Independent Assessment of Nuclear Criticality Safety Program and Controls at the Y-12 National Security Complex

May 2024

Office of Enterprise Assessments
U.S. Department of Energy

Table of Contents

Acronyms

ANS	American Nuclear Society
ANSI	American National Standards Institute
CAAS	Criticality Accident Alarm System
CARB	Corrective Action Review Board
CFR	Code of Federal Regulations
CNS	Consolidated Nuclear Security, LLC
CRAD	Criteria and Review Approach Document
CSE	Criticality Safety Evaluation
CSO	Criticality Safety Officer
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
MNC	Minor Non-compliance
NCS	Nuclear Criticality Safety
NCSC	Nuclear Criticality Safety Committee
NCSE	Nuclear Criticality Safety Engineer
NCSP	Nuclear Criticality Safety Program
NDA	Nondestructive Assay
NPO	National Nuclear Security Administration Production Office
OFI	Opportunity for Improvement
TOPIC	Tools for Opportunities – Performance Improvement through Communication
TSR	Technical Safety Requirement
UHSP	Uranium Holdup Survey Program
Y-12	Y-12 National Security Complex

INDEPENDENT ASSESSMENT OF NUCLEAR CRITICALITY SAFETY PROGRAM AND CONTROLS AT THE Y-12 NATIONAL SECURITY COMPLEX

Executive Summary

The U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA) conducted an independent assessment of the nuclear criticality safety (NCS) program (NCSP) and controls implementation at the Y-12 National Security Complex (Y-12) from January to February 2024. Y-12 is managed and operated by Consolidated Nuclear Security, LLC (CNS) and is overseen by the National Nuclear Security Administration Production Office (NPO). The primary objective of the assessment was to evaluate the effectiveness of CNS's activities to manage and maintain an appropriate NCSP, controls, and operating practices for Buildings 9204-2E and 9215. Additionally, the Federal oversight provided by NPO relating to NCS was evaluated.

EA identified the following strengths, including one best practice:

- The CNS operational review procedure requires nuclear criticality safety engineers (NCSEs) to observe work activities covered by the criticality safety evaluation (CSE). This is a strength because it requires NCSEs to observe operations covered by the CSE and not completely rely on document reviews for completion of the activity. (Best Practice)
- Appendix A of E-SD-2026, *Nuclear Criticality Safety Program Description*, provides a comprehensive crosswalk to Y-12 procedures, including traceability to applicable DOE and American National Standards Institute (ANSI)/American Nuclear Society (ANS) requirements and informs decisions on procedure revisions.
- CNS has a strong commitment to continue to bring CSEs into compliance with DOE-STD-3007-2017, *Preparing Criticality Safety Evaluations at Department of Energy Nonreactor Nuclear Facilities*.
- CNS has robust initial NCS training programs for fissile/non-fissile material workers that effectively incorporate the required elements of ANSI/ANS-8.20-1991, *Nuclear Criticality Safety Training*.
- The operations, training, and NCS organizations have closely coordinated to develop facility-specific NCS training that clearly communicates facility NCS limits/process controls, defines their associated bases, and includes relevant lessons learned from recent NCS events.
- NCS management promotes a low threshold for reporting NCS-related concerns, supporting early identification and resolution of issues.
- The NCS organization has effectively developed, monitored, and implemented relevant NCS program health metrics targeted to multiple audiences.
- CNS is currently installing a new ANSI/ANS-8.3-1997, *Criticality Accident Alarm System*-compliant commercial system that is intended to alleviate longstanding difficulties with maintaining the legacy criticality accident alarm system and to improve and modernize the safety basis, including the technical basis for detector placement.

EA also identified several weaknesses that could impact CNS's ability to maintain and further improve performance, as summarized below:

- CNS has not specified that the process for satisfying ANSI/ANS-8.1-2014, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, practice 4.1.2, is required for CSEs.

- The NCSE qualification program allows NCSEs-in-training to qualify on and independently perform NCS tasks without required supervision by a fully qualified NCSE.
- CNS primarily tracks NCS minor non-compliances and deficiencies in a separate NCS issues management system rather than consistently entering them into the enterprise-level issues management system per procedure requirements.
- NCSEs assigned to complete management assessments in 2023 were not qualified per the NCSE qualification program.
- CNS did not adequately implement ANSI/ANS-8.19-2014, *Administrative Practices for Nuclear Criticality Safety,* sec. 7.3 in two of six reviewed CSEs.
- CNS did not ensure that the action steps are written with enough clarity and detail to unambiguously guide the operator in implementing NCS requirements while performing the action steps.
- CNS did not ensure that procedures included those administrative controls and limits significant to the nuclear criticality safety of the operation.

In summary, CNS has effectively established and implemented an NCSP, controls, and operating practices for the assessed facilities. NPO has also performed effective Federal oversight of related CNS NCS activities. However, EA identified gaps associated with the configuration control of some operating procedures, specification of the process analysis requirement in NCSP procedures, the NCSE qualification program, issues management, assessments, implementation of the process analysis requirement in CSEs, and postings. Resolution of the weaknesses identified in this report will serve to enhance the management and overall effectiveness of the CNS NCSP, controls, and operating practices.

INDEPENDENT ASSESSMENT OF NUCLEAR CRITICALITY SAFETY PROGRAM AND CONTROLS AT THE Y-12 NATIONAL SECURITY COMPLEX

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 nuclear criticality safety (NCS) program (NCSP) and controls implementation at the Y-12 National Security Complex (Y-12). Consolidated Nuclear Security, LLC (CNS) is the primary contractor at Y-12, with the National Nuclear Security Administration Production Office (NPO) having Field element oversight responsibilities. The assessment was conducted from January to February 2024.

