DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004-2901
(202) 694-7000

March 9, 2000

The Honorable Carolyn L. Huntoon
Assistant Secretary for
Environmental Management
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Dr. Huntoon:

The Defense Nuclear Facilities Safety Board (Board) has been closely following the Department of Energy's (DOE) preparations for startup of K-Area Material Storage (KAMS) at the Savannah River Site. For about 2 years, DOE has been modifying the former K-Reactor building (105-K) to start receiving containers of high-assay plutonium from the Rocky Flats Environmental Technology Site (RFETS) in early 2000, and thereby support accelerated deinventory of RFETS. DOE has completed the modifications for KAMS Phase 1 startup and is making progress on those for Phase 2. Based on a satisfactory Operational Readiness Review and subsequent verifications, the DOE Savannah River Operations Office authorized KAMS Phase 1 startup on February 8, 2000.

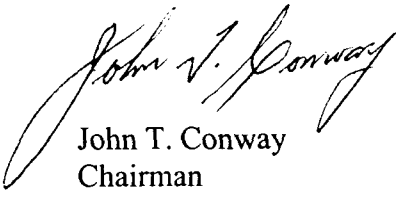
Enclosed for your consideration is an issue report prepared by the Board's staff that reviews the KAMS preparations, safety basis, and readiness for operation. The staff concludes that KAMS is adequate for double-stacked container storage for an interim period, subject to a continuing effort by DOE to resolve the issues identified in this report. This assessment is based on the facility's high-quality containers, robust building structure, new engineered features (e.g., fire walls), and new administrative controls.

However, the staff raises issues related to the longer-term safety and viability of using this aging facility as the largest plutonium storage facility at the Savannah River Site, and perhaps in the DOE complex, for what could be more than a decade. Probably the most significant of these issues are that KAMS has no capability to open, inspect, or repackage containers, and no capability to provide confinement in the unlikely event that one or more containers should fail. KAMS is dependent on other aging facilities at the Savannah River Site for assistance in addressing these issues, but the remaining service life of these facilities is uncertain. None of these facilities has the capability to restore a failed container to compliance with the plutonium storage standard (DOE-STD-3013), which is a requirement in the KAMS authorization basis. Currently, such capability appears to be several years away at the Savannah River Site. The anticipated plutonium disposition facilities might provide these capabilities. Doing so, however, appears outside the mission scope of these facilities; moreover, they will not be ready until 2008 or later.

The staff also identifies the need for a surveillance program to monitor the condition of the containers in KAMS, consistent with the requirements of DOE-STD-3013 and the facility's authorization basis. Finally, since KAMS may be used for longer than 10 years, Building 105-K surveillance and maintenance should be structured accordingly, particularly given the facility's age.

The Board will continue to closely monitor DOE efforts to address these issues. Please feel free to contact me if there are any questions on this matter.

Sincerely,



John T. Conway
Chairman

c: Mr. Mark B. Whitaker, Jr.
Mr. Greg Rudy

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

February 16, 2000

MEMORANDUM FOR: G. W. Cunningham, Technical Director
J. K. Fortenberry, Deputy Technical Director

COPIES: Board Members

FROM: C. H. Keilers, Jr. and R. W. Zavadoski

SUBJECT: K-Area Material Storage Project at Savannah River Site

This report documents an issue reviewed by the staff of the Defense Nuclear Facilities Safety Board (Board). The staff's observations are based on on-site reviews conducted during 1999 and early 2000 by staff members T. Burns, T. Davis, A. Gwal, C. Keilers, J. Roarty, and R. Zavadoski, as well as information provided by the Department of Energy (DOE) and Westinghouse Savannah River Company (WSRC).

For about 2 years, DOE has been converting portions of Building 105-K at the Savannah River Site (SRS) into a major plutonium storage facility, referred to as K-Area Material Storage (KAMS). In December 1999, DOE completed an Operational Readiness Review (ORR) for Phase 1 startup of KAMS. The ORR team recommended that DOE proceed with startup following the resolution of pre-start findings and issues.

Based on progress since then, on February 8, 2000, the DOE Savannah River Operations Office (DOE-SR) authorized KAMS to begin receiving and storing high-assay plutonium from the Rocky Flats Environmental Technology Site (RFETS). Initial receipts are now expected to arrive in mid to late spring. This facility may eventually store several thousand containers for up to 10 years.

The staff agrees that KAMS is ready for Phase 1 startup, but believes improvements to the facility should be pursued, given its age, lack of capabilities to monitor and repackage containers, and lack of capabilities to provide confinement for a damaged container. The staff's specific observations are summarized below.

