

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

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901



January 6, 2022

The Honorable Jill Hruby
Administrator
National Nuclear Security Administration
US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Administrator Hruby:

The Defense Nuclear Facilities Safety Board (Board) completed a review of pit staging at the Pantex Plant. The Board found that the number of pits staged in unsealed containers at Pantex has increased in recent years. Storage in the AL-R8 Sealed Insert container is preferred, because it provides an inert environment that protects against corrosion and provides a sealed barrier that would confine any radioactive material released by a breached pit. Unfortunately, unsealed containers without an inner sealed insert do not protect against corrosion or confine any radioactive material released by a breached pit. The population of pits in unsealed containers increased from 8 percent of the total inventory to 14 percent of the total inventory between 2014 and 2021, even as the total inventory of pits increased. This reflects a relaxation in requirements to preserve pit quality and integrity for the storage environment by the design agencies, and the focus at Pantex on priorities other than pit packaging.

Board Recommendation 1999-1, *Safe Storage of Fissionable Material Called "Pits,"* and Technical Report 18, *Review of the Safety of Storing Plutonium Pits at the Pantex Plant*, identified the need for Pantex to repackage pits into AL-R8 Sealed Insert containers due to long-term corrosion concerns. The Recommendation states:

Pits are predominantly made of plutonium metal which by itself would corrode in an air atmosphere, causing a possibility of dispersion of this hazardous material. Therefore, pits normally have a corrosion-resistant cladding, and where possible they are kept in an inert atmosphere....

Although the cladding of pits has rarely failed or been breached; most pits have been protected throughout their existence by the sealed atmosphere within a nuclear weapon, limiting their exposure to incompatible or corrosion-producing materials.... [P]its at Pantex are now in AL-R8 containers with a normal atmosphere, along with celotex packing material that is a potential source of moisture and chlorides.

In response to Recommendation 1999-1, the Department of Energy (DOE) committed in its implementation plan that “[a]ll pits stored at the Pantex Plant will be repackaged into the AL-R8 Sealed Insert container.” In closing Recommendation 1999-1 in 2005, DOE indicated it had completed repackaging almost all pits at Pantex into AL-R8 Sealed Insert containers. Currently, all pits in magazines are packaged in AL-R8 Sealed Insert containers; however, many pits are staged in unsealed containers in Zone 12 South facilities. Although these facilities are climate-controlled, the pits in unsealed containers are exposed to air, along with moisture and chlorides from Celotex™ packing material. These conditions can lead to degradation and breach of a pit in containers and facilities without credited confinement barriers.

The Board is concerned that if the National Nuclear Security Administration (NNSA) does not maintain an appropriate prioritization of pit repackaging, the population of pits in unsealed containers will continue to grow, with potential impacts to safety. During the Board’s safety review, the Pantex contractor, Consolidated Nuclear Security, LLC, indicated it is only achieving approximately 10 percent of its annual pit repackaging goals.

The enclosed safety report provides more detail on these matters. Pursuant to 42 United States Code § 2286b(d), the Board requests that NNSA provide the Board—within 120 days of receipt of this letter—with a report providing:

- The technical basis for the reduced pace of repackaging and the relaxed requirements to preserve pit quality and integrity for the storage environment;
- The plan and schedule to package pits in AL-R8 Sealed Insert containers, particularly for higher hazard legacy pits;
- Actions being taken to address any shortages in components of AL-R8 Sealed Insert containers; and
- An analysis of process improvements that can enhance safety by ensuring pits are packaged into AL-R8 Sealed Insert containers in a timely manner after removal from a weapon.

Sincerely,



Joyce L. Connery
Chair

Enclosure

c: Ms. Teresa Robbins
Mr. Joe Olencz

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Report

September 24, 2021

Pantex Plant Pit Inventory Review

Summary. The Defense Nuclear Facilities Safety Board's (Board) staff performed a safety review of the Pantex pit inventory, with a focus on understanding what types of containers are currently being used for pit staging. Pits are composed of fissionable material and are a primary component of a nuclear weapon. The main objectives of this safety review were: to determine the state of pit packaging for current stockpile and legacy pits; confirm that nuclear material staging configurations comply with safety basis requirements; evaluate how well material limits specified in the technical safety requirements (TSR) are implemented in site procedures and controls; and understand how on-site material movements are authorized, tracked, and compared against authorized material limits. The staff conducted the review from February 2020 to April 2021 and consisted of staff members D. Andersen, C. Berg, J. Anderson, and A. Gurevitch.