In accordance with the *Plan for the Independent Assessment of the Criticality Safety Program and Controls at the Y-12 National Security Complex, January – February 2024*, the primary objective of the assessment was to evaluate the effectiveness of CNS's activities to manage and maintain an appropriate NCSP, controls, and operating practices for Buildings 9204-2E and 9215 at Y-12. Additionally, the assessment evaluated the effectiveness of NPO oversight of CNS's activities with respect to the NCSP.

Y-12 serves DOE's nuclear security enterprise by maintaining the safety, security, and effectiveness of the U.S. nuclear weapons stockpile, thereby reducing the global threat posed by nuclear proliferation and terrorism, and by providing feedstock to fuel the U.S. Nuclear Navy. Building 9204-2E is a hazard category 2 nuclear facility, which supports disassembly and assembly of nuclear stockpile components, dismantling of unneeded components, and stockpile quality evaluations and maintenance. Building 9215 is a hazard category 2 nuclear facility providing uranium machining and finishing capabilities for production activities. While the Uranium Processing Facility presently under construction will replace most of Y-12's aging production facilities and operations, Buildings 9204-2E and 9215 have been designated as enduring mission facilities and are expected to continue their current functions for several decades following the startup of the Uranium Processing Facility.

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, the criteria used to guide this assessment were based on objectives CS.1, CS.2, and CS.3 of EA CRAD 31-30, Revision 4, *Criticality Safety Program and Criticality Safety Controls Implementation*. In addition, elements of EA CRAD 30-07, Revision 0, *Federal Line Management Oversight Processes*, were used to collect and analyze data on NPO oversight activities. To gather relevant assessment data, EA reviewed CNS and NPO policies, processes, procedures, calculations, and records supporting the NCSP; criticality safety evaluations (CSEs); work planning and execution; implementation and communication of NCS controls (including training); emergency preparedness; and issues management. EA also interviewed key contractor and Federal personnel responsible for developing, implementing, and overseeing the NCSP, and walked down significant portions of Buildings 9204-2E and 9215, focusing on the implementation of controls. 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 and Processes

This portion of the assessment evaluated the effectiveness of CNS's NCSP and associated processes, including policy and program procedures, NCSP staff qualification, performance metrics, training, issues management, assessments, and maintenance support.

Nuclear Criticality Safety Policy and Program Procedures

The CNS policy on NCS, E-POL-1019, *Nuclear Criticality Safety*, clearly states that all activities involving fissile material are to be conducted safely so that an inadvertent criticality accident is prevented. Additionally, this policy provides the basic framework for the Y-12 NCSP. CNS has established a generally adequate NCSP as required by DOE Order 420.1C, *Facility Safety*, and DOE-STD-3007-2017, *Preparing Criticality Safety Evaluations at Department of Energy Nonreactor Nuclear Facilities*. CNS document E-SD-2026, *Nuclear Criticality Safety Program Description*, defines the basic elements of the NCSP, including roles and responsibilities of NCS staff, audits and assessments, nuclear criticality safety engineer (NCSE) qualification, training, CSEs, implementation of criticality controls, inadvertent fissile material accumulation monitoring, the criticality accident alarm system (CAAS), and NCS guidance for firefighting. Additionally, appendix A of E-SD-2026 provides a comprehensive crosswalk to show how CNS satisfies the requirements of the American National Standards Institute/American Nuclear Society (ANSI/ANS)-8 series of NCS standards, including any exceptions taken to specific recommendations or requirements. This matrix provides a high level of traceability to requirements and informs decisions on procedure revisions. The current version of E-SD-2026 was submitted to and approved by the DOE Head of Field Element as required by DOE Order 420.1C.

Y70-150, *Nuclear Criticality Safety Program*, implements the NCSP for Y-12. Overall, the reviewed NCSP procedures adequately implement the requirements of E-SD-2026. However, there are conflicting definitions of the term "not credible," depending on its use in CSEs or NCS determinations. (See **OFI-CNS-1**.) Additionally, the independent assessment program is not described in E-SD-2026. (See **OFI-CNS-2**.)

Per the requirements of E-SD-2026, CNS has established a CSE update process to improve the quality of legacy CSEs written to a previous version of DOE-STD-3007-2017. This process involves an assessment of CSE quality, including reviewing reports of previous CSE assessments as well as the existing analysis and controls. CNS has made significant progress in this area over the past several years (e.g., completed 60 of 90 CSE updates) and continues to demonstrate a strong commitment to updating legacy CSEs consistent with DOE-STD-3007-2017. The strategy for updating CSEs is documented in RP Y-12-NCSDC-0001 000 01, *CSE Update Methodology White Paper*.

The observed quarterly meeting of the Nuclear Criticality Safety Committee (NCSC) was consistent with the requirements of E-SD-2026. The primary function of the NCSC is to provide programmatic guidance and oversight for the CNS NCSP. The meeting was well attended by senior CNS staff members and met quorum requirements identified in the NCSC charter. Observed discussions related to recent NCS events,

performance metrics, funding, the status of new projects, NCS goals, CSE upgrades, and the results of facility walkdowns conducted by NCSC staff.

