

MARCH 2023



Defense Nuclear Facilities Safety Board 33rd Annual Report to Congress

Required by Section 316 of the
Atomic Energy Act of 1954, as amended

The mission of the Board shall be to provide independent analysis, advice, and recommendations to the Secretary of Energy to inform the Secretary, in the role of the Secretary as operator and regulator of the defense nuclear facilities of the Department of Energy, in providing adequate protection of public health and safety at such defense nuclear facilities, including with respect to the health and safety of employees and contractors at such facilities”
42 USC § 2286a(a)

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Joyce L. Connery, Chair
Thomas A. Summers, Vice Chair
Jessie H. Roberson

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901



March 23, 2023

To the Congress of the United States:

The Defense Nuclear Facilities Safety Board (Board) is pleased to submit its *33rd Annual Report to Congress* for calendar year 2022. The Board is an independent, executive branch agency responsible for making recommendations to the Secretary of Energy, and in certain cases, to the President, to provide adequate protection of public health and safety at U.S. Department of Energy (DOE) defense nuclear facilities.

In 2020, congressional authorization and appropriation committees encouraged the Board to work with DOE to develop a bilateral memorandum of understanding (MOU) to address ongoing interface issues between the two agencies. In February 2022, the Deputy Secretary of Energy and the Chair of the Board signed a MOU. The document provides a strong foundation for mutual communication, transparency, and information-sharing. The Board and DOE also completed development of a staff-level Supplementary Agreement to implement the MOU. Senior staff members of both agencies signed the Supplementary Agreement in June 2022.

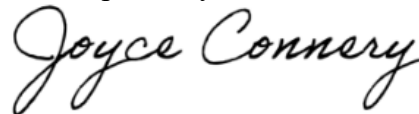
The Board has noticed a trend of delayed and partially addressed responses to Board reporting requirements. On October 20, 2022, the Board transmitted a letter informing the Secretary of Energy that DOE's delayed response to four open reporting requirements is affecting the Board's safety oversight. Separately, the Board transmitted a December 19, 2022, letter to the Secretary of Energy that cited four examples from various sites where the National Nuclear Security Administration (NNSA) provided responses to Board reporting requirements that only partially addressed the safety concerns identified in the Board's correspondence. The Board has met and discussed those delays with senior leadership in the Department of Energy. Finally, the Board has identified several instances where DOE appears to struggle with implementing and maintaining necessary safety controls, even after DOE recognizes the importance of those controls and commits to the Board to resolve the safety issues associated with those controls.

In November 2022, the Board conducted a public hearing in Santa Fe, New Mexico, to gather information on DOE's activities at Los Alamos National Laboratory. In addition to the dozens of in-person attendees, the remotely available live-stream videos for each of the hearing sessions had between 170 and 270 unique viewers. The Board conducted discussions with senior management from the Office of Environmental Management and NNSA to understand plans to remove legacy transuranic waste, nuclear safety risks NNSA has accepted at the Plutonium Facility, and the state of planned safety improvements to safety system infrastructure and safety programs.

Throughout 2022, Board members and staff conducted discussions with several citizen groups, including Tewa Women United, Honor Our Pueblo Existence, Concerned Citizens for Nuclear Safety, Breath of My Heart Birthplace, Nuclear Safety Advocates Group, Nuclear Watch New Mexico, Los Alamos Study Group, and SRS Watch.

As required by 42 United States Code § 2286e(a), this report describes the Board's accomplishments, current safety initiatives, assessments regarding improvements in the safety of defense nuclear facilities, unresolved safety issues, and includes more details of the Board's interface with DOE and its execution of its mission.

Respectfully submitted,

A handwritten signature in black ink that reads "Joyce Connery". The signature is written in a cursive, flowing style.

Joyce L. Connery
Chair

c: The Honorable Jennifer Granholm

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EXECUTIVE SUMMARY

EX. Executive Summary

Under the Atomic Energy Act of 1954, as amended, the Defense Nuclear Facilities Safety Board (Board or DNFSB) is charged with providing independent safety oversight of the Department of Energy's (DOE) defense nuclear facilities complex—a complex with the mission to design, manufacture, test, maintain, and decommission nuclear weapons and weapons production facilities, as well as other national security priorities. The act mandates that the Board review the content and implementation of DOE standards, facility and system designs, and events and practices at DOE defense nuclear facilities to provide independent analysis, advice, and recommendations to inform the Secretary of Energy regarding issues of adequate protection of public health and safety at DOE defense nuclear facilities.

The Board prioritizes its safety oversight activities based on risk to the public and workers, types and quantities of nuclear and hazardous material at hand, and hazards of the operations involved. This annual report summarizes the Board's significant safety oversight initiatives and some high-priority safety issues at defense nuclear facilities subject to the Board's oversight during 2022. Foremost among these initiatives and issues were:

- ***Memorandum of Understanding***—In 2020, congressional authorization and appropriation committees encouraged the Board to work with DOE to develop a bilateral MOU to address ongoing interface issues between the two agencies. On February 17, 2022, the Deputy Secretary of Energy and the Chair of the Board signed a MOU. The document provides a stronger foundation for mutual communication, transparency, and information-sharing. Later in 2022 the Board and DOE completed development of a staff-level Supplementary Agreement to implement the MOU. Senior staff members of both agencies signed the Supplementary Agreement on June 1, 2022. The Supplementary Agreement provides additional detail and processes describing how both agencies' staff members will carry out the MOU.
- ***Safety of Onsite Transportation of Radioactive Materials***—In 2021, the Board completed a review of Los Alamos National Laboratory's (LANL) transportation safety document and identified significant safety issues with both the transportation safety document and DOE's safe harbor directives governing safety analyses for onsite transportation activities. The Board communicated these concerns to DOE in a letter dated January 6, 2022, requesting a briefing and report on DOE's evaluation of these safety concerns. DOE responded with a letter and report on September 13, 2022, and a briefing to the Board on November 4, 2022. DOE acknowledged deficiencies in its safe harbor for safety analyses for onsite transportation but contended that the LANL transportation safety document was acceptable because it met the deficient safe harbor directives. DOE further contended that it was unnecessary to flow down safety requirements from Title 10, Code of Federal Regulations (CFR), Part 830, *Nuclear Safety Management*, to the safe harbor, on the grounds that the requirements of the regulation apply even if they are not included in the regulation's identified safe harbor directives. The National Nuclear Security Administration's (NNSA) Los Alamos Field Office recently provided the LANL management and operating contractor with a list of potential compensatory measures to address some of the safety deficiencies in

- the site's transportation safety document, but as of year's end, the contractor had not implemented any of the compensatory measures. These compensatory measures are necessary to reduce the risk of onsite transportation operations until the transportation safety document can be revised to meet updated DOE directives.
- ***Safety Posture of Pantex Nuclear Explosive Operations***—In June 2021, the Board transmitted a letter to DOE detailing safety issues with conduct of operations, training and qualification, and organizational culture at the Pantex Plant. NNSA developed an extensive set of improvement initiatives to address the safety issues. However, in 2022, NNSA and its contractor explored multiple production-driven changes with the potential to increase safety risks, including (1) establishing a full-time graveyard shift for nuclear explosive operations; (2) making procedural changes that increased operational complexity; (3) proposing revisions to DOE's nuclear safety directives to accept a greater likelihood of a high order nuclear weapon accident at Pantex; and (4) proposing to allow operations involving multiple units using conventional high explosives in a single nuclear explosive bay. The Board identified safety concerns with these changes in a July 20, 2022, letter that requested NNSA to brief the Board on its plans to maintain the positive safety trajectory it had sought to achieve at Pantex through its previously communicated safety initiatives. The letter also requested additional communications if NNSA approved the multiple unit operations in question. NNSA and its contractor conducted this briefing on November 22, 2022, providing a detailed list of actions to address to the Board's safety concerns and informed the Board that the multiple unit operations required further evaluation. NNSA and its contractor took actions that included increasing direct safety oversight and augmenting personnel resources to provide greater attention to the safe conduct of operations. The Board and its technical staff will continue to assess the effectiveness of these initiatives in 2023.
 - ***LANL Plutonium Facility Safety Posture***—NNSA continues to prepare the LANL Plutonium Facility for increased mission scope. Over the next few years, NNSA intends to significantly increase plutonium pit production to meet Department of Defense schedules, as well as increase operations with heat source plutonium for defense and space exploration missions. The Board has communicated numerous safety concerns related to the Plutonium Facility's ability to safely support this increase in operations in several letters to DOE, most recently in the August 11, 2022, letter on heat source plutonium operations and the August 11, 2022, letter on leak path factor analysis for the Plutonium Facility (a key element of NNSA's strategy of passive confinement for the facility). Further, in a March 15, 2022, letter to the Board, NNSA reversed a long-held position that the Plutonium Facility ventilation system would be upgraded to a safety-class, seismically qualified system and did not provide sufficient technical documentation on how its proposed safety strategy would appropriately mitigate a design basis event. The Board discussed these and other topics with senior NNSA officials at a public hearing in Santa Fe, New Mexico, on November 16, 2022, and is considering whether further action is needed to ensure the Plutonium Facility can carry out its missions safely.

- ***Savannah River Tritium Enterprise Release and Re-entry Event***—On January 30, 2022, operations personnel at H-Area New Manufacturing at the Savannah River Site (SRS) unintentionally released approximately 1000 curies (about 0.1 grams) of tritium gas from the stack. Due to unfavorable meteorological conditions, some of the tritium was then drawn back into the facility by the ventilation system and spread throughout the facility. The Board transmitted a letter to NNSA on August 11, 2022, detailing safety concerns with this unanalyzed accident progression in which tritium could be pulled into a building, potentially exposing workers. In addition, nearby non-process buildings do not have instruments and alarms like those in the tritium process buildings to detect and warn occupants of increased tritium concentrations in the air inside their buildings. The Board requested a briefing on NNSA’s plans to analyze the scenario and any actions taken to protect workers from similar events. NNSA provided the requested briefing on November 30, 2022. NNSA officials informed the Board that no additional analysis was needed for workers who would be exposed if tritium were drawn into a building. While NNSA has taken some action to improve the site’s procedures and response to small, planned tritium releases, it is unclear if these actions will be effective in protecting nearby workers during unplanned releases where tritium may be drawn into a building.
- ***Safety of Solid Nuclear Waste***—Over the past decade, DOE has experienced multiple events involving solid nuclear waste that have significant implications for safety of operations. As a result, the Board has conducted public hearings and communicated safety issues and deficiencies to DOE in multiple letters regarding its facilities that handle radioactive waste and DOE Standard 5506, *Preparation of Safety Basis Documents for Transuranic Waste Facilities*. Subsequently, in August 2021, DOE revised DOE Standard 5506. This revision contains significant safety improvements, including new safety requirements and improved guidance. The Board believes that DOE should implement the revised standard in an expeditious manner, as implementation would improve the safety posture of many transuranic waste facilities. The Board plans to evaluate implementation of DOE Standard 5506-2021 as it is incorporated into individual facility safety analyses.
- ***DOE Oversight***—The Board completed a review of DOE’s safety oversight across the defense nuclear complex, including DOE’s methods to evaluate the effectiveness of its safety oversight activities. The purpose of DOE’s safety oversight is to proactively identify contractor performance deficiencies and ensure timely correction of issues to ensure adequate protection. On August 17, 2022, the Board sent DOE a letter outlining improvements DOE should pursue in its safety oversight approach in the following areas: (1) effectiveness assessments, (2) staffing, (3) proactive safety oversight, and (4) safety issues management. The Board requested a briefing and written report within 120 days on DOE’s plans to address these safety matters. On October 28, 2022, DOE requested an extension until March 2023 for providing its response.
- ***Nuclear Safety Management***—In February 2020, the Board issued Recommendation 2020-1, *Nuclear Safety Requirements*. The recommendation is intended to strengthen

DOE's regulatory framework, including 10 CFR 830, *Nuclear Safety Management*, and relevant DOE orders and standards. In September 2021, the Secretary of Energy provided her final decision to the Board accepting Recommendation 2020-1 and issued an implementation plan on June 27, 2022. The Board responded on August 18, 2022, stating that while DOE's implementation plan does not fully endorse some actions recommended by the Board, the Board still finds that execution of the plan could result in improvements to DOE's nuclear safety framework consistent with the objectives of the recommendation. DOE has completed the first few implementation plan milestones, which the Board found to be consistent with the commitments in the implementation plan.

- ***Seismic Hazard Assessments***—On June 10, 2021, the Board transmitted Technical Report 47, *Seismic Hazard Assessments*, to DOE highlighting the Board's safety concerns with the process of periodically assessing the seismic hazard at DOE sites. Such assessments help ensure that credited seismic controls are analyzed using the latest information and will perform their safety functions when needed. DOE provided its report and briefing to the Board on December 14, 2021, and April 7, 2022, respectively. The Board found that DOE's response did not adequately clarify the expectations on timing for entry into the unreviewed safety question process in cases in which a probabilistic seismic hazard analysis update identifies an increased seismic hazard that exceeds qualification assumptions for seismic safety controls. On June 16, 2022, the Board sent an additional letter to DOE that requested a written response on how DOE sites would implement the unreviewed safety question process following a probabilistic seismic hazard analysis update. On November 2, 2022, DOE responded to the Board and stated the sites are required to follow the unreviewed safety question process after it is determined that the increase in hazard identified in the probabilistic seismic hazard analysis update is potentially not bounded by the safety analysis.
- ***DNFSB Interface with DOE and Issues Management***—The Board has noticed a trend of delayed and partially addressed responses to Board reporting requirements. On October 20, 2022, the Board transmitted a letter informing the Secretary of Energy that DOE's delayed response to the four open reporting requirements is affecting the Board's safety oversight. Separately, the Board transmitted a December 19, 2022, letter to the Secretary of Energy that cited four examples from various sites where NNSA provided responses to Board reporting requirements that only partially address the safety concerns identified in the Board's correspondence. When the Board communicated its concerns directly with DOE leadership, they noted that they are working to address these issues. Finally, the Board has identified several instances where DOE appears to struggle with implementing and maintaining necessary safety controls, even after DOE recognizes the importance of those controls and commits to the Board that it will resolve safety issues associated with those controls.

The table below summarizes substantive Board communications in 2022. All Board correspondence is available on the public website (www.dnfsb.gov), which aids in enhancing the Board's public outreach.

Table 1. Substantive Communications in 2022

Congressional and Intergovernmental Outreach	
January 12	Briefing to Senate Armed Services Committee, Subcommittee on Strategic Forces, on legislation
January 28	Briefing to House Armed Services Committee, Subcommittee on Strategic Forces, on legislation
March 10	Briefing to Senate Armed Services Committee, Subcommittee on Strategic Forces, on legislation
April 14	Briefing to Senate Armed Services Committee, Subcommittee on Strategic Forces, on the budget
April 21	Briefing to the Senate Appropriations Committee, Subcommittee on Energy and Water Development, and the House Appropriations Committee, Subcommittee on Energy and Water Development, on the budget
April 22	Briefing to House Armed Services Committee, Subcommittee on Strategic Forces, on the budget
May 12	Briefing to Senate Armed Services Committee, Subcommittee on Strategic Forces, on the budget
Board Interactions with Senior DOE Leadership	
January 26	Interaction with Secretary's Senior Advisor on Environmental Management
January 27	Interaction with the Deputy Secretary of Energy
March 24	Interaction with the NNSA Administrator
May 5	Interaction with the NNSA Administrator
June 1	Interaction with the Secretary of Energy
August 17	Interaction with the Secretary's Senior Advisor on Environmental Management
September 21	Interaction with the NNSA Administrator
October 28	Interaction with the NNSA Administrator
November 9	Interaction with the Deputy Secretary of Energy
Letters	
January 6	Conceptual design for the Surplus Plutonium Disposition Project at SRS
January 6	LANL onsite transportation safety document and the onsite transportation safe harbors
January 6	Summary of reviews of DOE safety directives and technical standards in FY2021 and listing of safety directives and technical standards the Board plans to review in FY2022
January 6	Safety concerns with pit staging at the Pantex Plant
January 6	Revised requirement for annual briefing on the Nuclear Criticality Safety Program
January 24	Conceptual design for the Savannah River Plutonium Processing Facility at SRS

February 17	DOE-DNFSB Memorandum of Understanding
May 10	Pantex external dosimetry program
June 1	Supplementary Agreement for DOE-DNFSB Memorandum of Understanding
June 16	Implementation of the unreviewed safety question process following a probabilistic seismic hazard analysis
June 16	Nuclear criticality safety program at the National Criticality Experiments Research Center at the Nevada National Security Site
July 19	Safety strategy for the 242-A Evaporator Facility at Hanford
July 19	Preliminary documented safety analysis for the High-Level Waste Facility at the Waste Treatment and Immobilization Plant project at Hanford
July 19	Safety of operations and maintenance activities at SRS Salt Waste Processing Facility
July 20	Safety posture of nuclear explosive operations at Pantex
July 26	Condition and structural adequacy of the 296-H stack, located within the Savannah River Tritium Enterprise at SRS
August 2	Electrical systems supporting the Savannah River Tritium Enterprise
August 11	Leak path factor analysis for Plutonium Facility safety basis updates at LANL
August 11	LANL Plutonium Facility safety basis addendum that supports heat source plutonium operations
August 11	January 2022 unplanned release from the SRS Tritium Facilities
August 17	DOE oversight effectiveness
August 17	LANL Area G safety posture
August 17	WIPP 700C fan restart efforts and safety-related instrumentation and control systems
August 18	Assessment of the DOE Implementation Plan for Recommendation 2020-1, <i>Nuclear Safety Requirements</i>
August 24	DOE's Safety Software Central Registry
October 6	Tank Side Cesium Removal system and ion-exchange column connection issues at Hanford
October 20	Delayed DOE responses on open Board reporting requirements
November 18	Potential uranium pyrophoric events with a sudden energy release at the Y-12 Complex
December 6	Confinement ventilation system at the LANL Plutonium Facility
December 16	Conduct of operations in Technical Area V at SNL
December 16	Summary of reviews of DOE safety directives and technical standards in FY2022 and listing of safety directives and technical standards the Board plans to review in FY2023
December 19	Concerns about recent NNSA responses to Board reporting requirements
Public Hearing	
November 16	Public hearing to gather information regarding legacy cleanup activities, nuclear safety, and increased production activities at LANL

In 2022, the Board's correspondence was accessed more than 1,900 times via its public website. The November 16 public hearing was accessed 1,266 times. In addition to letters, technical reports, and recommendation, the Board publishes resident inspector weekly reports for most DOE sites subject to the Board's jurisdiction and monthly reports for the remainder. The table below provides information on the number of times resident inspector weekly reports and other publications were accessed via the public website in 2022.

