Department of Energy
Under Secretary for Nuclear Security
Administrator, National Nuclear Security Administration
Washington, DC 20585

February 24, 2023

The Honorable Joyce L. Connery
Chair, Defense Nuclear Facilities Safety Board
625 Indiana Ave, NW, Suite 700
Washington, DC 20004

Dear Chair Connery:

This letter and the enclosed report are provided on behalf of the Secretary of Energy in response to your November 18, 2022, letter regarding reactive material hazards at the Y-12 National Security Complex (Y-12) in Oak Ridge, Tennessee. The Defense Nuclear Facilities Safety Board (Board) Staff Report enclosed with your letter highlighted opportunities to improve Y-12's safety posture by enhancing analysis and controls of uranium pyrophoric and chemical reactivity hazards. The Department of Energy (DOE) is committed to continuous improvement and appreciates your input and expertise as new technologies, process modernization, and associated process changes are evaluated and authorized.

DOE's National Nuclear Security Administration (NNSA) worked with Y-12's management & operating contractor, Consolidated Nuclear Security, LLC (CNS), to confirm that adequate controls and programs are in place to protect workers from the hazards posed by reactive materials. NNSA and CNS agree that there are opportunities to improve upon the corrective actions initially taken in response to events cited in the report enclosed with the Board's letter. NNSA and CNS have taken steps to improve training for operators and supervisors on how to appropriately respond to uranium pyrophoric events. During the past several years, NNSA and CNS also made several improvements to strengthen the evaluation of process changes that could affect chemical reactivity of uranium, including unintended consequences for downstream processes. NNSA and CNS are committed to improving the documented analysis of uranium pyrophoric and chemical reactivity hazards with the potential for a sudden energy release event. These improvements and corrective actions are further described in the enclosed report.

DOE/NNSA appreciates the Board's observations and insights and will coordinate with your staff to conduct a briefing specific to the enclosed report. If you have any questions, please contact Ms. Teresa Robbins, Manager, NNSA Production Office, at (865) 576-0841.

Sincerely,

Jill Hruby

Enclosure

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Response to Defense Nuclear Facilities Safety Board,
Hazards at Y-12 Associated with Reactive Materials

The Defense Nuclear Facilities Safety Board (Board) conducted a review of enriched uranium purification and recovery processes at the Y-12 National Security Complex (Y-12) in Oak Ridge, Tennessee to assess how reactivity hazards associated with uranium material forms (e.g., chips, briquettes, and buttons) are evaluated and controlled. The Board's primary concern was that additional actions are needed to implement safety controls that address facility worker hazards related to uranium pyrophoric events and other aspects of uranium chemical reactivity consistent with Department of Energy (DOE) guidance, specifically:

- Y-12 should improve controls to prevent and mitigate facility worker impacts from a uranium pyrophoric fire with a sudden energy release.

- Y-12's evaluation of process changes does not adequately identify uranium chemical reactivity hazards.

Actions taken by DOE's National Nuclear Security Administration (NNSA) and Y-12's management & operating contractor, Consolidated Nuclear Security, LLC (CNS), to address the Board's concerns are described below.

Y-12 should improve controls to prevent and mitigate facility worker impacts from a uranium pyrophoric fire with a sudden energy release.

- In response to the Board's review, Y-12 personnel recognized that formal documentation of chemical reactivity hazards with the potential for a sudden energy release can be improved. The Y-12 procedures that govern development of hazard analysis documentation are in the process of being revised. This effort is scheduled to be completed no later than the end of fiscal year 2023.

- The Board also expressed concern that Y-12 has not incorporated lessons learned from the uranium pyrophoric events cited in Table 1 and Appendix A of the Board's September 1, 2022, Staff Report on the safety basis safety control strategy for new technologies. The aforementioned improvements to hazard analysis documentation will be applied to ongoing projects involving new technologies (i.e., electrorefining, calciner, direct chip melt, and the Uranium Processing Facility project).

- Y-12 personnel have performed a comprehensive review of the hazard evaluation studies for operations involving reactive materials and have determined that credible scenarios have been evaluated and current control strategies are adequate. Safety-significant controls have been identified and implemented when warranted.

