Independent Assessment of Safety System Management for the Advanced Test Reactor at Idaho National Laboratory

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Office of Enterprise Assessments
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Acronyms

ASME	American Society of Mechanical Engineers
ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance, LLC
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CGD	Commercial Grade Dedication
CGI	Commercial Grade Item
CM	Configuration Management
CSE	Cognizant System Engineer
CTA	Central Technical Authority
DCN	Design Change Notice
DOE	U.S. Department of Energy
DOE-ID	Idaho Operations Office
EA	Office of Enterprise Assessments
EQ	Equipment Qualification
FR	Facility Representative
INL	Idaho National Laboratory
LOTO	Lockout/Tagout
M&TE	Measuring and Test Equipment
MEL	Master Equipment List
MWMM	Maintenance Work Management Module
NCR	Nonconformance Report
NE	Office of Nuclear Energy
NMMP	Nuclear Maintenance Management Program
NQA	Nuclear Quality Assurance
OA	Operational Awareness
OFI	Opportunity for Improvement
PM	Preventive Maintenance
PRV	Pressure Regulating Valve
psig	pounds per square inch gauge
QA	Quality Assurance
QAP	Quality Assurance Program
RMSS	Radiation Monitoring and Seal System
SAR	Safety Analysis Report
S/CI	Suspect/Counterfeit Item
SDD	System Design Description
SHR	System Health Report
SR	Surveillance Requirement
SSCs	Structures, Systems, and Components
SSO	Safety System Oversight
TEV	Technical Evaluation
TFR	Technical and Functional Requirement
TSR	Technical Safety Requirement
WO	Work Order

INDEPENDENT ASSESSMENT OF SAFETY SYSTEM MANAGEMENT FOR THE ADVANCED TEST REACTOR AT IDAHO NATIONAL LABORATORY

Executive Summary

The U.S. Department of Energy Office of Enterprise Assessments (EA) conducted an independent assessment of safety system management for the Advanced Test Reactor (ATR) at Idaho National Laboratory (INL) from July to September 2022. The assessment focused on the ATR confinement system and the radiation monitoring and seal system. INL is managed and operated by Battelle Energy Alliance, LLC (BEA) for the Office of Nuclear Energy and is overseen by the Idaho Operations Office (DOE-ID).

EA identified the following strengths, including three best practices:

- BEA has integrated its conduct of engineering framework with their iQ WorkSmart computer system to effectively manage the engineering change process. The iQ WorkSmart software automates and integrates many INL processes, procedures, instructions, and associated databases and forms. (Best Practice)
- BEA has established a comprehensive integrated work control process in the maintenance work management module (MWMM) of iQ WorkSmart. The MWMM effectively supports BEA's management of maintenance work, assets, supply chains, operations coordination, and compliance. (Best Practice)
- Cognizant system engineers (CSEs) use the E.R. Suite SystemIQ® software to effectively develop system health reports. The computer software integrates system health information in one place, organizes the system health reporting and scoring process, and assembles the system health reports, providing a very effective centralized system for the CSEs to manage their system health information and reports. (Best Practice)
- Operations personnel observed and interviewed are very knowledgeable and aware of the importance of the technical safety requirement credited safety systems and demonstrated effective communications and disciplined conduct-of-operations principles.
- BEA's operability determination process is thorough and robust and has been used effectively to address safety structure, system, and component operability issues at ATR.
- Day-to-day DOE-ID oversight provided by ATR Facility Representatives is thorough, effective, and well documented.

EA also identified several weaknesses, as summarized below:

- Two acceptance criteria associated with the confinement system leakage requirements lack adequate technical bases. Without an adequate technical basis, these acceptance criteria cannot ensure that the operation of this system will meet safety basis requirements. (Finding)
- BEA has not initially qualified and/or subsequently maintained confinement system components as safety-related with a requirement for equipment qualification. This lack of qualification records for these components challenges the operability of the confinement system. (Finding)
- BEA has not incorporated key governing Nuclear Quality Assurance (NQA)-1, *Quality Assurance Requirements for Nuclear Facility Applications*, requirements into the engineering processes. Non-compliant engineering processes may result in deficient design products and adverse impacts on safety-related structures, systems, and components. (Finding)

- BEA did not properly identify critical characteristics with attributes and acceptance criteria appropriate for the safety function for 12 packages implementing commercial grade item plans. (Finding)
- BEA lacks key process requirements to effectively manage shelf-life constrained items, which can impede the ability to identify and control such stock items.
- BEA does not monitor and record the temperature and humidity inside BEA's warehouses to prevent damage or loss and minimize deterioration of stored items.
- BEA lacks key procedural requirements to preclude suspect/counterfeit items from entering the site and to ensure their proper disposition.
- BEA did not perform, as written, 9 of 90 surveillance procedures implemented over the past two years and one surveillance observed during this assessment.
- BEA has not established a formal process to analyze and trend feedback information at ATR to detect adverse conditions.

In summary, BEA has established many of the essential programs and capabilities to manage and maintain the ATR confinement system and radiation monitoring and seal system and has implemented several best practices that strengthen their processes in areas including engineering design control and maintenance management. Further, DOE-ID has implemented a mature and effective process for oversight by Facility Representatives. However, identified gaps in safety system management programs and their implementation reduce the confidence that intended safety functions can be performed. Until the weaknesses identified in this report are addressed or effective mitigations are put in place, the ATR margin of safety is reduced.

INDEPENDENT ASSESSMENT OF SAFETY SYSTEM MANAGEMENT FOR THE ADVANCED TEST REACTOR AT IDAHO NATIONAL LABORATORY

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Nuclear Safety and Environmental Assessments, within the independent Office of Enterprise Assessments (EA), assessed the effectiveness of safety system management for the confinement system and the radiation monitoring and seal system (RMSS) at the Idaho National Laboratory (INL) Advanced Test Reactor (ATR). The assessment was conducted from July to September 2022.

INL is managed and operated by Battelle Energy Alliance, LLC (BEA) for the Office of Nuclear Energy (NE) and overseen by the Idaho Operations Office (DOE-ID). Consistent with the *Plan for the Independent Assessment of Safety System Management for the Advanced Test Reactor at the Idaho National Laboratory, August 2022*, this assessment evaluated the effectiveness of BEA's programs and processes for design engineering, quality assurance (QA), configuration management (CM), maintenance, safety system surveillance and testing, operations, cognizant system engineering, and feedback and improvement for the confinement system and the RMSS. EA also reviewed DOE-ID oversight of ATR.

ATR is a 250-megawatt (thermal) pressurized water test reactor that operates at very low pressures and temperatures compared to a large commercial nuclear power plant, and provides nuclear fuel and materials testing capabilities for military, Federal, university, and industry partners and customers. ATR's unique cloverleaf core design allows the reactor's corner lobes to operate at different power levels, making it possible to conduct multiple simultaneous experiments under different testing conditions. The reactor confinement system in conjunction with the RMSS are credited as a barrier against the uncontrolled release of radioactivity to the environment. Based on this safety function, the confinement system and RMSS are designated as safety-related systems, a U.S. Nuclear Regulatory Commission functional classification for structures, systems, and components (SSCs) similar to DOE's safety class designation and as allowed in 10CFR830, Appendix A, Table 1.

2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which is implemented through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. This report uses the terms "best practices, deficiencies, findings, and opportunities for improvement (OFIs)" as defined in the order.

As identified in the assessment plan, this assessment considered requirements related to the management of safety systems. Criteria to guide this assessment were based on selected criteria from within objectives SS.1 through SS.9 of EA Criteria and Review Approach Document (CRAD) 31-15, Rev. 1, *Safety System Management Review*. In addition, EA used elements of CRAD 30-07, Rev. 0, *Federal Line Management Oversight Processes*, to collect and analyze data on DOE-ID oversight activities.

EA examined key documents, such as ATR safety basis documents, system design descriptions (SDDs), work control packages, procedures, manuals, engineering analyses, and training and qualification records. EA also interviewed key personnel responsible for developing and executing the associated programs; observed ATR activities; and walked down significant portions of ATR, focusing on the confinement system and the RMSS.

The members of the assessment team, the Quality Review Board, and management responsible for this assessment are listed in appendix A.

There were no previous findings for follow-up addressed during this assessment.

