed to enable appropriate hazard identification. The STD-101 process, coupled with institutional radiation work permit and ALARA review requirements, provides an appropriate framework for analysis of radiological and non-radiological hazards associated with ATR maintenance work. With a few exceptions, use of the STD-101 integrated work control process has effectively identified the appropriate hazard controls for maintenance work at ATR. In a few cases, incomplete or ineffective analysis of radiological hazards resulted in potentially deficient controls in the area of external dosimetry, glovebox integrity, and air monitoring. However, the use of engineered controls, individual monitoring, the RCIMS database, extensive surveys, and the use of procedures are significant strengths at ATR.

Operations

ATR operations activities have good operating procedures and schedules in place for defining the scope of work. The processes for identification and analysis of operations hazards are generally well established and documented. Facility-level hazards associated with operations are analyzed through the authorization basis process, and the corporate hazards analysis process for operations activities provides a consistent and comprehensive method for performing and reviewing activity-level hazards. Consequently, most hazards associated with operations activities have been adequately identified and analyzed. In most cases, appropriate operational controls are established and implemented for recognized hazards. The ATR procedure development, review, approval, use, and modification process provides a comprehensive system for ensuring technically accurate operations procedures with appropriate ES&H controls. The reviewed operations procedures were generally well written and technically accurate, and they contained the appropriate information and level of detail to perform the tasks safely. However, communication of fire alarms is inadequate in some areas of the reactor building, the corporate process for controlling entries to non-permit confined spaces has several deficiencies, and requirements for classifying confined spaces have not been conservatively applied. Notwithstanding these isolated deficiencies, the vast majority of operations work is performed within established controls, and operators understand the activity hazards and the importance of procedural compliance.

Hoisting and Rigging

Requirements delineated in the DOE Hoisting and Rigging standard have been effectively implemented at ATR. Hoisting and rigging equipment is maintained in a safe manner, lifts are performed in accordance with approved procedures, and critical lifts are appropriately planned and performed.

Safety System Oversight (SSO)

Although not mandated, ID has appropriately decided to establish an SSO program at the ATR and has identified systems, assigned SSO personnel, and ensured that SSO personnel complete qualification requirements. However, the program has not been adequately defined or implemented. ID has self-identified most of these deficiencies and is taking actions to address them. ATR established a system engineer program long before required to do so by DOE Order 420.1A, has appropriately identified system engineers for each vital safety system, and has established appropriate training requirements. However, some weaknesses were identified in the identification of system engineer roles, responsibilities, tasks, and methods for performing the tasks. Furthermore, some system engineering tasks, such as maintaining system design descriptions, have not been adequately performed. BEA is aware of the current deficiencies and is taking actions, such as establishing a new engineering management position, to address them.

BEA/ATR Feedback and Improvement

A variety of feedback and improvement activities are conducted for ATR-related activities and processes. BEA conducts assessments, inspections, and management walkdowns; identifies and corrects deficiencies; and shares lessons learned. The senior supervisory watch program is an effective tool for involving management in monitoring field activities and interacting with workers. An active, behavior-based safety observation program provides real-time feedback to workers on unsafe behaviors and data for improving safety equipment, working conditions, and work processes. In some cases, however, assessment activities have not been sufficiently tailored to ATR activities and performance, and were not planned in accordance with the procedure. Most assessment activities are mandatory inspections and assessments driven by external organizations or regulations; few independent assessments are performed, and planning by some functional area managers is not in accordance with site requirements. The documentation and resolution of safety deficiencies are sometimes not managed in accordance with the requirements of the INL corrective action program. The documentation and tracking of corrective and preventive actions for occupational injuries also lack sufficient rigor. Most aspects of ATR corrective actions for the 2003 OA findings were adequately addressed. BEA has made a concerted effort to improve its USQ process, including addressing findings and observations from OA's 2003 inspection and other assessments, revising its USQ procedure, and conducting company-wide training and self-assessment. However, some weaknesses in the USQ process are still evident.

ID Oversight

ID has established processes for conducting operational awareness and planned evaluations of contractor ES&H performance, and many of the identified oversight activities are performed effectively. Facility Representatives are effective in monitoring contractor performance and identifying areas for continuous improvement. Most oversight activities are adequately documented and communicated to the contractor. Oversight of the DBR has generally been effective. However, activities related to issues management have not been consistently and rigorously implemented in accordance with requirements. ID has not ensured that the contractors rigorously and consistently implement the INL corrective action program. Further, ID verifications of contractor corrective action plans and completed actions and closures of several issues tracked in the DOE Corrective Action Tracking System and the Price-Anderson Amendments Act non-compliance tracking system were inadequate. ID also approved a deficient USQ procedure and provided inaccurate guidance related to the USQ corrective actions.

ATR Design Basis Reconstitution

Important improvements have been made by DOE and BEA in increasing confidence that the safety basis is adequate to support ATR operations. Most significant is the improvement in safety culture and questioning attitude, as evident from BEA's identification of numerous important design discrepancies in the first two safety systems that have undergone DBR. Further, NE and ID have provided active oversight of and good support for the DBR effort. Although the DBR effort has resulted in improvements, the scope and process have not been sufficiently defined to ensure completeness and timeliness. Furthermore, the schedule and the level and types of resources applied to the program have not been adequate for complete and timely identification and resolution of design basis issues. The process weaknesses have resulted in some deficiencies in the reconstitution of the emergency flow system design basis that was reviewed by OA. For example, some important functional parameters were not adequately supported by analysis, some functional parameters had not been adequately translated into technical safety requirement controls, the scope of review did not include sufficient evaluation of some


ATR Glovebox Activities

design aspects (e.g., compliance with codes and standards), and system boundaries were not adequately defined. Also, many gaps were either not entered into the USQ/potentially inadequate safety analysis process, or were not entered in a timely manner. As a result, actions required by the USQ process to ensure that ATR was placed in a safe condition and to formally notify DOE of a potential concern were not always timely. Further, the DBR schedule is too long (scheduled to be completed in 2011), considering the number and importance of the design basis issues that were identified by OA in 2003 and by BEA during its DBR of the first two systems; the DBR process has not been designed for early identification of potential safety-significant issues. NE, ID, and BEA have recognized the timeliness concern and taken some initial efforts to significantly accelerate the DBR process.

5.0 Conclusions

ATR has a strong nuclear safety culture, and maintenance, operations, and hoisting and rigging activities at ATR are performed with a high regard for safety. Extensive use of engineered controls and rigorous adherence to safety requirements and procedures were evident in the vast majority of work activities observed by OA. However, a few deficiencies were identified in otherwise overall effective systems in some aspects of radiation protection, correction of fire alarm notification deficiencies, and implementation of confined space requirements.

ATR has made progress in its DBR efforts and has identified and corrected numerous safety basis issues in the two systems addressed to date by the DBR effort. In addition, ATR has made significant improvements in its nuclear safety culture, and BEA personnel demonstrated the questioning attitude that is essential to identifying and resolving safety concerns. Further, NE and ID have provided active oversight of and good support for the DBR effort. While the scope of this OA review was not intended to address the overall effectiveness of all ATR safety systems, the OA team did not identify any specific conditions for the systems reviewed that would warrant shutdown of reactor operations. Although the DBR effort has resulted in improvements, a number of concerns warrant timely management attention in the areas of DBR scope, planning, resources, timely evaluation and reporting of identified deficiencies, and timeliness of the overall effort (which is a particular concern as the DBR effort is currently not scheduled for completion until 2011). NE, ID, and BEA have recognized the timeliness concern and have taken some initial actions to significantly accelerate the DBR process.

Many aspects of ID and BEA feedback and improvement programs are functioning effectively. ID has appropriately established an SSO program even though one is not mandated, and BEA established its system engineer program long before the requirements were issued. However, BEA needs to address process and performance weaknesses in issues management and some aspects of assessments and lessons learned. ID line management needs to focus on BEA actions concerning identified deficiencies and address weaknesses in safety system oversight and verification of corrective actions. In addition, ID and BEA need to correct deficiencies in the USQ process and its implementation, including revising ID guidance and the INL USQ procedure.

6.0 Ratings

The ratings reflect the current status of the reviewed elements of the ATR ISM program.

Implementation of Core Functions #1-4 for Selected Work Activities

Maintenance .... EFFECTIVE PERFORMANCE
Operations .... EFFECTIVE PERFORMANCE

Feedback and Continuous Improvement - Core Function #5

ID and BEA/ATR Feedback and Improvement Processes .... NEEDS IMPROVEMENT

APPENDIX A
SUPPLEMENTAL INFORMATION

A.1 Dates of Review

Planning Visit	May 23 - 26, 2005
Onsite Inspection	June 6 - 16, 2005
Report Validation and Closeout	June 28 - 30, 2005

A.2 Review Team Composition

A.2.1 Management

Glenn S. Podonsky, Director, Office of Security and Safety Performance Assurance
Michael A. Kilpatrick, Director, Office of Independent Oversight and Performance Assurance
Patricia Worthington, Director, Office of Environment, Safety and Health Evaluations
Thomas Staker, Deputy Director, Office of Environment, Safety and Health Evaluations

A.2.2 Quality Review Board

Michael Kilpatrick	Patricia Worthington
Dean Hickman	Robert Nelson

A.2.3 Review Team

Thomas Staker, Team Leader

Brad Davy	Jim O'Brien	Shivaji Seth
Bob Compton	Joe Panchison	Don Prevatte
Michael Shlyamberg	Ed Stafford	Mario Vigliani

A.2.4 Administrative Support

MaryAnne Sirk Tom Davis

A.3 Ratings

The Office of Independent Oversight and Performance Assurance uses a three-level rating system to provide line management with a tool for determining where resources might be applied toward improving environment, safety, and health. It is not intended to provide a relative rating between specific facilities or programs at different sites because of the many differences in missions, hazards, and facility life cycles, and the fact that these reviews use a sampling technique to evaluate management systems and programs. The three ratings and the associated management responses are:

- Effective performance, which indicates that management should address any identified weakness
- Needs improvement, which indicates a need for significantly increased management attention
- Significant weakness, which indicates a need for immediate management attention, focus, and action.

APPENDIX B
SITE-SPECIFIC FINDINGS

Table B-1. Site-Specific Findings Requiring Corrective Action

FINDING STATEMENTS	PAGE NUMBER
1. Analysis of potential radiological hazards associated with non-uniform radiation fields and glovebox failures has not been sufficiently rigorous to ensure that these hazards are adequately controlled.	17
2. ATR does not have a process for identifying controls for non-radiological hazards for RCTs entering spaces to perform surveys.	18
3. ATR has not established appropriate controls to ensure that all workers are promptly notified of fire alarms in areas where the alarms cannot be heard.	21
4. INL has not ensured that clear and unambiguous requirements for confined spaces are consistently applied at ATR to minimize the risk to workers, consistent with the intent of OSHA regulations.	23
5. BEA has not implemented a fully effective program of ATR assessment activities with sufficient scope and rigor tailored to ongoing activities, conditions, and past performance to ensure that ES&H performance is consistently and accurately evaluated.	31
6. BEA has not consistently implemented its corrective actions program at ATR in a manner that ensures that ES&H deficiencies are appropriately documented, categorized, and evaluated in a rigorous and timely manner, with causes, extent of condition, and appropriate recurrence controls identified.	34
7. INL established and ID approved a USQ procedure that is not fully consistent with the intent of 10 CFR 830 requirements for addressing discrepant as-found conditions that could indicate a potentially inadequate safety basis.	37
8. The DBR plan is: (1) not complete in its scope or adequately defined, (2) not supported by sufficient and appropriate resources, and (3) not appropriately focused to provide a higher-level evaluation of the safety systems' ability to perform their safety functions prior to an in-depth DBR.	46
9. BEA has not ensured that gaps identified by the DBR process are entered into the USQ process in a timely manner in accordance with 10 CFR 830 requirements.	48

APPENDIX C
CORE FUNCTION IMPLEMENTATION (CORE FUNCTIONS #1-4)

C.1 Introduction

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) evaluated work planning and control processes and implementation of the first four core functions of integrated safety management (ISM) for selected activities at Idaho National Laboratory (INL) Advanced Test Reactor (ATR). The OA review of the ISM core functions focused on environment, safety, and health (ES&H) programs as applied to selected aspects of ATR activities:

- Maintenance (see Section C.2.1)
- Operations (see Section C.2.2).

Radiation control programs were evaluated as a part of the review of both maintenance and operations. For the above areas, OA reviewed procedures, observed ongoing operations, toured work areas, observed equipment operations, conducted technical discussions and interviews with managers and technical staff, reviewed interfaces with ES&H staff, and reviewed ES&H documentation (e.g., plant standards, permits, and safety analyses). Specific processes in each area and OA team activities are discussed further in Sections C.2.1 and C.2.2.

ATR is a test reactor that is used to study the effects of radiation on materials. The ATR creates a wide range of reactor environments in which the effects of radiation on materials and fuels may be studied, and also produces rare and valuable medical and industrial isotopes. The primary user of the ATR is the Naval Nuclear Propulsion Program. However, ATR is a multipurpose facility that has several other government, commercial, and foreign users.

C.2 Results

C.2.1 Maintenance

All maintenance associated with the ATR is performed by the ATR Programs Maintenance Department. That Department consists of 65 craftspersons, including pipefitters, heavy equipment operators, electricians, instrument technicians, mechanics, carpenters, welders, machinists, custodians, and laborers.

ISM is incorporated into the maintenance planning process by Standard (STD)-101, *Integrated Work Control Process*. STD-101 establishes requirements for work planning, review, approval, conduct, and closeout. This process is mature, has been in place for several years, and is well understood by the personnel responsible for work planning and control. In addition to STD-101, many maintenance activities, such as experiment handling, are conducted in accordance with detailed operating procedures.

ATR radiological control functions are administered by the Radiological Control Organization, which falls under the INL Site Radiological Control Division and supports the Reactor Technology Complex (including ATR), the Central Facilities Area, and the Science and Technology Complex. This organization's Radiological Control Manager and staff are responsible for overall management of ATR radiological control activities.

ATR radiological control activities are governed by sitewide institutional requirements contained in the *INL Radiological Control Manual*, as well as a number of radiological control management control procedures (MCPs). These documents are intended to ensure proper implementation of and compliance with 10 CFR 835 regulatory requirements.

OA's evaluation of implementation of the first four core functions of ISM for maintenance work at ATR focused on safety performance during a planned outage to reconfigure experiments within the reactor core. OA observed a variety of maintenance work, including planning and execution of activities associated with experiment handling, various system and component repairs, routine outage-related preventive maintenance and inspections, scaffolding installation, and certain system calibrations needed for restart. Although OA's review of ATR radiological work planning and control encompassed both operations and maintenance activities, most of the radiological work that OA observed was related to maintenance. Consequently, while some elements of OA's review of radiological control functions would apply to both operations and maintenance functions—such as Radiological Control Information Management System (RCIMS) radiation work permit (RWP) entry control and as-low-as-reasonably-achievable (ALARA) reviews—these elements are presented in this section on maintenance.

Core Function #1: Define the Scope of Work

Maintenance work within ATR is clearly defined. ATR uses an integrated schedule, updated daily, that lists maintenance tasks with an expected start/finish time, resources required to perform the work, and critical-path tasks necessary to support facility mission requirements. Specific maintenance tasks are also clearly defined for the workers. The STD-101 process used for planning maintenance work is an effective and mature system. Work scope descriptions and the general sequence of tasks to be performed are clearly identified with a Passport work order traveler and associated work order documentation. Required craft specialties, training, locations of the work, and special tools are appropriately identified in the work package.

While work scopes are clearly defined, some weaknesses in scheduling of critical tasks by shop supervisors (more detailed control of specific tasks as opposed to work orders) contribute to inefficiencies in accomplishing work. Delays in performing work because radiation control technicians (RCTs) or quality inspectors are not available contribute significantly to inefficiencies in completing maintenance tasks. In some cases, these delays are caused by not adequately managing the sequence of events at the task level (shop supervisor coordination) and not ensuring that personnel are committed to the task when the schedule is approved. These inefficiencies may contribute to some internal perceptions that the STD-101 process is too rigorous for much of the work performed at ATR and could lead to pressure on management to relax the requirements and erode the effectiveness of a mature work control system.

In one case (i.e., Planned Work Order 87667 for the Heat Exchanger relief valve 3-year inspection), the work package included a larger-than-required scope, resulting in conflicting or incorrect hazard controls. Because the work package attempted to integrate operations activities (draining the heat exchanger) with maintenance activities (replacing the relief valves), it analyzed hazards and included conflicting controls that were beyond the scope of the maintenance work. The broader scope would have also required operators who drained the heat exchanger to be part of the maintenance pre-job briefing. These personnel and the RCT performing the pre-job survey were initially excluded from the pre-job briefing. RCT personnel were included in the second day briefing. The inclusion of the draining procedure in the work order would also require including the procedure in the workability walkdown; however, the procedure was not included.

Summary

The scope of work for maintenance work within ATR is clearly defined and sufficiently detailed to enable appropriate hazard identification. In some cases, maintenance work scopes may be overextended into operations activities, making subsequent planning efforts more difficult and contributing to scheduling problems.

Core Function #2: Analyze the Hazards

Hazards associated with most maintenance work at ATR are well characterized and documented. Facility-level hazards for ATR are addressed in the facility safety analysis report (SAR). Radiological hazards and a variety of industrial hazards are encountered during normal work at ATR. Activity-level hazards assessments for all maintenance work are tailored to the activity through the STD-101 work control process, and hazards are analyzed in accordance with that process. Most maintenance work packages contain an appropriately tailored listing of hazards for work to be performed and the associated controls.

Radiological hazards are analyzed using a graded approach through the institutional RWP and ALARA review processes. Routine radiological hazards are analyzed and documented in RWPs. The RWP process requires current radiological surveys to be available and reviewed before entry into radiological areas. ATR radiation control personnel rigidly enforce this requirement and ensure that workers are briefed on the current survey map before permitting them to sign in on RWPs. For higher-hazard work (i.e., exceeding pre-defined dose or contamination thresholds), a formal ALARA review is performed by a professional radiological engineer, and the results are incorporated into the RWP.

Hazards analysis in support of maintenance work was appropriately performed in most cases reviewed by OA. For example, a job to repair a high point vent valve in the nozzle trench appropriately considered potential high system temperatures, high system pressures, and heat stress. In another example, work to repair a primary pump check valve indication included analysis of such hazards as inadequate lighting, heat stress, elevated work while standing on the check valve, and potential noise hazards. A third example was the inspection of the primary coolant system pumps. The work packages appropriately identified hazards associated with elevated work on ladders, potential heat stress or high noise, access to confined spaces, and control of floor openings. Each of these jobs was supported by appropriate radiological surveys. In these cases, no unanalyzed hazards were identified during OA's observation of the work.

