Safety Evaluation Report for the
Justification for Small Gram Quantity Contents
Safety Analysis Report for Packaging
Model 9977-96
Addendum 3

S-SARA-G-00006, Revision 4

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Prepared by: James M. Shuler Date: 5/28/10
James M. Shuler
Manager, DOE Packaging Certification Program
Office of Packaging and Transportation (EM-45)
Office of Environmental Management

Approved by: Frank Marcinowski Date: 6/2/10
Frank Marcinowski
Headquarters Certifying Official
Deputy Assistant Secretary for Technical and Regulatory Support (EM-40)
Office of Environmental Management

OVERVIEW

This Safety Evaluation Report (SER) summarizes the results of the Department of Energy (DOE) Packaging Certification Program (PCP) review of the Model 9977-96 Package, Addendum 3, Revision 4 for the Type 4 contents. Type 4 contents may include ^{238}Pu, ^{239}Pu, ^{241}Am, ^{244}Cm, ^{252}Cf, ^{90}Sr, ^{226}Ra, ^{137}Cs, ^{60}Co and ^{192}Ir, with the Special Actinide Isotopes (^{242m}Am, ^{243}Cm, ^{245}Cm, ^{247}Cm, ^{249}Cf and ^{251}Cf) limited to a total of 1,000 ppm, for a total of 69.5 grams of radioactive material. Type 4 pertains primarily to the Offsite Source Recovery Project (OSRP). These new contents are authorized for shipment in the Model 9977-96 Package, supplementing the existing Revision 2 to the Safety Analysis Report for Packaging (SARP). Addendum 3, *Justification for Small Gram Quantity (SGQ) Contents*, for Type 4 contents, is accepted and Revision 5 of the Certificate of Compliance (CoC) is revised, reflecting the added contents. Existing Content Envelopes for the Model 9977-96 Package include heat sources in food-pack cans or in radioisotope thermoelectric generators (RTGs), neptunium metal, a beryllium-reflected plutonium ball, plutonium/uranium metal at 25% and 50% maximum ^{240}Pu, respectively, and uranium metal at limits of 95% and 100% ^{235}U, respectively. The percentages are of total radioactive material mass. The Isentropic Compression Experiment (ICE) apparatus is an additional content of the Model 9977-96 Package SARP. The latest content added to the Model 9977-96 Package is Type 5, AGR fuel compacts.

Addendum 3 was prepared by Savannah River Packaging Technology, Savannah River National Laboratory, Savannah River Nuclear Solutions, LLC, Savannah River Site, in support of work being performed by Los Alamos National Laboratory (LANL).

The Model 9977-96 Package is currently certified under two Certificate of Compliance Numbers, i.e., USA/9977/B(M)F-96 (DOE) and USA/9977/B(M)F-96 (DOE-S/T-1), covering transportation and periodic and extended maintenance, respectively. For transportation, the Safety Analysis Report for Packaging is S-SARP-G-0001, Revision 2 (August 2007). Extended maintenance is covered by Addendum 1, *Justification for DNDO Contents*, S-SARA-G-00003, Revision 2 (October 2008).

The new Content Envelope and container configurations are incorporated into Revision 5 to the Model 9977-96 Package SARP.

This SER addresses only Type 4 contents; content Types 1, 2, and 3 will be covered under a separate SER. Content Type 5 has been dealt with in a previous SER. Hereafter, in this SER, the Type 4 content may be referred to as *Sources*.

Chapter 1: General Information

This SER documents the DOE PCP Staff's review of *Justification for Small Gram Quantity Contents, Safety Analysis Report for Packaging, Model 9977, Addendum 3*, S-SARA-G-00006, Revision 4 (March 2010)[1] (the Submittal) prepared for DOE by Savannah River Packaging Technology, Savannah River National Laboratory, Savannah River Nuclear Solutions, LLC, Savannah River Site, to support the shipment of a variety of so-called *Orphan Sources*, using the Model 9977-96 Package. This section of the SER covers the review of the General Information provided in Chapter 1 of the Submittal.

