

**Office of Enterprise Assessments
Assessment of Conduct of Engineering at the
Idaho National Laboratory**



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Acronyms

ATR	Advanced Test Reactor
BEA	Battelle Energy Alliance, LLC
CFP	Construction Field Problem
CFR	Code of Federal Regulations
CM	Configuration Management
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
ECAR	Engineering Calculations and Analysis Report
eCR	Electronic Change Request
EDMS	Electronic Document Management System
EJ	Engineering Job
HSIS	Hydraulic Shuttle Irradiation System
INL	Idaho National Laboratory
MFC	Materials and Fuels Complex
NQA	Nuclear Quality Assurance
OFI	Opportunity for Improvement
PPE	Personal Protective Equipment
SDD	System Design Description
SSC	Structure, System, and Component
USQ	Unreviewed Safety Question
WO	Work Order

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Office of Environment, Safety and Health Assessments, within the independent Office of Enterprise Assessments (EA), conducted an assessment of conduct of engineering at the Idaho National Laboratory. The purpose of this EA assessment was to evaluate the effectiveness of engineering processes and programs implemented by the laboratory contractor, Battelle Energy Alliance, LLC (BEA).

The BEA engineering organization includes a centralized support staff and two facility-specific engineering groups located on site at the Advanced Test Reactor and Materials and Fuels Complex. The engineering groups at the Advanced Test Reactor and Materials and Fuels Complex support the Operations and Maintenance organizations, provide the system engineering function, maintain the technical baseline, and manage the design change process for their respective facilities, while the central engineering group controls laboratory-wide procedures and provides a limited support role in several areas.

This assessment examined engineering procedures and the application of those procedures in the development of engineering products, such as specifications, calculations, drawings, and design change packages. EA also examined the configuration management program, engineering performance monitoring, procurement, and issues management as implemented within the engineering organization.

EA concluded that most of the engineering processes examined are adequately structured to accomplish the intended functions. The technical baseline is well documented and generally meets DOE expectations. Implementation of the design change control and documentation control processes is adequate. The procurement process and its supporting elements of specification development, quality level determination, and commercial grade dedication are well implemented. The issues management process used by BEA is effective at identifying, analyzing, and correcting issues, including issues identified by engineering and issues that engineering helps to resolve.

EA also found, based on a sample, that most engineering products are of adequate quality and technically defensible.

Despite these strengths, EA identified some process and product related weaknesses that should be addressed:

- The calculation procedure contains insufficient guidance to ensure closure of open items.
- The configuration management assessment process is not being adequately implemented as defined in DOE STD-1073-2003, *Configuration Management*.
- The unreviewed safety question procedure does not adequately address consideration of design changes implemented in partial steps with intermediate return to service of affected systems/facilities.
- The organizational performance monitoring and assessment process is not effective, with no internal engineering self-assessment process and limited external assessments of engineering by other BEA organizations.

- Calculations were not always updated when impacted by an approved design change.
- In two instances, system design descriptions were not updated when impacted by a design change.
- Some design change packages lacked adequate technical basis for the proposed change.

These weaknesses reflect areas for improved performance. The minor exceptions noted in product quality were limited in impact and affected only a small portion of the overall review population. Many of the weaknesses identified by EA were documented in the laboratory-wide corrective action system before the end of the review.

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1.0 PURPOSE

The U.S. Department of Energy (DOE) Office of Environment, Safety and Health Assessments, within the independent Office of Enterprise Assessments (EA), performed an assessment of conduct of engineering at the Idaho National Laboratory (INL). The purpose of this EA assessment was to evaluate the effectiveness of engineering processes, products, and programs implemented by the laboratory contractor, Battelle Energy Alliance, LLC (BEA).

EA performed this assessment from March 19, 2018, through April 12, 2018. This report discusses the scope, background, methodology, results, and conclusions of the assessment, as well as the opportunities for improvement (OFIs) identified by the review team.

2.0 SCOPE

This assessment examined engineering processes in use by the BEA engineering support organization, and the application of those processes in the generation and delivery of engineering products, such as specifications, calculations, drawings, and design change packages. EA also examined the flowdown of safety basis requirements into technical baseline documents and other engineering deliverables, and the procurement process. Reviews were performed of the configuration management (CM) program, engineering performance monitoring, and issues management as implemented within the engineering organization.

This review scope was in accordance with the *Plan for the Office of Enterprise Assessments Assessment of Conduct of Engineering at the Idaho National Laboratory Site, March – April 2018*.

3.0 BACKGROUND

The Idaho Site has numerous facilities, with DOE oversight provided by the DOE Office of Nuclear Energy Idaho Operations Office (DOE-ID) for some and by the DOE Office of Environmental Management for others. The Office of Nuclear Energy provides oversight for INL, which includes both the Advanced Test Reactor (ATR) and Materials and Fuels Complex (MFC) facilities.

The BEA engineering organization includes a centralized support staff located in Idaho Falls, Idaho, and two facility-specific engineering groups located on site at ATR and MFC. These groups also have access to subcontractor engineering resources available from local outside agencies. The central engineering group controls laboratory-wide procedures, provides subject matter experts, performs specialized analyses, and supplements the facility-specific groups when necessary. The engineering groups at ATR and MFC support the Operations and Maintenance organizations; provide for the cognizant system engineer function required by DOE Order 420.1C, *Facility Safety*; maintain the technical baseline; and manage the design change process for the facility.

This assessment of engineering performance and quality is one of several either planned or completed at hazard category 1, 2, and 3 facilities across the DOE complex. This assessment, in particular, was proposed by DOE Idaho Operations Office line management within an EA-31/DOE-ID planning process,

and the implementation plan was developed with input from that organization. Assessments of the conduct of engineering were identified as a focus area in a memorandum from the Director of EA to DOE senior line management, dated May 3, 2016.

4.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*. EA implements the independent oversight program through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. Organizations and programs within DOE use varying terms to document specific assessment results. In this report, EA uses the terms “deficiencies, findings, and opportunities for improvement (OFIs)” as defined in DOE Order 227.1A. In accordance with DOE Order 227.1A, DOE line management and/or contractor organizations must develop and implement corrective action plans for the deficiencies identified as findings. Other important deficiencies not meeting the criteria for a finding are highlighted in the report and summarized in Appendix C. These deficiencies should be addressed consistent with site-specific issues management procedures.

As identified in the assessment plan, this assessment considered requirements related to the conduct of engineering. EA used the criteria and lines of inquiry for successful conduct of engineering identified in EA Criteria and Review Approach Document 31-13, *Conduct of Engineering*, Revision 1, to evaluate contractor performance.

EA examined key documents, such as system descriptions, calculations, procedures, manuals, design change packages, policies, procurement documents, and training and qualification records. EA also interviewed key personnel responsible for developing and executing the associated programs, and performed walkdowns where appropriate. The members of the EA assessment team, the Quality Review Board, and EA management responsible for this assessment are listed in Appendix A. A detailed list of the documents reviewed, personnel interviewed, and observations made during this assessment, relevant to the conclusions of this report, is provided in Appendix B.

There were no items from previous assessments requiring follow-up during this assessment.

5.0 RESULTS

5.1 Design Engineering Processes

This section discusses EA’s assessment of the processes in place within BEA to perform engineering functions. BEA is contractually committed to American Society of Mechanical Engineers Nuclear Quality Assurance (NQA)-1-2008 with 2009 Addenda. EA used this standard in conjunction with DOE requirements to form the basis for this portion of the assessment.

Objective:

Design engineering work is performed consistent with technical standards, DOE requirements, and safety basis requirements and commitments, using approved procedures and sound engineering/scientific principles in accordance with the requirements of 10 CFR 830.

