Independent Assessment of Nuclear Criticality Safety at the Pacific Northwest National Laboratory

May 2025

U.S. DEPARTMENT of ENERGY | Office of Enterprise Assessments

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Acronyms

325RPL	Building 325 Radiochemical Processing Laboratory
ANSI/ANS	American National Standards Institute/American Nuclear Society
BED	Building Emergency Director
BERO	Building Emergency Response Organization
BMI	Battelle Memorial Institute
CAS	Criticality Alarm System
CRAD	Criteria and Review Approach Document
CSCA	Criticality Safety Control Area
CSD	Criticality Safety Determination
CSE	Criticality Safety Engineer
CSE-A	Criticality Safety Engineer-Analyst
CSE-R	Criticality Safety Engineer-Representative
CSS	Criticality Safety Specification
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
EOC	Emergency Operations Center
EOS	Emergency Operations System
ERO	Emergency Response Organization
FM	Fissionable Material
FMH	Fissionable Material Handler
FMLM	Fissionable Material Line Manager
FMS	Fissionable Material Supervisor
HDI	How Do I?
ICP	Incident Command Post
ICS	Important to Criticality Safety
ITS	Issues Tracking System
MEL	Master Equipment List
MSG	Management Support Group
NCS	Nuclear Criticality Safety
NCSE	Nuclear Criticality Safety Evaluation
NCSP	Nuclear Criticality Safety Program
NDA	Non-destructive Assay
OFI	Opportunity for Improvement
PNNL	Pacific Northwest National Laboratory
PNSO	Pacific Northwest Site Office
POC	Patrol Operations Center
RMT	Radioactive Material Tracking
SED	Site Emergency Director
SFO	Shielded Facilities Operations
SME	Subject Matter Expert
SOC	Security Operations Center
SS	Safety Significant
SSCs	Structures, Systems, and Components

INDEPENDENT ASSESSMENT OF NUCLEAR CRITICALITY SAFETY AT THE PACIFIC NORTHWEST NATIONAL LABORATORY

Executive Summary

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an independent assessment of the effectiveness of nuclear criticality safety (NCS) program (NCSP) performance at the Pacific Northwest National Laboratory (PNNL), which is managed and operated for the DOE Pacific Northwest Site Office (PNSO) by Battelle Memorial Institute (BMI). The assessment also evaluated the effectiveness of PNSO oversight of BMI's NCSP. The assessment was performed in February and March 2025.

EA identified the following strengths, including three best practices:

- BMI's NCS staff hosts a periodic forum to address important criticality safety topics, including DOE lessons learned, with fissionable material handlers (operators), affording opportunities for open information sharing on criticality safety control improvements at the individual contributor level. (Best Practice)
- BMI's criticality safety-specific tabletop exercises effectively train operations, NCS staff, and management on how to respond to unexpected conditions that could occur. (Best Practice)
- BMI assembles "go-bags" for building emergency directors with essential policies, procedures, checklists, and supplies for responding to emergencies. These resources facilitate quickly standing up the incident response and provide prompt directions and guidance with muster area signage and boxes with vests, checklists, supplies, accountability references, and more. (Best Practice)
- The BMI NCSP is generally robust, well understood by affected personnel, and adequately managed, with a culture of continuous improvement and conservative decision-making.

EA also identified several weaknesses, as summarized below:

- Numerous instances were identified where program documents conflicted or did not appropriately flow higher-level requirements into implementation documents.
- Items important to criticality safety are not always appropriately identified and managed through configuration management processes.
- BMI did not demonstrate an effective response to a simulated criticality emergency.
- PNSO oversight procedures are out of date and, as a result, are not being implemented as written to provide required oversight of BMI's implementation of the NCSP. Also, the current practice of expert-based oversight performed outside of documented processes could be affected by personnel turnover.

In summary, BMI implements an NCSP at PNNL, with oversight by PNSO, that appropriately supports the analysis of proposed work activities involving fissionable material (FM), the derivation and documentation of criticality safety controls, and the implementation of derived controls through operating documents to prevent a criticality accident in operations with FM. Interviews established evidence of an open and collaborative work environment between NCS staff and FM workers. However, several conflicts were identified in implementing documents that could adversely impact program performance. Additionally, while strengths were identified in the emergency response program for responding to a criticality accident, BMI did not effectively demonstrate implementation of that program during an emergency drill. Until the concerns identified in this report are addressed, elevated risk remains that an NCSP deviation could occur, or that the response to an event could be unsuccessful at minimizing adverse consequences.

INDEPENDENT ASSESSMENT OF NUCLEAR CRITICALITY SAFETY AT THE PACIFIC NORTHWEST 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), conducted an assessment of the effectiveness of nuclear criticality safety (NCS) program (NCSP) performance at the Pacific Northwest National Laboratory (PNNL), which is managed and operated by Battelle Memorial Institute (BMI) for the DOE Pacific Northwest Site Office (PNSO). The assessment was conducted in February and March 2025.

Scientists at PNNL conduct research in diverse areas that include chemistry, computing, energy systems, and materials, in addition to their continuing contributions to national security. To support operations and research efforts, a graded approach to the application of criticality safety controls is based on facility designations for facilities in which fissionable material (FM) is stored, handled, or processed. There are currently four facility designations for the purposes of the NCSP,[1] of which an FM Facility is the only type with a credible criticality accident. The only FM Facility at PNNL is the Building 325 Radiochemical Processing Laboratory (325RPL), a hazard category 2 nuclear facility.

Consistent with the *Plan for the Independent Assessment of Criticality Safety at the Pacific Northwest National Laboratory, February 2025*, this assessment evaluated the effectiveness of BMI's implementation of criticality safety requirements, including emergency planning for a criticality event. The assessment reviewed laboratory-wide NCSP implementation, with performance-based observations focused on the 325RPL. This assessment also evaluated the effectiveness of PNSO oversight of BMI's NCSP.

2.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*, which EA implements 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 criticality safety, including response in the event of a criticality emergency. Criteria that guided this assessment are described in EA CRAD 31-30, Revision 4, *Criticality Safety Program and Criticality Safety Controls Implementation*,

[1] PNNL has four facility designations for the purposes of the NCSP, as defined in PNNL-MA-250, *PNNL Nuclear Criticality Safety Program*:

	Fissionable Material (FM) Facility	Isolated Facility	Limited Control Isolated Facility	Other Facility
Quantity of single parameter limit (SPL) listed in ANSI/ANS-8.1 and -8.15	≥ Small Quantity (≥ 3% of SPL)	> 50%	≤ 50% and > 3% (small quantity)	≤ 3% (small quantity)
Nuclear Criticality Safety Evaluation (NCSE)/Criticality Safety Specification (CSS) required?	Yes	Yes	No	No
Criticality credible?	Credible	Not credible		

along with selected objectives and criteria from EA CRAD 33-09, Revision 0, *DOE O 151.1D Emergency Management Program*. EA also used elements of EA CRAD 30-07, Revision 0, *Federal Line Management Oversight Processes*, to evaluate PNSO oversight activities related to criticality safety.