While CNS has established a generally adequate NCSP, contrary to DOE Order 420.1C, attachment 2, chapter III, section 3.b, CNS has not specified that the process for satisfying ANSI/ANS-8.1-2014, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, practice 4.1.2, is required for CSEs. (See **Deficiency D-CNS-1**.) Incomplete implementation of NCSP requirements could increase the likelihood of an inadvertent criticality event. Specifically, E-SD-2026, appendix A, table A.1, section 4.1.2, identifies three cascading implementing documents, inferring compliance with ANSI/ANS-8.1-2014, practice 4.1.2. First, Y70-150 directs analysts to request approval to perform applicable fissile material activities (i.e., a new fissile material operation or any proposed modification to an existing fissile material operation) according to Y70-160, *Criticality Safety Approval System*. Next, Y70-160 directs analysts to initiate CSE development according to Y70-68-001, *Criticality Safety Approval/Requirements Development, Review, and Approval*. Finally, Y70-68-001 directs analysts to use RP CNS-F-0002 000, *Criticality Safety Evaluation Writer's Guide*, which provides adequate guidance on how to address this topic but is not a requirement for compliance with ANSI/ANS-8.1-2014, practice 4.1.2.

Nuclear Criticality Safety Program Staff Qualification

In general, CNS has adequately established training and qualification programs for NCSEs, computational specialists, and criticality safety officers (CSOs). E-SD-2026 appropriately invokes ANSI/ANS-8.26-2007, *Criticality Safety Engineer Training and Qualification Program*, as the requirements basis for the CNS NCSE qualification program documented in RP 000Y-12-F-0027, *Engineering Division Training and Qualification Program Description for Nuclear Criticality Safety*. RP 000Y-12-F-0027 adequately defines the training requirements, roles, and responsibilities for NCSE-in-training, NCSE, senior NCSE, and computational specialist positions. Reviewed qualification records for three NCSEs were current and consistent with RP 000Y-12-F-0027 training requirements. RP 000Y-12-F-0027 also employs a task-based qualification approach that appropriately covers required NCSE training subject matter areas defined in ANSI/ANS-8.26-2007, section 7. However, contrary to E-SD-2026, section 9.2, and ANSI/ANS-8.26-2007, section 5.2, RP 000Y-12-F-0027 allows NCSEs-in-training to qualify on and independently perform NCS tasks without required supervision by a fully qualified NCSE. (See **Deficiency D-CNS-2**.) This alternate qualification approach has not been formally approved by NPO and is inconsistent with the current approved approach (i.e., ANSI/ANS-8.26-2007) invoked by E-SD-2026. Implementing a training and qualification approach inconsistent with approved methodologies reduces the assurance that personnel have the knowledge and experience expected by the program approval authority to independently perform key NCS activities. Additionally, once qualified on a specific task and with two years' experience, NCSEs-in-training are allowed by RP 000Y-12-F-0027 to sign off on task qualification competencies for other trainees. (See **OFI-CNS-3**.)

RP 000Y-12-F-0049, *Training and Qualification Program Description for Nuclear Criticality Safety Officers*, adequately defines the training requirements, roles, and responsibilities for the CSO-in-training and CSO positions. The program description clearly identifies the purpose and function of the CSO position and describes how it differs from the purpose and function of the NCSE position. Required CSO training tasks and competencies appropriately incorporate relevant NCS subject matter areas described in ANSI/ANS-8.26-2007, section 7. Interviewed CSOs were knowledgeable of their facility's processes, NCS limits and controls, and procedures for responding to abnormal NCS conditions. Reviewed qualification records for three CSOs were current and consistent with RP 000Y-12-F-0049 training requirements.

Performance Metrics

NCS management has effectively developed and monitored relevant NCS metrics based on a structured program health model, historical performance trends, and recent challenge areas. Metric data is routinely communicated to CNS and NPO NCS is directly incorporated into NCS performance improvement decision-making. Reviewed annual NCS metrics reports from 2022 and 2023 provided thorough status updates and analyses on key performance areas (e.g., CSE implementation, change management, NCS issues management). Additionally, reviewed metrics provided during the January 2024 CNS/NPO strategic NCS interface meeting and CNS NCS management briefing were appropriately tailored to the target audience and clearly identified emerging performance trends. During the observed NCSC meeting, NCS managers effectively presented current NCS metrics to senior CNS leadership and provided updates on actions taken in response to previous performance trends.

Nuclear Criticality Safety Training

CNS provides robust formal training to facility workers on pertinent NCS subject matter. Initial NCS courses for fissile and non-fissile material handlers incorporate all required training elements defined in ANSI/ANS-8.20-1991, *Nuclear Criticality Safety Training*, section 7. Reviewed course lesson plans effectively used a balanced combination of lecture, individual and small-group assignments, and simulated fissile material handling activities in a realistic fissile material area to educate personnel on NCS fundamentals, site processes and controls, and complex-wide NCS lessons learned. The courses are appropriately assigned to job positions (e.g., operators, field engineers, work planners, first-line supervisors) that directly and indirectly interact with fissile materials in Buildings 9204-2E and 9215. Additionally, reviewed 2023 annual fissile and non-fissile handler web-based NCS refresher courses appropriately included control parameters, site NCS policies and procedures, and recent lessons learned. Interviewed NCS training managers stated that relevant facility NCS subject matter experts work directly with operations to develop recurring facility/process-specific NCS training. Reviewed facility/process-specific training presentations clearly described NCS requirements using operations terminology and received proper approvals from the NCS and training organizations. The reviewed NCS lesson plan for general employee training appropriately covered basic fission reactions, lessons learned from historical criticality accidents, responses to CAAS activations, and fissile material signage designation areas; however, this lesson plan had limited discussion on NCS control parameters and lacked specific examples of fissile materials that employees may encounter in the field. (See **OFI-CNS-4**.)

