



Department of Energy

Washington, DC 20585

SAFETY EVALUATION REPORT for Revision 14 of the Safety Analysis Report for Packaging for the 9975 Package

Docket 03-1-9975

Chapter 1. General Information

This Safety Evaluation Report (SER) covers the staff's findings regarding the review of the 9975 Safety Analysis Report for Packaging (SARP) Revision 14 (References 1 - 3). This section of the SER covers the review of the general information provided in Chapter 1 of the SARP. Specifically, the review encompassed assessing the transportation safety impact of using the 9975 package to transport the following contents:

- Plutonium Composites per Table 1.18 of the SARP,
- Plutonium/Tantalum Composites per Table 1.19 of the SARP,
- Uranium Metal per Tables 1.20 of the SARP, and
- The use of a DOE-STD-3013 alternate spacer packaging configuration per Figure 1.11(i).

The results of the transport safety assessment of each proposed change are discussed below.

Plutonium Composites

The allowable isotopic composition and mass limits given by Table 1.18 – *9975 Package – Plutonium Composites* (pg.1-52c) of Revision 14 (dated October 2002) to the SARP are within the corresponding Contents K specification in Chapters 5 and 6. The maximum mass of the ²³⁹Pu material is limited by criticality considerations in conjunction with the maximum allowable mass of beryllium and vanadium. These mass limits of material result in exposures within the limits imposed by 10 CFR Part 71.

The contents are composites of plutonium/beryllium and plutonium/vanadium that are not homogeneously mixed. A maximum of 50 pieces of composite material is permitted within a package. Each piece is limited to a minimum mass of 50 grams and shall be processed in accordance with DOE-STD-3013.

Plutonium/Tantalum Composites

The allowable isotopic composition and mass limits given by Table 1.19 – *9975 Package – Plutonium/Tantalum Composites* (pg.1-52d) of Revision 14 (dated October 2002) to the SARP are within the corresponding Contents L specification in Chapters 5 and 6. For the contents given in Table 1.19, plutonium and tantalum are assumed to be physically separated with the maximum



plutonium mass limited to 2 kilograms and the maximum tantalum mass limited to 6 kilograms. These mass limits of material result in exposures that are bounded by Table 1.18 and within the limits imposed by 10 CFR Part 71.

Each composite piece is limited to a minimum mass of 50 grams and shall be processed in accordance with DOE-STD-3013.

Uranium Metal

The contents allowed by Table 1.20 - *9975 Package – Uranium Metal* (pg. 1-52e) of Revision 14 (dated October 2002) to the SARP are within the corresponding Content M specification in Chapters 5 and 6. The mass limits of material result in exposures that are within the limits imposed by 10 CFR Part 71.

DOE-STD-3013 Alternate Spacer Packaging Configuration

This is an alternate packaging configuration that utilizes a shortened version of the top spacer and a bottom ring to fill the primary containment vessel (PCV) cavity when shipping an outer 3013 container in 9975 packages with serial numbers 1301 – 2750. The configuration of the PCV with this alternate configuration is shown in Figure 1.11(i), *BNFL3013 Oxide Container Configuration with Alternate Spacer Details*. The alternate spacer configuration can be used with all 3013 packaging configurations for the specified packages.

The shortened 3013 top spacer is 10.63 cm (4.185 inches) in height with a nominal outside diameter of 12.5 cm (4.92 inches) and inside diameter of 11.13 cm (4.38 inches). The bottom ring is 1.27 cm (0.5 inches) in height with a nominal outside diameter of 11.43 cm (4.5 inches) and inside diameter of 8.64 cm (3.4 inches). The design and dimensions of these spacers are shown in Drawing R-R2-F-0037, *ALTERNATE 3013 SPACER COMPONENTS - DETAILS*.

Findings

Based on the review of the statements and representations in the SARP and the application, the staff concludes the package design has been adequately described to meet the requirements of 10 CFR Part 71, as long as the contents meet the conditions set forth below.

Conditions of Approval

Plutonium Composites

- A maximum of 50 pieces of plutonium composite material (beryllium and vanadium) is permitted within a package.
- Each piece is limited to a minimum mass of 50 grams.
- The contents shall be processed in accordance with DOE-STD-3013.