Background. In early 1998, DOE began to modify 105-K to receive containers of plutonium metal and oxides. DOE stated that KAMS would be used for interim storage for up to 10 years until containers could be transferred to the planned Actinide Packaging and Storage Facility (APSF) at SRS or otherwise dispositioned. In early 1999, DOE decided to defer construction of APSF. It is now uncertain that APSF will be built. KAMS will be the largest plutonium storage facility at SRS (3,300-container capacity), followed by Building 235-F (660-container capacity).

Description. Building 105-K is the former K-Reactor facility and consists of process areas, an assembly area, a spent nuclear fuel disassembly basin, a waste storage area, moderator storage, and a moderator purification area. KAMS occupies mainly the process areas (i.e., process/reactor room, crane wash area, crane maintenance area, and stack area). The plutonium will be stored in DOE-STD-3013 containers within 9975 shipping packages (Type B containers, qualified for off-site shipment). The packages will be banded together, five to a pallet, and stacked two high.

The KAMS safety posture is highly dependent on the containers. Specifically, the inner and outer DOE-STD-3013 containers will provide containment for the stored plutonium, and will be protected from fire, impact, and criticality by a 9975 shipping package. The 9975 package consists of primary and secondary containment vessels, lead shielding, Celotex (fiberboard) packing, and a stainless steel drum. Because of the containers, WSRC believes the dominant 105-K accidents involve events in other facility areas, such as the disassembly area.

DOE intends to start KAMS in two phases, since new fire walls and other modifications in the crane maintenance and stack areas will not be completed in time to support the RFETS deinventory schedule. Phase 1 storage (mainly RFETS metal) will be in the process room, which is separated from the other areas by a new security barrier and fire wall. Phase 2 modifications will need to stop and administrative controls for fire protection will need to be implemented whenever containers are moved from the loading dock to the process room. DOE is also considering increasing KAMS storage capacity by triple-stacking the containers, but this expansion is still preconceptual and beyond the scope of this report.

Safety Basis. In July 1999, DOE-SR approved changes to the 105-K Basis for Interim Operation and the Technical Safety Requirements to allow storage of up to 15 metric tons of weapons-grade plutonium metal and oxide in KAMS. KAMS storage is expected to be limited to plutonium metal until DOE updates the certification of the 9975 shipping containers to include oxides. KAMS safety analyses for oxides also need to be updated to address a broader range of plutonium isotopic distributions, convenience can configurations, and container backfill gases (now assumed to be pure helium). These updates are expected in early spring 2000. Tables 1 and 2 describe the KAMS engineered safety features and administrative controls.

Operational Readiness. In late 1999, WSRC and DOE conducted ORRs for startup of KAMS. Many of the WSRC ORR findings involved organizational interfaces, such as those between the security force and the facility, the security force and non-K-Area emergency responders, the facility and RFETS, and the facility and F-Area. The findings also include the lack of a plan for transporting a damaged shipping package from KAMS to FB-Line (a post-start finding), as well as the lack of an approved shipper-receiver agreement with RFETS (completed in mid-November). WSRC considered its pre-start findings to have been resolved by early December, except those involving security force integration, since the KAMS security force was still in training.

Later in December, the DOE ORR team observed KAMS operations and concluded that the operations had not been well executed by one of the two shifts observed. The ORR team

expressed confidence in the WSRC training process, but believed the proficiency of the fully staffed crew should be demonstrated. The team also observed that WSRC was still evaluating the controls in the job hazard analysis for loading and storing material, and that the Authorization Agreement will need to be approved before startup. The team concluded that the facility had not demonstrated its ability to verify compliance with Technical Safety Requirements for shipping packages because too many operations with outside organizations (e.g., RFETS, DOE) were simulated. The team also concluded that integration with security could not be verified, since the security force was not in place.

During their out-brief to the site, the DOE ORR team stated that they could not confirm readiness because of the issues related to the interface with RFETS, integration with security, and operator proficiency. Subsequently, the ORR team recommended that—after these issues have been resolved and before startup—DOE-SR should direct that an independent validation team observe the entire operation, from shipment authorization through container storage, with minimal simulation.

In January 2000, DOE-SR and WSRC implemented a plan to address the ORR findings and other issues. In mid-January, DOE-SR conducted a limited integrated readiness assessment that observed the entire operation with minimal simulation and with the security force in place. No pre-start issues were identified. Proficiency issues still existed with one shift and are being addressed by remedial training. A potential future issue is that additional facility modifications and container handling may be required to meet requirements imposed by the International Atomic Energy Agency, which are still not defined.