Issues Management

CNS has, in general, adequately managed recent NCS-related issues for Buildings 9204-2E and 9215. E-PROC-0006, *CNS Issues Management Process*, defines the enterprise-level process for screening events, selecting appropriate causal analysis methodologies based on event significance, and entering issues in key functional areas, including NCS, into CNS's authorized issues management system, Tools for Opportunities – Performance Improvement through Communication (TOPIC). E-PROC-3216, *Nuclear Criticality Safety Issues*, provides additional guidance directly related to identifying, categorizing, tracking, and resolving NCS-specific issues using a risk-based approach. Interviewed NCS field personnel stated that their management promotes a low threshold for reporting NCS concerns, supporting early identification and resolution of issues before they potentially escalate into larger events.

Reviewed Buildings 9204-2E and 9215 NCS field reports from 2021 to 2023 appropriately categorized NCS-related minor non-compliances (MNCs) and deficiencies in accordance with E-PROC-3216 guidance, and identified proper immediate actions to be taken in order to place affected systems/processes in a safe condition. However, contrary to E-PROC-0006, appendix A, NCS MNCs and deficiencies are primarily tracked in a separate NCS issues management system and are not consistently being graded and

entered into TOPIC, as required. (See **Deficiency D-CNS-3**.) Not entering NCS MNCs and deficiencies into the authorized enterprise-level issues management system may reduce the ability to effectively track NCS issues and identify adverse performance trends. Interviewed NCS personnel acknowledged challenges with managing NCS issues in two separate systems and stated that CNS leadership is exploring integrating the current NCS issues management system with TOPIC. Additionally, causal analyses for reviewed NCS MNCs and deficiencies were conducted inconsistently, with minimal guidance provided in E-PROC-3216. (See **OFI-CNS-5**.) For example, reviewed deficiencies associated with similar human performance issues and severity received varying levels of causal analysis, ranging from none to more detailed analyses.

CT 802012-0001, *Charter for the Nuclear Criticality Safety Advisory Council: Y-12 National Security Complex*, appropriately defines the organization, mission, and responsibilities of the Corrective Action Review Board (CARB), a group of senior NCS managers and subject matter experts who are directly involved in the development, tracking, and closure of NCS-related corrective actions. Reviewed corrective actions generated in response to recent Buildings 9204-2E and 9215 NCS non-compliances received proper CARB approvals for their development and closure.

Assessments

The CNS NCS assessment program is consistent with the requirements of ANSI/ANS-8.19-2014, *Administrative Practices for Nuclear Criticality Safety*, and E-SD-2026. The assessment program is governed by procedures E-PROC-3025, *Assessments of Nuclear Criticality Safety Program Activities*, and E-PROC-3004, *Enterprise Assessments Process*. These procedures adequately define the overall assessment program, including the types of assessments performed, format, required content, lines of inquiry, and periodicity. The assessment program appropriately consists of (1) quarterly management assessments to ensure that the basic program elements as defined in ANSI/ANS-8.19-2014 are met, (2) site-level independent assessments to continuously evaluate and improve day-to-day operations, and (3) operational evaluations to ensure that criticality requirements and controls remain effective and that field conditions have not substantially changed since the CSE was issued or last revised.

Y70-164, *Nuclear Criticality Safety Operational Reviews*, defines the requirements for review of CSEs and implementation procedures. This procedure fulfills the requirement of section 8.6 of ANSI/ANS-8.19-2014 to ensure that operations are reviewed at least annually to verify that procedures are followed, and that process conditions have not been altered to affect the applicability of the CSE. The operational review process outlined in Y70-164 is considered a **Best Practice** because it requires NCS staff to directly observe fissile material operations covered by the CSE. If fissile operations cannot be observed, a dry run may be substituted or the active CSE or operations procedures may be placed on a temporary hold. The temporary hold process ensures that operations cannot commence without first notifying NCS staff. Completed operational reviews from the past two years demonstrate that CNS is adequately implementing the requirements of Y70-164.

The reviewed assessments demonstrate that CNS is generally meeting the requirements of ANSI/ANS-8.19-2014 and E-SD-2026, with the following exceptions:

- Contrary to RP 000Y 12-F-0027 000 06, *Engineering Division Training and Qualification Program Description (T&QPD) for Nuclear Criticality Safety*, section 4.4, some CNS NCS staff assigned to complete management assessments in 2023 were not qualified to perform assessments. All assessments were led by a task 9 qualified NCSE in 2023. (See **Deficiency D-CNS-4**.) Not using qualified staff for NCS assessments could result in missed opportunities for early identification of NCS-related issues.

- The independent assessment scheduled for 2018 was not completed until late 2020. This self-identified issue was entered into TOPIC, and corrective actions were implemented to prevent recurrence.

Maintenance

NCS staff provides support for the Y-12 maintenance program by reviewing work orders to ensure that adequate NCS controls are in place for the prevention of a criticality accident. This process is outlined in DTI 373271 000 04, *Nuclear Criticality Guidance for Non-Production Work Activities*. The observed plan-of-the-day meeting demonstrated that NCS staff is actively involved in supporting Y-12 maintenance activities. NCS staff adequately specified NCS controls for two reviewed work orders and observed maintenance.