Plutonium/Tantalum Composites

- Each composite piece is limited to a minimum mass of 50 grams.
- The contents shall be processed in accordance with DOE-STD-3013.

Uranium Metal

Individual pieces shall have thicknesses greater than 1.0 mm (0.04 in.) and have specific surface areas less than 1 cm²/g (71 in²/lb).

DOE-STD-3013 Alternate Spacer Packaging Configuration

The alternate top spacer and bottom ring for the PCV cavity shall be the only configuration used when shipping outer 3013 containers in 9975 packages with serial numbers 1301 – 2750.

Chapter 2. Structural Evaluation

This section covers the structural evaluation of using the 9975 package to transport the following contents:

- Plutonium Composites per Table 1.18 of the SARP,
- Plutonium/Tantalum Composites per Table 1.19 of the SARP,
- Uranium Metal per Tables 1.20 of the SARP, and
- A DOE-STD-3013 alternate spacer packaging configuration.

The results of the structural evaluation of each the proposed contents are discussed below.

Plutonium Composites

The total content mass in the primary containment vessel, including packing material, shipped in a 9975 package for content allowed by Table 1.18 is less than the limiting mass of 20.1 kilograms given in Table 2.3 (pg. 2-14) of the SARP. No new structural evaluation is needed.

Plutonium/Tantalum Composites

The total content mass in the primary containment vessel, including packing material, shipped in a 9975 package for content allowed by Table 1.19 is less than the limiting mass of 20.1 kilograms given in Table 2.3 (pg. 2-14) of the SARP. No new structural evaluation is needed.

Uranium Metal

The total content mass in the primary containment vessel, including packing material, shipped in a 9975 package for content allowed by Table 1.20 is less than the limiting mass of 20.1 kg given in Table 2.3 (pg. 2-14) of the SARP. No new structural evaluation is needed.

DOE-STD-3013 Alternate Spacer Packaging Configuration

Although the designer of the new, alternate 3013 spacers believes that the spacer change is structurally insignificant, the change does alter significantly the load path from the 3013 can to the PCV bottom shell during a bottom-end drop of the package. Prior to the change, the inertial or impact load of the 3013 can and its content is transmitted through the entire honeycomb and is deposited onto the entire PCV bottom shell. However, after the addition of the spacer ring under the 3013 can, the load is transmitted mainly through a small honeycomb area directly under the spacer ring. Thus the impact load on the PCV will become more intense with the addition of the

spacer ring. In effect, the spacer ring can act like a “cookie cutter” which may be able to punch through the PCV bottom shell during a bottom-end drop of the 9975 package.

For the above reason, Westinghouse-SRS submitted two structural analyses (References 4 and 5) in support of the change in the 3013-content spacer system (Reference 6). These analyses evaluated the structural integrity of the PCV under a 30-ft bottom-end drop condition of the 9975 package. In the reviewer's opinion, these analyses, due to their extremely conservative approach, give adequate indication that the alternate 3013 spacer packaging configuration will not jeopardize the structural integrity of the PCV, and is, therefore, acceptable. Details of the review and consideration follow.

Using the results of two existing finite-element impact analyses, References 4 and 5 indirectly evaluated the possible detrimental effect of the spacer ring on the structural integrity of the PCV during a 30-ft bottom-end drop. The evaluation is indirect because the spacer ring is not included in the analytical models. In the first analysis (Reference 4), the 3013 can and the PCV are separated by a solid aluminum piece in place of the honeycomb while in the second analysis (Reference 5) the 3013 can and the PCV are in direct contact without the honeycomb. In addition, for the second analysis, the content mass, which is greater than the combined mass of the 3013 can and the PCV, is not realistically modeled and distributed. Instead, to simulate the missing impact energy of the content and other package components, which are not represented in the analytical model, the drop height for the analysis is raised to 140 ft from the 30-ft regulatory requirement. For additional conservatism, the models in both analyses assume the PCV impacts the rigid target directly without the protection of the impact limiter or overpack. The results of both analyses clearly demonstrated the “cookie cutter” effect on the PCV bottom shell near the PCV cylinder skirt. The maximum local plastic strain of 33% at the location is very near the failure strain of 34% for the PCV material (304 stainless steel). The deformed-geometry plot of the 3013 can from the second analytical model, however, also clearly showed the consequence of an unrealistic distribution of the content mass. The bottom shell of the 3013 can appeared to be undeformed by the impact, while the PCV bottom shell showed excessive deformation. Thus a proper modeling of the “cookie cutting” action due to the content mass is not assured. However, due to the extreme conservative assumptions of the impact condition (large drop height and without impact limiter), the analysis results should be usable to indicate that adding the spacer ring under the 3013 can will not jeopardize the structural integrity of the PCV.