EA examined key documents, such as nuclear criticality safety evaluations (NCSEs), criticality safety specifications (CSSs), system descriptions, work packages, procedures, manuals, analyses, policies, and training and qualification records. EA also interviewed key personnel responsible for developing and executing the associated programs; observed activities requiring criticality safety controls; observed a criticality nonconformance tabletop; and walked down significant portions of the 325RPL, focusing on NCSP implementation. Additionally, to evaluate emergency response capabilities following a criticality event, EA reviewed a limited-scope criticality drill that was performed by BMI at the 325RPL. The members of the assessment team, the Quality Review Board, and the 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 Nuclear Criticality Safety Program

This portion of the assessment evaluated the effectiveness of the BMI NCSP and associated processes, including policy and procedures; staffing, training, and qualification; issues management; and monitoring, assessments, and performance metrics.

Nuclear Criticality Safety Program Policy and Procedures

BMI has established an NCSP that, in general, adequately meets the requirements of applicable DOE orders and standards, particularly DOE Order 420.1C, *Facility Safety*, and the American National Standards Institute/American Nuclear Society (ANSI/ANS)-8 series of industry standards. The NCSP is adequately described in NCS-PD, *Nuclear Criticality Safety Program Description*, and further detailed in PNNL-MA-250, *PNNL Nuclear Criticality Safety Program*. These documents work together to define the basic elements of the NCSP, including roles and responsibilities of personnel who participate in the NCSP, NCSP monitoring and assessments, criticality safety engineer-analyst (CSE-A) and criticality safety engineer-representative (CSE-R) training and qualification, NCSEs, implementation of criticality safety controls, accumulation considerations, criticality accident alarm and response, and criticality safety nonconformances. Additionally, PNNL-MA-250, appendix E, provides a detailed crosswalk to demonstrate how BMI satisfies the individual requirements of the ANSI/ANS-8 series standards. The current version of NCS-PD was submitted to and approved by the DOE Head of Field Element as required by DOE Order 420.1C. (See also discussion in section 3.5 of this report.)

BMI has recently enhanced the effectiveness of the site Nuclear Criticality Safety Committee (NCSC) as described in NCS-PD and detailed in recently updated NCS-PLAN-008, *PNNL Nuclear and Criticality Safety Committee Charter*. During interviews, NCSC members noted that the NCSC had been underutilized in recent years and explained how the committee now meets the components of the updated charter as another means of ensuring the quality and health of the NCSP.

While BMI has established a generally adequate NCSP, the following weaknesses were identified:

- Contrary to DOE Order 420.1C, attachment 2, chapter III, section 3.b, BMI has not fully specified that the process for satisfying ANSI/ANS-8.1-2014, *Nuclear Criticality Safety in Operations with*

Fissionable Materials Outside Reactors, section 4.1.6, is required for Isolated Facilities. (See **Deficiency D-BMI-1**.) Incomplete flowdown of requirements to NCSP procedures could increase the likelihood of an unanalyzed condition through process drift or unidentified nonconformances. Specifically, in conflict with sections 2.2 and 8.2 of NCS-PD, NCS-ADM-002, *Nuclear & Criticality Safety Program Monitoring and Assessments*, does not require annual operational reviews of Isolated Facilities with NCSEs. These operational reviews have been completed for the last several years as a good practice despite not being required procedurally.

- In several instances, the PNNL-MA-250 crosswalk matrix of applicable DOE requirements identifies the manual itself as the implementing document and does not identify how specific requirements are proceduralized. In other instances, the listed documents are not inclusive of all implementing documents or were not relevant to the associated requirement. (See **OFI-BMI-1**.) Despite this inadequate documentation, EA did not identify any instances where the underlying requirements were not being met in the NCSP.
- PNNL-MA-250, the sole implementing document for several ANSI/ANS-8 series responsibilities assigned to NCS staff, is very large and covers a wide range of topics in detail. Some interviewees stated that they do not reference the document often, and one CSE-R was not able to describe the types of concerns that CSE-Rs look for when conducting required Lab Assist (BMI's online laboratory work planning and control software application) work control reviews. (See **OFI-BMI-2**.)

Staffing, Training, and Qualification

BMI has adequately established training and qualification programs for criticality safety engineers (CSEs) and senior CSEs. NCS-PD appropriately invokes ANSI/ANS-8.26-2007, *Criticality Safety Engineer Training and Qualification Program*, as the requirements basis for the qualification program documented in PNNL-MA-250. PNNL qualification cards Course 2920, *Criticality Safety Engineer-Analyst (CSE-A) Qualification*, and Course 2921, *Criticality Safety Engineer-Representative (CSE-R) Qualification*, lay out the requirements of each position. Roles and responsibilities are documented in NCS-PD and PNNL-MA-250. The purpose and function of the CSE-A position are clearly described, including how it differs from the purpose and function of the CSE-R position. In calendar year 2025, BMI achieved full NCS staffing, and many of the interviewed personnel stated that NCS staffing levels are adequate to meet their needs.

In support of continuous improvement and cross-organizational alignment, NCS personnel host a periodic forum to discuss important criticality safety topics with fissionable material handlers (FMHs) and separately with line management. The creation of the FMH/NCS forum, which occurred twice in 2024, has been an innovative practice. PNNL-MA-250 requires the forum to be held at least annually. The forum is used for CSE-Rs to confirm that FMHs know their responsibilities regarding criticality safety and understand that those responsibilities come from NCS policy. The forum is considered a **Best Practice** because it aptly includes DOE lessons learned, provides information sharing, and seeks feedback on criticality safety control improvements, offering CSE-Rs time to get open and honest FMH feedback separate from fissionable material supervisors (FMSs) and fissionable material line managers (FMLMs).

Additionally, BMI has established an adequate criticality safety training program for personnel who work in areas where controls are instituted to ensure criticality safety. Reviewed course content appropriately incorporated the required training elements defined in ANSI/ANS-8.20-1991, *Nuclear Criticality Safety Training*, section 7. General and facility-specific training is provided as lectures and/or videos. Training was appropriately assigned to relevant job positions (i.e., operators, FMSs, FMHs, and engineers). Interviewed FMHs and FMSs demonstrated an understanding of criticality safety terminology and controls. Reviewed training system records showed that FMSs were current in their qualification cards, and that they and FMLMs, except for one, were current in their criticality safety training for Isolated Facilities and Limited Control Isolated Facilities. During the period that the one FMLM was overdue for

training, he did not perform FMLM duties, such as FMLM checklists, nor was he assigned to be the FMLM for Isolated Facilities/Limited Control Isolated Facilities. The training organization has a dedicated nuclear training specialist, with whom many interviewees were familiar. NCS personnel are appropriately included in the review and approval process for training content. Additionally, NCS personnel are often present during criticality safety instructor-led courses to provide feedback and answer questions as needed. Training tasks and requalification are appropriately managed in a dedicated tracking system that interfaces with the Lab Assist software.