Nuclear Criticality Safety Program and Processes Conclusions

The CNS NCSP and supporting processes are generally compliant with applicable DOE and ANSI/ANS requirements. One best practice was identified for requiring NCSEs to directly observe work activities when conducting operational reviews. However, several weaknesses were identified. First, CNS has not specified that the process for satisfying ANSI/ANS-8.1-2014, practice 4.1.2 is required for CSEs. Second, the CNS training and qualification program for NCSEs is not consistent with the requirements of ANSI/ANS-8.26-2007. Third, CNS does not consistently grade and enter NCS-related MNCs and deficiencies into the enterprise-level issues management system as required. Finally, most NCSEs assigned to complete management assessments in 2023 were not qualified for that specific task.

3.2 Criticality Safety Evaluations

This portion of the assessment evaluated whether CNS CSEs demonstrate that processes involving fissile materials will remain subcritical under normal and credible abnormal conditions, including those initiated by design basis events.

Six reviewed CSEs (CSE 920402E-NSNM-0001, *Non-SNM Transfer Station for Building 9204-2E*; CSE 9215-CPK-0001, *Criticality Safety Chip Rinsing Operations*; CSE PT-MT-102 000 02, *Criticality Safety Evaluation for the Metallographic and Mechanical Properties Laboratory in Room 311 of Building 9204-2E*; CSE-B2E-14, *Criticality Safety Evaluation for Contaminated Combustibles and Non-combustibles*; CSE-CPK-057 000 05, *Criticality Safety Evaluation for Chip Packing Operations*; and CSE-MCS-056, *Criticality Safety Evaluation for Machine Coolant System*) were consistent with the documented safety analysis, and none required elevation of controls to technical safety requirements (TSRs). The reviewed supporting criticality calculations, criticality safety code validation reports, and KENO computer models were adequate. These calculations were consistent with the upper safety limits cited in the validation reports. Examples of KENO input files were confirmed to meet the contents evaluated in the CSEs and criticality calculations.

Three of the six reviewed CSEs met the requirements of 10 CFR 830, *Nuclear Safety Management*; DOE Order 420.1C and the ANSI/ANS-8 series of NCS standards, and the CSEs demonstrated sound engineering and scientific principles. These CSEs identified and evaluated the acceptable ranges of normal and credible abnormal conditions, and the identified control sets satisfactorily addressed the analyzed normal and credible abnormal conditions as they are evaluated in the CSEs. However, weaknesses were identified in the remaining three reviewed CSEs. Contrary to E-SD-2026, app. A, CNS did not adequately implement ANSI/ANS-8.19-2014, sec. 7.3 in two CSEs. Specifically, CNS did not ensure the CSE was documented in sufficient detail, clarity, and lack of ambiguity to allow independent judgment of results by personnel familiar with the physics of nuclear criticality. (See **Deficiency D-CNS-**

5.) Not including sufficient detail in CSEs could increase the likelihood of an inadvertent criticality event. Specifically:

- CSE-CPK-057 000 05, section 2.1.1, references an inadequate document (*BWXT Y-12 Position Paper on Uranium Chip Airborne Release Fraction* [ARF]) to support the use of an ARF for determining potential uranium holdup on hood roughing filters from a fire. Although CNS believes that the ARF is conservative, the unsigned position paper derived the ARF based on uncontrolled experiments, resulting in unvalidated assumptions in the CSE that could lead to unexpected consequences.
- CSE PT-MT-102 000 02, section 5.3.4, identifies "Other sources of moderation in-leakage" caused by natural phenomena hazards induced pipe breaks, but does not describe controls to prevent aging-related piping failures or an unintended addition of potable water.

Additionally, CSE-MCS-056 identifies assumptions that have some uncertainty, given that they have not been weighed against potential changes to the facility process over the years. For example, an assumption on uranium concentration in solids was derived from a 1983 letter documenting an analysis of uranium mass and the concentration of solids from sampling data in old settling tanks. The assumption is used throughout the CSE to support double contingency analyses, but the CSE has not documented that such assumptions remain valid, given the potential changes to the process over the years. (See **OFI-CNS-6**.)

Criticality Safety Evaluations Conclusions

Six reviewed CNS CSEs were generally compliant with the procedural requirements governing their implementation. However, in two of the six reviewed CSEs, CNS did not adequately implement a requirement to ensure that CSEs contain sufficient detail, clarity, and lack of ambiguity to allow independent judgment of results.

3.3 Criticality Safety Control Implementation

This portion of the assessment evaluated CNS's implementation of criticality safety controls.

CNS provides a generally adequate implementation of criticality safety controls as required by E-SD-2026, section 6.2 and appendix A, and procedure Y70-150, sections D and F. For Building 9215, observed workplace postings appropriately reflect CSE controls as documented in *Machine Coolant System CSE-MCS-056 NCS Controls Crosswalk*; *Chip Packing Operations CSE-CPK-057 NCS Controls Crosswalk*; and *Chip Rinsing Operations 9215-CPK-0001 NCS Controls Crosswalk*. Each NCS controls crosswalk appropriately includes a section, *Administratively Controlled Limits and Requirements*, that addresses applicable procedures and any required postings for the various CSE administrative controls.