Findings

Based on review of the statements and representations in the SARP and the application, the staff concludes that the structural design has been adequately described and evaluated and that the package design meets the structural requirements of 10 CFR Part 71, provided it meets the following conditions.

Conditions of Approval

- The maximum weight of the contents, including the fill material and any confinement of the ensemble of the contents, must be less than 20.1 kilograms.

- The alternate top spacer and bottom ring for the PCV cavity shall be the only configuration used when shipping a 3013 container in a 9975 package with a serial number of 1301 – 2750. The alternate spacer configuration can be used with all 3013 containers.

Chapter 3. Thermal Evaluation

This section covers the thermal evaluation of using the 9975 package to transport the following contents:

- Plutonium Composites per Table 1.18 of the SARP,
- Plutonium/Tantalum Composites per Table 1.19 of the SARP,
- Uranium Metal per Tables 1.20 of the SARP, and
- A DOE-STD-3013 alternate spacer packaging configuration.

The results of the thermal evaluation of each the proposed contents are discussed below.

Plutonium Composites

Table 1.18 of the SARP gives the isotopic composition of plutonium in composite with beryllium and vanadium. The limiting decay heat load is 19 watts given in Table 1.2 on page 1-37 of the SARP for the 9975 package. This limit on the decay heat load restricts the mass of ^{238}Pu to be less than 33 grams, which is greater than the allowed 2.2 grams of ^{238}Pu in Table 1.18. The heat generated by the allowed maximum mass of ^{239}Pu of 4.4 kilograms is within the decay heat load limit of 19 watts for the 9975 package.

The maximum temperatures of the 9975 package components with the contents bound by Table 1.18 will be less than the temperatures given in Table 3.3 for normal conditions of transport with a decay heat rate of 19 watts. The maximum pressure in the 9975 primary containment vessel for the contents bound by Table 1.18 will be less than the pressure given in Table 3.5 for a decay heat rate of 19 watts.

The maximum temperatures of the 9975 package components with the contents bound by Table 1.18 will be less than the temperatures given in Table 3.4 for a hypothetical accident condition fire with a decay heat rate of 19 watts. The maximum pressure in the 9975 primary containment vessel for the contents bound by Table 1.18 will be less than the pressure given in Table 3.6 for a decay heat rate of 19 watts.

Plutonium/Tantalum Composites

Table 1.19 of the SARP gives the isotopic composition of plutonium in composite with tantalum. The limiting decay heat load is 19 watts given in Table 1.2 on page 1-37 of the SARP for the 9975 package. This limit on the decay heat load restricts the mass of ^{238}Pu to be less than 33 grams, which is greater than the allowed 1 gram of ^{238}Pu in Table 1.19. The heat generated by the allowed maximum mass of ^{239}Pu of 2.0 kilograms is within the decay heat load limit of 19 watts for the 9975 package.

The maximum temperatures of the 9975 package components with the contents bound by Table 1.19 will be less than the temperatures given in Table 3.3 for normal conditions of transport with a decay heat rate of 19 watts. The maximum pressure in the 9975 primary containment vessel for the contents bound by Table 1.19 will be less than the pressure given in Table 3.5 for a decay heat rate of 19 watts.

The maximum temperatures of the 9975 package components with the contents bound by Table 1.19 will be less than the temperatures given in Table 3.4 for a hypothetical accident condition fire with a decay heat rate of 19 watts. The maximum pressure in the 9975 primary containment vessel for the contents bound by Table 1.19 will be less than the pressure given in Table 3.6 for a decay heat rate of 19 watts.

Uranium Metal

Table 1.20 of the SARP gives the isotopic composition of uranium metal. The limiting decay heat load is 19 watts as given in Table 1.2 on page 1-37 of the SARP for the 9975 package. The heat generated by the allowed maximum mass of uranium 13.5 kg is within the decay heat load limit of 19 watts for the 9975 package.

