DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901

June 22, 2015

Mr. Mark Whitney
Acting Assistant Secretary for Environmental Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Mr. Whitney,

The Defense Nuclear Facilities Safety Board (Board) issues project letters in conjunction with major critical decision points of new facilities. This letter is the project letter for Critical Decision 4, *Approve Start of Operations or Project Completion*, for the Savannah River Site K-Area Complex Purification Area Vault Project. The enclosure, provided for your information and use, documents the results of the Board's staff review of the Documented Safety Analysis for this Vault Project. The Department of Energy Savannah River Operations Office and the project contractor have identified opportunities to resolve several of the issues discussed in the enclosure. We will continue to monitor the resolution of the identified issues.

Sincerely,

Jessie H. Roberson
Vice Chairman

Enclosure

c: Mr. Joe Olencz

Enclosure
K-Area Complex Purification Area Vault Project Phase II Summary

The K-Area Complex (KAC) provides interim storage of excess fissile materials from the Department of Energy (DOE) complex. Phase II of the Purification Area Vault Project expands the storage capacity of the Material Storage Area (MSA) by approximately 30 percent by adding space in the Final Storage Vault (FSV). The safety strategy for storage relies on containment by the packages used to store plutonium and uranium materials. The facility does not provide confinement ventilation (with the exception of the K-Interim Surveillance (KIS) Vault), so maintaining the integrity of the storage packages is of paramount importance. Nondestructive and destructive surveillance activities required by DOE Standard 3013, *Stabilization, Packaging, and Storage of Plutonium-Bearing Materials*, are conducted within the KIS Glovebox to monitor the long term safety performance of 3013 containers. The packages are protected by the seismically robust facility, a fire protection program that relies on controlling combustible materials, and other safety programs that ensure safe storage configurations and control of vehicles within the MSA.

Members of the Defense Nuclear Facilities Safety Board's (Board) staff conducted an on-site review of the KAC Documented Safety Analysis (DSA) during February 9–12, 2015, which focused on safety-class and safety-significant controls necessary to provide adequate protection of the public and workers. Key observations include:

Shipping Container and Inner Containment Vessel Integrity. The Model 9975 shipping package consists of a nested arrangement of an O-ring sealed primary containment vessel (PCV), an O-ring sealed secondary containment vessel, and a 35-gallon drum sealed with a flange closure. Most of the plutonium-bearing material in KAC is stored in DOE Standard 3013 containers that are packaged into Model 9975 shipping packages. However, interim surveillance operations result in the need to repackage and store plutonium-bearing material at KAC. This material is typically repackaged into a non-3013 container configuration consisting of a vented slip lid can, a vented plastic bag, and a vented outer screw-lid can (can-bag-can), which is then nested within a 9975 package and stored in the MSA. Material in non-3013 containers packaged in non-certified 9975 shipping packages is subject to the packaging requirements of DOE M 441.1-1, *Nuclear Material Packaging Manual*. KAC personnel are in the process of implementing DOE M 441.1-1, and have developed documents to demonstrate compliance with DOE M 441.1-1. These documents generally address the material characteristics and packaging design criteria required by DOE M 441.1-1. The contractor's analysis adequately shows that most of the criteria are met.

The Board's staff team found that the contractor's analysis for radiation resistance of the 9975 package PCV O-ring seal for non-3013 containers stored in KAC may be incomplete because the analysis only assesses the cumulative dose from gamma radiation and does not account for the alpha dose to the O-ring. Excluding the alpha dose to the

PCV O-ring for the case of 3013 containers is reasonable because the 3013 container is designated as Safety Class for primary containment; hence, nuclear material is not expected to come in contact with the PCV O-ring seal. However, 9975/non-3013 containers are not credited with containment during storage and plutonium oxide particles could leak out of the can-bag-can into the PCV. Some of these particles could migrate to the surface of the O-ring, thereby exposing the elastomers to alpha radiation, which may degrade the integrity of the O-ring seal and compromise the containment function of the PCV. Therefore, the potential for radioactive material reaching the PCV O-ring surface and the impact of alpha radiation on the sealing integrity of the O-ring should be evaluated.

DOE M 441.1-1 also requires a surveillance program to validate the package design life by evaluating appropriate attributes of stored packages to determine whether the packages can continue to be stored safely. The Savannah River Site surveillance program for 9975/3013 packages in KAC states an additional examination of the PCV will be performed for 9975/non-3013 containers to ensure that no corrosion or contamination is present; however, the document does not provide a sampling plan for surveillance of 9975/non-3013 containers, as is done for 9975/3013 packages. A sampling plan for surveillance of 9975/non-3013 containers should be provided.