Criteria:

- *Engineering procedures are in place and contain appropriate detail to control development, approval, issuance, and revision of deliverables, as well as key processes essential to the design engineering function. (10 CFR 830)*
- *Engineering procedures provide barriers against poor performance, require participation and review by appropriate organizations, and drive communication between distinct groups. Verbatim compliance is required. (10 CFR 830)*

EA reviewed engineering processes for several primary engineering design functions, including preparation and approval of drawings, calculations, unreviewed safety question (USQ) evaluations/screenings, and design change packages. In most areas, the processes reviewed provide adequate guidance to accomplish the subject activities in a technically acceptable, controlled manner. Review results for individual processes are briefly summarized below:

- PDD-10000, *Conduct of Engineering*, provides a roadmap of the engineering process, with references to implementing procedures and an excellent overall description of how engineering work is to be accomplished. However, it calls out separate change processes for low rigor change control and for high rigor change control, but does not define the differences between these, or when one would be applicable versus the other. (See **OFI-BEA-1**.)
- LWP-10000, *Engineering Initiation*, establishes the process for initiating engineering work, including development of design inputs and determination of the applicable change process (Table 1 of LWP-10000 is used to determine when LWP-10501, *Engineering Change Control*, applies). This process is important to overall safety because BEA procedures allow changes to be made outside the change control process if they do not affect safety structures, systems, and components (SSCs), including those important to safety. LWP-10000 also defines the level of verification required, with both checking and design review required for changes to safety SSCs.
- LWP-10200, *Engineering Calculations and Analysis Report*, defines a process for preparing and issuing engineering calculations that is adequate in most respects, with one weakness noted. LWP-10200 requires the documentation of open items, such as unverified assumptions; however, it does not define any process to track those open items to closure. Calculations are generally performed in support of the design change process, so the absence of such a mechanism could result in installation or modification of SSCs without adequate technical basis. (An interview confirmed at least one instance of design change package closure without closure of an underlying calculation open item at MFC.) (**Deficiency**) BEA generated condition report CO-2018-0831, *Validating Engineering Assumptions*, to document and resolve this issue. EA also noted that the definition for safety SSCs in this procedure does not match that in LWP-10000 and LST-10000, *Engineering Definitions*.
- LWP-10106, *Engineering Verification*, requires adequate verifier independence per NQA-1 and defines an adequate verification process.
- LWP-10501 defines the design change control process for safety SSCs, with SP-30.1.2, *MFC and TREAT Facility Modification Control*, providing additional guidance specific to the MFC facilities. These procedures provide adequate guidance regarding the development of design inputs, identification of impacted documents, verification, interdisciplinary review, and document updates following implementation. However, consistent with the issue identified for LWP-10200 above, the

closure processes defined in LWP-10501 and SP-30.1.2 do not contain any requirement for verification that calculation open items have been addressed/closed.

- LWP-10800, *INL Category A Reactor Unreviewed Safety Questions*, and LWP-10801, *INL Unreviewed Safety Questions*, adequately cover the basic USQ screening and evaluation processes for ATR and MFC, respectively. However, neither procedure addresses requirements for USQ screening/evaluation of design change packages structured to be completed in multiple elements or phases. **(Deficiency)** Examples of such packages are discussed in Section 5.2 below. Return to service of a nuclear facility with a partially implemented change package must be based on compliance with the facility safety basis, a function normally accomplished through the USQ screening/evaluation process that may require prior change approval obtained through that process.
- LWP-10102, *Drawings and Sketches*, states in Section 1.0 that its purpose is for requesting and creating drawings or sketches. Provisions for those functions are adequate. However, Section 4.3 of LWP-10102 also provides guidance for revising drawings. LWP-10102 does not reference or mention LWP-10501 and provides a proceduralized path to change engineered drawings while avoiding the change control process. In response, BEA central engineering revised the procedure to include that reference and provide guidance on LWP-10501 applicability. Finally, EA's review indicated that, with few exceptions, drawings are not marked or labeled with either the quality level or safety category, potentially creating an error-likely situation for component classification determinations and change process selection (high rigor vs low rigor, see PDD-10000 above). BEA generated condition report CO-2018-0832, *Safety SSC Identification on Drawings*, to document and resolve this issue.

Engineering Process Conclusions

EA concluded that most of the engineering processes examined are adequately structured to accomplish the intended functions. However, review of the calculation procedure and the USQ procedures identified gaps, potentially indicating that these processes are not sufficiently rigorous.

5.2 Engineering Products Technical Review

This section focuses on the quality of engineering technical products created using the processes examined in Section 5.1. In each area, EA selected a limited sample of documents produced or closed within the last year for detailed review.

Objective:

Design engineering work is performed consistent with technical standards, DOE requirements, and safety basis requirements and commitments, using approved procedures and sound engineering/scientific principles in accordance with the requirements of 10 CFR 830.

Criteria:

- *Documents comprising the project technical baseline are readily identifiable and subject to appropriate control measures. System design documents and supporting documents must be identified and kept current using formal change control and work control processes. (10 CFR 830)*

- *Analyses and calculations are prepared with design inputs clearly identified and assumptions technically justified (or unverified assumptions clearly identified and tracked to resolution), prepared consistent with the design criteria and safety basis, and checked by a second party and verified by an independent verifier, as appropriate. (10 CFR 830)*
- *Design drawings are subject to interdisciplinary review as appropriate prior to issuance, accessible and retrievable in the most current version, and in accordance with applicable design criteria and industry standards. (10 CFR 830)*

Calculations

Engineering calculations and analysis reports (ECARs) are performed in accordance with LWP-10200. An electronic template, TEM-10200-1, *Engineering Calculations and Analysis Report Template*, is available to ensure that all required information is provided.

EA examined 33 ECARs to determine whether design inputs were clearly identified, assumptions were technically justified, and results were appropriately checked/verified. The examined ECARs were satisfactory, with the following exceptions:

- EA identified two instances of ECAR revisions that changed the assumptions in the ECARs but did not correspondingly update the appendix section that addressed verification of the assumptions. BEA produced evidence to demonstrate that the assumptions were appropriately verified, and initiated a change to capture the correct information in the affected ECARs. This issue is being tracked in the commitment tracking system as condition report CO-2018-0763, *ECARs need revision*.
- EA identified one instance of an ECAR assumption that was not adequately supported by the information provided in the report. ECAR-3245, *SSPAS Fire Assessment*, assumes a 0.1-inch gap between the first lead sheet of the shielded sample preparation area system shielding and the stainless steel outside shell. This gap provides enough resistance against heat transfer to prevent significant melting of the lead during the calculated fire. BEA was able to produce evidence from drawings that supported the existence of the gap.
- Calculation ECAR-2461, *Electrical Load Study for Panel 670-E-31*, specifies a 20A breaker for the new ATR canal demineralizer unit. Design change EJ-7.4.11.3-1/1340, *ATR Canal Ion Exchange System Replacement – Electrical*, installed a 15A breaker, which is adequate to supply the new demineralizer electrical load. However, ECAR-2461 has not been revised to reflect the installed (15A breaker) configuration. **(Deficiency)**

Technical Evaluations

BEA produces technical evaluations in accordance with LWP-10300, *Technical Evaluation*. BEA appropriately uses technical evaluations to document a determination of equivalency when an originally specified item is no longer available or if interface or functional requirements have changed.

EA reviewed 18 technical evaluations to determine whether the assumptions and conclusions were technically justified. EA determined that all of the technical evaluations examined were adequately justified and appropriately reviewed and checked.

Drawings

Engineering drawings are produced and revised in accordance with LWP-10102. EA examined over 100 drawings to determine conformance with the procedure and appropriate interdisciplinary review.

All of the drawings examined by EA were in accordance with industry standards, with clear, legible, dimensioning, and auxiliary views and/or solid model representations to aid in comprehension. Evidence of appropriate interdisciplinary review was found on electronic change requests (eCRs) that are used to capture review comments and resolutions.

Some of the reviewed drawings depicted safety-related components, while other drawings did not, even though items on the drawing were credited in the corresponding safety analysis. As noted under Engineering Processes, above, there is no requirement for identifying safety-related drawings in LWP-10102.