On February 8, 2000, DOE-SR authorized KAMS to receive and store RFETS plutonium in the Phase 1 storage area. The Manager, DOE-SR, and the President, WSRC, also signed an Authorization Agreement permitting KAMS operation.

Staff Observations. The Board's staff has periodically reviewed KAMS Phase 1 modifications, safety analyses, and startup preparations. The staff has also monitored the facility modifications and observed both the contractor and DOE ORRs.

Overall, the staff believes the KAMS safety basis and operations are adequate for an interim period for double-stacked container storage, subject to a continuing effort by DOE to resolve the issues identified in this report. This assessment is based on the facility's high-quality containers (multiple barriers to release), robust building structure (upgraded for K-Reactor operation), new fire walls and other design features, and new administrative controls. The staff reserves judgment on the concept of increasing storage by triple-stacking until more studies on this concept have been completed.

The staff observed several areas requiring improvement at KAMS, listed below. While several of these observations address longer-term concerns, others warrant prompt resolution to ensure that KAMS operations can continue safely.

- KAMS has no capability to open, inspect, or repackage containers. The current plan is to ship any damaged containers to SRS F-Area (i.e., FB-Line), but few details exist. Furthermore, FB-Line cannot repair or replace DOE-STD-3013 containers, and DOE has indicated a preference for shutting FB-Line down in a few years. APSF would have provided the required capability, but it is unlikely to be built, and the proposed plutonium disposition facilities would be available far too late to address this need.

- WSRC believes the possibility of a damaged DOE-STD-3013 container to be remote, and views the primary concern as criticality, not plutonium release. The staff agrees that the containers are expected to be highly reliable; however, it would be prudent to provide KAMS with the capability and procedures necessary to address a small number of leaky containers as an immediate response. Plans are also needed for shipping these containers to F-Area and dispositioning them there, consistent with the WSRC post-start finding.

- Given the high reliance on containers for safety, the staff believes there is a need to develop technically rational surveillance and maintenance programs for both the DOE-STD-3013 containers and the 9975 shipping containers. The KAMS administrative controls require a container surveillance program, but such a program has not yet been developed.

  - Few failure modes have been identified for a properly fabricated DOE-STD-3013 container; however, some of the several thousand containers could have unidentified flaws that would result in premature failure. Furthermore, DOE-STD-3013 specifically requires a technically justified surveillance program.

  - The shipping qualification for the 9975 container is valid for only 2 years, and the Celotex and the elastomer seals within the container may be subject to thermal degradation for a longer period during storage in the expected warm environment in KAMS. Such degradation could affect the safety margin to criticality, missile and fire protection, and secondary confinement (i.e., the seals).

- SRS's criticality analyses assume that overbatching of containers by RFETS will not exceed 1 kg. Expediting the planned startup of material control and accountability (MC&A) equipment, primarily the neutron multiplicity counter in KAMS, would increase confidence that this assumption will not be violated. DOE currently plans to begin receiving containers before this counter starts up, and to perform the counting at some future date. Expediting startup of this operation would also reduce risk and exposure of workers by minimizing double-handling of containers.

- Given delays in both the APSF and fissile material disposition projects, the staff believes it is likely that KAMS will be used for longer than 10 years. Through inventory control, WSRC intends to ensure that each 9975 container is limited to 10 years of service. However, since 105-K is already about 45 years old, an enhanced

facility surveillance and maintenance program appears warranted. Such a program could reduce risk by identifying emerging hazards, such as growth of existing roof cracks or increased fire potential due to aging electrical equipment.

- A large inventory of combustible electrical equipment and a heavy hoist (a missile hazard) reside in the actuator tower above the process room. Although WSRC has made a commendable effort to isolate this area from KAMS, it may be worthwhile in the longer term to reduce the inventory of combustibles and remove the heavy hoist. In the near term, periodic roving watch coverage of this area may be advisable.

- While security operations are outside the scope of the present review, the staff believes integration of security and KAMS operations has safety implications and generally warrants review during the ORR process. As noted, such a review was not performed because the security force was not yet in place. DOE has verified the operations-security interface independently. A related issue is the interface between the security force and the fire department, whose improper execution could result in delayed response to a medical emergency. Prompt resolution of this issue is warranted in the interest of worker safety.

- Current KAMS procedures require that receipt inspections be performed inside the Phase 1 vault area. Eventually, as the vault fills up, this practice could result in bringing a number of unconfirmed containers into close proximity with a large inventory of plutonium already in the vault. Since this situation could introduce a new hazard, the staff believes it would be prudent to eventually move receipt inspections to another location.

