Thomas A. Summers, Acting Chairman

Patricia L. Lee

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901

October 16, 2025

The Honorable Timothy J. Walsh
Assistant Secretary for Environmental Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Mr. Walsh:

The Defense Nuclear Facilities Safety Board (Board) conducted a review of the procedures and supporting documentation for welding lids for transportable storage containers (TSC) at Hanford's Waste Encapsulation and Storage Facility (WESF). The review evaluated whether the TSC closure welding process meets the requirements of applicable industry codes and standards. Specifically, the review focused on the project's use of an equivalency [1] allowing a visual inspection as the sole means of post-welding inspection to ensure that welds are free from defects such that they can perform their safety function. The welded closure of the TSCs is credited as an initial condition that prevents a radioactive material release for design basis accidents. Accident scenarios in the documented safety analysis indicate that a release can have moderate consequences to the co-located worker and high consequences to the facility worker.

The Board determined that the TSC closure welding process does not implement sufficient inspection requirements to ensure each safety significant TSC closure weld can reliably perform its confinement safety function (i.e., maintain a helium environment and therefore confine radioactive material). As evidenced by the detection of a welding-induced defect in the confinement boundary of a spent fuel canister at Hanford in September 2024, visual inspections alone can be insufficient. Therefore, the Board determined that the Department of Energy (DOE) should evaluate, select, and implement additional monitoring options to ensure that the TSCs continue to maintain their confinement integrity for the duration of capsule storage. In addition, the Board determined that DOE should ensure that information related to the spent nuclear fuel canister defect from 2024 be captured in its operating experience program to ensure that any lessons learned are available to users and regulators of spent nuclear fuel storage systems.

Pursuant to 42 United States Code (U.S.C.) § 2286b(d), the Board requests that DOE provide a briefing within 60 days of receipt of this letter that describes its path forward for ensuring the long-term confinement integrity of TSCs at WESF and the promulgation of related lessons learned.

Sincerely,

Thomas A. Summers

Thomas A. Summers
Acting Chairman

Enclosure

c: The Honorable Chris Wright, Secretary of Energy
Mr. Ray Geimer, Manager, Hanford Field Office
Mr. Joe Olencz, Director, Office of the Departmental Representative to the Board

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Report

August 29, 2025

Review of Transportable Storage Container Lid Welding at the Hanford Site's Waste Encapsulation and Storage Facility

Summary. The Defense Nuclear Facility Safety Board's (DNFSB) staff review team (staff team) conducted a review of procedures and supporting documentation for welding lids for transportable storage containers (TSC) at the Waste Encapsulation and Storage Facility (WESF). The TSCs are being used as part of WESF's project to transition capsules containing radioactive cesium and strontium from wet to dry storage. The staff team's objective was to confirm that the process of welding the lid to the container is conducted in accordance with the requirements of applicable industry codes and standards. The staff team focused on the project's use of an equivalency [1] to use visual inspection as the sole means of ensuring that welds are defect-free such that they can perform their safety function to retain helium inside the TSC. The welded closure of the TSCs is credited as an initial condition that prevents a radioactive material release for design basis accidents. Accident scenarios in the documented safety analysis (DSA) indicate that a release can have moderate consequences to the co-located worker and high consequences to the facility worker.

Based on its review, the staff team concluded that the reliance on weld qualification through visual inspection without additional non-destructive evaluation of the weld does not meet inspection requirements from the American Society of Mechanical Engineers (ASME) boiler and pressure vessel code (BPVC) [2] and, therefore, should be evaluated and approved by Department of Energy (DOE) headquarters instead of the Hanford Field Office (HFO). The project could provide an equivalent assurance of confinement integrity to the NRC standard review plan by establishing a monitoring program to detect helium leakage during an initial period of storage when cooling of the capsules is required. Additionally, periodic external surveys of the storage systems to identify radioactive contamination would provide additional assurance that the confinement integrity is maintained for the life of the storage system.

The staff team concluded that the TSC closure welding process does not provide equivalent assurance of confinement integrity per the ASME BPVC or NRC standard review plan or interim staff guidance. Without the ability to verify the absence of leakage, the approach reflects an exemption to the BPVC rather than equivalency, which would necessitate DOE approval at a higher level than the field office.

In addition, the staff team concluded that the September 2024 welding-induced defect identified in a multi-canister overpack (MCO) [3] should be communicated formally throughout DOE using the operating experience program due to the implications that a base metal defect could impact the adequacy of the large weld exception used to ensure confinement integrity.

