Safety Evaluation Report for the

Model 9977

Safety Analysis Report for Packaging

Addendum 1

Justification for DNDO Contents

S-SARA-G-00003, Revision 2
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OVERVIEW

The Model 9977 Package is currently certified for Content Envelope C.1, ^{238}Pu Heat Sources, either in Radioisotope Thermoelectric Generator (RTG), or in Food-Pack Can configurations, under Certificate of Compliance (CoC) Certificate Number 9977 and Package Identification Number USA/9977/B(M)F-96 (DOE).[1] Addendum 1, Justification for DNDO Contents, the Submittal[2], supplements Revision 2 of the Safety Analysis Report for Packaging for the Model 9977 Package.[3] The Submittal adds five new contents to the Model 9977 Package, Content Envelopes, AC.1 through AC.5. The Content Envelopes are neptunium metal, the beryllium-reflected plutonium ball (BeRP Ball), plutonium/uranium metal, plutonium/uranium metal with enhanced wt% ^{240}Pu (to 50 wt%), and uranium metal. The last three Content Envelopes are stabilized to DOE-STD-3013.[4] These Content Envelopes will be shipped to the Device Assembly Facility (DAF) at the Nevada Test Site (NTS), where they will reside, and, hence, to off-site locations in support of the Department of Homeland Security (DHS) Domestic Nuclear Detection Office (DNDO). The new certificate will apply to a limited number of Model 9977 Packages.[5]

At the same time, the Submittal requests an extension of the periodic maintenance requirements from one (1) year to up to five (5) years using a Radio-Frequency Identification (RFID) temperature-monitoring system to measure the ambient storage temperature in order to ensure that the temperature of the Viton® O-rings for the 6-inch Containment Vessel (6CV) remains below 200°F. The RFID tags and system have been developed by Argonne National Laboratory. An on-going surveillance program at the K-Area Materials Storage (KAMS) facility at the Savannah River Site, and an on-going examination of Viton® O-rings from mock Primary Containment Vessels (PCVs) at Savannah River National Laboratory (SRNL) provide the technical justification for the extension of the periodic maintenance interval.

Where extended periodic maintenance is desired, the decay heat rate for the Model 9977 Package is limited to 15 watts.

Chapter 1: General Information

This Safety Evaluation Report (SER) documents the Staff's review of the *Model 9977, Safety Analysis Report for Packaging, Addendum 1, Justification for DNDO Contents* the Submittal[2] prepared for the United States Department of Energy by Savannah River Packaging Technology, Savannah River National Laboratory, for the inclusion and shipment of five new Content Envelopes for the Model 9977 Package.[3] This section of the SER covers the review of the General Information provided in Chapter 1 of the Submittal.

The packaging meets the requirements of 10 CFR 71[6] and the *Regulations for the Safe Transport of Radioactive Material—2005 Edition—Safety Requirements* of the International Atomic Energy Agency (IAEA) Safety Standards, Safety Series No. TS-R-1.[7]

Addendum 1 adds five new Content Envelopes to the Model 9977 Package Safety Analysis Report for Packaging (SARP). The new Content Envelopes are all present in the form of metals. The currently approved Content Envelope is C.1, ^{238}Pu Heat Sources, contained in either Radioisotope Thermoelectric Generator (RTG) or Food-Pack Can configurations. The five, new Content Envelopes are AC.1 (Addendum Content 1), neptunium metal, either as a sphere of the metal or as metal pieces; AC.2, the beryllium-reflected plutonium ball (BeRP Ball), as a sphere of ^{239}Pu metal stored in an aluminum heat-sink holder; AC.3, plutonium/uranium metal where the maximum ^{240}Pu is 25 wt%; AC.4, plutonium/uranium metal where the maximum ^{240}Pu is 50 wt%; and, finally, AC.5, uranium metal, where the ^{235}U is limited to either 100 wt%, or 95 wt%, respectively. These Content Envelopes are discussed in more detail below. A one-piece, aluminum Sleeve and Plug component is used for Content Envelopes AC.1, AC.3, AC.4, and AC.5 for purposes of shielding or criticality control. The aluminum Sleeve and Plug fits inside the 6-inch Containment Vessel that provides the containment boundary for the Model 9977 Package.

The Criticality Safety Index (CSI) for Content Envelopes AC.1 through AC.5 is 1.0.

The decay heat rate is limited to 15 watts where extension of the periodic maintenance beyond one year is desired; otherwise, the decay heat rate remains at 19 watts as for the currently certified Model 9977 Package.

Content Envelope AC.1, Neptunium Metal

Neptunium metal has been previously approved for shipment in the Model 9975-85 Package for one-way shipments between Los Alamos National Laboratory (LANL) and the Device Assembly Facility (DAF) at the Nevada Test Site (NTS). Up to 6,070 g of neptunium metal is allowable in the shape of a sphere. The sphere may be contained in a Vollrath can, or in an aluminum heat-sink fixture, stored within a stainless steel Vollrath can. In the form of neptunium metal pieces, only 188 g is allowable. Two nickel cladding shells and a tungsten cladding shell add to the mass of the neptunium sphere for a total of 8226.9 g. The Sleeve and Plug component is required for shipment of Content Envelope AC.1 for purposes of shielding in that the dose rate at the surface of the Package must be maintained at less than the regulatory limit of 200 mrem/hr per 10 CFR 71.47(b)(1).[6] Per Table A.1.2 in the Submittal, plastic is limited to 100 g, the stainless steel is limited to 2,000 g (Vollrath can), and the aluminum is limited to 4,500 g in the form of the heat sink and/or aluminum foil.

Content Envelope AC.2, BeRP Ball

The BeRP Ball has been previously approved for shipment in the Model 9975-85 Package for one-way shipments between LANL and the Device Assembly Facility at the Nevada Test Site. The BeRP Ball consists of 4,484 g of alpha phase plutonium metal. A stainless steel shell makes for a total mass of 4,500 g. The BeRP Ball is shipped in an aluminum heat-sink fixture located inside a Vollrath can. The amount of plastic is limited to 100 g, according to Table A.1.2 of the Submittal. 2,000 g of stainless steel is permitted (Vollrath can), and 4,500 g of aluminum is allowed for the heat-sink fixture and/or aluminum foil. The Sleeve and Plug component is not required for the BeRP Ball.