Two cases were observed in which inadequate analysis of the radiological hazards resulted in potentially inadequate radiological controls for the work. In the first case, the ALARA review did not adequately consider the potential for dose rates and doses to both the whole body and extremities that would require supplemental dosimetry for the work. In the second case, insufficient analysis of radiological hazards associated with glovebox work resulted in ATR not implementing several MCP requirements for radiological control. These examples are further discussed below.

MCP-189 provides several criteria to determine whether multiple dosimeters are needed to assess non-uniform deep dose equivalent to the whole body and whether extremity dosimeters are needed to assess shallow dose equivalent to the extremities. Radiological engineers consider a series of questions posed by the ALARA review checklist to aid in making these determinations. The ALARA review for the 2D SW V-52 valve repair did not adequately consider some of these elements and the possible need for multiple dosimeters or extremity dosimeters. Specifically, the ALARA review form for the work indicated that dose rate gradients were not expected to meet the criteria for multiple dosimeters and that workers were not expected to access equipment where surface dose rates and doses to the extremities would require extremity dosimeters. However, the basis for these determinations is not documented in the ALARA review. The expected duration for the job is not included, so it is unclear how dose estimates were calculated from available dose rate information. There are no institutional expectations addressing the approach or level of documentation required to support ALARA reviews.

Radiological survey data and preliminary dosimetry results for this job indicated that multiple dosimeters and extremity dosimeters may have been needed for at least one of the workers based on his orientation. Pre-job survey data showed a 100 mrem/hr field approximately 1 inch from a pipe, and a corresponding 60 mrem/hr field approximately 1 foot away from that same pipe. During the work, the worker's head and shoulders were positioned close to that pipe. The dosimeter on the worker's chest was located outside the 100 mrem/hr field, and probably beyond the 60 mrem/hr field. Consequently, the actual whole body dose may have exceeded the dose recorded by the dosimeter worn on his chest by more than 50 percent, and would require multiple dosimeters according to MCP-189. Similarly, while not monitored, the job duration and survey data indicate that extremity doses could have exceeded the MCP-189 criterion for use of extremity dosimeters; the criterion specifies extremity dosimeters when the expected dose to an extremity is more than 5 times the whole body dose and the expected exposure rate to an extremity is 400 mrem/job.

The criterion in MCP-189 that expected dose to an extremity must be more than 5 times whole body dose may not be conservative and may not ensure compliance with the regulatory threshold requiring extremity monitoring (5 rem/yr) because it is based on a presumption that workers will not exceed the INL administrative control level of 700 mrem annual whole body dose during the year. That is, a worker receiving less than 700 mrem/year could not possibly exceed 5 rem/year to the extremities as long as the shallow dose rate is less than 5 times the whole body dose rate. This assumption is not explicit in the procedure and is not understood by most radiological control personnel. If a worker were to exceed the 700 mrem/year administrative control limit, he/she could easily exceed 5 rem/year shallow dose, regardless of the whole body to shallow dose ratio. There are no warnings in the procedure to ensure that radiological engineers consider the potential for exceeding the annual control limit when determining the need for extremity monitoring.

The second example relates to the use of ATR loop transmitter cabinet gloveboxes during transmitter calibrations. The analysis of radiological hazards and required controls associated with loop transmitter cabinet gloveboxes did not comply with INL technical documentation standards, resulted in operational glove change practices that conflicted with institutional requirements, and did not appropriately consider air monitoring requirements. This concern applies to several ATR experiment loops where gloveboxes are used as containment devices for radiological control. MCP-199 requires glove changes at least every

6 months. In September 2001, the ATR engineering manager issued a memorandum to the Radiation Control Manager that changed the replacement frequency to "inspect and replace all gloves anticipated to be used, prior to the scheduled outage." The memo was intended to implement the MCP provision that allowed for an alternate frequency defined in an approved operational procedure or technical basis document. There were a number of deficiencies with the memo and its implementation. First, it did not meet various INL MCP requirements for preparation, handling, and review of Scientific Information Products and Technical Analyses and should have been prepared as an Engineering Design File Document rather than a memorandum. Second, it did not specify an interval for requiring periodic glove changes, as required by MCP-199. Third, the specified replacement criteria were insufficient (i.e., gloves were not to be changed at a specified frequency, but only when they failed a visual inspection). As a result of these concerns, all loop transmitter calibration work was formally stopped pending review and resolution of the concern. Before resuming work, the facility decided to follow a more conservative interpretation of the technical memorandum, which required changing all the gloves used during the outage.

The potential for airborne radioactivity as a result of glovebox failures has not been adequately analyzed in accordance with MCP-352, *Determining Radiological Air Monitoring Requirements*. No radiological air monitoring of the room is performed during work in gloveboxes. Without performing the required analysis, there is no technical basis for the lack of air monitoring.

Finding #1. Analysis of potential radiological hazards associated with non-uniform radiation fields and glovebox failures has not been sufficiently rigorous to ensure that these hazards are adequately controlled.

The loop transmitter glove concerns discussed above represent multiple systemic deficiencies, including failure to properly implement several MCP requirements and failure to recognize and ensure compliance with requirements consistent with nuclear facility expectations for conduct of operations. While facility management took appropriate action to follow requirements when brought to their attention, no timely action was noted to characterize the problems and enter a problem issue report form into the site corrective action tracking system database, Issue Communication and Resolution Environment (ICARE), for reportability and Price-Anderson Amendments Act screening, root cause analysis, extent of condition, and needed corrective actions. (See Finding #6 in Appendix D.)

Summary

The STD-101 process, coupled with institutional RWP and ALARA review requirements, provides an appropriate framework for analysis of radiological and non-radiological hazards associated with ATR maintenance work. For two aspects of an otherwise effective radiation protection program, incomplete or ineffective analysis of some radiological hazards resulted in potentially deficient controls in the areas of external dosimetry, glovebox integrity, and air monitoring. However, the vast majority of hazards associated with maintenance work were appropriately analyzed.

Core Function #3: Develop and Implement Hazard Controls

The STD-101 work control process effectively identifies the appropriate hazard controls for maintenance work at ATR. Controls for identified hazards are clearly delineated in the work orders, RWPs, and procedures. In work orders and procedures, controls are directly associated with the hazards in a table, and are often integrated into the applicable work steps. Typical controls include lockout/tagout boundaries, radiation control surveys, training, pre-job briefings, hearing protection, and personal protective equipment (PPE).

Many hazards are effectively removed or minimized before work begins, particularly with regard to radiological hazards. Extensive use of current surveys and decontamination efforts prior to work were apparent during the work that OA observed. Engineered controls, such as supplemental ventilation by high-efficiency particulate air (HEPA) vacuums, glovebags, and drip containments, were appropriately used where practical, rather than relying on PPE. Much of the most hazardous work performed by crafts, such as experiment handling, is done with engineered systems. There is extensive use of tool sleeving for contamination control purposes for both reactor top and canal work. ATR implementation of lockout/tagout controls was rigorous and effective. For the 2D SW V-52 task, lockout/tagout logs were kept up to date, and all individuals involved in the job appropriately verified the status of the de-energized/de-pressurized components before hanging locks on the assigned lockbox.

Procedures are used for nearly all maintenance work within ATR. Procedures are appropriately detailed and accurately reflect the work to be performed. Detailed procedure steps are written at a level that reflects craft skill and training, while ensuring that work is properly performed as approved. Procedures include appropriate hold points for safety and quality.

To control radiological work, ATR makes good use of the powerful RCIMS electronic radiological control records database management program to manage RWPs, control entry into radiological areas, and track personnel and task-specific doses. The system tracks all individual entries on RWPs, requires workers to review specific PPE requirements and contamination/dose/dose rate limits, grants or rejects entry based on predefined criteria (e.g., radiation worker training status or cumulative dose), and allows preparation of a variety of reports (e.g., providing information about the effectiveness of work planning and radiological controls).

RCTs appropriately perform and document radiological surveys and monitoring in support of the radiological control program. Radiological surveys are conducted frequently at ATR in support of specific jobs and as part of a routine survey program. For the observed work, surveys were conducted in an appropriate manner and documented on required survey forms. Job-specific air sampling was also performed effectively for tasks that had a known potential for airborne activity. Both the 2D SW V-52 and the 213-JE-V-81 valve repairs had excellent placement of the air sampling head, which provided essentially the same coverage as would have been provided by a breathing zone lapel air sampler. Air sample calculations were completed correctly, and survey forms were legible and complete.

While generally effective, a few deficiencies in application of controls were identified. Some minor deficiencies were identified in hazard controls in one procedure. *Preoperational Inspection Of Crane/Rigging/Cask Attachments* lists a safety harness under Section 3.2, Special Tools, Equipment, Parts, and Supplies. However, the operator did not have a safety harness when performing inspections of the crane outside the rails on the catwalks. The operator believed the safety organization had reviewed the work and determined that a safety harness was not required for the portions of the crane accessed during the inspection. The procedure does not define when a safety harness would be required. The areas of the crane above the operator's cab that may be accessed without fall protection had not been documented or otherwise delineated.

Some RWPs with similar work scopes did not have similar controls to prevent the potential spread of contamination. For example, RWP 31004652, which covers RCT surveys in ATR and support buildings, specifies surgical gloves for handing and retrieving items across a contamination area boundary. However, the same requirement is not repeated in the RWP for performing work, and an RCT was observed using only his bare hands while holding a plastic bag used to accept potentially contaminated items from the mechanics. Similarly, the RWP for contamination area reach-overs requires performance of a whole body frisk upon exit, whereas the RWP for loop transmitter calibration does not contain the same requirement for contamination area reach-overs during this task.

A systemic concern was identified in controls for non-radiological hazards encountered by RCTs performing pre-job surveys. RCTs are generally the first individuals allowed to enter an area during an outage to obtain accurate, up-to-date radiological survey data. However, this work is not usually performed as part of the work package or other procedure that identifies the hazards and controls associated with such entry. The RCT foreman attempts to capture this type of information in a pre-outage electronic mail identifying areas to be accessed and any necessary controls. However, the process is not formalized, does not fit into a defined work control process, and does not always identify all the required controls. In one case, an RCT used installed scaffolding to perform a survey of elevated areas without a proper scaffolding inspection**.** Occupational Safety and Health Administration (OSHA) regulations and INL procedures require scaffolding to be inspected by a competent person prior to use. In another case, an RCT entered a non-permit (appropriately designated) confined space to perform surveys without the required pre-job briefing in accordance with the confined space entry procedure.

Finding #2. ATR does not have a process for identifying controls for non-radiological hazards for RCTs entering spaces to perform surveys.

Summary

With a few exceptions, use of the STD-101 integrated work control process has been effective in identifying the appropriate hazard controls for maintenance work at ATR. Engineered controls, individual monitoring, the RCIMS database, extensive surveys, and procedures are significant strengths at ATR. Controls for some activities, such as RCT surveys, are not always adequately implemented by existing work control processes.

Core Function #4: Perform Work Within Controls

In most cases, readiness to perform work is effectively verified and controlled through the plans of the day, plan-of-the-day meetings, and pre-job briefings. Pre-job briefings for ATR maintenance are generally effective in communicating work hazards and controls.

Most work observed by OA was performed by qualified personnel in accordance with approved procedures. For example, during work to troubleshoot and repair the primary pump check valve indication, workers appropriately stopped troubleshooting in accordance with the procedure once the problem was determined, and contacted the engineer and planner for a work order change. Workers used the appropriate fall protection specified in the work package and followed all identified radiological controls. In another case, workers inspecting two fans in the fan room identified that the room was posted as a high noise area. Although there was clearly no noise hazard because the fans were shut down and tagged out (per the work package), the workers used hearing protection in accordance with the posting and submitted a comment on the completed work package to revise or review the hearing protection posting on the fan room. For the high point vent valve repair in the nozzle trench, workers appropriately avoided potential high dose rate areas, used the engineered controls specified in the RWP to prevent airborne contamination, and used secondary barriers between pressure points when kneeling or sitting to perform the work. Hold points for quality assurance and radiological controls were observed and followed when specified in the procedures and work packages.

Some minor problems were observed with workers not following procedures. For example, some deficiencies were observed during the daily inspections of the 40-ton overhead gantry crane per the procedure *Preoperational Inspection Of Crane/Rigging/Cask Attachments*. This procedure is a "use type 1" procedure. As defined in MCP-2985, use type 1 procedures contain steps that are signed off or initialed as they are performed. Although the heavy equipment operator performed all steps in the procedure while carrying out the inspection, he did not know what the use type 1 designation meant and thus did not sign off the steps of the procedure as they were completed.

Some weaknesses in contamination control and ALARA implementation were identified during a few maintenance jobs. For example, workers did not survey their hands or treat them as potentially contaminated upon removal from glovebags and gloveboxes before handling clean items. The doffing station in the fan room is set up so that workers inside the contamination area must reach across the boundary to open a door while exiting the area, so they could inadvertently spread contamination to a clean area. On the 2D SW V-52 job, some necessary tools and equipment were not effectively pre-staged before starting the valve repair, resulting in some unnecessary delays during this relatively high dose job. Lastly, a worker was observed self-frisking with the instrument set on a scale too high to detect low levels of contamination.

There were also isolated instances where work was not performed in compliance with all required controls. For example, workers did not follow RWP requirements to don long plastic gloves that cover the entire arm before using a glovebag during experiment handling. Workers on several jobs did not tape the outer pair of anti-contamination gloves, in conflict with posted instructions and radiation worker training. The outer gloves were not taped, in order to facilitate frequent glove changes, but the procedure had not been modified to accommodate this practice. The pre-job briefing for the 2D SW V-52 valve repair did not cover some required items, such as review of material safety data sheets, error precursor checklists, and lessons learned. In addition, chemical goggles were not worn as required by the work order for this job.

Summary

Maintenance work at ATR was performed safely and in accordance with required controls. A few isolated examples were identified where workers did not follow verbatim requirements or exercised potentially poor contamination control practices. However, other controls, such as engineered controls and extensive decontamination and survey practices minimized the safety impact of these actions.

C.2.2 Operations

OA's review of the application of the core functions for ATR operations included experiment loop rounds and operations, main control room activities, secondary cooling water valve alignments (including confined space entries), heat exchanger drain and fill activities, and building truck confinement airlock operation. During these activities, OA observed the implementation of associated institutional, facility-level, and activity-level work control and hazards analyses processes and procedures.

Core Function #1: Define the Scope of Work

The scope of operations work at ATR is clearly defined through detailed task-specific operating procedures. The operations procedures specifically describe the scope of work for discrete activities. When new activities or revisions to existing processes are needed, ATR uses document action request forms to request new procedures or procedure revisions. These forms provide a detailed scope of the new or revised work, which becomes the basis for subsequent hazards analysis and identification of controls, and results in new or revised technical procedures and permits containing the appropriate task-specific scopes of work. ATR uses reactor cycle and experiment control documents to effectively define and sequence reactor and experiment cycle run requirements. For example, the current reactor cycle control document lists all prerequisite requirements for the various phases of start-up (required valve lineups, establishment of system parameters, surveillance requirements for mode changes, and startup requirements and reactor parameters unique to the cycle). Operations activities for the outage or maintenance interface work are adequately scheduled on plan-of-the-day schedules.

Summary

Overall, operations activities have effective operating procedures and schedules in place for defining the scope of work.

Core Function #2: Analyze the Hazards

At the facility level, the SAR provides the appropriate facility-level hazards analyses for operations activities (see Appendix E for discussion of efforts to enhance the SAR in ensuring system functionality). At the activity level, ATR uses the corporate hazards analysis process to effectively identify operational hazards. In most cases, activity-level hazards analyses for operations work are performed and documented during procedure development and review using the process defined in the MCP, *Hazard Identification Analysis and Control of Operations Activities*. The process uses a hazard evaluation group made up of applicable safety professionals and workers to review and walk down the procedure. The hazards and associated controls are then documented in a job safety analysis (JSA) for that procedure. Most of the operations activities have been performed in a similar manner for some time and thus are well understood and analyzed, and the existing JSAs are generally adequate to cover the major processes.

The hazards analysis process has improved over the last few years, and the improvement in quality is apparent in review of JSAs over the last five years (the review cycle for most operations procedures and associated JSAs). For example, a JSA developed five years ago for the primary heat exchanger secondary cooling water drain procedure (a procedure performed during a job reviewed by OA) did not identify all confined space hazards, resulting in omission of appropriate controls in the operating procedure. However, the JSA developed for the valve lineup to refill the heat exchangers, which was revised a year ago, appropriately addressed the confined space.

When hazards imposed by facility operations might affect other activities, operations staff effectively use established hazards analysis processes, such as safe work permits, to identify operational hazards and controls for the non-operations jobs. For example, a shift foreman developed and issued a safe work permit for a maintenance post-job inspection entry to a primary cubicle with the system at pressure. The shift foreman appropriately considered the hazards involved, obtained industrial hygiene/industrial safety input for specific controls, and performed a pre-job briefing with the worker to describe the controls associated with pressure hazards from the system operation.

Summary

The processes for identification and analysis of operations hazards are generally well established and documented. Facility-level hazards associated with operations are analyzed through the authorization basis process, and the corporate hazards analysis process for operations activities provides a consistent and comprehensive method for performing and reviewing activity-level hazards. Consequently, most hazards associated with operations activities have been adequately identified and analyzed.

Core Function #3: Develop and Implement Hazard Controls

Engineered controls are used for many of the hazards associated with operations at the ATR. For example, buildings are designed to provide extensive shielding and prevent contaminants from being released to the environment. For hazards not eliminated or mitigated by the engineered controls, ATR effectively implements appropriate administrative controls and/or PPE in most cases to control the hazards. The most prevalent administrative control for operations activities is use of procedures. Other commonly used administrative controls include postings, RWPs, and access controls.

The ATR process for operations procedure development, review, approval, use, and modification provides a comprehensive system to ensure that technically accurate procedures with appropriate ES&H controls are provided to and appropriately used by operators. As discussed under Core Function #2, the procedure review process requires a hazards analysis and JSA for all new and revised procedures. This process includes peer reviews, ES&H discipline reviews, and validation. The INL *Conduct of Operations Manual* chapter on procedure adherence (chapter 16) and the ATR-specific supplemental procedure on procedures (MCP-2241) establishes a program for strict adherence to procedures and lays out comprehensive management expectations for use of procedures. However, in one case, the MCP addressing ATR-specific requirements for operations procedures (MCP-2241) provides confusing instructions for "use type 2" procedures. This problem was also recently identified by ATR and entered into the ICARE corrective action tracking system, and management is taking appropriate action to address the problem.

