

Joyce L. Connery, Chair
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**DEFENSE NUCLEAR FACILITIES
SAFETY BOARD**

Washington, DC 20004-2901



July 7, 2021

The Honorable Jennifer M. Granholm
Secretary of Energy
US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Secretary Granholm:

The Defense Nuclear Facilities Safety Board (Board) completed a review of the Y-12 National Security Complex (Y-12) out-of-service (OOS) systems located in Building 9212. The Y-12 contractor has taken the necessary steps to disposition the specific OOS systems identified in its *Out of Service Equipment Risk in 9212* report. However, the continued discoveries of legacy items with unknown amount of uranium, including OOS items, indicate that the federal and contractor entities at Y-12 have not comprehensively identified and addressed the causes for the failures to manage OOS items with uranium holdup properly, which could lead to similar situations in the future. The Board observed that:

1. Y-12 is not optimizing its issues management system, and lacks rigor in its requirements for closure of issues; and
2. the continuing discovery of legacy OOS items indicates weaknesses in the initial process and scope of the extent of condition review and incomplete knowledge of conditions on the plant floor.

Y-12 will undergo a contract transition soon, and proper transition of issues to the new contractor will depend on a robust issues management system, as will Y-12's future ability to address issues adequately and effectively.

The National Nuclear Security Administration Production Office and its contractor briefed the Board on April 8, 2021, regarding their efforts to improve the nuclear criticality

safety program at Y-12, including management of OOS items. The Board will continue to evaluate their progress in improving the criticality safety program and reducing risk by cleanout of OOS items. The Board is providing the enclosed report for your information and use.

Sincerely,

A handwritten signature in black ink that reads "Joyce L. Connery". The signature is written in a cursive style with a large, prominent initial "J".

Joyce L. Connery
Chair

Enclosure

c: Mr. Joe Olencz

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Report

April 19, 2021

Out of Service Equipment in Building 9212

Summary. The Defense Nuclear Facilities Safety Board's (Board) staff completed a review of the criticality hazards of the out-of-service (OOS) equipment in Building 9212 at the Y-12 National Security Complex (Y-12). The staff team reviewed the criticality hazards of the OOS equipment with uranium holdup in Building 9212, select OOS equipment criticality safety evaluations and supporting nuclear criticality safety (NCS) analyses, and related issues management system (IMS) entries. The staff team conducted on-site walkdowns and discussions on January 24–26, 2020, and had three additional teleconferences on June 10, 2020, August 27, 2020, and January 19, 2021, with personnel from the National Nuclear Security Administration (NNSA) Production Office (NPO) and Consolidated Nuclear Security, LLC (CNS).

Before the onsite portion of the review, the staff team evaluated the CNS reports *Out of Service Equipment Risk in 9212* (Risk Report), *Causal Analysis Legacy Holdup in Out-of-Service Equipment in Building 9212*, and related technical documentation for selected systems. In particular, the staff focused on the systems identified by CNS in the Risk Report as posing the highest risk from a criticality safety perspective. Based on the onsite portion of the review, the staff team concluded that CNS was treating these specific systems appropriately, that the selected systems on the plant floor represented no immediate criticality safety hazards, and that CNS was instituting appropriate processes to ensure equipment taken out of service in the future would be dealt with in alignment with expectations in American National Standards Institute/American Nuclear Society [ANSI/ANS]-8.1, *Nuclear Criticality Safety in Operations with Fissile Material Outside Reactors*, as noted below.

While the corrective actions taken to date, discussed in the appendix to this report, have been appropriate, the staff team concluded that CNS has not comprehensively identified and addressed the potential causes for the failure to manage OOS equipment properly, which could lead to related situations in the future. The staff team concludes that the Y-12 issues management process should be better utilized; CNS personnel did not review previous IMS entries during the extent-of-condition (EOC) review and causal analysis for OOS equipment issues. The staff team also concludes that management of issue closure merits strengthening. Additionally, CNS continues to discover additional legacy items with unknown amount of uranium, including OOS items, which indicates weaknesses in the initial process and scope of the EOC review and an incomplete understanding of conditions on the plant floor.