Design Change Packages

BEA processes design changes using LWP-10501. MFC has augmented the requirements in LWP-10501 with facility-specific procedure SP-30.1.2. Each design change is appropriately tracked using an engineering job (EJ) package that documents the engineering deliverables, the discipline interfaces, the verification of the engineering deliverables, the implementation of the change, and turnover/closure. BEA uses a technical integrator and CM engineer to oversee the process and ensure compliance with expectations of the procedure.

EA examined over 41 EJs to determine the effectiveness of the design change process. The packages reviewed contained references to numerous engineering products, including drawings, calculations, technical evaluations, USQ reviews, and procurement specifications. EA also interviewed several engineers who performed the EJs, to understand their use of the process. The engineers were knowledgeable about the development of EJs and the application of EJs versus other engineering products.

The EJs sampled in this assessment adequately documented the full extent of the design change, with several exceptions listed below. Electronic copies of the completed EJs contained additional documents produced as part of the EJ, including eCRs and USQs. Although the specific types of documents attached to the electronic copies of the EJs varied somewhat, all of the EJs reviewed appropriately contained the unique document numbers of the engineering products associated with the EJ, as well as interim products, such as eCRs, to document satisfactory review, comment collection, comment resolution, and approval of the engineering products.

EA identified the following issues associated with the EJs:

- Two ATR EJs affected but did not update associated system design descriptions (SDDs). EJ 7.9.25-8, *Removal Of Irradiated HSIS Intank Assembly From ATR Reactor Vessel*, rendered the hydraulic shuttle irradiation system (HSIS) inoperable but recoverable. Engineering chose not to revise the SDD until it decided whether the HSIS would be restored using a new design. EJ 7.9.12-92, *ATR Loop 1 C-W, Relief Valve Discharge Piping Modification For SF-135, 137 and 535*, identified SDD-7.9.12, *Experiment Inpile Tube Facility ATR 1C-W*, as an affected document, but engineering did not update the SDD as a part of the design change package. Instead, engineering wrote CO-2017-0502, *AHTL Experiment Pressurized Water Loop 1C-W*, documenting the need for a separate effort to perform a major revision of the SDD since it has not been updated in 30 years. The general action to do this has not yet been completed.

- EJ 7.0-11, *Seismic Upgrade for ATR Control Room Masonry Partition Walls*, was issued to seismically upgrade a masonry wall in the ATR control room. Implementation of this EJ was accomplished in several phases during reactor outages, with the reactor returning to service between phases. The inadequate USQ screening performed for this EJ resulted in reactor operation under conditions of indeterminate compliance with the safety basis and in violation of at least one ATR procedure. Issues noted included the following: **(Deficiency)**
 - Holes were drilled through a confinement boundary, but this was not addressed in the USQ.
 - A work order (WO) to move conduit and utilities stated that the USQ was covered by the main WO or by exemption, neither of which was true.
 - One phase left a vertical steel column in the control room partially installed and unanchored at the top. No USQ was performed to evaluate potential consequences of this interim condition. SD-11.1.46, *ATR System Interaction Hazard Control*, does not allow unrestrained interactions from non-seismic commodities in the control room.
- EJ 7.9.2-28, *ID-N Asbestos Abatement*, replaced asbestos piping insulation with calcium silicate insulation in a room at ATR. EA identified the following issues: **(Deficiency)**
 - The EJ did not include the technical justification for the acceptability of the change from an engineering standpoint. When this question was raised, BEA provided EA with an email string where the difference in insulation weight was calculated and concluded to have no impact. (The basis for this no-impact determination was not provided.)
 - An existing piping analysis calculation (ECAR-2374, *ATR Experiment Loop ID-N PCS Piping and Support Analysis Per ANSI B31.1b-1973 Criteria*) was referenced, but the estimated increases in pipe loading of 2-7% from this EJ were not compared with available margins from that calculation.
 - ECAR-2374 was not revised to track the reduced margin. An interview with ATR individuals involved with this EJ revealed that stresses in some of the affected piping already exceeded code allowables prior to this change.
 - No USQ was performed for this EJ, even though a USQ was required by Appendix D of LWP-10501. **(Deficiency)**

Follow-up on this last issue with a nuclear safety program lead indicated that assessments are performed to assess the quality of USQ screens/evaluations; however, these assessments do not include any broader review of engineering products to gauge whether USQ screens/evaluations are being performed when required by procedure.

- EJ-1695, *MFC-754 Modification of Potable/Fire water Tank Level & Water Distribution Controls*, installed level indication on the MFC 400K gallon fire/potable water tank. The quality level determination risk analysis method performed for this design change describes the activity as having a moderate level of importance, stating that calculations and analyses were necessary. However, the document requirement section of EJ-1695 does not list any calculations, analyses, or technical evaluations associated with this design change. The work was completed and turned over without reference to any calculations or analyses, and BEA has not been able to produce a calculation for the MFC fire/potable required water volume and alarm setpoints. BEA initiated corrective action CO2018-0846 to address this issue.

- EJ-1793, *Static Trip III Replacement for Substation 786 North Main Breaker 1-2*, EJ-1812, *Static Trip III Replacement for Substation 786 South Main Breaker 5-2*, EJ-1813, *Static Trip III Replacement for Substation 786 Tie Breaker 3-2*, and EJ-1971, *Static Trip III Replacement for Substation 786 Feeder Breakers*, changed breaker trip settings on MFC Substation 768 to lower the personal protective equipment (PPE) requirements. The stated purpose of the EJs is to incorporate new trip settings as defined in TEV-2418, *Evaluation of Static Trips for the use in MFC 786 Substation Main Breakers 1-2, 5-2 & Tie Breaker 3-2*. EA’s review of the design analysis that established the new trip settings (TEV-2418) through the design change process indicated the following shortcomings and inconsistencies: **(Deficiency)**
 - The results and conclusion section for revisions 0 and 1 of TEV-2418 has two recommendations but does not specify any breaker settings, although the settings should have been clearly specified in the evaluation. The EJs and associated work orders directed the worker to set breakers per this TEV. Although the TEV does not call out revised breaker settings, there are breaker coordination curves in the back of the TEV that analyze new settings.
 - Figure 13, *Recommended Settings for 5-2, 1-2 and Tie Breaker 3-2*, of TEV-2418 determines five settings for these breakers but does not include the setting and time delay for the ground fault protection. There are seven settings for a breaker, but the TEV only established five settings, without specifying the ground fault settings or discussing how the ground fault settings would affect the arc flash analysis.
 - Figure 16, *TCC coordination between 5-2 and 5-3*, of TEV-2418 shows five setpoints for breaker 5-3 but does not clearly state that these are the recommended settings. Also, as in the case of Figure 13, the setting and time delay for the ground protection are not specified.
 - Drawing 742027, *MFC-768 HFEF 480V Substation Normal Power Substation and Switchgear Layout and One Line Diagram*, specifies a ground fault pickup setting of 20% with a 0.10 second delay for breakers 5-2, 1-2, and 3-2. These values are correct, but were not identified in the results of TEV-2418 or referenced in the EJs.
 - WO 216399, *786 Install Main Breakers for Substation*, adjusted the ground fault trip device settings for pick-up and time delay to *maximum*, rendering the ground fault device less effective. Although this may have been technically acceptable for a “main” breaker, there is no engineering justification or reference calculation provided.

BEA initiated corrective action CO-2018-0908, *Incorrect Breaker Trip Settings*, to correct the ground fault protection settings in accordance with the design drawing.

Engineering Product Technical Review Conclusions

Overall, most engineering products reviewed are of adequate quality and technically defensible. However, both SDDs and calculations are not always updated to reflect changed facility conditions. Implementation of the USQ screening/evaluation process is weak for design change packages implemented in multiple phases or elements. While most EJs reviewed were adequately developed, a limited portion lacked sufficient explanation or basis for the technical adequacy of the design change.