While training and qualification programs for CSEs and senior CSEs are adequate, interviews with NCS personnel revealed that program budgetary restrictions could prevent CSE-As from taking the required offsite training in a timely manner. As a result, qualifications may be delayed or alternative training sought out. This training is required by ANSI/ANS-8.26-2007, section 7.4.

Issues Management

BMI effectively managed the reviewed criticality safety-related issues and associated corrective actions. Issues management requirements at PNNL are communicated through multiple sources, including but not limited to IM-05, *Event Categorization and Notification Procedure*; OSD-001-05, *OSD Issue and Corrective Action Management*; NCS-ADM-001, *Nuclear and Criticality Safety Concerns and Issues*; and several "How Do I?" (HDI) workflows.[2] The issues management program includes appropriate processes for managing and tracking issues that were identified during events, assessments, self-evaluations, or other reviews of project or functional activities and corresponding corrective actions, if applicable.

The Issues Tracking System (ITS) and Optional Tracking System (OTS) effectively track issues and resultant actions to closure. However, these laboratory-wide tools lack the level of detail and granularity that NCS management desires for improved tracking and trending. As a result, with the help of a member of the Performance Assurance team, BMI is working on developing an additional metrics dashboard for management use. NCS appropriately tracks and trends non-conformances under a recently established metric and documents results in monthly reports, which are shared with PNSO. Criticality safety-related issues and their associated actions are tracked and discussed during a weekly management meeting.

In general, the NCSP adequately ensures that non-conformances are managed in accordance with NCSP requirements. ADM-RPL-715, *General Fissionable Materials Controls for Controlled Areas*, adequately provides for compensatory measures to be taken, including notifications to CSE-Rs. IM-05 appropriately implements DOE Order 232.2A, *Occurrence Reporting and Processing of Operations Information*, for non-conformances rising to the occurrence reporting level. Nuclear and criticality safety problem reports (NCSPRs) are used to document criticality safety-related issues, and all such events are appropriately required to be populated in ITS. Eight reviewed non-conformances were confirmed to be entered into the NCSPR system in accordance with NCS-ADM-001 and into ITS for corrective action tracking and trending. Reviewed NCSPRs appropriately categorized criticality safety-related concerns, identified proper immediate actions commensurate with the issue significance, and included an appropriate level of detail for tracking and trending.

While the NCSP generally ensures that non-conformances are managed and communicated adequately, the following opportunities for improvement were identified:

- Reviewed NCS metrics did not identify the source or organizational role of criticality safety non-conformances; tracking who identifies adverse conditions can provide an indicator of positive questioning attitude and the openness of organizations to self-reporting. (See **OFI-BMI-3**.)

[2] HDI workflows are procedure-equivalent web-based work control references maintained on the PNNL intranet.

- The NCS group does not always notify 325RPL Facility Management when investigating potential non-conformances or other criticality safety-related issues to provide Facility Management the opportunity to promptly take any needed actions. (See **OFI-BMI-4**.)

Monitoring, Assessments, and Performance Metrics

NCS metrics have been adequately developed and monitored by NCS management based on program health, risks, accomplishments, and recent issues. Metric data is communicated and reviewed triennially via extent of deployment (EOD) reports. The most recent EOD report provided thorough status updates on staffing, assessment planning, completion, and results, and analyses on key performance areas. For example, the EOD report stated that "vacancies in critical positions have introduced operational and productivity risks." A staffing plan was subsequently established and approved, and at the time of the assessment, NCS had achieved full staffing.

The BMI NCS assessment program is consistent with the requirements of ANSI/ANS-8.19-2014, *Administrative Practices for Nuclear Criticality Safety*. The NCS assessment program is governed by PNNL-MA-250; NCS-ADM-002; and NUC-PLAN-002, *Nuclear Operations and Facility Safety Program Assessment Plan*. These documents adequately define the overall assessment program, including the roles and responsibilities of NCSP participants, types of assessments performed, format, required content, and periodicity. The NCSP assessment program is well documented and comprehensive. The program includes operations surveillances and observations, NCS operational reviews, the NCS annual operational assessment, an annual emergency response training review, and a set of NCSP effectiveness assessments that cumulatively cover the entirety of the NCSP every three years. Additionally, NCSEs are reviewed triennially to determine their continued applicability and validity. A criticality alarm system (CAS) needs assessment and non-destructive assay (NDA) assessment related to inadvertent accumulation are conducted triennially as well. Reviewed assessments were adequately performed in accordance with procedures, were thorough in documenting issues and opportunities for improvement, and are being appropriately tracked in the applicable tracking system.

Nuclear Criticality Safety Program Conclusions

BMI has established an adequate NCSP and supporting processes that are generally compliant with applicable DOE requirements and invoked standards. As evidenced through interviews and observations, BMI demonstrated the NCSP culture to be one of continuous improvement and conservative decision-making. The NCSP is committed to several ongoing improvements, including to culture and conduct of operations rigor. The FMH/NCS forum was identified as a best practice. The BMI NCSP is generally robust, well understood by affected personnel, and adequately managed. However, a weakness was identified related to the incomplete implementation of ANSI/ANS-8.1-2014, section 4.1.6.

3.2 Nuclear Criticality Safety Evaluations

This portion of the assessment evaluated the effectiveness of the BMI NCSP to develop NCSEs such that FM processes will remain subcritical under normal and credible abnormal conditions, including those initiated by design basis events.

Evaluation

BMI has established and implemented an adequate approach to developing NCSEs. NCS-PD and PNNL-MA-250 adequately implement DOE Order 420.1C, attachment 2, chapter III, section 3.d, for developing NCSEs. NCS-PD applies appropriate standards, including the applicable ANSI/ANS-8 series standards and DOE-STD-3007-2017, *Preparing Criticality Safety Evaluations at Department of Energy Nonreactor*

Nuclear Facilities, to develop NCSEs. Process hazards analyses and criticality control strategies are developed in cooperation with 325RPL Research staff. A hazards analysis was appropriately performed in accordance with PSB-003, *Process Hazards Analysis*, to address standard criticality control parameters (e.g., mass, enrichment, reflection, moderation).