3.0 RESULTS

3.1 Design Engineering

This portion of the assessment evaluated BEA's engineering processes and design products for technical adequacy and consistency with Safety Analysis Report (SAR)-153, *Safety Analysis Report, Upgraded Final Safety Analysis Report for the Advanced Test Reactor*, and Technical Safety Requirement (TSR)-186, *Technical Safety Requirements for the Advanced Test Reactor*.

BEA has established a generally appropriate conduct of engineering program framework. This framework is integrated into the BEA-wide integrated computer system called "iQ WorkSmart." iQ WorkSmart is a new BEA system that automates and integrates many INL processes, procedures, instructions, and associated databases and forms. The automated and integrated iQ WorkSmart approach improves BEA's performance quality, aids a new generation of workers, and reduces costs. Use of this approach is considered a **Best Practice**.

Although LWP-10200, *Engineering Calculations and Analyses Report*, provides adequate guidance for developing calculations, only one of four reviewed calculations, instrument accuracy of RMSS radiation monitors (EDF 5091, *ATR Stack Radiation Monitor Instrument Uncertainty Analysis*), was determined to be technically adequate. This calculation has been appropriately integrated into surveillance procedure DOP-2.7.21, *PPS Automatic SATS Test.* DOP-2.7.21 and DOP-7.7.8, *Radiation Monitoring System Integrity Check*, implement three RMSS TSR surveillance requirements (SRs) and correctly verify setpoint stability, solenoid actuation, and response times of the RMSS.

While one engineering design calculation was technically adequate, EA identified weaknesses with three other engineering calculations and one engineering change associated with the reactor confinement system. The SAR credits confinement as a final barrier to delay the release of airborne radioactive contamination resulting from an accident and prescribes confinement leakage rate limits specified in the TSR. To ensure that these SAR-required leakage rate limits are met, the ATR design relies, in part, on the inflatable door seals for large confinement doors. The original design (not designated as safety-related) used the instrument air system (with a design pressure limited to 125 pounds per square inch gauge (psig)) to pressurize these seals. Air was supplied to these door seals through five pressure regulating valves (PRVs), one for each door, which limited inflatable door seal pressure to under 30 psig. A 1990 design change added a safety-related nitrogen system credited for accident mitigation (7.5.2-1 FCF-3632, *Back-up Gas Supply for ATR Door Seals*), which included two nitrogen gas bottles, a PRV to reduce nitrogen pressure from 2,500 to 50 psig, a safety relief valve (set at 150 psig) downstream of this PRV, and a check valve for isolation from the instrument air system. A 2017 modification of the nitrogen system (7.8.7.2-1/2343, *ATR Confinement Door Seal Additional Nitrogen Bottles Install*) added six more nitrogen bottles to ensure compliance with SAR, section 16.2.2.6, which requires confinement door inflatable seals to remain pressurized for at least 60 hours. EA identified the following weaknesses:

- Contrary to LWP-10300, *Technical Evaluation*, and LWP-10200, two acceptance criteria associated with the confinement system TSR leakage requirements lack adequate technical bases, as described further below. (See **Finding F-BEA-1**.) Without an adequate technical basis, these acceptance criteria cannot ensure that the operation of this system will meet safety basis requirements.

- The test acceptance criterion for TSR SR, SR 4.8.1.8, specified in DOP-7.7.4, *ATR Building Leak Rate Test* (nitrogen system leakage of less than 155 psig/hour), is unsubstantiated. The SAR credits the nitrogen system as a safety-related system, designed to pressurize confinement door seals following an accident to control the release of fission products. This system leakage acceptance criterion was developed in Technical Evaluation (TEV)-3057, *ATR Confinement Door Seals Test Results for D-13, D-15, D-51, D-52, and D-44*. Although this TEV was marked as approved and independently verified, it is technically inaccurate and incomplete. Contrary to LWP-10300, sections 4.2, *TEV Inputs and Development of Evaluation Scope*, and 4.3, *Perform Evaluation*, volume computations were based on gauge and not absolute pressures, resulting in an incorrect application of the Ideal Gas Law. Contrary to LWP-10300, section 4.4, *Document Evaluation*, leakage rate computations were based on observed pressure readings without considering the effects of instrument error or the inaccuracy of measuring pressures in the 150-250 psig range with the installed 2,500 psig gauge. Contrary to LWP-10300, sections 4.2, 4.3, and 4.4, only computational results were included in TEV-3057; assumptions, methodology, references, and the actual computations were not included. In response to this EA-identified weakness, BEA initiated condition report CO 2022-1623, *Potential Technical Deficiency in TEV-3057*.
- The acceptance criteria for SR 4.8.1.6 specified in reactor procedure RP-1238C, *ATR Programs ATR Reactor Auxiliary Operator Weekly Data Sheet*, note 13, are unsubstantiated. Note 13 states in part, "… If the high side reading is <1300 psig with 8 bottles online or <1500 psig with 7 bottles online then enter TSR-186, 3.8.1.A…" The 1,300 psig value was established by TEV-3057, which as discussed above, did not appropriately apply the Ideal Gas Law or consider the effects of instrument error. Contrary to LWP-10200, section 1, *Purpose*, and PDD-10000, *Conduct of Engineering*, section 2.1.D, *"Build, buy, or assemble apparatus/barriers/controls that need formal calculations…,"* the technical basis for the 1,500 psig value is nonexistent, as the only documentation provided by BEA is an email included in the electronic change request (eCR) 650281, *ATR Reactor Auxiliary Operator Weekly Data Sheet*; eCR 650281 does not include any inputs, assumptions, references, computational details, or records of independent verification and approval for the 1,500 psig value.

- Contrary to the SAR, section 3.11, *Environmental Design of Mechanical and Electrical Equipment*, and chapter 3, appendix A, *Master List of Safety-Related Equipment*, confinement system components were not initially qualified and subsequently maintained as safety-related with requirements for equipment qualification (EQ). (See **Finding F-BEA-2**.) The lack of documentation substantiating the initial safety-related designation for any of these components, as well as the subsequent activities to ensure this designation, challenges the operability of the confinement system.
  - While the SAR, chapter 3, appendix A, requires each of the five PRVs (which limit inflatable seal pressure to each door) to be safety-related and EQ qualified (e.g., component aging program and ability to survive harsh accident environments), BEA has no records that demonstrate implementation of these requirements. These PRVs have no documented design specifications or procurement records, and there is no evidence of a program (e.g., maintenance or periodic replacement) to maintain their safety-related designation or documentation addressing EQ.
  - BEA's original design does not include safety relief valves downstream of each of five PRVs to limit inflatable door seal pressure; if any PRV fails, the resulting seal pressures will exceed the manufacturer's rating (35 psig). In response to this EA-identified weakness, BEA initiated condition report CO 2022-1622, *Inadequate Pressure Relief Protection for Confinement Door Inflatable Seals*.
  - BEA does not have records to demonstrate that the original design of elastomeric components (some installed more than 60 years ago) satisfies the SAR designation of safety-related and

environmentally qualified. Elastomeric materials (inflatable door seals, black tubing connecting these seals to copper supply lines, and Tygon® tubing for sealing of equipment hatches) are relied upon to maintain confinement leakage within the limits stated in SAR, section 6.2.4, *Confinement Leakage Testing*, and TSR section 3.8.1, *Confinement Requirements*. In response to the EA-identified weaknesses with inflatable door seals and black tubing, BEA initiated condition report CO 2022-1619, *Environmental Qualification of Elastomeric Components Used in Confinement*.

- o BEA's documentation was inadequate for three procurements related to the confinement system sealing requirements. In 2021, BEA began replacing each of five PRVs using a commercial grade item (CGI) dedication procurement package, CGI-1204, *ATR Confinement Door Seal Pressure Regulator*. CGI-1204 inaccurately specified a maximum operating pressure of 125 psig (the normal source of pressure for the instrument air system) instead of 150 psig based on the design pressure rating of the safety-related nitrogen system. The 150 psig is the maximum pressure controlled by the safety relief valve should the PRV fail. Also, CGI-1204 contains no EQ requirements to reflect the accident conditions. In response to this EA-identified weakness, BEA initiated condition report CO 2022-1621, *Potential Inadequacy in Pressure Regulating Valves for Confinement Backup Nitrogen.*

  The inflatable seals are periodically replaced. A replacement inflatable seal for door 51 was purchased in 2021 (purchase order (PO) 00253944, *Inflatable Seal for Door 51*) and installed in January 2022 (work order (WO) 299389-01, *Install New Inflatable Seal on Door 51*); PO 00253944 did not identify any EQ requirements.