During the safety review, the staff team identified that many pits at Pantex are not staged in the most protective staging configuration; i.e., the AL-R8 Sealed Insert container. A comparison of the 2021 inventory with a previously received inventory from 2014 shows that the Pantex total pit inventory has increased by 10 percent since 2014, and pits in unsealed containers have increased from 8 percent to 14 percent of the respective total inventories. Although some pits in unsealed containers might be in-process, this would not be expected to account for 14 percent of the inventory, and many of the pits are of types not associated with current weapon life extension programs. Comparison of the 2014 and 2021 inventories indicates that pits from disassembly and dismantlement campaigns accumulated in AL-R8 containers without sealed inserts during that timeframe. In addition, pits associated with certain legacy programs remain staged without sealed insert containers.

Board Recommendation 1999-1, *Safe Storage of Fissionable Material Called "Pits"* [1], and Technical Report 18, *Review of the Safety of Storing Plutonium Pits at the Pantex Plant* [2], identified the need for Pantex to repackage pits from AL-R8 containers without sealed inserts due to the potential for long-term corrosion. As a result, Pantex undertook an aggressive campaign to repackage pits into AL-R8 Sealed Insert containers. Pits staged in magazines in Zone 4 were of particular concern to the Board and the site. The Board's staff confirmed during its safety review that pits currently staged in Zone 4 are packaged in AL-R8 Sealed Insert containers. However, many current stockpile program pits and some legacy pits remain staged in unsealed containers in Zone 12 South facilities. During the staff team's safety review, the site management and operating contractor, Consolidated Nuclear Security, LLC (CNS), stated it is only achieving approximately 10 percent of its annual pit repackaging goals, citing a lack of funding and priority.

The staff team also identified safety errors in the implementation of TSR requirements within site procedures and the Maximum Limits List (MLL) [3], the site's formal list of material limits by facility/room. Based on one deficiency identified by the staff team, CNS paused operations for certain facilities and generated an Occurrence Reporting and Processing System (ORPS) report, NA--NPO-CNS-PANTEX-2021-0016, *Inadequacy in Nuclear Criticality Analysis* [4], categorized as informational level. CNS personnel acknowledged the safety errors identified by the Board's staff and stated they plan to correct them. Details are provided later in this report.

Background. Information regarding nuclear material staging at Pantex, pit container types, and a past Board safety recommendation and technical report on pit staging is summarized below.

Nuclear Material Staging—Pantex formally controls nuclear material and explosive limits established in safety analysis reports (SAR) and TSRs [5] with the MLL [3]. The MLL identifies these limits for facilities (e.g., total facility, bay, cell, or magazine) and rooms (e.g., rooms at Building 12-116 or side A/side B of Modified Richmond magazines in Zone 4) authorized at Pantex for operations and staging of nuclear explosives, nuclear explosive-like assemblies, and nuclear materials, as well as explosives-only operations. Safety requirements for nuclear material operations (e.g., surveillance and packaging activities) are derived in the Nuclear Material SAR [6], while safety requirements for staging of nuclear explosives and nuclear material are derived in the Staging SAR [7].

The TSR specifies material limits for the site Nuclear Material and Explosives Inventory Control Program. Nuclear material activities include not only those activities associated with pits (e.g., staging, surveillance, re-qualification), but also those associated with canned subassemblies (CSA), radioisotope thermoelectric generators, and tritium reservoirs. Specific to pits, staging is authorized in the following facilities: 12-44 Cell 8, 12-64 Bays (certain bays), Zone 4 Modified Richmond Magazines, and Zone 4 Steel Arch Construction (SAC) Magazines.¹ Pit staging in 12-64 Bays and Modified Richmond magazines uses the “stage-right” configuration (specialized racks/pallets turned vertically and lifted via a specialized forklift) or single-array staging configuration. Pit staging in SAC magazines is only authorized in a single-array, floor staging configuration. Pits staged in the single-array configuration are easier to retrieve for surveillance, re-packaging, or re-use compared to pits in the stage-right configuration, which is intended for longer-term staging.