Table 2. *Access of Board Publications via Public Web Site in 2022*

Type of Publication	Number of Times Accessed
Resident Inspector Weekly Reports, Hanford Site	726
Resident Inspector Weekly Reports, Savannah River Site	734
Resident Inspector Weekly Reports, Los Alamos National Laboratory	793
Resident Inspector Weekly Reports, Y-12 National Nuclear Complex and Oak Ridge National Laboratory	771
Resident Inspector Weekly Reports, Pantex Plant	711
Letters	878
Technical Reports	486
Recommendations	602
Public Hearings/Meetings (includes November 16 public hearing)	1863
November 16, 2022, Public Hearing	1266



BOARD STATUTORY MISSION

I. The Board’s Statutory Mission

Congress established the Defense Nuclear Facilities Safety Board (Board or DNFSB) in 1988 as an independent federal agency within the executive branch of the government, subject to congressional oversight and direction. The Board consists of up to five members, who are appointed by the President and subject to confirmation by the Senate and are required to be “respected experts in the field of nuclear safety with a demonstrated competence and knowledge relevant to the independent investigative and oversight functions of the Board.” The Board is a collegial agency, meaning that its actions are determined by the Board as a whole. The Board’s Chair serves as the chief executive officer and performs this function subject to Board policies.

The Board’s essential mission is to provide independent analysis, advice, and recommendations to the Secretary of Energy to inform the Secretary, in her role as operator and regulator of DOE defense nuclear facilities, on providing adequate protection of public health and safety, which includes the health and safety of workers. The term “defense nuclear facilities” is defined in the Atomic Energy Act of 1954, as amended. It includes nuclear facilities operated by DOE that have a function related to national defense or store nuclear waste (excluding Yucca Mountain and other facilities operated pursuant to the Nuclear Waste Policy Act). “Defense nuclear facilities” thus do not include two major classes of government-regulated nuclear facilities: DOE’s nuclear projects that are civilian in purpose and commercial nuclear facilities regulated by the Nuclear Regulatory Commission. The Board’s oversight jurisdiction also does not extend to the U.S. Navy’s nuclear propulsion program or to environmental hazards regulated by other federal and state agencies. Table 3 lists the major sites with defense nuclear facilities that the Board oversees.

Table 3. Major Sites Subject to the Board’s Jurisdiction

Site	Location	Operations	Website
Hanford Site	Richland, WA	Management and treatment of radioactive wastes; facility decommissioning	www.hanford.gov
Idaho National Laboratory	45 miles west of Idaho Falls, ID	Storage and processing of radioactive waste	www.inl.gov
Lawrence Livermore National Laboratory	Livermore, CA	Research to support the nuclear weapons arsenal	www.llnl.gov
Los Alamos National Laboratory	Los Alamos, NM	Research to support the nuclear weapons arsenal; manufacturing of nuclear weapon components; disposition of legacy transuranic waste	www.lanl.gov
Nevada National Security Site	65 miles northwest of Las Vegas, NV	Disposition of damaged nuclear weapons; critical and subcritical experiments; waste management	www.nnss.gov

Site	Location	Operations	Website
Oak Ridge National Laboratory	Oak Ridge, TN	Energy research; treatment and disposal of radioactive wastes	www.ornl.gov
Pantex Plant	17 miles northeast of Amarillo, TX	Maintenance of the nuclear weapons stockpile	pantex.energy.gov
Sandia National Laboratories	Albuquerque, NM	Nuclear research; support for the weapons stockpile maintenance program	www.sandia.gov
Savannah River Site	Aiken, SC	Tritium extraction, recycling, and storage; management and treatment of radioactive wastes; nuclear materials storage and disposition; research and development	www.srs.gov
Waste Isolation Pilot Plant	26 miles east of Carlsbad, NM	Disposal of transuranic waste in underground repository	wipp.energy.gov
Y-12 National Security Complex	Oak Ridge, TN	Manufacturing and surveillance of nuclear weapons components; processing of weapons-grade uranium	www.y12.doe.gov

The Board's oversight mission covers all phases in the life cycle of a defense nuclear facility: design, construction, operation, and decommissioning. Congress granted the Board a suite of statutory tools to carry out its mission. Principal among these is the Board's authority to issue formal recommendations to the Secretary. The Atomic Energy Act requires the Secretary to either accept or reject a Board recommendation, and in the case of an acceptance, to write and execute an implementation plan. In the case of a rejection, the Secretary must report to the relevant congressional committees the reasoning for the rejection. This process all takes place on the public record. In addition to issuing recommendations that require a secretarial response, the Atomic Energy Act requires the Board to review and evaluate DOE requirements and standards affecting safety at defense nuclear facilities. Evaluation of these standards may result in recommendations or other appropriate analysis and advice provided to DOE.

To obtain information in service of its oversight responsibilities, the Board is empowered to hold public hearings (and subpoena witnesses or documents, if necessary), conduct investigations, and obtain information and documents needed for the Board's work from DOE and its contractors. DOE is required by law to grant the Board prompt and unfettered access to such facilities, personnel, and information as the Board considers necessary to carry out its responsibilities. In addition, the Board welcomes information from interested members of the public who have reason to believe an unsafe condition may exist at a defense nuclear facility. These safety allegations come most frequently from DOE employees or contractors who have relevant expertise and access to specific defense nuclear facilities. The Board fully evaluates

each of these allegations and follows up using the complete range of statutory powers at its disposal. Finally, the Board has resident inspectors stationed at several DOE sites with defense nuclear facilities. These resident inspectors provide real-time information to the Board regarding operations and safety issues at their respective sites.

Congressional Directives

Since its creation in 1988, the Board has received direction from Congress related to internal management, its relationship with DOE, and specific safety issues at defense nuclear facilities. In recent years, Congress has directed the Board via authorizations and appropriations legislation, and related congressional reports. The status of current items is summarized below.

Continuation of Functions and Powers During Loss of Quorum

The James M. Inhofe National Defense Authorization Act for Fiscal Year (FY) 2023 included a provision to enable the Board to continue to serve its safety oversight function in the event Board membership falls below the minimum of three required for a quorum. The Board is currently evaluating the new provision and will take necessary actions to ensure its implementation.

Minimum Staffing Level

On multiple recent occasions, Congress directed the Board to maintain adequate staffing levels to ensure that it can carry out its important mission. Specifically, Congress directed the Board to maintain at least 100 full-time employees for FY2020 in the FY2020 National Defense Authorization Act (NDAA). Additionally, Congress directed the Board to ensure a minimum of 110 full-time employee equivalents with a focus on maintaining appropriate technical capabilities in the Joint Explanatory Statement accompanying the Consolidated Appropriations Act, 2021.

In 2022, the Board had 106 full-time equivalents for FY2022 (and 113 total positions filled as of December 31, 2022), with 22 new hires and 10 separations. This was a net increase of three full-time equivalents (FTE) from FY2021, when it had 103 FTE. The DNFSB is authorized to have up to 130 FTE.

Nonpublic Collaborative Discussions

NDAA for FY2021 included a change to the Atomic Energy Act of 1954 allowing Board members to hold “nonpublic collaborative discussions” without following the requirements of the Government in the Sunshine Act, so long as certain requirements are met. In calendar year 2022, the Board held four nonpublic collaborative discussions on a variety of topics. Summaries of these discussion topics are available on the Board’s public website. The allowance for nonpublic collaborative discussions has facilitated candid discussion among Board members while still ensuring public transparency. In addition, nonpublic collaborative discussions have supported the Board’s efforts over the past year on matters ranging from development of a program for receipt of safety allegations to issues related to oversight and safety of specific DOE

facilities. Finally, the Board held an agency-wide informational session to ensure broad staff understanding of this new statutory tool and how it can facilitate collegial, effective leadership from the Board.

Executive Director of Operations

The Board's first executive director of operations departed in August 2022. The Board is actively recruiting to fill that vacancy in 2023.

Strategic Plan

The Board issued an updated strategic plan in May 2022. The strategic plan focuses on a vision of the Board's future that emphasizes technical excellence and allows for continuous improvement and nimble response to a challenging environment. It reflects continuity with the previous strategic plan completed in 2019 and incorporates key priorities of President Biden's administration, including diversity, equity, inclusion, and accessibility. The strategic plan will continue to support the Board in cultivating a multitalented, dynamic, and diverse workforce that embodies the Board's core values, focuses on the mission, and continuously hones its skills through training and development.

The Board has identified four interdependent strategic goals in its *Strategic Plan for Fiscal Years 2022-2026*. These strategic goals establish objectives for the Board's safety oversight of DOE's defense nuclear facilities.

- Provide proactive and independent safety oversight of the defense nuclear complex.
- Enhance transparency of ongoing agency initiatives and the state of safety within the defense nuclear complex.
- Develop and maintain an outstanding workforce to achieve the agency's mission.
- Maximize the agency's performance by pursuing excellence in our culture and operations.

Five-Year Budget Outlook

The Board instituted a new five-year budget outlook process to enhance planning for Board operations. Because DNFSB is a micro agency, small budgetary changes can have a large impact on its ability to operate effectively in accomplishing its mission. The five-year budget outlook provides a tool for the Board to plan for upcoming surges in expenses due to information technology and facility refresh campaigns, substantial equipment costs, rent increases, and shifts in salaries and benefits. Budgeting for out-year expenses allows the Board to be better able plan for and control its spending.

Human Capital Resource Plan

In its annual report last year, the Board shared that it contracted for additional human resources expertise to assist with human capital management. The effort to develop a strategic human capital plan is underway. DNFSB faces the same challenges in finding specialized staff for its operations and its nuclear safety oversight mission as competing employers. When completed, the human capital plan will identify gaps and risks within our current workforce and provide strategies for closing those gaps and reducing the risks. The human capital plan will help ensure that the Board is competitive in recruitment, development, and retention of nuclear scientists and engineers in particular.

Safety Allegations

Since its creation, DNFSB has received and evaluated safety allegations concerning defense nuclear facilities from interested members of the public. The Board is aware of the importance placed on this responsibility by congressional stakeholders. During 2022, the Board documented and formalized its practices for the receipt, evaluation, and disposition of these allegations. This newly formalized process takes the form of an operating procedure, and all employees received training in early 2023. Moreover, there is now a public website where interested members of the public can learn how to send the Board a safety allegation concerning any defense nuclear facility. The new website may be found at dnfsb.gov/safety-allegations.

Management Improvements

2021 Meritorious Presidential Rank Award

Christopher J. Roscetti, the Board’s technical director, was recognized by President Biden as a 2021 Meritorious Presidential Rank Award recipient. The award recognizes Mr. Roscetti’s sustained record of exceptional professional achievement at the DNFSB.



Figure 1. Board Chair Joyce Connery and Board Members Jessie Roberson and Thomas Summers Present the 2021 Meritorious Presidential Rank Award to Christopher J. Roscetti

Staff Awards Ceremony

DNFSB held its annual staff awards ceremony on October 20, 2022. The Board recognized the outstanding achievements of its staff for contributing to the safety of the defense nuclear weapons enterprise. This included honoring one staff member with 25 years of service, one staff member with 30 years of service, and one staff member with 35 years of service. DNFSB's Crawford award, named for founding Board Member Captain John (Jack) William Crawford, Jr., is presented to the technical staff member demonstrating excellence in achievement in safety oversight. This year's recipient of the Crawford award is Dr. Christopher Berg.

Filled Management Positions

Essential to the effective conduct of nuclear safety oversight is having a full leadership team in place. Over the last year, the Board filled two vacant Senior Executive Service positions within the Office of the Technical Director. These two positions round out the staff leadership within that office. Unfortunately, the executive director of operations position was vacated in August when the senior executive departed for service with another agency. The Board is currently conducting a search to fill the vacancy.



DOE INTERFACE

II. Interface with DOE

Congress directed the Board to work with DOE to develop a bilateral MOU to address ongoing interface issues between the two agencies. The need for a MOU was highlighted by the 2018 National Academy of Public Administration report, *Defense Nuclear Facilities Safety Board Organizational Assessment*, and in late 2020 by the Government Accountability Office. The Board and DOE developed a MOU that was signed by the Deputy Secretary of Energy and the Chair on February 17, 2022. In accordance with the MOU, the Board and DOE also developed a Supplementary Agreement, signed on June 1, 2022, that defines additional interface agreements that are consistent with the MOU. The Board conducted training for all technical staff on the content and expectations relative to the MOU and Supplementary Agreement. The Board also reviewed and is revising, where needed, internal procedures and processes.

The MOU between DOE and the Board contains a provision that the Secretary of Energy will inform the Board in writing if additional time is necessary to meet a reporting requirement imposed by the Board. However, the Board has noticed a trend of delayed and partially addressed responses to Board reporting requirements. On October 20, 2022, the Board transmitted a letter informing the Secretary of Energy that DOE's delayed response to the four open reporting requirements is affecting the Board's safety oversight. Separately, the Board transmitted a December 19, 2022, letter to the Secretary of Energy that cited four examples from various sites where NNSA provided responses to Board reporting requirements that only partially addressed the safety concerns identified in the Board's correspondence. In contrast, NNSA's November 22, 2022, briefing on the safety posture at the Pantex Plant (in response to the Board's letter dated July 20, 2022) focused on the safety of operations at Pantex and thoroughly addressed initiatives to sustain the positive trajectory of operational safety performance. The Board's semiannual report to Congress on information denials, dated January 19, 2023, also listed classified information requests that had not been fulfilled by NNSA for extended periods as of the date of the report.

During the year, the Board and staff engaged with several senior DOE leaders, including the Secretary of Energy, NNSA Administrator, Deputy Secretary of Energy, principal deputy administrator, assistant secretary of energy for congressional and intergovernmental affairs, associate under secretary of energy for environment, health, safety and security, and director of enterprise assessments. Additionally, the staff and Board members engage with local community stakeholders and interest groups when possible.



DOE Oversight and Issues Management

III. DOE Oversight and Issues Management

The Board focuses its oversight in four general areas: (1) DOE's nuclear safety requirements and standards; (2) the integration of safety into the design and construction of new defense nuclear facilities and major modifications of existing facilities; (3) the safety of operations at existing defense nuclear facilities; and (4) DOE's management and oversight of the defense nuclear complex.

The Board frequently expresses concern about DOE's ability to regulate and oversee the safe operations at its facilities, and its demonstrated challenges to implement timely and effective safety improvements. This year, those recurring concerns resulted in an explicit review of DOE's oversight framework, as discussed in the Nuclear Safety Programs section of this report. However, explicit reviews are not the only method the Board uses to evaluate the timeliness and effectiveness of DOE's oversight and issues management activities. The Board also draws inferences from observations gathered during all its reviews to determine the effectiveness and timeliness of DOE's oversight and the adequacy of its nuclear safety framework.

In 2022, the Board issued a total of 30 letters to DOE conveying the results of reviews and Board concerns. Over half of the Board's letters addressed issues that had either remained unresolved for an extended period or had demonstrated a pattern of repetition; nearly half of the letters addressed safety issues in the operation of existing defense nuclear facilities; and one-third of the letters explicitly discussed concerns with weaknesses in DOE's oversight of its contractors.

The Board's concerns about DOE's ability to implement timely and effective improvements to safety issues can be illustrated with two examples from the Board's 2022 correspondence with DOE: (1) the July 19, 2022, letter on DOE's efforts to develop a revised safety strategy for the 242-A Evaporator at Hanford; and (2) the August 24, 2022, letter on DOE's Software Central Registry.

The 242-A Evaporator at Hanford was originally placed into operation in 1977 with an expected design life of 10 years. Thirty-six years after that projected end date, DOE continues to operate this facility to support environmental remediation activities. On June 18, 2014, the Board issued a letter to DOE with the results of a review of the safety basis for the 242-A Evaporator, noting several issues with the safety analysis and the identified safety control set for the facility. In August 2015, DOE committed to install a seismically qualified safety-significant steam valve by September 30, 2015, and to implement two design/operational improvements to prevent flammable gas explosions by September 30, 2016. The valve was installed as per DOE's commitment, but the two design/operational improvements have been delayed twice (DOE letters dated October 13, 2016, and July 29, 2019). The July 19, 2022, Board letter addresses DOE's inability to implement those improvements and DOE's intent to revise the facility's safety strategy in a manner that does not comply with DOE's safety requirements. DOE responded to the Board letter with a briefing that did not address the Board's technical issues. This facility is only one example of DOE's many aging infrastructure difficulties. DOE intends to continue operating this facility well beyond its planned lifespan without appropriate safety

controls that would credibly extend its life and assure its safety, even after many years of Board correspondence regarding safety concerns that DOE originally agreed.

DOE relies on a wide variety of software for safety-related analyses and decision-making, and to control safety-related systems. In Board Technical Report 25, *Quality Assurance for Safety-Related Software at Department of Energy Defense Nuclear Facilities*, January 20, 2000, the Board identified deficiencies in the software quality assurance for both types of software and problems with code execution resulting from a lack of guidance and training. On September 23, 2002, the Board elevated its concerns by issuing Recommendation 2002-1, *Quality Assurance for Safety-Related Software*. As part of its implementation of that recommendation, DOE established the Safety Software Central Registry for the long-term maintenance and control of safety analysis “toolbox” codes that support DOE safety analysis and have widespread use and appropriate qualification in 2003. In two letters in 2008 (February 7 and December 22), DOE reported on its efforts to bring six toolbox codes into full compliance with DOE’s software quality assurance requirements, to add new codes to the registry, and to improve DOE’s management of the registry.