  Use of Tygon tubing for equipment hatches, instead of the previously used silicon sealant, was documented in 2014 TEV-2215, *TRA-670 Confinement Sealing and Testing Methodology*; TEV-2215 did not identify this tubing as safety-related or specify any EQ requirements in accordance with the SAR. The Tygon tubing seals equipment access hatches that are part of the confinement boundary. The SAR specifies that all SSCs inside confinement are subject to a harsh environment (temperature and gamma radiation).

- o BEA has not established a program (e.g., maintenance or periodic replacement) to ensure that the 2,500 to 50 psig PRV and safety relief valve designated as safety-related and installed in 1990, remained qualified as safety-related. Additionally, the opportunity to identify and address this deficiency was not realized during the 2017 modification of the nitrogen system.

- Contrary to PD-13000, *Quality Assurance Program Description*, which invokes American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1, *Quality Assurance Requirements for Nuclear Facility Applications*, Part I, Requirement 3, pars. 100, 300(a), 400, and 500, BEA has not incorporated three of five key NQA-1 requirements governing engineering processes for safety SSCs in its procedures. (See **Finding F-BEA-3**.) Inadequate engineering processes may result in deficient design products and adverse impacts on safety-related SSCs.

  - o iQ WorkSmart and LWP-10501, *Engineering Change Control*, do not meet NQA-1, Part I, Requirement 3, par. 100, "The design shall be defined, controlled, and verified… Design changes shall be governed by control measures commensurate with those applied to the original design." While BEA requires independent verification of individual design products (e.g., drawings, calculations, and specifications), BEA does not require independent verification of complete (new or changed) engineering packages, which involve multiple interdependent design products.

  - o iQ WorkSmart and LWP-10501 do not meet NQA-1, Part I, Requirement 3, par. 300(a), "The responsible design organization shall prescribe and document the design activities to the level of detail necessary to permit the design process to be carried out in a correct manner, and to permit verification that the design meets requirements. Design documents shall support facility design, construction, and operation." BEA does not require engineering analysis that demonstrates that the removal (construction/modification) of components (e.g., piping, conduit, or duct work) will not adversely affect nuclear safety, personnel safety, or other SSCs.

- iQ WorkSmart and the procedures (LWP-10000, *Engineering Initiation*, and LWP-10106, *Engineering Verification*) do not meet NQA-1, Part I, Requirement 3, par. 500 for applying design verification. The BEA graded approach does not explicitly require applicability of independent verification of all design activities for the safety-related SSCs.

Design Engineering Conclusions

BEA has established a generally appropriate conduct of engineering program framework that automates and integrates many company processes. EA identified BEA's integration of its framework with iQ WorkSmart as a best practice. However, EA identified weaknesses in the areas of calculations used for acceptance criteria, qualification of confinement system components, engineering processes, and use of surveillance information for trending.

3.2 Quality Assurance

This portion of the assessment evaluated BEA's quality assurance program (QAP), addressing training and qualification, nonconforming items, identifying and controlling items, procurement verification, and suspect/counterfeit items (S/CIs).

QA Program

BEA has established a DOE-approved QAP meeting the criteria specified in 10 CFR 830, Subpart A, *Quality Assurance Requirements*. BEA has adequately established a QA organization with an assigned QA manager responsible for the implementation, assessment, maintenance, and improvement of the QAP as documented in PDD-13000, *Quality Assurance Program Description*. The QAP effectively implements NQA-1-2008/2009a. BEA appropriately updated its 2022 QAP and received the required DOE approval in *Contract No. DE-AC07-05ID14517 - Annual Review of the Battelle Energy Alliance, LLC, Idaho National Laboratory Quality Assurance Program Contract Data Requirements List H.27 (CLN220350)*. Seven reviewed warehouse storage procedures for subcontractor, Kein West One, demonstrate that the QAP provides an effective flow down of applicable QA requirements to a sub-tiered contractor.

Training and Qualification of QA Personnel

BEA effectively trained and qualified personnel to perform QA functions. BEA provides an effective training and qualification approach that satisfies the general training requirements of NQA-1, including personnel selection, initial training, continuing training, qualification, and certification. Eleven reviewed QA personnel training/qualification records demonstrated adequate completion of training in performing independent qualification assessments. Seven reviewed training/qualification records for QA supplier assessors supporting procurements demonstrate that the assessors were appropriately qualified to perform these supplier qualification assessments. This training appropriately addresses NQA-1 lead auditor criteria utilizing the ten-point qualification requirements documented in MCP-4252, *INL Quality Assurance Oversight*. Interviews with a QA engineer and QA manager confirmed that they are knowledgeable of roles, responsibilities, and authorities in performing QA field inspections, procurement reviews, ATR facility in-service inspections, receipt inspections, storage facility inspections, nonconformance functions, and S/CI evaluations.

Nonconforming Items

BEA has implemented a generally effective nonconforming reporting program through LWP-13830, *Control of Nonconforming Items*. LWP-13830 adequately addresses the attributes of NQA-1, Part I, Requirement 15, including identification, segregation, and disposition. Reviews of 10 open nonconformance reports (NCRs), including walkdowns of the items' storage conditions, and 5 closed NCRs demonstrated that BEA adequately implemented LWP-13830 to ensure that these nonconforming items were effectively segregated and dispositioned based on proper engineering evaluation. However, a weakness in managing NCRs is discussed in the next subsection.

Identification and Control of Items

BEA has implemented a generally effective process for the identification and control of items through LWP-13120, *Identifying and Controlling Items*, except for stock item shelf-life and warehouse storage environmental control. Observed stock items were properly marked with category identification numbers to support item traceability in clean, organized warehouses. Interviewed warehouse personnel were knowledgeable of most storage and handling requirements. However, while LWP-13120 adequately addresses most NQA-1 requirements, BEA did not adequately implement stock item shelf-life control for in-stock ion exchange resins or ensure acceptable warehouse storage environments. Specific examples include:

- Contrary to LWP-13120, appendix E, which requires an NCR for expired shelf-life items, BEA did not maintain NCRs for in-stock ion exchange resins. (See **Deficiency D-BEA-1**.) Premature closure of NCRs on in-stock material can result in the loss of traceability to important engineering disposition criteria.

  During a tour of the Central Facilities Area (CFA), BEA warehouse personnel explained that they had self-identified various containers of ion exchange resin (nine boxes and four 55-gallon drums) that exceeded the manufacturer's shelf life. These containers were removed from the normal warehouse storage locations and placed on pallets in the facility; however, they did not display any NCR tags.

  Subsequently, the system engineer who dispositioned the NCRs explained that NCRs were originally initiated for these expired resins, but not until months after the resins' shelf-life expiration. BEA Engineering dispositioned both NCRs as "use-as-is" with limited use for certain reactor systems and identified new shelf-life expiration dates. Both NCRs state that NCR tags were placed on the items and that the items were segregated. However, at some indeterminate time after Engineering closed both NCRs, the NCR tags were removed, resulting in the lack of traceability to the conditional release criteria. Because the NCRs were closed by Engineering and the NCR tags removed, warehouse personnel were not aware of the limited use restrictions and the revised expiration dates of the in-stock resins.

- Contrary to NQA-1, Part I, Requirement 8, par. 302 requiring identification and control of limited life items, Engineering does not have a process to communicate the list of shelf-life constrained items with QA or warehouse personnel. (See **Deficiency D-BEA-2**.) The lack of communication on shelf-life constrained items to QA and warehouse personnel precludes the ability to identify and control such stock items.

  The engineer responsible for tracking shelf-life provided a requested list of in-stock items that are currently expired or due to expire in calendar year 2022 (hereafter referred to as the "shelf-life list"), demonstrating Engineering personnel's knowledge of such items. EA walked down each of the BEA supply chain storage warehouses (CFA, Core Internal Change Out, Kitting & Staging, and Kein West One), and confirmed that warehouse managers did not have access to the shelf-life list. EA also observed additional resin in the CFA warehouse stock that expired June 30, 2022, but remained comingled with conforming items. Interviewed warehouse personnel were unaware of this expiration date. The warehouse personnel immediately moved this material into the segregation area. Also, the reviewed shelf-life list identified six items with expired shelf lives that were in current inventory, of which the QA organization and warehouse personnel were not aware.