Content Envelope AC.3, Plutonium/Uranium Metals
Content Envelope AC.3 is limited to 4,400 g of plutonium or uranium metal. The maximum ^{240}Pu is set at 25 wt%. The ^{235}U is limited to 100 wt%. The plutonium metal must be stabilized per DOE-STD-3013. Up to 3,080 g of impurities are allowed as part of the total mass per the same standard. Either the Food-Pack can or 3013 configuration is allowed, but the Sleeve and Plug component is required in either case. Table A.1.2 of the Submittal allows for 100 g plastic, and for greater than 3,000 g plutonium or uranium metal per Food-Pack can, provided the thickness of the sum of can walls is limited to less than 0.26 inches, while the thickness of the sum of can bottoms and tops is limited to less than 1.77 inches, and the Food-Pack can must be 400 × 400 or larger, i.e, 4 inches diameter by 4 inches length. The identical restrictions apply to the inner/material can of the 3013 containers except that no plastic is allowed.

Content Envelope AC.4, Plutonium/Uranium Metals
For Content Envelope AC.4, the plutonium or uranium metal is limited to 2,000 g. The plutonium metal must be stabilized per DOE-STD-3013. The maximum ^{240}Pu is 50 wt%, in contrast to Content Envelope AC.3 where the maximum ^{240}Pu is 25 wt%. The ^{235}U is bounded at 100 wt%. Either the Food-Pack can or 3013 can configuration is permitted per Table A.1.2 of the Submittal, however the Sleeve and Plug component is required in either case for criticality control purposes, unless the mass of plutonium or uranium metal is less than 450 g. Once again, 100 g of plastics is allowed for Food-Pack cans, but none is allowed for 3013 containers.

Content Envelope AC.5, Uranium Metal
For Content Envelope AC.5, the mass of uranium metal is limited to 16,000 g for ^{235}U enrichments of up to 100 wt%, or 18,000 g, for ^{235}U enrichments of up to 95 wt%. Molybdenum metal is allowed up to 10 wt% as an alloy with uranium metal. The Sleeve and Plug component is required for criticality control. Either the Food-Pack can or 3013 can configuration is allowed for Content Envelope AC.5. For the Food-Pack can configuration, 100 g of plastic is allowed, and if greater than 3,000 g of uranium metal are present, the sum of the thicknesses of the Food-Pack cans is limited to less than 0.26 inches, while the sum of thicknesses of the bottoms and tops of the Food-Pack cans is less than 1.77 inches. The Food-Pack can must be 400 × 400 or larger. The same restrictions apply to the inner/material can of the 3013 can configuration, except that no plastic is allowed.

Table A.1.2 Global Restrictions
Table A.1.2 has restrictions that apply to all Content Envelopes. For example, there shall be no more than 1000 parts-per-million (ppm) of other radionuclides. Also, there shall be less than 100 ppm of other inorganic impurities, culminating in a total mass of less than 0.1 wt%, unless otherwise noted in the Submittal. Finally, the maximum content weight is 100 lb.

Extended Maintenance Period for the Model 9977 Package
A request to extend the maintenance period for the Model 9977 Package from one (1) year to up to five (5) years is a significant component of the Submittal. For those Model 9977 Packages subject to the greater than one-year maintenance period, the

Package is limited to 15 watts of decay heat rate, as opposed to the existing limit of 19 watts decay heat rate.

Findings

Changes to the maintenance period, the duration between post-load/pre-shipment leak test and shipment, and the mode of monitoring the ambient temperature during storage and transportation are not discussed in Chapter 1 of the Submittal. However, these are discussed in Chapter 7 and in Chapter 8.

Based on the review of the statements and representations in the Submittal, the Staff has concluded that the packaging design has been adequately described to meet the requirements of 10 CFR 71.

Conditions of Approval

The following conditions of approval are addressed by the new storage/transportation CoC (DOE-S/T-1) issued for the approval of this request:

- Table A.1.1 — Content Envelopes;
- Table A.1.2 — Summary of Packaging Configuration Requirements;
- Drawing, R-R4-G-0053, Revision 1, 9977 Sleeve and Plug Details;
- Fissile material is not authorized for air transport, since the package was not evaluated per the requirements of 10 CFR 71.55(f); and
- The published data on the experiments to monitor the performance of O-rings used in the Model 9975 package has demonstrated *leaktight* seal for up to twenty-four (24) months where O-ring temperatures are maintained below 200°F. Based on this test data and RFID monitoring of temperature, the maintenance period is extended from one (1) year to two (2) years. Positive findings from the ongoing O-ring long-term leak performance tests can be used to justify extending the maintenance period from two (2) years up to five (5) years.

Chapter 2: Structural Evaluation

This section of the SER covers the assessment of the Structural Evaluation information provided in Chapter 2 of the Submittal.

Details of the items reviewed are noted in Chapter 1. The results of the Structural Evaluation review are discussed below.

In Chapter 2, the Submittal presents the following information and conclusions concerning the structural requirements and performances of the Model 9977 Package with the requested Content Envelopes AC.1 through AC.5:

- The addition of requested Content Envelopes AC.1 through AC.5 to the Model 9977 Package SARP does not increase the total payload mass certified for shipment in the Model 9977 Package (100 lb). Thus, the certified package configuration bounds the structural behavior of the package with the new contents.

- Content Envelopes AC.3, AC.4, and AC.5 depend on the volume of the Sleeve-and-Plug component to maintain subcritical control under Normal Conditions of Transport (NCT) and Hypothetical Accident Conditions (HAC).
- Content Envelopes AC.1, AC.3, and AC.4 need the Sleeve and Plug component to maintain adequate separation of the content from the package exterior surface, so that the dosage measurement around the package can meet the regulatory dose rate requirement under NCT.
- As required by the regulation, the Sleeve and Plug component is designed and fabricated according to the design rules and standards of American Society of Mechanical Engineers (ASME) Code Case N-519 for the use of aluminum alloy for Class 1 reactor components.
- The Maximum Normal Operation Pressure (MNOP) will increase only slightly (1.68 psig) from the baseline of 41.2 psig during a five-year storage period.
- The Content Envelopes AC.1 through AC.5 and the Sleeve and Plug component cause no unacceptable galvanic, chemical, and radiation effects on the packaging.

Findings
Based on the review of the statements and representations in Revision 2 of the Submittal, the Staff has concluded that the packaging design has been adequately described to meet the structural requirements of 10 CFR 71, noting that:

- One of the analyses supporting the conclusions about the structural behavior of the package with the new contents is presented in a separate document[8], which is not cited or included in Revision 2 of the Submittal. This document should be included in the addendum supporting the next revision to the storage/transportation CoC.
- Content Envelope AC.4 also requires the Sleeve and Plug component to separate the content from the bottom surface of the package.