The maximum temperatures of the 9975 package components with the contents bound by Table 1.20 will be less than the temperatures given in Table 3.3 for normal conditions of transport with a decay heat rate of 19 watts. The maximum pressure in the 9975 primary containment vessel for the contents bound by Table 1.20 will be less than the pressure given in Table 3.5 for a decay heat rate of 19 watts.

The maximum temperatures of the 9975 package components with the contents bound by Table 1.20 will be less than the temperatures given in Table 3.4 for a hypothetical accident condition fire with a decay heat rate of 19 watts. Similarly, the maximum pressure in the 9975 primary containment vessel for the contents bound by Table 1.20 will be less than the pressure given in Table 3.6 for a decay heat rate of 19 watts.

However, uranium metal pieces with very small dimensions can spontaneously oxidize in normal atmospheric conditions. Such spontaneous oxidation may increase the heat load. Therefore, minimum dimensions and specific surface areas are required to limit spontaneous oxidation. These values are specified by DOE-STD-3013 as thicknesses greater than 1.0 mm (0.04 in.) and specific surface areas less than 1 cm²/g (71 in²/lb).

DOE-STD-3013 Alternate Spacer Packaging Configuration

There are no 3013 alternate spacer packaging configuration specific thermal requirements for the specified 9975 packages.

Findings

Based on review of the statements and representations in the SARP and the application, the staff concludes the thermal design has been adequately described and evaluated, and that the thermal

performance of the package meets the thermal requirements of 10 CFR Part 71, as long as the uranium metal meets the condition set forth below.

Conditions of Approval

Individual pieces shall have thicknesses greater than 1.0 mm (0.04 in.) and have specific surface areas less than 1 cm²/g (71 in²/lb).

Chapter 4. Containment

This section covers the containment-related aspects of using the 9975 package to transport the following contents:

- Plutonium Composites per Table 1.18 of the SARP,
- Plutonium/Tantalum Composites per Table 1.19 of the SARP,
- Uranium Metal per Tables 1.20 of the SARP, and
- A DOE-STD-3013 alternate spacer packaging configuration.

The results of the containment-related safety assessment of each the proposed contents are discussed below.

Plutonium Composites

A maximum of 50 pieces of plutonium composite material is permitted within a package. Each piece is limited to a minimum mass of 50 grams and shall be processed in accordance with DOE-STD-3013.

Plutonium/Tantalum Composites

Each plutonium/tantalum composite piece is limited to a minimum mass of 50 grams and shall be processed in accordance with DOE-STD-3013.

Uranium Metal

There are no uranium metal specific containment requirements for the 9975 package.

DOE-STD-3013 Alternate Spacer Packaging Configuration

There are no 3013 alternate spacer packaging configuration specific containment requirements for the specified 9975 packages.

Findings

Based on review of the statements and representations in the SARP and the application, the staff concludes the containment design has been adequately described and evaluated, and that the package design meets the containment requirements of 10 CFR Part 71.

Conditions of Approval

None.

Chapter 5. Shielding Evaluation

This section covers the shielding evaluation of using the 9975 package to transport the following contents:

- Plutonium Composites per Table 1.18 of the SARP,
- Plutonium/Tantalum Composites per Table 1.19 of the SARP,
- Uranium Metal per Tables 1.20 of the SARP, and
- A DOE-STD-3013 alternate spacer packaging configuration.

The results of the shielding evaluation for each of the proposed contents are discussed below.

Plutonium Composites

The isotopic composition of the plutonium composite material is within the envelope of allowable isotopic composition given for Contents K, Table 5.8 (pg. 5-23) of the SARP. From Table 5.1 (pg. 5-4) of the SARP, the plutonium composite material mass limit of 4.4 kilograms of Contents K results in radiation dose rates from the 9975 package that are less than the 10 CFR Part 71 limits for normal conditions of transport.

The results of the confirmatory shielding calculations on plutonium/beryllium composite contents of Table 1.18 concluded that an increase in the contact surface area between these materials would significantly increase the neutron dose rate at the 9975 package surface. The shielding evaluation presented in the submittal is based on the contact surface area of 50 pieces of these composite materials, each with the same cross sectional area of the can. The confirmatory calculations show that a small amount of these materials (~1%), if allowed to form a homogeneous mixture, could produce the same neutron production rate as the maximum mass of these undamaged composite materials. The submittal, however, does not consider powder formation or any increase in contact surface area as a result of NCT or HAC.