- Contrary to LWP-13120, appendix E, which specifies storage levels (with temperature and humidity limits) to prevent damage or loss and minimize deterioration, BEA does not monitor and record the temperature and humidity inside BEA's warehouses. (See **Deficiency D-BEA-3**.) Without the ability to monitor storage temperature and humidity, BEA cannot ensure the preservation of warehoused materials in accordance with manufacturers' recommendations. Interviews and observed signage confirmed that all BEA warehouses were rated as Level B storage, which requires that temperature and humidity are maintained within specified limits. BEA explained that these storage buildings are considered occupied buildings with temperature controls in place, although these buildings are not occupied at all times (night and non-workdays). However, in the event of a power outage during extreme cold weather, the lack of monitoring and recording capability precludes BEA's ability to ensure the integrity of stored components sensitive to cold temperature conditions.

Procurement Verification

BEA effectively procured safety-related SSCs through qualified suppliers. Ten supplier qualification reports demonstrate a thorough onsite review addressing the supplier's history of providing identical or similar products, the current quality records, and technical and quality capabilities in accordance with MCP 13323, *Supplier Evaluations Annual Performance Reviews, and Qualified Supplier List Change Control*. Five procurement packages appropriately included specifications and acceptance criteria for safety-related SSCs consistent with design documents. EA observed two BEA receipt inspectors appropriately applying the proper procurement acceptance criteria while performing two receipt inspections.

SSCs not available from qualified suppliers were adequately procured using BEA's commercial grade dedication (CGD) program to provide reasonable assurance that safety-related SSCs can perform their intended safety function. BEA acquired safety-related SSCs through a generally effective CGD process, iQ WorkSmart, in accordance with NQA-1, Part II, subpart 2.14, *Quality Assurance Requirements for Commercial Grade Items and Services*. Twenty CGD qualification records demonstrated that Engineering personnel were appropriately qualified to perform CGDs. However, contrary to iQ WorkSmart and NQA-1, Part I, Requirement 3, par. 300, which require proper identification of critical characteristics with attributes and acceptance criteria appropriate for the safety function, 12 of 12 reviewed packages implementing CGI plans were inadequate. (See **Finding F-BEA-4**.) Inadequate CGI packages can result in use of components in ATR that are not able to perform the intended safety function. Specific examples include:

- Eight packages implementing CGI plans for the personnel confinement door hardware (CGI-1016 02-11-2021, CGI-1016 03-22-2022, CGI-1016 07-31-2019, CGI-1016 10-19-2019, CGI-1090 07-06-2020, CGI-1090 07-31-2019, CGI-1090 09-05-2019, and CGI-1090 10-19-2019) incorrectly limited testing of the personnel confinement door closing hardware to post-installation operation only. However, this post-installation testing did not adequately address the accident forces from pressure inside the confinement volume on the door closure and latching mechanisms, should the accident occur when the door is open. Although the personnel doors are designated as passive in the SAR, attachment A, their closure mechanisms' function is active per SAR, section 3.11.1, *Equipment Identification and Environmental Conditions*.
- Two packages implementing CGI plans for the personnel confinement door seals (CGI-1017 10-19-2019 and CGI-1019 10-30-2019) did not include the EQ requirements of SAR, section 3.11.1.

- One package implementing the CGI plan for confinement door and canal bulkhead inflatable seals (CGI-1177 Completed) did not include EQ requirements as addressed in the SAR, chapter 3, appendix A.
- Section 3.1 of this report identifies an incorrect CGI package using CGI plan CGI-1204 for five PRVs, with respect to a lack of accident EQ requirements and an incorrect selection of the maximum operating pressure.

Suspect/Counterfeit Item

BEA provides generally appropriate control for S/CIs. LWP-13510, *Identifying and Controlling Suspect/Counterfeit Items*, appropriately assigns responsibilities for S/CI to engineering, procurement, and receipt inspection (QA) personnel. LWP-13510 also appropriately specifies requirements for procurement personnel to include contractual S/CI clauses in purchase orders to prevent acquisition of S/CIs. LWP-13510 includes S/CI identification guidelines to help workers identify S/CIs (e.g., during receipt inspections and maintenance evolutions). These LWP-13510 S/CI identification guidelines were effectively used by receipt inspectors during observed item receipt inspections. However, contrary to DOE Order 414.1D, *Quality Assurance*, att. 3, sec. 2.e and i, BEA's procedure LWP-13510 lacks key requirements to preclude S/CIs from entering the site and to ensure that discovered S/CIs are properly dispositioned. (See **Deficiency D-BEA-4**.) Specifically, LWP-13510 does not include:

- Defined responsibilities for collecting, maintaining, disseminating, and using the most accurate, up-to-date information on S/CIs (e.g., DOE's S/CI website and Occurrence Reporting and Processing System).
- The use of walkdowns (inspections) of installed equipment and various supply chain storage warehouses to identify S/CIs.
- Requirements for maintaining a list of BEA dispositioned S/CIs and vendors that have been identified as suspect.
- A process for dispositioning discovered S/CIs.

Not addressing these attributes in LWP-13510 impedes BEA's ability to effectively control S/CIs.

Quality Assurance Conclusions

BEA has established a DOE-approved QAP that meets DOE requirements. BEA effectively trains and qualifies QA personnel to perform quality functions. BEA has implemented generally effective processes for identifying and controlling items, procuring safety-related SSCs through qualified suppliers, and performing CGD. BEA also provides generally appropriate control for S/CIs. However, weaknesses were identified in the areas of stock item shelf-life control, warehouse storage environmental control, CGI packages not meeting the credited SAR safety-related requirements, and missing requirements in the BEA S/CI procedure.

3.3 Configuration Management

This portion of the assessment evaluated BEA CM processes for maintaining consistency between requirements, documents, and physical configuration; controlling system changes; and performing system assessments.

BEA has established and implemented generally adequate systems to ensure consistency between requirements, documents, and physical configuration. LWP-10500, *Managing the Configuration of*

Structures, Systems, and Components, addresses most requirements of DOE Order 420.1C, *Facility Safety*, ensuring that documents and physical configuration are consistent with the safety basis. During facility walkdowns of the confinement system, EA observed that the physical configuration of system components was consistent with approved piping and instrumentation diagrams and “as built” drawings.

The design changes (including modifications) to safety-related SSCs are adequately controlled and documented through design, procurement, installation, and operations practices. Interviewed cognizant system engineers (CSEs) and unreviewed safety question (USQ) evaluators understood the USQ process and when its use is required. Eight reviewed design change notices (DCNs) for safety-related SSC modifications were appropriately evaluated by nuclear safety specialists using the USQ process, and all were properly screened out as system changes that did not involve a USQ. The proposed system changes were adequately described in these DCNs with sufficient detail to enable a thorough understanding of the design, component specifications, and potential impacts. These DCNs were appropriately reviewed and approved by an independent CSE, other discipline representatives, and the senior design authority, to ensure that system requirements and performance criteria are not affected in a manner that adversely impacts the ability of the system to perform its intended safety function.

Further, two engineering instructions for the proposed design changes/modifications clearly identified the existing component, the new component, and the differences between the old and new components, and were effectively coordinated with facility operations and integrated into maintenance work packages. Documents affected by the proposed changes (e.g., piping and instrumentation diagrams, engineering evaluations, calculations, procurement specifications, CGD instructions, installation instructions, post-modification testing instructions and acceptance criteria, and SDDs) were appropriately identified and included in the change process. Other changes (e.g., physical, procedural, operational, software) potentially impacting safety-related SSCs, initiated by other organizations (e.g., operations, maintenance, procurement, procedures, training, security), are adequately controlled through the document review and work package process.

The BEA Office of Nuclear Assurance performs independent assessments of CM using MCP-100, *INL Integrated Oversight Process for Facility Nuclear Safety*. MCP-100 provides a proven and robust assessment approach that is based on the inspection process used by the U.S. Nuclear Regulatory Commission. A comprehensive collection of topic-specific inspection procedures effectively addresses scope, objectives, and inspection program elements and their attributes.

While BEA has generally established and implemented systems to ensure consistency between requirements, documents, and physical configuration, EA identified weaknesses in LWP-10500 scope and CM implementation, including:

- Contrary to DOE Order 420.1C, att. 2, ch. V, 3.c.(1)(b) and (e), which requires the contractor’s CM program to address system assessments and aging degradation, LWP-10500 does not address these topics. (See **Deficiency D-BEA-5**.) Omitting requirements for performing system assessments and aging degradation precludes assurance that these CM elements will be consistently addressed.
- Sections 3.1 and 3.6 of this report discuss implementation weaknesses in the areas of design consistency among the safety basis and technical baseline documentation (i.e., drawings, calculations, and specifications), procurement documentation addressing safety-related and environmental conditions, SR acceptance criteria, and incorrect component designation in a surveillance procedure.