The following facilities are authorized for pit operations: 12-64 Bays (certain bays); 12-86, Special Nuclear Material Component Requalification Facility; and Building 12-116. Circa 2014/2015, the safety basis for the 12-116 pit staging vaults/rooms was moved from the Staging SAR to the Nuclear Material SAR. Staging of pits in Building 12-116 use either the stage-right configuration, as shown in Figure 1, or single-array staging. In addition, certain 12-64 bays can switch modes from nuclear material operations to nuclear material staging, and vice versa. These bays are evaluated in both the Nuclear Material SAR and the Staging SAR and have different material limits depending on the operational mode. Lastly, pit radiography operations are analyzed under the LINAC/CT/X-Ray SAR [8].

¹ SAC magazines are authorized for nuclear explosive staging in addition to nuclear materials staging.



Figure 1. Initial loading of a room at Building 12-116 (late 1990s) with AL-R8 containers without sealed inserts in a “stage-right” configuration.

Pit Containers—The following containers are currently in use for pit staging at Pantex: the AL-R8 without sealed insert, AL-R8 Sealed Insert, and FL containers. Other approved pit containers, as described in Table 2.7.8-1, *Nuclear Materials Container Summary*, of the Sitewide SAR [9] and on the approved containers list of Section 5.7.9.1 of the TSRs [5], are not currently in use.² A brief description of pit containers currently in use at Pantex follows:

- **AL-R8 without sealed insert.** There are four models of AL-R8 containers without sealed inserts: 2030 and 2040 models, and 2030 and 2040 modified models. Modified AL-R8 containers without sealed inserts are slightly elongated to accommodate temperature monitoring equipment. The lid is secured to the drum body with a locking ring assembly, and the drums are vented with a one-inch diameter vent hole. Celotex™ fiberboard inserts are used for insulation, shock protection, and centering of the pit in the drum. When a pit is staged in an AL-R8 container without a sealed insert, the outer drum is black.
- **AL-R8 Sealed Insert.** The AL-R8 Sealed Insert containers also have 2030 and 2040 configurations. The outer drums for the 2030 models of the AL-R8 Sealed Insert and

² The most recent container phased out of use at Pantex is the AT-400A. In the early 1990s, the site developed the welded AT-400A container to replace the AL-R8 containers without sealed inserts for long-term pit staging. Subsequently, 18 pits were packaged into these containers. Later, the site developed the AL-R8 Sealed Insert container and selected this as the preferred long-term container over the AT-400A. The main factors for this decision were the higher costs and longer handling times associated with packaging, unpackaging, and welding of the AT-400A compared to the bolted sealed insert container. The pits staged in AT-400A containers were repackaged into AL-R8 Sealed Insert containers.

AL-R8 container without a sealed insert are the same. The sealed insert provides an inert and leak-tight atmosphere for a staged pit. A cross-section and photo of AL-R8 Sealed Insert containers are shown in Figures 2a and 2b, respectively. When a pit is staged in an AL-R8 Sealed Insert 2030 container, the outer drum is white.

- **FL Container.** The FL container is designed for staging, onsite transportation, and offsite shipping of pits. The FL container includes an outer drum and inner containment vessel.

