Independent Oversight Review of the Oak Ridge National Laboratory High Flux Isotope Reactor Implementation Verification Review Processes

January 2013

Office of Safety and Emergency Management Evaluations
Office of Enforcement and Oversight
Office of Health, Safety and Security
U. S. Department of Energy

Table of Contents

Acronyms

ACTS	Assessment and Commitment Tracking System
CAS	Contractor Assurance System
CFR	Code of Federal Regulations
CNS	Cold Neutron Source
COA	Condition of Approval
CRAD	Criteria, Review and Approach Document
DOE	U. S. Department of Energy
DSA	Documented Safety Analysis
eSOMS	Electronic Shift Operations Management System
FR	Facility Representative
FY	Fiscal Year
HFIR	High Flux Isotope Reactor
HSS	Office of Health, Safety and Security
IVR	Implementation Verification Review
IOS	ORNL Independent Oversight Services
LCO	Limiting Conditions for Operation
LFABB	Laboratory Facility Authorization Basis Board
NNFD	Nonreactor Nuclear Facilities Division
OFI	Opportunity for Improvement
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Office
OSO	ORNL Site Office
OSOP	OSO Procedure
PISA	Potential Inadequacy of the Safety Analysis
Pu-Be	Plutonium-Beryllium
RRD	Research Reactors Division
SAC	Specific Administrative Control
SAR	Safety Analysis Report
SBMS	Standards Based Management System
SBP	Safety Basis Procedure
SCMS	Office of Science Management System
SER	Safety Evaluation Report
SR	Surveillance Requirement
SSC	Structures, Systems, and Components
SSO	Safety System Oversight
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question
WP	Work Practice

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1.0 PURPOSE

This report documents the independent review of Implementation Verification Review (IVR) processes at the Oak Ridge National Laboratory (ORNL) conducted by the Office of Enforcement and Oversight (Independent Oversight), which is within the Office of Health, Safety and Security (HSS). The review was performed by the HSS Office of Safety and Emergency Management Evaluations during the periods of August 20-24 and September 25-28, 2012, and was carried out within the broader context of an ongoing program of assessments of the execution of IVRs at U.S. Department of Energy (DOE) sites with hazard category 1, 2, and 3 facilities. The overall purpose of these Independent Oversight reviews is to evaluate the processes and methods used for verifying and re-verifying the implementation of new or substantially revised safety basis hazard controls. The objective of this review was to evaluate the extent to which the site management and operating contractor, UT-Battelle, LLC, and the ORNL Site Office (OSO) have developed and employed appropriate implementation verification methods. The review included observation of an IVR at the High Flux Isotope Reactor (HFIR).

2.0 BACKGROUND

Subpart B of 10 Code of Federal Regulations (CFR) 830.201, *Performance of Work*, states, "A contractor must perform work in accordance with the safety basis for a hazard category 1, 2, or 3 DOE nuclear facility and, in particular, with the hazard controls that ensure adequate protection of workers, the public, and the environment." In addition, 10 CFR 830, Subpart A, *Quality Assurance Requirements*, establishes requirements for conducting activities that may affect safety at these facilities, including performing work in accordance with hazard controls, using approved instructions or procedures, conducting tests and inspections of items and processes, and independently assessing the adequacy of work performance.

In February 2008, the Defense Nuclear Facilities Safety Board requested that DOE evaluate the need to conduct "independent validations on a recurring basis" to ensure that facility equipment, procedures, and personnel training related to safety basis controls have not degraded over time. In response, the Department conducted an evaluation that led to the conclusion that the existing requirements for implementation of safety controls and DOE policy for oversight of the implementation of nuclear safety requirements were appropriate. The evaluation also concluded that Departmental directives contained no explicit requirement to validate safety basis hazard controls, so the Department committed to develop guidance on the validation of safety controls and to add that guidance to its directives.

A DOE working group developed a "best practices guide" for the validation of safety basis controls. In November 2010, the guidance for performing IVRs was incorporated in DOE Guide 423.1-1A, *Implementation Guide for Use in Developing Technical Safety Requirements*, Appendix D, *Performance of Implementation Verification Reviews (IVRs) of Safety Basis Controls*. In June 2012, DOE Guide 226.1-2, *Federal Line Management Oversight of Department of Energy Nuclear Facilities*, was issued; it includes guidance for DOE line management oversight of Technical Safety Requirement (TSR) implementation and safety system operability.

3.0 SCOPE

At the HFIR, OSO provides onsite line management, day-to-day oversight, and surveillance of UT-Battelle, as well as operations and support for accomplishing DOE strategic and long-term general goals. The OSO contractor assessment and oversight system is consistent with the Office of Science expectations for oversight of a contractor with a mature contractor assurance system. The system is designed based a coordinated partnership of the site office, the contractor's corporate parent company, and the onsite contractor "independent review" staff. The site office establishes contractual requirements, including DOE and Office of Science directives, and authorizes the work. The site office provides project management, facility and infrastructure support, and Documented Safety Analysis (DSA) and start up review and approval for category 2 and category 3 facilities (DSA approval for the category 1 facility, HFIR is performed by Office of Science Headquarters). OSO performs Federal functions such as formal program assessments and readiness reviews. Additionally, they perform oversight of the contractor's performance through an assessment system that includes field monitoring, formal assessments, and performance evaluation activities conducted by OSO personnel, and review of the documentation from the Contractor Assurance System evaluations performed by the contractor's personnel. Field monitoring is the routine day-to-day monitoring of work performance and includes site walkthroughs by facility representatives (FRs), Federal Project Directors, and subject matter experts. Formal assessments are structured evaluations of contractor programs and performance, and these may be partnered assessments with the contractor, or only involve Federal assessors. The Contractor establishes an operations plan, executes the work in accordance with identified work parameters, and performs measurements, monitoring, and self assessments.

For this review, the HSS Independent Oversight team assessed the establishment and execution of UT-Battelle processes and activities for verifying the implementation of changes to safety basis hazard controls. The HSS Independent Oversight team also assessed the establishment and execution of OSO processes to assure the safety basis controls were implemented. This scope was consistent with completion of Objectives 1 and 2 in HSS Criteria, Review and Approach Document (CRAD) 45-39, Rev. 1, *Implementation Verification Review of Safety Basis Hazard Controls: Inspection Criteria, Activities, and Lines of Inquiry*. The objectives were to determine whether:

- Processes have been established that provide assurance that safety basis hazard controls are maintained and hazard controls are correctly implemented.
- UT-Battelle and OSO have developed and implemented appropriate methods for performing IVRs or similar reviews.

The review was accomplished by assessing the documentation that establishes and governs the UT-Battelle and OSO IVR processes (for example, work instructions, procedures, forms, checklists, IVR plans and reports, and assessment reports), reviewing completed documentation, and interviewing key personnel responsible for developing and executing the associated practices.

Independent Oversight also performed a shadow review of an IVR at the HFIR performed by the contractor's review team to evaluate whether the IVR adequately examined the implementation of safety basis hazard controls. This portion of the review used Objectives 3 through 6 of HSS CRAD 45-39 as guidance. OSO does not routinely perform IVRs and did not perform direct oversight or shadowing of this particular contractor IVR. The review of OSO's oversight was based upon interviews, a FR walk down, and review of previous documentation of OSO oversight activities. OSO relies primarily on the DSA review and approval process, targeted planned program and project reviews, and on-going oversight performed by the FRs to assure conformance to the safety basis.

4.0 RESULTS

Objective 1: Processes have been established that provide assurance that safety basis hazard controls are maintained and hazard control changes are correctly implemented.

UT-Battelle

HSS Independent Oversight reviewed the procedures and processes that UT-Battelle has established to implement and maintain the safety basis hazard controls at its nuclear facilities, including HFIR. The review was conducted to determine whether these processes and/or procedures include an IVR or similar process for examining the implementation of new or revised safety basis documents where the reviewers are sufficiently independent of the groups responsible for developing and implementing the safety basis controls (i.e. reviewers should be from separate line organizations within the contractor's staff or outside support). The HSS review also assessed these processes and procedures to determine whether they contain an appropriate level of planning and formality for re-verification of safety basis hazard controls and for verification of the implementation of safety basis requirements prior to the startup of new or modified facilities with new or revised safety basis documents.

UT-Battelle has established reasonable expectations for implementing safety basis at its hazard category 1, 2, and 3 nuclear facilities through a set of procedures in the Standards Based Management System (SBMS). Under the safety basis subject area, a procedure, *Implementing the Safety Basis,* documents the required processes and responsibilities for implementation of new or revised safety basis, including the performance of a graded IVR. The procedure also requires managers to support scheduled line management and independent assessments of implemented safety bases as provided for in the contractor assurance system (CAS). This includes a requirement for independent re-verification of safety basis control implementation at each facility every five years using a graded selection process (based, for example, on the safety significance of the control) to determine which controls would be evaluated. The process also provides for identifying and tracking conditions of approval (COAs) to resolution.