Since 2008, DOE has struggled to keep the registry up to date, leading to the use of outdated software for safety-related calculations. In 2018, a DOE assessment of the Central Registry concluded that “as it is currently being implemented, [the Central Registry] does not meet the intent of the DOE IP [Implementation Plan] for DNFSB recommendation 2002-1.”¹ After conducting a review of the status of the Central Registry and DOE’s efforts to update it, the Board determined that some code versions had never been updated since they were originally put into the registry in 2004, and that others had been updated but the process took so long that in some cases newer versions had been issued in the interim. As a result, the Board issued a letter on August 24, 2022, encouraging DOE to make improvements in a timely manner and requesting a briefing on DOE’s plans for addressing the identified issues with the Central Registry to address the concerns relayed in its recommendation from 2002. The Board anticipates this briefing during 2023.

The Board recognizes that DOE faces significant challenges in overseeing operations and addressing safety concerns within its broad and aged portfolio of defense nuclear facilities. The Board also notes that DOE’s challenges extend to managing its aging infrastructure in general, and particularly in systematically evaluating the infrastructure that supports the safe operation of its defense nuclear facilities. However, the Board is concerned that DOE appears to struggle with implementing and maintaining necessary infrastructure and safety controls, even after recognizing the importance of those systems and controls to DOE’s ability to ensure adequate protection of its workers, the public, and the environment.

¹ Thayer, C., and D. Sparkman, *AU-32 Central Registry Management Assessment Report*, Prepared for Department of Energy, EHSS-CR-ASSMT-2018-01, 2018.



NUCLEAR WEAPONS OPERATIONS

IV. Nuclear Weapon Operations

In 2022, the Board performed nuclear safety oversight of high-priority operations within the nuclear weapons complex. The Board's oversight priorities were based on the nuclear safety risk of proposed and ongoing activities. The Board placed significant emphasis on safety oversight at the Pantex Plant and LANL during 2022. As discussed below, the Board focused on maintaining and improving the safety of nuclear explosive operations at Pantex during a period when NNSA was placing significant emphasis on achieving production milestones. Similarly, the Board focused on addressing safety vulnerabilities at LANL as NNSA prepares the Plutonium Facility, together with supporting facilities and activities, to produce 30 plutonium pits per year for the nuclear weapon stockpile. The Board held a public hearing in Santa Fe, New Mexico, in November 2022 to publicly discuss its safety concerns with officials from NNSA and LANL. The Board also executed a series of safety reviews aimed at improving worker protection at the Savannah River Tritium Enterprise, following up on Recommendation 2019-2, *Safety of the Savannah River Site Tritium Facilities*, which NNSA had rejected on the basis that it was already taking action to address the Board's safety concerns.

For LANL, the Savannah River Tritium Enterprise, and the Y-12 National Security Complex, the Board maintained full-time resident inspectors to monitor operations. Cognizant engineers on the Board's headquarters staff are dedicated to monitoring Lawrence Livermore National Laboratory, Nevada National Security Site, and Sandia National Laboratories. Due to unplanned vacancies, the Board monitored operations at the Pantex Plant using a full-time resident inspector for part of 2022, a headquarters staff member temporarily assigned as a resident inspector at the plant for part of 2022, and ongoing safety oversight by a cognizant engineer based at the Board's headquarters.

Pantex Plant

Safety Posture of Nuclear Explosive Operations

On July 20, 2022, the Board transmitted a letter to NNSA regarding opportunities to improve the safe execution of various initiatives that NNSA and its contractor were pursuing at the Pantex Plant. These initiatives included proposed revisions to DOE Standard 3016, *Hazard Analysis Reports for Nuclear Explosive Operations*; co-located unit operations for a nuclear weapon program; and other changes potentially impacting the safe conduct of operations and organizational culture.

DOE Standard 3016 Revision—DOE Standard 3016 is a standard invoked to govern safety analyses for nuclear explosive operations. NNSA proposed revising the standard to codify a significant increase in the screening threshold for determining whether high-order nuclear accident scenarios involving fully assembled nuclear explosives warrant safety class controls. Following discussions in 2021 and 2022 regarding the safety risk, NNSA withdrew the proposed revision. In October 2022, NNSA proposed a new revision to the standard—without the increase in the weapon response screening threshold—that the Board finds acceptable.

Proposed Co-Located Unit Operations—Under the current safety framework at Pantex, the assembly and disassembly of nuclear explosives with a conventional high explosive main charge are performed with only one such unit in the bay or cell. This approach prevents an accident on one unit from initiating an additional, possibly more severe, accident on a second unit. The Pantex contractor proposed an operational change for a specific weapon program with conventional high explosives that would allow conducting operations on a nuclear explosive while a fully assembled nuclear weapon of the same type is staged in its handling gear in the same bay. The contractor’s position was that all accidents involving the unit undergoing operations were reliably prevented by existing controls. As a result, the contractor did not fully evaluate the increased risk of high-order events, particularly events that initiate with the unit undergoing operations and propagate to the staged unit.

The Board noted that the presence of the staged unit would increase both the unmitigated and mitigated risk of a high-order accident due to additional scenarios with high-order consequences. After technical discussions regarding the safety issues, the contractor withdrew both the proposed safety basis change and its request for NNSA to perform a nuclear explosive safety evaluation. NNSA has deferred further consideration of this operational change until 2023. In its July 2022 letter, the Board requested that NNSA inform the Board if it elects to approve this operational change and follow up with a report detailing the basis for the decision. The Board and its staff will continue to assess the safety of this potential change in 2023.

Conduct of Operations and Organizational Culture—On June 9, 2021, the Board transmitted a letter to the Secretary of Energy detailing issues with conduct of operations, training and qualification, and organizational culture at Pantex. In its August 5, 2021, response, NNSA detailed an extensive set of improvement actions, notably longer-term enhancements such as establishment of a joint Disciplined Operations Council, personnel resource augmentation, and improvements to training and to the weapons training complex. In 2022, the Board’s resident inspectors reported on several operational changes that, if not thoroughly considered and analyzed, could disrupt the positive trajectory for the safety of operations and organizational culture that NNSA sought to establish in response to the Board’s findings. For example, the contractor was moving to expand the set of approved operating procedures to encompass processes previously approved on a case-by-case basis for off-normal units and adding a full-time graveyard shift, increasing operational complexity.

In its July 2022 letter, the Board identified that the suite of changes being pursued requires close monitoring to ensure that operational safety and the underlying organizational culture are not compromised. The Board urged NNSA to fully analyze and consider the effects of the changes to ensure that safety is enhanced as NNSA described in its August 2021 response. The Board also advised NNSA to consider implementing near-term actions, such as direct oversight of operations by federal personnel experienced in conduct of operations. Finally, the Board requested a briefing from NNSA on plans to maintain the positive trajectory of its previously communicated initiatives for conduct of operations and organizational culture during these operational changes. NNSA and its contractor provided this briefing on November 22, 2022, providing a detailed list of actions to address the Board’s safety concerns. The Board and its staff will continue to monitor the effectiveness of these initiatives.

Staging of Nuclear Weapon Pits

From 2020 through 2021, the Board conducted a review of nuclear weapon pit staging at Pantex, finding that the population of pits in storage containers without inner sealed inserts increased from 8 percent to 14 percent of the total inventory between 2014 and 2021, even as the total inventory of pits increased. The observed trend reflected a relaxation in staging requirements by the design agencies and the focus at Pantex on priorities other than pit packaging. Unsealed containers (i.e., those containers without an inner sealed insert) do not protect against corrosion or confine any radioactive material released by a breached pit. Although pits in unsealed containers are staged in climate-controlled facilities at Pantex, the pits in unsealed containers are exposed to air, along with moisture and chlorides from fiberboard packing material inside the storage container. These conditions could lead to degradation and breach of a pit in containers and facilities without credited confinement barriers. The Board communicated its safety concerns to NNSA in a letter dated January 6, 2022, requesting that NNSA provide a report that included a plan to package pits—particularly higher hazard legacy pits—into containers with sealed inserts (see Figure 2).

The NNSA Administrator responded to this letter on June 12, 2022, providing a strategy to increase pit repackaging rates and complete packaging pits in the current inventory with no near-term use into containers with sealed inserts by FY2026. Of note, NNSA and its contractor appropriately plan to prioritize repackaging of certain higher hazard pit types. The Board’s staff evaluated the current pit inventory and found that Pantex is progressing toward its goal for the repackaging effort.

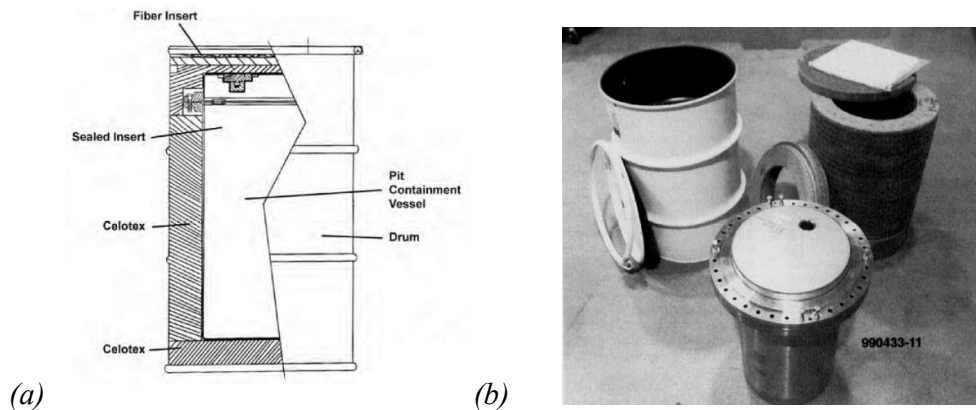


Figure 2. *Cross-section and photograph of pit storage container with sealed insert.*

Legacy Conditions of Approval and Planned Improvements

The Board conducted a review of the path to closure for various legacy planned improvements and conditions of approval for safety basis documents at Pantex during 2021–2022. In Recommendation 2019-1, *Uncontrolled Hazard Scenarios and 10 CFR 830 Implementation at the Pantex Plant*, the Board found that some safety-related conditions of approval remained open for many years after being imposed by the NNSA field office. This allowed the Pantex contractor to operate under an approved safety basis but without making the

safety upgrades required by NNSA. As part of the implementation plan for Recommendation 2019-1, NNSA committed to disposition the open legacy conditions of approval. The Board reviewed the closure packages for several of these conditions of approval and assessed the progress achieved by Pantex toward closing the remaining open actions. The Board also evaluated the path to closure for multiple planned improvements identified in the Pantex safety basis, which included replacing wood-framed false ceilings within specific nuclear explosive cells and addressing the inappropriate application of certain weapon response values in selecting safety controls for nuclear explosive operations.

On January 4, 2023, the Board issued a letter summarizing the conclusions from this review to NNSA for its information and use. Generally, NNSA and its contractor provided technically defensible responses to support the closure of the various conditions of approval and planned improvements. However, Pantex is closing a few of the legacy conditions of approval without fully addressing the specific safety improvements by reclassifying these items as continuous improvement initiatives versus actions needed to address safety basis deficiencies. The Board found this approach may result in the failure to implement valuable process improvements and identified that it would be prudent for NNSA to track the initiatives categorized as continuous improvements—such as the identification of a non-flammable cleaning fluid—to maintain progress to resolution.

Nuclear Explosive Safety

During 2022, the Board and its staff provided direct safety oversight of nuclear explosive operations at the Pantex Plant. For example, the Board’s staff observed and evaluated the B83 nuclear explosive safety study and W76 operational safety review. In addition, the staff assessed various nuclear explosive safety change evaluations associated with off-normal B61, W76, and W88 units and operating procedure modifications. During such activities, the Board’s staff evaluated execution of the nuclear explosive safety evaluation, assessed the proposed operations against the requirements in DOE and NNSA directives, and provided safety-related concerns to the study group and project team.

External Dosimetry Program Breakdown

The Board evaluated the breakdown of the Pantex external dosimetry program, with the objective of identifying opportunities for improvement to help prevent similar problems at Pantex and throughout the DOE defense nuclear complex. The Board issued a letter to DOE on its conclusions from this review on May 10, 2022. Additional information can be found in the Nuclear Safety Programs section of this report.

Los Alamos National Laboratory

Onsite Transportation Safety

In 2021, the Board completed a review of the LANL transportation safety document and identified significant safety issues with both the document and DOE’s safe harbor directives governing safety analyses for onsite transportation of radioactive materials. Specifically, the

Board is concerned with the lack of requirements and detailed guidance for meeting applicable requirements from 10 CFR 830 in developing transportation safety documents. Additionally, the Board is concerned with the level of technical analysis of hazards and accident scenarios in the approved transportation safety document for LANL. Given the allowable material-at-risk for each onsite transfer and the proximity of transport routes to the site boundary, the unmitigated consequences from various credible accidents are high to both workers at LANL and the offsite public (see Figure 3). The Board communicated these concerns to the Secretary of Energy in a letter dated January 6, 2022, requesting a briefing and report on DOE's evaluation of these safety concerns.



Figure 3. *Cliffs along onsite transportation route at Los Alamos National Laboratory.*

DOE responded with a letter and report on September 13, 2022, and a briefing to the Board on November 4, 2022. DOE's response acknowledged deficiencies in its safe harbor for onsite transportation and indicated it would revise the safe harbor to address some of the Board's concerns. However, DOE's response contended that the LANL transportation safety document was acceptable because it met the deficient safe harbor, and that it was unnecessary to flow down safety requirements from 10 CFR Part 830 to the safe harbor, on the grounds that the requirements of the regulation apply regardless of whether they are included in the safe harbor. In the Board's view, this is inconsistent with the role of safe harbors in 10 CFR Part 830, which describes them as "acceptable methodologies for preparing a documented safety analysis."

Based on its argument, NNSA did not, at the time, require the LANL contractor to enter its process for evaluating potential inadequacies of the safety analysis or implement compensatory measures for the safety deficiencies identified in the Board's letter. NNSA's Los Alamos Field Office more recently provided the LANL management and operating contractor with a list of potential compensatory measures to address some safety deficiencies in the transportation safety document, but as of year's end the contractor had not implemented any of the compensatory

measures. These compensatory measures are necessary to reduce the risk of onsite transportation operations until the transportation safety document can be revised to meet updated DOE directives.

Safety Posture of LANL Plutonium Facilities

The Board continues to closely follow NNSA's efforts to safely establish a war reserve plutonium pit production capability at LANL in addition to supporting other plutonium missions there. Preparations for this expanded production mission include removing and replacing gloveboxes and equipment in the Plutonium Facility (e.g., under the Los Alamos Plutonium Pit Production Project), upgrading the Radiological Laboratory Utility Office Building to a higher hazard categorization to allow it to handle greater quantities of plutonium, and other major construction projects onsite.

For almost two decades, DOE had planned to upgrade the Plutonium Facility's active confinement ventilation system to meet safety class requirements, which would significantly reduce the release of radioactive material during accident conditions, including severe earthquake and fire scenarios. However, in a March 15, 2022, letter to the Board, NNSA stated that it would no longer pursue a safety class, seismically qualified active confinement ventilation system for the Plutonium Facility. Accordingly, its safety control strategy will continue to rely on passive confinement and the associated leak path factor analysis to estimate how much radioactive material would escape from the facility during an accident. For several years, LANL has been working to develop a new leak path factor analysis for the Plutonium Facility in support of a new safety basis that will be compliant with current versions of DOE standards. The Board previously communicated concerns with the leak path factor analysis in a November 15, 2019, letter and Technical Report 44, *Los Alamos National Laboratory Plutonium Facility Leak Path Factor Methodology*. In 2022, the Board completed a review of LANL's latest working documents that describe its new methodology for calculating leak path factors. The Board found that the issues described in DNFSB Technical Report 44 are still applicable to the updated methodology, that analyses need refinement to ensure that the overall calculation is conservative, and that key inputs and assumptions need to be protected commensurate with their importance. The Board communicated these concerns to the Secretary of Energy on August 11, 2022.

In addition to plutonium pit production, NNSA uses the Plutonium Facility to process heat source plutonium for space and defense purposes (see Figure 4). Last year, NNSA began planning a mission to receive and repackage large amounts of heat source plutonium from Idaho National Laboratory (INL). To support this mission, LANL developed an additional safety basis to increase the material-at-risk limits for heat source plutonium in the facility. LANL's analysis shows the potential for very high mitigated offsite dose consequences (490–3,175 rem total effective dose) for certain seismic accident scenarios. NNSA needed to accept elevated safety risk in this situation because of the continuing delays in upgrading the safety systems at the Plutonium Facility. In an August 11, 2022, letter, the Board advised DOE to implement additional safety controls and operational restrictions to reduce the safety risk of this mission to the extent practicable.

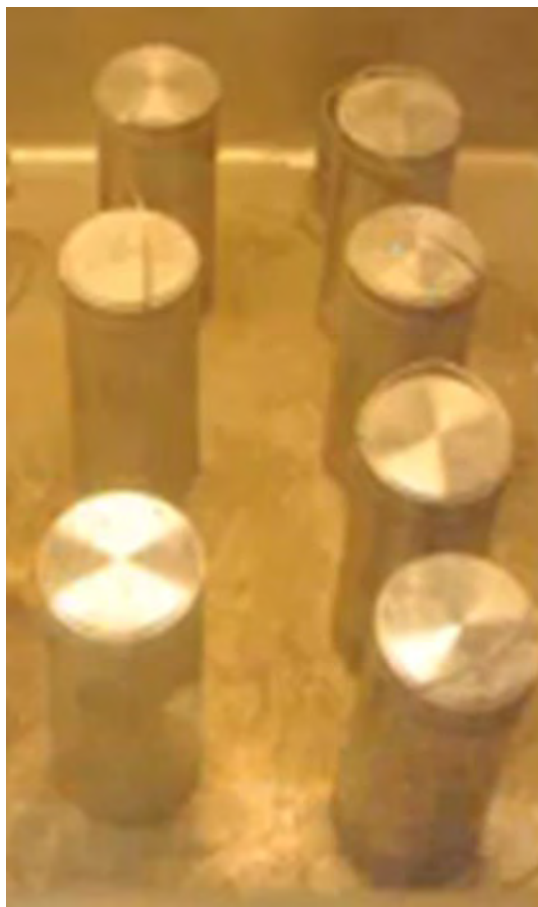


Figure 4. *Heat source plutonium containers.*

To support plutonium pit production activities, NNSA is upgrading the Radiological Laboratory Utility Office Building to a hazard category 3 facility to be called PF-400 (see Figure 5). During this upgrade, LANL encountered performance issues with the plenum deluge spray system that protects the high efficiency particulate air filters in the confinement ventilation system from fire damage. Rather than solve the issues with the deluge system, the LANL contractor prepared an analysis meant to show that the filters would remain intact and function during facility fire accidents without the deluge system. The NNSA Los Alamos Field Office approved an equivalency request based on this analysis, which allowed LANL to disconnect the deluge system. Moreover, the Board learned that the contractor was considering requesting a similar equivalency to allow disconnecting the filter plenum deluge system in the Plutonium Facility as well. In a December 6, 2022, letter, the Board identified deficiencies in the fire analysis and expressed concern with LANL's increasing reliance on modeling accidents instead of crediting reliable engineered safety controls. The Board requested either a report with an updated analysis that accounts for the deficiencies described in the letter or a briefing on NNSA's plans to restore the PF-400 deluge system, and a briefing and report on NNSA's plans to pursue a similar equivalency at the Plutonium Facility.