Furthermore, reviewed NCSEs adequately demonstrated sound engineering/scientific principles (e.g., defense in depth, conservative design margins, human factors engineering). Ten reviewed NCSEs, in general, adequately documented the process analyses in accordance with DOE-STD-3007-2017, section 3.4, and ADM-NOD-612, *Nuclear Criticality Safety Evaluation Documentation and Review*. Each of the reviewed NCSEs appropriately referenced the respective computer code validation reports, NOD-RPT-004, *Validation of the CSAS5 Module of SCALE 6.2.3 for Criticality Calculations at the Pacific Northwest National Laboratory*, or NCS-RPT-010, *Validation of MCNP6.2 for Criticality Calculations at the Pacific Northwest National Laboratory*. The validation reports were developed in accordance with ANSI/ANS-8.24-2017, *Validation of Neutron Transport Methods for Nuclear Criticality Safety Calculations* and were appropriately used by NCS staff to establish the safe subcritical limits in the NCSE. The reviewed NCSEs modeled bounding process conditions, which conservatively included moderators and reflectors that are more effective than water. However, one reviewed NCSE did not include controls protecting all assumptions; see further discussion in section 3.3 of this report.

Controls

Criticality safety controls were, in general, adequately derived and documented in the reviewed NCSEs. Procedures PNNL-MA-250; ADM-NOD-612; and ADM-614, *Development of Criticality Safety Specifications*, adequately implement ANSI/ANS-8.1-2014, sections 4.1.3 and 4.1.4, and ANSI/ANS-8.19-2014, sections 7.2, 7.3, 8.5.2, and 8.5.4. Most reviewed NCSE summaries of criticality safety controls and assumptions were adequately documented in accordance with ADM-NOD-612 and DOE-STD-3007-2017, section 3.6.

Double Contingency Principle

NCS-PD appropriately addresses (by requiring) the ANSI/ANS-8.1-2014, section 4.2.2, recommendation: "Process designs should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible." The 10 reviewed NCSEs adequately demonstrated in the hazards analysis section that the double contingency principle was appropriately applied. However, contrary to ADM-NOD-612, appendix A, some reviewed NCSE sections did not address minimum content to be documented (e.g., some summary and conclusions sections did not discuss application of the double contingency principle). (See **Deficiency D-BMI-2**.) Not including all required content in an NCSE could hinder a reviewer's ability to independently assess the adequacy and accuracy of the evaluation, as well as lessen an FMS's understanding of aspects of criticality safety relevant to operations and processes under their control.

Verification of Operations

BMI appropriately verifies criticality safety before conducting operations through NCS staff involvement, pre-job briefings, and tabletop exercises. PNNL-MA-250 appropriately requires NCS staff to screen new operations or changes to operations against existing NCSEs, in accordance with DOE Order 420.1C, attachment 2, chapter III, section 3.d. Further, PNNL-MA-250 appropriately requires NCS staff members to support the FMS in conducting initial and periodic job-specific briefings. These briefings confirm that the FMS's personnel are trained, understand operating documents, and are knowledgeable of safety considerations such that they can perform their functions without undue risk. Interviews with Shielded Facility Operations (SFO) staff confirm this support function.

Furthermore, ADM-RPL-905, *325RPL Training Plan*, appendix D, establishes criticality safety-specific tabletop exercises, which are considered a **Best Practice** because they effectively train operations, NCS staff, and management on how to respond to unexpected conditions/criticality safety upset scenarios that could occur at PNNL facilities. CSE-As, CSE-Rs, and management were observed to participate in these exercises. ADM-RPL-905 was under revision at the time of the assessment to further enhance these tabletop exercises.

Preparing and Modifying Nuclear Criticality Safety Evaluations

The NCSP appropriately requires the preparation of NCSEs in accordance with DOE-STD-3007-2017 or by other documented methods approved by the DOE Head of Field Element. Although NCSEs are appropriately developed and control derivation is adequate, ADM-908, *Nuclear Criticality Safety Technical Reports*, and PNNL-MA-250 have conflicting requirements for generating criticality safety determinations (CSDs). Consequently, contrary to DOE-STD-3007-2017, section 3.5, and ANSI/ANS-8.19-2014, sections 6.8 and 8.6, BMI does not define clear requirements for criticality safety control creation, revision, or deletion using CSDs, or establish requirements for periodically reviewing CSDs and the process conditions that could impact them. (See **Deficiency D-BMI-3**.) Conflicting or unclear requirements and lack of routine review could lead to inconsistencies in criticality safety control development and implementation. CSDs document clarifications/interpretation of an existing NCSE/CSS or extend the scope to include conditions associated with limited process modifications or use in a different location. CSDs are controlled by ADM-908, which provides that limits and controls not established by one or more of the NCSE/CSSs are not permitted to be added with a CSD, but modified limits and controls are permitted under select conditions without changing barriers analyzed in the NCSE. This conflicts with PNNL-MA-250 requirements, which state that new criticality safety controls that have not been established by an NCSE are not permitted to be added with a CSD. Further, the review processes of an NCSE and CSD are similar in that both require reviews by two separate CSE-As; however, the NCS group's annual operational assessments do not require review of the potential impact to CSDs (as is required for NCSEs per NCS-ADM-002, section 4.4.3), and ADM-908 does not require periodic reviews of CSDs to ensure that they remain applicable to process conditions per ANSI/ANS-8.19-2014.

Nuclear Criticality Safety Evaluations Conclusions

BMI has established and implemented an adequate approach to developing NCSEs. Reviewed NCSEs were generally compliant with the procedural requirements governing their development and derivation of controls and demonstrated that FM processes will remain subcritical under normal and credible abnormal conditions, including those initiated by design basis events. BMI's criticality safety-specific tabletop exercises simulate real-time upsets and were identified as a best practice. Reviewed validation reports and the corresponding NCSEs met ANSI/ANS-8.24-2017 requirements. However, weaknesses were identified associated with inadequate documentation of some NCSE sections, conflicting requirements for NCSEs and CSDs, and the lack of a requirement to periodically review CSDs.

3.3 Criticality Safety Control Implementation

This portion of the assessment evaluated the effectiveness of BMI's implementation of criticality safety controls in accordance with the requirements of the ANSI/ANS-8 series standards using documented and approved processes.

Management Organizational Structures and Systems

The NCSP establishes an adequate framework to ensure that criticality safety controls are implemented in an appropriate manner. PNNL-MA-250, section 2.0, table 2-1, appropriately categorizes facilities based

on FM inventory. Facility areas within the 325RPL are appropriately designated by the FM inventory as a percentage of the ANSI/ANS-8.1-2014 and ANSI/ANS-8.15-2014, *Nuclear Criticality Safety Control of Selected Actinide Nuclides*, single parameter limits (subcritical mass limits with no included margins to protect against uncertainties in process variables). BMI has implemented the radioactive material tracking (RMT) system, a safety software tool used to ensure that FM limits (established in proceduralized criticality safety controls) within these designated areas are not exceeded. An observation of RMT system implementation during an FM move confirmed that the move was not authorized until RMT inventory limit checks passed. FMHs demonstrated thorough knowledge during the preparation and performance of the observed FM move.