Since the appropriate reference for the structural behavior has been provided under separate cover, and the Sleeve and Plug component for Content Envelope AC.4 is a condition of approval (Chapter 6 of this SER) the Staff finds the information and conclusions in Chapter 2 of the Submittal to be acceptable. The Staff concurs that the Model 9977 Package with Content Envelopes AC.1 through AC.5 has adequate structural performance to meet the safety requirements of 10 CFR 71.

Conditions of Approval
The Staff has concluded that no additional conditions of approval are needed for the new storage/transportation CoC (DOE-S/T-1) issued for the approval of this request.

Chapter 3: Thermal Evaluation

This section of the SER covers the review of the Thermal Evaluation information provided in Chapter 3 of the Submittal and References of the Submittal.

Details of the items reviewed are noted in Chapter 1. The results of the Thermal Evaluation review are discussed below.

The packaging described in Addendum-1 to the Model 9977 Package SARP adequately complies with the transportation requirements of 10 CFR 71. The Staff has determined that the single containment system design, described in Addendum 1, will have a similar thermal margin of safety as original Model 9977 shipping package.

Thermal Loading of O-Rings

The request for extension of the maintenance period from one year to five years relies upon implementation of RFID temperature-monitoring devices to record ambient storage and transportation temperatures in order to ensure the temperature of Viton® O-rings in the 6CV is maintained equal to or less than 200°F.

The O-rings are made of Viton® GLT materials from Parker, and they have an unlimited shelf life. However, the manufacturer does not provide an application-specific life time. A one-year long bench test at aging temperatures over the range 175-400°F was carried out by SRNL,[5] and the test results indicate negligible material degradation to Viton® GLT O-rings if they are kept below 200°F over the desired storage period (extrapolated) of up to five years.

Another ongoing experiment for Viton® GLT O-rings has been set up by SRNL[9,10] to mimic conditions of storage or design basis limiting conditions at the K-Area Materials Storage using test temperatures of either 200°F or 300°F. The first temperature is the peak normal PCV seal temperature (202°F) for a package with a decay heat rate of 19 W stored at 130°F ambient. The second temperature is the containment vessel design limit and also the bounding seal temperature during loss of building ventilation (170°F ambient). Based on results from this series of experiments, the Applicant has concluded that Viton® GLT O-rings can maintain the seal integrity of the 6CV, if they are kept equal to or below 200°F for a 5-year test period. Furthermore, according to previous Finite Element Analysis (FEA) simulation results,[11] if the Model 9977 Packages are kept in a shaded environment in which temperatures are limited to 100°F, then the temperature of the O-Rings in the containment boundary will be below 200°F.

In case of the possibility of exposure of the package to an environment in which the temperature is higher than 100°F, the Applicant developed a relationship among 6CV Viton® O-ring temperature, $T_{o\text{-}ring}$, decay heat rate for the contents, W, and ambient air temperature, T_a, for the Model 9977 Package[12]:

$$T_{o\text{-}ring} = 10.921 + 4.647W + 0.94T_a.$$

If the value of $T_{o\text{-}ring}$ is limited to 200°F, then the relationship becomes:

$$W = 40.689 - 0.202T_a.$$

Table A.8.1 of the Submittal shows the results for this relationship for wattages between 0 and 19 watts and ambient temperatures between 100°F and 150°F. For Model 9977 Packages with an extended maintenance period, the decay heat rate is limited to 15 watts for the contents; otherwise, for the standard one-year maintenance interval, it is limited to 19 watts. An RFID temperature-monitoring system will be used to measure ambient temperatures during storage and transportation.

SNRL provided an additional simplified 2D FEA simulation for the condition of four Model 9977 Packages grouped in a square (2 × 2) configuration,[12] reflecting storage on a pallet with the edges of the packages touching. A 19-watt heat source is located in the middle of the PCV. The air between the drums is assumed to be trapped such that the boundary conditions of heat convection and radiation are shut off on one-fourth of the vertical, cylindrical wall of each package. As a result, the air trapped in the space between the four drums becomes hotter than the air surrounding the drums, i.e., a 64°F temperature difference. However, the PCV temperature increases only 2°F from 209°F.[11] The Addendum 1 (2x2) calculations were done assuming 19W in each drum, trapped air, no convection and radiation on one-fourth of the cylindrical wall of each package, and the PCV temperature increases only 2°F from 209°F. Limiting the heat load of the 9977 to 15W will decrease the O-ring temperature by 18.6°F.

Maximum Normal Operating Pressure

The MNOP is reported as 42.85 psig for a bare source located at the bottom of the 6CV and 39.28 psig for a bare source located at the top of the 6CV. The generation of helium during the five-year storage period is accounted for in these values (0.6% per year). Due to the very small value of 0.6% per year, it was neglected for the normal maintenance period of one year. Gas generation due to radiolysis of plastics is negligible, i.e., 0.036 cm^3/year.[13]

Findings

Based on the review of the statements and representations in the Submittal, the Staff has concluded that the packaging design has been adequately described to meet the requirements of 10 CFR 71. This determination is based on the following considerations:

- In the general case of NCT, for a package containing 19 W decay heat source, a one to one relationship between the ambient temperature and the O-ring temperature in Table A.8.1, provided by Applicant, is based on a simplified model valid only for a single package. For a single Model 9977 Package, about 78% (14.8 W) of the heat is transmitted radially, by radiation and convection, from the cylindrical wall of the drum, and about 21% (4.2 W) is heat loss transmitted axially from the top of the drum. In storage, the packages may be kept close together for a long time, so that heat transfer by radiation and by convection from the cylindrical wall may be inhibited. As a result, more heat will be dissipated from the top surface of a drum and cause the overall temperature of PCV and O-ring to rise. For the seven packages concerned in Addendum 1, the risk of O-ring temperatures achieving 200°F for a 100°F ambient temperature is small. The Applicant has demonstrated a possible maximum 2°F increase in the O-ring temperature in their analysis. The three-fourths of the exposed, vertical, cylindrical wall of each package works quite efficiently to transmit inside heat to the environment. The configuration in the analysis is viewed as relatively conservative for drums stored one high on pallets in a square (2 × 2) array.

- The Applicant has appropriately reduced the total wattage, contained in a Model 9977 Package from 19 W to 15 W, to account for the location uncertainty of the RFID tags in the drums configuration.