Background. One of the Hanford Site's earliest plutonium processing facilities was B Plant, located in the 200 East Area, and operated from 1945 through 1957 before it was initially shut down. Uranium fuel rods irradiated in nuclear reactors were taken to B Plant, where the rods went through a series of chemical baths to separate plutonium from uranium and fission products (e.g., the cesium and strontium). Because chemicals were needed to separate the plutonium from the rods, facilities like B Plant were also called chemical separation plants or "canyons" due to their shape and size. The separated plutonium was further processed to be used in the United States' stockpile of atomic weapons and the remainder of the irradiated fuel rods became waste.

Eleven years after the plant was shut down, it was modified and restarted. Its new mission was to separate the radioactive elements cesium and strontium from the tank waste. The removed cesium and strontium are stored in more than 1,900 capsules in a facility attached to B Plant called WESF. WESF was built specifically to fabricate the highly radioactive capsules in a series of hot cells. The capsules are then stored in a water-filled basin at the facility which provides radiation shielding and cooling. Construction of WESF began in 1971 and ended in 1973. WESF started operations in 1974 and processed cesium and strontium capsules until 1985. Some of the capsules were leased and shipped off-site for use as radiation sources but were returned to the WESF by 1996 and placed into underwater storage by 2000. While the B Plant canyon was deactivated in 1998, WESF continues to be operational.

The capsules are currently in a safe configuration. However, WESF is an aging facility. After the Fukushima incident, Hanford personnel recognized that dry storage would eliminate the possibility of releasing radioactive material in the unlikely event of a major earthquake that might result in loss of pool water. The loss of cooling would cause subsequent overheating, accelerated degradation, and potential breach of capsules. To move towards a dry storage capability, DOE initiated Project W-135, which included: construction of a mock-up facility for training at the Maintenance and Storage Facility in Hanford's 400 Area; construction of the CSA that is physically adjacent to WESF; fabrication of capsule transfer equipment; and modification of WESF to install equipment to facilitate transfer of the capsules to safer interim dry storage, allowing for the eventual deactivation of WESF. The dry storage approach includes placing the capsules into TSCs with a welded lid.

HFO has approved an equivalency [4] to only use visual inspection of the TSC closure welds instead of dye penetrant testing and helium leak testing, as required in the ASME BPVC [2] and U.S. Nuclear Regulatory Commission (NRC) interim staff guidance [5]. Additional weld qualification testing was performed to support the assurance that the welding process will produce defect-free welds. This qualification testing varied welding parameters while welding test assemblies. The test assemblies were then evaluated using remote visual inspection, dye penetrant testing, helium leak testing, and metallographic examination. HFO agreed that dye penetrant testing was not feasible due to the high radiation doses to personnel within the TSC loading cell and high temperatures which could pose a worker safety issue. HFO also agreed that leak testing was not necessary by using an NRC large weld exception.

The code of record for the capsule dry storage cites the 2010 version, with 2011 addenda, of the ASME BPVC [2] Section III, *Rules for the Construction of Nuclear Facility Components*, for the design of the TSC. The Capsule Storage Area (CSA) DSA [6] specifies the use of Division 1, subsection NB, *Class 1 Components*, of Section III. This section of the code requires full penetration welds, radiographic examination, and hydrostatic pressure testing to ensure the structural and containment integrity of the canisters. These tests are acknowledged to not be feasible for the closure welds. Historically, ASME developed code case N-595, *Requirements for Spent Fuel Storage Canisters* [7], to identify criteria to address these special circumstances. The code case was incorporated into the BPVC [2] as Section III, Division 3, Subsection WC, *Class SC Storage Containers*, which is included in the 2010/2011 addenda version of the BPVC. This section requires either volumetric (e.g., radiographic or ultrasonic examination), magnetic particle, or dye penetrant testing depending on the amount of reduction in the allowable stresses in the weld that the design is credited to assure the structural integrity of the weld. Helium leak testing in accordance with ANSI 14.5, *Leakage Tests for Radioactive Materials* [8], is required to verify the containment integrity.

The design of the TSC is based on the NAC International, Inc., multi-purpose canister (NAC-MPC) originally licensed by the NRC on April 10, 2000 [9]. Due to the age of the original canister design, the TSC designers used NRC Interim Staff Guidance, ISG-18 Rev. 1, *The Design and Testing of Lid Welds on Austenitic Stainless Steel Canisters as the Confinement Boundary for Spent Fuel Storage* [5], as the basis for closure weld inspections rather than the BPVC. ISG-18 includes similar requirements as the BPVC for weld examination and helium leak testing. However, ISG-18 allows a large weld exception to helium leak testing if all of the following conditions are satisfied to provide equivalent assurance of confinement integrity:

- Three conditions that dictate the weld configuration details; e.g., at least three layers of weld.
- Three conditions that dictate dye penetrant testing conditions, typically requiring that at least three layers of the weld are tested.
- Welds cannot have been executed under conditions where the root pass might have been subjected to pressurization from the helium fill in the container. It is also noted that mechanical closure device; e.g., quick disconnects, permit helium leakage. The TSC prevents pressurization during welding of the cover plate for the helium backfill valve by means of a safety-significant credited valve.