Figure 5. *Radiological Laboratory Utility Office Building at Los Alamos.*

Board Public Hearing (Plutonium Facility Focus)

On November 16, 2022, the Board conducted a public hearing in Santa Fe, New Mexico, to gather information on DOE’s activities at LANL (see Figure 6). The hearing was in-person and available remotely via a live-stream. It comprised four sessions; three of the four sessions related to the Plutonium Facility and to NNSA’s nuclear safety strategy and plans for increased pit production activities. The panel testifying before the Board included the NNSA Administrator, the NNSA associate principal deputy administrator, the NNSA Los Alamos Field Office manager, and the LANL director. The goals for these sessions were to gather information on (1) production activities to be conducted in the Plutonium Facility, (2) nuclear safety risks NNSA has accepted, and (3) the state of planned safety improvements to safety system infrastructure and safety programs.



Figure 6. *November 16, 2022, public hearing on Los Alamos safety posture.*

Most of the hearing discussions related to topics discussed above, including the Plutonium Facility's confinement ventilation system and fire suppression system, current and future operations with heat source plutonium, the leak path factor analysis supporting NNSA's passive confinement strategy, and the safety basis being developed to achieve compliance with current versions of DOE standards. The Board and panelists also discussed LANL's strategies for increasing staffing at the laboratory, NNSA's progress in shipping transuranic waste offsite to the Waste Isolation Pilot Plant (WIPP), and lessons learned from recent NNSA assessments of conduct of operations at the laboratory.

Savannah River Site

Co-located Worker Dose Reduction Strategy for SRS Tritium Facilities

NNSA rejected Recommendation 2019-2, *Safety of the Savannah River Site Tritium Facilities*, on September 10, 2019—and reaffirmed its rejection on January 3, 2020—based on the statement that it is already addressing the Board's safety concerns with proposed and ongoing actions. The Board and NNSA personnel differ significantly on the perception of the risk to workers and the public associated with the SRS tritium facilities. NNSA directed the contractor to develop a risk reduction strategy for co-located workers impacted by major accidents involving the tritium facilities and approved the contractor's strategy. A significant portion of the effort focuses on either refining the accident analysis parameters to reduce the predicted consequences or completing calculations to determine whether existing structures can be credited to reduce the calculated consequences in the safety basis. Unless done in conjunction with physical modifications to install or upgrade engineered controls, these types of efforts do not represent actual improvements to safety, but rather analytical reductions of calculated accident consequences. The Board is continuing to follow the actions that NNSA stated would address the Board's safety concerns at the SRS tritium facilities, while in parallel conducting a series of safety reviews aimed at identifying opportunities to strengthen the engineered and administrative safety controls that protect the workers and the public. Safety reviews completed in 2022 are summarized in the next four items below.

Tritium Release and Re-Entry Event at Savannah River Tritium Enterprise

On January 30, 2022, operations personnel at H-Area New Manufacturing at SRS unintentionally released approximately 1000 curies (about 0.1 grams) of tritium gas from the stack. Due to unfavorable meteorological conditions, some of the tritium was then drawn back into the facility by the ventilation system and spread throughout the facility. The Board transmitted a letter to the NNSA Administrator on August 11, 2022, detailing safety concerns with this unanalyzed accident progression in which tritium could be pulled into a building, potentially exposing workers. The Board noted that this event showed that some assumptions in the Savannah River Tritium Enterprise's hazards analyses may no longer be valid. In addition, nearby non-process buildings do not have safety-related instruments and alarms like those in the tritium process buildings to detect and warn occupants of increased tritium concentrations in the air inside their buildings. The Board requested a briefing on NNSA's plans to analyze the scenario and any actions taken to protect workers from similar events.

NNSA provided the requested briefing on November 30, 2022. NNSA officials informed the Board that the existing analysis of radiological dose consequences to the co-located worker at 100 meters is adequate and that they believe no additional analysis is needed for workers who would be exposed if tritium were drawn into a building. The Board has previously expressed concerns with protection of workers in Recommendation 2019-2, *Safety of the Savannah River Tritium Facilities*. While NNSA has taken some action to improve the site's procedures and response to small, planned tritium releases, it is unclear if these actions will be effective in protecting nearby workers during unplanned releases where tritium may be drawn into a building.

Review of Safety Management Programs and Specific Administrative Controls at the Tritium Facilities

The Board completed a review of select safety management programs and specific administrative controls at the SRS tritium facilities in September 2022. NNSA relies on these safety programs and specific administrative controls to protect the public and workers from accidents. Overall, the Board did not identify significant concerns with the programs or controls reviewed but did communicate opportunities for improvement to the NNSA field office. The NNSA field office has positively responded to these safety observations and identified corrective actions, when available.

Savannah River Tritium Enterprise Electrical Review

The Board conducted a safety review of the electrical systems supporting the Savannah River Tritium Enterprise at SRS during 2021 and 2022. The Board identified three safety items in its review and communicated its safety concerns to DOE in an August 2, 2022, letter. First, the recurring operational failures of safety significant glovebox oxygen monitors had not been appropriately addressed or systematically evaluated to determine cause. Safety equipment performance could be improved by facility personnel proactively responding to such failures, addressing their root causes, and demonstrating that the equipment qualification program adequately simulates aging and worst-case environmental conditions before installing new safety equipment. Second, facility personnel were not maintaining or monitoring the facilities' lightning protection system performance in accordance with National Fire Protection Association 780, *Standard for the Installation of Lightning Protection Systems*. Facility personnel have since performed a gap analysis for the lightning protection system, which identified deviations and degradations compared to the industry standard. Finally, the Board found that facility personnel could better demonstrate the adequacy of the existing facility electrical distribution system by validating the power system engineering calculations with field measurements. The Board requested that DOE provide a written report on the Savannah River Tritium Enterprise's approach to system health monitoring for the safety significant glovebox oxygen monitors. NNSA provided the requested report on December 20, 2022.

296-H Tritium Stack Structural Review

The Board conducted a review of the structural integrity of the 296-H stack at the Savannah River Tritium Enterprise during 2021 and 2022 (see Figure 7). The Board found that

existing technical evaluations of the stack's structural integrity did not adequately support safety basis assumptions that natural phenomena events, such as extreme wind/tornado or earthquake, could not topple the stack onto a nearby tritium storage vault. In addition, the Board identified that the contractor for the Tritium Enterprise had stopped inspecting the stack in 2007, inconsistent with industry recommended practices of conducting interior and exterior inspections every five years or sooner. Lastly, the Board noted that the design of the stack and penetrations cut through the stack increased its vulnerability to damage from recurring environmental loads and severe natural events. The Board communicated its findings to DOE in a July 26, 2022, letter that requested a report with NNSA's assessment of the concerns.



Figure 7. *296-H Stack at the Savannah River Tritium Enterprise.*

Y-12 National Security Complex

Reactive Materials Hazards in Production Facilities

Between 2016 and 2021, the Y-12 National Security Complex (Y-12) experienced several pyrophoric events involving uranium metal chips, briquettes, and buttons during storage, handling, and transfer operations. These events were likely caused by thermal runaway reactions of uranium in air. To understand why such events occurred frequently, the Board's staff evaluated uranium reactivity hazards and the safety control strategies to prevent or mitigate thermal runaway reactions of uranium materials processed in the Y-12 production facilities.

Y-12's safety control strategy seeks to mitigate uranium fire events via a credited fire suppression system and an administrative control that limits unattended combustibles in the production facilities. This safety control strategy may not be adequate to protect facility workers from a uranium thermal runaway reaction with a sudden energy release. Y-12 operators responded inconsistently to such events and in some cases responded with actions that were not consistent with DOE guidance. For example, on October 1, 2021, operators extinguished

burning uranium chips using an organic solvent instead of an extinguishing agent appropriate for a metal fire.

On November 18, 2022, the Board issued a letter stating that it believes Y-12 can improve the site's safety posture by ensuring that uranium pyrophoric and chemical reactivity hazards are adequately addressed consistent with DOE guidance. The Board further advised that Y-12 consider revisiting its control strategies for new process technologies, including those to be installed in the new Uranium Processing Facility, to ensure that facility worker hazards related to uranium pyrophoricity are addressed. The Board requested that NNSA provide a written report and briefing on actions taken to analyze hazards and implement control strategies for potential uranium pyrophoric events with a sudden energy release.

Sandia National Laboratories

Technical Area V—Conduct of Operations Review

The Board reviewed the conduct of operations at Technical Area V associated with in-service fuel element inspections at the Annular Core Research Reactor Facility. The Board's staff observed operations, conducted interviews with Annular Core Research Reactor Facility and Auxiliary Hot Cell Facility staff, and discussed hoisting and rigging procedures for critical lifts in Technical Area V (see Figure 8).

The Board issued a letter to the NNSA Administrator providing the results of this review, identifying six functional areas for potential improvement in formality and rigor for the conduct of operations safety management program, on December 16, 2022. The Board recognized some improvements in the safe conduct of operations when compared to the results of prior Board reviews at Sandia National Laboratories (SNL). However, the Board noted that conduct of operations at the Annular Core Research Reactor Facility continues to lack the formality and rigor required for sustained, high-level safety performance. In addition, the Board noted that NNSA faced continuing safety oversight challenges based on the ineffectiveness of corrective actions to prevent recurrence of off-normal events during lifting operations at the research reactor.



Figure 8. *Annular Core Research Reactor fuel element rack lifted over the reactor pool.*

Emergency Preparedness and Response

The Board's staff conducted a review of the emergency preparedness and response program at SNL in New Mexico in 2022. Since 2019, NNSA and its management and operating contractor have made substantial changes to the site's emergency management program, including revising its base support agreement and MOU with Kirtland Air Force Base to provide primary fire and rescue services to the site; restructuring the emergency management organization; adding new, key emergency response organization roles; and construction of a new emergency operations center, expected to be operational in 2023. In support of this review, the Board's staff observed the March and August 2022 SNL emergency exercises, held an on-site interaction in March 2022 to assess the site's progress, and communicated observations to the site. In 2023, the Board's staff will present observations from the review to the Board for its consideration.

Nevada National Security Site

Criticality Safety at the National Criticality Experiments Research Center

The National Criticality Experiments Research Center (see Figure 9) is located within the Device Assembly Facility at the Nevada National Security Site (NNSS). The research center supports a variety of nuclear security missions, including nuclear criticality safety research and training to collect nuclear data in support of criticality safety benchmark experiments for diverse customers and stakeholders. LANL is the primary user performing experiments at the research center. As a result, both the NNSS contractor and LANL implement portions of their respective DOE-approved nuclear criticality safety programs to form one integrated program at the research center.

Following a review of the nuclear criticality safety program at the center, the Board issued a letter to the Secretary of Energy on June 16, 2022. The Board identified weaknesses in the integrated criticality safety program that increase the potential for improper implementation of safety controls as well as weaknesses in safety oversight that decrease the likelihood of detecting safety deficiencies. Specifically, weaknesses included inconsistencies between the integrated criticality safety program used at the research center and the applicable LANL corporate program; inadequate consideration of the impact of changes in the site-specific seismic hazard on the research center’s criticality safety evaluations; insufficient metrics for federal safety oversight to measure the health of the integrated criticality safety program; and insufficient criticality safety analyst support for the research center.

The Board concluded that an increased focus on safety oversight of the activities at the research center, by both the responsible contractors and federal offices, would provide NNSA with an opportunity to address safety issues identified during this review. In its letter, the Board requested a report and a briefing on NNSA’s evaluation of the criticality safety program implemented at the research center, NNSA’s evaluation of the effectiveness of federal oversight of the implemented program, and any planned corrective actions.

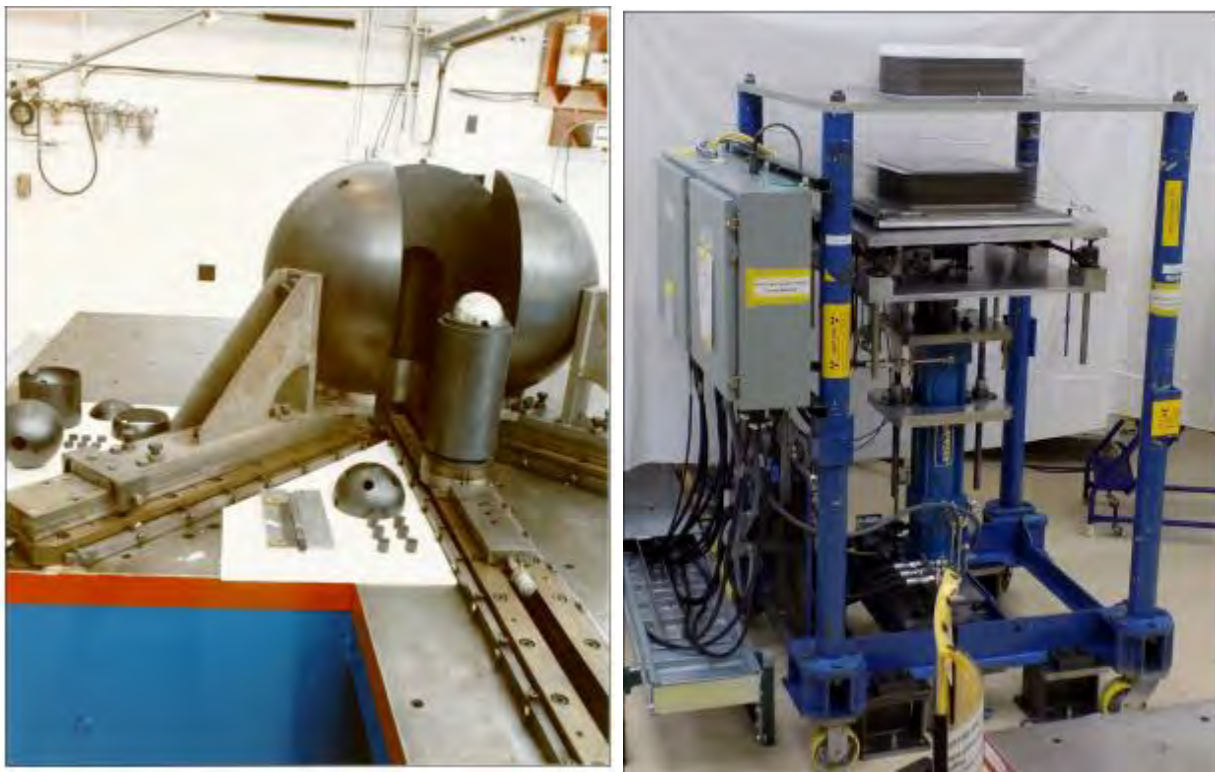


Figure 9. *Flattop (left) and Planet (right) critical assemblies at the National Criticality Experiments Research Center.*

NNSA provided its report and briefing to the Board on October 6, 2022, and December 9, 2022, respectively. NNSA assessed the Board’s safety issues and concluded that activities and operations at the research center are safe. However, NNSA acknowledged that the issues identified by the Board represented opportunities for improvement and informed the Board that

NNSA has developed and is implementing a series of actions to address the Board's safety concerns.

Livermore National Laboratory

Building 332 Recovery Glovebox Line for Plutonium Processing

The Recovery Glovebox Line comprises three new glovebox lines that were installed in the Plutonium Facility (Building 332) at Lawrence Livermore National Laboratory in 2021 (see Figure 10). The Recovery Glovebox Line is used to recover and purify plutonium through aqueous chemical processing of impure plutonium oxides, salts, and metal scraps obtained from various process operations in Building 332.

The Board's staff completed a review of the documented safety analysis and process hazards associated with the Recovery Glovebox Line and evaluated process controls for the ion exchange resin and hazards associated with hydrogen generation and deflagration during process operations. The staff is documenting the results of this review for Board consideration in 2023.



Figure 10. *Glovebox Line 1 of the Recovery Glovebox Line.*



DEFENSE NUCLEAR WASTE OPERATIONS

V. Defense Nuclear Waste Operations

In 2022, the Board performed nuclear safety oversight of high priority Office of Environmental Management operations within the nuclear weapons complex. The Board based its oversight priorities on the nuclear safety risk of proposed and ongoing activities. As discussed below, the Board continued to focus on the safety of solid nuclear waste at LANL, INL, and WIPP. In addition, the Board produced correspondence on safety concerns related to facility operations, accident analyses, and safety-related equipment at SRS, Hanford, LANL and WIPP. The Board held a public hearing in Santa Fe, New Mexico, in November 2022 to publicly discuss its safety concerns with officials from the Office of Environmental Management and LANL.

For Hanford, SRS, LANL, and the Oak Ridge National Laboratory, the Board maintained full-time resident inspectors to monitor operations. Cognizant engineers on the Board's headquarters staff are dedicated to monitoring INL and WIPP.