An SBMS exhibit, *Implementing Previously Unimplemented Safety Bases,* provides detailed steps for preparing safety basis implementation plans (primarily using matrices) for new facilities, major modifications, modifications involving a positive unreviewed safety question (USQ), new or revised TSRs, and other safety basis changes that have not been fully implemented. The exhibit suggests using an implementation plan for complex changes and provides instructions for preparing and independently checking the implementation actions. It also provides steps for completion of an IVR by an internal review board, organization, team, or individual, such as the Laboratory Facility Authorization Basis Board (LFABB), that is independent of the implementation or responsibility for the affected work. The stated purpose of the IVR is to verify the rigor of the line management implementation method, implementation of TSR controls and/or safety evaluation report (SER) requirements, implementation of associated physical modifications, implementation of procedures and work documents, adequacy and knowledge of staff, and protection of key assumptions. The IVR may be graded based on the extent, complexity, and importance of the changes, and the guidance suggests using the CRADs in DOE Guide 423.1-1A for extensive changes.

At ORNL UT Battelle nuclear facilities operations are split into two divisions; the Research Reactors Division (RRD), which handles HFIR, and the Nonreactor Nuclear Facilities Division (NNFD), which operates the hot cells. UT Battelle also maintains a variety of support organizations including the Nuclear and Radiological Protection Division which provide radiation safety project review, program assessment, facilities and environmental monitoring, measurements laboratories, dosimetry, and health physics support throughout the ORNL campus.

The RRD has two procedures governing changes to and maintenance of the safety basis: Safety Basis Procedure (SBP)-5600 establishes the roles, responsibilities, and actions for managing DSAs, and SBP-5500 is for TSRs. SBP-5600 requires review of DSA changes to identify any needed changes to procedures and training and preparation of an implementation plan to capture (and manage to resolution) final DOE comments, COAs, and issues. SBP-5500 includes a process for implementing TSR revisions, providing for the use of an implementation checklist and an implementation package prepared by the TSR coordinator. The TSR coordinator is also to maintain a TSR implementation matrix identifying each TSR requirement and the method of implementation. This implementation matrix is to be reviewed annually to verify that each requirement is addressed with an implementing procedure or other appropriate method. Attachments to the procedure provide detailed instructions for completing and approving the implementation. The process includes independent review of the identified changes for accuracy, independent quality assurance review of all documents on the list for implementation of the changes, and review of the implementation process and activities by an internal review board.

The NNFD also has a detailed procedure (NNFD-021, *Safety Basis Implementation and Independent Verification Reviews*) that incorporates the requirements from the SBMS procedures. This procedure includes instructions for assigning an implementation coordinator and for developing a safety basis implementation plan with appropriate reviews and approvals. The procedure includes a provision for LFABB review following completion of the process, which may be done in conjunction with the IVR. The facility manager (or transportation activity owner) determines whether an IVR is required based on evaluation of the following four conditions: new controls; new input assumptions to protect; new conditions or requirements; and/or changes to established controls, assumptions, conditions, or requirements. The procedure has sufficiently detailed instructions and tools to guide the IVR process, using an attached checklist. Overall, the procedure and checklist are well written and comprehensive. However, the procedure does not directly mention whether a TSR compliance matrix is maintained per the recommended practice in SBMS or how it is to be used, and the checklist does not contain space and instructions to guide the observation (or documentation) of performance of hazard control implementing procedures. This opens the possibility that there will be incomplete recognition and review of facility, equipment, or procedure changes that impact the safety basis commitments and/or an incomplete determination of the adequacy of those changes or compensatory measures to satisfy the safety or compliance requirement. (See Section 6, **OFI-1**.)

The SBMS subject area document, *Readiness Reviews*, provides an overview of startup and restart requirements and the readiness review process, including determining the type of readiness review, developing the startup notification report, conducting the contractor readiness review, and supporting the DOE readiness review. The process is supported by procedures and forms for determining, for example, whether a readiness review is required and the level of the review (level I or II readiness assessment or operational readiness review). The readiness review procedure, *Conducting Contractor Readiness Reviews,* includes appropriate steps for preparing the plan of action and the implementation plan, and flows through the conduct of the review to preparation of the draft and final reports. The level I readiness assessment uses a checklist that includes the plan of action, implementation plan, and readiness to proceed memorandum. When completed, it becomes the final report. A core requirements exhibit, along with the DOE readiness review standard and handbook, is referenced for use in developing the required readiness review documents. The procedure requires that the final report must adequately support the conclusions when read by a knowledgeable reader. The *Readiness Assessment Checklist* adequately addresses each of the core requirements and criteria, provides an appropriate level of instruction for completing the actions, and offers a format for documenting the results. Guidance on the form indicates the discussion in the evaluation of each core requirement should be sufficient to justify the conclusion. The procedures and checklist do not specifically mention the use of the IVR results, except in considering whether a readiness review is required.

The SBMS program description, *Contractor Assurance*, thoroughly describes the UT-Battelle approach to integrated performance, which was developed in accordance with contract requirements. It describes three assessment levels – laboratory management, Board of Governors, and partner entities – with performance management as the laboratory management portion of the model. The assurance system includes performance assessments conducted by the responsible line managers (management assessments) and by internal oversight bodies (independent assessment), including ORNL "Independent Oversight Services" (IOS).

Within the laboratory audits and assessments subject area, the SBMS procedure on management assessments provides instructions for planning and completing management assessments, including assignment of the team leader and team members, preparation of an assessment plan, conduct of the assessment, and preparation of the assessment report. The process is supported by a sample assessment report template that contains discussion of the contents of the report, along with a suggested report format. Completed reports are entered into the Assessment and Commitment Tracking System (ACTS), and line managers are expected to manage identified issues using the laboratory's issues management process.

QP-1200, *RRD Assessment Program*, implements both the SBMS required assessments system and the issues management system for subject areas for the RRD. The procedure requires development of an annual assessment program that is reviewed by the Plant Health Committee and entered into ACTS. Completion of the scheduled assessments is monitored by an assessments coordinator. Potential internal assessment activities include programmatic functional assessments, quality assurance group assessments, and staff assessments. A list of potential assessment topics attached to the procedure includes TSR implementation. Several attached forms are available to assist in completing the documentation; however, the forms do not contain guidance for objectives, criteria, or lines of inquiry.
(See Section 6, **OFI-2.**)

NNFD-PLAN-018, *Performance Assessment Plan*, outlines the NNFD approach to evaluating its performance. The division plan includes a five-year rolling schedule of important topical areas, including procedures, training, control of non-conformances, and work control. The plan does not specifically list TSRs as a topical area for assessment; however TSR implementation assessments as required by the DSA and specific TSRs, are also to be scheduled. In-service inspections and safety system assessments that are to be performed in accordance with separate procedures are included in the schedule. Assessments are scheduled by fiscal year (FY), with an appropriate planning period, and entered into ACTS. Safety basis assessments are addressed as a specific topic and include an annual assessment of compliance with the Safety Analysis Report (SAR) and TSRs (to evaluate, at a minimum, inventory control and TSR surveillances and to include a facility walk down) and a periodic (typically every three years) independent assessment addressing such areas as TSR and DSA compliance, training and qualification, and quality assurance program adherence.

In the laboratory audits and assessments subject area, an "independent review" function is intended to meet the quality assurance requirements in 10 CFR 830 for independent review. Two organizations provide UT-Battelle with an internal independent review capability for safety basis hazard controls: the LFABB performs independent review of the completion of the TSR implementation process (IVRs), and the ORNL "Independent Oversight Services Group" (IOS) conducts internal independent assessments. Independent assessment topics include management system effectiveness, line management performance assessment programs, and effectiveness of corrective actions for enforcement actions or high risk/high visibility issues. Assessments are scheduled on an annual basis, and completion and reporting of independent assessments are guided by procedures in the laboratory performance monitoring and analysis subject area. The independent assessment procedure appropriately requires the use of qualified auditors for independent oversight of nuclear requirements and the development of an assessment plan. Planning

is required to address document reviews, interviews, and performance observations. Independent assessment reports are prepared using a specified format and a review, comment, revision, and approval process.

RRD and NNFD also monitor the performance of structures, systems, and components (SSCs) that are credited by the safety bases with performing safety functions. Within RRD, system health reporting is accomplished for 16 equipment reliability groupings; one of the responsibilities is to identify threats to the reliability of prevention or mitigation capabilities. NNFD system performance monitoring also includes an evaluation of the system's ability to perform its safety function and meet established performance criteria. Both divisions require periodic system walk downs and preparation of health reports, but do not require specific evaluation of the surveillance tests against the safety basis to verify that the tests continue to demonstrate the safety function as defined in the safety basis are not required.

ORNL Site Office

HSS Independent Oversight reviewed OSO processes to determine whether they adequately assess the contractor's implementation of new and revised safety basis documents and provide sufficient information to confirm the ongoing effectiveness of contractor processes for the implementation of safety basis requirements.