Conditions of Approval
The Staff has concluded that no additional conditions of approval are needed for the new storage/transportation CoC (DOE-S/T-1) issued for the approval of this request.

Chapter 4: Containment

This section of the SER covers the review of the containment information provided in Chapter 4 of the Submittal.

Details of the items reviewed are noted in Chapter 1. The results of the Containment review are discussed below.

The Applicant has submitted numerous references in support of extending the maintenance period from one year to five years for the Viton® GLT/GLT-S O-rings that are part of the containment boundary. Viton® GLT and Viton® GLT-S O-rings are considered to be equivalent for use in the Model 9975-85, Model 9975-96 and Model 9977 Packages.[14] Some of the references pertain to the surveillance program at the K-Area Material Storage (KAMS) facility for the Model 9975 Packages stored there, and others pertain to examination of O-rings from mock Model 9975 Package PCVs. Although this Submittal applies to the Model 9977 Package, the Model 9977 Package contains a 6CV, while the Model 9975 Package contains both a 6CV and a five-inch containment vessel (5CV). Both of these Chalfant CVs are of the same design and have been in use for many years. Both CVs have the same closure design with two O-rings as part of the Cone Seal Plug. The outer O-ring is part of the containment boundary whereas the inner O-ring provides a volume for post-load leak testing, i.e., qualification of the outer O-ring.

Model 9975 Packages stored at KAMS are selected for characterization by destructive assay in another facility, the F-Area Material Storage Facility.[15,16,17] Also, nondestructive assay of 3013 containers stored in Model 9975 Packages at KAMS and nondestructive assay of Model 9975 Package components are performed. Post-load leak tests have been performed on fifty-one Model 9975 Packages as part of the nondestructive assay process in the F-Area Material Storage Facility.[9,10] Only one secondary containment vessel (SCV) failed the $<1 \times 10^{-3}$ ref cm^3/sec criterion. The PCVs all passed the post-load leak test criterion.

In the case of the mock Model 9975 Package PCV testing, there are five studies related to sixty-two mock-ups of the PCVs.[18,19,20,21,5] The O-rings were subjected to temperatures of 200°F and 300°F for periods of time as long as 24 months. In one case, the data extended over about 30 months. There were eleven leak tests that failed the 1×10^{-7}

ref cm^3/sec *leaktight* criterion of ANSI N14.5[22] at elevated temperatures. One of these failed tests was performed at 200°F, while ten of the failed tests were performed at 300°F. The Applicant conducted a post-test examination on the equipment involved in the 200°F failure and concluded the failure was due to the presence of a foreign material in the seal area. The leak tests performed at room temperature on the mock PCVs, following cool down from test temperatures, all passed the *leaktight* criterion.

The mock PCVs passed the *leaktight* criterion even when exposed to 2×10^5 rads; this is equivalent to a radiation dose of 2 rad/hour over a ten-year exposure period.[18] Doses in excess of 10^7 rads are required before significant physical changes to the properties of Viton® O-rings are observed.[23] For a fourth, but separate study, compression stress-relaxation behavior of Viton® GLT O-rings at 175-350°F was reported.[24] Viton® O-rings tested at 200°F exhibited 90% loss of initial sealing force after about 6 years and exhibited 100% loss of initial sealing force after about 12 years. These are extrapolated values, based on Arrhenius theory. For comparison, at 300°F, 90% loss of initial sealing force is predicted in about 5,000 hours (0.6 years) and 100% loss of initial sealing force is predicted in about 10,000 hours (1.1 years). The Applicant concluded that Viton O-rings will retain adequate sealing force to meet the requirements of a Model 9977 Package for five years at temperatures less than 200°F.[5]

Based on these tests, the Staff concludes that, subject to a qualification provided in Chapter 8, the Applicant has provided justification for an extended maintenance interval of 24 months. Positive findings from the ongoing O-ring long-term leak performance tests can be used to justify extending the maintenance period from two (2) years up to five (5) years.

Findings
Based on the review of the statements and representations in the Submittal, the Staff has concluded that the packaging design has been adequately described to meet the requirements of 10 CFR 71.

Conditions of Approval
The Staff has concluded that no additional conditions of approval are needed for the new storage/transportation CoC (DOE-S/T-1) issued for the approval of this request. The addendum supporting the next change to the storage/transportation CoC should incorporate key references that support extending the maintenance intervals into the addendum.

Chapter 5: Shielding Evaluation

This section of the SER covers the review of the Shielding Evaluation information provided in Chapter 5 of the Submittal.

Details of the items reviewed are noted in Chapter 1. The results of the Shielding Evaluation review are discussed below.

Shielding Analyses
The shielding evaluation was performed using Monte Carlo N Particle (MCNP) code, and very conservative contents that used the sum of the maximum allowed values for each isotope that, in some cases, added up to more than 100% of the maximum allowed contents as described in Table A.1.1 of the Submittal. The Model 9977 Package consists of a 6-inch containment vessel (6CV), but does not contain any photon or neutron shield, instead relying on distance from source to relevant points external to the package to reduce dose levels. For the specific contents in this addendum, a one-piece aluminum Sleeve and Plug assembly is inserted into the 6CV and the specific role of this assembly is discussed on a case-by-case basis by the Applicant. The packaging materials going outward from the 6CV consist of the drum liner, Fiberfrax® insulation, Last-A-Foam® insulation and impact limiter, and finally, the drum body. For the HAC analyses, a conservative model that assumes only the 6CV has survived is used to estimate external dose rates. Gamma and neutron source terms are determined using the proprietary code, Radiation Source Term Analysis (RASTA), as well as ORIGEN-S to decay certain isotopes such that a maximum activity level is achieved.

The Applicant used the root mean square method to determine the combined standard deviation of the neutron, neutron induced gamma, and gamma dose rates. The Staff had concerns with this approach, since this is valid only when the three dose rates are uncorrelated. There is correlation between the neutron and neutron-induced gamma dose rates, though because the neutron-induced gamma contribution is small, the impact of this correlation will be small.

Content Envelope AC.1, Neptunium Metal
This Content envelope consists mainly of neptunium metal, and an impurity of 0.005 g of beryllium was added to it. This Content Envelope is dominated by the gamma source with a small contribution from neutrons. However, the Staff points out that the neutron source presented in the Addendum for Content Envelope AC.1 of ~50 n/s is incorrect and the actual number is of the order of ~500 n/s. This will not change the conclusion that the dose rates are within the regulatory limits provided that the Sleeve and Plug assembly is used. The Staff confirmed these conclusions by independent analyses.