The rigorous development process has resulted in operations procedures that are generally high quality and technically accurate. Procedures follow a consistent format, appropriately use precaution and limitation sections, and contain specific hazard control requirements within the body of procedures. When problems are identified, operations management takes appropriate actions to promptly address the deficiencies. For example, a precaution in the Experiment Loop Shutdown and Startup procedure refers to cubicle entry requirements in another document; however, those requirements had been deleted, and the precaution had not been revised to address the deleted requirements. As a result of this observation, operations management initiated appropriate action to address the precaution in a new procedure addressing cubicle entries.

Although most hazards are appropriately controlled, the OA team identified deficiencies in compensatory measures for the lack of fire alarm coverage in some areas of the reactor building, controls for non-permit confined spaces, and the classification of permit-required versus non-permit-required confined spaces.

The first concern relates to periods of reactor shutdown, when many areas that are otherwise locked high-radiation areas at power or not normally occupied are accessible to personnel. In several of these areas, fire alarms cannot be heard, and there is no mechanism for ensuring that personnel in these areas are notified of alarms. For example, ATR has had problems in the past when workers in the heat exchanger area could not hear alarms and did not evacuate during a fire alarm. The ATR Facility Representatives raised this as a finding several years ago; however, the corrective actions were never effective in establishing a permanent solution, and the interim actions implemented at that time were subsequently dropped. (See Finding #6 in Appendix D for further discussion on the ineffective corrective actions.)

Finding #3. ATR has not established appropriate controls to ensure that all workers are promptly notified of fire alarms in areas where the alarms cannot be heard.

The other concerns relate to confined space controls. First, the corporate procedure on confined spaces (MCP-2749) provides confusing and incomplete requirements for entry into non-permit confined spaces. The procedure provides an example sign for non-permit confined spaces, which states that a safety review is required prior to entry, and these signs are used within ATR to identify non-permit confined spaces. However, the procedure and ATR do not have any further clarification as to requirements for or explanation of safety reviews for non-permit confined space entry, and most ATR workers who were questioned could not define what the required safety review encompasses. The industrial hygiene evaluations of confined spaces are documented on Confined Space Identification and Hazard Evaluation Forms. However, a second concern is that completed Confined Space Identification and Hazard Evaluation Forms are quite old in some cases, and the procedure provides no requirements for review (e.g., at a specified frequency or before use). Consequently, by the current procedures, a confined space that has not been entered in many years could be entered without performing a new Confined Space Identification and Hazard Evaluation Form to evaluate whether conditions have changed. In another concern, the index for the web-based database (the confined space inventory) does not match the actual confined space numbers in all cases. For example, the Confined Space Identification and Hazard Evaluation Form index listed ATR Bldg 670 heat exchanger pit M-85 as confined space TRA-CS-548, but the actual Confined Space Identification and Hazard Evaluation Form was labeled as confined space TRA-CS-545. In addition, this confined space has another designation, TRA-CS-378, on a different Confined Space Identification and Hazard Evaluation Form that has a more recent approval date than TRA-CS-545 and was actually used in the work package for draining the heat exchanger. (See Finding #4.)

As a result of these observations, the operations manager issued a Timely Order to Operators as an interim measure to address some of the problems. Specifically, this order defines the requirements for a safety review for a non-permit confined space entry, requires that the Confined Space Identification and Hazard Evaluation Form for a non-permit space be reviewed, requires that a new Confined Space Identification and Hazard Evaluation Form be completed by industrial hygiene if the existing one is dated earlier than January 1, 2004, and provides requirements for the pre-evolution briefing.

Finally, OA determined that ATR has incorrectly classified many confined spaces as non-permit-required confined spaces. ATR has numerous pits, sumps, and manholes where there is a potential for a hazardous atmosphere because of insufficient ventilation in combination with rusting equipment depleting oxygen, biological activity depleting oxygen, or potential accumulation of toxic gases (such as nearby vehicle exhaust). For example, the primary heat exchangers' secondary cooling water outlet valves are located in a 20-foot-deep covered pit accessible only by a permanent ladder and with no installed ventilation. This space contains equipment susceptible to rust (similar to a confined space with confirmed oxygen depletion documented in an August 20, 2001, lesson learned) and is located immediately adjacent to vehicle parking, potentially exposing it to vehicle exhaust. To enter, operators must establish portable ventilation to control the potential hazard of oxygen deficiency and purge any toxic gas buildup. In this case, the Confined Space Identification and Hazard Evaluation Form (TRA-CS-008) did not address the potential atmospheric hazards and classified this space as a non-permit confined space. This particular form allows the atmospheric test to be waived if the space has been ventilated for 30 minutes prior to entry and the space is ventilated during entry. In accordance with the conditions on the form, an operator entered this pit to operate the valves without atmospheric testing. Although OSHA regulations and the corporate procedure on confined spaces allows use of alternate procedures in lieu of a permit in these cases, they do not allow reclassification of these confined spaces as non-permit and do not allow waivers of certain controls, such as atmospheric testing. The regulation and MCP-2749 make the distinction between eliminating and controlling hazards and allow reclassification to non-permit only if all hazards are eliminated. MCP-2749 and OSHA regulations specifically state that control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. By incorrectly classifying the secondary header pit as non-permit, important controls required for permit-required confined spaces, such as atmospheric testing and more extensive hazard evaluation, are missed.

Other hazards are also not properly addressed by the evaluations, resulting in incorrect classification of confined spaces. In some cases, pits and vaults are 10 to 20 feet deep; however, the corresponding evaluations do not consider fall hazards. For example, the diesel day tank vault (TRA-CS-004) is 10 feet deep and contains a large diesel fuel tank and associated piping in tight quarters. Although the potential exists for a worker to fall and become wedged between the tank and the wall, the evaluation does not address fall hazards, and the vault is incorrectly classified as non-permit. Finally, some evaluations clearly identify hazards or conditions that would cause a confined space to be permit-required, but the evaluation incorrectly classifies these spaces as non-permit-required. For example, the evaluation for a 12-foot-deep vault (TRA-CS-531) checks "yes" for the potential for an oxygen-rich or depleted atmosphere, but classifies the space as non-permit. In another example, the evaluation for a 6-foot-deep vault (TRA-CS-409) states that "physical characteristics, hazards, and processes associated with this space are unknown," but classifies this space as non-permit-required.

Although MCP-2749 goes beyond OSHA requirements for non-permit-required confined spaces by applying requirements for atmospheric testing, this practice does not meet the necessary rigor for incorrectly classified spaces (i.e., requirements for evaluation of all real and potential hazards to workers in permit-required spaces). In addition, one of the provisions for waiving the atmospheric testing for non-permit-required spaces is that the spaces are ventilated and the ventilation is sufficient to maintain a safe atmosphere. As discussed previously, ventilation can only be used to control atmospheric hazards in a permit-required space, not eliminate them to allow classification as non-permit spaces. Management attention is needed to ensure that workers in confined spaces are adequately protected.

Finding #4. INL has not ensured that clear and unambiguous requirements for confined spaces are consistently applied at ATR to minimize the risk to workers, consistent with the intent of OSHA regulations.

Summary

A few specific aspects of operations warrant additional improvements, including communication of fire alarms, the corporate process for controlling entries to non-permit confined spaces, and conservative application of the requirements for classifying confined spaces. However, in most cases, appropriate controls are established and effectively implemented for recognized hazards. Controls applied to operations activities are effective and well designed to control the hazards. The ATR procedure development, review, approval, use, and modification process provides a comprehensive system to ensure technically accurate operations procedures with appropriate ES&H controls, and the reviewed operations procedures were well written, technically accurate, and contained the appropriate information and level of detail to perform tasks safely.

Core Function #4: Perform Work Within Controls

Readiness to perform operations activities is effectively verified on a daily basis through plan-of-the-day schedules, shift turnover activities, crew briefings, and pre-job briefings. For example, shift turnover in the main control room was performed efficiently and effectively. Operations staff effectively used shift turnover sheets to relay plant status. Oncoming operators appropriately reviewed plant conditions, ongoing work, logs, and orders. Following turnover, the shift supervisor conducted a crew briefing to ensure that all personnel were aware of conditions and to discuss planned work for the day.

Operations activities are generally performed safely and in accordance with established controls. For example, during a primary heat exchanger secondary cooling water valve lineup, vent, and fill operation, comprehensive pre-job briefings were conducted by the shift foreman for the operations evolution and by the RCT for the locked high-radiation area entry. Operators followed established controls for the non-permit confined space entries, such as ventilation requirements (although the established controls may not have been appropriate, as described above under Core Function #3). Operators followed the valve lineups and procedures as required, including use of plastic sleeves and erasable markers on the procedures.

Operators carry out control room activities professionally and in accordance with conduct of operations requirements. Logs are concise, neat, and orderly; communications are clear; repeat-backs are used extensively; access control to the main control room and experiment loop control area is consistent, with permission always required before entry; status boards are complete and up to date; key control logs are appropriately maintained; and data sheets are kept when required, with legible entries and appropriate corrections when necessary. In the only observed deficiency in otherwise rigorous control room operations, the out-of-date precaution (regarding cubicle entries) discussed under Core Function #3 had been signed off as reviewed by three separate senior operators over three shifts, but the problem with the precaution had not been noted.

Summary

Overall, operations activities are performed within established controls, and operators understand the associated hazards and the importance of procedural compliance.

C.3 Conclusions

Implementation of the ISM core functions at ATR is generally effective for both maintenance and operations. Engineered controls are used extensively and appropriately where feasible. PPE and administrative controls are implemented effectively, with few exceptions. ATR has a mature system of detailed procedures that clearly define safety controls for most hazards, and ATR personnel demonstrated a safety-conscious approach to performing work, including rigorous adherence to procedures. Although generally effective, additional management attention is needed in a few aspects of radiation protection, correction of fire alarm deficiencies, and implementation of confined space requirements.

ISM implementation for maintenance work at ATR is effective and mature. STD-101, *Integrated Work Control Process*, is the primary mechanism for implementation of ISM at INL. The STD-101 process for developing, reviewing, and approving maintenance work has been in place for several years. Supervisors, planners, and craft personnel are all familiar with the requirements, and they work together to ensure that work is performed safely. All work observed during this assessment was conducted by qualified personnel in accordance with approved procedures. Personnel responsible for and performing maintenance work demonstrated a firm culture of nuclear safety. The scope of work for maintenance work within ATR is clearly defined and sufficiently detailed to allow appropriate hazard identification. The STD-101 process, coupled with institutional RWP and ALARA review requirements, provides an appropriate framework for analysis of radiological and non-radiological hazards associated with ATR maintenance work. With a few exceptions, use of the STD-101 integrated work control process has effectively identified the appropriate hazard controls for maintenance work at ATR. In a few cases, incomplete or ineffective analysis of some radiological hazards resulted in potentially deficient controls in the areas of external dosimetry, glovebox integrity, air monitoring, and RCT entries. However, engineered controls, individual monitoring, the RCIMS database, extensive surveys, and procedures are significant strengths at ATR.

ATR operations activities have good operating procedures and schedules in place for defining the scope of work. The processes for identification and analysis of operations hazards are generally well established and documented. Facility-level hazards associated with operations are analyzed through the authorization basis process, and the corporate hazards analysis process for operations activities provides a consistent and comprehensive method of identifying and reviewing activity-level hazards. Consequently, most hazards associated with operations activities have been adequately identified and analyzed. In most cases, appropriate operational controls are established and implemented for recognized hazards. The ATR procedure development, review, approval, use, and modification process provides a comprehensive system to ensure technically accurate operations procedures with appropriate ES&H controls, and the reviewed operations procedures were generally well written and technically accurate, and contained the appropriate information and level of detail to perform the tasks safely. However, communication of fire alarms is inadequate in some areas of the reactor building, the corporate process for controlling entries to non-permit confined spaces had several deficiencies, and requirements for classifying confined spaces have not been conservatively applied. Notwithstanding these isolated deficiencies, most operations work was performed within established controls, and operators understood the activity hazards and the importance of procedural compliance.

C.4 Ratings

The ratings for the first four core functions are presented separately for the activities reviewed (maintenance and operations) to provide ATR management with information on the effectiveness of organizations and the implementation of the various core functions.

See top of next page for Core Function Ratings.

ATR ACTIVITY	CORE FUNCTION RATINGS			
	Core Function #1 – Define the Scope of Work	**Core Function #2 – Analyze the Hazards**	**Core Function #3 – Develop and Implement Hazard Controls**	**Core Function #4 – Perform Work Within Controls**
Maintenance	Effective Performance	Effective Performance	Effective Performance	Effective Performance
Operations	Effective Performance	Effective Performance	Effective Performance	Effective Performance

C.5 Opportunities for Improvement

This OA inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management, and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

Radiation Protection

1. **Improve personnel contamination control practices.** Specific actions to consider include:

   - Emphasize the need to treat hands as potentially contaminated when removing them from glovebags or gloveboxes.
   - Ensure that workers who do not often enter contamination areas remain proficient in self-frisking practices.
   - Ensure that all step-off pads are located so that workers do not have to reach across contamination boundaries to properly exit a control point.
   - Revise RWPs to include modified glove taping requirements where appropriate so that personnel do not have to violate the posted donning procedure.

2. **Improve current practices associated with radiological hazards analysis for non-uniform radiation fields and glovebox integrity.** Specific actions to consider include:

   - Modify MCP-189 to include a warning to ensure that radiological engineers understand that the potential for annual whole body doses in excess of the administrative control limit could render the criteria and assumptions inaccurate, resulting in a need for more conservative application of extremity monitoring criteria.
   - Establish worksheets to be used by radiological engineers for computing task-specific projected doses to be used in determining the need for such controls as multiple and extremity monitoring.
   - Consider adapting the requirements of MCP-2374 (related to documenting assumptions) for use in performing ALARA reviews, so that the basis for decision-making and controls is clear.
   - Conduct root cause analysis to determine the reasons for failing to follow all applicable MCPs related to RCT documentation and determination of radiological air monitoring requirements for permanently installed glovebox work.

- Prepare an Engineering Design File Document to replace the current memo and establish an appropriate frequency for periodic glove changes for ATR loop transmitter cabinet gloves.

- Implement MCP-352 to assess potential source terms and determine whether there is a need to perform any type of air sampling during loop transmitter glovebox work.

Maintenance

3. **Increase efforts toward better delineation of work scope and the required interfaces between STD-101 work packages and operations activities performed using procedures.** Specific actions to consider include:

   - Revise STD-101 to address proper preparation of work packages that involve operations prerequisite work. Normally, only crafts activities need to be included in the scope of STD-101 work orders.

   - Revise STD-101 to require review of operations procedures that may be referenced in STD-101 work orders to ensure continuing adequacy of controls and provide another feedback mechanism.

   - Provide additional training to work planners regarding preparation of work orders involving operations and maintenance actions.

4. **Improve resource and task scheduling to help reduce maintenance inefficiencies.** Specific actions to consider include:

   - Use plan-of-the-day meetings to identify tasks that may be delayed due to limited personnel resources (RCTs and quality assurance). Ensure that those resources are deployed to the critical-path tasks.

   - Find methods to more efficiently share limited personnel resources between jobs.

Operations

5. **Implement a permanent resolution to the problem of areas in ATR where the fire alarm cannot be heard.** Consider proceduralizing a requirement for a verbal, building-wide announcement as an immediate action following receipt of a fire alarm.

6. **Increase line management attention to control and analysis of confined spaces.** Specific actions to consider include:

   - Increase emphasis on classification of existing confined spaces and review/update the existing Confined Space Identification and Hazard Evaluation Forms.

   - Provide guidance and expectations for conservative interpretations of what causes a potential atmospheric hazard when classifying confined spaces.

   - Implement interim compensatory measures to ensure that all presently non-permit confined spaces at ATR are reviewed against the criteria for permit-required confined spaces before further worker entries.

   - Implement a policy to consider all confined spaces as permit-required when the actual hazards are unknown.

   - Develop guidance for implementing alternate procedures for entries to permit-required confined spaces, as allowed by OSHA regulations.

   - Revise MCP-2749 to provide clear and unambiguous guidance for control of non-permit confined spaces.

APPENDIX D
FEEDBACK AND CONTINUOUS IMPROVEMENT (CORE FUNCTION #5)

D.1 Introduction

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) evaluation of feedback and improvement processes at the Advanced Test Reactor (ATR) at the Idaho National Laboratory (INL) included an examination of the DOE Idaho Operations Office (ID) oversight of the ATR and contractor environment, safety, and health (ES&H) programs and performance at the ATR. The OA team examined three areas:

- ID line management oversight, including ID roles and responsibilities, the Facility Representative program, other operational awareness and assessment activities, and ID's evaluation of contractor contractual performance. (See Section D.2.1.)

- Feedback and improvement processes managed by the contractor, Battelle Energy Alliance (BEA), such as assessments and surveillances, corrective action/issues management, injury and illness investigation and reporting, lessons learned, the behavior-based safety program, and activity-specific processes. The ATR is part of the Reactor Technology Complex (RTC) at INL. RTC encompasses the ATR and was previously called the Test Reactor Area (TRA).[1] The BEA feedback and improvement processes reviewed on this inspection are typically those applied by the ATR Programs organization and encompass ATR and other RTC facilities. (See Section D.2.2.)

- Response to engineering and unreviewed safety question (USQ) findings identified in the 2003 OA assessment at INL, focusing on the findings that have impacted ATR's design basis reconstitution effort. In this portion of the review, OA focused on the technical quality of the corrective actions as implemented by ID and BEA. (See Section D.2.3.)

[1] For simplicity, the "RTC" terminology is used in this section, although many ID and INL documents still refer to TRA.

D.2 Results

D.2.1 ID Line Management Oversight

The ID feedback and improvement programs face a number of challenges because of recent organizational changes at the Idaho complex. These changes include: the division of the Idaho Complex into INL, under the DOE Headquarters Office of Nuclear Energy, Science, and Technology (NE), and the Idaho Cleanup Project, under the DOE Headquarters Office of Environmental Management; a new prime contractor and contract for management of the INL; the transfer of the former Argonne West facilities, now called the Materials and Fuels Complex, to a part of INL, and transfer of DOE line management responsibility for Argonne West to ID; the transition of contractor personnel, organization, and processes; and several recent reorganizations in ID, including a change in the management and reporting line for the Facility Representative program. As a result of these changes, many ID feedback and improvement processes are in transition to reflect the new organizations and responsibilities.

ID's line oversight of BEA ES&H and quality assurance (QA) performance is adequately described in a set of procedures, plans, guidance documents, and individual position description documents. The ID areas of responsibility and assigned personnel for oversight of the RTC/ATR are delineated in a roles and responsibilities document. The responsibilities for assigned facility engineers, project managers, Facility Representatives, and subject matter experts are identified.

ID has used a structured process to risk-rank oversight elements and develop annual RTC Environment, Safety, Health, and Quality Assurance Oversight Plans and schedules for contractor oversight activities. This process also provides for quarterly meetings between all ID oversight elements to exchange information about contractor performance and oversight plans. ID is modifying its oversight model and issued a guidance document in September 2004 that details a risk determination process for use in oversight planning.