The OSO safety management functions, responsibilities, and authorities are described in Oak Ridge Office (ORO) Manual 110, Chapter 3, Office of Assistant Manager for Science, which was last updated in 2007. Since that time, significant reorganizations in the Office of Science have rendered this document obsolete. Currently, OSO is a direct report to the Deputy Director for Field Operations within the Office of Science. OSO is organized into two divisions; the Operations and Oversight Division; and the Mission Integration and Projects Division. Per OSO work practice (WP) 420 *Review and Approval of Nuclear Facility Authorization Basis Documents*, responsibility for review of facility authorization basis documents is assigned to the Operations and Oversight Division, which includes the facility authorization basis document lead reviewer and the FRs. The Office of Science has delegated approval authority to OSO for category 2 and 3 nuclear facilities, but has retained that authority for the category 1 nuclear facility, HFIR. WP 420 still refers to delegation to the ORO Manager, which is inconsistent with the current organizational structure. (See Section 6, **OFI-7**.)

OSO WP 420, in conjunction with the Office of Science procedures for Facility Safety Authorization, addresses the process for review and approval of safety basis documents, including USQ determination evaluations, potential inadequacy of the safety analysis (PISA), and authorization agreements. The WP discusses the DSA review process, including development of a review plan, selection of review team members, comment preparation and resolution, and preparation of the SER (including COAs as needed). WP 420 specifically addresses documents for Office of Science and Office of Nuclear Energy hazard category 2 and 3 facilities but does not address hazard category 1 facilities. Final DSA approval for the HFIR Hazard Category 1 is performed by the Office of Science at DOE Head-quarters under the advisement of OSO. There are no other specific procedures for reviewing the HFIR safety authorization basis documents. Also, although the WP appropriately references DOE Guide 423.1-1, it was apparently not intended to include specific instructions for oversight of the implementation of safety basis hazard controls. Although the Office of Science Management System (SCMS) Procedure 1 "Reviewing and Approving Safety Basis Documentation" addresses the approval of updates to the safety basis, the HSS reviewers did not find any additional site office level documents or procedures that specifically address the implementation of safety basis hazard controls, participation in IVRs, or periodic re-verification of safety basis controls, or detailed responsibilities (Roles, Responsibilities, Accountabilities, and Authorities) for implementation oversight. (See Section 6, **OFI-6**.)

The site office uses Office of Science Management System (SCMS) readiness procedures designated Procedures 5, 6, 7, and 8. Procedure 5, *Verifying Readiness for Startup and Restart of Nuclear Facilities*, requires implementation of DOE Order 425.1D and defines the conditions requiring a readiness assessment or operational readiness review. Procedure 6, *Evaluating and Approving Startup Notification Reports*, adequately addresses the requirements for startup notification. Of the four SCMS readiness procedures, Procedure 6 is the only procedure to specifically mention the IVR process. Procedures 7 and 8 define the processes for readiness assessments and operational readiness reviews, respectively. Both procedures recognize the use of a graded approach, comply with the DOE startup and restart order, require the development of a plan of action and an implementation plan, and require that core requirements (which include the implementation of facility safety documentation) be evaluated for inclusion.

OSO Procedure (OSOP) 226, *Oversight*, provides the framework for OSO's oversight activities. On an annual basis, OSO issues an oversight plan that includes: oversight of contractor performance, Federal program self-assessment, and issues management and performance trending. Oversight of contractor performance is accomplished by field monitoring, formal assessments, and performance evaluation. OSO issues an annual plan which includes an integrated assessment schedule including formal assessments of the contractor's performance in specific areas, as well as self-assessments of the Federal programs. WP 453, *Contractor Formal Assessment Program*, describes the process the site office uses to plan, schedule, conduct, and report on assessments of the contractor's performance, including issues management. The WP requires the development of a three-year assessment schedule, the current year of which is included in the OSO oversight plan and transmitted to the contractor. OSO utilizes an assessment planning and scheduling tool spreadsheet that considers, for example, DOE orders, issues and trends, and performance metrics. Part 1, Oversight Approach, of the assessment planning and scheduling tool states that nuclear safety basis implementation will be assessed every two years for RRD and NNFD facilities. Formal assessments require the development of an assessment plan that includes performance criteria and lines of inquiry. Assessment report content is addressed, as well as categorization of findings (for example, priority 1 or 2 issues, observations, and notable practices). Issues management, corrective action plans, tracking, and trending are also discussed. The OSO WPs processes for the formal assessment program provide sufficient direction to support the planning, conduct, and reporting of assessments of contractor performance.

Field monitoring is accomplished through operational awareness and FR coverage, both of which are addressed in OSO procedures. WP 450, *Operational Awareness Program*, includes operational awareness visits, operational performance walkthroughs, and informal walkthroughs. OSOP 411, *Facility Representative Program*, was recently updated to be consistent with DOE-STD-1063-2011 and adequately addresses the FR roles and responsibilities. The ORNL Site Office does not have a Safety System Oversight (SSO) program, relying instead on FRs and subject matter experts to oversee systems to ensure that they will perform as required by the safety basis and other applicable requirements. As discussed in interviews with the FRs and the Director of the Operations and Oversight Division, FRs perform oversight of safety SSCs as part of their routine oversight, and portions of the SSO like duties and programs are addressed through formal assessments of related programs, such as maintenance, and walkthroughs by ORO subject matter experts (e.g., fire protection). However, no ORNL Site Office procedure or WP, including the FR procedure, describes how these aspects of oversight of safety systems are accomplished. (See Section 6, **OFI-6**.)

In addition to the FRs' routine oversight activities, OSOP 411 requires the FRs to develop a quarterly assessment plan, which is included in the contractor formal assessment program. Typically, two of the quarterly assessments address a major area of conduct of operations, and two address environment, safety, and health topics. The quarterly assessments are conducted in accordance with OSO's formal assessment

program. Day-to-day activities are to be documented in bi-weekly reports to OSO management. Overall, OSO WPs and procedures, in conjunction with the SCMS environment, safety, and health procedures, provide an adequate foundation for oversight of the implementation of safety basis hazard controls.

Objective 2: The contractor and site office have developed and implemented appropriate methods for performing IVRs or similar reviews.

Independent Oversight reviewed the UT-Battelle and OSO IVR methods to determine whether they adequately address the implementation of safety basis hazard controls. The review also examined whether the review criteria and approaches are appropriately tailored to the hazard controls being verified and sufficient for the scope of the review, and whether the review activities are sufficiently well documented (per procedures) to support the conclusions of the review.

UT-Battelle

Independent Oversight reviewed the completed implementation matrices for the HFIR SAR, Cold Neutron Source (CNS) DSA, and TSRs that were approved in June 2011. As required by procedure, implementation matrices were prepared by a nuclear safety analyst and independently verified by a second nuclear safety analyst. The matrices address the location of the requirement, citation, and commitment, how it is met, whether it is required for the implementation (Y/N), the responsible person, and independent verification of completion. Each of the required actions is initialed when it is complete and has been independently verified by a second person. Implementation actions include updates to drawings and flow diagrams, the safety related equipment list, procedures, and training. Actions related to procedures needing revision and training, which are not included in the matrix but listed separately, are initialed when complete and independently verified.

Independent Oversight reviewed the report of the 2011 IVR for the implementation of the HFIR safety basis documents. The report documents the status of the approved documents being reviewed, lists the approving SERs, and indicates that no actions were required to meet the single COA (to retain TSR Section 5.4.3). It summarizes the nine actions included in the implementation, which include document updates, procedure revisions, and independent verification of completion. As a result of the IVR review, a separate action was completed to verify the technical accuracy of outstanding USQ reviews (as required by the SBMS procedure but not included in the implementation matrices). The report discusses verification that TSR 5.4.3 remains in effect but does not address the implementing procedure(s). It also indicates that the training included specific administrative control (SAC) implementation, since this was the first use of SACs at the HFIR. The report documents the review of the on-line training module and identifies the numbers of the revised procedures, but does not mention review of any of the revisions or observation of performance (or walkthrough) of the revised procedures. Overall, the assessment was a review of the implementation process and not an independent verification of implementation. (See Section 6, **OFI-4**.)

Independent Oversight also examined reports for several IVRs completed for minor safety basis changes at other nuclear facilities, including NNFD Buildings 7920 and 3525. The IVRs were completed using a tabular format to record the results, using a reasonably comprehensive set of objectives, criteria, and lines of inquiry. The lines of inquiry were suitably adjusted to account for the scope and depth of the changes. In each case, the results of the review were sufficiently well documented to describe the IVR activities and support the conclusions of the reviewer. The reviewers identified some items requiring attention, and the report is complete.

Independent Oversight also reviewed the completed documentation (readiness assessment checklist) for a level 1 readiness review conducted for plutonium-beryllium (Pu-Be) source recovery at Building 7920.