Content Envelope AC.2, BeRP Ball
This Content Envelope consisted of the "BeRP" ball with 0.005 g of beryllium. The isotopic composition of this content envelope is known and is modeled with the actual masses of each isotope. The Staff confirmed that these contents meet the regulatory limits for external radiation for a non-exclusive use shipment without the use of the Sleeve and Plug assembly.

Content Envelope AC.3, Plutonium/Uranium Metals
The Content Envelope consists of plutonium/uranium metal with a maximum of 25 weight % ^{240}Pu. Since this Content Envelope can contain up to 15 weight % ^{241}Pu, and no specific mention is made of ^{241}Am, the Addendum assumes that the ^{241}Pu has decayed to the maximum amount of ^{241}Am equivalent to 19 W of decay heat. The Addendum also includes 0.00044g of ^{232}U that is 100 times the weight percent specified in the contents, leading to a conservative estimate of the contribution to the gamma

source from its daughter product, ^{208}Tl. These contents require the use of the Sleeve and Plug assembly. The Staff has independently confirmed that this configuration for this Content Envelope meets the regulatory limits for this Content Envelope.

Content Envelope AC.4, Plutonium/Uranium Metals

This Content Envelope also consists of plutonium/uranium metal but is different from Content Envelope AC.3 since it can contain up to 50 weight % ^{240}Pu. The Applicant has evaluated this content for a 300-g mass, while the actual maximum allowed is 2000 g. The Applicant also includes 100 times the maximum allowed mass of ^{232}U. The Addendum model places the 300-g payload source at the bottom of the 6CV without the Sleeve and Plug assembly. The dose rates obtained with 300 g are scaled up by the ratio 2000/300 to reflect the higher mass limit and presents data that is within the regulatory limit. The Staff had concerns with this approach, since the additional effect of subcritical multiplication with the 2000-g payload is ignored by this simple scale up. The Staff also disagrees with the statement in the Addendum that the increased distance between the center of the sphere of larger mass to the point of dose rate measurement more than compensates for the effect of subcritical multiplication. The Staff performed alternate calculations, using both an independently-generated model, as well as the model used in the Addendum and payloads of 300 g and 2000 g. The effect of the higher mass on the neutron dose rate is a factor of 8.25, compared to a simple scale up, which results in a factor of 6.67. More importantly, as a result of the larger neutron dose rate ratio, the model as presented in the Addendum (i.e., with the source at the bottom of the 6CV), would produce total dose rates that exceed the regulatory limits. However, since the Sleeve and Plug assembly is required for any payload over 450 g, the actual dose rates will be within regulatory limits, as confirmed by the Staff's independent calculations.

Content Envelope AC.5, Uranium Metal

This envelope has been analyzed with 21,000 g of uranium (95 wt% ^{235}U) metal and 100 times the maximum allowed mass of ^{232}U. The neutron contribution to the dose rate is negligible, and the overall radiation levels are compliant with the regulations. The Applicant modeled these contents as being at the bottom of the 6CV. In reality, these contents will be shipped with the Sleeve and Plug assembly because of criticality safety requirements. It is also noted that the total allowed mass of 95% by weight ^{235}U and the other allowed payload of 19,000 g of 100% by weight ^{235}U have been reduced to 18,000 g and 16,000 g, respectively, owing to criticality safety issues (see Chapter 6 of this SER). The Staff performed alternate calculations to confirm that the dose rates are within the regulatory limits. The Applicant states that the highest density would produce the most conservative results. The Staff performed sensitivity studies to determine the effect of a reduced density of this Content Envelope. The results showed that the lower density did indeed produce about 4-6% higher dose rates both on the side and bottom of the package. However, as stated above, there is sufficient margin to the regulatory limit for these contents, and this additional contribution to the dose rate will not pose a safety issue. The Staff agrees that the use of the 100 times larger amount of ^{232}U is conservative, however, it disagrees with the statement that the difference in the dose rates would negligible. The 100 times larger contribution of the ^{208}Tl gamma would have a non-negligible impact on the dose rates.

Findings

- Based on the review of the statements and representations in the Submittal, the Staff determined that the method used to extrapolate the dose rates for Content Envelope AC.4 from 300 g to 2000 g needs improvement. The Addendum calculations for AC.4 should be revised with the correct payload mass and configuration to demonstrate that the dose rates meet regulatory requirements of 10 CFR 71.47. The sensitivity of dose rates to content density should be demonstrated in the revised calculation. These updates should be performed for the next revision to the storage/transportation CoC.
- The method used in the Addendum to determine the uncertainty of the combined dose rate (neutron + neutron-induced gamma + gamma) needs improvement. The uncertainty should be determined by applying the 3-sigma uncertainty to the individual dose rates and summing them up to arrive at the final dose value, since covariance information is not available. This method would produce the most conservative value for the combined dose rate, though, in these cases, the difference in the final value between the two methods will be small. This issue should be addressed in a revision to the calculation sheet.[25] The Staff notes that all calculations containing the correct amount of ^{232}U in Content Envelopes AC.3, AC.4, and AC.5 will be revised for the next revision to the storage/transportation CoC.

Other than the Findings noted above, the Staff, through independent analyses, was able to confirm that all the Content Envelopes meet the regulatory dose rate requirements of 10 CFR Part 71.

Conditions of Approval

The Sleeve and Plug component is required for Content Envelopes AC.1, AC.3, and AC.4 for the purposes of meeting the regulatory dose rate requirements. The Staff has concluded that no additional conditions of approval are needed for the new storage/transportation CoC (DOE-S/T-1) issued for the approval of this request.

Chapter 6: Criticality Evaluation

This section of the SER covers the review of the Criticality Evaluation information provided in Chapter 6 of the Submittal.

Details of the items reviewed are listed in Chapter 1. The results of the Criticality Evaluation review are discussed below.

Fissile Material Contents

The currently approved Content Envelope is C.1, ^{238}Pu Heat Sources, contained in either Radioisotope Thermoelectric Generator (RTG) or Food-Pack Can configurations. Addendum 1 adds five new Content Envelopes to the Model 9977 Package Safety Analysis Report for Packaging (SARP). They are:

- AC.1 - Neptunium metal (6,070 g), either as a sphere of the metal or as metal pieces (188-g limit);

- AC.2 - Beryllium-reflected Plutonium ball (BeRP Ball, 4,500 g), as a sphere of ^{239}Pu metal stored in an aluminum heat-sink holder;
- AC.3 – Plutonium/Uranium metal with the maximum fissile mass of 4,400 g;
- AC.4 - Plutonium/Uranium metal with the maximum fissile mass of 2,000 g with Sleeve and Plug component, 450 g without Sleeve and Plug component; and
- AC.5 - Uranium metal, where the ^{235}U is limited to either 16,000 g (100 wt% ^{235}U) or 18,000 g (95 wt% ^{235U}).