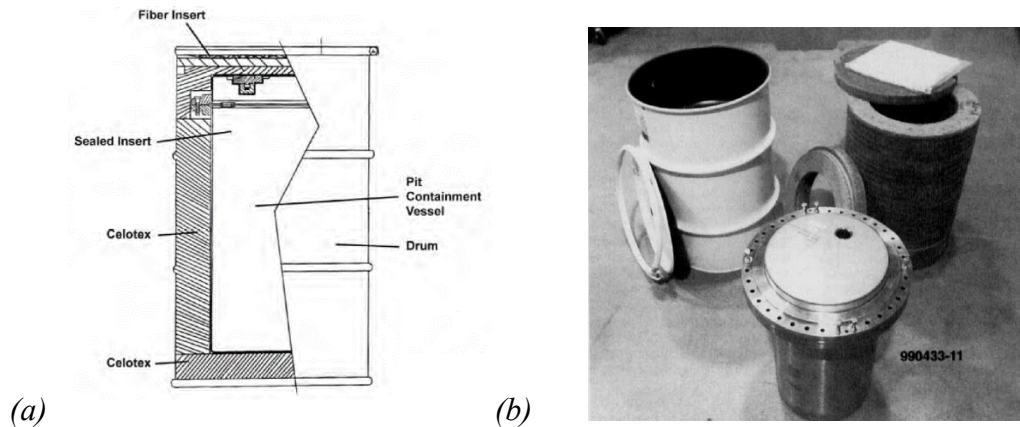


Figure 2. (a) AL-R8 Sealed Insert cross-section
(b) AL-R8 container with packing material and sealed insert.

Board Recommendation and Technical Report on Pit Staging—In the late 1990s, it became apparent to the Board that the staging mission of pits at Pantex was growing and would be prolonged. Earlier that decade, the Department of Energy (DOE) decided that the Rocky Flats Plant would not re-open and transferred many pits from that site to Pantex for staging. Hence, the Board conducted a safety review of the state of pit staging at Pantex and issued Board Recommendation 1999-1, *Safe Storage of Fissionable Material Called “Pits”* [1], and Technical Report 18, *Review of the Safety of Storing Plutonium Pits at the Pantex Plant* [2]. The safety report and Recommendation identified that many pits staged at the site would need to be repackaged into AL-R8 Sealed Insert containers for safe long-term staging. The Recommendation states:

Pits are predominantly made of plutonium metal which by itself would corrode in an air atmosphere, causing a possibility of dispersion of this hazardous material. Therefore, pits normally have a corrosion-resistant cladding, and where possible they are kept in an inert atmosphere. The design purpose of pits and their constituent material leads them to have singular importance, both from the standpoint of national security and that of safety. In particular, when pits are stored by themselves, not incorporated in a nuclear weapon (“stand-alone” pits), special attention is required to avoid any undue risk. . . .

Although the cladding of pits has rarely failed or been breached; most pits have been protected throughout their existence by the sealed atmosphere within a nuclear weapon, limiting their exposure to incompatible or corrosion-producing materials. . . . [P]its at Pantex are now in AL-R8 containers with a normal atmosphere, along with celotex packing material that is a potential source of moisture and chlorides. The containers are not tightly sealed, and they are kept in magazines with an atmosphere that communicates with the outside air through a normal ventilation system.

As discussed earlier, the AL-R8 container without a sealed insert does not provide a benign environment for long-term pit staging, notably in facilities without climate control, such as in Zone 4. AL-R8 drums are not leak tight and do not provide a sealed barrier that would confine radioactive material released by a breached pit. The Celotex™ packing material can create conditions that promote pit corrosion. Celotex™ is a fiberboard material made from sugar cane, paper, starch, and wax and can contain significant moisture and chlorides. In addition, a sealed insert provides additional thermal and radiological protection which can be important for certain pits. The sealed insert can provide enhanced criticality safety, protect the material handler from radiological dose, and isolates the stored pit from the products of thermal and radiological decomposition of the Celotex™ packing material. Board Recommendation 1999-1 noted:

The design laboratories have stated in letters to DOE and to Pantex in 1995 and 1997 that pits, when in AL-R8 containers for an extended period, face a possibility of corrosion. They recommended that no pit should be stored an appreciable period of time in these containers.

The closure of Recommendation 1999-1 in 2005 was tied to DOE's near-term commitment to complete repackaging of all pits identified in DOE's implementation plan [10]. A baseline assumption/decision of DOE's implementation plan was that "All pits stored at the Pantex Plant will be repackaged into the AL-R8 Sealed Insert container." In addition, DOE's final report on Recommendation 1999-1 discussed developments related to testing and approval of AL-R8 Sealed Insert containers and the implementation of a surveillance program for pit containers.

Staff Review. The Board's staff conducted a safety review of the Pantex pit inventory during February 2020 through April 2021. This safety review was divided into two parts:

- An initial safety review of the Pantex pit inventory, provided by the site in a classified spreadsheet, and a discussion to clarify the spreadsheet's nomenclature.
- A more detailed safety review of the inventory spreadsheet and a review of material movement implementing procedures and the MLL.