A formal Facility Representative staffing analysis was performed in the fall of 2004, and current staffing appears to meet the identified needs. The planned and scheduled Facility Representative oversight activities include surveillances, other operational awareness activities, and assessments developed specifically for RTC. Planning clearly identifies consideration of unique conditions, performance weaknesses, and trends in establishing oversight activities. The RTC oversight plan for fiscal year (FY) 2005 includes a schedule of activities for each quarter of the year. Work assignment goals for operational awareness and surveillance activities are defined in the plan.

RTC/ATR Facility Representatives conduct various operational awareness activities, including numerous facility walkthroughs and observation of maintenance activities and operations evolutions, attendance at plan-of-the-day and plan-of the-week meetings, reviews of Occurrence Reporting and Processing System (ORPS) reports, backshift inspections, and technical document reviews. Observations of Facility Representative activities by the OA team and interactions during the observation of contractor work activities indicated that Facility Representatives have a good knowledge of the facilities, systems, and contractor processes and appropriately interact with contractor workers and management. Facility Representative activities at the RTC are documented in monthly reports, which are transmitted to the contractor. These reports confirm that the Facility Representatives are formally identifying safety issues and communicating them to the contractor for action. When appropriate, subject matter experts from the ID operations support staff provide support for assessment and surveillance activities and consultation on issues raised during operational awareness activities.

Specific planned oversight activities of ID Laboratory Operations project personnel assigned to the RTC are integrated into the RTC/ATR oversight plan. For FY 2005, the only formal scheduled oversight activity was a "vertical slice" assessment of the reactor shutdown system. ID subject matter experts in the Quality and Safety Division of the Operations Support organization also develop oversight plans for evaluating contractor activities across the INL site, including the RTC/ATR. In response to the design basis issues identified by OA in 2003 and the contractor's implementation of the Design Basis Reconstitution (DBR) plan, DOE formed a DBR review team of ID personnel (a Facility Representative and the facility engineer) and Headquarters personnel from NE and the DOE Office of Facility Authorization Bases (EH-23) to monitor the contractor's implementation of this program. The DBR review team issued one report in April 2005 summarizing activities, findings, observations, and recommendations.

ID establishes annual ES&H performance measures and system assessment measures for its contractors in its Performance Evaluation and Management Plan. The FY 2005 plan identifies several objectives and measures, with monetary penalties for performance related to reducing operating events, effectively consolidating and implementing integrated safety management (ISM), and improving occupational injury case rates. The BEA contract also requires that the contractor develop a contractor assurance system (including ten key attributes) that is to be approved and monitored by the board of directors by the end of calendar year (CY) 2005.

Although most aspects of ID oversight are effective, several weaknesses in DOE oversight of the INL contractor were identified by the OA team:

- ID inappropriately verified and closed several DOE Corrective Action Tracking System (CATS) actions from the 2003 OA findings and recommended closure of an associated Noncompliance Tracking System (NTS) report. ID's review of the contractor's corrective action plans and completed actions for the 2003 OA findings of inadequate USQ and in-service testing processes and implementation was not sufficiently rigorous to identify deficiencies in USQ processes and testing procedures. Similarly, the contractor's corrective actions for the 2003 OA finding of an inadequate configuration management program at ATR and associated NTS and ORPS reports did not address several of the judgments of need identified in the formal root cause analysis of these issues. However, ID validated these corrective actions as effective in CATS, NTS, and ORPS and recommended closure of this NTS report to the Office of Environment, Safety and Health (EH), and the OA issue was closed in CATS. (See Section D.2.3 for discussion of corrective action management for 2003 OA safety system findings and related deficiencies identified by OA during this inspection.)

- Oversight activities and planning by various ID organizations with oversight responsibilities are not sufficiently integrated and coordinated institutionally to ensure efficiency and effectiveness. Reorganizations of oversight elements in ID in February and June 2005 and the other changes in oversight elements cited above have contributed to uncertainty and discrepancies between procedures and the existing organizational structure.

- ID, particularly the Facility Representatives, has not effectively evaluated the contractor and ensured that the contractor has consistently and properly implemented the issues management program at the RTC.

- RTC/ATR project personnel and the DBR review team do not regularly document their oversight activities in surveillance reports or communicate them formally to the contractor.

The status and effectiveness of ID safety system oversight is also discussed in Appendix F of this report and reflected in the evaluation of the overall ID feedback and improvement program. As noted in Appendix F, ID has been proactive in establishing a safety system oversight program, but the program has not been adequately defined or implemented.

D.2.2 Contractor Feedback and Improvement Systems

Assessments

BEA has defined and established a formal, institutional integrated assessment program that includes management self-assessments, inspections, and surveillances and independent assessments of safety performance. A Standard Practices procedure provides implementing instructions for management assessments for Reactor Programs. Workers, management, QA, and ES&H professionals conduct functional area independent and management self-assessments, including inspections, surveillances, and management reviews at ATR. Assessment activities are planned by identifying the mandatory assessments specified in regulations and DOE requirement documents from an institutional-level list (LST-202) and adding other elective assessment activities. As required by the institutional procedure, multiyear assessment plans have been developed for ATR Programs, including the ATR. The self-assessment plans for the RTC identify assessment topics, drivers (i.e., whether they are mandatory per LST-202 or elective), the type of assessment (inspection, surveillance, or management review), and the required frequency. A comprehensive and rigorous team management self-assessment of training was conducted last fall at RTC that identified approximately 70 issues, which were entered into the INL corrective action tracking system. Quarterly facility condition safety and health inspections are performed at approximately 50 RTC facilities with continuous operations.

ATR has implemented an effective assessment program called the senior supervisory watch (SSW) program, which requires regular management involvement in field observations and interactions with workers and work documents. Assigned SSWs, selected from a pool of about 40 supervisors and managers from all organizations, observe and assess various work activities for a full shift on each normal workday at the ATR, often with "required" observations of significant activities as determined by the Director of ATR Programs. SSW observation reports, logged into a computer database, reflect a variety of work observations that identify safety and operational problems and good practices. In most cases, problems are appropriately evaluated and addressed, including documentation in the INL corrective action tracking system. In addition to identifying and correcting deficient conditions and promoting ES&H awareness, the SSW program exposes managers and supervisors who are not routinely involved with field operations and maintenance activities to the processes, requirements, and challenges associated with application of ES&H requirements to work activities.

Some independent assessments have been performed at the RTC/ATR. These include a comprehensive institutional team assessment performed by the Facility Evaluation Board in October 2003, assessments of the QA program and the ATR Programs management assessment program in May 2005, and a recent assessment of conduct of operations led by ATR Programs staff. About two years ago, the previous contractor made a concerted effort to improve the quality of assessments performed at INL and concurrently to significantly reduce the number of assessments. Scheduled assessment activities at the RTC were reduced from 399 in FY 2003 to 101 in FY 2004 and to 86 in FY 2005. Each month, the Director of ATR programs issues a detailed report on the status and management's analysis of ten RTC programmatic performance indicators, most of which directly or indirectly reflect ES&H performance.

Although BEA conducts a variety of self-assessment activities that identify deficiencies in safety processes, conditions, and performance at the ATR, effective feedback is hindered by assessment planning and performance deficiencies. Assessment schedules and plans for some independent and management/self-assessments do not reflect the tailoring of assessment activities to the work, conditions, past performance, and vulnerabilities at the ATR.

ATR Programs has not identified and documented elements of management processes implemented by the directorate or maintained/revised multiyear assessment plans as specified in management control procedure (MCP)-9172, *Developing, Integrating, and Implementing Assessment Plans and Schedules*. Most assessment-like activities planned and scheduled for the ATR are mandated by technical safety requirements (TSRs), standards, or regulations as identified in institutional LST-202. All of the management assessments on the schedule for FY 2004, 2005, and 2006 are mandatory assessments from LST-202. The FY2004/2005/2006 schedule of inspections, surveillances, and management reviews (data analyses) improperly describes a number of required assessment activities as "elective." For example, assessments that are required as an action item for resolving issues being tracked in the Issue Communication and Resolution Environment (ICARE) system are included in elective assessments. Elective self-assessments for such groups as operations, training, radiological control, engineering, and maintenance are designated in the ATR Programs schedule without identifying a topic other than the functional area, and they are listed under a single identification number with a start date at the beginning of the year and an end date at the end of the year. In addition, using a single assessment designator does not indicate that some of these organizations perform multiple assessment activities. These practices do not reflect the rigor of planning and scheduling required by the MCP.

The areas of nuclear design and configuration management at ATR were identified as a significant weakness in the 2003 OA inspection at INL. Issues in these areas have resulted in several NTS and ORPS reports, as well as development of the DBR effort and several positive USQs. However, the planning for the needed management self-assessments in the ATR engineering organizations has not used a structured or documented process that identifies specific engineering topics for assessment. None of the reviews (four surveillances, one inspection, and two management reviews) of the generic engineering area addressed basic design control elements or processes. No institutional-level functional area manager assessments of engineering were performed in FY 2004 or FY 2005 to date. (The Facility Evaluation Board assessments of INL facilities included design control as an assessment topic, but the Facility Evaluation Board has been discontinued.) The only management self-assessment related to engineering/design control that was planned, scheduled, or performed for RTC during FY 2004, FY 2005, or FY 2006 was a part of the May 2004 QA program assessment that addressed the design control element of nuclear QA standards. This portion of this assessment focused primarily on process adequacies; it did not look at implementation documentation or the DBR effort or address other issues identified in the 2003 OA report. The QA organizations conducted a surveillance of configuration management that addressed configuration control processes in December 2004, but the evaluation of implementation was limited (e.g., in most cases application of processes was established by interviews with engineering personnel rather than examination of work products).

Many reports of ATR Programs assessments and assessment-like activities do not reflect sufficient depth or breadth or challenging lines of inquiry. Many ATR SSW reports lack sufficient detail, especially on the actions taken to resolve identified problems or references to other tracking systems (e.g., assessment input forms). Inconsistent documentation of determinations that actions "met expectations" detract from the value of SSW reports as a trending tool. For example, the same problem on subsequent days was answered as "yes" by one SSW and "no" by another.

In a number of cases, assessment lines of inquiry do not address the stated purpose of the assessment. For example, an annual management review of performance to operating goals (IAS04364) did not address the performance element but just described the process and activities of routine reporting to DOE and the client (Naval Reactors). In a surveillance of operations to "ensure procedure compliance," only one of five lines of inquiry involved actually observing work, and that one was limited to an undefined portion of one evolution. In another surveillance of "the effectiveness of reviews conducted by facility staff," which was performed to meet a TSR, the lines of inquiry and reported results primarily describe various staff review processes and contain no information about their effectiveness. A surveillance to establish whether a viable USQ program existed did not involve either reviews of any USQ determinations to establish program viability, or a review of other data (e.g., modifications or procedure changes) to identify whether USQ screening and determination evaluations were being performed when required.

MCP-1175, *Analyzing Environment, Safety, Health, and Quality Assurance Performance*, requires the performance of quarterly performance management reviews to identify trends and evaluate the quality of assessments, corrective action program issues, injuries/illnesses, and occurrence reports. The two most recent performance management reviews conducted at the RTC did not evaluate the quality of causal analyses, an element specified in the MCP. The stated reason for not evaluating this topic was that such an evaluation was unnecessary because all formal root cause analyses are performed by trained and qualified analysts. However, training and qualification do not guarantee compliance or effectiveness and do not warrant the exclusion of the topic from assessment. Further, these reviews did not address other causal analyses, such as the "apparent cause" determinations that are performed for the majority of corrective action items.

The INL institutional independent assessment program has been significantly curtailed. The Facility Evaluation Board and their periodic cross-cutting management and functional area independent assessments have been eliminated. Although several independent assessments have been performed at RTC in the past year, minimal independent assessment activity is being planned and scheduled for RTC/ATR; only one independent assessment is on the ATR Programs FY 2005 assessment schedule. MCP-9172 requires functional support managers and the INL Performance Assurance Director to identify, schedule, and perform independent assessments and has not been revised to reflect the discontinuation of the Facility Evaluation Board. However, because of BEA reorganizations, the independent oversight group and functions have been shifted from Performance Assurance to the Internal Audits and Oversight Directorate. Performance Assurance independent assessments of ES&H topics are now limited to data analysis and support, when requested, for the assessments performed by Audits and Independent Oversight. The independent oversight organization has conducted one independent assessment at the RTC/ATR and has started an institutional ISM review that includes the RTC/ATR. MCP-9172 requires that the functional support managers, assigned to almost 50 functional areas, identify and document the elements of each functional support area and develop multiyear plans to evaluate the implementation of all elements. However, the plans recently developed for the functional areas of ATR Programs/Nuclear Facility Startup/Restart and ATR Programs/Conduct of Operations only identified one element each: "Nuclear Facility Startup/Restart" (the functional area title) and "training," respectively.

Finding #5. BEA has not implemented a fully effective program of ATR assessment activities with sufficient scope and rigor tailored to ongoing activities, conditions, and past performance to ensure that ES&H performance is consistently and accurately evaluated.

Corrective Action and Issues Management

INL has established a comprehensive, risk-based institutional corrective action and issues management program in MCP-598, *Corrective Action System*. The associated issue evaluation and tracking system, ICARE, allows anyone to input potential issues for evaluation, validation, and disposition in a structured, risk-based manner. The ICARE process includes the appropriate elements of issues management. An RTC Corrective Action Review Board, composed of QA and management personnel, meets monthly to review and discuss the status and actions for current issues. This board provides an effective forum for managing issues and ensuring consistent and appropriate implementation of the corrective action processes.

Many ATR Programs/ATR ES&H issues have been put into the ICARE system for evaluation, categorization, resolution, and tracking to closure. All assessment reports are reviewed by management to determine issues to be put into ICARE and screened by the ATR Programs QA staff. In many cases, recommendations or opportunities for improvement are input to ICARE for evaluation and tracking of corrective actions.

ATR has also established a formal program for documenting and tracking the resolution of material and equipment deficiencies in the Material Deficiency Tracking System. The process is detailed in an ATR Standard Process procedure and is being implemented as required in the procedure. Employees are required to document material and equipment deficiencies on an Assessment Input Form (AIF), although deficiencies may be identified by any method or means. AIFs are screened by the ATR facility manager for categorization in accordance with MCP-598, prioritization, root cause coding, and whether it should be input to ICARE. AIFs are assigned to an owner for action and are tracked in a database to closure by an administrator. Over 500 AIFs are open at RTC (most, but not all, for ATR), and over 225 AIFs have been generated to date in CY 2005.

For consistency and simplicity, ATR management is in the process of transitioning the Material Deficiency Tracking System process to the Passport maintenance management system, which provides the correction mechanism for almost all issues documented on AIFs.

INL has established institutional procedures for event investigation and occurrence reporting (MCP-190) and critiques (MCP-165). Few operational/safety events at ATR have been reported through ORPS and the number of reportable events has been declining, due in part to the 2003 revisions in DOE Order 231.1. Authorization basis issues accounted for many of the events reported through ORPS for 2003 and 2004. Two ATR events/incidents since 2002 that were deemed not to be ORPS-reportable were formally critiqued, investigated, and documented. One of these non-reportable events was adequately documented on the critique form and documented on a Potential Issue Report (the initiator for issues into ICARE system) as required by MCP-190.

Although many ES&H deficiencies related to ATR activities are being identified, documented, and addressed using the formal issues management process, procedural and performance deficiencies limit the effectiveness of corrective action management at the RTC/ATR. As a result, identified ES&H problems are not being consistently managed or adequately analyzed to identify appropriate recurrence controls. Specific deficiencies in INL and RTC corrective action and issues management processes and performance are described in the following paragraphs.

In some cases, deficiencies in processes, performance, and physical condition are not formally documented in any tracking system, and resolution is handled informally via verbal communication or electronic mail to report the issue and its correction. In other cases, issues are not formally documented using the ICARE process at the time of discovery as required by MCP-598, but only after most or all of the corrective/preventive actions have been determined and taken. This failure to employ the formal issues management processes bypasses the formal, documented decisions regarding reportability, causal analysis, and extent of condition. In other cases, issues that were documented in ICARE were inadequately dispositioned. For example, in a number of cases, operational, work control, and other safety problems were noted in SSW reports, but the resolution, follow-up, or linkage to a corrective action process was not documented. In several cases, problems met the criteria for entry into ICARE, but the Facility Manager's review determined that no input to ICARE was required. During interviews, several RTC/ATR personnel indicated that the ICARE tool was difficult to use and time-consuming for infrequent users and cited the associated expense of processing issues through ICARE.

ATR did not properly document and manage the resolution of cracks in welds and structural members of the safety-significant 40/10-ton main bridge crane (see Appendix F) as required by the INL corrective action program and procedures. Deficiencies were noted in various aspects of the application of corrective action management processes, including not developing timely non-conformance reports or ICARE issues, not properly documenting corrective actions, not writing AIFs in some cases, and not adequately describing the crack locations in ICARE deficiency reports and ORPS reports. As discussed in Appendix F, ATR devoted significant attention and effort to ensuring proper technical resolution of these defects. However, the administration and documentation of the corrective action process did not meet site requirements and bypassed documented determinations of ORPS and Price-Anderson Amendments Act (PAAA) reportability, extent-of-condition and causal analyses, and the documentation trail for tracking and closing corrective actions provided by the corrective action management system.

As discussed in Section D.2.3, the process for managing the resolution of gaps and application of MCP-598 requirements for issues identified through the ATR DBR plan ("gaps") has not been incorporated into the DBR plan. In May 2005, the site identified the need for a formal process to manage the documentation and resolution of these issues, including ORPS and NTS reporting, using the ICARE process, but this process has only been documented in the form of interoffice memoranda.

The documentation, evaluation, corrective actions, and closure of the safety system functionality issues identified in the 2003 OA inspection were not managed by ATR in accordance with INL corrective action program requirements. Although the resolution of most of the specific technical issues was adequate (as described in Section D.2.3), several important process weaknesses were identified in the adequacy of the causal analysis, the identification of appropriate preventive actions in response to the OA findings and related NTS and ORPS reports, and the closure of the NTS report and CATS actions for the OA findings. One formal root cause analysis, linked to the filing and disposition of an initial PAAA NTS report, was performed for the OA findings and subsequent USQs and design basis gaps. This causal analysis identifies the failure to maintain configuration control since initial design in the discussions of the direct cause, contributing causes, and the root cause. However, it does not identify the individual configuration/design control processes that failed, and it does not address the adequacy of these processes. Seven "judgment-of-needs" were identified in this causal analysis, including establishing or verifying the existence of an adequate ATR configuration management program. However, the one NTS report action item related to configuration management was to "establish a team" to develop and address the safety basis, design basis, configuration management, and operational issues identified in the causal analysis. This action does not sufficiently identify the specific areas needing action and the specific actions to be performed to address each area by this team. Another judgment of need, addressing establishing criteria and guidance for performing periodic ATR safety system assessments, was not addressed in NTS, ORPS, or DOE CATS action plans. The contractor verified all six corrective actions specified in the PAAA NTS report as complete in March 2004, based on the issuance of the DBR plan and the formation of the DBR team, and the actions were closed with ID's concurrence in February 2005. However, the DBR plan does not establish or verify the existence of an adequate ATR configuration management program as specified in the root cause analysis. There have been no documented studies or assessments by the DBR team or other organizations to address this judgment of need. Because the same configuration management-related corrective action statement and subsequent closure rationale were also used for other ORPS reports and an ICARE Deficiency Report (#32083), the closure of these documents was also inappropriate.