The contents used in the criticality analyses are consistent with those specified in the General Information Chapter of the SARP.

General Considerations for Criticality Evaluations

The NCT tests did not cause any damage to the Model 9977 Package that significantly affected criticality. The Applicant's analyses, show that an infinite number of undamaged packages remain subcritical under the NCT conditions.

The HAC tests did cause damage to the Package that affected the criticality calculations. The HAC model conservatively took into account the foam burn test and drop test data. Displacements of the 6CV in neighboring packages in an array are treated to maximize their interaction and produce maximum reactivity. This is a very conservative treatment of the HAC damage.

For the HAC array calculations, fissile materials are located within the 6CV to give the closest interaction with respect to the fissile materials in other neighboring packages. This treatment maximizes the reactivity.

The closest packed array of Model 9977 Packages for Addendum 1 achievable is hexagonal in a lateral plane (perpendicular to the package axes), but square in the vertical direction for subsequent layers of packages. The Applicant's analyses used square arrays in both directions, but decreased the lateral pitch by 7% to account for this approximation in the lateral-plane layers.

Because the Model 9977 Package has no in-leakage occurring during HAC tests, the HAC array calculation model assumes that the 6CV is dry. For single package calculations, the fissile materials are treated as spherical metal in water within the packaging and surrounded by water. For the NCT and HAC calculations, the most reactive fissile material contents were used in the form of a dry sphere (or cylinder in certain cases).

The density for any allowed fissile material is its maximum theoretical density. For the purpose of conservatism, the plutonium and uranium contents were assumed to be 100 wt % ^{239}Pu, and 100 wt % ^{235}U, respectively (except in Content Envelope AC.5). One hundred grams of polyethylene material (density of 0.95 g/cm^3) has been properly considered for the presence of nylon/plastic/PVC or equivalent hydrogenous materials.

Criticality Analysis:

1. Content Envelope AC.1 - Neptunium metal (6.07 kg), sphere or metal pieces

The Applicant's criticality evaluation was performed based on a similar content evaluation for the Model 9975 shipping container. No confirmatory calculations for Model 9977 Package Addendum 1 were provided.

Neptunium-237 (^{237}Np) is a non-fissile element and has a threshold of ~600 KeV. Isotopes with an even number of neutrons, such as ^{237}Np, can be made critical, but the mass required for criticality is in the kilogram range. These even numbered nuclides (even numbers of neutrons) characteristically exhibit rather sharp thresholds in their fission cross sections, with little or no probability for sub-threshold fission. The effect of moderation on these nuclides is to prevent, rather than enhance, criticality. The critical mass of ^{237}Np increases with the addition of moderators, and its neutron scattering properties make steel a better reflector than water. The minimum critical mass of ^{237}Np was estimated to be 33,000 g in ANSI/ANS8.15[26] for steel-reflected metal. The critical mass of a bare ^{237}Np sphere was estimated to be 56,000 g in a recent critical measurement.[27]. Therefore a 6,070-g ^{237}Np sphere would be subcritical under dry and flooded conditions in a single unit.

An infinite array of ^{237}Np spheres (6,070 g) under NCT conditions was shown to be subcritical for the Model 9975 Package.[28] A HAC array of a 5x5x2 cluster was also shown to be subcritical for the Model 9975 shipping container. The reactivity values for the NCT and HAC arrays range from 0.61 to 0.64. It was also shown in the Model 9975 Package study that the reactivity of a 6,070 g of ^{237}Np sphere is significantly less than that for a ~4,500-g plutonium sphere.

The Staff performed a confirmatory calculation for the single unit of ^{237}Np sphere in a Model 9977 Package Addendum 1, configuration. The k_{eff} value for a single unit (dry inside) is 0.592, while the corresponding k_{eff} value for a 4,400 g of plutonium sphere is 0.842. It is judged that the neptunium content will be well bounded by Content Envelope AC.3 (4,400 g of plutonium metal).

The Staff has concluded that a Model 9977 Package as described in the Addendum 1 will remain subcritical for a content of 6,070 g of ^{237}Np with a CSI of 1.0.

2. Content Envelope AC.2 - Beryllium-reflected Plutonium ball (BeRP Ball, 4.5 kg), as a sphere of ^{239}Pu metal stored in an aluminum heat-sink holder

The Content Envelope is called BeRP Ball which is a 2.987-inch diameter plutonium sphere having a total mass of 4,484 grams of alpha phase plutonium. This content is more than 4,400 g of plutonium metal which is the approved plutonium metal content for the Model 9975 Package SARP, Revision 0.[29] The plutonium sphere will be placed in a 4.8-inch diameter by 5-inch tall aluminum heat sink that will be placed in a stainless steel Vollrath can. The Vollrath can, containing the plutonium sphere, will be placed inside the Model 9977 Package containment vessel, the 6CV.

This Content Envelope was evaluated for the Model 9975 shipping container and was approved in a Model 9975 Package Addendum.[28] The Model 9977 Package containment volume was reduced to reflect a Model 9975 Package five inch containment vessel (5CV). Since the drum dimensions of the Model 9975 Package and that of the Model 9977 Package are very similar, and the containment volumes are the same, it is expected that other differences between Model 9975 and Model 9977 Packages will not produce a large difference in reactivity for identical contents. This is noted by the analysis results. For example, the k_{eff} value for the Model 9975 Package single unit dry with a BeRP ball is 0.8491,[28] while the k_{eff} value for the Model 9977 Package, Addendum 1 (with Sleeve and Plug component), single unit dry with BeRP ball is 0.8424 [Table A.6.8 of Addendum 1].[2] The Staff performed an independent confirmatory analysis with a different code (MCNP) and a different cross section set. This analysis shows that the k_{eff} for the corresponding case, Model 9977 Package, Addendum 1, is 0.853.

Similarly, the k_{eff} value for the Model 9975 Package in the NCT case (infinite array, all dry) with BeRP ball is 0.892,[28] while the corresponding k_{eff} value for the Model 9977 Package, Addendum 1, with BeRP ball is 0.880 [Table A.6.8 of Addendum 1].[2]

The maximum k_{eff} for the maximum reactivity configuration under the HAC scenario is 0.897.