The Central Plateau Cleanup Company (CPCCo), WESF's management and operating contractor, determined that the thermal and radiation conditions at the container lid challenge the ability to conduct work in proximity to the closure welds. CPCCo developed an equivalency request [1] to use the large weld exception instead of leak testing. The equivalency request also proposed a robust weld qualification process along with visual inspection during the welding in place of dye penetrant testing. HFO approved this equivalency on June 6, 2024 [4].

Discussion. The weld qualification process and visual inspection, along with a reduction in allowable stresses in the weld commensurate with the absence of ultrasonic or dye penetrant testing, provide a reasonable assurance of the structural integrity of the weld. However, the visual inspection does not provide an assurance of confinement integrity for the TSC.

ISG-18 states that helium leakage testing for dry cask storage was established to provide assurance that no leakage occurs after the closure welds of the cask system are executed, as no active or passive methods are typically used to monitor the presence of helium in a welded storage container over its lifetime. The large weld exception allows the use of at least three layers of weld that is dye penetrant tested to identify flaws that could result in leakage. While the weld does have three layers, without the dye penetrant testing for the TSCs, there is the potential for these types of flaws to exist undetected.

The equivalency request cites visual examination acceptance criteria from ASME BPVC Section V, Article 9, with acceptance to ASME BPVC Section III, NG-5360, includes: "Weld reinforcement, underfill, undercut, and overlap shall not exceed the allowable limits of this Subsection," and "The examined surface shall be free of abrupt irregularities." These criteria do not include detection of flaws which could result in the loss of helium. The review team inquired whether qualification testing established that the visual inspection could identify a minimally sized flaw that could allow helium leakage sufficient to impact the safety function. CPCCo identified that the visual inspection could not identify this type of defect.

The equivalency request cited the example of the high-level waste glass canisters at the Defense Waste Processing Facility (DWPF) to support the use of weld qualification instead of helium leak testing. The staff team reviewed the system design description for the DWPF final canister closure process [10] and identified that the glass canisters were neither credited safety components nor ASME pressure vessels. Additionally, the leakage requirements were "to prevent the ingress of water into the canister and thus, the final weld is required to be leak tight to water," as opposed to the TSC which is required to be leak-tight to helium.

The equivalency request also cited the success of welding approximately 400 MCOs using automated welding processes similar to that planned for the WESF TSCs. However, during welding of the cover plate for the helium backfill valve in the MCO lid assembly, a through-wall leak was identified during helium leakage testing [3]. The defect was also identified during dye penetrant testing (see *Figure 1*). The leakage was determined to be outside the weld area but in the zone affected by welding heat. This was likely a latent base metal defect that opened up during the welding process. This type of defect could compromise confinement and helium retention safety functions and would not be identifiable by visual inspection of the weld. If dye penetrant testing had not covered a wide area for the MCO, that testing could also have missed this type of defect. The staff team inquired whether this inspection result had been the subject of an occurrence report or captured by DOE's operating experience program as a defective safety-related component. The response was that it had not.

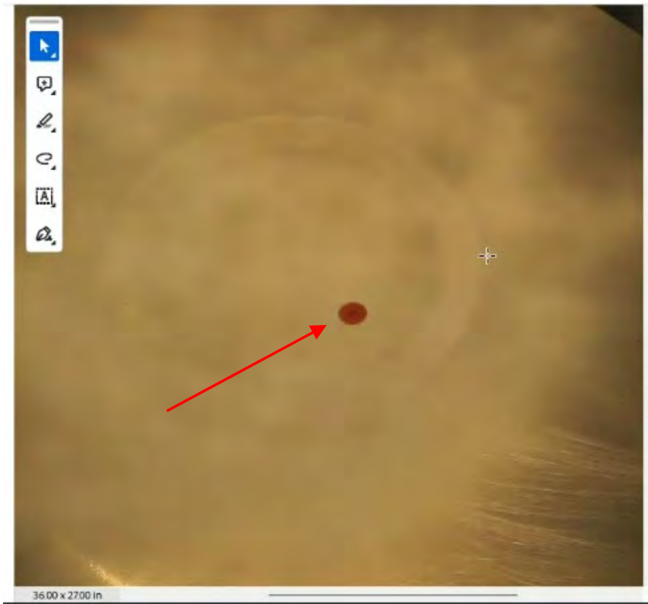

Figure 1. Defect in MCO Backfill Valve Cover Plate Base Metal Identified by Dye Penetrant Testing