Safety of Solid Nuclear Waste

DOE has experienced two waste events in the past decade that resulted in radiological releases. One occurred in February 2014 at WIPP and another in April 2018 at INL. Since then, several other events have occurred that did not involve releases, but also have significant implications for the safety of operations involving solid nuclear waste. These events reinforce the importance of continued diligence during waste operations. Each event is summarized below, and additional detail is included in the WIPP, INL, and LANL sections of this report.

- The 2014 WIPP radiological release event involved inappropriately remediated nitrate salt waste from LANL. The waste experienced an energetic chemical reaction in the WIPP underground that ruptured the drum and spread radioactive contamination. This event led to a three-year shutdown of the facility.
- The 2018 INL event involved four drums containing solid radioactive waste at the Radioactive Waste Management Complex over-pressurizing, resulting in the ejection of their lids. The ejections spread radiological material within the facility.
- The 2021 LANL Plutonium Facility event involved an unexpected chemical reaction that caused sparks to emanate from a waste drum. While this event did not release radioactive material, LANL personnel failed to recognize the hazard that this waste presented in non-inert environments.
- The 2021 INL event involved energetic sparking of uranium in the Accelerated Retrieval Project VIII Retrieval Area. The waste was staged in arrays of trays, awaiting a disposal campaign. The event did not release radiological material but could have done so under different circumstances.

- Two events in 2022 involved waste shipped from INL to WIPP in which operators discovered unexpected liquids or corrosion upon receiving the waste in New Mexico. These events did not involve radiological releases and DOE is still evaluating the full impact.

As a result of the events noted above, the Board has continued to evaluate how DOE analyzes hazards and implements controls at defense nuclear facilities that generate, process, and store radioactive waste. In the past five years, the Board has communicated several safety issues and deficiencies to DOE through correspondence and hearings.

- DNFSB Technical Report 43, *Deficiencies in DOE Standard 5506-2007, Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities*, March 15, 2018.
- Board Letter on Flammable Gas Hazards Associated with Solid Waste, October 18, 2019.
- Public Hearing on Safety Management of Waste Storage and Processing in the Defense Nuclear Facilities Complex, June 20, 2019.
- DNFSB Technical Report 46, *Potential Energetic Chemical Reaction Events involving Transuranic Waste at Los Alamos National Laboratory*, September 24, 2020.
- Board Letter on Review of DOE Standard 5506, July 26, 2021.
- Public Hearing on Legacy Cleanup Activities at LANL, November 16, 2022.

One of the main issues in the Board correspondence was the need for DOE to revise DOE Standard 5506-2007, *Preparation of Safety Basis Documents for Transuranic Waste Facilities*, to address deficiencies and incorporate lessons learned from across the DOE complex. In 2020 and 2021, the Board's staff transmitted more than 250 comments to DOE regarding concerns with draft revisions of DOE Standard 5506. DOE and the Board's staff worked together to resolve many of these concerns. In August 2021, DOE issued the revision to DOE Standard 5506. The updated standard contains significant improvements, most notably:

- new requirements for waste generator sites to identify potential undesired chemical reactions;
- updated methods for estimating the severity of potential accidents, informed by the 2014 WIPP event and 2018 INL event; and
- improved guidance for hazard analysis, accident analysis, and control selection.

The Board believes that DOE should implement the revised standard in an expeditious manner, as implementation would improve the safety posture of transuranic waste facilities. To aid in implementing the standard, DOE provided multiple training events focused on DOE

Standard 5506-2021 at a series of sites across the complex. The Board's staff evaluated this training and concluded that the training was well prepared, well delivered, and highly effective. The training was delivered by the authors of DOE Standard 5506 as well as senior personnel from the Office of Environmental Management, who provided real-time insights into key implementation questions. The Board's staff provided feedback on the training, most of which was addressed during subsequent sessions. This is an example of a particularly effective working relationship between the Board and DOE.

To understand the impacts of implementing the new standard, the Office of Environmental Management and NNSA sent memoranda to field offices in 2021. These memoranda required field offices to identify any gaps between current safety basis documents and changes made in the revised DOE Standard 5506. In 2022, the Board reviewed these gap analyses and identified concerns with the quality and adequacy of the gap analyses. The Board's staff has discussed these concerns with DOE management in detail.

In a related, parallel effort, on September 24, 2020, the Board issued Technical Report 46, *Potential Energetic Chemical Reaction Events involving Transuranic Waste at Los Alamos National Laboratory*, to the Secretary of Energy. This report built upon previous Board efforts and provided a site-specific case study of how the safety bases for several different facilities at LANL treat hazards posed by energetic chemical reactions. Overall, the report concluded that LANL safety bases do not consistently or appropriately consider a potential energetic chemical reaction involving transuranic waste.

The Secretary of Energy responded to Technical Report 46 in a letter dated March 30, 2021, that stated that DOE is adequately and consistently controlling transuranic waste hazards at LANL and would use the Board's technical report to aid DOE's review of the unexpected sparking event that occurred in waste at LANL in 2021. In April 2022, DOE briefed the Board on corrective actions and improvements being made at LANL in response to Technical Report-46.

The Board believes that DOE is making improvements at LANL facilities in response to Technical Report 46. Further, DOE plans to implement DOE Standard 5506-2021 at LANL facilities in the near-term. Specifically, Area G and the Plutonium Facility plan to implement the revised standard in 2023, which should further improve the safety posture at those facilities. The Board plans to evaluate implementation of DOE Standard 5506-2021 as it is incorporated into other individual facility safety analyses.

Savannah River Site

Salt Waste Processing Facility Operations and Maintenance

The SRS Salt Waste Processing Facility commenced operations with radioactive materials in late 2020. In 2021, continuing into 2022, the Board assessed implementation of basic conduct of operations and maintenance principles, with a specific focus on radiological controls, readiness to execute abnormal operating procedures, control room operations, general procedural compliance, and work planning and control. In a July 19, 2022, letter to the Office of

Environmental Management, the Board identified numerous best practices that were aligned with good conduct of operations principles. Of note, the extended review of this facility's operations coincided with four technical safety requirement violations, one of which was identified by the Board. The Board believes that site personnel appropriately identified this negative trend and took appropriate corrective actions. The Board also identified weaknesses in the quality of some technical procedures, the application of the unreviewed safety question process, and the general rigor associated with addressing minor facility deficiencies. During 2022, the Board's staff conducted follow-up observations in the facility and noted positive progress in applying the unreviewed safety question process to appropriate operating documents and improving the rigor associated with tracking abnormal conditions in operator logs.

Savannah River National Laboratory Safety Basis

The Board's staff reviewed the Savannah River National Laboratory (SRNL) safety basis to assess the implementation of safety-related controls against the requirements of DOE orders and directives, particularly DOE Standard 3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, and DOE Standard 1186-2014, *Specific Administrative Controls*. Consistent with previous correspondence by the Board, this review identified persistent issues with the identification of specific administrative controls for safety-related functions credited in the safety basis, and issues with the safety-related boundary for the credited fire suppression system. The Board's staff also identified new issues with the implementation of controls to handle nuclear material outside credited safes and with the analysis supporting the design requirements for safety-related instrumentation and alarm systems. The Board is determining the need for additional correspondence to ensure ongoing DOE and laboratory contractor actions successfully resolve previously identified deficiencies in the laboratory's safety basis.

Building 235-F Safety

The Board received DOE's annual briefing in July 2022 regarding progress made to deactivate and decommission Building 235-F and associated inspections, corrective actions, and activities. DOE deactivated Building 235-F during 2022 and has received a final regulatory determination on the decommissioned end-state for the facility. In the deactivated state, while design work for final decommissioning progresses, DOE will conduct periodic inspections of the facility focused on structural integrity and radiological conditions. Recommendation 2012-1, *Savannah River Site Building 235-F Safety*, remains open, with the Board's focus being on monitoring the results of periodic inspections. This topic is covered in more detail in Appendix A: Board Recommendations.

Respirator Training

DOE requires personnel to acquire specific training certifications to ensure they are properly protected prior to entering areas involving airborne radiological hazards. The Board's staff identified multiple instances where respiratory protection training was not conducted in a manner compliant with DOE training standards or SRS procedures. Non-compliances included instructors conducting job performance measures in a group setting rather than individually

evaluating a worker's performance, and instances in which instructors certified personnel despite failures to correctly perform critical steps. Allowing inadequately trained employees to work in hazardous situations could endanger them, other employees, and the public. In response to the Board's staff's concerns, DOE took substantial action to revise the site's respirator training program. Improvements completed to date include significant training for the instructional staff, procedure enhancements that ensure personnel cannot pass after failing a critical step, and requirements that all job performance measures to be conducted in a one-on-one setting.

Event Investigations

The Board's staff observed issue investigation and fact-finding meetings used to evaluate abnormal events and occurrences throughout 2022, identifying multiple non-compliances with requirements in DOE Order 422.1, *Conduct of Operations*, across all major contractor organizations. The overall performance of event investigations varied widely across the site and within organizations. Significant shortcomings included a lack of qualification for investigative/fact-finding personnel; a lack of training on facility systems, operations, and investigation techniques; failure to require independence of investigators; and failure to identify the responsible manager for investigations. The Board's staff communicated these observations to DOE and contractor personnel, who have taken actions to improve the program and strengthen the investigative process. The Board plans to review the program improvements and to continue to observe event investigations at SRS as well as other sites across the complex.

Hanford Site

242-A Evaporator Safety Strategy

In 2014, the Board sent a letter to DOE detailing safety deficiencies in the design of safety systems at the 242-A Evaporator Facility. Because of the safety deficiencies, DOE could not ensure prevention of a deflagration or explosion in the evaporator systems if a fire damaged components in the safety significant controls. Additionally, instead of applying an engineered control, DOE relied on a weak administrative control to ensure the evaporator was placed in a safe condition after a seismic event. In its August 28, 2014, response, DOE agreed to resolve these problems.

However, in early 2020, DOE and its contractor decided to change the safety approach for both conditions. Instead of fulfilling previous commitments to provide robust engineered safety controls, DOE opted to pursue a less robust approach that relies primarily on administrative controls to protect collocated workers. The Board reviewed DOE's revised strategy, concluding that, as proposed, the modified approach is not consistent with DOE's hierarchy of controls and does not provide a level of safety that is commensurate with the consequences of a flammable gas explosion in the evaporator.

On July 19, 2022, the Board sent a letter to the Secretary of Energy providing the results of this review and requesting a briefing from DOE showing how the final revised safety strategy for operating the 242-A Evaporator facility (see Figure 11) will meet DOE's safety requirements and address the Board's safety concerns. On October 12, 2022, DOE and contractor

representatives from the Hanford Site briefed the Board on the proposed safety strategy. The briefing did not fully address the Board's concerns. The Board is currently reviewing safety basis changes that the contractor developed to support the revised strategy. Information from that review will be used to inform the Board's next steps in resolving these safety issues.

The evaporator is currently in an outage to replace failed transfer lines, evaluate other degraded transfer lines, perform pump repairs and replacements, and complete other facility upgrades. DOE currently projects that evaporator operations will resume no earlier than September 2023.



Figure 11. 242-A Evaporator Facility at Hanford Site

Current Tank Farm Operations

The tank farm facility's mission is to safely manage and treat approximately 56 million gallons of mixed radioactive and chemical waste. The waste is stored underground in 149 single-shell tanks and 28 double-shell tanks.

The single shell tanks are years beyond their useful life. Between 1968 and 1986, DOE built the double-shell tanks that are used on the site. The aging single-shell tanks were subsequently stabilized by transferring all pumpable liquids to the double-shell tanks. However, in some cases, the liquid waste remaining in the single-shell tanks is leaking to the environment. Retrieval of the remaining sludge, saltcake, and liquid in the single-shell tanks involves mobilizing the waste by using pressurized water directed through robotic sluicing equipment, then pumping the slurry to a double-shell tank for safe storage. To date, waste from 19 single shell tanks has been retrieved. Retrieval from the 20th single shell tank is in progress. Complete waste retrieval from all remaining single shell tanks is currently scheduled for 2040.

Tank Side Cesium Removal System Fitting Structural Integrity

The tank farms contractor began operation of the Tank Side Cesium Removal system in January 2022. This system is an enabler for DOE's direct feed approach to startup of the Waste Treatment and Immobilization Plant Low-Activity Waste facility.

In October 2021, during the contractor's readiness assessment, some safety significant fittings were noted to be damaged. As DOE and its contractor dispositioned the damage, the Board's staff observed that there were gaps in the contractor's implementation of its condition reporting program, quality control program, and the procedural controls governing installation of the fittings. On October 6, 2022, the Board sent a letter to DOE providing its report on the Tank Side Cesium Removal system and ion-exchange column connector issues (see Figure 12). The Board's letter detailed concerns associated with these program and procedural gaps, which had the potential to affect a fitting's ability to perform its safety function.



Figure 12. *Tank Side Cesium Removal ion exchange column threaded connectors before and after repair.*

On December 20, 2022, DOE briefed the Board on actions that had been completed, and others yet to be taken, that will address the Board's concerns. DOE outlined actions to evaluate and upgrade the technical basis for structural integrity of the connectors, fitting assembly procedures, condition reporting, and quality assurance processes.

Hanford Site Risk Reduction

The Hanford Site contains former plutonium production, processing, and refining facilities, waste disposal sites, and other excess facilities. Among these facilities are decommissioned reactors and canyons along with their support facilities, the Solid Waste Operations Complex, and the waste burial grounds. Current activities in this area are focused on risk reduction, achieved through characterizing, removing, and remediating nuclear and chemical hazards; interim maintenance and stabilization of facilities; and interim safe storage or disposal of waste products. Specific projects of higher interest are highlighted below.

Building 324—Building 324 is a hazard category 2 nuclear facility currently being decommissioned after operating for more than 30 years (see Figure 13). Building 324’s mission was to conduct studies on the chemical and physical properties of radioactive materials and irradiated targets. From October 2018 to November 2019, there were 13 contamination events in Building 324 while performing various cleanup and stabilization activities within the facility. Due to this observed trend in contamination events, the contractor declared a “stop work” on November 14, 2019. With the resumption of full-scale remediation activities in 2022, the Board’s staff initiated a review of conduct of maintenance and the associated radiological controls at Building 324. The Board’s staff also reviewed the contractor’s conduct of operations and corrective action implementation for radiological controls, as well as DOE’s oversight of Building 324 resumption of activities. One key issue challenging the contractor at Building 324 is the high rate of personnel turnover and the ability to staff required positions with experienced personnel. The Board continues to monitor the overall safety posture at Building 324 as remediation proceeds.



Figure 13. *Building 324.*

100-K Area End States—Along with Building 324, stabilization of the 105-K West reactor and its basin is one of the few remaining high hazard activities along the Hanford Site River corridor. The contractor’s ongoing efforts at the facility are focused on final preparations for dewatering the basin. Once dewatered, remaining material in the basin will be stabilized with grout, and the basin will be demolished. Most of the resulting demolition material will be placed in the Environmental Restoration Disposal Facility. The Board continues to monitor ongoing activities and has started a review of facility operations and radiological control practices.

Los Alamos National Laboratory

Justifications for Continued Operation at Area G

Since January 2020, the LANL Area G contractor has declared 24 potential inadequacies in the safety analysis against the Area G safety basis. To address these issues, the contractor developed, and the Office of Environmental Management approved, six justifications for continued operation. In an August 17, 2022, letter, the Board sent DOE the results of its review of the justifications for continued operation and the interim Area G control strategy. The Board identified three accident scenarios for which DOE was accepting high mitigated offsite consequences (between 10 and 18 rem total effective dose) and encouraged DOE to expeditiously complete and implement a new safety basis document, which is nearing submission and is meant to ensure compliance with current versions of DOE safety standards.

Board Public Hearing (Environmental Management Focus)

On November 16, 2022, the Board conducted a public hearing in Santa Fe, New Mexico, to gather information on DOE's activities at LANL. The hearing was in-person and available remotely via a live-stream. It comprised four sessions; the first focused on the Office of Environmental Management's mission and activities at Area G, a transuranic waste management facility (see Figure 14). The panel testifying before the Board included the manager of the Environmental Management field office and the president and program manager of the Area G contractor. The goals of this session of the hearing were to (1) understand actions completed and planned to strengthen the safety basis, and (2) discuss plans to remove legacy transuranic waste while minimizing the amount of aboveground transuranic waste.

During the Environmental Management session, the Board and the field office discussed the benefits and challenges of having a separate field office and contractor dedicated to cleanup efforts. Additionally, the Board and the contractor discussed available data regarding waste shipments to WIPP and the capabilities required to ship more containers. The Board and the panel also discussed the timeliness of contractor submittals and field office approvals regarding safety basis documentation, both historically and in the future. The session ended with a public comment period.

Safety of Solid Nuclear Waste

In response to a titanium powder flash event in 2020 and Technical Report 46, *Potential Energetic Chemical Reaction Events Involving Transuranic Waste at Los Alamos National Laboratory*, the LANL contractor instituted a new procedure for developing and using chemical compatibility evaluations for processes that generate transuranic waste. Using this procedure, LANL has started systematically reevaluating processes that have the potential to generate transuranic waste at the Chemistry and Metallurgy Research Building and the Plutonium Facility. In 2022, the Board began a review of the new procedure and several chemical compatibility evaluations.



Figure 14. *Potentially energetic waste container stored in Area G at LANL.*

Flanged Tritium Waste Containers

There are currently four flanged tritium waste containers temporarily stored at Area G. Since these containers have potentially flammable headspaces, they must be vented prior to undertaking further movement or disposal actions. The team that will vent the containers performed a proficiency demonstration for federal assessors in the summer of 2022. DOE is awaiting permits from the state before it can start the venting.

Oak Ridge National Laboratory

The Initial Processing Campaign is a project at Oak Ridge National Laboratory to down-blend uranium-233 from Building 3019 for disposal as low-level waste and to extract thorium-229 using the hot cells in Building 2026. DOE directives require contractor and DOE operational readiness reviews to confirm readiness for safe start-up of operations.