An investigation of whether the normal conditions of transport and/or hypothetical accident conditions can cause any portion of the plutonium/beryllium composite (Content K) to break down into dust, powder, rubble, etc. was pursued. The results of this investigation indicate that for NCT there appears insufficient vibration or impact to cause a significant increase in contact surface area of these composite materials (the NCT condition of most concern being the four-foot drop). However, for HAC, the material properties and configuration of these materials are such that significant increases in contact surface area cannot be precluded. Detailed analyses or testing would require significant time and resources.

The neutron dose rate is dependent on the contact surface area between plutonium and beryllium, and the formation of powder, dust, and/or rubble during HAC would result in an increase in the contact surface area, which would increase the neutron production rate due to more alpha-n reactions. This situation could lead to an increase in the dose rate beyond 10 CFR Part 71 limits.

Therefore, for the plutonium/beryllium contents allowed by Table 1.18, any 9975 package that is subjected to an impact condition beyond that described in 10 CFR 71.71, Normal Conditions of Transport, shall be surveyed for neutron dose rate prior to contact or handling.

The dose rate for the plutonium/beryllium composite material bounds the dose rate for the plutonium/vanadium composite material because vanadium does not produce an extra neutron source by alpha-n reactions.

Plutonium/Tantalum Composites

The isotopic composition of the plutonium/tantalum composite material is bounded by the envelope of allowable isotopic compositions given for Contents K, Table 5.8 (pg. 5-23) of the SARP. From Table 5.1 (pg. 5-3) of the SARP, the plutonium mass limit of 2.0 kilograms results in radiation dose rates from the 9975 package that are bounded by the radiation dose rates for Contents K and are less than the 10 CFR Part 71 limits for both normal conditions of transport and for hypothetical accident conditions for non-exclusive use shipments.

Uranium Metal

There is no shielding analysis in Chapter 5 for the uranium metal allowed by Table 1.20 of the 9975 SARP and identified as Contents M (13.5 kg U). The text of Chapter 5 regarding Contents M consists only of a statement on pages 5-36v – 5-36w regarding the DT22 material (which includes Contents M) that says, “Only the first (Pu/Be composites) is analyzed since the other compositions do not include materials capable of increasing the neutron source.” In addition, there appears to be a fair amount of confusion in the tables in Chapter 5 concerning Contents M. The column of radiation dose rates given in Table 5.7 (pg 522) for Contents C indicates in a footnote that Contents C “Also bounds Contents M” in these dose rate values. These values are the values given in Table 5.1 (pg 5-3) for the 9975 package Contents C of 4,400 grams, which is significantly less than the 13.5-kg mass that Table 1.20 allows for Contents M. Furthermore, the dose rates reported in Table 5.1 for Contents M are identical to those from Contents C for the 9973 package, which also has the lower mass limit of 4,400 grams U. It appears that the values listed for Contents M in Table 5.1 (pg 5-3) were copied directly from those listed for Contents C for the 9973 from the same table (Table 5.1, pg 5-3).

Despite the confusion, the staff conducted confirmatory evaluations and comparisons of the isotopic contents allowed by Table 1.20 (pg 1-52e) of the SARP with other contents for the 9972-9975 packages [Contents F of Table 5.1 (pg. 5-3)] of the SARP. These evaluations indicate that the uranium metal mass limit of 13.5 kg will result in radiation dose rates from the 9975 package that are less than the 10 CFR Part 71 limits for both normal conditions of transport and for hypothetical accident conditions for non-exclusive use shipments.

DOE-STD-3013 Alternate Spacer Packaging Configuration

There are no 3013 alternate spacer packaging configuration specific shielding requirements for the specified 9975 packages.

Findings

Based on the review and confirmatory calculations of the plutonium/beryllium isotopic contents allowed by Table 1.18, the staff concludes that the shielding design is adequate for this contents as long as the plutonium/beryllium contents meets the condition set forth below.

Based on the review of the plutonium/vanadium isotopic contents allowed by Table 1.18 and the isotopic content allowed by Table 1.19, the staff concludes that the shielding design is adequate for these contents and that the package meets the external radiation dose requirements of 10 CFR Part 71 for both normal conditions of transport and for hypothetical accident conditions.