While criticality safety control implementation is generally adequate, the following weaknesses were identified:

- Contrary to Y68-007, app. A, step 2.a, CNS did not ensure that the action steps are written with enough clarity and detail to unambiguously guide the operator in implementing NCS requirements while performing the action steps. The absence of clear, unambiguous steps in procedures that implement NCS requirements may increase the likelihood of an inadvertent criticality event. (See **Deficiency D-CNS-6**.) Specifically,
    - Seven of 25 identified controls in Y50-01-B2-120 were incorrectly referenced to CSE-B2E-14 instead of CSE-B2E-4.
    - The round metal cage bag holders that are being used instead of the step-on cans in Building 9204-2E are not described in procedure Y50-01-B2-120, *Handling Enriched Uranium Low-*

Level Contaminated Waste. Furthermore, the analysis provided in CSE-B2E-14 does not address the use of bag holders.

- Contrary to E-SD-2026, app. A, CNS did not incorporate an administrative control into a procedure as required by ANSI/ANS 8.19, sec. 8.5.2. Specifically, CSE-CPK-057, control 3.3.3, "A Hospital Can that is left unattended after being weighed shall be reweighed before the contents are loaded into a Chip Cylinder," was not included in procedure Y58-08-MOPS-001, *Chip Packing*. The absence of properly identified CSE controls into procedures may increase the likelihood of an inadvertent criticality event. (See **Deficiency D-CNS-7**.)

Criticality Safety Control Implementation Conclusions

CNS has generally adequately implemented criticality safety controls for Buildings 9204-2E and 9215. However, CNS did not include sufficient clarity and detail in a procedure to unambiguously guide the operator in implementing NCS requirements and did not ensure that a procedure included an administrative control significant to the nuclear criticality safety of the operation.

3.4 Nuclear Criticality Emergency Planning and Response

This portion of the assessment evaluated the effectiveness of CNS's ability to plan and respond to a criticality accident, including emergency response planning and functionality and testing of the CAAS.

Nuclear Criticality Emergency Response Planning

Emergency response duties, responsibilities, and functions associated with criticality accidents are well defined in a suite of comprehensive site and building emergency plans and procedures, manuals, training materials, and related documents. These documents adequately address ANS/ANSI-8.23-2019, *Nuclear Criticality Accident Emergency Planning and Response*, requirements for criticality accident evaluations, emergency response plans, equipment, evacuation, reentry, training, exercises, and evacuation drills.

To ensure adequate criticality controls when responding to fires in or adjacent to moderator-controlled areas, the Y-12 Fire Department has adequately planned, coordinated, and provided input in support of emergency response planning. Specifically, Y/DD-708, *Nuclear Criticality Safety Guidelines for Firefighting in Y-12*, appropriately addresses firefighting techniques and organizational interfaces, and identifies specific areas in these buildings where water restrictions are warranted to prevent inadvertent criticality. Also, PLN 9204-2E-PFP-021, *Pre-Incident Plan*, and PLN-9215-PFP-028, *Pre-Fire Plan*, appropriately provide detailed listings of specific hazards in each building.

CNS has conducted biennial criticality accident exercises to validate the effectiveness of the Y-12 emergency response organization's ability to respond to a criticality incident consistent with ANS/ANSI-8.23-2019 requirements. Reviewed after-action reports for the two most recent biennial criticality exercises were thorough with appropriate documentation of the results, including findings, deficiencies, and improvement items.

Criticality Accident Alarm System

CNS operates an adequate legacy CAAS for Buildings 9204-2E and 9215 that was installed in 1957. E-SD-2026, section 10.2, appropriately implements ANSI/ANS-8.3-1997, section 4.2.1, addressing the need for a CAAS for "all fissile control areas within nuclear facilities except in any area where specific NCS analysis has been documented to justify the risk of a criticality accident is only trivial." To alleviate longstanding difficulties with maintaining the legacy CAAS and to improve and modernize the safety basis, including the technical basis for detector placement, CNS is appropriately in the process of

installing a new ANSI/ANS-8.3-1997 compliant commercial CAAS system. In the interim, the legacy CAAS is generally configured to accomplish the intent of ANSI/ANS-8.3-1997.

While a few ANSI/ANS-8.3-1997 requirement deviations exist due to the legacy CAAS pre-dating the ANS/ANSI standard (e.g., initial testing, detector placement and coverage), CNS has developed sound and detailed technical bases and compensatory measures to support the system's adequacy. For example, even though the legacy system detector placement does not meet ANSI/ANS-8.3-1997, B.3 methods, RP-YAREA-CAAS-0010, *Basis for the Y-12 Legacy Criticality Accident Alarm System Accident Coverage*, provides an adequate technical basis for the current CAAS configuration based on a detector coverage area with a radius of approximately 400 feet and overlapping coverage by at least two CAAS detection stations.

ANSI/ANS-8.3-1997 also states that the alarm trip point should be set high enough to minimize the probability of an alarm from sources other than criticality. The established maximum CAAS alarm trip setpoint of 35 milliroentgen per hour stipulated in the facility TSRs was semi-quantitatively determined to be low enough to detect a theoretical minimum accident of concern outlined in ANSI/ANS-8.3-1997, section 5.6, and high enough to minimize spurious alarms. The technical basis for use of this setpoint is appropriately addressed in YAREA-CAAS-0003, *CAAS Detector Alarm Trip Point to Support the Current Radius of Coverage*.

