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**DEFENSE NUCLEAR FACILITIES
SAFETY BOARD**

Washington, DC 20004-2901



April 5, 2023

Mr. William I. White
Senior Advisor
Office of Environmental Management
US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Mr. White,

The Defense Nuclear Facilities Safety Board (Board) completed a review of the Savannah River National Laboratory (SRNL) safety basis. As SRNL leadership takes steps to expand programmatic activities under the Department of Energy's (DOE) new laboratory-focused management and operations contract, the Board is concerned that several long-standing safety basis deficiencies remain unresolved.

In prior correspondence addressed to the Secretary of Energy, the Board identified issues pertaining to the SRNL safety basis that involved improper designation of specific administrative controls and inappropriate classification of vital fire protection equipment. As detailed in the enclosure, these deficiencies fail to satisfy DOE's nuclear safety requirements and threaten to undermine the reliability of administrative and engineered controls that are credited to ensure continued safe operation of the SRNL nuclear facility. While work continues to upgrade and modernize the SRNL safety basis, the Board's recent review found that these previously communicated safety concerns persist.

The Board appreciates that DOE and SRNL management intend to undertake several important remedial steps, including action to re-evaluate relevant specific administrative control determinations at the laboratory. However, the overall plan and schedule to resolve persistent SRNL safety deficiencies remain unclear. Therefore, pursuant to 42 United States Code §2286b(d), the Board requests a briefing and report within 120 days of receipt of this letter. The briefing and report should describe the planned actions and associated timeline to address the

improper designation of specific administrative controls and inappropriate classification of fire protection equipment or provide DOE leadership's position as to why additional corrective actions are not required.

Sincerely,

A handwritten signature in black ink, appearing to read "Joyce L. Connery". The signature is fluid and cursive, with the first name being the most prominent.

Joyce L. Connery
Chair

Enclosure

c: The Honorable Jennifer Granholm
The Honorable Jill Hruby
Mr. Michael Budney
Mr. Joe Olencz

Staff Report

February 1, 2023

Savannah River National Laboratory Safety Basis Review

Summary. The staff of the Defense Nuclear Facilities Safety Board (Board) reviewed Revision 2 (Rev. 2) of the Savannah River National Laboratory (SRNL) documented safety analysis (DSA) and technical safety requirements (TSR). While Department of Energy (DOE) approval of Rev. 2 represented an important step in modernizing the SRNL safety basis, several safety issues threaten to undermine the long-term reliability and effectiveness of credited SRNL controls and fail to satisfy DOE's nuclear safety requirements.

The deficiencies of primary concern involve improper designation of specific administrative controls (SAC) and inappropriate functional classification of key fire protection equipment. The Board identified similar issues in past correspondence to the Secretary of Energy. Following interactions with the Board's staff, DOE and laboratory personnel determined they will take several important corrective actions, particularly related to SAC designations; however, additional management attention is necessary to ensure these persistent issues are resolved in upcoming SRNL safety basis revisions.

Background. Nuclear operations at SRNL are currently governed by Rev. 21 of a legacy safety basis that has been repeatedly revised over time to address deficiencies. Laboratory personnel have been working for nearly a decade to produce an upgraded and modernized SRNL safety basis that includes major updates to facility hazard and accident analyses and control selection. Prior efforts to replace the legacy SRNL safety basis with proposed upgrades (Rev. 0 and Rev. 1) have been unsuccessful. In December 2021, as part of the longstanding campaign to improve and modernize the SRNL safety basis, DOE's Savannah River Operations Office approved Rev. 2 of SRNL's DSA and TSRs.

The Board's staff performed a review of this approved safety basis to evaluate the adequacy of the hazard and accident analyses, the efficacy of credited safety controls, and the resolution of previously identified safety issues communicated in prior Board correspondence to DOE leadership. The Board's staff conducted the onsite portion of this review in April 2022 and held a follow-up interaction with site personnel in October 2022.

After performing initial work to implement the approved Rev. 2 of the SRNL safety basis, DOE and laboratory management halted implementation activities prior to completion. Site personnel based this decision on the emergence of unanticipated implementation challenges and the desire to support a new programmatic mission. SRNL personnel are currently preparing a new safety basis revision (Rev. 3) that will address implementation issues and support the new mission activity.

Discussion. DOE approval of Rev. 2 of the SRNL DSA and TSRs represented an important step in upgrading and modernizing the laboratory's safety basis. Despite this progress,

several safety issues threaten to undermine the long-term reliability and effectiveness of credited SRNL controls and fail to satisfy DOE's nuclear safety requirements. Key deficiencies identified in Rev. 2 are described below to inform ongoing SRNL safety basis revision activities.