The original revisions provide an appropriate plan of action and implementation plan for the review and were approved by the facility manager and startup authority, as required by procedure. The completed readiness assessment checklist provides adequate documentation of completion of the review. The readiness assessment was conducted over ten days and included document reviews, interviews, and an observed evolution. The report identified 3 pre-start and 3 post-start findings and 26 opportunities for improvement. Brief responses document the observations made for each of the criteria (lines of inquiry), including safety basis implementation, though some entries lack detailed descriptions of how the new safety basis controls were verified.

The ORNL FY 2012 Integrated Laboratory Assessment Schedule includes seven SAR and/or TSR management assessments and a number of system performance assessments scheduled by NNFD. It also includes an independent assessment of nuclear facility safety basis support systems (safety management programs) and the triennial review of the criticality safety program, which was completed in the FY's third quarter. The FY 2012 integrated assessment schedule does not include management assessments of TSR or safety basis hazard control implementation at HFIR. (See Section 6, **OFI-3**.)

Since 2009, ORNL's IOS has completed independent assessments of TSR implementation at each of the non-reactor nuclear facilities within NNFD. As noted above, an independent assessment of nuclear facility safety basis support systems, including HFIR, has also recently been completed. The assessment teams included independent personnel from UT-Battelle, as well as external assessors. Each of the reviews was conducted using a detailed plan that appropriately addressed objectives, criteria, and lines of inquiry and included document reviews, interviews, and observations of work activities. The results of the assessments are well documented in reports, and the discussions fully support the conclusions. The reports also provide evidence of critical reviews and record a number of appropriately classified findings and opportunities for improvement. In particular, the plans and reports provide evidence of an appropriate emphasis on the observation of work activities. The IOS has not completed an assessment of TSR implementation at HFIR. (See Section 6, **OFI-3**.)

Independent Oversight observed the performance of a contractor IVR at the HFIR. The scope of the IVR included moderate changes to the safety basis resulting from SAR revisions 9, 10, and 11; CNS DSA revisions 3, 4, and 5; and TSR revision 17. Notable safety basis changes (described in the IVR overview) included the modification of the surveillance requirement (SR) for the pony motor battery room door fire dampers and conversion of a compensatory measure related to use of the hydrogen equipment area crane to a SAC. The UT-Battelle IVR team assessment was conducted according to a written plan (contained in the IVR checklist) that included a reasonable set of objectives, review criteria, and lines of inquiry. The assessment was conducted using an appropriate degree of rigor and included interviews, document reviews, walk downs, and field observations. IVR team members were sufficiently independent of HFIR line management and possessed adequate technical expertise to complete the assessment. The IVR team placed sufficient emphasis on observation of activities. Assessment results, including issues, were properly documented. The IVR team identified three observations and four minor items for correction.

Overall, the IVR adequately evaluated changes in safety basis hazard control implementation; however, Independent Oversight identified some opportunities for improvement in the IVR process. The IVR team used the safety basis implementation matrix as the basis for the review but did not validate the accuracy of the matrix (or the referenced list of revised documents) as part of the team's verification process; instead relying on the independent verification of the implementation conducted by a second nuclear safety analyst. In addition, although the IVR team reviewed the modification of the pony motor battery room door fire dampers, they did not review the modification associated with seismic upgrade of the pony motor batteries; both modifications were included in the SAR revisions being implemented. Furthermore, while sampling might be appropriately used for a large IVR, the small number of design modifications associated with these SAR revisions and the relative importance of the pony motor batteries (versus the

fire dampers) would indicate that the pony motor battery installation should have been included in the scope of the IVR (in accordance with criterion 1.2 of the IVR checklist). Instead the SBMS safety basis IVR process allowed this modification to be excluded from the IVR on the presumption that it had been verified by HFIR personnel when initially implemented. The IVR also did not address changes in the safety basis hazard controls that were included in the SAR revisions but not in the TSR revisions. For example, an update to the fire safe shutdown analysis that included several commitments, including one to modify operating procedures, was not included in the IVR scope. (See Section 6, **OFI-4**.)

Independent Oversight also reviewed a sample of the HFIR safety basis documents that were not a part of the specific scope of the IVR to gain additional perspective on the thoroughness of the safety basis change control process. Based on the sample, this review identified no additional sections of the safety basis documentation that were impacted by revisions 9-11 of the SAR, revision 17 of the HFIR TSR, or revisions 3-5 of the CNS DSA beyond those that were submitted by ORNL and approved by DOE.

In addition, Independent Oversight reviewed the continuity of SER commitments through succeeding revisions to the safety basis documents. SERs dated April 30, 2010, and June 23, 2011, were reviewed against the latest versions of the safety basis documents (including CNS DSA Revision 6, submitted for DOE approval in April 2012) to ensure that commitments have been properly implemented and maintained. The commitments contained in the April 30, 2010, SER were properly implemented and carried forward into the current versions of the safety documents. The June 23, 2011, SER implemented HFIR SAR revisions 7, 8, and 8a; TSR revisions 13c and 14; and CNS DSA revisions 2 and 2a. Most of the SER commitments were properly implemented and maintained, but one commitment does not appear to have been adequately implemented, and five commitments were not properly carried forward into the latest versions. For example:

- Comment 8-5 included a commitment to revise SBP-5600 to improve the configuration control and traceability of documents referenced in the DSAs; however, the revision to the procedure does not appear to address improvement in the traceability of referenced documents.

- The resolution to Comment 7-3 required a revision to the HFIR Safety Related Equipment List definition of "safety class" to match the definition in the SAR, but that change was not included in the most recent version of the list (revision 17).

- The committed wording changes to address Comments 8-28 and 8-30 were not carried over into the latest version of the HFIR SAR (revision 11).

In addition, two commitments related to CNS DSA revisions 2 and 2a were not maintained in subsequent revisions. The commitments appear to have been initially implemented on October 5, 2011, and maintained in revision 5 of the DSA implemented on October 2, 2012. However, revision 6 of the DSA, which was formally submitted to DOE for review and approval in April 2012, does not include implementation of these commitments.

Interviews with the HFIR SAR coordinator indicated that after receipt of the SER approving revision 11 of the HFIR SAR on June 20, 2012, the previously approved changes were not added into the approved revision 11, which is currently being implemented. Discussion with the coordinator also revealed that the wrong version of the CNS DSA version was used to develop revision 6; apparently, a version prior to revision 2a was used. UT-Battelle later confirmed that the corrections were made to revision 11 before final implementation on October 2, 2012, and that CNS DSA revision 6 page changes will be formally submitted to OSO.

The above are examples of incomplete configuration control of safety basis documentation. Although the failure to implement the commitments noted above does not appear to be safety significant, the contractor process for safety basis documentation implementation should be improved to ensure proper continuity of commitments contained in DOE SERs. (See Section 6, **OFI-5**.)

ORNL Site Office

The OSO work practice WP 453, *Contractor Formal Assessment Program*, requires a schedule to be prepared and approved during the first quarter of each FY, and includes a 36-month planning horizon. The assessment planning tool defines the oversight approach for nuclear safety basis implementation to be once every two years for RRD and NNFD. Two assessments were conducted during this period: one by OSO FRs as part of their quarterly assessment program in 2010 and the other by the Office of Science in 2011. The OSO FR quarterly assessments are included in the formal assessment schedule. The assessment planning tool also includes the three year planning horizon, and the FY 2012 version did not show any planned assessments for DSA or TSR implementation verification in 2012, 2013, or 2014. OSO management advised Independent Oversight that OSO does not perform independent IVRs, and no evidence was presented of shadow assessments of contractor IVRs. (See Section 6, **OFI-6**.)

The FRs' assessment of TSR and credited engineering controls in 2010 was documented in a formal report that included sections on the assessment team members, performance criteria, assessment approach, results, conclusions, lines of inquiry, and notable practices and issues. The assessment was conducted in accordance with the issued assessment plan. The scope included facility-specific TSRs and credited engineering controls, calibration of instrumentation, technical adequacy of surveillance tests, timeliness of surveillances, and operational knowledge. Facilities within the assessment scope included several in the NNFD (Building 3025E, Irradiated Materials Examination and Testing Facility; Building 3525, Irradiated Fuels Examination Laboratory; and Radiochemical Engineering Development Center, Buildings 7920 and 7930) and the RRD (HFIR), as well as the Spallation Neutron Source. Building 3047, a hazard category 3 nuclear facility, was not included in this assessment. The assessment process included interviews and document reviews but did not include observation of performance of surveillances, instead relying upon normal quarterly walkthroughs. The assessment included limiting conditions for operations (LCOs) and surveillances, SACs, and design features for safety. The assessment was thorough and appropriately identified a number of observations.

Additionally, OSO conducted a 2008 assessment of the NNFD's safety basis implementation process. The assessment report was thorough and identified a number of level 2 findings and observations.