It was also noted that the reactivity differences for cases with and without the Sleeve and Plug component are small.

It is judged that the BeRP content will remain subcritical for the single unit, NCT, and HAC scenarios. Sufficient reactivity margin is available, because the k_{safe} value is 0.931.

The Staff has concluded that a Model 9977 Package as described in Addendum 1 will remain subcritical for a content of about 4,500 g of ^{239}Pu (BeRP Ball) with a CSI of 1.0.

3. Content Envelope AC.3 – Plutonium/Uranium metal with the maximum fissile mass of 4.4 kg

This Content Envelope was evaluated in great detail for the Model 9975 shipping container and was approved for the Model 9975 Package SARP. The Model 9977 Package 6CV containment volume was reduced to reflect a Model 9975 Package 5CV containment volume. Since the drum dimensions of the Model 9975 Package and that of the Model 9977 Package are very similar, and the containment volumes are the same, it is expected that other differences between Model 9975 and Model 9977 Packages will not produce a large difference in reactivity for identical contents. This is noted by the analysis results.

For example, the k_{eff} value for the Model 9975 Package single unit dry configuration with 4,400 g of plutonium in a 3013 container is 0.8509 [Table 6.11],[29] while the k_{eff} value for the Model 9977 Package, Addendum 1 (with Sleeve and Plug component), single unit dry configuration with 4,400 g of plutonium in a 3013 container is 0.8453 [Table A.6.14 of Addendum 1].[2] The Staff performed an independent confirmatory analysis with a different code (MCNP) and a different cross section set. This analysis shows that the k_{eff} for the Model 9977 shipping container for the corresponding case is 0.843.

The maximum k_{eff} value for the single unit, solution case is 0.703. The NCT dry case k_{eff} is 0.8734 (infinite array, including 3013 container). The most reactive HAC k_{eff} for the 6x6x3 array (with 3013 container, two-cluster model) is 0.904.

It is judged that the 4,400 g plutonium content will remain subcritical for the single unit, NCT, and HAC scenarios. Sufficient reactivity margin is available, because the k_{safe} value is 0.931.

Based on a comparison with the corresponding cases for the Model 9975 shipping container and from the observation of the Model 9978 shipping container confirmatory results of identical cases, the Staff has concluded that a Model 9977 Package as described in Addendum 1 will remain subcritical for a content of about 4,400 g of ^{239}Pu with a CSI of 1.0.

4. Content Envelope AC.4 - Plutonium/Uranium metal with the maximum fissile mass of 2.0 kg (with Sleeve and Plug component), 0.45 kg (without Sleeve and Plug component)

The fissile mass of 2,000 g is bounded by the analysis of the Content Envelope AC.3 (4,400 g). Therefore, no additional calculations are needed. It is noted that Model 9977 Package containment must have a Sleeve and Plug component as shown in Addendum 1. This Content Envelope has double the percentage of ^{240}Pu (from 25% to 50%), and therefore, the fissile mass was reduced to limit the dose at the surface (to comply with the regulatory shielding requirements).

If the containment volume is not reduced by the Sleeve and Plug component to correspond to an equivalent 5CV, it becomes a 6CV. In that case, only 450 grams of ^{239}Pu can be shipped. The mass limit corresponds to the ANSI/ANS 8.1 standard subcritical limit for ^{239}Pu.[30] This is a very conservative value, and is accepted without any detailed calculational support. Based on previous studies, the interaction between Model 9977 Package units in an array configuration is small.

The Staff has concluded that a Model 9977 Package as described in Addendum 1 will remain subcritical for Content Envelope AC.4 with a CSI of 1.0.

5. Content Envelope AC.5 - Uranium metal, where the ^{235}U is limited to either 16 kg (100 wt% ^{235}U) or 18 kg (95 wt% ^{235}U)

The uranium mass limit is increased from 13,500 g for the Model 9975 shipping containers to 16,000 g (100 wt% ^{235}U) and 18,000 g (95 wt% ^{235}U) for the Model 9977 Package, Addendum 1. The single unit analysis for uranium metal (dry or flooded) indicates that the system remains subcritical for uranium masses up to 19,000 g (100 wt% ^{235}U) and 22,000 g (95 wt% ^{235}U). A single package with solution configuration is subcritical for up to 25,000 g of uranium (100 wt% ^{235}U). The NCT calculations demonstrate that uranium up to 20,000 g (100 wt% ^{235}U) or 22,000 g (95 wt% ^{235}U) will remain subcritical. However, the HAC analysis requires that the maximum allowable mass needs to be reduced to maintain subcriticality. For example, the maximum mass limit is reduced to 17,000 g of uranium (100 wt% ^{235}U) or to 19,000 g of uranium (95 wt% ^{235}U) to limit the k_{eff} value below the k_{safe} value of 0.931.

For conservatism, the Applicant has reduced the mass limits for Content Envelope AC.5. to 16,000 g of uranium (100 wt% ^{235}U) or 18,000 g of uranium (95 wt% ^{235}U).

Based on the confirmatory analysis, the Staff has concluded that a Model 9977 Package as described in Addendum 1 will remain subcritical for Content Envelope AC.5 with a CSI of 1.0.

The Staff has also confirmed that the SARP has used the most reactive configuration in demonstrating subcriticality.

Criticality Safety Index for Nuclear Criticality Control
A minimum criticality CSI of 1.0 is assigned to the Model 9977 Package for Addendum 1, based on the HAC array calculations showing that 6x6x3 =108 (minimum 2N = 2*50 = 100) packages in any configuration have a multiplication factor plus bias and uncertainties that is less than the k_{safe} of 0.931. The CSI is consistent with that reported in Chapter 1, General Information, in the SARP. The Staff concurs with this value.

Benchmark Evaluations
The SARP used the same criticality computer code, hardware, and cross-section library sets to determine the bias values from benchmark experiments as those used to calculate the multiplication factors for the Packages. The benchmark experiments, used in this study, were taken from the various volumes of the *International Handbook of Evaluated Criticality Safety Benchmark Experiments*,[31] and are appropriately referenced. This collection of benchmark experiments is the accepted standard in the criticality community.

The SARP determined an acceptable value for the bias for different contents. Acceptable statistical analyses demonstrate that this value is accurate, and conservative. The Staff concurs that the benchmark experiments and corresponding bias value are applicable and conservative as applied to the Model 9977 Addendum 1 Package.