Further, the 2003 OA essential system functionality issues and resulting USQs were not adequately described and addressed in the two NTS reports related to these concerns. The initial NTS report only includes one example cited for one of the five OA findings related to essential system functionality. That NTS report and the NTS for the subsequently identified positive USQs do not discuss the details of the management issues and underlying causes.

Other corrective actions in ICARE Deficiency Report #32083 were also improperly verified and closed by ATR. An action item (#31946) to "Develop a corrective action plan based on the root cause analysis" was appropriate but was not properly implemented. Another action item (#32639) specified that an assessment should be performed to verify and validate whether the corrective actions taken for deficiency report #32083 had been "effective" and documented on a Corrective Action System Verification Checklist (Form 414.79B). INL Performance Assurance performed the verification assessment in September 2004, incorrectly stating that all criteria had been met, that all action items had been performed with appropriate objective evidence, and that all causes of the root cause analysis judgments of need were addressed in the corrective action plan. In addition, the form did not include any criteria for establishing the effectiveness of these actions, and the comments on the completed form did not address effectiveness.

Several weaknesses were identified in the ATR Material Deficiency Tracking System. This system and the AIF specify categorization by the Facility Manager that is not consistent with MCP-598. Until late April 2005, the cause determination required by procedure was not recorded on CY 2005 AIF. There is no evidence of any trend analysis of AIFs.

Other examples were identified where ATR Programs/ATR management did not take appropriate actions to address identified weaknesses or deficiencies in performance in accordance with INL processes. The investigation of a non-ORPS-reportable event (related to installation of the center flux trap baffle) was not adequately documented on the critique form, there were no specified corrective actions, and the specified lessons learned were unclear and lacked sufficient specificity for application (nor was any mechanism cited to ensure/track application). The ID Facility Representatives had identified an issue concerning the inability to hear fire alarms in remote or isolated areas of the plant (which OA also identified during this inspection) over a year earlier, but the temporary corrective actions that were taken were never finalized and were subsequently canceled. The contractor's corrective action was to issue a "timely order" to operators that required the shift supervisor to be notified and to keep track of personnel in remote areas of the plant; this order was later cancelled without incorporating the actions into facility procedures (see Appendix C).

Two other issues identified by the OA team during this inspection were not properly entered into the ICARE process when discovered, as required by MCP-598. Radiological control concerns related to the changeout frequency for gloves in the loop transmitter cabinet gloveboxes and the inadequate hazards analysis of air monitoring needs in glovebox areas were determined to be violations of procedures and management expectations. Corrective actions were initiated and implemented to make ATR equipment and processes compliant with requirements. However, these issues were not documented in ICARE or managed using the INL corrective action process to ensure proper screening and documentation, causal analysis, and corrective action planning and tracking.

The injury and illness investigation and prevention section, below, identifies other examples of deficiencies in identification, documentation, and tracking of corrective and preventive actions.

Finding #6. BEA has not consistently implemented its corrective actions program at ATR in a manner that ensures that ES&H deficiencies are appropriately documented, categorized, and evaluated in a rigorous and timely manner, with causes, extent of condition, and appropriate recurrence controls identified.

Injury and Illness Investigation and Prevention

Injury and illness statistics for recordable and lost workday rates at RTC/ATR are better than "all DOE" rates and have shown an improving downward trend. First aid and recordable cases at RTC/ATR are also low and have been on an improving downward trend since 1998. Six recordable and 17 first aid cases were reported in CY 2003, one recordable and 15 first aid cases in CY 2004, and two recordable and three first aid cases through June 2005.

The ATR Programs/ATR process for investigation and reporting of Occupational Safety and Health Administration recordable injuries and first aid cases is detailed in institutional MCP-49, *Accident Reporting and Followup*. Facts related to injuries and illness events, including the evaluation of the conditions and causes and specification of corrective and preventive actions, are documented on forms that are consistent with DOE requirements. Investigations are primarily performed during a meeting between the injured employee, the responsible supervisor, an ES&H subject matter expert, and the Employee Safety Team representative. In practice, the Employee Safety Team representative documents the investigation results on the form and transmits this report to the INL Injury/Illness Records Coordinator, who manages cases for determining and reporting recordability, work restrictions, lost work days, and Computerized Accident/Incident Reporting System (CAIRS) reporting.

Although most investigations evaluated by the OA team were appropriate and sufficiently documented, weaknesses were identified in procedures and the investigation and documentation of the corrective and preventive actions for occupational injuries and illnesses. The OA team examined reporting and investigation case files for a sample of eight injury or exposure events dating back to December 2003. Some of the investigation reports inadequately described the conditions pertinent to the injury or exposure, such as the applicable work control document and whether it was being followed, the identified hazards and controls, or the use of proper personal protective equipment or other specified controls. For example, one case identified a cluttered, unsafe laboratory as a contributing factor in a event where a maintenance mechanic was stuck with a used hypodermic needle; the investigation report did not address deficiencies in routine facility inspections that did not identify the unsafe conditions and did not address the fact that inspectors found additional, similar safety problems two days after the initial cleanup of this laboratory.

In some cases, ISM elements, causes, recurrence controls, and failure to report injuries in a timely manner were not fully addressed. The investigation form only documents immediate actions and the actions recommended by the investigation team. It is the manager's responsibility to evaluate recommendations, determine the corrective/preventive actions, and implement them. However, the procedure is not clear on documenting the actual actions taken or to be taken. MCP-49 specifies that any actions not completed when the investigation form is submitted (required within five days of the incident) are to be documented in the ICARE process. However, subsequent corrective and preventive actions taken are not formally documented or tracked to completion, but are typically handled verbally or using electronic mail. There is no feedback on the final corrective actions to the investigation team for record purposes, and there are no defined responsibilities for the ES&H subject matter experts or the Employee Safety Team representatives to verify or monitor completion of corrective actions.

Lessons Learned

INL has established and implemented an institutional lessons-learned program that is described in MCP-192, *Processing Lessons Learned and External Operating Experience Information*. The INL lessons-learned program was revised in April 2005 to improve the rigor applied to documenting evaluations and applications of externally generated lessons, and new personnel are administering the program. Externally generated lessons learned are screened, evaluated, and distributed by the INL Performance Assurance organization and either posted to the INL database or sent to subject matter experts or cognizant directors for applicability evaluations. A designated person in ATR Programs sends batch electronic mail notices of lessons learned posted to the INL database to a standard distribution list of over 80 BEA and ID personnel once or twice a month. These mailings identify the lessons-learned identification number, priority color, and subject and provide links to the full lessons-learned report. Many lessons learned are being reviewed, generated, disseminated, and acted upon at the ATR. Evidence indicates that lessons related to product recalls and other safety-related hardware deficiencies have been evaluated for applicability to the RTC. ATR sends "flash notices" by electronic mail to INL organizations and managers to quickly communicate information about events that serve as a real-time, but less thorough and formal, lessons-learned tool.

ATR operations is developing a comprehensive lessons-learned report for the various evolutions and maintenance actions during the recently completed Core Internals Changeout, an infrequent evolution that occurs approximately every ten years at ATR, for use in planning the next changeout. This lessons-learned report is a commitment to ID, and its issuance is being tracked as an action item from the monthly DOE/ATR status meetings.

Although many lessons learned are being reviewed, generated, and disseminated, the existing processes and application have been informal, especially in the area of documentation and feedback on needed actions or actions taken. Few specific actions are ever designated as required actions, and few actions are formally tracked to completion. For ATR Programs, there has been no record of feedback on applicability reviews or actions taken/recommended for lessons learned distributed to ATR Programs personnel. However, the recent revisions to the institutional lessons-learned program has the potential to address these concerns (e.g., the new process requires applicability reviews with formal responses). Extensive criteria for these reviews are now provided, and responses are monitored and maintained in a database that identifies the institutional screening and results, as well as the responses from reviewers. However, a lessons-learned point of contact was only recently designated for the ATR Programs organization, and only three lessons have been forwarded to this individual to date for required applicability. All three were forwarded recently (June 2005), and none had yet been reviewed or responded to.

A lessons learned prepared for the recently identified cracked welds in the 40-ton ATR main bridge crane was appropriately distributed internally within INL. Although other sites may have similar concerns, INL did not disseminate a formal notification to the DOE complex of the defects and design deficiencies identified in the crane.

Some important lessons-learned documents about events and experiences in the DOE complex have not been screened for applicability to INL or included in the INL lessons-learned database. For example, the lessons-learned program did not address two special reports on electrical safety and hoisting and rigging issued by EH in 2004.

Several procedural weaknesses remain in the revised MCP-192. This procedure does not identify the means and minimum content required to document evaluation and application results, especially for lessons posted to the INL database and distributed to cognizant directors. Further, the responsibilities section does not list any responsibilities for applying relevant lessons learned or taking corrective actions when evaluations so dictate.

Other Feedback and Improvement Processes

INL employs other appropriate means to communicate feedback and initiate improvements in safety programs and performance. Documented maintenance work order post-job reviews and worker/job supervisor feedback are required by MCP-3003, *Performing Pre-Job Briefings and Documenting Feedback*, and are being completed for some work orders. In addition, the RTC Integrated Management Plan (PLN-1202) describes RTC process improvement objectives and target dates in the areas of environment, safety, communication, work control, and assessments. However, the status of actions identified in the management plan has not been accurately maintained, no action items have been identified for FY 2005, and the future role of this plan is indeterminate.

INL has also implemented a behavior-based observation program called the Worker Applied Safety Program, or WASP. This employee-managed program, initiated in 1999, is actively implemented at RTC/ATR, with workers using almost 30 different checklists for identifying safe or at-risk behaviors for such topical areas as general safety activities, lockout/tagout, welding, radiological controls, forklifts, pipefitting, and material handling, and several error precursor checklists are also used. In CY 2004, over 2,300 checklists were completed by workers. Completed checklist cards are logged into the INL WASP database and evaluated individually for adverse trends by local team members and by the INL WASP committee. In addition to the real-time safety performance feedback to the worker being observed, analyses of completed checklists identified a number of safety improvements in personal protective equipment and site conditions and processes that have been implemented by management, resulting in a safer working environment.

D.2.3 Corrective Actions for Engineering and USQ Findings

Engineering Findings

All engineering findings from the 2003 OA assessment and engineering findings from INL's subsequent self-assessment were rolled into four significant deficiency reports. These reports addressed a multitude of technical problems (e.g., insufficient available net positive suction head, vortexing, insufficient operator torque for safety-related valves, pressure rating of safety-related components less than design parameters).

OA reviewed a sample of the corrective actions related to the ATR safety systems' capability for mitigating design basis accidents and concluded that most were adequate. For example, previous concerns about the ability of the primary coolant pumps to mechanically survive and deliver acceptable flows to the core for design basis accident conditions that would produce pump cavitation were resolved. Also, previous concerns that the design basis accident line break for the 2-inch primary surge tank off gas line did not also include the 1-inch nitrogen supply line for the seismic break were resolved; a qualitative evaluation of the support of the 1-inch line concluded that it was adequately supported for this event. BEA also addressed OA's concern about system interactions by developing a procedure that provides comprehensive guidance for evaluating them.

Although most of the engineering weaknesses identified in 2003 have been adequately corrected, the OA team identified two specific instances where the resolution was not fully effective, as discussed in the following paragraphs.

The initial disposition of a concern from a 2003 OA assessment that vortexing could occur in the primary surge tank during a loss-of-coolant accident did not appropriately address the effect of air entrainment on reactor core heat transfer; this issue was dispositioned by an engineering analysis and a USQ evaluation that addressed the effects of air entrainment on primary coolant pump performance only. Subsequent to this analysis and USQ evaluation, a design change was implemented that eliminated the potential for vortexing, and thus the potential for air induction into the core. However, the BEA analyst responsible for the resolution did not recognize that the initial disposition was in error. Although no current safety issues resulted from this chain of events, the failure to recognize the error in the initial disposition indicates that the improvements in attention to detail and safety culture that OA noted during this assessment may not be uniform across all organizations.

OA's 2003 assessment concluded that INL had not implemented an effective configuration control program. This 2005 review determined that numerous procedures were developed that adequately address many aspects of engineering configuration management, such as modifications, engineering software management, design verification, and replacement item equivalency evaluations. Further, as discussed in Appendix E, INL has undertaken a substantial effort to reconstitute its design basis. However, one important element was not addressed for the configuration management of calculations. Specifically, measures have not been established to specify their classification (current, archived, superseded, etc.) and control storage, filing, issuance, and other such measures to ensure that they are used only for their specific appropriate applications. Although no examples of calculations being inappropriately utilized were identified during this review, the current system does not include appropriate controls. OA inspections have identified numerous examples of ineffective configuration control of calculations across the DOE complex, reflecting, in part, a lack of specific guidance for control of calculations in DOE's configuration management standard.

OA also identified a concern that INL generally did not perform adequate evaluations of the extent of condition for most of the engineering discrepancies identified in 2003. Although the DBR plan contains elements that should address concerns about extent of condition, the DBR plan is not complete or timely. Thus, similar problems could exist in other safety-related systems that have not been evaluated. For instance, the current OA review of the in-service testing program for the emergency flow system pumps identified issues virtually identical to those identified by OA in 2003 for the emergency firewater injection system pumps (see Appendix E for further details).

USQ Findings

OA's 2003 inspection identified several USQ process deficiencies that could affect the resolution of issues identified as part of the DBR process. OA reviewed the current USQ procedure (MCP-123) to determine whether those process deficiencies have been corrected and whether the current procedure is adequate to support the DBR resolution process.

BEA has made a concerted effort to improve its USQ process, including addressing findings and observations from OA's 2003 inspection and other assessments, revising its USQ procedure, and conducting company-wide training and self-assessment. OA determined that some of the weaknesses related to the USQ process were appropriately corrected. For example, certain specific concerns about the screening process have been addressed; the screening questions are clear, and multiple forms are no longer used. Screening forms for proposed changes to the facility and procedures no longer prompt the user to perform evaluations that should have been performed using the USQ evaluation process. Furthermore, the USQ procedure was revised to incorporate several improvements, such as pre-determined applicability to a controlled list of company-wide procedures and elimination of questionable categorical exclusions.

BEA has a noteworthy practice for keeping USQ personnel informed of significant documents affecting the current safety basis. ATR interoffice memoranda provide the updated listing and qualification status of USQ evaluators and updated training needs. For example, BEA recently issued a memorandum providing completion status of a required reading related to the TSR on Loss of Heat Sink and Surge Tank Level Controls, and reminding all TRA USQ personnel to include system interactions when performing USQ evaluations.

Although improvements have been made, concerns still exist, particularly in timely application of the USQ process. The most significant concern is that BEA's procedure for processing "discrepant as-found" conditions does not fully meet the intent of 10 CFR 830.203 requirements and associated DOE guidance. Specifically:

- The procedure directs making a positive USQ determination before declaring a potentially inadequate safety analysis (PISA), thereby potentially delaying the actions to place or maintain the facility in a safe condition and to notify DOE of the PISA.

- The procedure allows completing the factual accuracy phase of an assessment before entering the USQ process when multiple safety basis issues are identified during an inspection. This provision could delay initiating a PISA assessment by a considerable time (e.g., four weeks for issues identified in typical assessments).

- The procedure does not provide any expectation that a PISA assessment should be completed in a reasonably short time period, which the DOE Guide indicates should be hours or days.

The genesis of the second concern identified above is an ID letter to the previous contractor (dated March 5, 2004) that provided inappropriate guidance for addressing weaknesses in the USQ process identified by OA and for applying the USQ process to the ATR DBR effort. This guidance was developed in concert with EH and NE. The current USQ procedure was reviewed and approved by ID. However, during this inspection, OA identified numerous examples of significant delays in applying the USQ process to safety basis deficiencies (gaps) identified during the ATR DBR (see Appendix E). These appear to be due, in part, to weaknesses in the USQ procedure.

Finding #7. INL established and ID approved a USQ procedure that is not fully consistent with the intent of 10 CFR 830 requirements for addressing discrepant as-found conditions that could indicate a potentially inadequate safety basis.

In addition, although not formally incorporated into the USQ procedure, ID guidance to treat the DBR as an "upgrade" for the purpose of applying the USQ process (noted in the letter cited above) undermines DOE requirements and guidance on USQ. It states an ID position that "this safety basis reconstitution is in fact a DSA [documented safety analysis] upgrade," thereby generally exempting it from the USQ process unless the safety basis is inadequate. In the light of already existing DOE guidance (also cited in the letter), this additional guidance is confusing because few DBR gaps result from new requirements or the use of new or different analytical tools. Also, this additional guidance is erroneous because the USQ process would not be applied in situations where the safety basis is "potentially inadequate" as required by 10 CFR 830.203. Discussions with ID and BEA staff indicate that this guidance is not preventing the application of the USQ process to the gaps identified in DBR activities.

Another concern about the USQ procedure (related to a concern identified in 2003) is that it does not provide adequate guidance on screening issues for further processing, which is needed to determine whether a PISA or USQ exists. The USQ procedure Form 431.61 provides four appropriate questions for determining whether the safety basis could be not bounding or otherwise inadequate. However, as DOE Guide 424.1-1 points out, the safety basis may be inadequate for any number of reasons. For example, a significant condition not analyzed in the existing safety basis might be screened out from entering the USQ process. Neither the main procedure nor the PISA form indicates that the four questions do not address all possible cases.

During evaluation of the current USQ procedure, OA identified some additional concerns (unrelated to issues identified in 2003) that could impact the effectiveness of processing USQs and PISAs during the DBR effort. Specifically:

- The minimum qualification requirements for USQ personnel (evaluators, screeners, reviewers, and approvers) have not been completely established as required by BEA's USQ procedure and indicated in DOE Guide 424.1-1. While training requirements are identified, BEA has not defined the educational background and experience requirements for USQ personnel, although the Facility Manager is expected to "consider" them in qualifying a candidate. (Also see Appendix F for discussion of lack of USQ training for system engineers.)