- Results of a recent WSRC engineering evaluation on expanded storage indicate that stronger pallets may be needed if triple-stacking is pursued. It may be worthwhile to begin using the stronger pallets in advance of the decision to triple-stack. Doing so would eliminate the risks and worker exposure to radiation associated with transferring containers in KAMS to stronger pallets at some future date.

Table 1. KAMS Engineered Safety Features

KAMS Design Feature	Description
9975 Type B shipping containers	Prevent plutonium release during fires, impacts, and falling structural debris. Consist of the following (from the inside out): inner and outer DOE-STD-3013 containers (both seal-welded), primary and secondary containment vessels (both screw-lid with double o-rings), a lead shield, Celotex fiberboard packing, and a 35-gallon stainless steel drum. The containers are the sole containment during normal and accident conditions. The facility safety basis relies on conditions (e.g., fire, impact, criticality) not exceeding those for Type B qualification for off-site shipment.
Existing concrete reactor building	Credited for external hazards. No credit is taken for containment or confinement. Constructed in the 1950s to withstand high blast loads (e.g., 1,000 psf on walls). Evaluated in the early 1990s for natural phenomena hazards to support K-Reactor restart. Roof is being resealed to prevent water intrusion.
Seismic restraints for overhead equipment	The 120-ton crane and the charge and discharge machine have been parked and restrained to prevent them from falling on 9975 containers during an earthquake.
Shortened stack	Existing stack is susceptible to spallation under high wind, which would lead to debris impacting the rooftop, in turn causing secondary debris from the inside face of the roof to fall on containers. During 1999, the stack was shortened by 70 ft to reduce the size of any secondary debris and decrease the possibility of container damage.
New 2-hour fire walls	Provide separation between KAMS and the purification area, assembly area, forklift/pallet truck battery charging station, and truck dock. New truck dock concrete wall provides a missile shield. Walls are required to meet seismic requirements (Performance Category 3).
Actuator Tower modifications	Penetrations between the Actuator Tower and KAMS have been grouted, a large roof vent has been installed, and structural steel is being coated with fire-proofing. These upgrades address an accident scenario involving a fire that initiates in a passageway, propagates through the ventilation duct to the Actuator Tower, and from there to KAMS.
Fork lift and pallet truck	Design includes weight, speed, and lift height restrictions, as well as Underwriters Laboratories (UL) requirements to ensure that a battery explosion would be self-contained.
Discharge and Exit Canal cover and rails	Credited to keep containers off the cover and out of the canal water and thereby maintain high margin to criticality.
Material Control and Accountability Instrument Room	Located in the crane wash area. Walls meet seismic requirements and provide shielding. To address a fire scenario, the Neutron Multiplicity Counter plastic shielding is encapsulated, and internal electrical wires and components are shielded.

Table 2. Representative KAMS Administrative Controls

Program or Control	Description
Limiting Condition of Operation (LCO)	If a 9975 package is damaged or unauthorized (e.g., noncompliant), stop container and moderator movement within 2 m of a suspect package. Develop response plan within 24 hr.
Receipt and Shipping Program	Review shipping documentation and confirm: • Material is contained within a 9975 shipping package (includes DOE-STD-3013 container). • Mass of contained materials is within DOE-STD-3013 requirements. • Heat generation is less than 19 watts per container. • Water in a 9975 Primary Containment Vessel (PCV) is less than 30 mg/g Pu oxides. • No water permitted in the PCV for metal. • Plastic reflector within the PCV is less than or equal to 100 g.
Material Storage Program	Receipt inspection is required (i.e., checking for authorization, contamination, and container damage). Opening of containers in K-Area is prohibited. Limits are placed on the number of containers in each room: process room (1200), crane maintenance area (1500), stack area (600). Limits are also placed on the number of containers per pallet (5) and the pallet stack height (2). Inventory control shall ensure that no container exceeds the 10-year authorized storage. Also, containers shall undergo a periodic surveillance, with statistically based frequency, sample population, and container selection. A minimum separation is specified between containers and uncontained fissile/fissionable material (2 m of air or 0.6 m of concrete). Neutron sources are prohibited unless specifically authorized. Only the transport vehicle, forklift, and pallet truck are permitted in the truck unloading area when containers are nearby. The driver of a transport vehicle shall be in the vehicle, and prepared to disconnect the tractor and remove it in the event of a fire. A qualified fire watch is required during loading and unloading of the transport vehicle and shall visually inspect the vehicle before operations commence.
Fire Protection Program	Transient combustibles are limited to 20 lb equivalent plastic within a 6 ft diameter area to maintain fire loading within the 9975 container qualification.