The first interaction was held on September 22, 2020, and the second interaction was held on April 12, 2021, both via classified teleconference. In addition, during the week of April 19, 2021, a member of the staff review team observed pit packaging and surveillance activities, walked down a nuclear material staging area, and received a demonstration of the Integrated

Production Planning and Execution System computer program. A close-out discussion was held on August 2, 2021. All interactions were held with personnel from CNS and the NNSA Production Office (NPO).

Current Pit Inventory—In early 2020, the Board’s staff received a classified spreadsheet of the entire pit inventory for Pantex; the Board’s staff received updated inventory information in late 2021. After the first interaction, the staff was able to sort and analyze the spreadsheet and obtain a complete understanding of pit staging at Pantex. The Board’s staff also inquired about the process for authorizing the movement of nuclear material, including pits, and the process for changing facility status from nuclear material operations to nuclear material staging, and vice versa, because different limits on material quantities apply for different facility modes.

A comparison of the 2021 inventory with an inventory from 2014 shows that the total pit inventory at Pantex had increased by 10 percent since 2014, and pits in containers without sealed inserts increased from 8 percent to 14 percent of the total inventory (percentages based on the 2014 and 2021 total inventory quantities, respectively).³ Although some pits in unsealed containers might be in-process (e.g., recently removed from a weapon, planned to be used in an upcoming assembly or life extension program, or pending surveillance), this would not be expected to account for 14 percent of the pit inventory. Comparison of the 2014 and 2021 inventories showed that pits accumulated in AL-R8 containers without sealed inserts from disassembly and dismantlement campaigns during that timeframe. Many of these pits are of types not associated with any current life extension program. In addition, pits associated with certain legacy programs have remain staged without sealed insert containers since the 2014 inventory.

CNS personnel stated that the increase in the number of pits staged without sealed inserts can be partially attributed to relaxed staging requirements issued in 2014 by the design agencies (Los Alamos National Laboratory and Lawrence Livermore National Laboratory). Staging requirements for pits at Pantex are documented in RM257919, *Packaging Requirements, for Storage of LANL and LLNL Pits (U)* [11]. Prior to a 2014 revision, this document contained the storage requirement that “[s]torage in packages similar to the AL-R8 that do not provide a dry inert atmosphere for the pit shall be limited to a total consecutive time of twenty-four months without prior review, analysis, and approval by the pit [design agencies].” The design agencies removed this storage requirement from RM257919 in 2014, and supporting documents provided by CNS did not provide the technical basis for the relaxed storage requirements. Also, CNS personnel maintained that the DOE commitments made as part of closure of Board Recommendation 1999-1 continue to be met; it was their position that the recommendation only applied to pits staged in Zone 4 magazines, which lack environmental controls. The staff review team disagrees with this position; Recommendation 1999-1 and its closure were not tied to specific facilities, but the entire inventory at the site.

CNS personnel informed the staff team that CNS is only achieving approximately 10 percent of its annual pit repackaging goals, citing a lack of funding and priority. At the current packaging rate, repackaging of pits not in sealed insert containers cannot be achieved for

³ From 2020 to 2021, the total pit inventory remained approximately the same, yet the percentage of pits in unsealed containers rose from 12 percent to 14 percent of the total inventory.

a significant number of years. CNS indicated packaging operations are dependent on funds received from the NNSA Office of Stockpile Sustainment (NA-122), Stockpile Services Division (NA-122.1). CNS personnel further stated that although the supply of sealed inserts is adequate, there appears to be a shortage of outer drums for the AL-R8 Sealed Insert containers. CNS is resolving this shortage by requalifying containers and working with the supplier to acquire additional drums.

Additional discussions during the staff team's review focused on inconsistencies between the actual staging configurations for certain legacy programs and how they are described in the Pantex Staging SAR [7]. The Staging SAR states these higher risk legacy pits are only staged in AL-R8 Sealed Insert containers; however, the staff team's review of the pit inventory found that several of these pits are staged in AL-R8 containers without sealed inserts. CNS personnel responded by stating that this language could be removed from the SAR since it was not formally carried forward to the TSRs as a safety requirement and is not a baseline assumption of the accident analysis. The staff review team noted that it would be appropriate for the language in the SAR to be consistent with field conditions.