While the submittal did not provide a shielding evaluation of the 9975 for the isotopic contents allowed by Table 1.20 (pg 1-52e) of the SARP, comparisons and confirmatory evaluations conducted during the review have led the staff to conclude that the shielding design is adequate for this contents and that the package meets the external radiation dose requirements of 10 CFR Part 71 for both normal conditions of transport and for hypothetical accident conditions.

Conditions of Approval

Plutonium Composites

For the contents allowed by Table 1.18, the post-loading combined neutron and gamma dose rate measurement at the drum surface may not exceed the limits of 10 CFR Part 71. In addition, for the contents allowed by Table 1.18, any 9975 package that is subjected to an impact greater than that of a four-foot drop shall be surveyed for neutron dose rate prior to contact or handling.

Plutonium/Tantalum Composites

For the contents allowed by Table 1.19, the post-loading combined neutron and gamma dose rate measurement at the drum surface may not exceed the limits of 10 CFR Part 71.

Uranium Metal

For the contents allowed by Table 1.20, the post-loading combined neutron and gamma dose rate measurement at the drum surface may not exceed the limits of 10 CFR Part 71.

DOE-STD-3013 Alternate Spacer Packaging Configuration

None.

Chapter 6. Criticality Evaluation

This section covers the criticality evaluation of using the 9975 package to transport the following contents:

- Plutonium Composites per Table 1.18 of the SARP,
- Plutonium/Tantalum Composites per Table 1.19 of the SARP,
- Uranium Metal per Tables 1.20 of the SARP, and
- A DOE-STD-3013 alternate spacer packaging configuration.

The results of the criticality evaluation for each the proposed contents are discussed below.

Plutonium Composites

The isotopic composition of the plutonium composite material is within the envelope of allowable isotopic composition given for Envelope K, Tables 6.12a and 6.13(cont.) (pg. 6-31a and 6-32a) of the SARP. From Tables 6.18b and 6.19a (pg. 6-51c and 6-51g) of the SARP, the plutonium/beryllium/vanadium composite material mass limit of 4.4 kilograms of Envelope K results in k_{eff} values for the single unit less than the calculated k_{safe} value accounting for the uncertainty in modeling and benchmarking. These k_{eff} values for the single 9975 package are less than the 10 CFR Part 71 limits for normal conditions of transport.

From Table 6.19c (pg. 6-51i) of the SARP, the plutonium/beryllium/vanadium composite material mass limit of 4.4 kilograms results in k_{eff} values for the arrays less than the calculated k_{safe} value accounting for the uncertainty in modeling and benchmarking. These k_{eff} values for arrays of 9975 packages are less than the 10 CFR Part 71 limits for hypothetical accident conditions.

Plutonium/Tantalum Composites

The isotopic composition of the plutonium/tantalum composite material is within the envelope of allowable isotopic composition given for Envelope L, Tables 6.12a and 6.13(cont.) (pg. 6-31a and 6-32a) of the SARP. From Table 6.18b (pg. 6-51c) of the SARP, the plutonium/tantalum composite material mass limit of 8.0 kilograms of Envelope L results in k_{eff} values for the single unit less than the calculated k_{safe} value accounting for the uncertainty in modeling and benchmarking. The k_{eff} values from Table 6.19a (pg 6-51g) bound the k_{eff} values for the plutonium/tantalum composite material. These k_{eff} values for the single 9975 package are less than the 10 CFR Part 71 limits for normal conditions of transport.

From Table 6.19d (pg. 6-51j) of the SARP, the plutonium/tantalum composite material mass limit of 8.0 kilograms results in k_{eff} values for the arrays less than the calculated k_{safe} value accounting for the uncertainty in modeling and benchmarking. These k_{eff} values for arrays of 9975 packages are less than the 10 CFR Part 71 limits for hypothetical accident conditions.

Uranium Metal

The isotopic composition of the Uranium Metal is within the envelope of allowable isotopic compositions given for Envelope M, in Tables 6.12a and 6.13 (cont.) (pg 6-31a and 6-32a) of the SARP. From Table 6.18b and 6.19b (pg 6-51c and 6-51h) of the SARP, the Uranium Metal mass limit of 13.5 kg of Envelope M results in k_{eff} values for the single unit less than the calculated k_{safe} value accounting for the uncertainty in modeling and benchmarking.