The DOE Office of Science conducted an assessment of the ORNL DSA and TSR flow down in March 2011. Two TSRs were selected – Building 3525 voloxidation pressure relief valves and Building 7930 in-service testing and surveillance/maintenance. The evaluation criteria included derivation of controls and identification of key assumptions in the DSA and the flow down to the TSRs, and implementation of TSRs (control implementation and documentation flow down). The DSA review included tracing the controls through Chapters 3, 4 and 5 of the SAR (including the identification of an issue), the protection of key assumptions, and a review of the technical basis document for pressure relief valve flow conditions. The assessment of the implementation of a sample of TSRs was comprehensive and included a walk down of the voloxidation system and reviews of the qualification status of the systems engineer; change control packages; and daily, weekly and monthly round sheets. The review was very thorough and critical, identifying a number of level 2 and level 3 findings, as well as a noteworthy practice.

Independent Oversight reviewed the SER that evaluated HFIR SAR revisions 9, 10, and 11; HFIR TSR revision 17; and HFIR CNS DSA revisions 3, 4, and 5. Appropriate guidelines were used for the review (for example, Nuclear Regulatory Commission Regulatory Guide 1.70, DOE-STD-3009, and DOE Guide

421.1-2). The SER review team consisted of the lead reviewer and a HFIR FR. The SER included an executive summary; a discussion of the review process, standards, and acceptance criteria; evaluations of the DSA; and conclusions and recommendations. The evaluations included a review of each chapter by revision. The SER was well written, provided a thorough review of significant changes, and included COAs as appropriate.

Several review plans for HFIR (annual SAR update revision 7), Building 7920 (annual SAR and TSR update), and Building 7930 (annual SAR and TSR update) were reviewed and found to appropriately include the background, scope, review team responsibilities, review process, SER format, and review schedule. The review plans for Buildings 7920 and 7930 also included, as an appendix, a DSA review checklist, including lines of inquiry. WP 420 requires review plans only for initial submittals or substantial revisions of facility authorization basis documents.

WP 420 includes the expectation that authorization basis documents be reviewed within 90 days from receipt (step 3.6.2); however, the site office is currently behind schedule on the HFIR safety authorization basis documents. Although urgent safety basis changes have been implemented through amendments, the delay in reviewing the annual updates and issuing SERs could result in delays in implementation of up-to-date hazard controls, and was a contributing factor to the configuration control issues in the safety basis documents noted above for UT-Battelle. The site office acknowledges the need for improvement and has made progress toward reducing the backlog. (See Section 6, **OFI-7**.)

Additionally, it was noted that OSO does not use a formal process for tracking and resolution of SER COAs. OSO's normal practice is to identify, via a stamp on the internal concurrence sheet, that commitments are contained in the document. An attempt is made to discuss any COAs that have been adequately resolved by reference to subsequent letters transmitting other SERs. However, the practice does not consistently close all COAs, and no formal process is in place to ensure this closure by OSO. (See Section 6, **OFI-6**.)

UT-Battelle has conducted two readiness reviews within the past several years: a readiness assessment for the Pu-Be Source Recovery at Building 7920 in 2011, and a readiness assessment for the first shipment of full-length fuel rods in Building 3525 in 2009. OSO observed the Pu-Be readiness assessment and documented this oversight activity in a report that included sections on the scope, performance criteria, assessment methods, DOE review team membership and its responsibilities, results, and conclusions. The report noted that the safety basis supplement and TSR were declared implemented by UT-Battelle, but no further review was performed. It was stated that an IVR was conducted before the readiness assessment and was observed by the FR; however, no documentation of FR oversight of the IVR was available. The FR observed the 2009 readiness assessment and documented this observation in the FR Quarterly Summary Report. Independent Oversight's review of the startup notification report process indicates that OSO is appropriately following the process, although there has been little activity to report.

Before each reactor startup for each new fuel cycle, DOE concurrence is required. As part of this process, the FRs review the HFIR Restart Readiness Checklist, which includes review areas such as, status of surveillance test procedures, maintenance status, systems engineering, PISAs, and USQ determination. Although not a readiness review, this review provides additional assurance that safety basis controls are implemented.

In addition to formal assessments, OSO relies on the FRs for oversight of IVRs and other activities related to the implementation of safety basis controls. Interviews with the FRs indicated that they perform oversight of IVRs and implementation of safety basis hazard controls as part of their routine oversight. The FRs also provide daily oversight of contractor operations, including verifying facility operation within the established safety basis controls. FR walkthroughs are documented in an electronic

system, and oversight activities are documented in bi-weekly reports and FR Quarterly Summary Reports, which showed that FR walkthroughs involved subject matter experts in accordance with an issued schedule. Additionally, the FRs conduct quarterly assessments that are included in the contractor's formal assessment program. Independent Oversight's review of a sample of bi-weekly reports provided evidence of ongoing FR oversight of contractor IVRs, safety basis compliance, and operations. The bi-weekly reports are thorough and informative. A review of SERs confirmed that the FRs are routinely included as members of the safety basis review teams, thus ensuring that they have up-to-date knowledge of changes to the safety basis controls.

During interviews, the FRs exhibited a good understanding of the safety basis controls for their facilities and demonstrated knowledge of the processes for implementing TSR controls, including the use of IVRs. However, of the seven IVRs UT-Battelle conducted from 2010 through 2012, OSO oversight was documented for only two of the IVRs (and this was provided as input to the FR bi-weekly report). The FRs have been effective in identifying issues related to the safety basis, as evidenced by a PISA on the "decrease in heat removal" scenario, a PISA on the testing of the pony motors and batteries, and a PISA on an inadequate definition of a surveillance requirement related to the pool-to-vessel check valve.

Overall, the OSO assessment process provides adequate oversight for the implementation of TSR controls. However, given the complexity and number of hazard controls, and the expectation that the FRs assume responsibility for oversight of vital safety systems, it is difficult to determine whether all TSRs and vital safety systems are being verified and/or re-verified on a periodic basis. (See Section 6, **OFI-6**.)

Objective 3: Contractor IVRs or similar reviews and site office oversight activities are sufficient to verify that safety basis hazard controls have been effectively incorporated into implementing administrative and operating procedures and work control documents.

UT-Battelle

The IVR team verified implementation of revisions to several administrative and operating procedures that fulfill the HFIR TSRs, such as ADM-0105, *Surveillance Test Procedure Administrative Guidelines*; ADM-0161, *Technical Safety Requirement (TSR) Documenting and Tracking*; and EG-1, *Review and Approval Process for HFIR In-Vessel and Gamma Irradiation Experiments*. The contractor IVR team adequately reviewed and assessed the procedures associated with these changes in the safety basis. Independent Oversight observed that the procedures were adequately written, reviewed, approved, controlled, and maintained and that the procedure changes adequately maintain facility operations with the revised safety basis. During the review, Independent Oversight noted that (in addition to EG-1) system engineering procedures for controlling modifications to the beam-tube facilities are also needed to implement the requirements of SR 4.9.1.e, but are not included in the TSR compliance matrix.

ORNL Site Office

OSO accomplishes its review of implementing administrative and operating procedures and work control documents as part of the FRs' routine oversight and the FR quarterly assessment program. Interviews with the HFIR FRs indicated that the FRs review procedures as part of their normal walkthroughs, and they periodically accompany the operator conducting shift checks. The HFIR FRs have electronic access to the contractor's procedures, including surveillance test procedures. One bi-weekly report discussed the FR review of the surveillance test procedure for the pony motor/battery bank functional test, which resulted in a PISA.

The FRs conducted a quarterly assessment of the ORNL conduct-of-operations technical procedures and operator aids program at the Spallation Neutron Source, NNFD, and RRD. Although this assessment

focused on procedure use and development, the FRs observed two technical procedures in progress in NNFD facilities 7930 and 3525. A review of the FR quarterly assessment of the TSR and credited engineering controls showed that lines of inquiry were included in the surveillance guidelines, and these address procedures for calibrations and for surveillance tests. Additionally, the assessment included a review of numerous procedures and several maintenance work packages.

The FRs stated that the LCOs and SRs are reviewed to ensure consistency with the safety basis during the review of updated safety basis documents, as evidenced by the evaluation of the HFIR TSRs in the SER supplement for TSR revision 17. Examples include the review of SRs 4.6.2.4 and 4.6.2.5, SAC 5.13.3, and the bases for LCO 3.3.10.

Objective 4: Contractor IVR or similar processes and site office oversight activities are sufficient to verify that the safety SSCs and design features are installed, inspected, and maintained as described in the safety basis documentation.

UT-Battelle

The IVR team appropriately verified implementation of the fire door ventilation louver modification by walking-down the modified doors and interviewing the responsible system engineering personnel. The IVR team members also observed the performance of the revised operator shift check (surveillance). However, as noted previously, the SAR updates also included a previous installation of upgraded, seismically qualified batteries to support pony motor operation. In this case, the IVR team assumed that the qualification process performed by HIFR personnel during installation was sufficient to verify implementation of the SAR requirements. The team did not include this safety-related modification in the scope of the review, but noted that "previously implemented modifications are not in scope of an ORNL IVR per the SBMS procedure."