The staff team also asked why pits discovered in 2017 in AL-R8 Sealed Insert containers with rusted outer drums were repackaged into AL-R8 containers without sealed inserts [12] and remain staged that way. CNS personnel informed the staff team that these pits were held in unsealed containers while CNS conducted an extent-of-condition review and developed a corrective action plan. CNS personnel stated that "repackaging will be conducted as time and resources allow" now that those activities are complete.

Lastly, the staff review team confirmed that actual facility and room/vault material inventories for Zone 12 South and Zone 4 pit staging facilities complied with material limits established in the TSRs. In addition, the staff team confirmed that all pits currently staged in Zone 4 are in AL-R8 Sealed Insert containers.

Based on this safety review, the staff team concludes that repackaging into AL-R8 Sealed Insert containers is treated as a lower priority at Pantex compared to other programmatic needs. The staff team concludes that NNSA should reexamine the priority for repackaging pits staged at Pantex into AL-RI Sealed Insert containers, particularly given the prolonged time pits have been and will continue to be staged at Pantex.

Material Limits and Movement Authorization—In addition to reviewing the pit inventory, the staff review team evaluated the MLL and the material movement authorization procedure for all nuclear material staging and nuclear material operations. The staff team identified the following safety observations.

- The staff team identified a TSR requirement for a room that allowed for either a certain quantity of tritium **or** a certain amount of ^{238}Pu . CNS personnel noted the safety requirement was intended to allow both tritium **and** ^{238}Pu , as was implemented in the MLL. CNS personnel acknowledged the error in the TSR and are developing a safety basis change package to correct the mistake. During the teleconference, the staff team asked why CNS did not declare a potential inadequacy in the TSRs

(PITSR) for this safety discrepancy; CNS personnel informed the staff that a PITSR did not exist since the Nuclear Material SAR [6] analyzed the condition of having both materials in the room and that the TSR specified a more restrictive material limit.

- CNS personnel confirmed that ORPS entry NA--NPO-CNS-PANTEX-2021-0016, *Inadequacy in Nuclear Criticality Safety Analysis*, was identified in response to a line of inquiry from the staff team's agenda. The staff team identified a facility with an "explosive-only" operational mode that allowed a quantity of ^{235}U that exceeded the single-parameter subcritical limit for ^{235}U metal provided in ANSI/ANS-8.1-2014 [13]. In this situation, DOE Standard 1027-2018, *Hazard Categorization of DOE Nuclear Facilities* [14], requires a criticality analysis or assessment that screens criticality as not credible based on segmentation or the nature of the process. CNS personnel informed the staff team that the operational mode for the specific facility had previously been "archived" (i.e., no longer available for use), so there is no issue for that facility; however, an extent-of-condition review by CNS identified three bays in Building 12-104 with inadequate documentation regarding criticality safety. This resulted in a pause in operations for the affected facilities and the declaration of the occurrence in ORPS. CNS subsequently developed documentation identifying that criticality is precluded for these bays by the nature of the process. These efforts by CNS enhanced nuclear criticality safety by providing a technical basis for continuing safe operations in the affected facilities.
- The staff identified that P7-3400, *Material Movement Authorization*, General Safety Requirement 2.1, only cites the TSR sections for material limits for nuclear explosive cells, some nuclear material facilities, facilities covered by the Transportation SAR, and high explosives-only facilities. However, references are not included to all the nuclear material facilities, nuclear explosive bays, linear accelerator (LINAC) bays, and all staging facilities. Although other procedures implement material limit requirements for Zone 12 South and Zone 4 facilities, it is important that the references to TSRs also be complete in P7-3400. CNS personnel acknowledged the error and are correcting the procedure.
- The staff team identified five facilities that do not have material limits established in Section 5.7.13 of the TSRs: four nuclear explosive special purpose facilities (two LINAC bays and two vacuum chamber bays) and one CSA re-acceptance bay. The MLL does establish material restrictions for these facilities. CNS personnel stated that the special purpose nuclear explosive bays do not have TSR-level controls on material limits because these limits would not affect the conclusions of the accident analysis. The staff team believes that TSR-level controls are warranted since limits on the total number of nuclear explosives in each special purpose bay are addressed in the source term analysis of Section 3.4.2.A.2, *Fire in Bay, Cell, or Special Purpose Facility*, and Section 3.4.2.C.15, *High Mast Light Tower (HMLT)*, of the Sitewide SAR [9].