Issue Discovery. Beginning in 2017, Y-12 personnel discovered enriched uranium accumulation in several processing areas in Building 9212. CNS initially conducted an EOC review of uranium accumulations that focused on active processes. Once the EOC review for active processes concluded, CNS conducted an EOC review for uranium accumulation in OOS equipment, starting in Building 9212 and expanding to other facilities. The EOC review consisted of walkdowns to identify abandoned equipment and generate a consolidated list of OOS equipment.

From the EOC review, CNS personnel discovered 151 OOS systems and components in Building 9212. Forty-eight of those systems and components were not bounded by an existing criticality safety evaluation (CSE) [1]. CNS categorized 8 of the 48 systems/components as deficiencies because they either had uranium holdup greater than 700 grams (g) or had an unknown amount of holdup [2]. These 8 systems/components were taken out of service before Y-12 suspended fissile material operations in 1994 due to criticality safety noncompliances. CNS categorized the remaining systems/components as minor non-compliances either because the holdup amount was between 350–700g but the system/component lacked a CSE, or because the holdup was less than 350g but the system/component was not isolated and separated per the requirements of Y-12 procedure *Criticality Safety Approval System*. These situations represented potential misalignments with ANSI/ANS-8.1-2014, which states that “[b]efore a new operation with fissionable material is begun, or before an existing operation is changed, it shall be determined that the entire process will be subcritical under both normal and credible abnormal conditions.” At a minimum, these situations meant that at some time in the past, the contractor took equipment out of service (e.g., “an existing operation [was] changed”) without clearly documenting such a determination.

CNS personnel have since dispositioned the specific deficiencies and instituted new site requirements to align the program more closely with ANSI/ANS-8.1-2014 requirements. The updated procedure, *Y70-160*, required NCS approval documents for any equipment containing greater than 350g of fissile material that is not physically isolated or separated by at least two feet from other fissile equipment. Additionally, the updated procedure required documentation for cleaning out the equipment to less than 350g fissile material holdup, or less than 700g if cleaned to the maximum extent possible [3]. CNS subsequently updated *Y70-160* to refer to a technical basis document that provides the criteria that OOS equipment must meet to not have a NCS approval document. The technical basis document contains criteria that were previously in *Y70-160* for physical isolation/disconnection [4]. The technical basis document also refers to the general handling requirement to maintain one-foot separation of fissile material from other fissile containers and equipment in lieu of the two-foot separation distance previously in the *Y70-160* exception criteria. The staff team concluded that these actions, if properly implemented according to the updated procedure, meet the intent of the ANSI/ANS standard.

CNS personnel also conducted a causal analysis for the legacy uranium holdup in OOS equipment in Building 9212. CNS personnel identified the root cause of the deficiency as **“[c]urrent standards for managing criticality safety under CNS have exceeded that established by previous contractors.”** [5] The causal analysis team identified that prior to the update of the CNS *Criticality Safety Approval System* procedure in April 2019, CNS had no quantitative requirements for canceling CSEs. The causal analysis determined that the absence of criteria for *de minimis* quantities of material led to: (1) cancellation of CSEs for systems containing between 350g and 700g of fissile material, (2) absence of requirements for safe control of hazards from enriched uranium operations, and (3) CNS’s failure to address possible holdup in excess of 350g prior to revising the *Criticality Safety Approval System* procedure. The causal tree of the causal analysis states that “[n]oncompliance with the limit was considered possible when Y70-160 was revised.” However, CNS personnel did not address these concerns prior to revising *Y70-160* because they believed that “[h]oldup of this quantity was not a

concern” and that the “[c]ondition would have been deficient regardless of when Y70-160 was revised.”

Continuing Issues. The staff team reviewed the causal analysis for the holdup discoveries in OOS equipment in Building 9212 and found it to be lacking. Additionally, the staff team concludes that CNS could make better use of IMS, given that CNS personnel did not review previous IMS entries during the EOC review and causal analysis for OOS equipment concerns. The staff team also concludes that the issue closure process could be strengthened.