The Submittal is an Addendum to S-SARP-G-00001, Revision 2 (August 2007),[2] just as S-SARA-G-00003, Revision 2[3] is Addendum 1, *Justification for DNDO Contents*, to the Model 9977-96 Package SARP. Addendum 2 to the Model 9977-96 Package SARP is *Justification for Metal Contents*, S-SARA-G-00005, Revision 1, December 16, 2008.[4] The safety basis, described in the Submittal, addresses specific supplements to the currently approved SARP. The Model 9977-96 Package is currently certified for transportation by the DOE under Revision 4 to the CoC,[5] and for storage/transportation under Revision 0 to the CoC.[6]

The new Content Envelope, Content Type 4 (i.e., Sources), will assist the OSRP for the disposition of radioactive sources. For Sources, various radioactive isotopes have been proposed for shipment, including ^{238}Pu, ^{239}Pu, ^{241}Am, ^{244}Cm, ^{252}Cf, ^{90}Sr, ^{226}Ra, ^{137}Cs, ^{60}Co and ^{192}Ir, with the Special Actinide Isotopes (^{242m}Am, ^{243}Cm, ^{245}Cm, ^{247}Cm, ^{249}Cf and ^{251}Cf) limited to a total of 1000 ppm.

Three different types of Shielded Containers are proposed for use in transporting these Sources. The first, SGQ-SC1 is constructed of lead and encapsulated in stainless steel, with a threaded stainless steel closure. The lead provides gamma-radiation shielding. The second, SGQ-SC2, is constructed of high-density polyethylene (HDPE). The HDPE provides neutron radiation shielding. The third, SGQ-SC3, is constructed of tungsten and is also encapsulated in stainless steel, with a threaded stainless steel closure. An Engineered Container (SGQ-EC1) is also described in the Submittal and is used for shipments that do not require shielding, provided that the administrative dose rate limits of 180 mrem/hr (on contact of the unshielded source or piece) and 9 mrem/hr (at a distance of 1 meter of the unshielded source or piece) are met. This process is only allowed for unshielded sources and pieces. Shielded sources and pieces must go in one of the appropriated approved shielded containers because the shielding integrity of the sources can not be assured under hypothetical accident conditions (HAC) for the SGQ-EC1 container

Gamma-sources will be placed in the lead containers (SGQ-SC1) to meet the requirements of 10 CFR 71.47.[7] The decay heat load for the SGQ-SC1 containers is limited to 6 watts. Gamma-sources can also be placed in the tungsten containers (SGQ-SC3), as the tungsten containers are an acceptable substitute for the lead containers. Neutron-sources, on the other hand, will be placed in the HDPE containers (SGQ-SC2) to meet the neutron shielding requirements of 10 CFR 71.47. In this case, however, the decay heat load is limited to 3 watts.

The Submittal addresses nonexclusive use shipments, and the maximum weight of the payload remains at 100 pounds.

1.1 Findings

The contents for Type 4 contents are intended mainly for the shipment of what are called *Orphan Sources* and in many cases these *Orphan Sources* have been at the sites for several years. The applicant has developed mass limits for Type 4 contents and has performed calculations to estimate external dose rates when using the three shielded containers (i.e., SGQ-SC1 and SGQ-SC3 for gamma shielding and the SGQ-SC2 for neutron shielding). These calculations show that the dose limits under HAC were bounded by the dose limits under NCT. The DOE PCP Staff reviewed these calculations and in agreement with the applicant established a bounding set of mass limits for all of the Type 4 contents. The use of the Engineered Container (SGQ-EC1) for Type 4 contents, which are unshielded sources or pieces that do not require shielding, is bound by the analysis performed on three shielded containers and meet normal conditions of transport (NCT) and HAC shielding requirements. The applicant has established procedures that allow the shipper to use Type 4 contents in the SGQ-EC1 configuration provided the administrative dose limits of 180 mRem/hr (on contact of the unshielded source or piece) and 9 mRem/hr (at a distance of 1 meter of the unshielded source or piece) are met. These administrative dose limit procedures require measurements of the individual sources and the summing of sources if more than one source is placed in the SGQ-EC1 and then of SGQ-EC1 with the sources. This process is only allowed for unshielded sources and pieces. Shielded sources and pieces must go in one of the appropriated approved shielded containers because the shielding integrity of the sources can not be assured in HAC for the SGQ-EC1 container.