The Board's staff observed and evaluated the contractor operational readiness review in March 2022. During the demonstrations, the contractor review team, DOE personnel, and the Board's staff observed weaknesses in conduct of operations, procedure implementation, radiological protection, and emergency drills. The Board's staff communicated its observations to the DOE Oak Ridge Office of Environmental Management and contractor personnel. In April 2022, the DOE Oak Ridge Office of Environmental Management appropriately urged the

contractor to take the necessary time to properly address the safety concerns and findings identified during the contractor operational readiness review.

DOE conducted its operational readiness review in July 2022. The Board’s staff observed improvements in conduct of operations, procedure implementation, and radiological protection as measured against the contractor operational readiness review. The DOE operational readiness review team identified some findings to be addressed but concluded that readiness had been achieved. The Board communicated an observation to DOE Oak Ridge Office of Environmental Management personnel related to oversight of the planned transition from single-cell operation to multi-cell operations, which was subsequently addressed. In October 2022, the contractor successfully started Initial Processing Campaign operations in Building 2026.

Idaho National Laboratory

Safety of Solid Nuclear Waste

As discussed in the Safety of Solid Nuclear Waste section of this report, the Board followed up on two events related to radiologically contaminated shipping containers that arrived at WIPP from INL.

In March 2022, INL personnel loaded six waste drums into a shipping container, designated as TRUPACT-II 148. Upon arrival at WIPP in early April 2022, personnel began unloading the shipping container to inspect its contents. WIPP personnel determined that the contents did not meet the waste acceptance criteria when they found unexpected liquids inside the shipping container and radiological contamination on the outside of some drums (see Figure 15). The shipment was sent back to INL, arriving in early May 2022.



Figure 15. *Areas of corrosion, paint bubbles, and fluid under a 100-gallon drum from TRUPACT-II 148.*

As a technical investigation at INL progressed over the next several months, the site shipped additional drums under an enhanced inspection program with treated contents from the same waste stream that the TRUPACT-II 148 drums contained. In August 2022, WIPP received and inspected another TRUPACT-II, number 180, finding substantial corrosion and what appeared to be small holes, at the bottom of one of the waste drums within. WIPP personnel likewise returned this shipment later that month to INL for investigation.

After issues with the TRUPACT-II 148 and 180 shipments, INL personnel reviewed both payloads, performed non-destructive examinations of the two failed drums from both payloads, and hypothesized that the most likely causes for failure were storage age, interior drum corrosion, and stresses induced during transport. INL personnel contend that they properly inspected these drum payloads, closed in 2015 and 2017, before shipping them.

In November 2022, INL personnel authored *TRUPACT-II 148 Initial Investigation Report*. This report concludes that “[t]here were no issues identified with payload assembly or shipping procedures....There was no definitive source of liquid that we can point to...” and commits to investigate further the TRUPACT-II 180 shipment. The Board has emphasized in continued interactions with DOE Idaho Operations Office personnel the importance of considering how environmental factors in prolonged staging, waste treatment methods involving absorbents, and debris from waste compaction may have contributed to the waste shipping events. INL personnel have indicated their intent to produce a final report that covers issues with the problematic waste stream, particularly the TRUPACT-II 148 and 180 shipping events.

Meanwhile, the Board has continued its oversight of how DOE is managing the safety of waste containers at INL. Additional controls are warranted to enhance safety while personnel move drums, especially those with potentially flammable contents. The Board continues to evaluate these concerns, including those related to the need for full implementation of revised DOE Standard 5506-2021 as well as DOE Standard 3009-2014.

Integrated Waste Treatment Unit

The Integrated Waste Treatment Unit is designed to process approximately 900,000 gallons of liquid sodium-bearing radioactive waste, which is now staged at the Idaho Nuclear Technology and Engineering Center tank farm, as well as newly generated liquid waste from the center. Waste processing operations have not started, so the facility is still radiologically clean.

In late February and March 2022, the Integrated Waste Treatment Unit was processing simulant material to gain operating experience. During this “simulant run,” the facility experienced a suite of rapid shutdown system alarms, which automatically secure it in a safe configuration to prevent any release of untreated material. When operations personnel investigated the cause for the alarms, they discovered that simulant material had leaked throughout the process gas filter (see Figure 16). The outage resulting from the process gas filter leak enabled personnel to gain additional experience with maintenance management and radiological protection, topics that the DOE readiness assessment in August 2022 later evaluated. The Board’s staff observed the DOE readiness assessment, including field demonstrations and

interviews with operations and radiological protection personnel and did not identify any safety issues that would prevent the contractor from performing waste processing in a safe and effective manner. However, the Board remains concerned about observed weaknesses in radiological work practices and conduct of maintenance.

DOE anticipates the Integrated Waste Treatment Unit to transition into radiological operations during the first quarter of 2023.



Figure 16. *Opening the process gas filter on the Integrated Waste Treatment Unit at INL.*

Waste Isolation Pilot Plant

Safety of Solid Nuclear Waste

As discussed in the Safety of Solid Nuclear Waste and INL sections of this report, the Board followed up on two events related to radiologically contaminated shipping containers that arrived at WIPP from INL. In both instances, WIPP personnel observed abnormal conditions on the exterior of the drums and returned the shipments to INL to investigate. The INL section of this report contains details associated with the ongoing technical investigation and potential corrective actions.

WIPP Operations

On August 17, 2022, the Board sent a letter to DOE concerning the WIPP 700C fan restart efforts and provided additional information for consideration more broadly by DOE. The main nuclear safety concern is the ability of continuous air monitors to reliably detect a radiological release from an active waste panel (see Figure 17) and transmit a signal to shut down the 700C fan before airborne radiological contamination from the underground can be carried to the surface. Overall, however, operational issues with continuous air monitors, as well as the design and operation of safety significant instrumentation and control systems, will impact more than just the 700C fan. The Board highlighted several relevant previous letters to DOE dated February 19, 2016, March 26, 2018, August 27, 2019, and August 13, 2021.



Figure 17. *Waste containers in an active waste panel at WIPP.*

The Board's staff is continuing to follow up on errors in the Waste Data System software used to track shipments from waste generators sites to WIPP. This software issue resulted in the generation of duplicate shipping data for two waste shipments to WIPP, necessitating a return of the erroneous shipment to the generator site. The WIPP contractor continues to work on the software revisions necessary to correct this issue.

National Transuranic Program Oversight

Carlsbad Field Office Letter on Nitric Acid/Nitrate Salts with Polysaccharides

On September 8, 2021, the Board transmitted a letter to DOE discussing the Carlsbad Field Office's direction letter that provided a methodology for evaluating waste containing mixtures of nitric acid or nitrate salts with polysaccharides, the same waste type that was involved in the 2014 WIPP radiological release event that led to a three-year shutdown of WIPP. The Carlsbad Field Office had concluded that such waste would not undergo autocatalytic runaway reactions after the waste had been aged for a specified time under specific conditions. The Board found that the DOE letter lacked the technical basis to support that conclusion. The Board's findings were consistent with the conclusions of a DOE-sponsored technical review team assigned to evaluate disposal pathways for the inappropriately remediated nitrate salt waste stored at the Waste Control Specialists facility in Andrews County, Texas.

The Board's letter included a requirement for a report and briefing that described its plan for safely managing these types of waste materials across the complex. DOE provided a briefing to the Board in December 2021, after which the Board extended the deadline for the written report into early 2022 to allow DOE to resolve this safety issue in a more comprehensive manner. The Carlsbad Field Office incorporated the Board's technical feedback to develop a revised direction letter. On December 21, 2021, the Carlsbad Field Office issued a revised direction letter to its certified programs to: (1) remove references to technical documents and conclusions that the Board had questioned; (2) provide a statement on risk acceptance; (3) remove a reference to wheat-based sorbents; and (4) establish a sunset clause for the direction to preclude applicability of the letter to waste generated after May 31, 2022. On February 1, 2022, DOE provided the Board the written report, *Plan to Manage Transuranic Waste Containing Nitric Acid or Nitrate Salts with Polysaccharides*, effective January 13, 2022, explicitly responding to several of the safety issues raised by the Board. This professional interaction represented not only a mutual commitment to safety, but also a robust process by which new technical and scientific information may be evaluated for use across the complex.

Carlsbad Field Office Response to Los Alamos Titanium Fines Event

On August 25, 2022, the Board conducted a teleconference with the Carlsbad Field Office to discuss the response to the LANL Plutonium Facility reactive titanium metal fines event of February 26, 2021. The objective of this call was to evaluate any analyses, lessons learned, or corrective actions Carlsbad Field Office personnel performed or implemented in response to the sparking event involving reactive titanium metal fines. Carlsbad Field Office personnel did not conduct their own review or investigation into the sparking event. The contractor causal analysis report identified some recommendations and shortfalls that were specific to the National Transuranic Program's certified program activities at LANL. The Board continues to evaluate both the LANL and the Carlsbad Field Office response to this event and the implementation of corrective actions.

Transuranic Waste in Andrews County, Texas

The 2014 WIPP radiological release event involved LANL waste containing inappropriately remediated nitrate salts. An extent-of-condition review identified many additional non-compliant remediated nitrate salt waste containers. Prior to the event, more than 100 of these non-compliant containers had been shipped to a facility for temporary storage in Andrews County, Texas. To date, all non-compliant containers except those stored in Texas have been successfully treated and/or safely dispositioned at WIPP. A DOE-sponsored integrated project team including relevant hazardous waste regulators and Nuclear Regulatory Commission representatives continue to work on a safe disposition path for the remaining drums.

In early 2022, DOE contracted Southwest Research Institute to conduct additional surrogate testing of the inappropriately remediated nitrate salt containers remaining in Texas. On April 27, 2022, Southwest Research Institute issued its report, which identified its test results as non-conclusive. The Board's staff conveyed its technical evaluation of the testing to DOE in June 2022 and continues to track and evaluate DOE's development of a safe disposition path for these non-compliant containers.

Lawrence Livermore National Laboratory

The Centralized Waste Processing Line at LLNL is a specialized glovebox enclosure in the Plutonium Facility designed and built specifically to process transuranic waste, both newly generated and previously packaged (see Figure 18). The range of operations include transferring waste parcels into a workstation, disassembling the waste parcels and their primary components, documenting the absence of prohibited items, and completing documentation as required by the waste acceptance criteria for WIPP. The Board's staff observed readiness assessment activities for the restart of processing line operations. The Livermore Field Office approved restart of processing line operations on October 5, 2022.



Figure 18. *Centralized Waste Processing Line gloveboxes in the Plutonium Facility.*



DESIGN AND CONSTRUCTION

VI. Design and Construction

In 2022, the Board performed nuclear safety oversight of DOE projects to construct new or modified defense nuclear facilities consistent with its prioritization of overall nuclear safety risk in the DOE enterprise. The Board evaluates staff analyses, along with other sources of data such as input from resident inspectors, Board member field visits, DOE project status briefings, and Board hearings, to form the basis for identifying any nuclear safety deficiencies to DOE.

Major design and construction projects the Board evaluated in 2022 are listed in Table 4 below. In 2022, most of the Board's identified safety concerns involved ensuring the safety of workers inside and co-located to the DOE projects. Additional discussion of those concerns and summaries of the Board's project evaluations performed in 2022 are discussed in the following table.

Table 4. *Design and Construction Projects under Evaluation in 2022.*

Project Name	Location	Status of Project	Status of Review
Waste Treatment and Immobilization Plant, High-Level Waste Facility	Hanford	Concurrent design and construction	Ongoing—project letters issued 05/09/2019, 10/14/2020, 7/19/2022
Waste Treatment and Immobilization Plant, Low-Activities Waste Facility	Hanford	Construction complete, testing in progress	Ongoing—project letter issued 06/25/2020
Savannah River Plutonium Processing Facility	Savannah River Site	Preliminary design	Ongoing—Project letter issued 1/6/2022
Surplus Plutonium Disposition Project	Savannah River Site	Preliminary design	Ongoing—Project letter issued 1/6/2022
Safety Significant Confinement Ventilation System	Waste Isolation Pilot Plant	Construction	Ongoing—project letters issued on 03/26/2018, 08/27/2019, 8/17/2022
Uranium Processing Facility	Y-12 National Security Complex	Construction	Ongoing—project letter issued on 06/26/2017

Hanford Waste Treatment and Immobilization Plant

The tank farms at the Hanford Site near Richland, Washington, contain 56 million gallons of radioactive and toxic waste stored in 177 underground tanks. In the late 1990s, DOE began work on the Waste Treatment and Immobilization Plant, which will be used to vitrify the Hanford tank waste prior to its permanent disposal. This planned radiochemical processing plant consisted of four primary facilities: Pretreatment, Low-Activity Waste, High-Level Waste, and the Analytical Laboratory. DOE will dispose of the low-activity waste glass on-site and will ship the high-level waste glass offsite for permanent disposal once a national repository is available.

Since initial design efforts began, numerous technical issues have arisen at the Waste Treatment and Immobilization Plant, primarily related to the design of the planned Pretreatment and High-Level Waste facilities. Resolution of the technical issues, along with funding constraints, introduced significant delays in constructing the facilities. Consequently, to move the tank waste disposal mission forward, DOE modified its approach to focus on bringing the less technically challenging Low-Activity Waste facility online first to process feed provided directly from the tank farms, bypassing the Pretreatment facility.

In 2012, the design and construction of the High-Level Waste facility was paused while DOE evaluated the resolution approach for significant technical and safety issues associated with the design, some of which were identified by the Board. In a letter transmitted on May 9, 2019, the Board agreed that DOE identified acceptable strategies for resolution of the safety issues, but noted that, in some cases, further analysis was necessary to validate or clarify assumptions underpinning those strategies. In February 2021, DOE issued a revised preliminary documented safety analysis for the High-Level Waste facility. Among other updates, the revision included changes to further address Board-identified safety issues, including those related to unanalyzed melter accidents, the hydrogen control strategy, and seismic qualifications of safety-related controls.

High-Level Waste

The Board reviewed the revised preliminary documented safety analysis focusing on the proposed hydrogen hazard control strategy, as well as the fire protection and chemical safety programs. On July 19, 2022, the Board issued a letter communicating the results of the review, concluding that DOE had made progress in resolving some long-standing technical issues, but the hydrogen hazard control strategy for process vessels was still not fully defined. This letter also noted that, because of discussions held during the review, project personnel stated they plan to proactively develop technical safety requirements several years earlier than originally planned. The Board considers this a positive effort that will help identify gaps in the hydrogen hazard control strategy.

In 2022, DOE conducted an analysis of alternatives to evaluate options for progressing the high-level waste mission. DOE also initiated a second effort, titled the High-Level Waste Facility Firm the Foundation Team, to validate assumptions and design inputs, review design criteria, and clarify proposed approaches. This teaming approach between DOE and the Waste Treatment and Immobilization Plant contractor is being used to bring alignment and agreement on best paths forward and support the management decisions necessary to proceed with design and construction of the High-Level Waste facility. The Board is monitoring progress to ensure timely integration of safety into the design.

Low-Activity Waste

The Low-Activity Waste facility is undergoing cold commissioning and readiness activities to demonstrate that the facility can safely produce vitrified low-activity waste (see Figure 19). In 2022, the Board's staff conducted two reviews related to the Low-Activity Waste facility. The first review evaluated the integration of the safety bases of the facilities involved in

the treatment of the low-activity waste: Hanford Tank Farms, the Low-Activity Waste facility, and the Liquid Effluent Retention Facility. The second review evaluated the chemical safety management programs used by DOE to manage chemical hazards that occur while processing radioactive waste at the Low-Activity Waste facility.

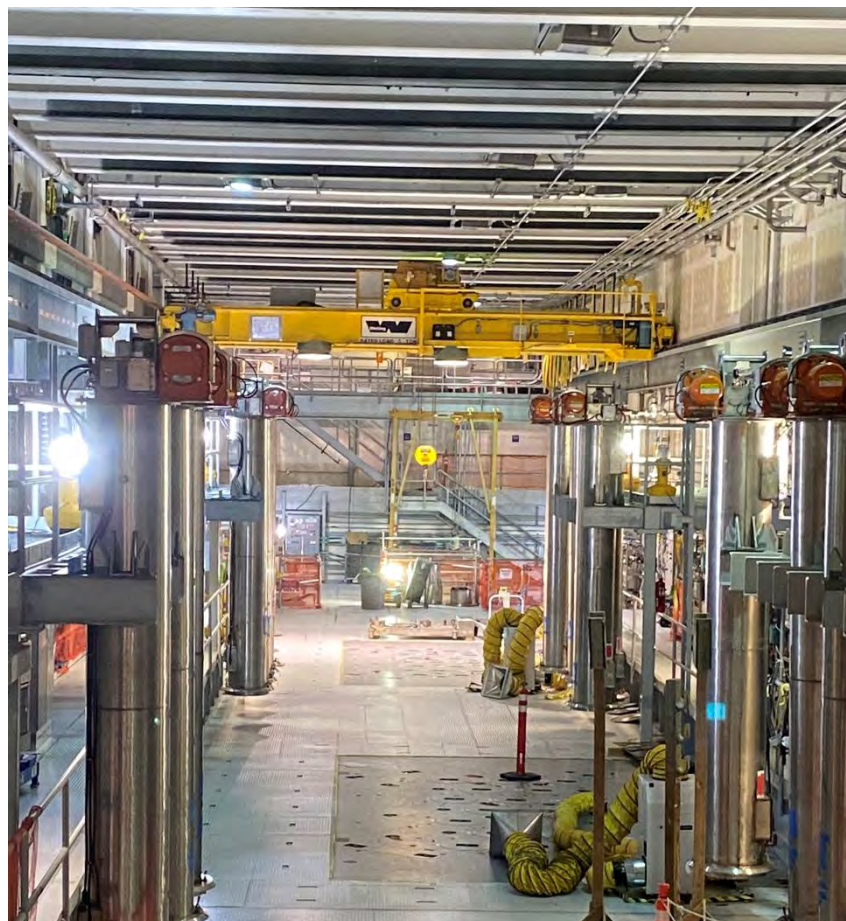


Figure 19. *Melter gallery in the Low-Activity Waste facility.*

SRS Savannah River Plutonium Processing Facility

The 2018 Nuclear Posture Review, conducted jointly by the Departments of State, Energy, and Defense, recommended establishing “the enduring capability and capacity to produce plutonium pits at a rate of no fewer than 80 pits per year by 2030.” NNSA is designing the Savannah River Plutonium Processing Facility to produce 50 of these pits per year using the partially constructed Building 226-F at SRS (see Figure 20). Building 226-F was originally intended for the Mixed Oxide Fuel Fabrication Facility project, which is now canceled. On June 25, 2021, the Deputy Secretary of Energy approved Critical Decision-1, *Approve Alternative Selection and Cost Range*, for the Savannah River Plutonium Processing Facility, marking the completion of the project definition phase and the conceptual design. NNSA stated in its Critical Decision-1 approval letter that it estimates project completion between FYs 2032 and 2035. The Savannah River Plutonium Processing Facility is now in preliminary design.