The single unit cases for Contents M in Table 6.18b (cases 8, 9 and 10) in the criticality evaluation did not, however, include what appears to be the most reactive case: the flooded case with the 3013 container. For the dry cases, the k_{eff} with the 3013 container (case 9) is 0.023 higher than the k_{eff} without the 3013 container (case 8). The flooded case, without the 3013 container (case 10), is higher than either dry case.

While the 3013 container is not required for the Uranium Metal contents, inspection of the cases for Pu, with and without the 3013 container, including 30 cm of water reflection, shows a similar difference in k_{eff} values and bounds the Uranium Metal values. Based on these comparisons, it is concluded that the k_{eff} value for the uranium case with a flooded 3013 container will not exceed the k_{safe} value.

From Table 6.19a (pg. 6-51h) of the SARP, the Uranium Metal mass limit of 13.5 kg results in k_{eff} values for the arrays less than the calculated k_{safe} value, accounting for the uncertainty in modeling and benchmarking. These k_{eff} for arrays of 9975 packages are less than the 10 CFR Part 71 limits for normal conditions of transport.

From Table 6.19e (pg. 6-51k) of the SARP, the Uranium Metal mass limit of 13.5 kg results in k_{eff} values for the arrays less than the calculated k_{safe} value, accounting for the uncertainty in modeling and benchmarking. These k_{eff} for arrays of 9975 packages are less than the 10 CFR Part 71 limits for hypothetical accident conditions.

DOE-STD-3013 Alternate Spacer Packaging Configuration

There are no 3013 alternate spacer packaging configuration specific criticality requirements for the specified 9975 packages.

Findings

Based on the review and confirmatory calculations of the isotopic contents allowed by Tables 1.18, 1.19, and 1.20, the staff concludes the criticality safety design of the 9975 meets the nuclear criticality safety requirements of 10 CFR Part 71.

Conditions of Approval

None.

Chapter 7. Operating Procedures

This section covers the operating procedures aspects of using the 9975 package to transport the following contents:

- Plutonium Composites per Table 1.18 of the SARP,
- Plutonium/Tantalum Composites per Table 1.19 of the SARP,
- Uranium Metal per Tables 1.20 of the SARP, and
- A DOE-STD-3013 alternate spacer packaging configuration.

The results of the transportation-related safety assessment of each the proposed contents are discussed below.

Plutonium Composites

For hypothetical accident conditions, the material properties and configuration of the plutonium/beryllium composite materials are such that significant increases in contact surface area cannot be precluded. Significant increases in the contact surface area can lead to an increase in the neutron production rate due to more alpha-n reactions.

Plutonium/Tantalum Composites

There are no plutonium/tantalum composite specific operating procedure requirements for the 9975 package.

Uranium Metal

There are no uranium metal specific operating procedure requirements for the 9975 package.

DOE-STD-3013 Alternate Spacer Packaging Configuration

The shipper must ensure that only the 3013 packaging configuration shown in Figure 1.11(i) is used with 9975 packages having serial numbers 1301-2750.

Findings

Based on review of the statements and representations in the SARP and the application, the staff concludes the operating controls and procedures for the package are adequate as long as they meet the conditions set forth below.

Conditions of Approval

Plutonium Composites

For the contents allowed by Table 1.18, any 9975 package that is subjected to an impact greater than that of a four-foot drop shall be surveyed for neutron dose rate prior to contact or handling.

Plutonium/Tantalum Composites

None.

Uranium Metal

None.

DOE-STD-3013 Alternate Spacer Packaging Configuration

When shipping 3013 containers in 9975 packages with serial number 1301-2750, the shipper must ensure that the PCV honeycomb and bottom ring spacer are in place before loading the 3013 container and the shortened top ring spacer is placed on top of the 3013 container before installing the PCV cone seal. This is the only configuration permitted when shipping 3013 containers in these particular packages.

Chapter 8. Acceptance Tests and Maintenance

This section covers the acceptance tests and maintenance aspects of using the 9975 package to transport the following contents:

- Plutonium Composites per Table 1.18 of the SARP,
- Plutonium/Tantalum Composites per Table 1.19 of the SARP,
- Uranium Metal per Tables 1.20 of the SARP, and
- A DOE-STD-3013 alternate spacer packaging configuration.