Configuration Management Conclusions

BEA has generally established and implemented systems to ensure consistency between requirements, documents, and physical configuration. The BEA Office of Nuclear Assurance implements a robust independent assessment approach based on the inspection process used by the U.S. Nuclear Regulatory Commission. However, EA identified weaknesses in LWP-10500 scope and CM implementation.

3.4 Maintenance

This portion of the assessment evaluated BEA's nuclear maintenance management program (NMMP), maintenance resources, personnel training and qualification, maintenance performance, and spare parts and materials.

Nuclear Maintenance Management Program

BEA has established an adequate NMMP for the conduct of maintenance activities. PDD-6000, *INL Nuclear and Non-Nuclear Maintenance Management Program*, adequately addresses all 17 elements of DOE Order 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*. BEA has appropriately submitted its NMMP revisions to DOE-ID at least every three years. Additionally, the SAR appropriately addresses the NMMP in accordance with 10 CFR 830.204, *Documented Safety Analysis*.

BEA has appropriately conducted NMMP implementation assessments at least every three years. NMMP assessment reports dated November 1, 2021, and June 13, 2022, demonstrate adequate assessment performance. These reports reflect a rigorous and thorough review of the assessed areas. For example, ASMT-2022-0423, *ATR Preventive Maintenance Program*, examined procedure compliance for preventive maintenance (PM) processes. ASMT-2022-0423 identified several self-critical deficiencies in the areas of WO quality, change control, exceeded grace periods, maintenance histories, and records. BEA adequately addressed these deficiencies in five condition reports and identified appropriate corrective actions.

Maintenance Resources

BEA provides adequate resources (personnel, maintenance tracking database, facilities, and calibrated equipment) for scheduling and performing nuclear maintenance activities. Maintenance personnel staffing levels are determined annually through a formal staffing plan and updated, as required, during the year. The current staffing plan provides an adequate basis for the existing organization. Maintenance resources are adequately coordinated with facility management through plan-of-the-week and plan-of-the-day schedules. This coordination demonstrates adequate use of the graded approach in prioritizing attention on safety-related SSCs.

BEA effectively controls maintenance work and has established a comprehensive integrated work control process in the maintenance work management module (MWMM) of iQ WorkSmart. Using the MWMM, maintenance personnel demonstrated effective screening, planning, and work approval to ensure that the scope of work and the associated hazards are appropriately identified, analyzed, and controlled. The MWMM seamlessly links other software applications (e.g., Asset Suite®, BEA's old, computerized maintenance management database; the Electronic Document Management System; and LabWay®, BEA's issues management system). EA considers BEA's effective use of the MWMM module of iQ WorkSmart to automate its management of maintenance work, assets, supply chains, operations coordination, and compliance processes as a **Best Practice**.

Maintenance Personnel Training and Qualification

Maintenance personnel are adequately trained and qualified to perform nuclear maintenance work in accordance with PDD-105, *ATR Programs Training*, which appropriately addresses requirements of DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*. RP-4300, *Training Design Plan for ATR Programs Maintenance School*, was developed using PDD-105 and DOE Order 426.2 as a basis for appropriately determining training needs and maintenance school curriculum. RP-4300 provides a comprehensive approach to training and qualification of nuclear facility maintenance personnel. RP-4300 also adequately identifies requisite maintenance topics that are the basis for BEA's maintenance school curriculum, which was designed and established to train and qualify maintenance personnel rapidly and effectively. The curriculum includes facility system-specific courses that effectively address system overviews, basic purpose, function, TSR requirements, and locations of equipment. All craft and planner candidates are appropriately required to complete the curriculum to receive initial qualifications. The BEA training group tutors and coaches personnel in completing the curriculum. BEA training plan 361.72, *Continuing Training Plan*, provides an adequate continuing training program on a two-year cycle that requires qualified personnel to complete required items at specified intervals to maintain their qualification. Current qualification status is adequately tracked in the Asset Suite® database. Review of three completed qualification cards demonstrated that the required continuing training elements were included.

Maintenance Performance

BEA performs PM and corrective maintenance and maintains maintenance histories using the MWMM to ensure safe, efficient, and reliable operation of safety-related SSCs.

Review of three PM work schedules and work packages signed by the facility manager demonstrated effective planning and coordination with facility management. The PM coordinator/planner effectively tracked observed PM work progress and performed a final review of completed PM WOs prior to submittal to the records management organization. Performance of a PM work package observed by EA demonstrated effective pre-job briefs; documented measuring and test equipment (M&TE) associated with the work; performance of work steps in sequence; proper use of hold points for quality inspections; completed post-maintenance testing; and effective post-job debriefings. BEA effectively uses a maintenance equipment reliability index (a maintenance management trend indicator) to prioritize PM work. PM completion metrics for April through July 2022 demonstrated that PM for safety-related SSCs was prioritized and completed in a timely manner: 84.5% were completed on time, and five overdue PMs are being actively worked.

Corrective maintenance WOs demonstrated adequate work performance. Three completed corrective maintenance WOs demonstrated timely review and proper coordination with facility management, completion of maintenance work, post-maintenance testing, and verification that the corrective action resolved the problem. The maintenance equipment reliability index report for April through July 2022 identified no corrective maintenance items in the grace period (an allowable time extension before a maintenance item is considered overdue), but the monthly backlog of work is above the established goal of four corrective maintenance WOs per month for this period. Maintenance activities for reactor core internal change-out were appropriately prioritized over these corrective maintenance WOs based on available personnel resources.

BEA adequately documents and uses maintenance history information. The Lead Maintenance Planner is skilled at accessing WO histories through the MWMM. Historical entries adequately demonstrated proper recording in accordance with MCP-6402, *Master Equipment List and Equipment History*. WOs are appropriately reviewed weekly by the ATR Plant Health Committee (composed of management personnel from operations, maintenance, system engineering, and production control groups), which ensures that critical WOs are prioritized.

Spare Parts and Materials

In general, spare parts and materials are adequately stored and uniquely identified at the CFA warehouse, but EA identified weaknesses in controlling BEA warehouse environments, as addressed in section 3.2 of this report. Maintenance requests for specific parts are effectively submitted to CFA through Asset Suite® for each WO. The ATR Complex has a designated kitting and staging area where spare parts and materials are adequately staged according to the WO. Observed staged parts/materials are adequately tagged with WO number, material request number, engineer, planner, job title, date staged, and staging location. BEA has effectively established minimum and maximum quantities for critical spare parts and inventory levels for safety-related SSCs and other equipment, with input from CSEs on quantities required.

Generally, BEA adequately manages spare parts. However, the CSE for RMSS faces a growing challenge to maintain operability and reliability of this system due to the lack of spare parts. The current RMSS technology was installed about 40 years ago. Manufacturers no longer fabricate critical RMSS components, resulting in the lack of any spare parts for the sensing portion of RMSS (detectors, cabling, and amplifiers) and few logic input/output cards. The lack of these spare parts for the RMSS could adversely impact the ATR mission. (See **OFI-BEA-1**.) BEA has prepared a long-term asset management plan to address this issue, but this plan is not scheduled to start until the fiscal year 2025 timeframe or later based on current management priorities.

Maintenance Conclusions

BEA has established an NMMP that adequately covers all 17 elements of DOE Order 433.1B. Maintenance activities are properly scheduled, planned, and performed by qualified craft personnel. Craft facilities and calibrated equipment are properly controlled and available. EA considers the use of MWMM in iQ WorkSmart to be a best practice. The performance of an observed PM and reviewed PM and corrective maintenance documents demonstrated an adequate approach to maintenance work performance. Maintenance histories are effectively maintained and used to monitor SSC performance trends. However, the lack of spare parts for the RMSS is a growing challenge.

3.5 Safety Systems Surveillance and Testing

This portion of the assessment evaluated BEA's performance of surveillance and testing and use of M&TE to ensure operability of the confinement system and RMSS.

