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**DEFENSE NUCLEAR FACILITIES
SAFETY BOARD**

Washington, DC 20004-2901



May 11, 2017

The Honorable Frank G. Klotz
Administrator
National Nuclear Security Administration
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0701

Dear Administrator Klotz:

The annual reporting requirement regarding the safety of Y-12's 9212 Complex established by our March 13, 2007, letter to the NNSA Administrator is terminated. The Y-12 extended life program and associated safety strategy mitigates the risks associated with aging infrastructure. The program has many positive aspects that may be worth replicating at other defense nuclear sites.

The attached staff report is provided for your information and use.

Sincerely,

A handwritten signature in black ink, appearing to read "Sean Sullivan", written in a cursive style.

Sean Sullivan
Chairman

Enclosure

c: Mr. Joe Olencz

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

March 16, 2017

MEMORANDUM FOR: S. A. Stokes, Technical Director

COPIES: Board Members

FROM: R. Oberreuter

SUBJECT: Y-12 National Security Complex Extended Life Program Safety Strategy

Members of the Defense Nuclear Facilities Safety Board's (Board) staff conducted a review of the safety strategy [1] for the Y-12 National Security Complex (Y-12) extended life program (ELP) for Building 9204-2E and the 9215 Complex. The staff team conducted the on-site review November 9–10, 2016. The staff team discussed additional lines of inquiry with Consolidated Nuclear Security, LLC (CNS) and National Nuclear Security Administration (NNSA) Production Office (NPO) personnel via teleconference on November 30, 2016, and January 18, 2017.

The Board's staff review team found the initiatives taken by CNS and NPO in documenting key safety basis-related assumptions, decisions, and scheduled activities to be a positive step. As a living document, the ELP safety strategy will continue to evolve to provide additional specificity and refinement regarding the planned evolution of the 9215 Complex and Building 9204-2E safety bases. In its review of the safety strategy, the staff team identified the following areas as requiring further development: facility structures, nuclear criticality safety, and confinement.

Background. In 2014, NNSA reduced the planned operational scope of the Uranium Processing Facility (UPF) project [2]. As a result, certain uranium processing operations, such as component fabrication, assembly, disassembly, and surveillance, will remain in the existing 9215 Complex and Building 9204-2E for at least 25 more years (through 2040 for the 9215 Complex and beyond 2040 for Building 9204-2E).

On January 28, 2016, CNS issued a report with recommendations [3] for extending the operational lives of the 9215 Complex and Building 9204-2E, built in the 1950s and late 1960s respectively. The report recommended performing requirements gap analyses in parallel with continuing risk reduction initiatives intended to reduce material at risk (MAR) inventories to near "just-in-time" levels. In these gap analyses, CNS investigated gaps between the current capabilities of the facilities and modern requirements, and recommended closing gaps in the areas of safety basis (including confinement), natural phenomena hazards design, fire protection,

and electrical systems. NPO and the Y-12 contractors historically had accepted these gaps, in part, because the facilities were assumed to have limited operational lives and would eventually be replaced by UPF.

NPO directed CNS to “develop a safety strategy for NPO approval which identifies the scope, priority, and actions required to execute the proposed risk reductions and resolve any gaps in meeting applicable requirements captured in the ELP Report” on April 14, 2016 [4], and on June 30, 2016, CNS issued the safety strategy. On August 31, 2016, the NNSA Chief of Defense Nuclear Safety issued a memo to the NPO Assistant Manager for Nuclear Safety and Engineering containing advice regarding approval of the ELP safety strategy [5]. NPO sent a letter to CNS approving the ELP safety strategy on September 1, 2016, [6].

Department of Energy Requirements. Department of Energy (DOE) Order 420.1C, *Facility Safety*, contains programmatic requirements (e.g., nuclear criticality safety) that are applicable to all DOE nuclear facilities, as well as facility requirements (e.g., nuclear safety design criteria) applicable to new facilities and major modifications to existing facilities. The safety strategy states that while the existing safety bases for the ELP facilities “were prepared consistent with” the previous revision of the order, DOE Order 420.1B, CNS used the *programmatic* requirements from DOE Order 420.1C, along with its associated guides and standards, to identify key regulatory gaps to address in the ELP. The safety strategy also compares the capabilities of Building 9204-2E and the 9215 Complex with certain DOE Order 420.1C *facility* requirements. The CNS safety strategy [1] identified the following notable gaps to DOE Order 420.1C requirements:

Safety Controls—“Safety-SSCs [structures, systems, and components] and safety software must be designed to perform their safety functions when called upon” (DOE Order 420.1C, Attachment 2, Chapter I, section 3.b(6)). The 9215 Complex facility structure cannot withstand certain design basis events commensurate with its safety-significant designation.