During the review, the IVR team found that a number of TSR surveillances are logged and tracked by using the electronic Shift Operations Management System (eSOMS), an electronic data system. The IVR team fittingly reviewed the software quality assurance plan and interviewed responsible personnel to determine whether the appropriate level of quality assurance was applied to this software (which the applicable software quality assurance plan identifies as non-safety). The IVR team identified that because conformance to the TSRs is immediately checked or verified through the data logging system, the software may need to be considered as safety-related; that is, it may be subject to additional software quality assurance requirements. Independent Oversight noted that the eSOMS software contains a number of logical operations (programmed by the operations staff) that perform the checks to determine whether or not the TSR surveillance requirements are met. Following the instructions in the *Software Quality Assurance for Safety Software* procedure and supporting documents, this should lead to categorizing the software as safety software. The current software quality assurance plan for eSOMS provides for verification testing of the software, categorized as "business function," and for validation of the software using the walk down review checklist of PMP-1000, *RRD Procedure Management*. However, the walk down review checklist does not require any specific software testing to validate whether the eSOMS test copy accurately reflects the procedure revision. (See Section 6, Finding **P2-1**.)

ORNL Site Office

As noted previously, oversight of the safety SSCs is provided primarily by the FRs as part of their routine oversight, with support from ORO subject matter experts (e.g., fire protection). A review of HFIR FR assessment reports identified walkthroughs with the ORO fire protection subject matter expert, who inspected fire barriers, fire doors, and penetrations. Additionally, portions of the SSO program are addressed through formal assessments of related programs. As one of their quarterly assessments, the FRs recently conducted a triennial assessment of the maintenance management program for category 1, 2, and 3 nuclear facilities. Independent Oversight found that the lines of inquiry (Appendix I of the draft assessment report) addressed numerous aspects of SSO, including the master equipment list, the use of system engineers in the maintenance process, and the configuration management program. The assessment was thorough and involved a reasonable number of interviews, document reviews, and observation of activities, including radiation monitoring system testing and vibration testing of a fan. The assessment identified two notable practices, four findings, and seven observations. Interviews with the HFIR FRs indicated that they oversee the implementation of SSC safety functions through routine oversight, through review of safety related equipment lists and surveillance test procedures, and as part of the safety basis review process. Additionally, before the start of each new fuel cycle, they review the HFIR restart readiness checklist, which addresses the status of surveillance test procedures. The FRs also review monthly system status reports but do not typically shadow the contractor cognizant system engineer's walk downs of vital safety systems.

Objective 5: Contractor IVR or similar processes and site office oversight activities are sufficient to verify that specific administrative controls (SACs) are implemented such that they adequately meet the functional requirements and expectations of the safety basis.

UT-Battelle

The contractor's IVR team appropriately reviewed implementation of the SAC restricting use of the hydrogen equipment area crane. Team members conducted a walk down of the area and, in the process, reviewed the equipment postings and controls and interviewed two cold source (CNS) staff members to ascertain their understanding of the SAC. The IVR team noted that the implementing procedure for this SAC was not reviewed and/or revised by RRD (to address the guidance in DOE-STD-1186, *Specific Administrative Controls*) in response to the change from a compensatory measure to an SAC. The contractor IVR team also noted that there were weaknesses in the procedure. For example, the shift supervisor's signature is not required on the checklist prior to crane use, independent verification is not conducted, and the completed checklist is not required to be retained as a quality assurance record. The contractor's IVR team encompassed these weaknesses in an appropriate opportunity for improvement (OFI). HSS Independent Oversight concurs with this observation.

ORNL Site Office

Implementation of SACs is verified primarily through the FRs' routine oversight. Interviews with the FRs indicated that they periodically review the surveillance test procedure results for SACs that are in the LCO format. For SACs without associated surveillances, the FRs review the implementing procedures. The FR quarterly assessment of TSRs and credited engineering controls also address some SACs. The HFIR FRs have reviewed the implementing procedure for the hydrogen equipment area crane, as noted on the FR checklist for safety basis implementation.

Objective 6: Contractor personnel working at the facility are adequately trained and qualified to implement and maintain the safety basis hazard controls, and the site office personnel are sufficiently trained and knowledgeable to provide oversight of safety basis hazard control

implementation.

UT-Battelle

UT-Battelle has established, documented, and implemented a formal training and qualification program for HFIR personnel conducting the range of safety basis hazard control tasks. Required training is assigned to personnel training based on their position description, assigned duties, and access authorizations. The performance and completion of training are tracked in an electronic database. Where applicable, personnel cannot log into the computerized systems required for performance of their shift duties without first completing assigned and required on-line training. HFIR personnel who were interviewed demonstrated adequate awareness of the TSR changes that were being reviewed as part of the IVR.

ORNL Site Office

HSS Independent Oversight interviewed the FRs with responsibility for HFIR and the NNFD nuclear facilities. All FRs had numerous years of FR experience, and all are fully qualified to perform FR duties in accordance with the FR functional area qualification standard and facility-specific standard. Completed and signed qualification cards were provided for all of the FRs. The FRs are knowledgeable of their facilities and participate as team members on the safety basis review teams for those facilities. Independent Oversight's review of two facility-specific written examinations found them to be comprehensive and to address appropriate topics (e.g., TSRs, safety basis controls and safety systems). The HFIR FR training and requalification program includes material and exam questions used for training HFIR operators. During discussions with the HFIR FRs, they demonstrated detailed knowledge of the safety basis controls implemented in the current SAR and TSR revisions, and they have been actively involved in the review of the revised safety basis documents, including the accident analysis section. Independent Oversight shadowed a daily walkthrough by a HFIR FR that included the overlook area, the control room, the hydrogen equipment area, the cold source equipment area, the helium compressor room, the alcove area, the pony motor battery area, and the cold source control room. During the walkthrough, the HFIR FR demonstrated detailed knowledge of the facility operations and status of facility monitoring.

5.0 CONCLUSIONS

UT-Battelle

UT-Battelle has established and implemented an adequate set of institutional and facility procedures governing the conduct and documentation of IVRs and similar activities at ORNL. The set of SBMS procedures establishes appropriate institutional requirements for performing independent IVRs and periodic re-verification of safety basis hazard control implementation. Institutional procedures are adequately supplemented by divisional procedures and processes at both RRD and NNFD. In addition to the specific IVR procedures, UT-Battelle has established and implemented procedures and processes that adequately address safety basis hazard control verification during readiness reviews. Through the CAS, UT-Battelle has also established institutional and divisional processes and methods for scheduling, performing, and documenting periodic re-verification of hazard control implementation. The CAS appropriately includes requirements for both management and independent assessments that address, among other items, implementation of TSRs. Independent Oversight's review of the documentation of completed IVRs and internal assessments found that the reviews were generally well planned and included document reviews, interviews, and observation of evolutions, where applicable. For the most part, completed reports describe the results sufficiently to support the reviewers' conclusions and provide evidence of thorough, critical reviews. Independent Oversight personnel also found the HFIR IVR review

was conducted according to the checklist plan (applicable to the moderate revisions) and included appropriate observations of evolutions and walk downs of the facility, along with document reviews and a number of interviews of key facility personnel. The IVR reviewers were thorough and critical, and the completed report adequately documents their findings. Although the IVR and assessment processes at ORNL are mostly sound, some opportunities for improvement were identified during the review. For example, the checklist plan did not include steps to verify the accuracy of the facility's TSR implementation plan, which served as the basis of the IVR scope, and did not include some important safety basis changes in the review's scope. Additionally, Independent Oversight identified a problem with continuing maintenance of the configuration of the safety basis documents while awaiting DOE approval of the submittals.

ORNL Site Office

Overall, OSO has established and implemented a set of procedures and processes to verify the implementation of safety basis hazard controls at the site's nuclear facilities, although some opportunities for improvement were identified. OSO's processes and WPs related to: the review and approval of safety basis documents, oversight, operational awareness, and the FR program, along with Office of Science SCMS readiness procedures, provide an adequate set of instructions for overseeing the implementation of safety basis controls. It is noted that only one of these procedures or WPs specifically addresses the IVR process. OSO does not routinely conduct IVRs or shadow the contractor's IVRs. The OSO WPs and processes for the formal assessment program provide sufficient direction to support the planning, conduct, and reporting of assessments. OSO develops an annual oversight plan that includes the functional area of nuclear safety basis implementation. OSO has conducted formal assessments of the contractor's IVR process and the implementation of TSR controls, and the FRs provide ongoing review of hazard control implementation as part of their routine oversight. Even though OSO does not typically shadow the contractor's IVR assessments, the routine surveillance by the FRs and formal assessment processes provide a foundation to assure conformance to the safety basis requirements. The OSO cadre of FRs is well qualified and trained to perform oversight of the implementation of safety basis controls, and is extensively involved in the review of safety basis documents. The HFIR FRs demonstrated a detailed knowledge of operational status and safety systems during interviews and a walkthrough. However, given the complexity and number of hazard controls and the expectation that the FRs assume responsibility for oversight of vital safety systems, it is difficult to ascertain whether all TSRs and vital safety systems are being verified and/or re-verified on a periodic basis. Regarding the review and approval of safety basis documents, the OSO staff performs a thorough review of the documents, as documented in the SERs; however, OSO has not always completed these reviews in a timely manner. OSO acknowledges the need for improvement and has been making progress toward reducing the backlog.