1.2 Conditions of Approval

DOE PCP has also concluded that the following additional conditions of approval will be added to the existing CoC[5] for the approval of this request:

- The maximum masses/activities for the proposed Type 4 contents are limited to the masses/activities noted below:

Isotope	Maximum Mass Limit [g]	Maximum Activity [Ci]
Co-60	1.0E-04	0.11
Cs-137	1.0E-01	8.70
Ir-192	3.8E-03	35.00
Sr-90/Y-90	1.0E+00	281.80
Ra-226	2.0E-01	0.20
Am-241	1.0E+00	3.43
Cf-252	6.7E-06	0.0036
Cm-244	1.0E+00	80.90
Pu-238	2.0E-01	3.42
Pu-239	6.6E+01	4.09

and

- The Packaging Configuration requirements specified in Addendum Table A.1.2, *SGQ Packaging Configuration*, must also be followed, with the additional notation that the

SGQ-SC3 (tungsten) container may be used as a suitable replacement for the SGQ-SC1 container for any of the γ-emitters.

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 above in Chapter 1. The results of the structural review are discussed below.

In Chapter 2, the Submittal presents the following information and conclusions concerning the structural requirements and performances of the Model 9977-96 Package with the Small Gram Quantity Shielded Containers (SGQ-SC1, SGQ-SC2, and SGQ-SC3) and the Engineered Container (SGQ-EC1):

- The weight of each of the containers, including the contents, is near the design payload weight of 100 lb. Thus, the overall impact performance of the package is unchanged, and the maximum impact acceleration measured from the certification drop tests are used for the design of the shielded carrier and its supports within the containment vessel cavity (spacers).
- The allowable decay heat rate is 19 watts for the contents. However, the rate is reduced to 6 watts for the contents of SGQ-SC1, and to only 3 watts for those of SGQ-SC2. These reductions are necessary to maintain adequate strength of the shielding materials. These requirements are supported by the thermal analyses described in Chapter 3 of this Submittal. Chapter 3 also provides estimates of the maximum normal operating pressure (MNOP). They are bounded by the design MNOP of the 9977-96 package.
- The SGQ design requires each of the contents carriers/containers, except for the SGQ-EC1, to maintain its structural integrity during NCT. Because the SGQ-EC1 is intended for use for contents without significant radiation emissions, and its structural integrity is not a concern. Appendix 2.1 of Chapter 2 of the Submittal[8] has demonstrated by analysis that the weakest carrier (SGQ-SC1) would survive a 4-ft NCT free drop. Since test results of the package have shown that the HAC free drop produces about the same maximum impact accelerations, the contents carriers are also expected to survive the HAC drops. Thus the design of the carriers has exceeded the regulatory requirements.

2.1 Findings

Based on the review of the statements and representations in Revision 4 of the Submittal, the DOE PCP Staff has concluded that the packaging design has been adequately described to meet the structural requirements of 10 CFR 71. DOE PCP finds the information and conclusions in Chapter 2 acceptable. DOE PCP concurs that the contents carriers SGQ-SC1, SGQ-SC2, SGQ-SC3 and SGQ-EC1 have adequate structural performance to meet the safety requirements of 10 CFR 71.

2.2 Conditions of Approval

DOE PCP has concluded that no additional structurally-related conditions of approval need to be added to the existing transportation CoC 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 its associated Appendices.

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

The Model 9977-96 Package is presently authorized for the shipment of contents in RTGs, Food-Pack Cans, DOE-STD-3013 Containers, and Engineered Containers.[5] The maximum decay heat from radioactive contents is limited to 19 watts for the package, which is based on the considerations of materials integrity for the 6CV and on the maximum operational temperature limit of the Viton® O-Rings.[9]

This addendum requests new contents and new package configurations. The newly proposed contents are listed as Type 4 Sources. The decay heat limits per package are 6 watts for the Lead Shielded Container (i.e., the SGQ-SC1) configuration, and only 3 watts for HDPE Shielded Container (the SGQ-SC2) configuration. Although the Tungsten Shielded Container (the SGQ-SC3) configuration is actually rated for up to 19 watts, the Tungsten Shielded Container configuration, in this case, is only allowed as an acceptable substitute for the Lead Shielded Container configuration.

The limiting temperature for the lead is 200 °F, as required in the structural evaluation.[8] For HDPE and tungsten, the limiting maximum temperatures are 226 °F and 6,129 °F, respectively.

The Submittal indicates that the maximum local temperature of the lead is about 247 °F under NCT, including insolation, and is less than 199 °F, under NCT, without insolation. For HDPE, the maximum local temperature under NCT with insolation is marginal. However, the shipment is proposed to be in a closed conveyance under non-exclusive use shipment.

There is no calculation for the case of NCT without insolation for the SC2 configuration, however based on the results of higher decay heat in that configuration, the HDPE will be below the limiting temperature of 226 °F.