5.3 Configuration Management and Change Control

The engineering role in CM includes functions associated with creating and maintaining the technical baseline for the facility, controlling the design change process, managing engineering records, and

performing self-critical assessments to ensure continued adequacy of performance in these areas. Guidance for these functions is included in DOE-STD-1073-2003, *Configuration Management*, and DOE Order 420.1C.

Objective:

A documented CM program has been established and implemented in accordance with DOE Order 420.1 that ensures consistency among system requirements and performance criteria, system documentation, and physical configuration of the systems within the scope of the program.

Criteria:

- *Design input and output documents are appropriately established. Requirements from upper tier documents are appropriately incorporated into successor (or lower tier) documents. System design basis documents are kept current using formal change control and work control processes. (DOE-STD-1073-2003)*
- *A design change process is in place to ensure that all documents affected by a change, both predecessor and successor, are identified and revised as part of the change process; that changes are reviewed by all potentially affected disciplines and organizations; and that extant changes against technical documents are tracked from initial issuance until incorporation in an approved revision. (DOE-STD-1073-2003)*
- *A records management system has been implemented to provide accessibility to engineering documents using a process that defaults to the most recent revision; tracks unincorporated changes outstanding against issued documents; and limits outstanding changes against engineering documents, such as drawings, to avoid negative impacts from excessive change paper and difficulties in determining the current design configuration. (DOE-STD-1073-2003)*

PDD-10502, *INL Configuration Management Program*, is the BEA program document for CM. It is supported by LWP-10500, *Managing the Configuration of Structures, Systems, and Components*, an overview document with general guidance reflecting a system-based approach to CM. Overall, responsibility for CM rests with the facility engineering manager.

Technical Baseline

The technical baselines for nuclear facilities at both ATR and MFC are documented and maintained in various safety basis documents, including Safety Analysis Reports, Documented Safety Analyses, engineering design files, ECARs, technical evaluations, and other technical documents, some of which were addressed previously in Section 5.2 of this report. Procedure LWP-10105, *Facility/System Requirements Documentation (COR/T&FR/SDD)*, addresses development and documentation of the technical baseline for nuclear SSCs, requiring SDDs for all active safety SSCs in hazard category 1, 2, or 3 nuclear facilities at INL. SDDs are used appropriately as the primary mechanism to document the requirements, features, and critical characteristics of systems that perform a safety function. LWP-10105 includes electronic template TEM-10105-2, *Template for System Design Descriptions*, for ensuring a standard format when creating or revising SDDs.

LWP-10105 and TEM-10105-2 adequately capture the recommended format and content for SDDs contained in DOE STD-3024-2011, *Content of System Design Descriptions*. EA also reviewed 15 SDDs for various nuclear systems at ATR and MFC. The requirements in LWP-10105 were followed, and the SDDs adequately described the intended safety systems. Most of the SDDs were current; however, a few

had not been updated in eight years. Section 5.2 of this report notes that two SDDs affected by design changes had not been updated as required.

Some of the SDDs contain color photographs and figures to clarify key attributes of complex components and system arrangements that might not be readily apparent without entering a radiological area, supporting minimization of personnel exposure in these areas.

A recent procedure revision was made by BEA to clarify the quality level of the individual components of a safety system through the addition of a table of safety significant critical components. Although only a few examples were available for review, this practice supports successful procurement of system components by focusing quality assurance on the critical components.

Engineering Change Control

LWP-10501 (laboratory-wide) and SP-30.1.2 (MFC-specific) define the design change control process for safety SSCs, as discussed in Section 5.1. Both procedures are adequate in this regard. Both procedures include provisions for partial turnover of an SSC undergoing modification to the facility manager, allowing the SSC to be returned to service even if the entire scope of the modification has not yet been completed. Section 5.2 of this report documents review of a large sample of design change packages (or EJs). Although several issues were noted, overall implementation of the design change process by BEA Engineering is adequate.

Both ATR and MFC have a designated CM engineer. This was found to be necessary, at least in part due to the fact that design change packages are not scanned into the electronic document management system (EDMS) after engineering approval. Change packages are kept in hardcopy in the engineering files until fully implemented and submitted for closure. Interviews with MFC Engineering personnel indicated that MFC has 10 legacy design change packages that cannot be located. Both ATR and MFC plan to implement use of Asset Suite 9 software, which will permit electronic processing of EJs. Asset Suite 9 will preserve digital copies of EJ packages during this process and, therefore, will resolve this issue in the longer term.

Engineering Document Control

LWP-1201, *Document Management*, is referenced in PDD-10000 as the vehicle for “low rigor change control;” however, neither document defines that term. LWP-1201 contains an adequate review process for documents affecting safety SSCs when changes are processed outside the LWP-10501 procedure. Both LWP-10501 and SP-30.1.2 also reference LWP-1201 as the controlling procedure for processing document updates upon EJ closure.

EA used the BEA EDMS extensively to access documents of all types. Based on this experience, it was apparent that BEA’s processes for records management are being implemented appropriately. Only one exception was noted, as discussed in the paragraph regarding the use of hardcopy EJ packages under Engineering Change Control above.

Assessments

Both ATR and MFC rely on the cognizant system engineering function to assess CM. PDD-10502 calls for assessments but they are limited to system functionality. The periodic system walkdowns performed by cognizant system engineers to support the system health reporting process help to validate the physical configuration of ATR and MFC. ATR also implements a rotational five-year as-built process for essential drawings, helping validate the scope over each such period. This approach complies with the requirement

for system assessments in DOE Order 420.1C, Attachment 2, Chapter V, Paragraph 3.c, but does not accomplish the assessment function defined in DOE STD-1073-2003. Other aspects of CM, such as design change control and document control, are not assessed periodically at either ATR or MFC.
(Deficiency)

Configuration Management Conclusions

The technical baseline is well documented and meets DOE expectations. Overall implementation of the design change control and documentation control processes by BEA Engineering is adequate. However, BEA is not adequately implementing the assessment process as defined in DOE STD-1073-2003.

5.4 Issues Management and Performance Monitoring Within the Engineering Organization

Engineering often has a key role in identifying problems, determining the needed corrective actions, and implementing those actions through the engineering change process. This section discusses EA's assessment of BEA's implementation of issues management and performance assessment processes to improve its performance.

Objective:

Programs and processes are in place to identify and correct problems, ensure that personnel are appropriately trained and qualified, and assess internal performance, identifying lessons learned and implementing appropriate corrective actions. (10 CFR 830)

Criteria:

- *Internal assessments are performed on a periodic basis to examine performance with regard to procedural and programmatic requirements. Assessors are independent of the area being examined. Lessons learned are identified and communicated to engineering personnel. Identified problems are documented using the contractor assurance system and tracked to completion of corrective actions. (10 CFR 830)*
- *An effective contractor assurance process is in place wherein problems are identified and corrective actions are determined and accomplished in a timely manner. Corrective actions are effective in addressing both the extent of condition of the identified problem and recurrence control. (10 CFR 830)*

Issues Management

BEA manages issues in accordance with LWP-13840, *Issues Management*, which appropriately covers identification, analysis, and correction of a broad range of workplace problems. A software tool, LabWay, is used by BEA to support the issues management process. When an employee enters an identified issue into LabWay, a "condition report" is generated.

EA assessed issues management within the engineering organization by examining a sample of 24 condition reports in which engineering played a role in either the initiation or resolution of the condition to determine whether:

- Issues were identified and documented in LabWay, exhibiting a willingness on the part of engineering personnel to report problems.

- Corrective actions developed in response to identified issues were adequate to correct the problem.

The condition reports covered a range of topics, such as:

- Requesting engineering to determine whether a pump could still be considered operable if the ventilation fan for the pump house were out-of-service.
- Updating drawings, revising analyses to reflect as-installed configurations, and correcting SDD references that had been superseded.
- Troubleshooting a reactor safety rod that failed to fully insert on a SCRAM.
- Confirming that diesel fuel oil for a safety-related fire pump met consensus standards.