6.0 FINDINGS AND OPPORTUNITIES FOR IMPROVEMENT

During the review, Independent Oversight identified several issues, most representing opportunities for improvement (OFIs). These issues are characterized in accordance with the OSO formal assessment program, WP 453, and are annotated in the report by level and number (for example, OFI-1). The OSO procedure defines three levels of findings. A priority 1 finding is of major significance and results in work cessation or limitation. A priority 2 finding represents a nonconformance, deviation, and/or deficiency in the implementation of requirements, procedures, standards, and/or regulations. Observations are considered priority 3 issues and closely approximate OFIs, which, according to Independent Oversight protocols, "are suggestions offered by the Independent Oversight appraisal team that may assist line management in identifying options and potential solutions to various issues identified during the conduct of the appraisal."

During the review, Independent Oversight identified a priority 2 finding and six OFIs in the implementation of the safety basis controls. As with priority 3 issues, OFIs are not mandatory and do not require formal resolution by management through the corrective action process. The findings and OFIs are provided to OSO for evaluation and follow-up in accordance with OSO procedures and processes.

Independent Oversight identified one priority 2 finding (P2) for UT-Battelle:

UT-Battelle

P2-1: Although the eSOMS software performs a hazard control function in support of the TSRs, it has not been appropriately categorized as safety software in accordance with software quality assurance procedures (for example, *Software Quality Assurance for Safety Software*, and supporting documents such as the Software Categorization Table) and DOE Order 414.1C.

Independent Oversight identified seven OFIs (level 3 findings), five for UT-Battelle and two for OSO:

UT-Battelle

OFI-1: Consider revising NNFD-021 to address whether (and when) a compliance matrix is necessary and to incorporate additional expectations regarding observation and documentation of evolutions as part of the IVR process.

OFI-2: Consider providing guidance or instructions for use of the documentation forms associated with QP-1200 *RRD Assessment Program that includes objectives, criteria or Lines of Inquiry*.

OFI-3: Review the FY 2013 Integrated Laboratory Assessment Schedule and evaluate whether it should include management or independent assessments of TSR implementation at HFIR.

OFI-4: To improve the IVR process, evaluate expanding the scope and depth of the IVR to: verify the accuracy and adequacy of the TSR implementation checklist; include changes to the SAR and DSA that may not be directly reflected in TSR changes; more thoroughly address facility modifications; and verify full implementation of changes that were part of the USQ process.

OFI-5: Review the process for maintaining configuration control of safety basis documents, and consider changes to ensure that previous commitments are carried through to succeeding document revisions.

ORNL Site Office

OFI-6: The OSO processes for oversight of safety basis control implementation could be improved by:

- Documenting the processes for oversight of safety basis control implementation
- Conducting independent IVRs and/or shadowing contractor IVRs (and documenting the shadow reviews)
- Periodically re-verifying safety basis controls
- Including assessments in the topical area of nuclear facility safety implementation in the three-year planning schedule
- Developing a scheduling matrix that lists each TSR control (including vital safety systems and design features) and includes past verifications and planned verifications, such that safety class items and SACs are verified at least once every three years and safety significant and passive design features are

verified at least once every five years

- Defining how oversight of the contractor's Cognizant Systems Engineer (CSE) program and vital safety system configuration management are accomplished. The site office should provide further definition of the roles responsibilities, accountabilities, and authorities for performing these duties, and clarify how site office personnel receive training or the necessary knowledge, skills, and abilities (KSA) to perform these tasks.

OFI-7: OSO review and approval of safety basis documentation could be improved by:

- Ensuring timely review of safety basis documents, including issuance of the safety evaluation report (SER);
- Revising WP 420 to address hazard category 1 facilities and clarify approval authorities
- Developing and instituting a formal process for tracking SER COAs to resolution and closure.

7.0 FOLLOW-UP ITEMS

Independent Oversight will follow up on any corrective actions resulting from this assessment and resolution of the issue relating to the eSOMS software as part of its normal operational awareness activities under the site lead program.

Appendix A
Supplemental Information

Dates of Review

Onsite Review: August 20-24, 2012
September 25-28, 2012

Office of Health, Safety and Security Management

Glenn S. Podonsky, Chief Health, Safety and Security Officer
William A. Eckroade, Principal Deputy Chief for Mission Support Operations
John S. Boulden III, Director, Office of Enforcement and Oversight
Thomas R. Staker, Deputy Director for Oversight
William E. Miller, Deputy Director, Office of Safety and Emergency Management Evaluations

Quality Review Board

William Eckroade
John Boulden
Thomas Staker
William Miller
Michael Kilpatrick
George Armstrong
Robert Nelson

Independent Oversight Site Lead

Timothy Mengers

Independent Oversight Reviewers

Timothy Mengers – Lead
Glenn Morris
David Odland
Terry Olberding

Appendix B
Documents Reviewed, Interviews, and Observations

Documents Reviewed

- ADM-0105, Surveillance Test Procedure Administrative Guidelines, Rev. 24, 10/11
- ADM-0105, Surveillance Test Procedure Administrative Guidelines, Rev. 25, Draft
- ADM-0151, Console Operator Hourly Readings, Rev. 45, 7/12
- ADM-0159, HFIR Hoisting/Rigging Control Program, Rev. 18, 5/12
- ADM-0161, Technical Safety Requirement (TSR) Documenting and Tracking, Rev. 20, 12/11
- ADM-0161, Technical Safety Requirement (TSR) Documenting and Tracking, Rev. 21, Draft
- AOP-9011, Disaster Response, Rev. 14, 8/06
- AOP-9011, Disaster Response, Rev. 15, Draft
- ASRP-OSO-6.22.2012-232409, FR Walkthrough of HFIR and Cold Source with the FP SME on 6/12/12, 6/22/12
- ASRP-WALK-D4R-4/20/2007-35583, Walkthrough, HFIR-Calculation Review-Cleanup/Pressurization Flow, 4/20/07
- Department of Energy (DOE), Office of Science (SC) Review of Oak Ridge National Laboratory (ORNL) Documented Safety Analysis (DSA)/Technical Safety Requirement (TSR) Flow Down, 3/11
- DOE Oak Ridge Office letter, Subject: Approval of the High Flux Isotope Reactor (HFIR) Safety Analysis Report (SAR) Revisions, Technical Safety Requirements (TSR) Revisions, and Cold Neutron Source (CNS) Documented Safety Analysis (DSA) Revisions, 6/20/12
- DOE/ORO/OSO Building 3525 Irradiated Fuels Examination Laboratory Written Form, 8/26/2009
- Draft Triennial Assessment of the Maintenance Management Program, Hazard Category 1, 2 and 3 Nuclear Facilities, FR Quarterly Assessment, 3rd Quarter, FY 2012
- EG-1, Review and Approval Process for HFIR In-Vessel and Gamma Irradiation Experiments, Rev. 9, 3/09
- E-OSD, Reactor Shutdown and Monitoring from Outside the Control Room, Rev. 2, 8/02
- Facility Representative Assessment of the Oak Ridge National Laboratory Technical Safety Requirements and Credited Engineering Controls, Assessment Plan, 2nd Quarter, FY 2010, 2/8/10
- Facility Representative Bi-weekly reports, 5/14/11 through 5/28/11, 5/28/11 – 6/11/11, 6/11/11-6/25/11, 6/25/11 – 7/9/11, 7/9/11-7/23/11
- Facility Representative Bi-weekly reports, 7/11/11-7/22/11,and 3/19/12-3/30/12
- Facility Representative Bi-weekly reports, 7/8/12-7/21/12, 6/10/12-6/23/12, 3/4/12-3/17/12, 2/5/12-2/18/12, 1/22/12 -2/4/12, and 1/8/12 – 1/21/12
- Facility Representative Facility Specific Qualification Card, REDC 7920 and 7930, 9/16/09
- Facility Representative Facility Specific Re-Qualification Card, Spallation Neutron Source Accelerator Facility, 11/10
- Facility Representative Facility Specific Qualification Card, IMET 3025E, 3/10
- Facility Representative Facility Specific Re-Qualification Card, HFIR, 6/10
- Facility Representative Facility Specific Re-Qualification Card, HFIR, 3/11
- Facility Representative Facility Specific Written Exam, HFIR, 7/10
- Facility Representative Quarterly Assessment of the Oak Ridge National Laboratory Conduct of Operations, 2nd Quarter 2012
- Facility Representative Quarterly Summary Report, 2nd Quarter, FY 2009
- FY 2011 UT-Battelle Performance Evaluation and Measurement Plan, 9/10
- FY 2012 UT-Battelle Performance Evaluation and Measurement Plan, 9/11