Use and Closure of IMS Entries—During the OOS review, the staff team discovered an old IMS entry regarding OOS equipment from a management assessment that the previous Y-12 contractor, B&W Technical Services (B&W), performed in 2013. B&W personnel made an observation in the assessment that “[c]ertain fissile processing equipment not re-started after the 1994 shutdown but still in-place in the Facilities had their CSAs canceled, kicking them out of periodic oversight under Y70-150 Se. J. *NCS Program Monitoring*.” [6] B&W personnel handed off this concern to CNS during the contract transition, and CNS included this issue in the IMS as part of an aggregate issue from the B&W management assessment. After performing some actions, CNS personnel closed this IMS entry in October 2014 [7]. The staff team concludes that CNS did not properly close this IMS entry because it did not document performance of one action item: it stated that the NCS organization would evaluate the canceled CSEs and determine if the CSEs needed to be brought back into suspension mode and not cancelled. NPO personnel agreed with the staff team regarding the lack of closure evidence for the 2014 IMS entry. The observation B&W made in the 2013 management assessment—lack of NCS analyses for some OOS equipment—is similar to the current OOS equipment concerns that led to NCS deficiencies and minor noncompliances. CNS did not review relevant IMS entries during its OOS equipment EOC review and causal analysis, leading to omission of the 2014 IMS review that indicated concerns similar to the current OOS equipment concerns.

The staff team reviewed a sample of IMS entry closures and observed instances where a single person was responsible for both executing and approving closure actions. The staff team reviewed the *CNS Issues Management Process* procedure and noted that the roles and responsibilities for a “review closure approver” position is not defined. More specifically, the procedure does not ensure independence between the “review closure approver” and “issue owner.” [8] This lack of independence could result in inadequately closed IMS entries, specifically for issues categorized at significance levels that do not require an effectiveness review. A single person could perform the actions and approve the closure of these issues, potentially leading to improper closure of an issue like the 2014 IMS entry.

CNS is required to obtain NPO approval for closing specific issues per the *CNS Issues Management Process* procedure: 1) “if the issue is identified by a DOE O227.1 Independent Oversight or a NNSA RA/ORR,” and 2) “if the issue is for a [Weapons Quality Assurance] Level 1 or 2 finding identified in a [Quality Assurance Survey] or other NPO-approved [Action Plan].” During the staff team’s interactions, NPO personnel stated that “NPO has an opportunity to review and challenge any contractor-identified issue, but primarily relies on a healthy Contractor Assurance System [CAS] to self-regulate contractor-identified issues.” NPO may evaluate recent contractor-identified issues and corrective actions when performing an

independent assessment of a given functional area, but the determination is generally left to the assessment lead with input from their team and supervisor. For higher risk issues, NPO prioritizes and performs corrective action effectiveness assessments using its *Site Integrated Assessment Plan*. In NPO's recent assessment, *Final Report of the Fiscal Year 2020 Nuclear Criticality Integrated Assessment of Uranium Accumulations Actions*, NPO indicated that there were "several quality concerns with IMS that were identified as issues." This NPO assessment further reinforces the need to improve the contractor's IMS process.

Continuing Discoveries—During its site visit in January 2020, the staff team questioned the comprehensiveness of the walkdowns to identify all OOS equipment. CNS personnel informed the staff team that the EOC review "consisted of comprehensive walk downs in every area of 9212 to identify all abandoned equipment in the field and generate a consolidated list of OOS equipment." However, since that time CNS personnel have discovered several additional OOS items with previously unknown issues related to holdup. An example, as reported in the Board's resident inspectors' weekly report dated March 5, 2021, a criticality safety engineer discovered several plutonium-beryllium sealed sources in an OOS system in Building 9212 that did not have a criticality safety evaluation or equivalent. Additionally, as reported in the resident inspectors' weekly report dated March 19, 2021, CNS personnel identified numerous legacy items that were not labeled as non-fissile and had indications that they might contain fissile material, including an OOS centrifuge and four legacy vacuums [9, 10, 11, 12].

The staff team is concerned that CNS personnel continue to make such discoveries. While most of the newly discovered conditions likely do not pose a serious criticality safety hazard, they do indicate weaknesses in the process and scope of the EOC review that CNS used to find and categorize OOS systems when the issue first emerged in 2019. Without a robust, systematic method for categorizing plant systems and items, CNS may continue to have incomplete understanding of conditions on the plant floor.