The last item from the above list, relating to the diesel fuel for the ATR safety-related fire pump, was originally identified by BEA Nuclear Assurance. Although BEA appropriately added periodic testing of the fuel to the schedule, the analysis of the existing fuel took months to accomplish, resulting in a second condition report for lack of timely resolution. When BEA finally obtained the sample and had it analyzed, the analysis showed the fuel to be within prescribed limits for acceptability. EA noted that no operability evaluation was performed for the safety-related fire pump while this condition existed. The reactor was not operated during the time that the fuel quality was indeterminate.

EA concluded that:

- The issues identified in the condition reports reflect a reasonable cross section of issues with varied significance levels, indicating an apparent willingness to identify issues of even minor significance. This contributes to the efficacy of the corrective action process and its ability to support the identification of problem and performance trends.
- The corrective actions specified for the reported problems are generally sufficient to correct those problems.
- Corrective actions are generally accomplished in a timely manner commensurate with the significance of the reported problem.

Performance Monitoring and Assessment

Independent assessment of work performance is required by 10 CFR 830, Subpart A, paragraph 830.122(j). BEA procedure LWP-13730, *Performance Assurance and Assessment*, describes an adequate process for scheduling and performing risk-informed or required assessments. The procedure is focused on BEA “Mission Centers” (e.g., ATR and MFC) and laboratory-wide supporting organizations. With the reorganization of the engineering organization, ATR and MFC engineering are included with their mission centers, while the centralized engineering group is considered a supporting organization. Procedure LWP-13730 also applies to assessments performed by the quality assurance organization.

In the last two years, BEA Engineering completed a single assessment report documenting an evaluation of the EJ backlog at MFC: ASMT 2016-0706, *MFC EJ Assessment*. The assessment resulted in closing or cancelling many old EJs that MFC Engineering appropriately concluded would not be implemented.

ATR and MFC Engineering have no formal mechanism or schedule in place to implement their self-assessment process. Prior to the reorganization of BEA Engineering, a formal assessment program existed. MFC does conduct an observation program for the Mission Center as a whole that provides limited feedback, but the observations are often focused on performance of physical work or on short term activities, rather than on the quality of engineering products.

There is also no program for routine performance assessments of common engineering activities, such as the development of calculations, design change packages, or procurement specifications by organizations outside of Engineering. Assessments performed by BEA Nuclear Assurance were generally characterized as in-depth looks at problems identified by other means or in response to an event at a facility, generally focusing on that event. Quality Assurance has performed assessments of engineering performance, which included design control within the assessment scope; however, the most recent assessment of design control was found in ASMT 2016-0782, *Audit of INL QA Program Implementation at ATR No. 2*. No issues were identified in that assessment.

Based on the information provided in this area, BEA is not adequately assessing work performance within the Engineering organization. **(Deficiency)** BEA generated condition report CO-2018-0833, *Engineering Annual Assessments*, to document and resolve this issue.

EA also examined 15 construction field problems (CFPs) to determine whether or not BEA's engineering products were effectively communicating the design intent to the construction workforce. EA concluded that 5 of the 15 CFPs were written to resolve inadequacies in the original engineering products:

- CFP-3, *Chemical Inventory Submittals*, was created because chemical inventories were not specified on vendor data schedules.
- CFP-04, *In-service Fire Suppression Testing*, was created because an engineering drawing specified a test that was not included by engineering on the vendor data schedule.
- CFP-18, *Shielded Container Stand(s)*, was created because the stands were depicted differently on different drawings. One drawing incorrectly depicted leveling feet, while another drawing correctly depicted anchor pads.
- CFP-22, *Shield Wall Connection Plates*, was created to resolve interferences overlooked in the design.
- CFP-44, *Piping Regulators*, was created because the originally specified regulators would not allow the system to function as designed, nor meet code requirements.

Issues Management and Performance Monitoring Conclusions

The issues management process used by BEA is effective at identifying, analyzing, and correcting issues, including issues identified by engineering and issues that engineering helps to resolve. The performance monitoring and assessment process is not effective, with no internal engineering self-assessment process and limited external assessments. Physical conditions are assessed as part of the system health reporting process, but these activities do not examine the implementation of engineering work processes.

5.5 Engineering Procurement

Engineering supports the procurement process by establishing technical requirements as outlined below. Those requirements establish minimum standards for equipment performance and ensure compliance with the safety basis.

Objective:

Design engineering work is performed consistent with technical standards, DOE requirements, and safety basis requirements and commitments, using approved procedures and sound engineering/scientific principles in accordance with the requirements of 10 CFR 830.

Criteria:

Engineering procedures for procurement specifications are in place and contain appropriate detail to control development, approval, issuance, and revision. Specifications for equipment procurement adequately reflect:

- *Design criteria and safety basis functional and performance requirements*
- *Technical requirements, including reference to applicable drawings and industry codes and standards*
- *Safety classification*
- *Quality requirements*
- *Environmental qualification criteria*
- *Labeling criteria*
- *Test, inspection, and acceptance criteria. (10 CFR 830)*

BEA's engineering procurement is performed in accordance with LWP-4001, *Acquisition of Materials and Services*. BEA develops specifications for both procurement and construction in accordance with LWP-10101, *Specifications*. Electronic templates are available for general specifications and construction specifications. Construction specifications appropriately use the Construction Standards Institute format. General specifications are used for engineered items.

EA examined 19 specifications to determine whether both processes were being implemented properly and effectively. All engineered item specifications within the sampled population contained appropriate references to applicable national codes and standards, quality requirements, design criteria, performance requirements to ensure the items would be suitable for their intended function, and requirements for testing, inspection, and acceptance. Labeling and shipping criteria were likewise included to prevent misidentification of items and ensure that items were protected from damage during shipping.

Construction specifications reviewed by EA appropriately contained relevant Construction Standards Institute-formatted and -numbered sections to define suitable consensus codes and standards for specific portions of the construction work (nitrogen piping installation, miscellaneous steel framing erection, etc.). Documentation and inspection requirements were appropriately incorporated in the specifications, and quality assurance requirements were adequately defined. EA found no issues with the construction specifications.

Quality levels for items to be procured are assigned by the BEA system engineer using a graded approach in accordance with LWP-13014, *Determining Quality Levels*. BEA recently revised the quality level designation process to clarify the level determination and eliminate inconsistencies found with the

previous process. The new procedure appropriately uses the terms “nuclear use,” “commercial use,” or “general use” to designate the required level of quality assurance for materials and equipment.

LWP-10109, *Commercial Grade Dedication*, describes the dedication process applied when commercial items are used in safety-related applications. An electronic template, TEM-10109, *Template for a Commercial Dedication Plan*, is available to ensure that all required information is provided. EA examined commercial grade dedication plans for a variety of items and confirmed that the plans appropriately defined the salient features of the items that would impact their suitability for the intended service. All of the plans that EA reviewed correctly described the safety functions that the item would need to perform, as well as the applicable service conditions. Critical characteristics were then appropriately described, along with the suitable examination or testing method(s) for verifying the acceptance criteria. EA did not identify any issues with the commercial grade dedication plans.

Engineering Procurement Conclusions

EA identified no issues with the aspects of the procurement process examined in this assessment, including specification development, quality level determination, and commercial grade dedication.

6.0 FINDINGS

EA did not identify any findings during this assessment. Deficiencies that did not meet the criteria for a finding are listed in Appendix C of this report, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified some OFIs to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in appraisal reports, they may also address other conditions observed during the appraisal process. EA offers these OFIs 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.

Battelle Energy Alliance, LLC

OFI-BEA-1: Consider revising PDD-10000 to explain the differences between low rigor change control and high rigor change control and where each would be applicable within the engineering process.