Findings
Based on review of the statements and representations in the application, the Staff concludes that the nuclear criticality safety design has been adequately described and evaluated, and that the Model 9977 Package, Addendum 1, meets the subcriticality requirements of 10 CFR 71.

Conditions of Approval
The Staff has concluded that the Sleeve and Plug configuration is required for Content Envelopes AC.3, AC.4, and AC.5 for purposes of criticality safety control. The Staff has concluded that no additional conditions of approval are needed for the new storage/transportation CoC (DOE-S/T-1) issued for the approval of this request.

Chapter 7: Package Operations

This section of the SER covers the review of the Package Operations information provided in Chapter 7 of the Submittal.

Details of the items reviewed are noted in Chapter 1. The results of the Package Operations review are noted below.

Findings

The Staff's review of the information, provided in Chapter 7 of the Submittal, concludes that there are no specific issues with respect to the addition of the new Content Envelopes, i.e., A.C.1 through A.C.5. A new storage and transportation CoC will be issued as a result of the approval of this application.

The general instructions on how to monitor the ambient temperature of the Model 9977 Packages using the RFID temperature-monitoring system are given in Section 7.4.3 of the Addendum. For a Model 9977 Package identified with an extended maintenance period, a specific RFID tag will be installed during Periodic Maintenance. The tag number is listed on the "Periodic Maintenance Data Label" affixed to the drum (see Figure A.8.2 in the Addendum). Since this specific RFID tag is assigned to monitor this specific Model 9977 Package, the pair must remain together for the package's entire Maintenance Period. The Periodic Maintenance Data Label also records the Date that the RFID tag is attached, the Maximum Allowable Ambient Temperature, and the Maintenance Expiration Date. Based on published test data on the O-ring leak performance to date, the Staff concludes that an extended maintenance interval of 24 months is justified. Positive findings from the ongoing O-ring long-term leak performance tests can be used to justify extending the maintenance period from two (2) years up to five (5) years.

Other than the findings noted above, the Staff has concluded that the packaging operation has been adequately described to meet the requirements of 10 CFR 71.

Conditions of Approval

The Staff has concluded that the following additional conditions of approval is needed for the new storage/transportation CoC (DOE-S/T-1) issued for the approval of this request.

- The serial number of the Model 9977 Packages should be identified in the CoC.

Chapter 8: Acceptance Tests and Maintenance Program

This section of the SER covers the review of the Acceptance Tests and Maintenance Program information provided in Chapter 8 of the Submittal.

Details of the items reviewed are noted in Chapter 1. The results of the Acceptance Tests and Maintenance Program review are discussed below.

Findings

The request for an extension of the maintenance period from one (1) year to up to five (5) years relies upon implementation of RFID temperature-monitoring devices to record ambient storage and transportation temperatures in order to ensure the temperature of Viton® O-rings in the 6CV is maintained equal to or less than 200°F and on the information from a test program presented as References [18], [19], and [21] in this SER. The Applicant has also provided evidence that an ongoing surveillance program on actual Model 9975 Packages in the environmental conditions of the KAMS facility has not revealed any leak failures.

The Staff does not conclude from the data presented that an extension to five years has been adequately demonstrated. The information presented in the most recent of these reports, Reference [21], covers about 24 months of the leakage testing program with a small amount of data out to 30 months. Since the available information does not appear to date back to a time-frame that is more than 24 months old with the bulk of the data pertaining to the 18-month and the 24-month time periods, and the Model 9975 Packagings in the KAMS surveillance Program are not subject to a 150°F external temperature (corresponding to the 200°F Viton® O-rings temperature restriction), the Staff concludes that more comprehensive information must be provided, to justify extended maintenance beyond the 24 months.. The Staff also notes that the evidence presented does not preclude a longer maintenance interval, just that adequate justification has not been provided.

The Staff is also concerned that the data presented did not adequately demonstrate the physical differentiation between permeation and true leakage; and that the data was not in a format that clearly demonstrates measured helium flow rates versus time. A request for an increase in the extended maintenance interval beyond 24 months should include traceability with respect to testing requirements such as those specified in American Society for Testing and Materials (ASTM) E 1603.[32]

Based on the review of the statements and representations in the Submittal and other than the findings noted above, the Staff has concluded that the packaging design has been adequately described to meet the operational requirements specified in 10 CFR 71.

Conditions of Approval

Because the requirements specified in the Acceptance Tests and Maintenance Program Chapter of the SARP are normally incorporated, in their entity, as Conditions of Approval into the CoC, the Staff has concluded that the following new requirement be included as a Conditions of Approval in the new storage and transportation CoC (DOE-S/T-1) for the approval of this request:

- Based on the information available at this time, the request for extended maintenance is extended to a time-frame that is 24-months or less.

Chapter 9: Quality Assurance

This section of the SER covers the review of the Quality Assurance (QA) program description and packaging-specific QA requirements provided in Chapter 9 of the Submittal.

Details of the items reviewed are noted in Chapter 1. The results of the Quality Assurance review are discussed below.

New Content Envelopes AC.1 through AC.5 and Extended Maintenance Period
The addition of the new contents envelopes does not change the description of the QA program in Chapter 9 of the Model 9977 Package SARP.[3] The 6CV Sleeve and Plug, and BeRP Heat Sink Fixture are new components and were added to the Q-list in Table A.9.1 of the Submittal. A package temperature certification record (for extended maintenance packages only) is a new QA record added to Table A.9.2 of the Submittal. The QA for the RFID temperature-monitoring system is described in Chapter 9 of the Submittal. The RFID system is considered measuring and test equipment and is controlled and calibrated under Section 9.12, *Control of Measuring and Test Equipment,* of the 9977 SARP. The QA program for the extended maintenance O-ring test program is described in document, WSRC-TR-2003-00325, *Task Technical and Quality Assurance Plan for Characterization of Model 9975 Package O-rings and Celotex® Materials*.[33]

Findings
Based on review of the statements and representations in the Submittal, the Staff concludes the QA program has been adequately described and meets the QA requirements of 10 CFR 71, Subpart H. Packaging-specific requirements are adequate to assure the packaging is designed, fabricated, assembled, tested, used, maintained, modified, and repaired in a manner consistent with its evaluation.

Conditions of Approval
The Staff has concluded that no additional condition of approval is needed for the new storage/transportation CoC (DOE-S/T-1) issued for the approval of this request.

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