CNS has established appropriate facility-specific TSRs and associated implementing procedures for periodic testing of the CAAS in accordance with ANSI/ANS-8.3-1997, sections 6.3 and 6.4. The CAAS testing and surveillance requirements governed by specific technical procedures include weekly, quarterly, and annual testing of various parameters of the systems. Specifically, CAAS detection station status indications, detector calibration date, and CAAS power supply functionality are verified weekly to confirm that electric power from the building distribution system is available to the required CAAS or element of CAAS (e.g., detectors, horns, lights, relay panels, amplifiers, speakers). The quarterly surveillance appropriately includes a radiation response test of the radiation detectors at all CAAS detection stations to ensure that each detector has the capability to detect radiation levels at or above the alarm trip setpoint. The detector relay matrix, alarm signal, and actuation relays are tested annually to verify that the alarm is audible above background noise and/or is visible throughout the CAAS annunciation area (excludes inaudible areas addressed by the NCSP). Reviewed CAAS surveillance records for the two most recent quarterly and annual testing, and an observed weekly surveillance testing sequence in Building 9204-2E demonstrated effective implementation of procedure steps, requirements, and data reporting.

CNS has appropriately addressed the use of compensatory measures in areas of each nuclear facility where a CAAS alarm may not be sufficient to notify personnel due to audibility concerns. These CAAS controlled access areas are required to be posted as "CAAS Deficient Areas" and include a requirement for personnel to be issued personal radiation detection instruments prior to entry. Personal radiation detection instruments are used as compensatory notification devices to augment notification for areas where audibility is impaired, and as a detection and alarm capability during some off normal or recovery situations. The devices are calibrated to alarm at an accumulated dose of 30 millirem or a dose rate of 30 millirem per hour, which provides a significant margin to detect a criticality accident. This process is adequately described in technical procedure Y-70-151, *Criticality Accident Alarm System*, which meets ANSI/ANS-8.3-1997, section 4.4.2.

Nuclear Criticality Emergency Planning and Response Conclusions

CNS has developed comprehensive site and building emergency response plans and procedures, manuals, training materials, and related information that adequately address the ANS/ANSI-8.23-2019

requirements associated with criticality accident evaluations, emergency response plans, equipment, evacuation, reentry, training, exercises, and evacuation drills. CNS operates an adequate legacy CAAS for Buildings 9204-2E and 9215 that pre-dates ANS/ANS-8.3 but has been generally configured to accomplish the intent of the standard. Finally, CNS has established appropriate facility-specific TSRs and associated implementing procedures for periodic testing of the CAAS in accordance with ANSI/ANS-8.3-1997, sections 6.3 and 6.4.

3.5 Uranium Holdup Survey Program

This portion of the assessment evaluated the effectiveness of CNS's ability to detect enriched uranium accumulations within process equipment and support systems.

E-SD-2026, section 6.5.6, adequately addresses the CNS approach to detecting, through radiological measurements and mass calculations, the inadvertent accumulation of fissile material using Y15-014, *Uranium Holdup Survey Program (UHSP)*, which implements DOE Order 420.1C, attachment 2, chapter III, section 3.e. This program adequately addresses the potential for the long-term accumulation of fissile material (e.g., powders, solutions) that can present a criticality hazard in such areas as ventilation ductwork and large wastewater tanks. The UHSP is implemented and managed by the Nondestructive Assay (NDA) Engineering organization and provides an adequate system for monitoring areas where fissile material holdup is a potential concern.

The UHSP is supported by well-documented program and implementing documents (UHSP program plan, NDA implementing procedures, and technical basis documentation). Y15-014 adequately describes the operations, requirements, and responsibilities for detecting the accumulation of uranium holdup during enriched uranium operations at Buildings 9204-2E and 9215. This includes technical procedure Y50-69-NDA-001, *UHSP Equipment Surveys*, which provides adequate direction for performing routine qualitative equipment holdup surveys, including pre-designated surveys, equipment calibration, and transferring, reviewing, and submitting collected survey data. Procedure Y17-69-418, *Nondestructive Characterization of Special Nuclear Material Holdup in Y-12 Uranium Processing Facilities*, also adequately describes the steps for performing quantitative NDA measurements, including key measurement parameters such as enrichment levels and background radiation levels, taking the holdup measurements with NDA equipment, and performing holdup calculations. The technical basis for the NDA process being used by the UHSP is thoroughly described in TB-NDA-ENG-002-00, *Technical Basis for Non-Destructive Analysis of Enriched Uranium Holdup in Processing Equipment and Salvage at the Y-12 Plant Using Portable NAI Detectors/Multi-Channel Analyzers*.

Based on NDA work observations and document reviews, both operators and NDA Engineering personnel are appropriately involved in fissile material accumulation control. Observation of quantitative field NDA operations and a review of program records and reports verified that identified potential accumulation locations are being labeled and surveyed, and that appropriate holdup mass calculations are being performed and evaluated, including any needed maintenance or cleanout activities.

Uranium Holdup Survey Program Conclusions

E-SD-2026, section 6.5.6, adequately addresses CNS's approach to detecting the inadvertent accumulation of fissile material using Y15-014, which implements DOE Order 420.1C, attachment 2, chapter III, section 3.e. Observation of quantitative field NDA operations and review of program records and reports demonstrate effective implementation of the UHSP.

3.6 Federal Oversight

This portion of the assessment evaluated the effectiveness of NPO's oversight of CNS's NCSP and management of CNS-identified issues.