Figure 20. *A rendering of the completed Savannah River Plutonium Processing Facility.*

In a letter dated January 24, 2022, the Board identified eight safety observations that should be addressed as the project advances through preliminary design. In one observation, the Board concluded that some other sites in the DOE complex credit containers in their safety analyses, but this practice has not yet been adopted at SRS. In another observation, the Board found NNSA did not classify certain important systems, such as the gloveboxes where workers handle the plutonium, as safety controls for facility worker protection. This makes the facility unique amongst other facilities in the defense nuclear complex with plutonium operations. Instead of classifying these systems as safety controls, NNSA credits the worker's ability to detect certain accidents and self-protect. The Board is planning a follow-up review on the classification of controls for facility worker protection in 2023.

SRS Surplus Plutonium Disposition Project

The Surplus Plutonium Disposition Project, currently in the preliminary design phase, involves a major modification to Building 105-K in the K-Area Complex, an existing hazard category 2 nuclear facility, including construction of an additional structure to house ventilation and electrical equipment. The project's mission is to expedite removal of plutonium from South Carolina by expanding the capability to disposition surplus weapons-grade plutonium using the dilute and dispose approach. The four primary activities to be covered by the Surplus Plutonium Disposition Project are: (1) un-package plutonium oxide, (2) dry blend plutonium oxide with adulterant, (3) perform non-destructive assay and package, and (4) prepare diluted plutonium oxide for shipment. The project achieved the Critical Decision-1, *Approve Alternative Selection and Cost Range*, milestone in October 2019. The project continued to advance the design during 2022, also proposing a revision to the safety design strategy that would substantially alter the control strategy for fire accident scenarios.

Following the Board's letter to DOE dated January 6, 2022, which highlighted concerns with the project's conceptual design, the Board remained engaged with DOE as efforts continued to address open concerns and make design progress. The Board's staff observed DOE's technical independent project review and annual peer review in February 2022. In May 2022,

the project submitted a revised safety design strategy that included a proposal to downgrade the classification of the fire suppression system from safety class to safety significant and changes to the planned control of material-at-risk. These changes were predominantly supported by the results of fire testing on storage containers conducted by Sandia National Laboratories. Consequently, the Board's staff began a review of the proposed revision to the strategy and the details of the fire testing that will continue into 2023. In the interim, the project retracted the revision to the safety design strategy and reverted to a safety-class fire suppression system.

WIPP Safety Significant Confinement Ventilation System

The Board and DOE have been corresponding on various aspects of the overall effort to improve underground ventilation at WIPP since the 2014 accident (the release of radiological materials due to energetic chemical reactions in waste drums). The Safety Significant Confinement Ventilation System project is just one component of DOE's plan. The confinement ventilation system is designed to mitigate design basis accidents with high unmitigated dose consequences to the facility and co-located workers.

The Board continued to provide safety oversight on the progress of the Safety Significant Confinement Ventilation System project. As of December 5, 2022, more than 90 percent of the vertical structures of the safety significant New Filter Building had been completed. In addition, issues with prefabricated roof panels were resolved through a combination of additional acceptance testing and the repair or replacement of panels. The contractor started placement of roof panels on December 12, 2022.

As discussed in the WIPP section of this report, the Board continues to evaluate a series of safety issues that could impact the design of the safety significant continuous air monitors, which are crucial instrumentation and control components for the ventilation system. In particular, the Board is concerned that observed malfunctions and failures in currently operational continuous air monitors, due to issues such as corrosion and excessive salt buildup, are indicative of a systemic problem. If the issues are not addressed in the ventilation system design, they could adversely affect the reliability of the control system that shifts ventilation into a safe, filtered configuration during a radiological release event.

Y-12 Uranium Processing Facility

Since construction began in 2018, the Uranium Processing Facility continues progress towards completion of the three main structures (i.e., Main Processing Building, Salvage and Accountability Building, and Mechanical and Electrical Building). In the Main Processing Building, project personnel are primarily procuring and installing equipment for uranium processing. In the other two buildings, project personnel continue to install mechanical, electrical, fire protection systems, and interior partitions.



Figure 21. *Glovebox line manufactured at a vendor facility.*

In 2021, the Uranium Processing Facility project reached major milestones related to factory acceptance testing for safety-related equipment (see Figure 21). The Board's staff completed a review of the project's implementation of factory acceptance testing in 2022, including onsite observation of factory acceptance testing and review of documentation associated with the testing. The factory acceptance testing was conducted consistent with applicable project codes and standards.

The Board's staff has continuously monitored the progress of the project, and any issues that may affect safety related structures, systems, and components. A key part of the project is the construction of a connector to the Highly Enriched Uranium Material Facility. The Board's staff evaluated critical construction elements of the connector structure, which has largely been built in areas outside of the security perimeter. In addition, the Board's staff is currently evaluating the equipment procurement and installation procedures and implementation associated with this process. The review will determine whether the procurement, receipt inspection, and installation processes for safety significant and defense-in-depth equipment are being performed in accordance with design documents, approved procedures, and appropriate nuclear quality assurance requirements.



NUCLEAR SAFETY FRAMEWORK, PROGRAMS AND STANDARDS

VII. Nuclear Safety Framework, Programs, and Standards

A robust nuclear safety framework is fundamental to safe operations at DOE defense nuclear facilities. DOE establishes this framework in rules, directives, and technical standards. In 2022, the Board continued to focus on DOE's overall safety framework, safety management programs, DOE oversight, and the effectiveness of standards. The Board communicated to DOE on several cross-cutting safety areas including nuclear safety requirements, seismic hazard assessments, DOE oversight, software quality assurance, and dosimetry programs. The Board also continued to review and comment on DOE directives that define nuclear safety requirements for nuclear explosive operations, nuclear safety analysis, and fire protection. The Board will continue to prioritize cross-cutting safety areas that impact nuclear safety across the defense nuclear complex.

Nuclear Safety Framework

Recommendation 2020-1, Nuclear Safety Requirements

The Board issued Recommendation 2020-1, *Nuclear Safety Requirements*, in February 2020, with the intent of strengthening DOE's nuclear safety regulatory framework including 10 CFR 830, *Nuclear Safety Management*, and relevant DOE orders and standards. The Board originally issued Recommendation 2020-1 while DOE was revising 10 CFR 830. In June 2020, the Board received DOE's response rejecting most of the recommendation, and DOE subsequently issued the revised final rule in October 2020. The Board assessed DOE's response and the final rule and evaluated whether to reaffirm the recommendation, including holding a public meeting on these matters in December 2020. On June 1, 2021, the Board reaffirmed Recommendation 2020-1, revising it to reflect DOE's response and completion of the rulemaking for 10 CFR 830. The reaffirmed Recommendation 2020-1 provided recommendations in the following areas:

- ***Aging Infrastructure***—The Board recommended that DOE develop requirements for aging management, including a formal process for identifying and performing infrastructure upgrades that are necessary to ensure facilities and structures, systems, and components can perform their safety functions.
- ***Hazard Categories***—The Board recommended DOE revise DOE Standard 1027-2018, mandate use of the revised standard for new defense nuclear facilities and review existing hazard category 3 and below hazard category 3 defense nuclear facilities to ensure they are appropriately categorized.
- ***DOE Approvals***—The Board recommended DOE establish a required periodic review of contractor documented safety analyses to ensure they meet the requirements of 10 CFR 830.
- ***Evaluation of Safety Basis Preparation and Review Processes***—The Board recommended that DOE conduct an independent review of contractor and federal processes to identify and evaluate the underlying issues that prevented the annual

submittal and approval of high-quality safety basis documents, and use the findings to improve the relevant processes

- ***Safety Basis Process and Requirements***—The Board recommended that DOE incorporate specific implementation requirements for unreviewed safety questions, technical safety requirements, and specific administrative controls in its regulatory framework, including 10 CFR 830.

On September 8, 2021, the Secretary of Energy provided her final decision to the Board accepting Recommendation 2020-1. In an October 14, 2021, letter to DOE, the Board acknowledged DOE's acceptance of the recommendation, while noting that some DOE responses do not fully embrace actions recommended by the Board.

On June 27, 2022, the Secretary of Energy transmitted DOE's implementation plan for the recommendation. The Board responded on August 18, 2022, stating that while DOE's implementation plan does not fully endorse some actions recommended by the Board, the Board still finds that execution of the plan could result in safety improvements to DOE's nuclear safety framework consistent with the objectives of the recommendation. The Board also noted the staff-level interactions during implementation plan development were beneficial towards developing mutual understanding of safety issues and perspectives. DOE's implementation plan contains actions and milestone deliverables to:

- Adopt best practices for aging infrastructure management,
- Continue improvement on an effective hazard categorization process,
- Establish requirements for key safety basis concepts,
- Conduct an independent review of the safety basis development process,
- Evaluate and update safety basis document review requirements, and
- Evaluate DOE's regulatory framework for ensuring appropriate implementation of safety basis concepts.

Milestone deliverable due dates span from three months following issuance of the implementation plan to December 2025.

DOE completed the first two deliverables in October 2022. One was the charter for a benchmarking review effort to identify best practices and process enhancements regarding management of aging infrastructure, which could result in new requirements for this area. The other deliverable was a plan for an independent review by the Office of Enterprise Assessments of DOE's processes for documented safety analysis preparation and approval. The Board found both deliverables to be consistent with the actions laid out in the implementation plan. DOE also informed the Board in December 2022 of its plan to develop a new chapter in DOE Order 420.1C, *Facility Safety*, that contains new requirements for unreviewed safety questions,

technical safety requirements, and specific administrative controls. Development of these requirements would be responsive to the Board’s recommendation in this area.

The Board and its staff will continue to engage with DOE as it executes the implementation plan for Recommendation 2020-1. The Board anticipates receiving additional milestone deliverables throughout 2023.

Seismic Hazard Assessments

In 2021, the Board’s staff completed a complex-wide review of implementation of the requirements in DOE Order 420.1C, *Facility Safety*, to periodically assess the seismic hazard at DOE sites. For defense nuclear facilities, seismic accidents have the potential to cause significant safety consequences to the public. The DOE process for periodically assessing the seismic hazard ensures that credited seismic controls are analyzed using the latest information and will perform their safety functions when needed.

On June 10, 2021, the Board sent a letter to the Secretary of Energy, which included Technical Report 47, *Seismic Hazard Assessments*. The letter and report highlight the Board’s safety concerns with the process of periodically assessing the seismic hazard at DOE sites. Specifically, the Board identified the following issues: sites have not implemented the required unreviewed safety question process to assess the impacts of an increased seismic hazard on safety controls; most site field offices have not approved seismic hazard assessments and subsequent analyses as required by DOE Order 420.1C; sites have been slow to analyze the impact of an increased seismic hazard on safety controls; and DOE’s directives lack sufficient guidance and standardization on conducting seismic hazard assessments. The Board letter requested a report and briefing on actions DOE plans to take to ensure the identified safety issues do not reoccur in future implementation of the process.

DOE provided its report and briefing to the Board on December 14, 2021, and April 7, 2022, respectively. In both the report and briefing, DOE committed to the following: direction to site offices to verify that unreviewed safety question procedures adequately cover new natural phenomena hazards assessments; DOE action when site offices are not in compliance with natural phenomena hazards requirements; and review of applicable DOE directives to evaluate if improvements are needed. However, the Board found that DOE’s response did not adequately clarify the expectations on timing for entry into the unreviewed safety question process in cases in which a probabilistic seismic hazard analysis update identifies an increased seismic hazard that exceeds qualification assumptions for seismic safety controls.

On June 16, 2022, the Board sent an additional letter to DOE that requested a written response on how the DOE sites will implement the unreviewed safety question process following a probabilistic seismic hazard analysis update. On November 2, 2022, DOE responded to the Board and stated that sites are required to follow the unreviewed safety question process if the increase in hazard identified in a probabilistic seismic hazard analysis update is potentially not bounded by the safety analysis.

DOE Safety Basis Review and Approval Process

In 2022, the Board’s staff completed a complex-wide review of the process for review and approval of safety basis documents. The objective of the review was to better understand how each field office performs the safety basis review and approval process by comparing the site-specific procedures to the requirements and guidance in DOE Standard 1104-2016, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*. The review also compared implementing procedures between the different field offices to identify any different or noteworthy practices.

The process for review and approval of safety basis documents varied among field offices. While the differences do not necessarily imply that there is a nuclear safety concern, the differences in implementation do highlight potential areas where DOE Standard 1104-2016 could provide more guidance. The Board’s staff shared these observations with DOE for consideration as it executes its implementation plan for Board Recommendation 2020-1, *Nuclear Safety Requirements*, which includes revising DOE Standard 1104-2016.

Nuclear Safety Programs

DOE Oversight

The purpose of DOE’s safety oversight is to proactively identify contractor performance deficiencies and ensure timely correction of issues to ensure adequate protection. The Board embarked on a comprehensive review of DOE’s safety oversight across the defense nuclear complex, including DOE’s methods for evaluating its own effectiveness by reviewing documents, interviewing DOE personnel, and conducting interactions with multiple DOE headquarters organizations and field offices, including the Office of Enterprise Assessments, the Office of Environmental Management, NNSA, the NNSA Production Office at the Y-12 National Security Complex, and the Carlsbad Field Office.

On August 17, 2022, the Board sent the Secretary a letter outlining improvements DOE should pursue to ensure its safety oversight approach is effective in the following areas:

- *Effectiveness Assessments*—DOE needs to improve its required effectiveness assessments for safety oversight at all levels within DOE’s safety oversight framework. For example, DOE safety oversight leverages contractor assurance systems without a sufficient, documented federal assessment basis to justify that contractor assurance systems are reliable and effective. There is also a lack of documented DOE “effectiveness” reviews validating that the remainder of federal oversight is effective.
- *Staffing*—DOE needs to improve its staffing plans and implementation to ensure sufficient technical capability is applied to safety oversight activities.
- *Proactive Safety Oversight*—DOE needs to increase proactive safety oversight to ensure safety issues are identified in a timely manner.

- *Safety Issues Management*—DOE needs to implement an effective safety issues management system to ensure timely and effective correction of safety issues.

The Board also identified several specific safety oversight best practices at some DOE offices. The Board requested a briefing and written report from DOE within 120 days that would address how DOE plans to address the safety matters described above. On October 28, 2022, DOE requested an extension of the reporting requirement until March 2023. DOE's extension request noted the breadth of the areas discussed in the Board's letter, the diversity of the data needed to allow adequate analyses, and the extensive coordination required to develop a proper response. The Board will continue to work with DOE in 2023 to improve nuclear safety oversight.

Pantex External Dosimetry Program

In 2019, the Pantex contractor identified age-related degradation of a thermoluminescent dosimeter reader that impacted the ability to monitor the exposure of Pantex workers to ionizing radiation from nuclear weapon components and radiography equipment. The Pantex contractor subsequently determined that all thermoluminescent dosimeter readers at Pantex were inoperable. The Board reviewed the external dosimetry program at Pantex, with the objective of identifying opportunities for improvement to help prevent similar problems at Pantex and throughout the DOE defense nuclear complex. The Board's review identified that NNSA and its contractor did not recognize and preemptively respond to weaknesses in the external dosimetry program, including significant personnel turnover, aging equipment, lack of timely contract maintenance support, and the unavailability of replacement equipment.

On May 10, 2022, the Board issued a letter to DOE urging that NNSA identify the causes and develop lessons learned from the breakdown of the external dosimetry program at Pantex and apply those lessons across the DOE defense nuclear complex. The Board requested that NNSA provide the Board with a written report and briefing on lessons learned from the Pantex external dosimetry program breakdown and actions to prevent recurrence at Pantex and other DOE defense nuclear facilities.

On October 7, 2022, and December 8, 2022, NNSA provided a report and briefing to the Board, respectively. NNSA discussed actions taken to improve its safety oversight responsibilities and bolster the issues management processes. NNSA and its contractor also discussed actions taken to improve the maintenance of aging safety equipment and address other contributing factors, including testing emergency backup dosimetry provisions to ensure operability when needed. In addition, NNSA will develop lessons learned information in accordance with DOE's corporate operating experience program to be distributed across the DOE defense nuclear complex.

DOE Safety Software Central Registry

The DOE Safety Software Central Registry is currently a database of eight software packages that DOE's contractors use for purposes such as estimating the consequences of

potential accidents. An overall goal of the central registry is to provide enhanced quality assurance of the software used in safety analysis. The central registry also includes guidance from DOE on how to use the software. Per DOE Standard 3009-2014, DOE encourages its contractors to use the software in the central registry.

On April 2, 2022, the Board issued correspondence regarding its review of the central registry. The Board found that DOE has struggled to maintain the central registry. As a result, DOE contractors sometimes use outdated versions of software for safety calculations. This situation is problematic because older versions of software could contain errors and pose a cybersecurity risk. The Board also found that DOE’s guidance on the use of the codes has become outdated.

DOE is aware of its challenges with the central registry and is currently considering changes. The Board advised DOE to continue a centralized approach with the software registry, while enacting changes to make the registry more sustainable. The Board requested DOE to provide a briefing on its plans; this briefing is expected to occur in early 2023.