- As detailed in DOE-HDBK-1224-2018, *Hazard and Accident Analysis Handbook*, there are parameters that need to be present for complex phenomena like dust explosions and sudden energy release scenarios to occur. Consistent with DOE-STD-3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*, for those operations where a scenario is plausible and could lead to a prompt fatality or serious

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injury to the facility worker, the subject scenario is analyzed in the applicable hazards analysis, and safety-significant controls are applied to prevent or mitigate the scenario. None of the 15 events cited in the Board's report could have credibly resulted in a prompt fatality or serious injury to the facility worker due to: (a) a lack of intermixing of fuels and oxidizers in a manner that maximizes contact area and (b) lack of confinement, which precludes pressure buildup.

- Safety Management Programs (e.g., Fire Protection, Configuration Management, Emergency Response, Procedures and Training) are established and implemented at Y-12 consistent with the guidance and requirements of federal regulations, DOE Directives, and industry consensus standards. Application of these programs to Y-12 operations helps ensure that the parameters necessary for sudden energy release scenarios to occur are minimized, as practical, to provide reasonable assurance of adequate protection.

- The Board evaluated 15 specific pyrophoric events that occurred at Y-12 during the past 6 years. The staff determined that operator and firefighter response to these events was inconsistent with the recommendations contained in DOE Handbook 1081-2014, *Primer on Spontaneous Heating and Pyrophoricity*. In response to these events and feedback received from the Board's staff, NNSA and CNS made improvements to Y-12 training programs associated with enriched uranium pyrophoric and chemical reactivity hazard events, including clarification on the specific actions to be taken if a pyrophoric event occurs. The DOE Handbook includes guidance for actions to be taken if a uranium pyrophoric event occurs. Suggested actions include manual extinguishment, use of process chemicals, and self-extinguishment, all of which were clearly addressed in the training improvements. In response to the concerns raised by the Board, NNSA and CNS leadership have committed to ensure training improvements are sustained via incorporation of the training in qualification requirements for both operators and supervisors, in addition to ensuring facility drill programs routinely address these types of reactive material events. Following each event, NNSA and CNS also evaluated the conditions that led to the unplanned uranium pyrophoric reaction and, when possible, implemented process improvements to minimize the potential for recurrence. CNS will ensure that these improvements are applied to other applicable process areas, taking the form of the material and nature of the operation into consideration.

- Nine of the 15 pyrophoric events noted in the Board's report involved the backlog of uranium briquettes stored in lock boxes awaiting processing into a safer material form. These events led NNSA and CNS leadership to initiate a high-priority campaign to complete processing the backlog of briquettes. This campaign was completed in 2022.

Y-12's evaluation of process changes does not adequately identify uranium chemical reactivity hazards.

The Board's Staff Report cites training, configuration management, and process review improvement actions initiated by Y-12 personnel to address unintended process change. Specific actions of particular relevance to the Board's concern include the following:

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- Subsequent to the examples of inadequately evaluated process changes cited in the Board's report, Y-12 personnel revised the change control process to actively evaluate if conditions resulting from proposed changes to operations could result in unintended chemical reactivity hazards. Specifically, the change control process and associated documentation were revised to include questions related to potential chemical reactivity hazards, which require review by Process Engineering, System Engineering, and Operations personnel.

- Y-12 personnel have developed and are actively implementing statistical process controls that will monitor process chemical changes that could lead to unexpected changes in chemical reactivity. These statistical process controls are currently being implemented for operations in Building 9212, but will subsequently be adopted in other nuclear facilities at Y-12. These improvements are being incorporated into the qualification program for process engineers.

- To ensure assumptions related to material form in process safety analyses remain bounding and that only those material forms of uranium that have been previously evaluated for the process are introduced, improvements have been made to how material form codes are utilized and implemented. These improvements have been incorporated into material form code training for operators and supervisors.

NNSA and CNS appreciate the effort put forth by the Board to research and evaluate the adequacy of Y-12's control strategies to ensure that facility worker hazards related to uranium pyrophoricity and reactive materials are addressed. The Board's feedback enables NNSA and CNS to take additional actions to improve the safety posture of Y-12. NNSA and CNS look forward to continuing to work with the Board's staff to ensure the improvement actions being taken are effective at minimizing the risk to the workforce.

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