Surveillance and Testing

BEA adequately performed observed safety system surveillance and testing activities to ensure that the confinement system and RMSS can accomplish their safety functions and continue to meet applicable system requirements and performance criteria. BEA uses an effective scheduling and tracking system that ensures that SRs are performed within TSR-required frequencies. There have been no TSR-related occurrence reports (safety class equipment failures or missed SRs) in the last three years. Ninety previously performed surveillance procedures for the systems appropriately cited applicable safety requirements; identified precautions, and system and test prerequisite conditions; and included clear performance steps. These surveillance procedures also included provisions for listing discrepancies and the timely notification of facility management of any test failure so that the system can be declared inoperable and necessary actions taken to place the plant in a safe condition. The Facility Manager's signature appropriately documented the review and acceptance of final test results. However, issues with surveillance acceptance criteria for the confinement seal system, identified in section 3.1 of this report, may impact the operability of the confinement system.

Measuring and Test Equipment

BEA adequately controls M&TE used to perform surveillance procedures. Ninety performed surveillance procedures demonstrate that M&TE was appropriately calibrated and maintained at prescribed intervals (or before use) against reference calibration standards having traceability to nationally recognized standards or a documented basis. The calibration documentation appropriately included all required information (i.e., identification, traceability to the calibration standard, calibration data, recalibration due date or interval, and identification of the individual performing the calibration). Calibrated M&TE identified in the completed work packages was properly labeled, tagged, or suitably marked or documented to indicate a due date or interval of the next calibration and uniquely identified to provide traceability to its calibration data.

Further, interviews with the M&TE coordinator, reviews of completed M&TE documentation, and observations of M&TE use in the field confirmed that calibrated M&TE is properly handled and stored to maintain instrument accuracy. Out-of-calibration M&TE and instruments suspected to be in error are properly tagged and segregated, as required by LWP-13455, *Control of Measuring and Test Equipment*. Lost or damaged M&TE is appropriately documented. M&TE users and associated system engineers are properly notified when instruments are out-of-calibration using the out-of-tolerance notification (OTN) and evaluation system. Five reviewed OTNs properly evaluated previously collected measurement data acceptability.

A walkdown of the M&TE tool cribs in each craft shop demonstrated that suitable controls are in place for calibrated M&TE, in accordance with LWP-13455. Calibrated M&TE is adequately tracked using the Asset Suite® database in MWMM. M&TE returned for recalibration and then reissued to maintenance personnel and operators is adequately controlled and scheduled by M&TE personnel.

Safety Systems Surveillance and Testing Conclusions

BEA effectively performs surveillance and testing activities using calibrated and controlled M&TE. However, issues with surveillance acceptance criteria for the confinement seal system, identified in section 3.1 of this report, may impact the operability of the confinement system.

3.6 Operations

This portion of the assessment evaluated BEA's shift operations, operator training and qualification, and procedure development, use, and adherence to ensure the availability and functionality of the ATR confinement system and RMSS.

Shift Operations

BEA operations personnel have established and implemented effective shift turnover and routine operational activities consistent with the requirements of DOE Order 422.1, *Conduct of Operations*. Observed shift turnovers between operations personnel at ATR were conducted thoroughly in a distraction-free environment in accordance with MCP-9502, *ATR Programs Operations Implementation*, section 8.4, *Shift Turnover*, and associated checklists. Operators clearly articulated the status of systems under their purview, reviewed system trends and alarms, updated operator narrative logs, discussed activities for the upcoming shift, and summarized relevant system indicators and displays. Narrative electronic logs were current with consistent documentation of key shift activities. Upon turnover completion, the incoming operator appropriately logged acceptance of the shift, prior to the outgoing operator's departure.

Even though ATR was in shutdown mode, observed operations personnel adequately performed routine operational activities, including operator rounds, system walkdowns, and system equipment lineups. Appropriate control and monitoring of facility access, organized workstations with up-to-date approved operator aids, and the operators' use of relevant and readily accessible procedures were observed during operator rounds on the ATR SSCs. Field and control room operators used approved checklists and formal three-way communications (sender states information/receiver acknowledges by repeating/sender confirms or corrects) to confirm key system parameters, alarm status, and system configurations. Interviewed operators and managers exhibited a strong questioning attitude. New and experienced operators confirmed during interviews they were aware that all personnel have stop-work authority; each had no fear of retaliation for reporting safety concerns and stated that management consistently values safe operations above schedule pressures.

Operator Training and Qualification

BEA adequately ensures that control room operators and shift supervisors are trained and qualified to safely operate ATR. PDD-105 adequately addresses the requirements of DOE Order 426.2 to ensure that operators are sufficiently knowledgeable and skilled. PDD-105 describes an adequate process for the selection, training, and qualification/certification of personnel involved in managing and operating ATR (e.g., reactor operators, control room operators, senior reactor operators, senior reactor auxiliary operators, and shift supervisors). These positions are appropriately identified on the training implementation matrix required by DOE Order 426.2, chap. I, sec. 1. The initial and continuing training programs of these positions appropriately consist of a mixture of classroom and computer-based training, simulator training, required reading, on-the-job training, facility walkdowns, and written and oral examinations.

Interviews and three reviewed initial qualification records demonstrated that personnel are adequately trained and qualified. Interviews with experienced and newly qualified ATR operators and review of required coursework demonstrated a rigorous training process with strong emphasis on operating SSCs in accordance with applicable requirements. Reviewed training/qualification records for three control room operators (employed for the past two years) demonstrated requalification in accordance with the two-year requirement specified in PDD-105. These records documented those operators had completed reviews of ATR operating procedures, passed associated knowledge tests, and demonstrated proficiency in executing key operational tasks. The ATR operations organization uses an effective electronic training and qualification tracking software application that provides operators and management with real-time notifications regarding qualification status and upcoming training requirements.

Procedure Development, Use, and Adherence

BEA personnel generally performed work in accordance with procedures as demonstrated by observations and reviewed work documents. LWP-9101, *INL Procedure Usage*, provides adequate requirements for ATR operating procedure development, validation, issuance, and revision, in accordance with DOE Order 422.1. EA observed appropriate conduct of routine operational activities, including operator rounds, system monitoring, alarm response, and functional testing in accordance with governing procedures. Observed operators had ready access to hard copies of procedures in the ATR control room and at various workstations throughout the facility. All observed procedures were properly marked and were the correct revision. Reviewed operations records (completed procedures, calibration sheets, configuration checklists, and calculation sheets) adhered to work performance instructions, including required verifications performed by qualified persons.

Further, independent verifications were properly performed by qualified operators and appropriately documented during observed evolutions (lockout/tagout (LOTO) installation and removal, performance of operator rounds, and surveillance activities). Interviewed operators were appropriately aware of the requirement that independent verifiers be qualified on the systems to be verified, as specified in GDE-9103, *Guidance for Communications*, section 4.10, *Verifications*. Observed operators installing a LOTO demonstrated proper actions to ensure that verifiers met requirements.

Additionally, procedures are appropriately updated as needed and communicated to the workforce. Based on review of procedural changes associated with ATR SSC upgrades, operations management, safety basis subject matter experts, training coordinators, and procedure writers closely coordinated to ensure that proposed updates considered impacts on safe operations. The BEA required reading program, which is documented in GDE-9103, section 4.2, *Required Reading*, and implemented using the training software in combination with the Electronic Document Management System, provides a systematic approach for ensuring that ATR operators remain current on updated processes and procedures.

Observed procedure use by operators was generally effective. However, contrary to MCP-9501, *ATR Programs Communications and Procedure Use*, sec. 5, which requires verbatim procedure compliance, 9 of 90 surveillance procedures performed over the last two years and one observed surveillance were not performed as written. (See **Deficiency D-BEA-6**.) Improperly performed surveillance procedures may not ensure personnel safety, protect the environment, minimize equipment damage, and confirm that operations are within the facility's safety basis. DOP-7.7.4 contains two steps that are not capable of being performed as written and should have resulted in a pause in performance and changes to the procedure before proceeding. Specifically, step 5.2.2.5 states, "Ensure Door 31 …" instead of the correct door, "13", and step 5.2.7.3 states, "Ensure BL-642 is shut" instead of the correct valve, "BK-642." Also, an operator who conducted a walkthrough of DOP-7.7.4 to demonstrate how the procedure would be performed explained that he would operate the equipment that he assumed the procedure required, without stopping to have the procedure corrected.