DOE Emergency Preparedness and Response

In 2022, DOE and NNSA sites resumed the performance of in-person, field drill and exercise activities, which had been paused at several sites in 2020 and 2021 due to the COVID19 pandemic. Accordingly, the Board resumed its efforts to evaluate the current competencies and capabilities for emergency response in the field. In 2022, Board Vice Chair Thomas Summers and members of the Board’s staff observed emergency response exercises at SRS, Y-12 National Security Complex (also joined by Board Member Jessie Roberson), LANL, and WIPP (see Figure 22). The Board’s staff observed emergency response exercises at SNL, INL, the Hanford Site, the Pantex Plant, and NNSS. Board Vice Chair Thomas Summers also provided remarks at the Emergency Management Issues Special Interest Group annual meeting in August 2022.

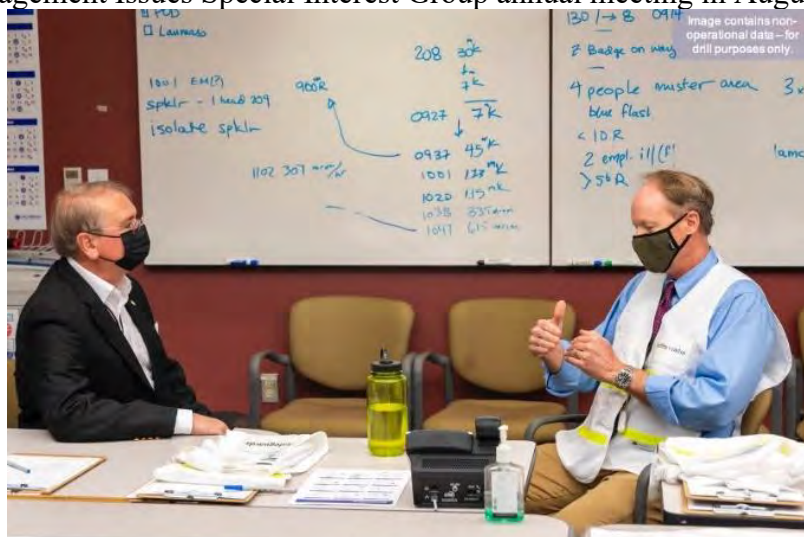


Figure 22. Board Vice Chair Thomas Summers (left) speaks with Facility Operations Division Leader during an emergency exercise at LANL.

During these exercises, several sites shared a common trend of lack of workforce proficiency at taking protective actions and performing accountability actions. These issues are attributed in part to a lack of field response proficiency due to pandemic-related pauses and are expected to improve with further drill and exercises in 2023. DOE and NNSA's commitment to improving complex-wide emergency management is reflected in investments in new emergency operations centers at LLNL, SNL, NNSS, Y-12 National Security Complex, and SRS, all expected to begin construction or become operational by the end of 2023. These new facilities will meet the modern design requirements of DOE Order 151.1D, *Comprehensive Emergency Management System*, for habitability and survivability, and will provide long-term improvements in emergency response capabilities and reliability at those sites.

In 2022, the Board's staff also conducted a review of SNL's emergency preparedness and response program, as noted in the Nuclear Weapon Programs section of this report.

Reactive Materials at Y-12 National Security Complex

Between 2016 and 2021, the Y-12 National Security Complex experienced several pyrophoric events involving uranium chips, briquettes, and buttons during storage, handling, and transfer operations. The Board's staff evaluated uranium reactivity hazards and control strategies to mitigate thermal runaway reactions of uranium materials for the production facilities at Y-12. Additional details are provided in the Nuclear Weapon Programs section of this report.

DOE Corporate Operating Experience Program Implementation

The Board's staff began a safety review of DOE's implementation of its operating experience program under DOE Order 210.2A, *DOE Corporate Operating Experience Program*. DOE Order 210.2A provides requirements governing identification, evaluation, dissemination, and use of operating experience (i.e., lessons learned from operational events or issues) within the DOE complex. DOE originally issued Order 210.2A in 2006 in response to Board Recommendation 2004-1, *Oversight of Complex, High-Hazard Nuclear Operations*, to provide for a more robust operating experience program for feedback and improvement within DOE.

The Board's staff gathered information and conducted interactions with multiple DOE headquarters organizations including the Office of Environment, Health, Safety and Security, NNSA and the Office of Environmental Management. The purpose of these interactions was to better understand coverage and emphasis of relevant operating experience, including coverage of events/issues related to nuclear operations or nuclear safety at defense nuclear facilities. In 2023, the Board's staff will conduct interactions with selected DOE sites and present findings of the safety review to the Board for its consideration.

Nuclear Safety Standards

Review and Comment in Calendar Year 2022

The Board's staff conducted several reviews of DOE technical standards that were being revised in DOE's online review, comment, and approval process in 2022. For DOE Limited

Standard 3016, *Hazard Analysis Reports for Nuclear Explosive Operations*, the Board's staff disagreed with NNSA's proposed revision that would modify the weapon response screening threshold for certain nuclear explosive configurations. Additional information can be found in the Pantex Plant section of this report. Following several meetings in 2021 and 2022, NNSA withdrew the revision. In October 2022, NNSA proposed a new revision that the Board's staff finds acceptable.

For DOE Handbook 1224, *Hazard and Accident Analysis Handbook*, the Board's staff met with DOE personnel on several occasions in 2022 to discuss its comments and will continue the effort in 2023. For DOE Standard 1066, *Fire Protection*, the Board's staff has worked closely with DOE since 2021 on an update to this standard that provides acceptable methods and approaches for meeting DOE fire protection program and design requirements. In September 2022, the Board's staff provided significant comments to DOE that would enhance the fire safety programs and will continue the effort in 2023.

Planned Reviews in 2023

The Board's staff has reviewed preliminary drafts of DOE Handbook 1545, *Seismic Evaluation Procedure for Equipment in U.S. Department of Energy Facilities*, and DOE Order 425.1, *Verification of Readiness to Start Up or Restart Nuclear Facilities*. In 2023, the Board plans to continue these directives reviews in DOE's online review, comment, and approval process, as well as evaluate other DOE directives that have complex-wide effects and those that establish controls for high-hazard activities, such as DOE Standard 1239, *Chemical Safety Management Program*. The Board may elect to add reviews of DOE directives as it deems appropriate.



FIELD OPERATIONS

VIII. Field Operations

Full-time resident inspectors from the Board's staff are located at the Hanford site, LANL, the Pantex Plant, SRS, and the Y-12 National Security Complex to monitor operations. In 2022, the Board hired five new resident inspectors. This allowed the Board to increase the number of resident inspectors at SRS to four. It also supported planned staff rotations at the Y-12 National Security Complex and LANL as well as begin the transition for a new resident inspector at the Hanford site. Furthermore, two candidates accepted job offers to become resident inspectors at the Pantex Plant. To increase the pool of possible resident inspector candidates, the Board continued to directly hire resident inspectors rather than solely relying on internal transfers. This allowed the Board to hire staff with extensive military, commercial, and field operations experience.

In 2022, the resident inspectors conducted focused reviews on eight topics such as emergency preparedness, alarms management, maintenance, and supply chain impacts. Their data and field observations were analyzed to identify facility, site, and cross-cutting trends; identify unsafe field conditions; and communicate best practices. These reviews were also used to train resident inspectors (e.g., how to inspect penetrations of fire barriers) and provide lines of inquiry that can be used for future reviews. The Board's staff shared site safety observations and overall safety trends with DOE headquarters and site managers. This resulted in actions to address several safety issues identified by the resident inspectors. For example, facility personnel fixed improperly working or propped open fire doors, removed unauthorized operator aids, investigated questionable penetrations through fire barriers, improved training of emergency preparedness drill controllers, revised poorly written technical procedures, updated fire protection zone plans, and took corrective actions to improve the management of suppressed alarms and bypassed interlocks.



APPENDIX

A

Appendix A: Board Recommendations Recommendations Open in 2022

Recommendation 2020-1, *Nuclear Safety Requirements* (REMAINS OPEN)

In February 2020, the Defense Nuclear Facilities Safety Board (Board) issued Recommendation 2020-1, *Nuclear Safety Requirements*. The recommendation is intended to strengthen the regulatory framework of the Department of Energy (DOE), including 10 Code of Federal Regulations (CFR) Part 830, *Nuclear Safety Management*, and relevant DOE orders and standards. Following DOE's response rejecting most of the recommendation in 2020, the Board revised and reaffirmed Recommendation 2020-1 in June 2021.

In September 2021, the Secretary of Energy provided her final decision to the Board accepting Recommendation 2020-1. DOE issued its implementation plan for Recommendation 2020-1 on June 27, 2022. The Board responded on August 18, 2022, stating that while DOE's implementation plan does not fully endorse some actions recommended by the Board, the Board still finds that execution of the plan could result in improvements to DOE's nuclear safety framework consistent with the objectives of the recommendation. DOE transmitted the first two implementation plan milestone deliverables to the Board on October 4, 2022, and provided a third deliverable on December 22, 2022. The Board has found the deliverables received to date to be consistent with the commitments in the implementation plan.

Recommendation 2019-2, *Safety of the Savannah River Tritium Facilities* (REJECTED)

The NNSA rejected Recommendation 2019-2, *Safety of the Savannah River Site Tritium Facilities*, based on the grounds that it was already addressing the Board's safety concerns with proposed and ongoing actions. In the Board's assessment, NNSA's proposed and ongoing plans will not result in sufficient improvement to the safety posture of the tritium facilities.

In December 2019, NNSA approved a new combined documented safety analysis for the Savannah River Site (SRS) tritium facilities, which contains some improvements but does not address all the Board's safety concerns. Specifically, the calculated dose consequences for co-located workers impacted by major accidents involving the tritium facilities are still unacceptably high (based on DOE own safety requirements); calculated dose consequences for the public challenge DOE's evaluation guideline for consideration of safety class controls; and no new controls have been identified and implemented that reduce the calculated dose consequences to acceptable levels in accordance with DOE's safety directives. Furthermore, safety management programs that could help mitigate accident consequences, such as the site's emergency preparedness and response program, have not been tested to demonstrate their effectiveness for a major accident involving the tritium facilities. Moreover, the contractor for the SRS tritium facilities (with NNSA's consent) will not implement improved safety controls identified in the new combined safety basis until the end of 2023 and has not implemented any compensatory measures to ensure safety in the interim.

On July 13, 2021, the Board held a public hearing focused on these concerns. NNSA previously directed the contractor for the SRS tritium facilities to develop a risk reduction

strategy for co-located workers impacted by major accidents involving the tritium facilities. Shortly before the Board's public hearing, NNSA approved the contractor's strategy to reduce the risks presented by several postulated accidents at the tritium facilities. The actions in the strategy focus on either refining the accident analysis parameters to reduce the predicted consequences or completing calculations to determine whether existing structures can be credited to reduce the calculated consequences in the safety basis. Most of the proposed actions do not represent actual improvements to safety, but rather analytical reductions in accident consequence calculations, unless done in conjunction with physical modifications to install or upgrade engineered controls.

On May 10, 2022, SRS conducted its site annual emergency exercise, which was observed by a Board member and the Board's staff. The exercise scenario involved an explosion at the Tritium Extraction Facility and a release of tritium oxide. The exercise tested the ability of the site emergency response organization to respond to radiation exposures greater than 5 rem total effective dose and tritium exposures outside the tritium facilities' fence line, including collection of radiological bioassay samples from potentially exposed workers to determine which workers may be at risk of a significant tritium uptake. Demonstration of these capabilities was responsive to concerns described in the Board's recommendation and discussed during the Board's July 13, 2021, public meeting and hearing. The Board's staff continues to monitor site efforts to develop, test, and implement a site evacuation and re-location plan, an effort ongoing into 2023.

The Board is conducting a series of safety reviews aimed at identifying opportunities to strengthen the engineered and administrative safety controls at the SRS tritium facilities that protect the workers and the public (discussed in the SRS portion of the Nuclear Weapon Programs section of this report). On July 26, 2022, the Board communicated to DOE its findings from a structural evaluation of the 296-H tritium stack that challenged the assumptions of the combined safety basis that collapse of the stack would not impact a nearby tritium storage vault. On August 11, 2022, the Board transmitted a letter to NNSA detailing concerns with an unanalyzed accident progression in which tritium was released and subsequently drawn into a tritium processing building by the building's ventilation system on January 30, 2022. The Board also completed safety reviews of the electrical systems and the implementation of safety management programs and specific administrative controls at the tritium facilities.

The Board continues to evaluate NNSA's progress towards completion of its proposed and ongoing safety actions, and to evaluate whether those actions will effectively address safety issues at the SRS tritium facilities. The Board has shared its concerns with NNSA leadership and remains concerned with the risk to workers and the public associated with postulated accident scenarios at the Savannah River Tritium Facilities.

***Recommendation 2019-1, Uncontrolled Hazard Scenarios and 10 CFR Part 830
Implementation at the Pantex Plant (REMAINS OPEN)***

On February 20, 2019, the Board issued Recommendation 2019-1 and identified the following safety issues: (1) portions of the safety basis for Pantex nuclear explosive operations do not meet 10 CFR Part 830, including high-consequence hazard scenarios that are not adequately

controlled; (2) multiple components of the process for maintaining and verifying implementation of the Pantex safety basis are deficient; and (3) the Pantex federal and contractor organizations have been unable to resolve known safety basis deficiencies.

The Board recommended that DOE: (1) implement compensatory measures to address all deficiencies described within the recommendation’s appendices; (2) perform an extent-of-condition evaluation of the Pantex safety basis and implement subsequent corrective actions to ensure compliance with DOE regulations and directives; (3) implement actions to ensure process design and engineered controls eliminate or protect the nuclear explosives from impact and falling technician scenarios, including those identified in the recommendation’s enclosure; (4) ensure the design, procurement, manufacturing, and maintenance of special tooling is commensurate with its safety function; and (5) train safety basis personnel to ensure future revisions to the safety basis comply with 10 CFR 830 requirements.

DOE accepted the recommendation on April 16, 2019, and transmitted its implementation plan on July 16, 2019. Upon review, the Board found that the “language and terms of the implementation plan in fact reject significant parts of the recommendation,” and reaffirmed Recommendation 2019-1 in a letter dated August 22, 2019. In a public meeting on December 12, 2019, NNSA personnel committed to revise the implementation plan to address the Board’s concerns. NNSA transmitted the revised implementation plan to the Board on June 5, 2020, and briefed the Board on the revised plan on August 4, 2020. In a September 16, 2020, letter, the Board informed the Secretary of Energy that the revised implementation plan addressed the Board’s concerns with the original plan, and that the Board found the revised implementation plan to be responsive and indicative of DOE’s acceptance of Recommendation 2019-1. The Board’s letter emphasized that the frequent and constructive staff-level interactions during the revision process of the implementation plan greatly facilitated productive discussions and resulted in a product that addressed the safety recommendations. The Board also advised DOE to consider adding or expanding the use of engineered controls such as transfer carts, where applicable, to reduce hazards by eliminating both hand lifts of tools and swing arms in tooling.

NNSA and its contractor are working to accomplish all the identified safety improvements by September 2023 and have completed 65 of the 69 deliverables committed to in NNSA’s implementation plan thus far. The Board continues to review actions and deliverables associated with the implementation plan. In 2022, the Board’s staff completed an evaluation of closure documentation for various legacy conditions of approval and planned safety improvements that had remained open for more than a decade. Additionally, the staff commenced reviews of the various safety basis changes resulting from Recommendation 2019-1, as well as the projects to replace wood-framed false ceilings in two nuclear explosive cells. The Board and its staff will continue these reviews and continue to evaluate the effectiveness of NNSA’s implementation plan deliverables during 2023.

Recommendation 2012-1, Savannah River Site Building 235-F Safety (REMAINS OPEN)

In 2012, the Board identified safety concerns related to the hazards associated with plutonium-238 hold-up material in Building 235-F at SRS. At present Building 235-F is deactivated, with facility structure and radiological condition inspections being conducted on

prescribed periodicities. The regulatory review of DOE's engineering evaluation and cost analysis was completed during 2022 and the end-state for eventual decommissioning was finalized. The design efforts to support this end-state are ongoing.

The Board issued Recommendation 2012-1, *Savannah River Site Building 235-F Safety*, on May 9, 2012, which documented the Board's concerns and recommended several actions DOE should take to improve the Building 235-F safety posture. In response, DOE developed an implementation plan and completed several actions to improve the safety of Building 235-F, including removing some material-at-risk, combustibles, and ignition sources.

In May 2020, DOE developed a revised implementation plan outlining significant changes to the overall strategy used to address the hazards in Building 235-F, which focused on eliminating fire risks instead of removing additional material-at-risk. DOE subsequently indicated to the Board that all actions identified in the revised implementation plan were completed on June 22, 2020.

On November 2, 2021, the Board established a new reporting requirement for an annual report and briefing regarding (1) progress made to deactivate and decommission Building 235-F; (2) results of radiological surveys and inspections to verify that contamination is not spreading; (3) status and schedule for establishing a final end state determination with regulatory authorities; (4) results of structural integrity inspections, and any corrective actions identified and implemented from these inspections; and (5) any changes to the status of the E-5 ventilation system and sand filter, including any maintenance activities performed. DOE briefed the Board on July 7, 2022, addressing these elements. Significantly, DOE completed actions in September 2022 to deactivate Building 235-F, which involved electrical and mechanical isolation of the building. The site also received final regulatory approval for the final end-state, which will consist of grouting all the process areas and installing a new engineered roof.

The Board is encouraged by efforts to deactivate Building 235-F and understands DOE's approach to monitor conditions in the facility, particularly in the performance of structural integrity and radiological condition inspections, to ensure that safety risk is sufficiently mitigated for the remaining life of the facility. The Board will continue to follow these monitoring efforts closely, along with design progress supporting eventual decommissioning of the facility. The timeline for decommissioning is currently not certain, potentially occurring in the next decade.



APPENDIX

B

Appendix B: Acronym List

CFR	Code of Federal Regulations
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
INL	Idaho National Laboratory
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
NDAA	National Defense Authorization Act
NNSA	National Nuclear Security Administration
NSS	Nevada National Security Site
SNL	Sandia National Laboratories
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
WIPP	Waste Isolation Pilot Plant