BMI is appropriately improving its FM inventory control program by developing a reverse inventory procedure (involving field verification of FM locations followed by a comparison against the RMT system) as a corrective action to resolve two significant loss of inventory events that occurred in October 2023 and February 2024. Interviews of FMLMs and reviewed corrective actions confirmed that implementation and sustainment of the corrective action plan from these events should adequately correct the causes of these events and minimize the risk of similar loss of inventory issues in the future.

BMI has, in general, adequately implemented NCSE controls into CSSs. ADM-614 establishes appropriate requirements for developing CSSs and defines the process for incorporating NCSE-derived criticality safety controls into the CSSs. Interviewed personnel demonstrated a thorough knowledge of the process. Four reviewed CSSs demonstrated the adequate flowdown of NCSE-derived controls.

OSD-CM-PLAN-001, *Configuration Management Plan*, appropriately defines different classification levels for structures, systems, and components (SSCs) and credited controls, including NCSE-credited engineered safety features. SSCs can be classified as safety significant (SS), important to defense in depth, important to criticality safety (ICS), industrial, or commercial. NCS-PD identifies ICS as those NCSE-identified engineered safety features not credited as SS or defense in depth but subject to configuration management.

While NCSE controls are generally adequate, the following weaknesses were identified:

- Contrary to DOE-STD-3007-2017, section 3.6, NCS-CSE-010, *Criticality Safety Evaluation for Storage of Fissionable Material in the East Storage Yard (ESY) at the Radiochemical Processing Laboratory (325RPL)*, section 6.0, does not include a control for one of the NCSE assumptions, but the control was included in CSS-325-15, *East Storage Yard (ESY) General Container Storage and Operations - 250 g Pu Equivalent*. (See **Deficiency D-BMI-4**.) Not specifying all controls in an NCSE could result in required controls not being implemented, increasing risk of an inadvertent criticality; acceptance of CSS requirements that do not align with NCSEs could lead to complacency in permitting misalignment between NCSEs and CSSs.
- Contrary to OSD-CM-PLAN-001, the classification of NCSE-credited engineered safety features is not always consistent; ICS SSCs are not all documented in the master equipment list (MEL); and the ICS list in RPL-RPT-18-013, *Identification of 325 Building Radiochemical Processing Laboratory (325RPL) Equipment Important to Criticality Safety*, appendix A, has not been maintained up to date. (See **Deficiency D-BMI-5**.) Inaccurate or incomplete documentation could result in changes being made to NCSE-credited equipment or design features without recognition of the safety impact of those changes. Specifically, the 325RPL documented safety analysis (PNNL-DSA-325, *325 Building Radiochemical Processing Laboratory Documented Safety Analysis*) appropriately classifies the CAS as SS; however, PNNL-MA-250, appendix B, identifies the CAS as ICS. Further, the interviewed configuration management subject matter expert (SME) explained that he does not use the ICS list and is not aware of the specific ICS items, even though ICS items are subject to configuration management per NCS-PD. In addition, OSD-CM-PLAN-001, table 2, states that the MEL documents

ICS SSCs, but not all ICS items were listed in the MEL (revision 12 of the MEL removed ICS discussion). The revision log for ADM-RPL-701, *Radiochemical Processing Laboratory Basic Work Control*, also showed the removal of the ICS review without explanation. Moreover, BMI self-assessment AST-03598, *2024 NCS Annual Operational Assessment*, identified several ICS items that are no longer installed due to glovebox removal.

- Annual inspections were no longer being performed for a criticality safety spacing rack, even though the rack was classified as ICS. (See **OFI-BMI-5**.) Annual inspections were not needed because NCS-CSE-004, *Floor Storage Container (FSC) in the Radiochemical Processing Laboratory (RPL) (325 Building)*, determined that a criticality due to loss of spacing was not credible.

Communication of Criticality Safety Controls

Criticality safety controls are, in general, adequately communicated to workers via training, procedures, postings, and other operator aids, as appropriate. PNNL-MA-250 appropriately requires administrative controls derived from NCSEs to be implemented through operating documents that include CSSs when the limits and controls are not complex or sequence sensitive. Technical operating procedures are developed for more complex operations when sequencing of steps is necessary. ADM-RPL-715 is appropriately required to be posted in criticality safety control areas (CSCAs). ADM-RPL-714, *Fissionable Materials Administrative Process*, properly requires FMSs to maintain postings current when operating procedures or NCSEs are revised. Required actions for staff members who manage, supervise, or work with FM were sufficiently integrated into reviewed HDI work control and operating documents. Additionally, interviews confirmed that FMLMs, FMSs, and FMHs have a good working relationship with the NCS group, promoting effective communication.

Interviews indicated that relationships between CSEs and laboratory personnel are functioning appropriately and have recently seen a marked improvement. Interviewed FMSs explained that, in the past, some CSEs were not receptive to modifying potentially operationally burdensome controls. However, CSEs are presently more willing to re-work controls. Research FMHs stated that they initiate conversations and walkdowns with FMSs and the NCS group when a control is identified as potentially burdensome. This practice demonstrates healthy improvements in the NCS group's support of effective criticality safety controls implementation.

While the communication of criticality safety controls is generally adequate, the following weaknesses were identified:

- Interviewed SFO and Research FMHs stated that they do not always check that operating documents are the current revisions per Vault (the PNNL document control system), conflicting with expectations communicated to staff from FMLMs and the SFO Manager to meet RPL-PLN-1106, *RPL Conduct of Operations Applicability Matrix*, section 3.16, paragraph 2.p, attribute (8)(d). (See **OFI-BMI-6**.)
- NCS-ADM-002 recommends but does not require that CSE-Rs validate that postings are accurate and visible, and does not mention legibility. This condition does not reflect appropriate rigor in ensuring that the ANSI/ANS-8.19-2014, section 8.5.4, requirement is met: "Where these supplements [posted criticality safety limits] are used, they shall be kept in good repair, legible, and consistent with current controls and limits." (See **OFI-BMI-7**.) One reviewed NCS operation observation (NCS-SUR-2024-008, *Operational review of various RPL CSCAs*) stated that, while not NCSP-required, all postings in visited 325RPL rooms were appropriate and well placed; no notes were made of postings being in good repair. EA observed postings during two walkdowns, all of which were in good repair and legible.

- BMI has not developed and posted a reference map of all 325RPL CSCAs. Even though the RMT contains descriptions of CSCAs, and CSCA access points are posted with pertinent information (e.g., boundary, applicable FMS, work planning and control documents, area description), no document contains a map of all designated CSCAs. (See **OFI-BMI-8**.)
- BMI does not conduct plan of the day meetings for Research FMHs and FMSs to ensure effective communication prior to starting work. (See **OFI-BMI-9**.)
- BMI has not documented the FMLM expectations for Research FMHs regarding the process of conducting like-for-like replacements. An interviewed Research FMH stated that he was permitted to perform a like-for-like equipment replacement himself, without a review, in contrast to interviewed FMLMs who stated that this practice was not permitted. (See **OFI-BMI-10**.)