Other Observations. As mentioned above, situations where OOS equipment have unknown quantities of holdup material represent misalignments with the expectations of ANSI/ANS-8.1-2014. Specifically, the standard states that "Before a new operation with fissionable material is begun, or before an existing operation is changed, it shall be determined that the entire process will be subcritical under both normal and credible abnormal conditions." This language, subpart 4.1.2, is known as the "process analysis requirement."

In an initial response to the Board staff team's agenda dated December 17, 2019, CNS personnel stated that "the process analysis requirement in ANSI/ANS-8.1 applies to fissionable material operations, it does not address abandoned or out of service equipment with residual amounts of fissile material." The staff team disagreed with this statement and concludes that the process analysis requirement is applicable to OOS systems. There is no separate requirement from the standard to govern equipment taken out of service in the past. After a series of discussions, NPO and CNS clarified in the response to the Board staff's agenda dated October 13, 2020, that ANSI/ANS-8.1 Subpart 4.1.2, *Process Analysis*, applies to OOS equipment. NPO personnel stated that "ANSI/ANS-8.1 Subpart 4.1.2 Process Analysis is applicable to all fissionable material operations, including legacy unused equipment in a stagnant configuration." Similarly, CNS stated that "OOS equipment with non-trivial quantities of uranium hold-up

require process analysis to demonstrate safety for normal and abnormal conditions.” The staff team concurs with the actions CNS has taken to update procedures in this area; however, the staff team will continue to emphasize that the basic requirement driving these procedural changes is in fact the process analysis requirement.

Conclusion. The staff team reviewed the hazards associated with uranium holdup in CNS-identified OOS equipment in Building 9212 to ensure the safe condition of the OOS equipment. The staff team conducted walkdowns, evaluated NCS analyses and related IMS entries. The staff team concludes that issues management processes can be better utilized by incorporating reviews of previous IMS entries during an EOC review and/or causal analysis and that the closure of issues merits strengthening to ensure independence between the issue owner and closure approval authority. Additionally, the continuing discovery of legacy OOS items indicates weaknesses in the initial process and scope of the CNS EOC review and an incomplete understanding of conditions on the plant floor. Consequently, the staff is concerned that CNS has not fully identified and addressed contributing causes to the OOS equipment issues, which could lead to related situations arising in the future.

APPENDIX

Actions to Address Out-of-Service Equipment Deficiencies

Issue Summary. Beginning in 2017, Y-12 personnel discovered enriched uranium accumulation in several processing areas in Building 9212. Consolidated Nuclear Security, LLC (CNS), initially conducted an extent-of-condition (EOC) review of uranium accumulations that focused on active processes. Once the EOC review for active processes concluded, CNS conducted an EOC review for uranium accumulation in out-of-service (OOS) equipment in Building 9212 and other nuclear facilities. The EOC review consisted of walkdowns in every area of Building 9212 to identify all abandoned equipment and generate a consolidated list of OOS equipment. CNS personnel discovered 151 OOS systems and components in Building 9212, of which 48 systems and components were not bounded by an existing criticality safety evaluation (CSE) [1]. CNS classified 8 of the 48 systems/components as deficiencies because they either had uranium holdup greater than 700 grams (g) or had an unknown amount of hold-up [2]. CNS classified the remaining systems/components as minor non-compliances either because the holdup amount was between 350–700g but the system/component lacked a CSE, or the holdup amount was less than 350g but the system/component was not isolated and separated per the requirements of Y-12 procedure *Criticality Safety Approval System*.

Specific Actions Taken to Address OOS Systems. The eight systems/components that CNS designated as deficient are:

1. HH fan room wet vacuum OOS systems
2. Auxiliary casting furnaces
3. Auxiliary casting line
4. Dry vacuum system and enclosure
5. HH spencer vacuum producer
6. OOS chip burning equipment and calciner
7. Dry filter tear down hood
8. Pulverizer equipment and enclosure

CNS personnel have conducted a new nuclear criticality safety analysis for the following systems/components: HH fan room wet vacuum OOS systems, auxiliary casting furnaces, auxiliary casting line, and dry vacuum system and enclosure [4]. For the HH spencer vacuum producer, CNS personnel identified a suspended criticality safety analysis (CSA) that is reviewed triennially. For the OOS chip burning equipment and calciner, CNS personnel discovered a legacy CSA and evaluated it to be bounding; additionally, the legacy CSA was reactivated as “suspended,” which will ensure review of the system triennially. For the dry filter tear down hood and the pulverizer equipment and enclosure, CNS personnel quantified the system to contain less than 700g of uranium via nondestructive assay and re-classified it as a minor non-compliance.