Designation of Specific Administrative Controls—Administrative controls play a vital role in the SRNL safety strategy to protect workers and the public. DOE created the SAC classification to enhance the reliability and effectiveness of administrative protocols that have a level of importance similar to safety-related engineered features. Requirements established in DOE Standard 3009-94 Change Notice 3 (CN3), *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, and DOE Standard 1186-2004, *Specific Administrative Controls*, direct administrative controls to be designated as SACs if they meet the following criteria:

- The administrative control is identified in the DSA as a control needed to prevent or mitigate an accident scenario; and
- The administrative control has a safety function that would be safety significant or safety class if the function were provided by an engineered structure, system, or component.

In ten instances, Rev. 2 of the SRNL safety basis relies on administrative controls that meet both criteria above, but in each case the safety basis fails to identify an associated SAC, contrary to DOE requirements. The table below summarizes information related to these ten administrative controls, including the functional classification (i.e., safety class or safety significant) assigned by the safety basis and the number of accident scenarios that rely on each control to perform a preventive or mitigative safety function.

The controls in Table 1 are identified in Rev. 2 of the SRNL safety basis as programmatic administrative controls rather than SACs. However, DOE Standard 3009-94 CN3 states:

*...programmatic administrative controls should not be used to provide preventive or mitigative functions for accident scenarios identified in the safety basis where the safety function has importance similar to, or the same as the safety function of safety-class or safety-significant SSCs. **The classification of SAC was specifically created for this safety function.** [emphasis added]*

In a letter to the Secretary of Energy dated September 13, 2017, the Board communicated similar issues regarding safety bases at SRS facilities, including SRNL, relying on programmatic administrative controls to perform credited safety functions in lieu of SACs. The Board emphasized that this practice is inconsistent with DOE requirements for SACs and can lead to inadequate design, implementation, and maintenance of safety-related administrative controls.

Table 1. Credited SRNL Administrative Controls without SAC Designations

Administrative Control	Events Crediting Prevention or Mitigation	Safety Class / Safety Significant
Safety Class Safety Protection Prog. Prevent Direct Flame Impingement	43	Safety Class
Tritium Handling Program	8	Safety Significant
Structural Integrity Program	5	Safety Significant
Conduct of R&D Program	3	Safety Significant
Hoisting and Rigging Program	3	Safety Significant
Fire Protection Program	2	Safety Significant
Radioactive Waste Program	2	Safety Significant
Explosive Control Program	1	Safety Significant
Traffic Control Program	1	Safety Significant
Energetic Container Control Prog.	1	Safety Significant

Following interactions with the Board’s staff, contractor management created a commitment in the site issues management system to re-evaluate SAC determinations for administrative controls credited to perform safety functions in the SRNL safety basis. The results of this re-evaluation are expected to inform development of Rev. 3 of the SRNL safety basis. Contractor management also documented a commitment in the issues management system to revise the site procedure governing the SAC designation process to better align with DOE requirements.

Safety Significant Boundary of the Fire Water Supply and Sprinkler System—Rev. 2 of the SRNL safety basis credits the fire water supply and sprinkler system as a safety significant control to mitigate postulated accident consequences to workers from a broad range of operational (i.e., non-seismically-induced) fire scenarios. Key elements of this engineered system include a dedicated fire water storage tank, a fire water storage tank low-level alarm, fire pumps, external fire water supply piping, and a sprinkler system network inside the facility. Each of these elements is necessary for the system to meet performance requirements specified by the safety basis, but Rev. 2 only assigns a safety significant classification to the tank’s low-level alarm and the facility sprinkler system network. The balance-of-system components are classified as general service.

The general service external piping and fire pumps support the safety significant function of the system by ensuring facility sprinklers have an adequate supply water at operating pressure. DOE Standard 3009-94 CN3 includes the following requirement governing functional classification of support systems:

Identify SSCs [structures, systems, or components] whose failure would result in a safety-significant SSC losing the ability to perform its required safety function.

These SSCs would also be considered safety-significant SSCs for the specific accident conditions or general rationale for which the safety-significant designation was made originally.

At SRNL, failure of external supply piping or fire pumps would result in the safety significant sprinklers losing the ability to perform their required safety function; however, supply piping and fire pumps are classified as general service rather than safety significant, contrary to DOE requirements. The Board communicated similar concerns in correspondence to the Secretary of Energy, dated August 7, 2020.

Regarding the classification of fire water supply components, the SRNL safety basis notes that equipment was downgraded from safety significant to general service during execution of the A-Area Firewater Repair/Replacement Project. This project was established to replace legacy fire water supply components that had degraded and were at risk of catastrophic failure, including a leaking water storage tank and poorly performing fire pumps.

Rev. 2 of the safety basis summarizes site management's position that downgrading components to a general service classification expedited the replacement of failing equipment and hastened the elimination of attendant safety risks. Additionally, since replacement equipment was designed and installed in accordance with National Fire Protection Association (NFPA) codes and standards, the safety basis argues that the reliability of the resulting NFPA-compliant general service system does not differ significantly from a safety significant system.