- Neither the USQ procedure nor its associated forms for conducting USQ evaluations require the signed concurrence of a second USQ-qualified technical reviewer who actually performs an independent review of the USQ document. At present, ATR has chosen to implement the independent review requirement by having the Safety Operations Review Committee (SORC) chair sign concurrence following approval by the Facility Manager. However, the SORC chair typically assigns qualified individual(s) to provide an independent review, and it is not clear who actually performed and is accountable for the independent review. It is considered a good industry practice to require the independent reviewer who actually conducts the technical review to sign the USQ document to indicate concurrence. The requirement for the independent reviewer to sign was in place until last year, when the revised procedure was implemented and the requirement eliminated.

- The "Definitions" section of the Facility Engineering Change procedure (MCP-2811) contains a definition of USQ whose last element concerning margin of safety is incorrect and non-conservative with respect to 10 CFR 830.203 and inconsistent with the USQ procedure. It incorrectly refers to the margin of safety as being that defined in TSR basis descriptions. (The definition was correct under DOE Order 5480.21, but is not under 10 CFR 830, which defines a USQ more broadly.)

D.3 Conclusions

ID has established processes for conducting operational awareness and planned evaluations of contractor ES&H performance, and many identified oversight activities are performed effectively. Facility Representatives are effective in monitoring contractor performance and identifying areas for continuous improvement. Most oversight activities are adequately documented and communicated to the contractor. Oversight of the DBR has generally been effective. However, activities related to issues management have not been consistently and rigorously implemented in accordance with requirements. ID has not ensured that the contractors rigorously and consistently implement the INL corrective action program. Further, ID verifications of contractor corrective action plans and completed actions and closures of several issues tracked in CATS and the PAAA non-compliance tracking system were inadequate.

A variety of feedback and improvement activities are conducted for ATR-related activities and processes. BEA conducts assessments, inspections, and management walkdowns; identifies and corrects deficiencies; and shares lessons learned. The SSW program is an effective tool for involving management in monitoring field activities and interacting with workers. An active behavior-based safety observation program provides real-time feedback to workers on unsafe behaviors and data for improving safety equipment, working conditions, and work processes. In many cases, however, assessment activities have not been sufficiently tailored to ATR activities and performance or planned in accordance with the procedure. Most assessment activities are mandatory inspections and assessments driven by external organizations or regulations. Few independent assessments are performed, and planning by some functional area managers is not in accordance with site requirements. The documentation and resolution of safety deficiencies are sometimes not managed in accordance with the requirements of the INL corrective action program. The causal analysis and associated corrective action plans for the engineering-related findings identified at ATR by OA in 2003 were not sufficient to ensure sufficient recurrence controls, and the verification and closure of the specified action plans in the associated NTS and ORPS reports, CATS action items, and deficiency reports were inappropriate. The documentation and tracking of corrective and preventive actions for occupational injuries also lack sufficient rigor.

Most aspects of ATR corrective actions for the 2003 OA findings have been adequately addressed. BEA has made a concerted effort to improve its USQ process, including addressing findings and observations from OA's 2003 inspection and other assessments, revising its USQ procedure, and conducting company-wide training and self-assessment. However, in a few instances, resolution of the engineering findings was not fully effective, and the extent of condition was not adequately evaluated. Further, there are still concerns associated with the USQ process, particularly in timely application, because BEA's procedure for processing "discrepant as-found" conditions does not fully meet the intent of 10 CFR 830.203 requirements and associated DOE guidance.

D.4 Rating

ID and BEA/ATR Feedback and Continuous Improvement Processes...NEEDS IMPROVEMENT

D.5 Opportunities for Improvement

DOE Headquarters (Office of Environment, Safety, and Health)

1. **Consider enhancing the guidance provided in DOE standards to address control of calculations.** The major elements of this guidance should include: distinction between current and historical calculations of record, maintenance of calculation configuration control, relationship between calculations and plant procedures, and relationship between calculations and their references (including calculations).

Idaho Operations Office

1. **Strengthen ID processes and oversight activities for integration of contractor oversight activities and evaluation of the contractor's assurance system implementation.** Specific actions to consider include:

   - Conduct an overall review of ID manuals, plans, and procedures related to oversight processes to ensure that they are updated and fully integrated, and that they have not been adversely affected by recent reorganizations and other major changes at INL.

   - Establish more formal, coordinated processes and tools that provide continuous evaluation and data collection on the contractor's implementation of self-assessment and corrective action programs. Consider specifically identifying and documenting the effectiveness of the contractor's self-assessment performance for every issue identified by ID or adding a specific monthly assessment element to evaluate and report on the implementation of the contractor's assurance system.

   - Include routine, formal oversight input from assigned facility engineering and project management staff into monthly RTC oversight reports.

- Strengthen processes for and the rigor applied to verifying the adequacy of contractor corrective action plans and implementation and validating the effectiveness of corrective/ preventive actions and closure of issues reported in CATS, NTS, ORPS, or ID assessments and surveillances.

2. **In coordination with BEA, enhance the USQ procedure and process.** Specific actions to consider include:

   - Revise the guidance provided to the previous contractor on USQ issues resulting from OA and other similar assessments, in particular guidance in the March 5, 2004, letter from ID to the previous contractor in the areas of: steps to be taken when a facility discovers a PISA; situations involving multiple safety basis-related questions; and the position that the ATR DBR is a safety analysis upgrade. DOE Guide 424.1-1 provides sufficient guidance on the issues addressed in the letter, and the letter could set an incorrect precedent or be adapted and misapplied at other sites. The revision of the ID guidance should clarify how the USQ process applies to the ATR DBR and is consistent with DOE Guide 424.1-1.

   - Modify the part of the current procedure executing the USQ process for a PISA to: (1) remove direction to perform a USQ evaluation before completing PISA assessment for a discrepant as-found condition; (2) clarify that the screening questions provided for PISA assessment are not all-inclusive; (3) include the expectation that a PISA assessment must be completed in a reasonably short period (hours or days); and (4) remove direction that it is acceptable to complete the "factual accuracy" phase of an assessment (e.g., external audit) before entering the USQ process. Modify the USQ procedure to require signed concurrence by a second USQ-qualified technical reviewer who actually performs the independent technical review of a USQ evaluation.

   - Establish a complete set of training and qualification requirements for USQ personnel. As recommended in DOE Guide 424.1-1, these requirements should address educational background, years and types of work experience, knowledge of the facility, understanding of DOE requirements for facility safety bases (including the USQ process), and familiarity with the facility-specific safety basis, in addition to training and retraining requirements.

Battelle Energy Alliance

1. **Strengthen the ATR/RTC self-assessment program to ensure that safety programs, processes, and performance are appropriately tailored to the activities, conditions, and past performance and rigorously evaluated based on a structured analysis of activities, conditions, and risks.** Specific actions to consider include:

   - Ensure that annual integrated self-assessment planning for ATR/RTC organizations, such as operations, engineering, safety, and maintenance, establish the number of and specific topical areas for planned assessments.

   - Reevaluate the planning for nuclear program functional area manager independent assessments to identify appropriate program elements and establish priorities and frequencies for assessment of these elements. Review other functional areas to determine the adequacy of pre-planning of independent assessment activities.

   - Strengthen the rigor of self-assessment lines of inquiry and assessment performance to ensure a stronger focus on performance, observation of work activities, and reviews of records and other documentation that reflect performance.

   - Consider integrating some individual organizational surveillance activities into more comprehensive and detailed assessments, as was performed on the training program in 2004.

2. **Take actions to ensure that safety issues and potential issues are managed in accordance with institutional corrective action, QA, and ISM processes.** Specific actions to consider include:

- Conduct user surveys and review the existing processes to identify and remove barriers and inefficiencies that hinder the effective use of the corrective action program or contribute to perceptions that the processes are hard to implement.

- Communicate clear expectations from RTC/ATR management that the formal BEA corrective action program is to be used to document, evaluate, and otherwise manage potential or validated safety problems.

- Incorporate the process for documenting and managing gaps and issues into procedures used to implement the DBR plan.

- Strengthen the process and rigor applied to verifying and validating the adequacy of closure of actions and issues.

- Take advantage of Corrective Action Review Board meetings by increasing the frequency of discussions and critiques of proposed corrective action plans to promote stronger causal analysis and recurrence controls. Consider requiring responsible issue owners to make presentations to the board on issue evaluations and planned actions.

- Strengthen the processes for identifying and documenting operational and safety events and incidents that do not meet ORPS reporting criteria to support effective analysis and corrective actions and to support the trending requirements of DOE Order 231.1.

- Clarify and revise MCP-598 and MCP-190 regarding the processing of events and incidents with respect to ORPS reportability. Change MCP-598 to clearly require the timely documentation of events on Potential Issue reports and the use of the ICARE processes to document evaluations and decision points. Revise MCP-190 to more fully address the use of the ICARE process for managing and documenting evaluations and decisions regarding reportability (ORPS and PAAA) and corrective actions. Delete the statement in the "NOTE" in section 4.12 that allows entry of information into the ICARE system at any time up to final report submittal, which clearly conflicts with earlier statements that all corrective actions are to be tracked in the ICARE database.

3. **Strengthen the occupational injury and illness investigation and reporting processes to ensure that these events are thoroughly documented and analyzed, causes are determined, and appropriate preventive actions are identified and implemented.** Specific actions to consider include:

   - Consider revising the investigation form to better support documentation of the investigation and to address the core functions of ISM, analysis of the causes of the event, and implementation of effective recurrence controls.

   - Establish formal processes and controls to ensure that corrective and preventive actions are tracked and appropriately completed by line supervisors. Consider using the ICARE system to document all injuries and illnesses/exposures, document evaluations and actions, and track implementation.

4. **Strengthen the lessons-learned program to provide assurance that lessons learned are consistently screened for applicability, that needed actions are identified, and that formal feedback is formally solicited from workers.** Specific actions to consider include:

   - Specify in MCP-192 the responsibilities for implementing corrective/preventive actions and otherwise applying lessons learned.

   - Establish specific expectations for the content and documentation of feedback on applicability and action evaluation reviews. Consider developing a standard form to ensure consistent feedback and provide auditable and trendable evidence of these reviews.

   - Develop mechanisms to encourage the documentation of post-job comments and reviews on maintenance work packages and operations tasks and ensure formal review, resolution, and feedback to workers when post-job feedback is provided.

APPENDIX E
ESSENTIAL SYSTEM FUNCTIONALITY

E.1 Introduction

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) evaluated design basis reconstitution (DBR) efforts under way at the Advanced Test Reactor (ATR) at the Idaho National Laboratory (INL). The DBR is a major effort to ensure functionality of ATR essential safety systems and ensure compliance with safety basis requirements. The DBR effort at the ATR was first established in 1999; a major revision to the plan occurred in 2004, in part because of significant design inadequacies identified during the 2003 OA inspection. DOE and ATR management devoted significant effort to develop the current DBR plan, obtain outside expert input on the DBR effort, and obtain resources and dedicate senior staff to implement it. This essential safety system review was performed to provide DOE and INL management with information about the status of the extensive DBR program at ATR and to identify potential improvements in this program. Because the purpose of this review was to provide a status update, this review was not rated.

This 2005 OA inspection evaluated three aspects of the DBR: (1) the adequacy of the DBR program, including its planning, process, resources, and schedule; (2) the effectiveness of the implementation of the DBR program, evaluated by reviewing the reconstitution efforts for the emergency core flow system; and (3) the process for analyzing and resolving discrepancies in the design basis ("gaps") identified during the DBR effort. In related efforts, OA also assessed nuclear facility safety systems oversight by the Idaho Operations Office (ID) and Battelle Energy Alliance (BEA), which is discussed in Appendix F, and corrective action management for safety system findings from the 2003 inspection, as discussed in Appendix D. BEA took over responsibility for operation of INL, including ATR, in early 2005 and has continued to implement the DBR developed by the previous contractor, with some revisions.

E.2 Results

E.2.1 Design Basis Reconstitution Plan

Planning and Processes

The current plan appropriately focuses on identifying system requirements and performance criteria related to the system's safety functions, the basis for these requirements and criteria, and demonstrating that the current system configuration satisfies these requirements and criteria by performing a system functionality assessment using a "vertical slice" approach. Other appropriate elements of the plan include identifying pertinent reference and engineering documents, compiling the system's modification history, identifying gaps between system requirements and actual conditions, and evaluating such programmatic issues as seismic qualification and single failure criteria. In addition, BEA recently enhanced the DBR process by adding a programmatic review of instrument uncertainties; this enhancement was prompted by concerns in this area that were identified during DBR efforts for the first two systems and are applicable to all of ATR's safety systems.

The DBR plan has many appropriate elements, but it is missing some important elements, and there are no detailed implementing procedures guiding its implementation:

- DBR design topics/programmatic elements, such as configuration management, environmental qualification, quality assurance, and in-service inspection/in-service test programs, are not included in the DBR plan.

- Some activities/elements of the plan have not been appropriately translated into the plan's safety analysis basis reconstitution flow diagram and/or the cost and schedule work breakdown.

- Methods for performing a vertical slice system assessment are not defined.

- Methods for addressing design topics/ programmatic elements (e.g., seismic qualification, fire protection, and single failure) when reconstituting the design basis for a system are not defined.

- Methods for performing the system boundary definition, function definition, and safety analysis basis validation are not defined.

The lack of detailed procedures/processes can have negative impacts:

- Essential elements of the system design, including applicable programmatic requirements such as environmental qualification, may be overlooked.

- The DBR evaluation and documentation may not be performed in a complete, controlled, consistent manner.

- Reviews may not be performed in an efficient manner that assures that safety concerns will be identified and resolved in a timely manner.

As discussed in Section E.2.2, OA determined that some of the above impacts occurred during INL's DBR of the first two systems.

Another concern about the plan is that it does not include a phased approach. A February 2004 report (locally referred to as the Rice Report) recommended that the contractor perform system reviews in three distinct phases to identify significant safety concerns in the most timely manner and to most efficiently use available resources. According to the recommendation, the first two phases (a vertical slice-type assessment and an assessment of functional capability of the system) would be performed in a relatively short timeframe. The last phase, performed over a longer timeframe, would be aimed primarily at verifying consistency between the design documentation and the actual physical configuration. Contrary to this recommendation, BEA's initial DBR efforts used a single-phase, in-depth approach for two pilot systems only. BEA chose this approach, in part, to provide insights on the magnitude and types of issues that are likely to be identified, and to help better define the DBR effort. However, the functional capability determination for the other ATR safety systems has still not even begun after almost 18 months since the Rice Report.

Resources and Schedule

INL established a team to implement the DBR plan. The DBR team consists of three senior technical members (a shift supervisor, a safety analyst, and an engineer) and reports to the engineering manager. Although the team members have much of the appropriate experience and background needed to perform the DBR tasks, the team lacks the assessment experience needed to perform the most effective DBRs. In addition, performing the DBR with only in-house personnel can result in some important deficiencies being missed because of ingrained acceptance of corporate design and analysis methodologies. Furthermore, the team resources have not been adequate to keep the plan on schedule (e.g., Revision 2 of the plan has an end date two years beyond Revision 1). INL has used little external support in implementing the plan; only one programmatic area of the review, instrument uncertainty, was supported by an external subcontractor, and that support was terminated when BEA took over the INL contract.

The current schedule for completing the DBR program by 2011 is not timely, considering the number and importance of the design basis issues that were identified by OA in 2003, by BEA during its DBR of the first two systems, and during this OA review. The DOE Headquarters Office of Nuclear Energy, Science, and Technology (NE), ID, and BEA recognize that the current schedule and resources are not adequate, and have identified some initial measures, such as adding resources and revising the plan, to significantly accelerate the DBR process. These organizations are working together to evaluate the possibility of reducing the time for program completion from six years to two years from now (i.e., completing the effort in 2007 rather than 2011).

Summary

The DBR program was initiated at ATR because recent evaluations identified concerns that ATR safety systems may not be adequately designed to perform their safety function under all accident conditions. BEA developed a DBR plan that contains many appropriate elements for completing this task, established a senior-level team to implement it, and over the last 18 months has reconstituted the design basis for two safety systems. However, there are weaknesses in the DBR program in the areas of planning (e.g., missing important elements and lack of a phased approach), implementation processes (e.g., no procedures to define methods and expectations), and schedules (e.g., insufficient resources for timely completion). NE, ID, and BEA have initiated efforts to address these concerns.

E.2.2 Implementation of the Design Basis Reconstitution Plan

OA evaluated the implementation of the DBR plan for reconstituting the design basis using a vertical slice approach. Specifically, OA examined the DBR application for a selected system – the emergency flow system – and evaluated its capability to perform its safety-related function.

In most respects, the BEA team appropriately evaluated the system's functionality and identified and corrected deficiencies in the design basis. The BEA team identified over 60 design basis and configuration management issues, several of which were determined to be potentially inadequate safety analyses (PISAs) or unreviewed safety questions (USQs) that resulted in appropriate plant changes and limitations on operations to ensure safety. In identifying and correcting these issues, the BEA team demonstrated a strong questioning attitude and safety-conscious culture, which are essential to successfully performing high-quality design basis reconstitution.

Some of the resultant plant improvements include:

- Testing the auto-start of emergency coolant pumps (ECPs) upon loss of commercial power
- Modifying emergency operating procedures to open the upper head emergency firewater injection valves before depressurizing the reactor with the vessel vent valves
- Upgrading the engineering analysis supporting the safety analysis report (SAR).

The emergency flow system is appropriately designed and maintained in most respects. For example, the current design basis accident analyses indicate that the system can meet the required reactor core flow parameters even under very severe event accident scenario sequences. The SAR analyses show the system as being capable of supplying the required core flow during a loss-of-coolant accident (LOCA) with a failed open primary coolant pump check valve, a failed closed reactor inlet butterfly valve, or all but one of the primary coolant pumps seized.

Although the emergency flow system is robust, the OA team identified several weaknesses in the DBR for the emergency flow system. Most of these weaknesses can be attributed to: (1) the lack of detail in the DBR plan or implementing procedures to describe expectations and methods for implementing the plan, and (2) not utilizing sufficient and appropriate resources (e.g., outside experts) in the DBR effort. Weaknesses in the design of the emergency flow system that were not identified during the DBR effort are discussed in the following paragraphs.

The emergency flow system flow analyses model did not properly account for some factors that could render the model non-conservative. For example, the pump performance capability input into the model was the vendor curve for a new pump, whereas the proper approach is to use actual curves derived from the installed pumps (reduced by some value to represent the expected level of degradation as the pumps aged). The model indirectly accounted for pump degradation by increasing system resistance in the model to yield reduced pump flows equal to the test procedure acceptance criteria. However, this approach is not mathematically equivalent to inputting degraded pump performance curves, and could yield non-conservative results. In addition, the model did not account for specific points of water diversion from the core flow that could exist after an accident, such as pump seal leakage resulting from loss of the gland seal system, check valve back-leakage at the various pumps in the primary coolant system, and normal, allowable out-leakage from the operating primary coolant system. In response to this issue, ATR revised the model to more appropriately account for pump performance. However, the revised model still does not address flow diversions, is incomplete with respect to instrument uncertainties, and does not realistically model degraded pump performance.