The results of the transportation-related safety assessment of each the proposed contents are discussed below.

Plutonium Composites

There are no plutonium composite specific acceptance test or maintenance requirements.

Plutonium/Tantalum Composites

There are no plutonium/tantalum composite specific acceptance test or maintenance requirements.

Uranium Metal

There are no uranium metal specific acceptance test or maintenance requirements.

DOE-STD-3013 Alternate Spacer Packaging Configuration

There are no 3013 alternate spacer packaging configuration specific acceptance test and maintenance requirements for the specified 9975 packages.

Findings

Based on review of the statements and representations in the SARP and the application, the staff concludes that the acceptance tests for the packaging meet the requirements of 10 CFR Part 71 and that the maintenance program is adequate to assure the packaging performance during its service life.

Conditions of Approval

The requirements specified in Chapter 8 of the SARP have already been incorporated into the existing Certificate of Compliance for the 9975 Package.

Chapter 9. Quality Assurance

This section covers the quality assurance aspects of using the 9975 package to transport the following contents:

- Plutonium Composites per Table 1.18 of the SARP,
- Plutonium/Tantalum Composites per Table 1.19 of the SARP,

- Uranium Metal per Tables 1.20 of the SARP, and
- A DOE-STD-3013 alternate spacer packaging configuration.

The results of the quality assurance safety assessment of each the proposed contents are discussed below.

Plutonium Composites

There are no plutonium composite specific quality assurance requirements.

Plutonium/Tantalum Composites

There are no plutonium/tantalum composite specific quality assurance requirements.

Uranium Metal

There are no uranium metal specific quality assurance requirements.

DOE-STD-3013 Alternate Spacer Packaging Configuration

There are no 3013 alternate spacer packaging configuration specific quality assurance requirements for the specified 9975 packages.

Findings

Based on review of the statements and representations in the SARP and the application, the staff concludes the quality assurance plan has been adequately described and meets the quality assurance requirements of 10 CFR Part 71, Subpart H. Package-specific requirements are adequate to assure the package is designed, fabricated, assembled, tested, used, maintained, modified, and repaired in a manner consistent with its evaluation.

Conditions of Approval

None.

REFERENCES

1. **SAFETY ANALYSIS REPORT – PACKAGES 9972-9975 PACKAGES (U), Rev. 12, WSRC-SA-7** (June 2001).
2. Letter from W. J. Johnson, Vice President and General Manager, Nuclear Materials Management Division, Westinghouse Savannah River Company, to Mr. R. K. Hall, Acting Assistant Manager, Material and Facility Stabilization, U.S. DOE Savannah River Operations Office, **TRANSMITTAL OF 9975 SAFETY ANALYSIS REPORT FOR PACKAGING (SARP) REVISION 14 CHANGED PAGES** (October 15, 2002).
3. Memorandum from R. Kevin Hall, Acting Assistant Manager for Material and Facility Stabilization, to Sandra L. Johnson, Director, Office of Safety, Health, and Security (EM-5), HQ, Subject: **SUBMITTAL OF 9972-9975 SARP REV. 14 PAGE CHANGES AND**

SUPPORTING DOCUMENTATION TO ADDRESS PRIMARY CONTAINMENT VESSEL (PCV) FIT-UP PROBLEMS WITH 3013 CONTAINERS (December 30, 2002).

4. **EXTRACTION OF STRESS ANALYSIS RESULTS FROM M-CLC-F-00746, ANALYSIS OF GAP SIZES BETWEEN COMPONENTS OF 9975 PACKAGE SUBJECTED TO A 55-FOOT DROP**, SRTC-RMPT-2002-00041.
5. **DYNAMIC ANALYSIS OF 30-FOOT DROP FOR 9975 PCV WITHOUT OVER-PACK**, M-CLC-F-00830, Rev. 0.
6. **JUSTIFICATION FOR A MODIFIED 3013 PACKAGING CONFIGURATION FOR THE 9975 PACKAGE**, SRT-RMPT-2002-00039, Rev. 1.

7.

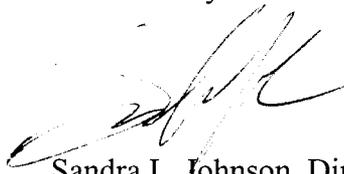
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Date: 2/3/03