Expeditious risk reduction was warranted when legacy fire water supply equipment was exhibiting the potential for further degradation or outright failure. Nevertheless, now that the A-Area Firewater Repair/Replacement Project is complete, ensuring newly installed equipment is classified appropriately is essential to safeguarding the long-term reliability and effectiveness of SRNL's fire water supply system. Requirements codified in DOE Standard 3009 govern the assignment of functional classifications, even for systems that fully comply with industry (e.g., NFPA) codes and standards.

Systems classified as safety significant in accordance with DOE requirements are subjected to an elevated level of visibility and rigor that promote reliable and effective performance over time. As an example, safety significant controls require coverage in facility TSRs, whereas general service systems do not. For active components like fire pumps, TSR coverage includes specification of limiting conditions for operation, surveillance requirements, and formal response actions to be taken if equipment becomes inoperable.

In situations where safety basis requirements identify a need to upgrade the functional classification of existing controls, SRS has developed a backfit analysis procedure to guide the process. A backfit analysis determines the necessary and sufficient set of actions required to support the elevated classification and the process includes elements designed to prevent gratuitous or counter-productive rework. Backfit analyses have already been performed for several SRNL safety systems, including facility sprinklers. Applying the backfit analysis process could be a valuable initial step in upgrading the functional classification of fire water supply piping and fire pumps to safety significant. A classification upgrade facilitated by backfit

analysis would achieve compliance with DOE Standard 3009 requirements and safeguard the long-term reliability and effectiveness of a key safety support system.

Control of Material at Risk (MAR) Undergoing “Temporary Confinement Changes”— Safety class safes are a critical element of SRNL’s control strategy to protect public health and safety. The SRNL safety basis relies on these robust safes to maintain confinement integrity under all postulated accident conditions to prevent the release of any MAR protected inside. Rev. 2 of the safety basis extends this concept of protection to situations involving “temporary confinement changes.” Under a temporary confinement change condition, the safety basis allows MAR to be physically removed from a safety class safe, but still treats the material as fully protected from damage and release in an accident.

The SRNL safety basis requires activities conducted under the temporary confinement change allowance to be non-intrusive, non-experimental, continuously attended by facility personnel, and limited in duration to a single shift. Within these constraints, the safety basis presumes an operator will always be positioned to quickly restore affected MAR to the protection of a safety class safe if accident conditions develop during a temporary confinement change.

However, Rev. 2 of the safety basis imposes no limit on the number of items or the quantity of MAR that can be involved in a temporary confinement change. This creates a vulnerability in which MAR can be removed and arranged in a manner that does not ensure timely return to a safety class safe. As an example, under temporary confinement change conditions specified in Rev. 2, ten items containing MAR could be removed from a safe and placed in ten remote locations around a room. In this case, a rapidly developing accident sequence could impact MAR before facility personnel could collect and restore all items to the protection of a safety class safe.

The potential for MAR to be damaged and released while undergoing temporary confinement changes invalidates key assumptions in the accident analysis underpinning the SRNL safety basis. Following interactions with the Board’s staff, SRNL management acknowledged this vulnerability and agreed to strengthen controls associated with temporary confinement changes in the upcoming Rev. 3 of the SRNL safety basis.

Safety Integrity Level Determinations for Safety Instrumented Systems—SRNL relies on safety instrumented systems to protect facility and collocated workers from hazards stemming from flammable gas accumulation in process enclosures. Rev. 2 of the safety basis credits loss of air flow alarms as a preventive control for postulated explosion events. The SRS Engineering Standards Manual, in a section titled, *Application of ISA 84.00.01-Part 1 for SRS Non-reactor Facilities*, requires safety instrumented systems that protect collocated workers to be evaluated using the layer of protection analysis (LOPA) methodology.

For SRNL’s safety significant loss of air flow alarms, a LOPA would account for other controls credited to protect collocated workers from relevant explosion hazards and determine the required safety integrity level (SIL) to ensure alarms are designed to operate with the necessary level of reliability. Facility documents indicate that SRNL engineers assigned the loss of air flow

alarms a SIL-1 rating, corresponding to the lowest level of reliability expectations, without performing a determination using the required LOPA methodology. In response to this concern, SRNL management has agreed to reperform affected SIL determinations using the LOPA methodology required by the SRS Engineering Standards Manual.

Conclusion. DOE approval of Rev. 2 of the SRNL DSA and TSRs represented an important step in upgrading and modernizing the laboratory's safety basis. Despite this progress, several significant deficiencies that were identified by the Board in prior correspondence to the Secretary of Energy remain unresolved. Specifically, issues involving the designation of SACs and the functional classification of key fire protection equipment threaten to undermine the long-term reliability and effectiveness of vital administrative and engineered controls credited in the SRNL safety basis. While site personnel have initiated action to re-evaluate relevant SAC determinations, additional management attention is needed to ensure persistent safety issues are successfully addressed in upcoming safety basis revisions.