Nuclear Criticality Safety—“Criticality safety evaluations must show that entire processes involving fissionable materials will remain subcritical under normal and credible abnormal conditions, including those initiated by design basis events” (DOE Order 420.1C, Attachment 2, Chapter III, section 3.f). Criticality safety evaluations for both Building 9204-2E and 9215 Complex processes cannot demonstrate that processes remain subcritical following certain design basis events.

Confinement—“Hazard category 1, 2, and 3 nuclear facilities with uncontained radioactive materials...must have the means to confine the uncontained radioactive materials to minimize their potential release in facility effluents during normal operations and during and following accidents, up to and including design basis accidents (DBAs)...An active confinement ventilation system [is] the preferred design approach for nuclear facilities with potential for radiological release. Alternate confinement approaches may be acceptable if a technical evaluation demonstrates that the alternate confinement approach results in very high assurance of the confinement of radioactive materials” (DOE Order 420.1C, Attachment 2, Chapter I, section 3.b(3)). Neither Building 9204-2E nor the 9215 Complex have active confinement ventilation

systems, and CNS has not performed analyses to demonstrate the facility structures can provide high assurance of confinement of radioactive materials.

Staff Team Review. The Board’s staff review team found the initiative taken by CNS and NPO in documenting key safety basis-related assumptions, decisions, and scheduled activities to be a positive step. As a living document, the ELP safety strategy will continue to evolve to provide additional specificity and refinement regarding the planned evolution of the 9215 Complex and Building 9204-2E safety bases. In its review of the safety strategy, the staff team identified the following areas as requiring further development: facility structures, nuclear criticality safety, and confinement.

Facility Structures—The 9215 Complex facility structure cannot withstand certain design basis events commensurate with its safety-significant designation as discussed in the safety strategy [1]. This is contrary to DOE Order 420.1C (as well as DOE Order 420.1B), which requires safety controls “be designed to perform their safety functions when called upon.” In the safety strategy, CNS proposed to perform structural reanalysis of Building 9204-2E and, if necessary, upgrade the facility to meet seismic design category (SDC)-2 requirements commensurate with a new safety-significant facility structure. At that time, per the safety strategy, CNS would only consider identifying practicable upgrades to the 9215 Complex and would not attempt to demonstrate that it could meet SDC-2 performance requirements.¹

Subsequent to issuing the safety strategy, CNS enlisted a panel of structural engineering experts to walk down the ELP facilities and provide recommendations for future analyses and upgrades. The expert panel recommended reanalysis of both the 9215 Complex and Building 9204-2E, and suggested that it may be possible to upgrade both facilities to meet SDC-2 requirements. During the staff’s on-site review of the safety strategy, CNS personnel indicated that they intended to pursue the path recommended by the expert panel. The staff team is encouraged by this change in approach. Combined with near-term actions to aggressively reduce facility MAR, the approach represents an appropriate strategy to address this requirements gap. The staff team suggested CNS add discussion of the reanalysis and potential upgrades to the next safety strategy revision to codify the path forward. The staff team plans to review these efforts as they progress. The outcome of the reanalysis and potential upgrades could have significant bearing on resolving additional requirements gaps.

Nuclear Criticality Safety—DOE Order 420.1C, Attachment 2, Chapter 3, states: “Criticality safety evaluations must show that entire processes involving fissionable materials will remain subcritical under normal and credible abnormal conditions, including those initiated by design basis events.” This programmatic requirement applies to both existing facilities and new facilities. The safety strategy indicates that nuclear criticality safety analyses are unable to demonstrate that processes remain subcritical following certain design basis events in both the 9215 Complex and Building 9204-2E. During the review, the staff team learned that the design basis events of concern are those for which the post-event configuration of the facility structures would be unknown. These events include natural phenomena events, aircraft impacts, and large

¹ CNS viewed Building 9204-2E as the more structurally sound of the two facilities and therefore a likelier candidate to bring into compliance with modern structural requirements, whereas CNS viewed the 9215 Complex as being either impossible or very costly to bring into compliance.

fires that overwhelm the fire suppression systems and cause significant structural damage. CNS has not conducted quantitative analyses of Building 9204-2E and the 9215 Complex to predict the structural configuration following such events. CNS criticality safety analysts therefore assume that nuclear materials could be affected in such a way as to make criticality accidents credible.