The maximum temperatures for the accessible surfaces of the package for all loading configurations are below the required 122 °F for non-exclusive use shipment by about 13%. Under NCT, the maximum temperatures for the CV and the O-Rings are 236°F and 228°F, respectively, which are lower than the corresponding 321°F and 302 °F temperatures of the original Model 9977-96 SARP results.

Under HAC conditions, the maximum component temperatures for the CV and the O-Rings are less than the values reported in the Model 9977-96 SARP as a result of less thermal loading with the Type 4 contents.

The MNOP for the Model 9977-96 Addendum 3 is based on the configuration using the SGQ-SC2. The maximum normal operating pressure (under NCT) is 117.3 psia (102.6 psig), which includes contributions from decomposition gases of plastic bag material, decomposition from 4.7 kg HDPE, and helium generation from the radioactive decay of the contents. The

assumptions for the calculations [2, 8] are reasonable, and a safety factor for the MNOP of about 7 is demonstrated. Although the calculation of the containment vessel pressure under HAC reported in the addendum is incomplete because the gas generation from HDPE was not included, the DOE PCP Staff estimated that the pressure in the CV under HAC should be less than 137 psig, which results in a safety margin of about 5.8.

3.1 Findings

On the basis of the review of the statements and representations in the Submittal, the DOE PCP has concluded that the packaging design has been adequately described to meet the requirements of 10 CFR 71.

3.2 Conditions of Approval

DOE PCP has concluded that no additional thermally-related conditions of approval need to be added to the existing CoC 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 proposed addition of the Type 4 contents to the Model 9977-96 Package SARP does not increase the impact loading on the containment vessel, the temperatures that must be sustained, or the pressure that must be contained. Therefore, package containment *leaktight* performance (in accordance with ANSI Standard N-14.5[10]), as documented in the existing Model 9977-96 Package SARP, is still valid for the Type 4 contents addition.

4.1 Findings

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

4.2 Conditions of Approval

DOE PCP has concluded that no additional containment-related conditions of approval need to be added to the existing CoC for the approval of this request.

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 review are discussed below.

5.1 Shielding Evaluation

This SER covers the review of Type 4 contents, material contents from the OSRP. The applicant has provided external dose rates for the these sources placed inside the lead shielded container

(SGQ-SC1) for the gamma-sources and the HDPE shielded container (SGQ-SC2) for the neutron emitters that, in turn, are placed inside the 6-inch containment vessel of the Model 9977-96 packaging. The neutron and gamma-source terms for these materials were estimated using the standard accepted codes.

The applicant performed calculations to estimate the external dose rates using 1 gram of each material. The bounding dose rate was determined to be at the surface of the package, which has a regulatory limit of 200 mrem/h. The applicant scaled down the mass such that the bounding dose rate at the surface is 190 mrem/h, thus allowing an additional 5% margin to the regulatory limit. The DOE PCP Staff performed confirmatory calculations, and, for the most part, matched the applicant's estimates of the maximum shippable mass for each isotope. In some cases, the applicant's estimates were lower than the DOE PCP Staff's estimates, while in others, the reverse was true. In the interest of conservatism in these estimates, it was recommended by the DOE PCP Staff that the smaller amount of the two estimates be taken as the bounding mass for each isotope. This recommendation was accepted by the applicant, and the set of bounding mass limits were included as the bounding set of mass limits for the Type 4 contents listed in Table A.1.1 of the Addendum. The table below specifically outlines these specified limits.

Isotope	Recommended Maximum Mass Limit [g]	Recommended Maximum Activity [Ci]
Co-60	1.0E-04	0.11
Cs-137	1.0E-01	8.70
Ir-192	3.8E-03	35.00
Sr-90/Y-90	1.0E+00	281.80
Ra-226	2.0E-01	0.20
Am-241	1.0E+00	3.43
Cf-252	6.7E-06	0.0036
Cm-244	1.0E+00	80.90
Pu-238	2.0E-01	3.42
Pu-239	6.6E+01	4.09

5.2 Findings

On the basis of the review of the statements and representations in the Submittal and independent estimates by the DOE PCP Staff, the PCP has concluded that the packaging design has been adequately described to meet the external radiation requirements of 10 CFR 71 for Type 4 contents, provided that the individual mass limit of each isotope provided listed in the table above is not exceeded, and provided that the appropriate shielded containers are used SGQ-SC1 for the gamma sources, and SGQ-SC2 for the neutron sources. Combinations of isotopes are permitted provided that the individual mass limit of each isotope is not exceeded, and the overall external dose rates meet the regulatory limits.