Operations Reviews

BMI, in general, adequately verifies the implementation of NCSP requirements at the 325RPL. The NCS-ADM-002 review and monitoring requirements include CSE monthly and quarterly operational observations of work activities via facility walkdowns. Two reviewed BMI triennial assessments, one reviewed Idaho National Laboratory-performed independent assessment of PNNL NCSP implementation, and one reviewed CSE annual operational assessment of active operating procedures (i.e., CSSs) identified meaningful issues, that procedures are generally being followed, and that process conditions that affect applicable NCSEs have not been altered. Ten reviewed CSE monthly or quarterly observations demonstrate that the observations are being performed, including those of actual operations, within the required frequency; issues identified during these observations are being adequately addressed in a timely manner based on a lack of recurring issues or completed corrective actions noted on the observation forms. One reviewed CSE-A surveillance was performed in a detailed, high-quality manner. In addition, four reviewed FMLM checklists show that FMLM inspections are being performed per the HDI work control, *Fissionable Material*, to confirm that process and equipment controls are implemented. However, one checklist item on observation NCS-SUR-2024-015, *Operation Observation of 325RPL/HLRF/Multiple*, was not marked with a response.

Firefighting, Moderator Control Areas, and Non-destructive Assay

BMI has, in general, appropriately addressed firefighting activities through NCSEs that bound firefighting water (e.g., through analyzing more effective moderating materials) such that firefighting water is not restricted in moderator control areas. If changes in operations dictate the need for such restrictions, PNNL-MA-250, section 5.8, appropriately requires NCS staff to verify the inclusion of firefighting designations in 325RPL's pre-incident plan. AST-03245-00001, *Fire Protection Assessment Report*, shows that NCS staff has reviewed the Hanford Fire Department-maintained 2024 pre-incident plan for the 325RPL. However, NCS-PD, section 9.0, states that there are no moderator control areas at the 325RPL "with respect to firefighting activities." While current analysis indicates that firefighting activities do not need to be restricted due to moderator controls, such controls still exist. (See **OFI-BMI-11**.)

Additionally, NCS-PD, section 2.1, describes administrative control of moderators in areas where material configurations could challenge or exceed the upper subcritical limit. Contrary to DOE Order 420.1C, attachment 2, chapter III, section 3.b, BMI identified ANSI/ANS-8.22-1997, *Nuclear Criticality Safety Based on Limiting and Controlling Moderators*, as inapplicable and omitted it from its NCSP, despite having described areas and conditions where moderator control is required and implemented. However, the ANSI/ANS-8.22-1997 standard provides guidance for limitation and control of moderators, not just their exclusion, and practices for limiting and controlling moderators are included in the NCSP

(PNNL-MA-250, section 5.4). (See **Deficiency D-BMI-6**.) Not applying industry standards could lead to a less than adequate control set or not applying known industry best practices.

Finally, BMI adequately evaluates and provides controls to prevent inadvertent FM accumulation. NCS-CSE-008, *Criticality Safety Evaluation for General Chemistry Laboratories in the Radiochemical Processing Laboratory (325RPL)*, correctly determined the FM threshold quantity below which an inadvertent FM accumulation will not result in a criticality in the absence of other criticality safety controls, which the NCSP uses to define a significant quantity of FM. CDNO-21-008, *Completed Accumulation Evaluations*, demonstrates that NCS staff adequately assessed a low potential for accumulating significant quantities of FM based on a previously conducted NDA baseline survey. NCS-PLAN-007, *Nuclear Criticality Safety Program Fissionable Material NDA Plan*, provides adequate guidance on identifying areas that will undergo NDA analysis by considering risk, quantity, form, processes, and operational history. NCS-PLAN-007 appropriately recommended that an accumulation assessment with associated NDA measurements be performed at least every three years beginning in fiscal year 2024 to ensure that operations generating inadvertent FM accumulation are properly tracked and controlled. The most recent triennial NDA assessment (AST-03558, *2024 NCS Triennial Accumulation Non-Destructive Analysis Assessment*) identified no excess FM accumulation and no additional areas for potential holdup and concluded that no additional NDA assessments on similar processes were needed until the next triennial assessment. Interviewed operations personnel demonstrated thorough knowledge of RMT use to track FM below de-minimis levels in accordance with PNNL-MA-250, table 1-1.

Criticality Safety Control Implementation Conclusions

The NCSP establishes an adequate framework to ensure that criticality safety controls are implemented in an appropriate manner. BMI's implementation of NCSP requirements at PNNL is generally adequate. Further, relationships between CSEs and laboratory personnel are functioning appropriately and have recently seen a marked improvement. However, weaknesses were identified in the areas of NCSE control documentation, configuration management, review of procedures governing the use of firefighting water, and implementation of ANSI/ANS-8.22-1997.

3.4 Response to Criticality Emergency

This portion of the assessment determined whether the PNNL emergency operations system (EOS) provides centralized collection, validation, analysis, and coordination of information related to a BMI response to a criticality emergency, and whether that information is used to obtain and maintain situational awareness and disseminate a common operating picture among response components to achieve a well-coordinated, well-understood, and effective response.

BMI periodically conducts criticality drills to exercise EOS capabilities. One limited-scope criticality drill performed on March 13, 2025, was reviewed as part of this assessment. The scenario involved a simulated miscommunication between workers that led to double the intended amount of FM being used in a glovebox, resulting in a criticality event and a CAS actuation. During the drill, BMI had adequate EOS capabilities to collect and disseminate incident information from a centralized and well-equipped incident command post (ICP) facility and to use needed expertise for incident analysis. In addition, the DOE-approved PNNL-MA-110, *Pacific Northwest National Laboratory Emergency Management Plan*, and implementing documents appropriately direct the EOS to integrate with a diverse support response structure (e.g., management support group (MSG), patrol operations center (POC), security operations center (SOC)) that integrates needed expertise and governs the expansion of the emergency response organization (ERO) up to and including full activation of the Hanford emergency operations center (EOC) and assumption of key duties by the Site Emergency Director (SED).

PNNL-MA-110 identifies a two-tiered emergency response system, with the first tier addressed by the Building Emergency Director (BED), who communicates primarily with onsite organizations (e.g., MSG, SOC, PNSO). The first tier is followed by a second tier implemented in a declared emergency, which involves activation of the Hanford EOC and turnover to the SED, who oversees the Hanford-wide incident response and communications with DOE Headquarters, offsite agencies, and public affairs. During the reviewed drill, the Hanford EOC, MSG, POC, and SOC participated but were not evaluated. Evaluated portions included the PNNL BED/325RPL's Building Manager, Building Emergency Response Organization (BERO), CSEs, and the Radiological Protection organization.