- HFIR Overview Presentation, 8/12
- HFIR Safety Basis Document List, 4/18/12
- Implementation Matrix for HFIR Cold Neutron Source Documented Safety Analysis (DSA) Revision 2, 8/25/11
- Implementation Matrix for HFIR Safety Analysis Report (SAR) Revision 8 and Technical Safety Requirements (TSR) Revision 14, 8/25/11
- Implementation Matrix for HFIR Safety Analysis Report (SAR) Revision 8a, Cold Neutron Source Documented Safety Analysis (DSA) Revision 2a, and Technical Safety Requirements (TSR) Revision 13C, 8/25/11
- Independent Verification Review (IVR) for Implementation of Building 7920 SSA for Lifting Heavy Loads, 8/10
- Independent Verification Review 3525 SAR 2b and TSR 4b, 7/11
- Independent Verification Review 3525 SAR 3a and TSR 4c, 3/12
- Independent Verification Review 7920 SAR 4d and TSR 5A, 11/11
- Independent Verification Review SBS for Bettis Pu-Be Sources, 1/11
- IO-2010-7, Building 3525 Technical Safety Requirements Implementation Assessment, 5/10
- IO-2010-7, Building 3525 Technical Safety Requirements Implementation Assessment – Lines of Inquiry, 6/10
- IO-2011-11, System Engineering and Buildings 7920 and 7930 Technical Safety Requirements Implementation Assessment, 9/11
- IO-2012-8, Assessment of Nuclear Facility Safety Basis Support Systems, 8/12
- IVR Team Out Brief, 9/28/12
- Laboratory Facility Authorization Basis Board Charter, 7/12
- Laboratory Facility Authorization Basis Board Charter, 7/12
- Letter, J. Moore to T. Mason, Subject: Approval of the HFIR SAR Revisions, TSR Revisions and Cold Neutron Source Documented Safety Analysis Revisions, 6/20/12
- Letter, J. Moore to T. Mason, Subject: DOE Office of Science Review of ORNL Documented Safety Analysis (DSA)/Technical Safety Requirement (TSR) Flow Down, 5/26/11
- Letter, J. Moore to T. Mason, Subject: ORNL OSO Facility Representative Program Assessment of Technical Safety Requirements and Credited Engineering Controls at ORNL, 6/24/10
- Letter, J. Moore to T. Mason, Subject: ORNL OSO FY 2010 Assessment Schedules – Contractor Formal Assessment Program and OSO/UT-Battelle Partnership Assessments, 12/16/09
- Letter, J. Moore to T. Mason, Subject: ORNL OSO FY 2011 Assessment Schedules, 1/28/11
- Letter, J. Moore to T. Mason, Subject: ORNL OSO FY 2012 Assessment Schedules for UT-Battelle, 12/9/11
- Letter, K. Beirschmitt to J. Moore, Subj: HFIR Statement of Operational Readiness for Operating Cycle 438, 10/6/11
- LFABB Review of Implementation of HFIR SAR Rev. 8, CNS DSA Rev. 2 and TSR Rev. 16D, 10/11
- Memo for Kelly from McBrearty, Delegations of Authority for Office of Science Operations and Safety, Property Management, and Safeguards and Security, 8/17/12
- Memo for Moore from McBrearty, Delegations of Authority for Office of Science Operations and Safety, Property Management, and Safeguards and Security, 8/31/12
- MMP-0705, Outage Management, Rev. 15, 2/12
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- NNFD-021, Safety Basis Implementation and Independent Verification Reviews, Rev. 1, 9/10
- NNFD-022, System Performance Monitoring, Rev. 0, CN-2, 12/09
- NNFD-PLAN-018, Performance Assessment Plan, Rev. 7, 10/11
- NOP-2106, Operation of the Primary Coolant Pumps, Rev. 30, 9/09

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- SBMS: Additional Guidance for Safety Basis Implementation, 8/12
- SBMS: Information Technology: Software Quality Assurance, Exhibit Title: Safety and General Software Work Activities, 6/11
- SBMS: Information Technology: Software Quality Assurance, Exhibit Title: Safety Software Grading Level Table, 6/11
- SBMS: Information Technology: Software Quality Assurance, Exhibit Title: Safety and General Software Work Activities, 6/11
- SBMS: Information Technology: Software Quality Assurance, Exhibit Title: Software Categorization Table, 6/11
- SBMS: Information Technology: Software Quality Assurance, Exhibit Title: Software Type Table, 6/11
- SBMS: Information Technology: Software Quality Assurance, SQA for Safety Software, 3/12
- SBMS: Integrated Performance: Contractor Assurance, 5/12
- SBMS: Integrated Performance: Independent Oversight, 4/12
- SBMS: Integrated Performance: Laboratory Performance Monitoring and Analysis: Independent Assessments, 11/10
- SBMS: Integrated Performance: Laboratory Performance Monitoring and Analysis: Management Assessments, 11/10
- SBMS: Nuclear and Facility Safety: Readiness Reviews, 8/11
- SBMS: Nuclear and Facility Safety: Readiness Reviews: Conducting Contractor Readiness Reviews, 7/11
- SBMS: Nuclear and Facility Safety: Readiness Reviews: Determining the Type of Readiness Review and Authorization Authority, 7/11
- SBMS: Nuclear and Facility Safety: Readiness Reviews: Developing Start-up Notification Reports (SNR), 7/11
- SBMS: Nuclear and Facility Safety: Readiness Reviews: Exhibit Title: Core Requirements, 7/11
- SBMS: Nuclear and Facility Safety: Safety Basis: Exhibit: Implementing Previously Unimplemented Safety Bases, 11/09
- SBMS: Nuclear and Facility Safety: Safety Basis: Implementing the Safety Basis, 8/12
- SBMS: Readiness Assessment Checklist
- SBMS: Readiness Review (RR) Process Flowchart
- SBP-5500, Revision Process for Technical Safety Requirements, Rev. 6, 7/11
- SBP-5600, Management of the High Flux Isotope Reactor (HFIR) Documented Safety Analyses (DSAs), Rev. 7, 4/12
- SCMS: Facility Safety Authorization: Procedure 1, Reviewing and Approving Nuclear Facility Safety Basis Documentation, Rev. 3.0, 6/11
- SCMS: Facility Safety Authorization: Procedure 3, Reviewing and Approving Contractor's Unreviewed Safety Question (USQ) Process and Processing Potential Inadequacies of the Documented Safety than Hazard Category 3 Threshold Quantities, Rev. 3.0, 6/11
- SCMS: Facility Safety Authorization: Procedure 5, Verifying Readiness for Startup and Restart of Nuclear Facilities, Rev. 3.0, 6/11
- SCMS: Facility Safety Authorization: Procedure 6, Evaluating and Approving Startup Notification Reports (SNRs), Rev. 3.0 6/11

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- Software Quality Assurance Plan (SQAP), Reactor Research Division eSOMS, 7/10
- STP-5130, Reactor Pool to Vessel Check Valve Functional Test, R 19, 3/30/07
- STP-5130, Reactor Pool to Vessel Check Valve Functional Test, Rev. 23, Draft
- WP 420, Review and Approval of Nuclear Facility Authorization Basis Documents, R1, 7/30/10
- WP 450, Operational Awareness Program, Rev. 0, 1/10
- WP 453, Contractor Formal Assessment Program, Rev. 1, 6/10
- USQD-M-HFIR-2006-032**,** USQD for PISA-HFIR-2006-005 (Pool-to-Vessel Check Valve Surveillance), R0, 12/28/06

Interviews

- HFIR Facility Representatives
- HFIR IVR Team Lead
- HFIR Nuclear Safety and Experiment Analysis Manager
- HFIR Safety Analyst
- Independent Oversight Services Lead Assessor
- DOE Facility Representatives for RRD and for NNFD
- Current Director, Operations and Oversight Division, OSO
- Former Director, Operations and Oversight Division, OSO
- Assessment Program Lead, OSO
- Lead Safety Basis Reviewer, OSO

Observed Interviews

- TSR Coordinator
- Operator (during Shift Rounds)
- Cold Source Staff Members (2)
- Operations Procedure Coordinator
- Nuclear Safety Manager
- Integrated Performance Management (Quality Assurance) Lead
- SAR Coordinator
- Operations Engineer
- Operations Manager
- System Engineering Group Lead
- System Engineer
- Engineer
- Training Manager

Observed Activities

- IVR Team In Brief
- Shift Rounds
- Walk down of Pony Motor Battery Room Fire Door Modification
- Walk down of Hydrogen Equipment Area Crane Control

- IVR Out Brief
- Daily FR walkthrough of HFIR