Appendix A Supplemental Information

Dates of Assessment

Onsite Assessment: March 19, 2018 – April 12, 2018

Office of Enterprise Assessments Management

William A. Eckroade, Acting Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments
William E. Miller, Deputy Director, Office of Environment, Safety and Health Assessments
C.E. (Gene) Carpenter, Jr., Director, Office of Nuclear Safety and Environmental Assessments
Kevin G. Kilp, Director, Office of Worker Safety and Health Assessments
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EA Assessors

Charles R. Allen – Lead
Rosemary B. Reeves
Sarah C. Rich
Gregory D. Teese
Kenneth L. Johnson

Appendix B
Key Documents Reviewed, Interviews, and Observations

Documents Reviewed

AL-2016-004, *ALARA Review of L&O Work in HCA and CA Gloveboxes and Transfer Ports*, Revision 3, 3/3/2018

AL-S17-012, *Airflow Pattern Data for B-141 CNO Glovebox and Hoods*, Revision 0, 7/12/2017

AL-S18-001, *Airflow Pattern Data for B-137, B-141, B-142, B-148, and B-154*, Revision 0, 1/3/2018

ASMT 2017-0333, *IMCL CORR for High Rad Rate Samples*, Revision 0, 7/12/2017

ASMT 2016-0781, *Audit of INL QA Program Implementation at ATR No. 1*, Revision 0, 8/23/2017

ASMT 2016-0782, *Audit of INL QA Program Implementation at ATR No. 2*, Revision 1, 11/2/2017

ATR Complex-USQ-2013-514, *EJ-7.4.11.3-1/1340, ATR Canal Ion Exchange System Replacement*, Revision 0, 10/30/2013

ATR Complex-USQ-2014-160, *ATR Canal Ion Exchange System Replacement (EJ-7.4.11.3-1/1340 and EJ-7.4.11.3-2/1454)*, Revision 0, 4/1/2014

ATR Complex-USQ-2014-354, *EJ 7.3.1-35, "Install Vacuum Motor Starters Into 670-E-1 Cubicles 3 and 4 and 670-E-2 Cubicles 9 and 10"*, Revision 0, 12/15/2014

ATR Complex-USQ-2015-162, *EJ 7.3.1-36, "Install Vacuum Motor Starters into Switchgear 670-E-1 Cubicles 5 and 6 and 670-E-2 Cubicles 11 and 12"*, Revision 0, 04/09/2015

ATR Complex-USQ-2015-204, *Temporary Modification (TM) -2015-003, Affected Equipment: Relay TRA-786-E-8 and Power Panel TRA-786-E-13*, Revision 0, 5/8/2015

ATR Complex-USQ-2015-268, *OMM 7.10.13.1.29, Canal Ion Exchanger System Operation, & 7.10.13.1.36 Changing ATR Canal Ion Exchanger System Filters*, Revision 0, 6/15/2015

ATR Complex-USQ-2015-343, *AGR-5/6/7 Supplemental Instrumentation (EJ-1916)*, Revision 0, 9/22/2015

ATR Complex-USQ-2015-493, *AGR-5/6/7 Supplemental Instrumentation (EJ-7.9.18-34/1916)*, Revision 0, 8/9/2016

ATR Complex-USQ-2015-514, *Remove Code Rejection Plates from ATR Primary Coolant Pump Motor Starters (EJ 7.3.1-35)*, Revision 0, 11/01/2015

ATR Complex-USQ-2016-502, *Removal of Irradiated HSIS Intank Assembly EJ# 7.9.25-8/2164*, Revision 0, 08/16/2016

ATR Complex-USQ-2017-063, *ATR Loop 1C-W, Relief Valve Discharge Piping Modification For SF-135, 137 and 535*, Revision 0, 03/01/2017

ATR Complex-USQ-2017-152, *AGR-5/6/7 Supplemental Instrumentation Installation Phase Modification Checklist*, Revision 0, 5/3/2017

ATR Complex-USQ-2017-331, *670-M-15 Pressurizing Pump Jackshaft Configuration Restoration*, Revision 0, 9/21/2017

ASMT 2016-0706, *MFC EJ Assessment*, 2/23/2017

ASMT 2016-1015, *MFC Maintenance Tools and Equipment Control*, 12/7/2016

CFP-01, *Isolation Pads*, Revision 0, 7/25/2016

CFP-02, *Shield Wall Joints and Bases Paint Removal*, Revision 0, 7/25/2016

CFP-03, *Chemical Inventory Submittals*, Revision 0, 7/27/2016

CFP-04, *In-service Fire Suppression Testing*, Revision 0, 7/27/2016

CFP-09, *Rack Location*, Revision 0, 8/10/2016

CFP-11, *EPMA Confinement Box stand bolting issues*, Revision 0, 8/16/2016

CFP-18, *Shielded Container Stand(s)*, Revision 0, 8/25/2016

CFP-22, *Shield Wall Connection Plates*, Revision 0, 8/8/2016

CFP-27, *Confinement Box and Stand Bolting issues (SEM and FIB)*, Revision 0, 9/1/2016

CFP-42, *Confinement Box Safety Significant Bolt Replacements*, Revision 0, 10/10/2016

CFP-44, *Piping Regulators*, Revision 0, 10/11/2016

CFP-46, *Booster Blower Install*, Revision 0, 11/3/2016
CFP-48, *Install shielding around IMCL shield wall cable penetrations*, Revision 0, 2/7/2017
CFP-48r1, *Install shielding around IMCL shield wall cable penetration for the EPMA only*, Revision 1, 3/22/2017
CFP-49, *Broken Taps*, Revision 0, 5/8/2017
CGI-842, *FMF Glovebox Secondary Control System for NRG and TBG*, Revision 1, 1/13/2016
CGI-843, *FMF Glovebox Transfer Ports for NRG and TBG*, Revision 0, 1/06/2016
CGI-897, *ATR Emergency Coolant Pump Dedication Plan*, Revision 0, 8/16/2016
CGI-946, *Turbo, TRA-688 Diesel Fire Pump Engine*, Revision 0, 9/27/2017
CGI-964, *ATR Deepwell #1 Pumping System Replacement*, Revision 0, 8/29/2017
CO-2016-3252, *Seismic Evaluation for 670-E-26*, Revision 0, 5/9/2017
CO-2017-0024, *ATR Primary Coolant Valve Check Parts WR 15-397*, Revision 0, 10/5/2017
CO-2017-0097, *South Safety Rod failed to insert on scram*, Revision 0, 10/4/2017
CO-2017-0371, *ATR Complex Warm Waste Treatment Facility*, Revision 0, 10/3/2017
CO 2017-0502, *AHTL Experiment Pressurized Water Loop 1C-W*, Revision 0, 03/15/2017
CO-2017-0574, *ATR 6-ton Crane Install*, 6/6/2017
CO-2017-0645, *ATR 688-M-2 Firewater Pump Inoperable*, Revision 0, 4/27/2017
CO-2017-0752, *Failure to test diesel fuel IAW NFPA 25 8.3.4*, Revision 0, 10/4/2017
CO-2017-0990, *Needed engineering evaluation for DOP 8.3.1*, Revision 0, 7/5/2017
CO-2017-1106, *ATR Prescreen members' job code*, Revision 0, 6/21/2017
CO 2017-1198, *Pre Start 7.1-1 IMCL Thermal Analysis*, Revision 0, 05/31/2017
CO-2017-1323, *South Safety Rod did not insert on SCRAM*, Revision 0, 8/22/2017
CO 2017-1526, *IMCL CORR - Pre-Start Finding 8.1-1*, Revision 0, 06/30/2017
CO-2017-1624, *Failure to complete commercial grade dedication 688-M-2*, Revision 0, 10/25/2017
CO-2017-1625, *Actions to Analyze ATR Diesel Fuel not Timely*, Revision 0, 10/19/2017
CO-2017-2201, *ATR HVA-2 Confinement Breach*, Revision 0, 9/10/2017
CO-2017-2526, *Confinement Delay on DCS not set*, Revision 0, 10/25/2017
CO-2017-2766, *ATR Engineering Performance of LWP-10601, "Nuclear Facility Safety System Health Status Reporting"*, Revision 0, 11/14/2017
CO-2017-3089, *TRA-601-HVE-1 is out-of-service*, Revision 0, 2/19/2018
CO-2018-0763, *ECARs need revision*, Revision 0, 4/2/2018
CO-2018-0823, *EJ#2061 Deficiencies*, Revision 0, 4/10/2018
CO-2018-0831, *Validating Engineering Assumptions*, Revision 0, 4/11/2018
CO-2018-0832, *Safety SSC Identification on Drawings*, Revision 0, 4/11/2018
CO-2018-0833, *Engineering Annual Assessments*, Revision 0, 4/11/2018
CO-2018-0908, *Incorrect Breaker Trip Settings*, Revision 0, 4/19/2018
DCN-1701-E1-01, *IMCL – EPMA and FIB*, Revision 0, 2/8/2018
DCN-EJ2194-E1-01, *IMCL-1729 SAS Floor Sealing and Feed-Through Fire Protection and Shielding*, Revision 0, 11/13/2017
Drawing 011149, *ATR Complex Bldg 653 Maintenance Building and TRA 662 Warehouse One Line Power Diagram*, Revision 28, 7/13/2016
Drawing 156516, *ATR Canal Recycle Ion Exchange Flow Display Panel Wiring Diagram*, Revision 5, 10/19/2017
Drawing 182382, *INTEC CPP_651 One Line Diagram*, Revision 8, 6/27/2016
Drawing 335739, *ATR Reactor Top Terminal Box TBX-MS-3678*, Revision 16, 2/13/2018
Drawing 413453, *ATR AHTL Cubicle 1C-W Hanger Installation and Details (Cubicle 1C-W)*, Revision 14, 08/29/2017
Drawing 413769, *ATR AHTL Cubicle 1C-W Relief Piping First Basement Layout*, Revision 7, 08/29/2017
Drawing 418330, *ATR Electrical Distribution Lighting Panels*, Revision 58, 10/19/2017
Drawing 445223, *ATR Complex Bldg 653 Maintenance Shop Electrical Panel Schedules*, Revision 10, 11/4/2015