BMI personnel, in general, adequately identified the simulated criticality safety incident, evacuated the building, accounted for employees, screened staff for radiological exposure, and accurately classified the incident as a General Emergency in accordance with RLEP 1.0, *Recognizing and Classifying Emergencies*, appendix 1–PNNL.325. The use of a "go-bag" (containing essential policies, procedures, checklists, and supplies), an equipment case stocked with ERO supplies, and pre-staged incident response boxes that were permanently affixed outdoors in the primary staging area with muster sheets and vests for identification of key response personnel make this process highly efficient for the BED. The use of go-bags, the equipment case, and incident response boxes, which are routinely updated, is considered a **Best Practice** because they ensure that the BERO and BED have the needed tools to initiate an incident response in the earliest moments of an emergency with consistency and efficiency.

During the criticality drill, BMI activated its BERO for the 325RPL along with corresponding EOS capabilities used to obtain and maintain situational awareness and disseminate a common operating picture among response components. A criticality alarm was used to initiate an evacuation as part of the drill, and in accordance with BEP-325RPL, *325RPL Building Emergency Procedure*, everyone was directed to immediately leave the building and report to the Building 350 staging area for a quick sort survey and accountability of personnel. BEP-325RPL requires that the quick sort survey occur once building evacuees have reached the Building 350 staging area, approximately one third of a mile south of the 325RPL, but the two players who received simulated lethal radiation doses in the scenario stopped halfway along the walk due to simulated headaches, nausea, and vomiting. Also, some personnel reported to areas other than the Building 350 staging area, as discussed below. This condition resulted in personnel (e.g., role players, controllers, and observers) being spread out along the walk between the 325RPL parking lot and the Building 350 staging area, delaying the ultimate completion of the quick sort survey and accountability of personnel. (See **OFI-BMI-12**, **OFI-BMI-13**.) Further, the ICP activation inside Building 350 was delayed because role players did not know who was in which position due to players not wearing their position vests to identify key incident response positions and an excessive number of controllers and observers at the ICP. (See **OFI-BMI-14**.)

The drill was conducted safely. However, BMI identified several EOS performance issues during the post-drill hotwash, including the following:

- Contrary to DOE Order 151.1D, *Comprehensive Emergency Management System*, attachment 3, paragraphs 4.b and 11.b, BMI did not demonstrate an effective EOS that obtained and maintained situational awareness and disseminated a common operating picture among response components and external partners. (See **OFI-BMI-15**.) Specifically, because of the ICP activation delay, the ERO did not consistently have the necessary understanding of the incident to provide an effective response at all response venues.
- Some personnel evacuating the 325RPL due to the criticality alarm reported to the primary staging area for non-criticality-related building evacuations, rather than assembling at Building 350, as required by BEP-325RPL, section 6.5.2.4, during response to a criticality alarm. (See **OFI-BMI-12**.)

- Personnel evacuating the 325RPL who correctly reported to Building 350 reported to both the north and south parking lots. EIP-325RPL, *325RPL Building Emergency Information Posting*, and BEP-325RPL, appendix I, contain a graphic showing the evacuation route leading to the south parking lot entrance and states "alternative staging area at 350 bldg"; it does not specify where. (See **OFI-BMI-12**.)
- During the evacuation of the 325RPL, the SOC was not notified, as required by BEP-325RPL, section 6.5. The SOC also reported not being able to hear the alarms, a possible exercise artificiality.

Response to Criticality Emergency Conclusions

Overall, the PNNL EOS had adequate capabilities to collect and disseminate incident information from a centralized and well-equipped ICP facility. BMI's use of go-bags, the equipment case, and incident response boxes was identified as a best practice. However, BMI did not effectively implement its EOS during the reviewed drill and did not demonstrate an effective EOS that obtained and maintained situational awareness and disseminated a common operating picture among response components within its own response structure and those involving the Hanford EOC.

3.5 Federal Oversight

This portion of the assessment evaluated PNSO oversight of BMI's NCSP, including whether PNSO maintains sufficient technical capability and knowledge of site and contractor activities to make informed decisions about hazards, risks, and resource allocation.

PNSO criticality safety oversight is described in PNSO-PCDR-37, *PNSO Nuclear Safety Procedure*, section 5.3, *Nuclear Criticality Safety*. This procedure is out of date (last updated May 2012) and is no longer consistent with current oversight processes. For example, PNSO-PCDR-37 states that review of BMI's NCSP document is performed in accordance with DOE Order 420.1B, *Facility Safety*, by the DOE Office of Science Integrated Support Center. DOE Order 420.1B has been superseded by DOE Order 420.1C, and the Integrated Support Center no longer exists. Interviewed PNSO SMEs stated that the NCSP document is instead reviewed locally in accordance with DOE Order 420.1C by an SME appropriately qualified in accordance with DOE-STD-1173-2009, *Criticality Safety Functional Area Qualification Standard*. Consequently, contrary to DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*, section 4.a.(1), PNSO-PCDR-37 references out-of-date requirements and is not implemented as written to establish PNSO's program for criticality safety oversight. (See **Deficiency D-PNSO-1**.) Based on interviews and reviewed documentation of two recent criticality safety oversight activities performed by both the former and current criticality safety SMEs, including an appropriately documented July 2024 review and approval of the BMI NCSP document (NCS-PD) in accordance with DOE Order 420.1C, appropriate programmatic oversight is being performed to current requirements. However, not maintaining procedures current and not working to approved procedures could result in inconsistent or incorrect application of requirements, especially with turnover of personnel who have been implementing oversight using an expert-based rather than procedure-based process.

Additionally, PNSO has appropriately established PNSO-GUID-19, *PNNL Facility-Specific Safety System Oversight (SSO) Qualification Card: Criticality Accident Alarm System (CAS)*, to qualify an existing SSO (qualified in accordance with DOE Order 426.1B, *Department of Energy Federal Technical Capabilities*) to provide specific oversight of contractor technical activities that could impact safe operations at the 325RPL. However, due to a recent personnel departure, PNSO currently has no qualified SSO for the SS CAS. The current criticality safety SME stated in interviews that he plans to complete the PNSO-GUID-19 qualification.

Operational oversight, including criticality safety, is performed by Facility Representatives (FRs). An FR staffing analysis was last performed in April 2024, in accordance with DOE-STD-1063-2021, *DOE Standard Facility Representatives*. The staffing analysis concluded that 3.85 full-time equivalents were required for full FR coverage; at the time of the assessment, three FR positions were staffed, with one qualified FR assigned specifically to the 325RPL. Organizational-specific qualifications for the 325RPL FR were verified to be complete in accordance with PNSO-GUID-12, *DOE-PNSO Facility Representative Organizational-Specific Qualification Standard for PNNL*. While PNSO-GUID-12 contains a requirement that a candidate review the BMI's NCSP as required reading, there is no specific knowledge competency related to criticality safety. (See **OFI-PNSO-1**.)