The staff team reviewed the risk ranking of the OOS systems/components, causal analysis, and applicable nuclear criticality safety (NCS) analyses, procedures, and issues management system entries. In January 2020, the staff team walked down several of these

systems to assess the risks and discuss the path forward with the National Nuclear Security Administration's Production Office (NPO) and CNS personnel. The staff team did not identify any immediate criticality safety concerns regarding the identified OOS equipment or systems. In general, these systems are large and complex, or else contain holdup levels only slightly greater than one critical mass (700g of uranium). Consequently, most systems and components are configured in such a way that accidental assembly of a critical mass is not credible.

The staff team believes that CNS introduced adequate requirements in the updated *Criticality Safety Approval System* procedure to ensure the safety of future OOS equipment, if implemented properly. *Y70-160* was subsequently updated to refer to a technical basis document that provides the criteria that OOS equipment must meet to not have a NCS approval document. The technical basis document contains criteria previously provided in *Y70-160* for physical isolation/disconnection [4]. The technical basis document also refers to the general handling requirement to maintain one-foot separation of fissile material from other fissile containers and equipment in lieu of the two-foot separation distance previously in the *Y70-160* exception criteria.

CNS personnel plan to use the risk-ranking results of the *Out of Service Equipment Risk in 9212* analysis as an input to the 9212 Transition Strategy Program to determine priorities for legacy equipment remediation. For fiscal year 2021, CNS personnel plan to isolate 11 OOS systems. CNS personnel plan to use change packages to isolate and, if needed, clean the OOS systems to comply with the fissile material cleanout thresholds and documentation requirements of the updated *Criticality Safety Approval System* procedure.

References

- [1] Consolidated Nuclear Security, LLC, *Out of Service Equipment Risk in 9212*, RP 9212-F-0239-000-00, October 2019.
- [2] Consolidated Nuclear Security, LLC, *NCS Field Report*, DEF-024-2019 Rev.2, February 19, 2020.
- [3] Consolidated Nuclear Security, LLC, *Criticality Safety Approval System*, Y70-160, March 24, 2019.
- [4] Consolidated Nuclear Security, LLC, *Basis of Nuclear Criticality Safety for Equipment Removed from Service*, RP YAREA-F-1724-000-00, January 2020.
- [5] Consolidated Nuclear Security, LLC, *Causal Analysis: Legacy Holdup in Out-of-Service Equipment in Building 9212 (NCS DEF 024-19)*, RP 9212-F-0244-000-00, November 2019.
- [6] B&W Technical Services Y-12, LLC, *Management Assessment Report Compliance with Y70-163 Review Criteria 3.2, 4.9, 6.6, 8.9*, December 2013.
- [7] Consolidated Nuclear Security, LLC, *Issue Number 31151999*, October 23, 2014.
- [8] Consolidated Nuclear Security, LLC, *CNS Issues Management Process*, E-PROC-0006, November 2019.
- [9] Defense Nuclear Facilities Safety Board, *Oak Ridge Activity Report for Week Ending February 26, 2021*, February 2021.
- [10] Defense Nuclear Facilities Safety Board, *Oak Ridge Activity Report for Week Ending March 5, 2021*, March 2021.
- [11] Defense Nuclear Facilities Safety Board, *Oak Ridge Activity Report for Week Ending March 19, 2021*, March 2021.
- [12] Defense Nuclear Facilities Safety Board, *Oak Ridge Activity Report for Week Ending March 26, 2021*, March 2021.
- [13] Consolidated Nuclear Security, LLC, *NCS Field Report*, MNC-018-19, October 17, 2019.
- [14] Consolidated Nuclear Security, LLC, *Y-12 Issues Management Process*, Y15-312, December 2019.

- [15] B&W Technical Services Y-12, LLC, *Extent of Condition Review – IMS Issue 31151999*, April 2014.