Drawing 514815, *TRA Electrical Utility Upgrade Project DWP #3 Wiring and Schematic Diagrams*, Revision 5, 8/15/2017

Drawing 523645, *INEEL TRA Upgrade 786-MS-1,3 Control Diagram*, Revision 15, 3/6/2018

Drawing 523648, *INEEL TRA Upgrade 786-MS-1,3 Wiring Diagram*, Revision 11, 3/6/2018

Drawing 523649, *INEEL TRA Upgrade 786-MS-1,3 Wiring Diagram*, Revision 10, 8/15/2017

Drawing 600269, *ATR Hydraulic Shuttle Irradiation System P&ID*, Revision 7, 08/23/2016

Drawing 602266, *ATR Capsule Distributed Control System Remote Processing Unit Cabinet 6 Wiring Diagram*, Revision 12, 2/13/2018

Drawing 604207, *ATR Complex Bldg 653 Maintenance shop Electrical Panel Schedules Ripout and install*, Revision 0, 12/11/2012

Drawing 605389, *ATR Complex TRA-653 Maintenance Building 653-M-255 Air Compressor Install INL Site Map, ATR Complex Area Map and Drawing Index*, Revision 0, 12/16/2015

Drawing 605397, *ATR Complex TRA-653 Maintenance Building 653-M-255 Air Compressor Install Electrical Power Ripout and Install*, Revision 0, 12/16/2015

Drawing 605398, *ATR Complex TRA-653 Maintenance Building 653-M-255 Air Compressor Install Electrical Power Schematic*, Revision 0, 12/16/2015

Drawing 605432, *ATR Capsule Distribution Control System Remote Processing Unit Cabinet 6 wiring Diagram Interim Install*, Revision 2, 2/13/2018

Drawing 605434, *ATR AGR-5/6/7 Experiment Wireway & Conduit Routing Plan Install*, Revision 2, 2/13/2018

Drawing 605435, *ATR AGR 5/6/7 Test Leadout Cable (TLOC) AGR-TC-1/2 Assembly and Detail*, Revision 2, 3/2/2017

Drawing 605436, *ATR AGR 5/6/7 Test Extension Cable (TEC) AGR-TC3-18 Assembly and Detail*, Revision 3, 3/2/2017

Drawing 605437, *ATR AGR 5/6/7 Test Extension Cable (TEC) AGR-TC-19 Assembly and Detail*, Revision 1, 12/7/2016

Drawing 605438, *ATR AGR 5/6/7 Supplemental Instrumentation Cable Assembly & Detail*, Revision 1, 12/7/2016

Drawing 605637, *ATR IC-W Safety Relief Valve and Spool Piece Replacement Project Installation, Assembly and Details*, Revision 1, 08/09/2017

Drawing 605801, *ATR AGR 5/6/7 Supplemental Instrumentation Cabinet Assembly*, Revision 1, 2/3/2018

Drawing 605802, *ATR AGR 5/6/7 Supplemental Instrumentation Cabinet Wiring Diagram*, Revision 1, 2/3/2018

Drawing 605809, *ATR AGR 5/6/7 Test Leadout Cable (TLOC) AGR-TC-3/18 and AGR_TC_19 Assembly and Detail*, Revision 0, 3/8/2017

Drawing 605810, *ATR AGR 5/6/7 MPFD Cable Assembly & Detail*, Revision 2, 2/13/2018

Drawing 628256, *ATR Reactor Top Terminal Box TBX-MS-3678 Assemblies & Detail*, Revision 3, 2/13/2018

Drawing 602269, *ATR AGR Test Extension Cable (TEC) Assembly and Details*, Revision 0, 5/4/2011

Drawing 604681, *ATR AGR 5/6/7 Thermocouple and Fuel Compact Summary*, Revision 0, 4/14/2016

Drawing 630331, *RTC Deep Well #3 786-E-13 Panel Schedule*, Revision 4, 8/15/2017

Drawing 688810, *MFC-775 Zero Power Physics Reactor (ZPPR) Criticality Monitors KI Relay Panel, Aux. Relay Box, CAS-RBX-111, CAS-RBX-106 & CAS-RBX-105 Control Diagram*, Revision 15, 1/16/2018

Drawing 742027, *MFC-786 HFEF 480V Substation Normal Power Substation and Switchgear Layout and One Line Diagram*, Revision 9, 11/4/2013

Drawing 742027, *MFC-786 HFEF 480V Substation Normal Power Substation and Switchgear Layout and One Line Diagram*, Revision 10, 11/2/2014

Drawing 742027, *MFC-786 HFEF 480V Substation Normal Power Substation and Switchgear Layout and One Line Diagram*, Revision 11, 1/8/2015

Drawing 742027, *MFC-786 HFEF 480V Substation Normal Power Substation and Switchgear Layout*