In the safety strategy approved by NPO on September 1, 2016, CNS recommends that NNSA continue to accept this regulatory gap. The staff team questioned this decision given that DOE Order 420.1C requires processes be evaluated to ensure subcriticality following credible design basis events. During a follow-up teleconference with CNS and NPO personnel, CNS personnel indicated that following the planned structural evaluations that are part of the ELP, CNS analysts will use the updated quantitative analyses to determine specific criticality safety vulnerabilities and identify potential compensatory measures. These criticality safety analyses are anticipated to begin in the 2020 timeframe. CNS personnel intend to update the ELP safety strategy to reflect this path forward and submit it to NPO for approval.

When the staff team asked if CNS or NPO were considering near-term compensatory actions, CNS personnel pointed to ongoing MAR reduction activities as providing a reduction in overall facility hazard. While the staff team acknowledges that reducing MAR reduces hazards, it does not fundamentally address the need to demonstrate that processes remain subcritical following design basis events. Overall, the staff team agrees with the approach proposed by CNS: short of deinventorying the facilities, the direct path toward improving the post-design basis criticality safety of Building 9204-2E and the 9215 Complex will involve pursuing natural phenomena analyses, structural analyses, criticality vulnerability studies, and targeted upgrades. The sequential nature of these activities makes the anticipated 2020 timeframe for updated criticality safety analyses reasonable. The staff team finds that updating the safety strategy to reflect this revised approach would represent a significant improvement in CNS and NPO's path forward for addressing the potential for post-design-basis event criticalities in these facilities. The staff team will evaluate the long term acceptability of this strategy once CNS has completed the analyses and identified intended structural upgrades.

Confinement Ventilation—Neither Building 9204-2E nor the 9215 Complex have active confinement ventilation systems, and both facilities would face loss of passive confinement capability following certain design basis events as discussed in the safety strategy [1]. In the safety strategy, CNS proposed re-performing confinement technical evaluations (originally performed in response to Board Recommendation 2004-2, *Active Confinement Systems*) using planned just-in-time material inventories and updated facility lifetimes. However, the means by which CNS will demonstrate that the facilities maintain confinement following design basis events remained unclear.

During the review, the staff team learned that CNS intends to use revisions to the Recommendation 2004-2 confinement technical evaluations as the vehicle for determining whether and/or how the ELP facilities provide very high assurance of confinement. The staff team plans to review the technical evaluations when they are available. The staff team notes, however, that the success of this approach is largely contingent on demonstrating the facilities'

structures are able to survive design basis events and, if an active confinement capability is not added, demonstrating the structures can provide a passive confinement function.

Conclusion. The Board's staff review team is encouraged by the initiative taken by CNS and NPO in documenting key safety basis-related assumptions, decisions, and scheduled activities. As a living document, the ELP safety strategy will continue to evolve to provide additional specificity and refinement regarding the planned evolution of the 9215 Complex and Building 9204-2E safety bases. The staff team believes that CNS and NPO should continue to pursue reanalysis and upgrade of the ELP facility structures, as well as improved strategies for addressing post-design basis event criticality scenarios and providing confinement of radioactive materials.

References

- [1] Consolidated Nuclear Security, LLC, *Safety Strategy for the Extended Life Program, Buildings 9204-2E and 9215*, June 2016.
- [2] UPF Red Team, *Final Report of the Committee to Recommend Alternatives to the Uranium Processing Facility Plan in Meeting the Nation's Enriched Uranium Strategy*, April 15, 2014.
- [3] Consolidated Nuclear Security, LLC, *Extended Life Program Buildings 9204-2E and 9215*, January 2016.
- [4] Beausoleil, G.L., Manager, National Nuclear Security Administration Production Office, Letter to W.C. Tindal, Vice President and Y-12 Site Manager, Consolidated Nuclear Security, LLC, April 14, 2016.
- [5] Roberson, J.L., Chief of Defense Nuclear Safety, National Nuclear Security Administration, Memorandum to K.A. Hoar, Assistant Manager of Nuclear Safety and Engineering, National Nuclear Security Administration Production Office, August 31, 2016.
- [6] Ivey, K.D., Safety Basis Approval Authority, and C. McFall, Associate Deputy Manager for Operations Y-12, National Nuclear Security Administration Production Office, Letter to A.S. Boser, Director Y-12 Engineering, Consolidated Nuclear Security, LLC, September 1, 2016.