As for the CSA re-acceptance bay, the MLL specifies a certain allowance of ^{235}U and

a certain number of CSAs permitted in the bay. Based on discussions with NPO and CNS personnel, a TSR-level material limit is not required because the quantities of material are considered below the hazard category 3 threshold per DOE Standard 1027-18, *Hazard Categorization of DOE Nuclear Facilities* [14]. In addition, CNS determined criticality to be not credible due to the nature of the process [15], further justifying designating the bay as less than Hazard Category 3; CNS developed this evaluation in response to occurrence NA--NPO-CNS-PANTEX-2021-0016, as discussed earlier.

Conclusion. Pit repackaging in AL-R8 Sealed Insert containers remains a lower priority at Pantex. Many pits remain staged in AL-R8 containers without sealed inserts, and disassembly and dismantlement campaigns continue to add to this population. Moreover, some pits from legacy programs remain staged in containers without sealed inserts. Long-term staging in unsealed containers with Celotex™ packing material exposes the pits to an environment that can promote corrosion. Although all the pits stored in unsealed containers are in climate-controlled Zone 12 South facilities, climate control cannot be solely relied on to prevent corrosion, and unsealed containers do not provide a barrier to prevent release of radioactive material from a breached pit. The staff review team concludes that NNSA should place greater priority on repackaging pits at Pantex into sealed insert containers, particularly in the context of commitments made by DOE when Board Recommendation 1999-1 was closed.

References

- [1] Defense Nuclear Facilities Safety Board, *Safe Storage of Fissionable Material Called "Pits"*, Recommendation 1999-1, August 11, 1999.
- [2] Defense Nuclear Facilities Safety Board, *Review of the Safety of Storing Plutonium Pits at the Pantex Plant*, Technical Report 18, November 25, 1997.
- [3] Consolidated Nuclear Security, LLC, *Maximum Limits List (MLL)*, RPT-MIS-47388, Issue JD, April 21, 2020.
- [4] Department of Energy, *Inadequacy in Nuclear Criticality Safety Analysis*, ORPS Report NA--NPO-CNS-PANTEX-2021-0016, February 26, 2021.
- [5] Consolidated Nuclear Security, LLC, *Technical Safety Requirements for Pantex Facilities*, RPT-SAR-199801, May 6, 2021.
- [6] Consolidated Nuclear Security, LLC, *(U) Nuclear Material Safety Analysis Report*, AB-SAR-379417, Rev. 61, October 23, 2019.
- [7] Consolidated Nuclear Security, LLC, *(U) Staging Safety Analysis Report*, AB-SAR-940092, Rev. 76, February 21, 2020.
- [8] Consolidated Nuclear Security, LLC, *(U) LINAC/CT/X-Ray Safety Analysis Report*, AB-SAR-940070, Rev. 95, September 9, 2021.
- [9] Consolidated Nuclear Security, LLC, *Sitewide Safety Analysis Report (SAR)*, AB-SAR-314353, May 10, 2021.
- [10] Department of Energy, *Implementation Plan 99-1 for Defense Nuclear Facilities Safety Board Recommendation 99-1*, January 27, 2000.
- [11] Lawrence Livermore National Laboratory, *Packaging Requirements, for Storage of LANL and LLNL Pits (U)*, RM257919, Issue J, November 6, 2018.
- [12] Consolidated Nuclear Security, LLC, *Rusted AL-R8 SI Engineering Evaluation*, WSD-0185, May 25, 2017.
- [13] American Nuclear Society, *Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors*, ANSI/ANS-8.1-2014, 2014.
- [14] Department of Energy, *Hazard Categorization of DOE Nuclear Facilities*, DOE-STD-1027-2018 (CHG 1), January 2019.
- [15] Consolidated Nuclear Security, LLC, *Criticality Accident Precluded by Nature of Process for Canned Subassembly (CSA) Re-acceptance Operations in Building 12-104A*, RPT-0029, Issue 1, February 2021.