The staff team evaluated the NRC NUREG-1536, *Standard Review Plan for the Spent Fuel Dry Storage Systems at a General Facility License*, [11] for information on how radioactive material storage casks are managed if confinement integrity is not assured by testing. The NUREG identifies that welded closure lids that are tested to be leak-tight, as defined by ANSI N14.5, do not need to analyze the impacts of leaks like what has been done in the CSA DSA. The NUREG typically requires monitoring of the confinement unless the closure meets the welded closure requirements. As the closure welds have not been verified as leak-tight, monitoring of the TSC closure during storage is warranted to support the accident analysis assumptions.

The staff team concluded that the TSC closure welding process does not provide equivalent assurance of confinement integrity per the ASME BPVC or NRC standard review plan or interim staff guidance. Without the ability to verify the absence of leakage, the approach reflects an exemption to the BPVC rather than equivalency. As discussed in DOE Order 420.1D, *Facility Safety*:

"Equivalencies to DOE technical standards and industry codes and standards determined to be applicable to the facility design or operations must demonstrate an equivalent level of safety (i.e., meets or exceeds the level of protection) and be approved by the DOE Head of Field Element or designee"

As such, the approach proposed by the equivalency request would necessitate DOE approval at a higher level than the field office.

Conclusion. The welded closure of the TSCs is credited as an initial condition that prevents a radioactive material release for design basis accidents in the CSA DSA. Other accident scenarios in the DSA indicate that a release can have moderate consequences to the co-located worker and high consequences to the facility worker.

The staff team determined that the potential impacts of the defect in the MCO should be communicated through DOE's operating experience program to ensure that other users of spent fuel containers are aware of the potential defect type to exist and ensure that their inspections programs can identify such defects.

The staff team concluded that the TSC closure welding process does not provide equivalent assurance of confinement integrity per the ASME BPVC or NRC standard review plan or interim staff guidance. Without the ability to verify the absence of leakage, the approach reflects an exemption to the BPVC rather than equivalency, which would necessitate DOE approval at a higher level than the field office.

The project could provide an equivalent assurance of confinement integrity to the NRC standard review plan by establishing a monitoring program to detect helium leakage during an initial period of storage when cooling of the capsules is required. Additionally, periodic external surveys of the storage systems to identify radioactive contamination would provide additional assurance that the confinement integrity is maintained for the life of the storage system.

References

[1] Central Plateau Cleanup Company, *Equivalency Request for the Management of the Cesium and Strontium Capsules Project Cask Storage System, CPCC-00684, Revision 0,* 2024.

[2] American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code, 2010 with 2011 addenda*, 2011.

[3] Central Plateau Cleanup Company, *Nonconformance Report, MCO Canister Cover Plate, HEAT# A3CA, Installed on MCO-036, MCO Cover S/N: C-052 (CID#0000597532),* September 2024.

[4] DOE Hanford Field Office, "CONTRACT NO. 89303320DEM000030 – Transmittal for Approval of the Equivalency Request for the Management of the Cesium and Strontium Capsules Project Cask Storage System," June 6, 2024.

[5] Nuclear Regulatory Commission, *The Design and Testing of Lid Welds on Austenitic Stainless Steel Canister as the Confinement Boundary for Spent Fuel Storage, Division of Spent Fuel Storage and Transportation Interim Staff Guidance ISG-18, Rev 1.*

[6] Central Plateau Cleanup Company, "Capsule Storage Area Documented Safety Analysis, CPCC-00176, Rev. 0," August 2023.

[7] American Society of Nuclear Engineers, *Requirements for Spent Fuel Storage Canisters, Boiler and Pressure Vessel Code Case N-595,* September 1999.

[8] American National Standards Institute, *American National Standard for Radioactive Materials - Leakage Tests on Packages for Shipment, ANSI N14.5,* 2022.

[9] Nuclear Regulatory Commission, *Certificate of Compliance for Spent Fuel Storage Casks, NAC-Multi-Purpose Canister, Certification No. 1025,* April 2000.

[10] Savannah River Remediation LLC, *System Design Description, Final Canister Closure, CC-02, G-SYD-S-00067, Revision 4,* July 2019.

[11] Nuclear Regulatory Commission, *Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility - Final Report, NUREG-1536, Revision 1,* July 2010.