Operations Conclusions

The observed operational activities involving safety and mission-essential systems are effectively performed in accordance with DOE Order 422.1. A strong questioning attitude exists throughout the ATR operations organization, and operators understand the potential impacts of their work on nuclear safety. Initial, continuing, and requalification training programs for operators are well developed and effectively implemented. However, EA identified a weakness in verbatim compliance with 9 of 90 previously completed surveillance procedures performed over the last two years and one observed surveillance that were not performed as written.

3.7 Cognizant System Engineer

This portion of the assessment evaluated BEA's CSE program implementation, system design documents, and CSE system assessments.

CSE Program Implementation

BEA implements a generally adequate CSE training program that ensures that CSEs are properly trained and qualified. PDD-10600, *System Engineering Program*, and PDD-10002, *Engineering Training Program*, meet requirements of DOE Order 420.1C, att. 2, ch. V, 3.a, and adequately define the CSE training and qualification program requirements. PDD-10002 provides discretion to the supervisor in requiring participation in continued training to maintain and improve an engineer's skills and abilities. All reviewed active safety-related SSCs were properly assigned a CSE, and these assignments were correctly identified in PDD-10600. The CSE for confinement areas of the building, structures, and components has appropriately completed all training and qualification program requirements, including the oral board, as demonstrated by his qualification card; his qualification adequately aligns with the requirements of DOE Orders 420.1C and 426.2. However, BEA has not yet developed a specific system examination for the RMSS CSE, so the CSE for RMSS had not completed the system examination for his full qualification, as specified in AFTRA725, *ATR Programs Cognizant System Engineer System Specific Qualification Checklist*, sec. II.c, which meets the requirements of PDD-105. The CSE Manager is currently working with the training group to develop the examination document.

BEA effectively established and implements a list of all active safety-related SSCs. BEA's master equipment list (MEL), maintained in Asset Suite®, appropriately identifies all active safety-related SSCs. The RMSS CSE adequately demonstrated his skills, knowledge, and use of the MEL. As observed during a walkdown, the MEL appropriately included key components of the RMSS. Sampled MEL entries confirmed that identified SSC grading levels were aligned with the safety basis. The maintenance planner properly identified maintenance WOs as critical or normal based on the MEL's designation of safety-related classification.

CSEs actively support operations and maintenance personnel to ensure that safety-related systems comply with safety basis requirements. Three reviewed corrective maintenance WOs demonstrated that CSEs provided adequate instructions and technical direction to operations and maintenance personnel for confinement door seal issues, confinement door latching issues, and the RMSS solenoid valve replacement. The CSEs actively participated in engineering evaluations of system operability reviews, including functionality determinations and final justifications/actions. For example, OPR 2020-0116, *Operability Review*, was generated from a condition report (in the BEA issues management system) to address a leaking seal on door 51. The CSE reviewed the associated WO 00297748 to repair the seal and determined that the seal was operable after satisfactory post-maintenance testing of seal integrity.

System Design Documents

MCP-3572, *System Design Descriptions*, provides an adequate process for developing SDDs in accordance with the requirements of DOE Order 420.1C, att. 2, ch. V, 3.c.(2), and the guidance in DOE-STD-3024-2011, *DOE Standard Content of System Design Descriptions*. SDD-7.7.4, *Radiation Monitoring and Seal System*, provides a comprehensive description of how the current system configuration satisfies the requirements and performance criteria specified in the SAR. The SDD addresses system testing and provides a comprehensive reference source for design inputs, performance standards, SRs, and modification history.

Additionally, BEA has appropriately established another type of SDD, Technical and Functional Requirement (TFR)-7.0, *Technical and Functional Requirement for Buildings and Miscellaneous Structures*. The TFR adequately identifies the requirements associated with safety-related buildings and structures credited in the SAR for "limited leakage perimeter" (confinement). The CSEs demonstrated adequate knowledge and understanding of the SDD/TFR.

CSE System Assessments

CSEs perform and document system assessments using system health reports (SHRs) that address system operability, reliability, and material condition for the RMSS and confinement areas of the ATR Building. LWP-10601, *Nuclear Facility Safety System Health Status Reporting*, provides an adequate process that fully addresses the requirements of DOE Order 420.1C, att. 2, ch. V, 3.c.(3). The CSEs use the E.R. Suite SystemIQ® software to effectively generate SHRs. This computer software integrates system health information in one place, organizes the system health reporting and scoring process, and assembles the SHRs. EA considers the use of this software to be a **Best Practice** because its features provide a very effective centralized system for the CSEs to manage system health information and reports.

Three reviewed quarterly SHRs for each of the systems (confinement system and RMSS) appropriately communicated performance information. The reviewed SHRs provided important information regarding safety-related systems operability, reliability, material condition, CM, surveillance test results, maintenance backlog, and overall system reliability and availability. The SHRs demonstrated that CSEs are appropriately identifying issues (e.g., system degradation and open WOs) that could impact the functional requirements specified in the SAR. However, the current RMSS SHR lacks important information on interim actions being taken to address aged and obsolete detection system components and logic system input/output cards, discussed in section 3.4 of this report. Also, contrary to SD-22.1.4, *ATR Complex Engineering Roles and Responsibility Statement*, section 4.1.3.8, which requires attaching operational trending data to SHRs, the RMSS CSE did not attach the trending of stack radiation channels calibration drift issues (informally tracked in a spreadsheet) to the RMSS SHR. (See **Deficiency D-BEA-7**.) Not including trending data in the SHR precludes management's ability to understand the significance of adverse trends.

Cognizant System Engineer Conclusions

BEA implements a generally adequate CSE program. The CSEs demonstrated adequate knowledge, understanding, and ownership of their assigned safety system SDD and/or TFR. The reviewed SDD and TFR were adequately developed and maintained to reflect system requirements and performance criteria in accordance with safety basis requirements. EA considers the use of E.R. Suite SystemIQ software to be a best practice. SHRs from the previous three quarters adequately addressed system operability, system performance, and maintenance activities, except that the current RMSS SHR omits some important information and trending data.

3.8 Feedback and Improvement

This portion of the assessment evaluated BEA's collection, analysis, and use of feedback information to promote safety-related SSC engineering, operations, and maintenance improvement.

BEA performs adequate management and independent assessments to collect feedback information for analysis and use. LWP-13730, *Performing Assessments and Assurance Activities*, establishes an effective process for conducting management and independent assessments in accordance with DOE Order 414.1D. LWP-13730 appropriately establishes sufficient authority and freedom from line management for independent assessment teams. Six management observations demonstrated management's commitment to perform self-evaluations. Ten reviewed management and independent assessment reports from November 2020 to August 2022 demonstrate adequate evaluation in the areas of engineering, operations, maintenance, and technical programs. The training records of personnel associated with the reviewed independent assessments demonstrate proper qualification at the time of the assessments. These reports identified a variety of issues to drive performance improvement in such areas as work requests, WOs, LOTO, engineering processes, procurement specifications, drawings, operations processes, and PM. However, contrary to ATR's assessment schedule for calendar year 2022, 14 of 55 assessments are currently overdue.

BEA has established and implemented a generally effective issues management system. LWP-13840, *Issues Management*, adequately addresses issue identification, notification/occurrence reporting, investigation, graded response actions, and records management. Out of 37 issues identified in the last two years, five reviewed closed issues exhibited thorough conformance with LWP-13840. LWP-13840, sec. 4.6.6, appropriately requires assignment of trend codes and analysis of performance trends, and references guidance in GDE-574, *Trend Coding and Analysis Guide*. However, contrary to LWP-13840, BEA could not provide any documentation demonstrating analysis of performance trends. (See **Deficiency D-BEA-8**.) The lack of documented analysis of performance trends impedes BEA's ability to identify adverse conditions. The Performance Assurance Manager explained that his organization performs "cognitive trending" as defined in GDE-574 but has no documentation of this performance. For example, while BEA has identified failed confinement barrier door latches (door latches that did not engage upon door closure; 11 during calendar year 2020 through 2022) and performed repairs, BEA has not recognized this trend and entered an issue in the issues management system for performing extent-of-condition and causal analysis. Instead, past corrective maintenance actions for these door latches were limited to identification and repair.

Feedback and Improvement Conclusions

BEA has established and implemented an adequate feedback and improvement program through management and independent assessments and a generally effective issues management system. However, BEA has not implemented a formal process at ATR to analyze and trend feedback information to detect adverse conditions, which has resulted in a significant missed trend associated with failed confinement barrier door latches.

3.9 Federal Oversight

This portion of the assessment evaluated the DOE field element and Headquarters oversight of activities at ATR, with a specific focus on those oversight activities relating to safety-related systems.