The SAR analysis of the reactor inlet butterfly valve failing closed did not account for the potential for primary coolant pump shutoff at 65 seconds (this shutoff feature had been added by modification in 1999). ATR discovered this discrepancy while researching answers to OA inquiries during this inspection and took appropriate action to issue a PISA.

The approach for verifying that ECPs can meet the minimum acceptable flow for the worst design basis case event is not adequate to ensure that pump operability can be determined in a timely manner. The pump flow acceptance thresholds for performance testing do not represent actual minimum allowable flows; they represent flow thresholds that require additional analysis to determine whether the pumps are operable. This approach does not provide clear, immediate go/no-go criteria for pump operability and is, therefore, not conducive to timely operability determination. Additionally, because there is no procedure for adjusting the model to account for such errant data and performing such evaluations, this approach is highly dependent on the analyst's skill at the time of an operability question. Although ATR identified a similar SAR deficiency during the DBR and noted it for processing as a gap, the deficiency as stated did not address concerns about translating the design analysis into testing procedures and practices.

ECP surveillances are not performed in accordance with the surveillance requirements of American Society for Mechanical Engineering (ASME) Section XI, which are cited as commitments in the ATR In-Service Inspection Plan. For example, ASME requirements for establishing a test reference based on results of pre-service testing or the results of the first in-service test have not been met. No specific test reference is specified in the procedure, and there is no documentation that one was ever established. As another example, ASME requirements for establishing an acceptance criterion that has no more than a 10 percent deviation from the pre-service or first in-service reference have not been met. Because of these deficiencies, evaluation and trending of pump degradation as required by ASME Section XI has not been performed, and INL cannot quantify the current degradation of the M-10 and M-11 ECPs. Informal analysis by the OA team determined that the M-10 pump is degraded and may be approaching ASME Section XI limits. An additional concern is that the surveillance procedure does not identify a sufficient set of actions to take if minimum acceptable flow is not achieved; the only specified action is to notify engineering; and there is no action item or procedure dictating subsequent engineering actions. This in-service inspection/in-service test issue was not addressed or identified as a DBR gap, in part because the DBR plan does not include in-service testing and inspection as a generic review topic. This topic should have been included because a similar issue was identified during the 2003 OA inspection. A subsequent INL deficiency report identified that all pumps in the in-service inspection plan were affected by the 2003 OA finding and that testing on all pumps should be reviewed and updated. Actions to update the in-service testing program are ongoing but not yet fully implemented.

ECP performance controls have not been adequately translated into technical safety requirements (TSRs) or TSR surveillance procedures. The TSRs do not identify a minimum acceptance flow (or other appropriate parameters) to demonstrate the operability of the ECPs during power operation; they only delineate a required flow value, 3,600 gallons per minute (gpm), from an obsolete plant operating mode. Additionally, the TSR ECP surveillance procedure specifies a minimum allowable flow criterion of 4,300 gpm. This criterion does not have an adequate analytical basis and is not consistent with the ATR core thermal model, which requires a minimum coolant flow of 4,352 gpm to prevent violating allowable core thermal margins during some analyzed events. Further, this surveillance procedure may not be adequate because it does not account for the difference between the performance required for alternating current (AC) and direct current (DC) pumps.

The emergency flow system boundary was not explicitly defined as part of the DBR effort. Defining the boundary is an important step in the DBR process and was specifically identified as a step/milestone in the DBR plan (although details for how to define the system boundary were not provided in the plan or an implementing procedure/guide).

The safety designations of emergency flow system components identified in the system design description do not have a well-documented basis, and they are non-conservative for some of the major system components and non-existent for others. For example, the ECPs' safety functional requirements are identified as safety-significant (defense-in-depth) in the system design description, whereas the system itself is designated safety-class. Further, the system design description does not provide a safety classification for all components that have safety functions, and the SAR does not classify the emergency flow system as an "Essential Safety Feature" even though it meets the criteria for such designation.

Some important parameters for the battery supporting DC-powered ECP operation have not been evaluated or controlled. The DC-powered ECP test procedure does not address the pump motor current. The design basis battery load calculation uses a DC-powered ECP motor current of 140 amps, which is based on the motor nameplate. However, the actual current is not recorded, trended, and analyzed by the test procedure to verify that it is reasonably consistent with the analyzed value and with previous values. As a result, there is no way to detect any trend that could indicate mechanical or electric problems in the system. In addition, there is no temperature control for the ECP battery. The design battery load analysis was performed for a minimum temperature of 65° Fahrenheit (F), but lower temperatures could significantly reduce actual battery performance below the analyzed value. Such controls are typically reflected in a TSR limiting condition for operation.

None of these weaknesses were identified during the DBR for this system, in part because of: (1) the lack of detail in the DBR plan or implementing procedures to describe expectations and methods for implementing the plan, and (2) not utilizing sufficient and appropriate resources (e.g., outside experts) in the DBR effort. These weaknesses highlight the need (as discussed in Section E.2.1) to implement a rigorous DBR process, provide additional resources, and accelerate the schedule for completing the DBR in order to ensure that safety systems are appropriately designed and maintained to perform their safety function and to identify and resolve concerns in a timely manner.

Finding #8. The DBR plan is: (1) not complete in its scope or adequately defined, (2) not supported by sufficient and appropriate resources, and (3) not appropriately focused to provide a higher-level evaluation of the safety systems' ability to perform their safety functions prior to an in-depth DBR.

During the OA inspection, BEA took some appropriate actions to address some of these specific engineering concerns. For example, BEA issued a PISA for the minimum flow of the DC-powered ECP, which concluded that the minimum flow requirements were satisfied. However, some of the concerns identified by the OA team had not been formally entered into the BEA DBR gap or corrective action process for evaluation. One of these concerns (i.e., inadequate translation of ECP performance controls into TSRs and TSR surveillances) meets the criteria for a PISA specified in the INL USQ procedure. This and other concerns identified by OA should be evaluated through formal processes to ensure appropriate and timely action. The gap and corrective action process is discussed in Section E.2.3, below. OA's evaluation of the USQ process is discussed in Appendix D.

Summary

The DBR program has been successful in identifying and correcting numerous design basis issues associated with the two systems that have been addressed. ATR personnel have demonstrated a strong questioning attitude and safety culture during DBR efforts and have identified and resolved numerous design issues. However, the DBR for the emergency flow system did not identify several important design deficiencies, indicating that improvements are needed in the DBR process and implementation. Discrepancies included not accounting for all factors that could render the accident analyses non-conservative, inadequate translation of the required ECP performance into TSR requirements and testing procedures, not performing pump testing per ASME Section XI, not clearly defining the system boundaries, incorrectly identifying the safety classification of system components, and not establishing appropriate controls for the DC pump's power source.

E.2.3 Gap Analysis and Resolution

OA evaluated the effectiveness of BEA efforts to process and resolve gaps (discrepancies in the design basis) identified during the DBR effort. BEA identified over 60 gaps during the DBR of the first two systems. BEA has developed a well-structured database for recording and tracking gaps, which provides a succinct summary of gap descriptions, evaluations, and references to any documents related to PISAs and USQs, and near-term gap resolution actions. Also, the ATR Facility Operations Safety Board and ID periodically review the gaps and any cumulative impacts of those gaps to ensure that appropriate actions, including any interim operating restrictions, have been identified and taken. OA determined that many of the gaps have been appropriately dispositioned, including any necessary PISA and USQ evaluations.

However, BEA does not have a detailed procedure to guide and implement the gap identification, analysis, and resolution process. For example, the process:

- Does not provide expectations for timeliness of processing gaps (in particular, expectations for timely entrance into the PISA process)
- Does not provide for a systematic and sufficient analysis of gaps to determine causal factors, extent of condition, or any trends and patterns to help

identify other gaps with safety significance as early as possible, and also determine the cumulative impact of gaps

- Does not provide for a systematic examination of the interactions between corrective actions for a specific gap and actions taken (or to be taken) for previously identified gaps

- Does not define criteria or methodology for prioritizing the resolution of gaps (BEA determined that the prioritization process using benefit-cost ranking was unworkable and is not being used)

- Does not provide the necessary documentation of the scope and status of DBR work completed for the system at hand.

These process weaknesses contributed to delays in addressing identified gaps through the PISA/USQ process. OA found numerous gaps for which BEA did not enter the PISA/USQ process until several months after identification. BEA staff typically began evaluating the gaps to confirm the existence of a safety basis problem rather than promptly starting their process to evaluate whether a PISA existed. DOE Guide 424.1-1, which addresses the USQ process, indicates that such assessments should be performed in hours or days, not weeks or months.

Examples of gaps for which a PISA assessment was delayed by months are:.

- **Emergency pump flow variation.** This gap identified a large variation in the DC-powered ECP flow rate compared to the corresponding safety analysis model assumption. Some variables, including the effect of the initial battery voltage drop at the beginning of a design basis accident, are not clearly accounted for in the analysis. The contractor determined that a PISA existed about eight months after this issue was formally documented in the gap database. The subsequent USQ evaluation confirmed that a USQ existed.

- **TSR requirement for emergency flow initiation system (EFIS) actuation.** This gap identified a discrepancy between the accident analysis (which requires actuation of EFIS 75 seconds after actuation of vessel vent valves) and a TSR (which specifies opening the vent valves before exceeding a vessel outlet temperature of 200° F and actuating EFIS before exceeding 228° F). A preliminary analysis showed that the TSR direction would result in fuel element temperatures high enough that fuel cladding thermal hydraulic margins would not be clearly met. The contractor determined that a PISA existed two months after this issue was formally documented in the gap database. The subsequent USQ evaluation confirmed that a USQ also existed.

- **Single failure during a loss of commercial power.** This gap identified an error in the accident analysis model, in that the model did not consider failure of the operating ECP upon loss of commercial power, as required by the safety analysis. The delay in PISA assessment was about nine months. The assessment concluded that a PISA did not exist.

- **Actuation of high differential pressure and LOCA pump shutoff engineered safety features.** This gap identified an operational event that has significance for the safety analysis. The event involves combined actuation of two engineered safety features because of a pressure transient following a manual scram and resulting in early, complete loss of flow. The delay in PISA assessment was about nine months. The assessment concluded that a PISA did not exist.

The gaps listed above were not entered into the USQ process until months had elapsed, and some were later identified as PISAs and, more significantly, USQs. As a result, these potentially significant safety issues were not promptly addressed, and formal actions required by the USQ process to place the facility in a safe condition and to notify DOE were delayed. In several of the gaps, the initial determination that no PISA assessment was required was revisited when additional information was discovered. However, some gaps inappropriately did not undergo a PISA assessment at all or were otherwise inadequately analyzed. Examples include:

- **A gap identifying the lack of a test for ECP spin-up time did not enter the PISA process.** The gap identified that the requirement for spin-up time, which must be less than or equal to 10 seconds when started by the low recirculation flow feature, was not specifically verified during testing. Based on successful timing tests conducted after this issue was identified, a PISA assessment was not completed; however, the initial concern about the lack of appropriate surveillance testing still remained and was not addressed.

- **A gap identifying inadequate separation of process recirculation flow transmitters that share the same line as other channel transmitters did not enter the PISA process.** The gap identified that the as-found configuration conflicts with safety basis general design criteria for separation of protection and control systems. Subsequent evaluation showed that there is little potential for an adverse interaction or feedback between the two systems, and so a PISA assessment was not conducted. The evaluation also identified that two separate detailed operating procedures gave incorrect descriptions. These documents were subsequently revised through a change package that included a justification and negative USQ.

- **The analysis of a gap identifying the impact of voltage drops on ECP pump functionality was incomplete.** BEA identified a concern that ECP flow values used in the safety analysis model did not account for reduced pump speeds/performance that could result from degraded electrical conditions in a design basis accident. For the DC-powered pump, the battery voltage could immediately drop from the charger float voltage, 264 volts, to the no-charger, accident-demand voltage of 231 volts, and then continue to slowly degrade. For the AC-powered pump, speed (and hence performance) could degrade because of the steady-state frequency drop when powered from the emergency diesel generator. BEA's assessment of this concern was incomplete because it only addressed the DC-powered pump and did not recognize that the AC pump could also be affected by frequency drop, and because it had not initiated corresponding changes to the pumps' surveillance test acceptance criteria and the SAR's accident analysis descriptions.

Finding #9. BEA has not ensured that gaps identified by the DBR process are entered into the USQ process in a timely manner in accordance with 10 CFR 830 requirements.

Summary

As part of the DBR effort, BEA has identified numerous gaps that, when resolved, will strengthen the ATR safety basis. However, because BEA does not have a detailed procedure for gap analysis and resolution, there have been significant delays and inconsistencies in processing the gaps through the USQ process, as well as insufficient analyses of gaps.

E.3 Conclusion

DOE and BEA have made important improvements in increasing confidence that the safety basis is adequate to support ATR operations. Most significant is the improvement in safety culture and a questioning attitude, as evident in BEA's identification of numerous important design discrepancies in the first two safety systems that have undergone the DBR process. Further, NE and ID have provided active oversight of and good support for the DBR effort.

Although the DBR effort has resulted in improvements, the scope and process have not been sufficiently defined to ensure completeness and timeliness. For example the DBR plan: (1) does not contain detailed procedures describing how to accomplish the plan's basic elements; (2) does not address evaluation of some programmatic areas, such as environmental qualification and in-service inspection; (3) does not require performing the DBRs in a phased manner that promptly reveals most system functionality concerns; and (4) does not adequately define the gap resolution process. Furthermore, the schedule and the level and types of resources applied to the program have not been adequate for complete and timely identification and resolution of design basis issues.

These process weaknesses have resulted in some deficiencies in the reconstitution of the emergency flow system design basis that was reviewed by OA. For example, some important functional parameters were not adequately supported by analysis, some functional parameters were not adequately translated into TSR controls, the scope of review did not include sufficient evaluation of some design aspects (e.g., compliance with codes and standards), and system boundaries were not adequately defined. Also, many gaps identified during the DBR were not entered into the PISA/USQ process, or were not entered in a timely manner, thus delaying actions required by the USQ process to ensure that ATR was placed in a safe condition and to formally notify DOE.

Although this review was not intended to assess the overall effectiveness of all ATR safety systems, the OA team did not identify any specific conditions in the systems reviewed that would warrant shutdown of reactor operations. The DBR schedule is too long (scheduled completion in 2011), considering the number and importance of the design basis issues that were identified by OA in 2003 and by BEA during its DBR of the first two systems; the DBR process has not been designed for early identification of potential safety significant issues. NE, ID, and BEA have recognized the timeliness concern and have taken some initial actions to significantly accelerate the DBR process. Management attention and support from DOE and INL are needed to ensure that planned improvements in schedule and process to the DBR effort are finalized and implemented.

E.4 Opportunities for Improvement

This OA inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management, and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

1. **Modify and enhance the DBR plan and its implementation.** Specific actions to consider include:

   - Obtain outside expert support for performing the DBR to provide such benefits as:

     – "Outside-the-box" perspectives

     – Expertise in performing vertical slice assessments, with the ability to quickly and efficiently identify potential issues and a range of solutions

     – Freeing up in-house experts to deal with the issue resolution

     – Mentoring in-house staff in the engineering assessment techniques.

   - Establish and define a graded approach for the DBR effort, both in the sequencing and the scope. Commercial nuclear power industry experience has demonstrated that 100 percent reconstitution is generally not achievable, practical, or necessary to ensure that pertinent safety aspects of the system design bases are reconstituted.

   - Develop a detailed procedure or guidance document supporting implementation of the next step of the current DBR plan (i.e., validating accident scenarios). The procedure should detail the scope and approach for validation, including the approach to be used for ensuring that all high-level system functions are identified and the methods for validating that systems can perform their functions. The approach should emphasize prompt and complete identification and resolution of significant issues that can impact safety system operability.

   - Develop a detailed procedure or guidance document supporting vertical slice assessments of safety system functions. Ensure that the procedure addresses system physical and functional boundaries, critical safety functions and variables, critical components, key documents and procedures, and industry experience. Consider adapting the Nuclear Regulatory Commission (NRC) Safety System Functional Inspection vertical slice methodology as described in the NRC inspection manual as a basis for this procedure. This manual provides instructions on:

     – Identification of critical safety functions and variables

     – Review of authorization basis to ensure that the critical safety functions and variables are captured in the authorization basis (e.g., TSRs)

     – Review of design documents (e.g., calculations, drawings, specifications) for ensuring appropriate translation of authorization basis requirements into design documents

- Review of plant procedures to ensure that design requirements have been appropriately incorporated

- Determination of the status of cross-cutting programs, such as configuration management, environmental qualification, quality assurance, and in-service inspection/ in-service testing.

- Integrate program reviews, such as those for the configuration management, environmental qualification, quality assurance, and in-service inspection/in-service test programs, with the vertical slice assessment. The program reviews should support the vertical slice assessment by explicitly identifying program requirements that safety systems and components must meet. The vertical slice assessment should provide data on how well the programs are being implemented and generic issues that need to be resolved.

- Treat the DBR effort as a single project and provide a dedicated project manager to manage it. The planned DBR activities (e.g., vertical slice assessments, program reviews, findings resolutions, design basis document development) will require coordination of tasks and manpower. Each individual activity should have a detailed schedule of discrete activities based on the individual activity plan. These schedules should be rolled up into an integrated schedule.

- Consider developing design basis documents as an output from the vertical slice evaluations.

  - Develop a controlled document specifying all the various safety designations of system components that are based upon the SAR. This information should be captured in the formal design document, which should receive independent verification.

  - The generic outlines for system-specific and topical design basis documents in the AREVA report is based on nuclear power industry experience and should be considered.

  - Consider implementing the “index type” design basis document format and not the “mixed” format recommended by AREVA, since the effort required to document the missing information within the design basis document is only slightly less than the effort required to develop the formal engineering analysis. The initial increase in scope will be more than offset by the reduced effort in design basis document maintenance and configuration management gains.

2. **Consider modifying the gap resolution process.** Specific actions to consider include:

   - Develop a detailed procedure for gap identification, analysis, and resolution, including guidance on the need for timely PISA assessment.

   - Establish the criteria and approach for prioritizing the resolution of gaps. Specific corrective actions should be prioritized based on the probabilistic risk analysis determination of the core melt frequency contribution associated with identified discrepancies In addition, consider the cross-cutting impact of gaps for input into evaluations of programmatic issues.

   - Use the Issue Communication and Resolution Environment (ICARE) system to promptly process gaps. Do not wait to collect or analyze gaps before entering them into the ICARE system.