Structural Integrity of the MSA and Assembly Area. The Performance Category 3 (PC-3) FSV floor slab requires the piping tunnel below the FSV to withstand PC-3 loading to prevent collapse scenarios that could impact the FSV. The staff team noted several inconsistencies with the existing analysis of the piping tunnel and the FSV floor slab loadings, such as not including the weight of equipment as a dead load and a wall thickness not matching the as-built dimension. This may lead to incorrect predictions of the facility response due to seismic loading.

Contractor personnel stated that they are developing an Engineering Study Report (ESR) that incorporates the contractor's responses to the staff's questions concerning the structural integrity of KAC. In addition, the ESR will describe a minor revision to the Exhaust Fan Building soil structure interaction calculation where a model dimension did not match the as-built dimension. The ESR will be referenced in the next revision of the Structural Summary Report for KAC.

Fire Protection Program. The DSA credits fire barriers in several areas of the complex as part of the safety basis. Site personnel agreed with the Board's staff team that the DSA could be clarified to identify specific individual barriers that are credited. Also, the DSA identifies some operations that require a Specific Administrative Control that specifies personnel to stand watch with a fire extinguisher available to fight incipient fires. The DSA cites 29 CFR 1910.155, *Fire Protection*, in defining an incipient stage fire as one that can be controlled or extinguished by portable fire extinguishers. Site-wide portable fire extinguisher training is provided to employees; however, there is no hands-on component to the training provided to employees who are performing a fire watch role. 29 CFR 1910.155(c)(41) provides further clarification by defining training as

"the process of making proficient through instruction and hands-on practice in the operation of equipment, including respiratory protection equipment, that is expected to be used and in the performance of assigned duties."

Fire Accident Analyses. During the review of the DSA, the Board's staff team noted some inconsistencies within accident analyses and interpretations of DOE requirements and guidance. In each of the cases identified, site personnel described plans for the next revision to the DSA that would address the concerns raised by the Board's staff team. Revising the accident analysis to address the issues listed below would significantly increase the postulated dose consequences and could result in changes to the classification of some safety structures, systems, and components. However, contractor personnel stated that they plan to make other changes to the accident analysis and do not expect impacts to the current safety control set. The Board's staff team will review these changes when they are available later this calendar year. Specific examples of these inconsistencies include:

- The currently-approved DSA uses leak path factors that are inconsistent with DOE Standard 3009-94, Change Notice No. 3, *Preparation Guide For U.S Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. Specifically with regard to the unmitigated consequence analysis for Assembly Area fires, a leak path factor of 0.01 for leakage due to failure of O-rings is used in the analysis. This contradicts DOE-STD-3009, which states the unmitigated calculation should "take no credit for passive safety features producing a leak path reduction in source term." During the on-site discussions between site personnel and the Board's staff team, site personnel indicated that they were already planning to use a leak path factor of 1 in all of the unmitigated cases in the next DSA revision.

- With regard to venting of pressurized powders from containers of plutonium-bearing material in Assembly Area fire scenarios, the current DSA uniquely derives an airborne release fraction (ARF) and respirable fraction (RF) that are inconsistent with the bounding values published in DOE Handbook 3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*. Site personnel indicated that the new accident analysis for the Assembly Area will utilize the bounding ARF from Handbook 3010, and this will be documented in the next revision of the DSA.

- The DSA uses a reduction factor of 0.25 for the ARF*RF value. This reduction in source term was meant to account for differences between the experiments described in Handbook 3010 and the circumstances in K-Area. However, the basis for the reduction is largely qualitative in nature. For many of the factors or mechanisms identified by the contractor as possibly reducing the source term, there are no specific experimental data available to technically support a reduction in ARF*RF. Site personnel explained that this reduction factor will no longer be used and that a new

accident analysis for Assembly Area fires will supersede the current analysis. Site personnel indicated that the next revision of the DSA will reflect this change.

Emergency Lighting. During the facility walk-down, the Board's staff team did not see evidence of the emergency egress lighting being either seismically supported or seismically qualified, nor were facility personnel able to confirm if the emergency lighting conformed to a seismic qualification standard, such as the Institute of Electrical and Electronics Engineers Standard 344-1987, *Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations*. Section 2.8.1.3, Emergency Lighting System, of the DSA states that "the self-contained emergency lights provide lighting for building habitability, personnel evacuation, and areas that require operator action during an emergency." The DSA categorizes emergency lighting as part of a set of worker safety features which are not Safety Significant structures, systems, and components. The staff noted that along with the life-safety aspect of evacuating the facility in an emergency such as a design basis earthquake/seismic event, several specific administrative controls call for operator action that may be impaired if the emergency lights are compromised. Thus, it would be prudent to confirm that the emergency lighting system could function following a design basis earthquake, and if not, then address any shortcomings as appropriate.