Federal Oversight Conclusions

In general, PNSO currently provides oversight of BMI's NCSP at PNNL as required by DOE Order 420.1C. However, guidance documents are out of date and recent staffing changes could impact the effectiveness of future oversight.

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:

- BMI NCS personnel host a periodic FMH/NCS forum, which is used for CSE-Rs to confirm that FMHs know their responsibilities regarding criticality safety. The forum includes DOE lessons learned, provides information sharing, and seeks feedback on criticality safety control improvements, offering CSE-Rs time to get open and honest FMH feedback separate from FMSs and FMLMs.
- BMI's criticality safety-specific tabletop exercises effectively train operations, NCS staff, and management on how to respond to unexpected conditions/criticality safety upset scenarios that could occur at PNNL facilities.
- BMI assembles go-bags for its BEDs, who are on call 24/7, for carrying essential policies, procedures, checklists, and supplies with them. Supplementing this are an equipment case of ERO supplies kept in the BED's office and permanently affixed metal incident response boxes and signs located in the primary staging area. These resources facilitate quickly standing up the incident response and provide prompt directions and guidance with muster area signage and boxes with vests, checklists, supplies, accountability references, and more. This best practice saves time and enhances the performance of BERO staff.

5.0 FINDINGS

No findings were identified during this assessment.

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.

Battelle Memorial Institute

Deficiency D-BMI-1: BMI has not fully specified that the process for satisfying ANSI/ANS-8.1-2014, section 4.1.6, is required for Isolated Facilities. (DOE Order 420.1C, att. 2, ch. III, sec. 3.b)

Deficiency D-BMI-2: BMI has not ensured that all NCSE sections address minimum content to be documented. (ADM-NOD-612, app. A)

Deficiency D-BMI-3: BMI does not define clear requirements for criticality safety control creation, revision, or deletion using CSDs, or establish requirements for periodically reviewing CSDs and the process conditions that could impact them. (DOE-STD-3007-2017, sec. 3.5; ANSI/ANS-8.19-2014, secs. 6.8 and 8.6)

Deficiency D-BMI-4: BMI NSCE NCS-CSE-010, section 6.0, does not include a control for one of the NCSE assumptions, but the control was included in CSS-325-15. (DOE-STD-3007-2017, sec. 3.6)

Deficiency D-BMI-5: BMI has not ensured that the classification of all NCSE-credited engineered safety features is consistent, that all ICS SSCs are documented in the MEL, and that the ICS list in RPL-RPT-18-013, appendix A, has been maintained up to date. (OSD-CM-PLAN-001)

Deficiency D-BMI-6: BMI identified ANSI/ANS-8.22-1997 as inapplicable and omitted it from its NCSP, despite having described areas and conditions where moderator control is required and implemented. (DOE Order 420.1C, att. 2, ch. III, sec. 3.b)

Pacific Northwest Site Office

Deficiency D-PNSO-1: PNSO-PCDR-37 references out-of-date requirements and is not implemented as written to establish PNSO's program for criticality safety oversight. (DOE Order 226.1B, sec. 4.a.(1))

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified the OFIs shown below 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.

Battelle Memorial Institute

OFI-BMI-1: Consider procedurally documenting how all applicable requirements from DOE orders and applicable standards are met by the NCSP.

OFI-BMI-2: Consider generating procedural guidance in addition to PNNL-MA-250 to assist CSEs in their various responsibilities. A standalone desk instruction, guide, or procedure for these types of tasks may better help personnel track and perform all the different roles and responsibilities given to them by PNNL-MA-250, including review of work control documents for criticality safety implications.

OFI-BMI-3: Consider establishing a metric reflecting the sources or organizational roles that identify criticality safety non-conformances.

OFI-BMI-4: Consider requiring the NCS group to notify 325RPL Facility Management every time NCS investigates potential non-conformances or other criticality safety-related issues.

OFI-BMI-5: Consider reevaluating the classification of the criticality safety spacing rack in the 325RPL floor storage container area.

OFI-BMI-6: Consider establishing procedural requirements that SFO and Research FMHs check that operating documents are the current revisions per Vault prior to use.

OFI-BMI-7: Consider having NCS-ADM-002 require that CSE-Rs validate that postings are accurate, visible, and legible to ensure that the ANSI/ANS-8.19-2014, section 8.5.4, requirement is met.

OFI-BMI-8: Consider creating a map tool that shows all 325RPL CSCAs to support criticality safety control implementation.

OFI-BMI-9: Consider creating a plan of the day meeting for Research FMHs and FMSs for greater CSE-R coordination on and monitoring of activities, which would improve communication between CSE-Rs and Research FMHs and increase CSE-R awareness of activities.

OFI-BMI-10: Consider clarifying FMLM expectations for Research FMHs to involve other reviewers prior to making like-for-like equipment replacements and updating OSD-CM-PLAN-001 with this expectation.

OFI-BMI-11: Consider revising NCS-PD, section 9.0, to clarify that moderator control areas exist within the 325RPL but do not currently restrict firefighting activities.

OFI-BMI-12: Consider revising the *Emergency Evacuation Routes and Alternate Staging Area* graphic in BEP-325RPL and EIP-325RPL, and adding clarification in 325RPL general employee and visitor training modules, to more clearly specify the location where people are expected to muster at the alternate staging/evacuation area. Consider placing signs along the route to facilitate prompt egress and accountability.

OFI-BMI-13: Consider renaming the Staging Area Supervisor position to a National Incident Management System (NIMS)-compliant term (e.g., evacuation zone supervisor), and renaming the staging area to evacuation area to deconflict with the NIMS definition that means an area where resources can be placed awaiting tactical assignment (e.g., first responder assets).

OFI-BMI-14: Consider establishing procedures to control and limit the total number of observers and where they can move, and training controllers and evaluators so they do not detract from exercise play while performing their duties.

OFI-BMI-15: Consider implementing an electronic tool (e.g., the Web-based Emergency Operations Center Software, or WebEOC) to link emergency response elements (e.g., POC, SOC, MSG, and SED) together in a real-time capacity to allow a "common operating picture," validation of information, and method to inquire that also archives activities input shared for the official record.

Pacific Northwest Site Office

OFI-PNSO-1: Consider revising PNSO-GUID-12 to include more rigorous knowledge requirements of the BMI NCSP, similar to existing knowledge requirements for the emergency preparedness, radiation protection, integrated safety management, and lockout/tagout programs.

Appendix A
Supplemental Information

Dates of Assessment

February 10 to March 20, 2025

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
Brent L. Jones, Acting 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
Brent L. Jones, Director, Office of Nuclear Engineering and Safety Basis Assessments

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