and One Line Diagram, Revision 12, 11/2/2015
 Drawing 742027, *MFC-786 HFEF 480V Substation Normal Power Substation and Switchgear Layout and One Line Diagram, Revision 13, 5/3/2017*
 Drawing 746394, *MFC-704 Fuel Manufacturing Facility (FMF) Suspect Exhaust System Process and Instrumentation Diagram, Revision 11, 11/30/2017*
 Drawing 750757, *MFC-704 Fuel Manufacturing Facility (FMF) Argon Supply System Process and Instrumentation Diagram, Revision 10, 6/1/2017*
 Drawing 766311, *HFEF Bldg 786 480V Switchgear Substation 3-Line Diagram, Revision 9, 5/16/2012*
 Drawing 770868, *MFC-7076 Fire Pump House Process and Instrumentation Diagram, Revision 4, 5/8/2017*
 Drawing 774054, *Lighting Standard Work Stations Layout, Revision 0, 9/4/1970*
 Drawing 775801, *MFC 775 Clamshell Overpack, Overpack Assembly, Revision 4, 11/16/2016*
 Drawing 775802, *MFC 775 Clamshell Overpack, Body Weldment, Revision 4, 3/1/2017*
 Drawing 775803, *MFC 775 Clamshell Overpack, Gasket, Revision 2, 4/26/2016*
 Drawing 7758041, *MFC 775 Clamshell Overpack, Lid, Revision 3, 11/16/2016*
 Drawing 778053, *Generic Glovebox Alpha Smear Counting Station Alpha Monitor Window and Plug Assemblies, Revision 1, 2/4/2013*
 Drawing 779522, *Generic Glovebox Alpha Smear Counting Station Installation, Revision 2, 9/10/2014*
 Drawing 779262, *Hot Fuel Examination Facility (HFEF) Sealed Slave Repair Glovebox Trolley Assembly, Revision 1, 10/6/2012*
 Drawing 780565, *MFC-775 ZPPR Glovebox Facility Modifications Floor Plan, Revision 0, 12/18/2012*
 Drawing 780566, *MFC-775 ZPPR Glovebox Facility Modifications Section and Detail, Revision 0, 12/18/2012*
 Drawing 783749, *IMCL Shield Container, Container, Stand and Cart Drawing Tree, Revision 0, 3/30/2017*
 Drawing 784775, *MFC-794 Experimental Fuels Facility (EFF) Air System Process and Instrument Diagram, Revision 5, 1/18/2018*
 Drawing 784776, *MFC-794 Experimental Fuels Facility (EFF) Eastside Heating and Ventilation Process and Instrumentation Diagram, Revision 3, 2/14/2018*
 Drawing 784777, *MFC-794 Experimental Fuels Facility (EFF) Gas Distribution System Process and Instrument Diagram, Revision 8, 3/5/2018*
 Drawing 784999, *MFC 1729 EPMA Shield Walls Cable Shield Assembly, Revision 0, 12/15/2016*
 Drawing 785002, *MFC 1720 EPMA Shield Walls Lip, Revision 0, 12/15/2016*
 Drawing 785554, *MFC-775, MFC-776 and MFC-777 ZPPR Complex Building Air Supply Process and Instrument Diagram, Revision 1, 06/02/2016*
 Drawing 785555, *MFC-775, MFC-776 and MFC-777 ZPPR Complex Suspect Exhaust Process and Instrument Diagram, Revision 2, 11/22/2016*
 Drawing 787315, *INTEC CPP-651 Overcurrent Protection for XFR-YDC-232 One Line Diagram Ripout and Installation, Revision 1, 6/27/2016*
 Drawing 789152, *MFC-776 ZPPR Reactor Cell GGE Glovebox Partial Floor Plan and Photos – Ripout, Revision 0, 7/7/2015*
 Drawing 790284, *MFC-785 HFEF Window 5M Lighting, Power and Communication 8.1016 Feed-Thru Installation, Revision 0, 4/29/2015*
 Drawing 790285, *MFC-785 HFEF Window 5M Lighting, Power and Communication 8.1016 Feed-Thru Flow Diagram, Revision 2, 4/18/2017*
 Drawing 790287, *MFC-785 HFEF Window 5M Lighting, Power and Communication 8.1016 Feed-Thru Assembly and Wiring Diagram, Revision 1, 4/1/2015*
 Drawing 790288, *MFC-785 HFEF Window 5M Lighting, Power and Communication JBX-199 Breakout Box Assembly and Wiring Diagram, Revision 1, 4/18/2017*
 Drawing 790289, *MFC-785 HFEF Window 5M Lighting, Power and Communication JBX-200 Breakout Box Assembly and Wiring Diagram, Revision 1, 4/18/2017*

Drawing 790290, *MFC-785 HFEF Window 5M Lighting, Power and Communication 8.1016 Feed-Thru Cable Wiring Diagrams*, Revision 0, 4/29/2015

Drawing 792341, *MFC-785 AFC Met Mount Gauge Assembly*, Revision 0, 10/2/2017

Drawing 793903, *MFC-1729 Fire Alarm System Shielded Sample Preparation Area (SSPA) Floor Plan*, Revision 1, 10/29/2015

Drawing 793904, *MFC-1729 Fire Alarm System Shielded Sample Preparation Area (SSPA) Plan View*, Revision 1, 10/29/2015

Drawing 793905, *MFC-1729 Fire Alarm System Shielded Sample Preparation Area (SSPA) Wiring Diagram*, Revision 1, 10/29/2015

Drawing 798202, *MFC-1740, 1740A MFC Fire Water Tank and Pump House Project Control and Instrumentation Diagram*, Revision 0, 4/20/2017

Drawing 798696, *MFC-785 NRAD Universal Fixturing Fork Assembly*, Revision 1, 1/11/2017

Drawing 798697, *MFC-785 PGS ATF-1 Capsule/Rodlet Holders Assemblies*, Revision 1, 7/25/2017

Drawing 799374, *MFC-785 NRAD ATF-1 Capsule Holder Assembly*, Revision 0, 7/26/2016

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Interviews

Facility & System Engineering Manager MFC
 Design Engineering & Drafting Manager MFC
 Drafting Supervisor MFC
 Engineering Director MFC
 Engineering Management Systems Lead, Facility Services
 Plant and Project Engineering Division Director ATR
 Facility Design & Project Engineering Manager, Facility Services
 Engineering Analysis Manager, Facility Services
 Drafting Supervisor, Facility Services
 Performance Assessment Specialist MFC
 Configuration Management Engineer ATR

Nuclear Safety Program Lead
Nuclear Assurance Lead
Operations Division Director ATR
Nuclear Remote Systems Manager MFC
Nuclear Safety Manger MFC
Nuclear Acquisition Manager MFC
Design Engineer ATR
Design and Project Engineering Manager ATR
Performance Assurance Lead ATR
Quality Assurance Manager ATR
Management and Independent Assessment Lead
Cognizant Engineer ATR
Experiment Engineer ATR

Observations

Tour of Hot Fuel Examination Facility
Tour of Irradiated Materials Characterization Laboratory

Appendix C Deficiencies

Deficiencies that did not meet the criteria for a finding are listed below, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

- Contrary to the requirements of 10 CFR 830.122, the calculation process does not include provisions for tracking and closure of open items such as unverified assumptions. BEA generated condition report CO-2018-0831, *Validating Engineering Assumptions*, to document and resolve this issue.
- Contrary to the requirements of 10 CFR 830.203, the BEA USQ process, as described in LWP-10800 and LWP-10801, does not adequately address the screening or evaluation of design change packages that will be implemented in phases or elements with intermediate return to service.
- Contrary to the requirements of 10 CFR 830.122 and NQA-1-2008, Requirement 3, part 601.3, two examples were noted (ECAR-2374 and ECAR-2461) where calculations were not updated to reflect current design and as-built configuration, resulting in inconsistent design documentation and challenging CM.
- Contrary to the requirements of 10 CFR 830.203 and SD-11.1.46, EJ 7.0-11 had a less than adequate USQ screening performed. Specifically, the USQ for EJ 7.0-11 did not address conditions caused by phased installation, including breach of a confinement barrier and the potential for un-evaluated seismic interactions due to incomplete anchorage of steel columns.
- Contrary to the requirements of NQA-1-2008, Requirement 3, part 600, no technical justification was provided for EJ 7.9.2-28 addressing the weight differential introduced by the insulation replacement and its impact on piping qualification or stress analysis margins, including potential impact to safety-related piping and supports.
- Contrary to the requirements of LWP-10501, no USQ screening/evaluation was performed for EJ 7.9.2-28.
- Contrary to the requirements of LWP-10501 and LWP-10500, the implementation of EJs 1793, 1812, 1813, and 1971 caused several discrepancies in breaker settings, lowering the effectiveness of the ground fault trip device. These discrepancies impeded the CM process. BEA initiated corrective action CO-2018-0908, *Incorrect Breaker Trip Settings*, to address this issue.
- Assessments of the CM process are not performed periodically as required by DOE STD-1073-2003.
- Contrary to the requirements of 10 CFR 830.122, BEA does not have an assessment program to gauge engineering performance on a regular basis. BEA generated condition report CO-2018-0833, *Engineering Annual Assessments*, to document and resolve this issue.