DOE Field Element Oversight

As required by DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, DOE-ID maintains sufficient technical capability to make informed decisions about ATR hazards, risks, and resource allocation. DOE-ID has sufficient staffing with the necessary expertise to effectively oversee ATR activities. The bulk of DOE-ID's day-to-day oversight at ATR is provided by Facility Representatives (FRs). DOE-ID has a staffing analysis that shows that three FRs are required to adequately oversee operations at the ATR Complex. Currently, three ATR FRs are assigned, two qualified and one in qualification.

DOE-ID has a mature oversight program that effectively implements operational awareness (OA) activities and formal assessments. Based on a review of weekly OA reports, DOE-ID has a robust OA program that effectively captures staff observations. Observations are captured in an electronic log, making them readily retrievable. Ultimately, all log entries are input to the ZEUS system to document assessment and OA activities. DOE-ID has adequately established and implemented a formal assessment program including written assessment plans and schedules, as well as documented assessment results. Assessment results are captured in the ZEUS system and on the INL intranet.

DOE-ID demonstrated a weakness in effectively meeting the DOE Order 420.1C, 5.d.(11), responsibility to oversee the BEA CSE program and the operability of associated safety systems. This oversight is commonly provided by safety system oversight (SSO) engineers. However, there is no specific requirement that this oversight be performed by an individual qualified as an SSO engineer. At present, there is no formal assignment of SSO duties at ATR, although the nuclear safety specialist assigned to ATR is in the process of qualifying as an SSO engineer and is expected to perform SSO duties at ATR.

To be effective, SSO engineers examine a myriad of information regarding the maintenance and performance of safety systems, generally relying upon contractor-generated SHRs. However, no DOE-ID assessment or OA activities were identified and documented that examined this data. (See **OFI-DOE-ID-1**.) Two SHRs for the RMSS show that the system repeatedly failed its inter-channel comparison test, requiring a procedural workaround, yet this observation is not documented via DOE-ID assessments or OA activities.

DOE Headquarters Oversight

The NE Central Technical Authority (CTA), who is responsible for providing centralized technical expertise and ensuring adequate implementation of nuclear safety policy and requirements, is the Assistant Secretary for Nuclear Energy. DOE Order 226.1B, section 5.c.(3), establishes the responsibility that the CTA "periodically assess DOE Headquarters and field element programs for oversight of high consequence activities, such as high hazard nuclear operations." DOE-ID specified that the NE CTA meets this responsibility by maintaining awareness of ATR-related activities and issues via routine interface with DOE-ID. EA was unable to immediately determine whether this approach meets the applicable requirements.

Federal Oversight Conclusions

FR oversight and cognizance of ATR operations is robust. DOE-ID oversight activities at ATR are well documented, and DOE-ID has a mature oversight program that is effectively implemented. A weakness was identified with the DOE-ID oversight of the CSE program and the operability of the associated safety systems.

4.0 BEST PRACTICES

Best practices are safety-related practices, techniques, processes, or program attributes observed during an assessment that may merit consideration by other DOE and contractor organizations for implementation. The following best practices were identified as part of this assessment:

- BEA has integrated its conduct of engineering framework with their iQ WorkSmart computer system to effectively manage the engineering change process. The iQ WorkSmart software automates and integrates many INL processes, procedures, instructions, and associated databases and forms. The iQ WorkSmart approach has the potential to produce significant improvements in efficiency thereby reducing costs.
- BEA has established a comprehensive integrated work control process that implements the MWMM of iQ WorkSmart. BEAs implementation and use of the MWMM effectively supports the management of maintenance work, assets, supply chains, operations coordination, and compliance.
- CSEs use the E.R. Suite SystemIQ software to effectively develop SHRs. The computer software integrates system health information in one place, organizes the system health reporting and scoring process, and assembles the SHRs, providing a very effective centralized system for the CSEs to manage their system health information and reports.

5.0 FINDINGS

Findings are deficiencies that warrant a high level of attention from management. If left uncorrected, findings could adversely affect the DOE mission, the environment, the safety or health of workers and the public, or national security. DOE line management and/or contractor organizations must develop and implement corrective action plans for findings. Cognizant DOE managers must use site- and program-specific issues management processes and systems developed in accordance with DOE Order 226.1B to manage the corrective actions and track them to completion.

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Finding F-BEA-1: BEA did not provide adequate technical bases for two acceptance criteria associated with the confinement system TSR leakage requirements. (LWP-10200)

Finding F-BEA-2: BEA has not initially qualified and/or subsequently maintained confinement system components as safety-related with a requirement for EQ. (SAR, sec. 3.11 and appendix A)

Finding F-BEA-3: BEA has not incorporated key governing NQA-1 requirements for engineering processes into its procedures. (ASME NQA-1, Part I, Requirement 3, pars. 100, 300(a), 400, and 500)

Finding F-BEA-4: BEA did not properly identify critical characteristics with attributes and acceptance criteria appropriate for the safety function for 12 of 12 CGI packages. (NQA-1, Part I, Requirement 3, par. 300, and iQ WorkSmart)

6.0 DEFICIENCIES

Deficiencies are inadequacies in the implementation of an applicable requirement or standard. Deficiencies that did not meet the criteria for findings are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

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Deficiency D-BEA-1: BEA did not maintain NCRs for in-stock ion exchange resins with expired shelf-life. (LWP-13120, app. E)

Deficiency D-BEA-2: BEA procedure LWP-13120 does not require Engineering to share the list of shelf-life constrained items with QA or warehouse personnel. This has resulted in items with expired shelf-life being kept in active inventory with conforming items. (NQA-1, Part I, Requirement 8, par. 302)

Deficiency D-BEA-3: BEA does not monitor and record the temperature and humidity inside BEA's warehouses to prevent damage or loss and minimize deterioration of stored items. (LWP-13120, app. E)

Deficiency D-BEA-4: BEA procedure LWP-13510 lacks key requirements to preclude S/CIs from entering the site and to ensure their proper disposition. (DOE Order 414.1D, att. 3, 2.e and i)

Deficiency D-BEA-5: BEA's CM program (procedure LWP-10500) does not address system assessments and aging degradation. (DOE Order 420.1C, att. 2, ch. V, 3.c.(1)(b) and (e))

Deficiency D-BEA-6: BEA did not ensure that 9 of 90 previously completed surveillance procedures and one observed surveillance procedure were performed as written. (MCP-9501, sec. 5)

Deficiency D-BEA-7: BEA did not ensure that the CSE attached trending data for RMSS to the SHR. (SD-22.1.4, sec. 4.1.3.8)

Deficiency D-BEA-8: BEA has not implemented a formal process to analyze and trend feedback information at ATR to detect adverse conditions. (LWP-13840, sec. 4.6.6)

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified two OFIs to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in assessment reports, they may also address other conditions observed during the assessment process. These OFIs are offered only as recommendations for line management consideration; they do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

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OFI-BEA-1: BEA should consider initiating an obsolescence study to understand and prepare for a rapid response should the RMSS operability be compromised.

DOE Idaho Operations Office

OFI-DOE-ID-1: DOE-ID should consider using a dedicated SSO engineer (an individual without collateral duties) to enhance safety system oversight by improved monitoring and documentation of ATR safety-related system management.

8.0 ITEMS FOR FOLLOW-UP

A follow-up assessment will be performed to evaluate the adequacy of NE Headquarters oversight with a focus on implementation of the roles and responsibilities of the NE CTA.

Appendix A
Supplemental Information

Dates of Assessment

Onsite Assessment: August 22 – September 1, 2022

Office of Enterprise Assessments (EA) Management

John E. Dupuy, Director, Office of Enterprise Assessments
William F. West, Deputy Director, Office of Enterprise Assessments
Kevin G. Kilp, Director, Office of Environment, Safety and Health Assessments
David A. Young, Deputy Director, Office of Environment, Safety and Health Assessments
Kevin M. Witt, Director, Office of Nuclear Safety and Environmental Assessments
Kimberly G. Nelson, Director, Office of Worker Safety and Health Assessments
Jack E. Winston, Director, Office of Emergency Management Assessments
Joseph J. Waring, Director, Office of Nuclear Engineering and Safety Basis Assessments

Quality Review Board

William F. West, Advisor
Kevin G. Kilp, Chair
Christopher E. McFearin
Michael A. Kilpatrick

EA Site Lead for Idaho National Laboratory

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