Oversight and Assessments

NPO has effectively performed oversight of NCS activities at Y-12 through routine field observations, close engagement with CNS's NCS organization, and formal assessments. The Facility Representatives and NPO NCS staff maintain a strong presence at Y-12 facilities, performing facility walkdowns several times a week and observing operational briefings and CARB meetings. During interviews, the Facility Representatives and NPO NCS staff members demonstrated comprehensive knowledge of facility operations in Buildings 9204-2E and 9215 and emphasized their close coordination with CNS NCS engineers when evaluating the adequacy of NCS control implementation in the field. The NPO NCS staff perform recurring operational awareness activities and meet regularly with their CNS NCS counterparts. The reviewed NPO NCS oversight activities for fiscal year 2024 (listed in the *NNSA Production Office Nuclear Criticality Safety Oversight Strategy Fiscal Year 2024*) include a formal assessment of the long-term actions associated with the E-5600 birdcage misloading event, five shadow assessments, and various operational awareness walkdowns. NPO-3.4.1.1.2, *Nuclear Criticality Safety Engineering Oversight*, provides NPO personnel adequate guidance to conduct oversight and assessment activities, meeting the requirements of DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*. NPO assessment *NPO Assessment of Operating Procedures Production Organization Surveillances and NCS Operational Reviews* was conducted by qualified NCS staff, appropriately incorporated current ANSI/ANS-8.19-2014 requirements into review criteria, included relevant interviews and document reviews, and clearly listed assessment results. NPO-driven site integrated assessment plan assessments are assigned based on the NPO risk rating system described in NPO-3.4.1.1.2. The NCS program area screened as "very high" requiring a formal assessment in in fiscal year 2024. The assessment will review the long-term actions associated with the birdcage misloading event and subsequent NPO reactive assessment. .

Issues Management

NPO has performed effective oversight of recent CNS NCS issues and associated corrective actions. The reviewed NPO assessment *Effectiveness Review of Y-12 Personnel Error and Accumulation Corrective Actions TOPIC AS-462* demonstrates appropriate NPO oversight in the issues management area of event follow-up. Specifically, the assessment verified that issues management system actions were closed in a timely manner and that completed actions provided reasonable assurance of preventing or reducing the likelihood of recurrence of the event.

Federal Oversight Conclusion

NPO has effectively performed Federal oversight of the Y-12 NCSP in accordance with DOE Order 226.1B. NPO has appropriately communicated its NCS oversight findings and monitored associated corrective action development, execution, and closure through close coordination with CNS.

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 practice was identified as part of this assessment:

- CNS procedure Y70-164 requires NCS staff to directly observe fissile material operations covered by the CSE when conducing operational reviews. This ensures that operational reviews are not solely document reviews.

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.

Consolidated Nuclear Security, LLC

Deficiency D-CNS-1: CNS has not specified that the process for satisfying ANSI/ANS-8.1-2014, sec. 4.1.2, is required for CSEs. (DOE Order 420.1C, att. 2, ch. III, sec. 3.b)

Deficiency D-CNS-2: CNS procedure RP 000Y-12-F-0027 allows NCSEs-in-training to qualify on and independently perform NCS tasks without required supervision by a fully qualified NCSE. (E-SD-2026, sec. 9.2, and ANSI/ANS-8.26-2007, sec. 5.2)

Deficiency D-CNS-3: CNS primarily tracks NCS MNCs and deficiencies in a separate NCS issues management system and does not consistently grade and enter them into TOPIC as required. (E-PROC-0006, app. A)

Deficiency D-CNS-4: CNS NCS staff assigned to complete management assessments in 2023 were unqualified to perform assessments. (RP 000Y 12-F-0027 000 06, sec. 4.4)

Deficiency D-CNS-5: CNS did not adequately implement ANSI/ANS-8.19-2014, sec. 7.3 in two of six reviewed CSEs. (E-SD-2026, app. A)

Deficiency D-CNS-6: CNS did not ensure that the action steps are written with enough clarity and detail to unambiguously guide the operator in implementing NCS requirements while performing the action steps. (Y68-007, app. A, step 2.a)

Deficiency D-CNS-7: CNS did not ensure that procedures included those administrative controls and limits significant to the nuclear criticality safety of the operation as required by ANSI/ANS 8.19, sec. 8.5.2. (E-SD-2026, app. A)

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.

OFI-CNS-1: Consider clarifying the definition of "not credible" in NCSP documents.

OFI-CNS-2: Consider adding a description of the independent assessment program in E-SD-2026.

OFI-CNS-3: Consider using only fully qualified NCSEs for evaluating and verifying the completion of task competencies associated with NCSE-in-training and NCSE qualifications.

OFI-CNS-4: Consider updating the NCS portion of general employee training to include audience-appropriate discussions of NCS control parameters and specific examples of fissile materials that employees may encounter in the field.

OFI-CNS-5: Consider applying the enterprise-level causal analysis process guidance provided in E-PROC-3216 to NCS-specific issues.

OFI-CNS-6: Consider reviewing CSE-MCS-056 to ensure that data-based assumptions remain valid given the uncertainties associated with potential process changes to the machine coolant system over the years and update as necessary.

Appendix A
Supplemental Information

Dates of Assessment

January 15 – February 8, 2024

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
Thomas E. Sowinski, 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

Quality Review Board

William F. West, Advisor
Kevin G. Kilp, Chair
Margaret A. Kotzalas
Todd M. Angel
William A. Eckroade

EA Site Lead for Y-12 National Security Complex

Matthew M. Toth

EA Assessment Team

Brannen J. Adkins, Lead
Thomas E. Sowinski
Michael Shlyamberg
Mario A. Vigliani
Marc R. Woodworth