   - Analyze gaps systematically to identify any relationships, trends, or patterns that would help identify other gaps with safety significance as early as possible, as well as the cumulative impact of the gaps.

3. **Consider making the following additions/ revisions to the reconstituted design bases for the emergency flow system and translating them into plant procedures.** Specific actions to consider include:

   - Revise the RELAP model of the emergency flow system to more accurately represent the system and its required performance:

- Replace the currently installed artificial system resistance intended to simulate degraded pumps. Instead, use actual baseline pump curves degraded to account for worst-case pump speeds associated with design basis post-accident battery conditions for the DC pump and maximum emergency power frequency drop for the AC pump, and further degraded to account for the minimum acceptable performance that will provide the required core margins for worst-case design basis accidents or the ASME Section XI allowable degradation, whichever is higher.

- Install modeling of the presently unaccounted-for water diversion points in the primary coolant system from the core flow path that could exist after an accident, such as pump seal leakage due to loss of the gland seal system, check valve back-leakage at the various pumps in the primary coolant system, recirculation flow, and normal operating primary coolant system allowable out-leakage.

- Continue and accelerate efforts to accurately quantify uncertainties for accident-related instruments whose setpoints affect required ECP performance, and revise the model to account for these uncertainties.

- Revise the ECP surveillance test acceptance criteria to reflect the minimum acceptable performance as determined from the model revised as described above. Revise the TSRs and surveillance test procedures to reflect these acceptance criteria values as the minimum go/no-go thresholds for determining pump operability with respect to hydraulic performance.

- Revise the emergency flow system DBR report to clearly identify the system boundaries, including identification of all supporting and interfacing structures, systems, and components.

- Revise the emergency flow system design description to correctly and completely reflect the safety classification of the system's components and to identify the system as an "Essential Safety Feature." Revise other flowdown documents, such as the master equipment list, accordingly to reflect these safety changes.

- Perform formal, documented environmental qualification evaluations of the emergency flow system's critical safety components as required by the SAR. Establish checks for the completeness of such qualifications as an integral part of future DBRs.

- Add a requirement to the DC-powered ECP surveillance test procedure to determine the running current and to compare this with: (1) the assumed value in the design basis battery discharge analysis, and (2) previous test values, in order to detect any trend indicating system degradation.

- Add a limiting condition for operation to the TSRs that limits battery room temperature to a minimum of 65° F, the temperature at which the design basis load analysis was performed, and add a corresponding periodic temperature check to the operator rounds procedure.

- Revise the ATR pump in-service testing program to document and trend pump degradation from an established test reference.

4. **Improve the procedures for maintenance of the RELAP model.** Enhance existing BEA procedures to provide guidance on the extent and rigor of testing changes to the ATR model depending on the nature, complexity, and safety significance of such changes (e.g., the need for regressive testing, preparation of independent test plans and test cases, and any additional independent review). Provide guidance on when model changes should be consolidated and the model revalidated.

5. **Improve data archiving and retrieval capabilities.** The file type used for the information stored is not searchable. This information should be converted into searchable files (e.g., an Acrobat PDF file), preferably going back to the original (ASCII type) document if available. Index all information using commercially available indexing programs to allow simultaneous Boolean logic searches of all documents.

APPENDIX F
MANAGEMENT OF SELECTED FOCUS AREAS

F.1 Introduction

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) inspection of environment, safety, and health (ES&H) at the Idaho National Laboratory (INL) Advanced Test Reactor (ATR) included an evaluation of the effectiveness of the Idaho Operations Office (ID) and the contractor – Battelle Energy Alliance (BEA) – in managing selected focus areas. Based on previous DOE-wide assessment results, OA identified a number of focus areas that warrant increased management attention because of performance problems at several sites. During the planning phase of each inspection, OA selects applicable focus areas for review based on the site mission, activities, and past ES&H performance. In addition to providing feedback to ID and BEA, OA uses the results of the review of the focus areas to gain DOE-wide perspectives on the effectiveness of DOE policy and programs. Such information is periodically analyzed and disseminated to appropriate DOE program offices, sites, and policy organizations.

The focus areas selected for review at ATR and discussed in this appendix were:

- Hoisting and rigging (see Section F.2.1)
- Safety system oversight (SSO) by ID and the BEA system engineer program (see Section F.2.2).

The SSO review is discussed in this appendix, but the evaluation of this topic is reflected in the evaluation of the broader feedback and improvement systems in Appendix D. OA also identified corrective action management as a focus area. Corrective action management systems, as implemented by ID and BEA for ATR, are discussed in Appendix D as part of the overall feedback and improvement process.

F.2 Results

F.2.1 Hoisting and Rigging

OA identified hoisting and rigging as a focus area because OA inspection results and site occurrence reports indicate that a number of sites have experienced events, near misses, and injuries during hoisting and rigging activities. OA reviewed hoisting and rigging activities performed by BEA during operations and maintenance work at ATR, primarily associated with experiment handling on the reactor top and fuel and experiment handling in the canal. The review of the hoisting and rigging program included observation of lifting activities and crane maintenance, review of hoisting and rigging procedures, and inspection of hoists, slings, lifting fixtures, and cranes in the ATR.

INL uses the 2004 version of the DOE Hoisting and Rigging standard. Requirements of the standard are implemented through a series of management control procedures (MCPs), which provide guidance for more detailed, site-specific implementation of the DOE standard requirements. Within ATR, inspections and use of hoisting and rigging equipment are implemented through detailed operating procedures and model work orders.

ATR has several installed overhead bridge cranes, which are essential to the reactor operation program. Cranes include a 40/10-ton overhead bridge crane, a 30/5-ton crane used to handle items in the fuel canal, a 12-ton crane that services a laydown area, a 7-ton crane used in the diesel area, a 2-ton overhead crane in the reactor main floor, and a 2-ton jib crane that bridges the area between the reactor and the fuel canal. The 40/10-ton overhead bridge crane is categorized as safety significant because it is used to handle reactor experiments. Each of these cranes is subjected to daily inspections before use, a monthly inspection, an annual inspection, and a three-year weight test. These inspections are conducted in accordance with procedures, and records are maintained. All required inspections for the cranes were completed within the required period.

An INL procedure, *Status Tagging of Hoisting and Rigging Equipment*, requires hoisting and rigging equipment to have a status tag attached that indicates a unique identification number for the equipment, the rated capacity, and the month and year the inspection expires. At ATR, these requirements have been modified to minimize the risk of dropping the tags into the reactor. An ATR procedure further specifies the requirements for controlling critical lifts, establishes two categories of critical lifts, and establishes practices for marking hoisting and rigging equipment to indicate the frequency of documented inspection. Those markings are color coded (colored tape on the equipment) to indicate when the equipment is due for inspection. The color codes are listed in the procedure and posted on approved operator aids in the areas where the equipment is used.

The ATR Building Lift Book provides load handling restrictions for the ATR building that are not specified in the technical safety requirements. These formal restrictions control lifting activities and are designed to limit the risk of facility and fuel damage from a load drop. The use of these controls is a commitment in the *Upgraded Final Safety Analysis Report for the Advanced Test Reactor*. Lifts associated with the ATR Critical Facility are also controlled by the Lift Book. Cask and non-cask loads and all load handling devices, including cranes, forklifts, and portable lifting devices, are addressed for lifting activities in or over the ATR building.

The material condition of all the installed bridge cranes in ATR is good. All lifting and rigging activities observed were conducted with slings and lifting devices that were appropriately tested and inspected. Some miscellaneous lifting equipment was identified inside contamination areas (including portable shop cranes and hand-operated chain hoists) that did not have current inspection tags or markings. However, this equipment was not in use, and procedures that involve hoisting and rigging include steps to verify the inspection and weight test status of equipment before it is used.

In 2004, a visual inspection of the ATR 40/10-ton crane identified a crack in a weld on the 10-ton crane trolley. That discovery led to an extensive inspection and repair effort, including a 100 percent visual inspection of all welds on the 40/10-ton crane. During that inspection, several more cracks were identified and repaired. ATR's consultation with a professional crane inspection company revealed that these cracks are common for cranes manufactured in the same time frame as the ATR crane. INL subsequently extended the inspection to cranes throughout the site. Repairs were completed to meet welding standards that exceed the original manufacturer's requirements. The responsible engineer has initiated a preventive maintenance work order that will require a more detailed inspection of critical welds at the end of each outage, but that requirement has not yet been formally implemented. (See Appendix D for discussion of deficiencies in applying the corrective action management processes for the crane issue.)

Summary

Requirements delineated in the DOE Hoisting and Rigging standard have been effectively implemented at ATR. Hoisting and rigging equipment is maintained in a safe manner, lifts are performed in accordance with approved procedures, and critical lifts are appropriately planned and performed.

F.2.2 Safety System Oversight

OA selected SSO as a focus area because DOE requirements in this area are relatively new and previous OA inspection results indicate that a number of deficiencies in engineered safety systems could be corrected and prevented by effective SSO. To assess this area, OA interviewed ID and BEA personnel, reviewed various documents and procedures, and examined training and qualifications. OA evaluated the effectiveness of ID's SSO program, which is responsible for monitoring and assessing INL programs for ensuring effective design, configuration management, maintenance, and operation of essential safety systems. OA also evaluated INL's system engineering program, which is responsible for ensuring the functionality of nuclear facility safety systems. OA's review of the ID and BEA programs focused on their implementation at the ATR.

ID SSO Program

ID is implementing an SSO program at the ATR even though the ATR is not a defense nuclear facility and therefore is not required to meet DOE expectations for an SSO program contained in DOE Manual 426.1-1A, *Federal Technical Capabilities Manual*. This manual implements Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 2000-2 for improving safety system management. ID routinely evaluates the sitewide applicability of DNFSB recommendations for both its defense and non-defense nuclear facilities, and after evaluating Recommendation 2000-2, ID appropriately concluded that an SSO program would be a prudent measure at the ATR, which is a hazard Category 1 nuclear facility.

ID started its efforts in fiscal year 2002 in response to the DNFSB recommendation, well before DOE issued DOE Manual 426.1-1A in May 2004. ID efforts included identifying vital safety systems and designating SSO personnel for safety systems. Further, ID established a qualification standard for SSO personnel and aggressively pursued their qualification; all five ID SSO personnel have completed their qualification requirements. The qualification program appropriately delineates the knowledge that SSO personnel need to perform their duties, such as knowledge of assigned system(s), contractor system engineers activities related to the system design and maintenance, and the facility authorization basis.

Although ID has taken some important first steps in establishing some of the basic elements of an SSO program, the program has not been well defined, does not meet all of DOE expectations identified in the DOE manual, and has not been fully implemented. There is no SSO program document, and SSO roles and responsibilities are not identified or defined in the current ID Function, Responsibilities, and Authorities Manual. The clear definition of roles and responsibilities and development of a program document are essential in ensuring that appropriate resources are allocated and that SSO personnel will be able to adequately perform their duties. In addition, ID has not performed formal assessments of safety system operability until just recently and has not assessed the contractor system engineer program; these are two important duties of SSO personnel.

Currently, one individual, the ATR facility engineer, has been assigned to perform the SSO function for all safety systems at ATR, as well as other collateral duties. The facility engineer demonstrated a very good understanding of the ATR safety systems and the status of the design basis reconstitution effort. In addition, the facility engineer recently led a vertical slice assessment of a safety system at the ATR, which was appropriately conducted and identified some weaknesses. The facility engineer is also leading an effort to evaluate design basis reconstitution gap resolutions, including processing of unreviewed safety questions. Although the ATR facility engineer is appropriately performing many SSO duties, it is not clear that one individual is sufficient to perform all of the SSO duties for all the safety systems at ATR. Because ID has not adequately defined the SSO program and has not identified and allocated supporting resources (e.g., ID Facility Representatives and subject matter experts) for the ATR SSO, it currently cannot adequately determine the resources needed to perform the SSO function at ATR.

Two assessments of the ID SSO program were conducted in 2004: an ID self-assessment, and an assessment by the Federal Technical Capabilities Panel. These assessments were generally well performed and identified many of the same issues identified by OA. ID is in the process of implementing corrective actions for these assessments, including developing an SSO program document; revising the Functions, Responsibilities, and Authorities Manual; and updating the qualification card to better conform to DOE Manual 426.1-1A.

BEA System Engineer Program

The contractors responsible for ATR (i.e., BEA and preceding contractors) have had aspects of a system engineer program in place since the 1990s, long before being contractually required (July 2002) to establish such a program in accordance with DOE Order 420.1A. BEA has identified the vital safety systems and assigned system engineers and backups for each system (a total of 14 system engineers assigned for the 20 vital safety systems at ATR). Training and qualification requirements for system engineers are well defined in an INL document, *Competency Commensurate with Responsibility, INEEL System Engineer,* and are adequate in most respects. One exception is that training on the unreviewed safety question process is not identified, even though the system engineer is likely to be the person addressing unreviewed safety questions and evaluating the adequacy of systems to meet their design basis.

System engineer activities are generally described in the Conduct of Engineering Manual and include ensuring technical adequacy of the systems, monitoring system status, and ensuring that design documents accurately reflect the design basis. In addition, specific system engineer roles and responsibilities are contained in three documents: an INL web page document, a Test Reactor Area Engineering Roles and Responsibility Statement document, and system engineer employee position descriptions.

Although these documents delineate appropriate requirements for the system engineers, there are some inconsistencies between them, and the relationship among the documents is not clear. Furthermore, these documents are not referenced in the qualification manual for system engineers, and neither the system engineer lead nor the engineering manager was aware of the existence of the Test Reactor Area (which includes ATR) engineering roles and responsibilities document. In addition, BEA has not established a system engineering program document that specifies how all the system engineering duties are to be performed (and does not provide linkages to other engineering procedures that provide those details).

Some system engineering activities have not been performed effectively. For example, ATR system engineers have not adequately maintained system design descriptions and system notebooks. Furthermore, system engineers have not performed systematic and formal periodic review of system operability, reliability, and material condition and assessed the system's ability to perform its design and safety functions. These deficiencies are at least partly attributable to the high work load for the ATR systems engineer, which is in large part a result of the age of the systems, the degraded state of configuration management, and the large backlog of engineering actions. BEA recognizes that it is difficult for system engineers to perform all their tasks effectively and is taking actions to address these concerns, such as establishing a new engineering management position to focus on system engineering, configuration management, and quality assurance and hiring a person to fill that position.

Summary

Although not mandated, ID has appropriately decided to establish an SSO program at the ATR and has made some progress in identifying systems, assigning SSO personnel, and ensuring that SSO personnel complete the qualification requirements. However, the program has not been adequately defined or implemented. ID has self-identified most of these deficiencies and is taking actions to address them.

ATR contractors proactively established a system engineer program long before required to do so by DOE Order 420.1A. INL has appropriately identified system engineers for each vital safety system and has established appropriate training requirements. However, some weaknesses were identified in the identification of system engineer roles, responsibilities, tasks, methods for performing the tasks, and training on unreviewed safety questions. Furthermore, the system engineering workload is high, and some tasks, such as maintaining system design descriptions, are not being adequately performed. BEA is aware of the current deficiencies and is taking actions, including establishing a new engineering management position, to address them.

F.3 Conclusions

ID and BEA implementation of the DOE hoisting and rigging requirements is effective at ATR. ID has also taken initial steps to establish an SSO program at the ATR, even though such a program is not mandated. ID self-identified the need for improvements in their initial efforts to define and implement SSO expectations and is taking appropriate corrective actions. INL also established a system engineer program before one was contractually required by DOE Order 420.1A. While a good framework is in place for the system engineer program at ATR, weaknesses were identified in the definition of system engineer roles, responsibilities, tasks, mechanisms for performing identified tasks, and implementation of processes for maintaining system design descriptions. Although additional actions and improvements are needed in these focus areas, ID and BEA have devoted appropriate resources and management attention to these areas and generally understand the residual deficiencies and needed actions.

F.4 Opportunities for Improvement

This OA inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management, and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

Idaho Operations Office

1. **Fully define and implement the ID SSO program.** Specific actions to consider include:

   - Complete development of a system engineer program document/procedure that clearly establishes responsibilities, expectations, documentation requirements, and methods and frequency of SSO activities (e.g., frequency of assessments).

   - Update the Functions, Responsibilities, and Authorities Manual to reflect SSO program responsibilities.

   - Conduct an initial assessment of the INL/ATR contractor system engineer program and establish provisions for periodic assessments in the future.

- Evaluate needed SSO staffing levels for ATR and evaluate the availability and effectiveness of supporting resources (e.g., ID Facility Representatives and subject matter experts).

Battelle Energy Alliance

1. **Clearly mark hoisting and rigging equipment located in contamination areas as "out of service" until necessary inspections and/or weight tests are completed.** Specific actions to consider include:

   - Identify all miscellaneous hoisting and rigging equipment located in the ATR building.

   - Establish an inventory control mechanism to track the use of this equipment.

   - If the equipment is not used, or is infrequently used, remove it from the reactor building to prevent its use.

2. **Enhance system engineer program documentation and implementation of responsibilities.** Specific actions to consider include:

   - Develop a system engineer program document/procedure that provides instructions for implementing system engineer responsibilities or references appropriate implementing documents. Ensure consistency with and among existing roles and responsibilities documents (e.g., manuals, web pages, and employee position descriptions). Resolve existing discrepancies in the current documents.

   - Update the system engineer training requirements to include training on the unreviewed safety question process.

   - Perform assessments of system engineer workloads to determine appropriate near-term and long-term staffing levels. Consider the current engineering backlog, resources needed to address design basis reconstitution issues, and engineering support for aging systems as part of this assessment.

Abbreviations Used in This Report (Continued)

FY	Fiscal Year
ICARE	Issue Communication and Resolution Environment
ID	Idaho Operations Office
INL	Idaho National Laboratory
ISM	Integrated Safety Management
JSA	Job Safety Analysis
LOCA	Loss-of-Coolant Accident
MCP	Management Control Procedure
NE	Office of Nuclear Energy, Science and Technology
NRC	Nuclear Regulatory Commission
NTS	Noncompliance Tracking System
OA	Office of Independent Oversight and Performance Assurance
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration
PAAA	Price-Anderson Amendments Act
PPE	Personal Protective Equipment
PISA	Potentially Inadequate Safety Analysis
QA	Quality Assurance
RCIMS	Radiological Control Information Management System
RCT	Radiation Control Technician
RTC	Reactor Technology Complex
RWP	Radiation Work Permit
SAR	Safety Analysis Report
SORC	Safety Operations Review Committee
SSO	Safety System Oversight
SSW	Senior Supervisory Watch
STD	Standard
TSR	Technical Safety Requirement
TRA	Test Reactor Area
USQ	Unreviewed Safety Question
WASP	Worker Applied Safety Program