The contents for Type 4 contents are intended mainly for the shipment of what are called *Orphan Sources* and in many cases these *Orphan Sources* have been at the sites for several years. The applicant has developed mass limits for Type 4 contents and has performed calculations to

estimate external dose rates when using the three shielded containers (i.e., SGQ-SC1 and SGQ-SC3 for gamma shielding and the SGQ-SC2 for neutron shielding). These calculations show that the dose limits under HAC were bounded by the dose limits under NCT. The DOE PCP Staff reviewed these calculations and in agreement with the applicant established a bounding set of mass limits for all of the Type 4 contents. The use of the Engineered Container (SGQ-EC1) for Type 4 content which are unshielded sources or pieces that do not require shielding is bound by the analysis performed on three shielded containers and meet NCT and HAC shielding requirements. The applicant has established procedures that allow the shipper to use Type 4 contents in the SGQ-EC1 configuration provided the administrative dose limits of 180 mRem/hr (on contact of the unshielded source or piece) and 9 mRem/hr (at a distance of 1 meter of the unshielded source or piece) are met. These administrative dose limit procedures require measurements of the individual sources and the summing of sources if more than one source is placed in the SGQ-EC1 and then of SGQ-EC1 with the sources. This process is only allowed for unshielded sources and pieces. Shielded sources and pieces must go in one of the appropriated approved shielded containers because the shielding integrity of the sources can not be assured under HAC for the SGQ-EC1 container.

5.3 Conditions of Approval

The CoC must contain the restriction that the Type 4 contents be bounded by the individual mass limits prescribed in Table A.1.1 of the Addendum, and that the appropriate shielded containers are used (i.e., SGQ-SC1 for the gamma-sources and SGQ-SC2 for the neutron-sources). Combinations are permitted, with the contents placed in the appropriate shielded container, provided that the individual mass limits of each isotope is not exceeded and that all external radiation dose rate limits comply with 10 CFR 71 requirements governing non-exclusive shipments. Shielded sources and pieces must go in one of the appropriated approved shielded containers because the shielding integrity of the sources can not be assured in HAC for the SGQ-EC1 container.

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 the introduction to Chapter 1. The results of the criticality review are discussed below.

6.1 Criticality Evaluation

Chapter 1 specifies that the Type 4 contents are composed of Pu-238, Pu-239, Am-241, Cm-244, a trace amount of Cf-252, and a few other radioactive isotopes, such as Sr-90, Ra-226, Cs-137, Co-60, and Ir-192. The total amount of Type 4 contents is less than 80 grams. In addition, the Type 4 contents excludes a few fissile materials (e.g., Cf-251,Cf-249, Am-242m, Cm-247, Cm-245, and Cm-243), which are restricted to trace amounts (i.e., less than 1,000 ppm, or 0.1 gram), because they have critical masses much lower than those of uranium and plutonium isotopes.[2] Also worth noting is that 0.1 grams of special actinides can be bounded by 9 grams of equivalent Pu-239 (conservatively assuming all special actinides are composed of Cf-251, which is most reactive; the subcritical mass limit of Cf-251 is 5 grams; and the subcritical mass limit of Pu-239 is 450 grams; thus, the Eq. Pu is 0.1*450/5 = 9 grams).

The criticality evaluation for the Type 4 contents was performed by using the bounding calculations for the Type 2 contents envelope.[11] The Type 2 contents are limited to 100 grams of fissile and non-fissile materials, as is shown in Table A.1.1 of the Submittal. The Type 2 analyses were performed with the most widely used fissile isotopes (e.g., U-235, U-233, Pu-239, and Pu-241). Therefore, the bounding fissile content for Type 4 analyses is less, compared to those for Type 2, and is therefore conservative.

Light elements and impurities are limited to 50 grams for the Type 4 content envelope (identical to Type 2). The analyses were performed with a very conservative assumption that all light elements and impurities are beryllium (Be). For criticality analyses, Be will bound any combination of light elements and impurities as a moderator and/or reflector. The use of 100 grams of polyethylene material to represent a few plastic bags for contamination control is also conservative.

Single Package Analysis. These analyses were performed by using a sphere of fissile material reflected by Be or Poly inside the 6CV with or without an SGQ-SC2 polyethylene shielded container. It is noted that no calculations with lead-shielded or tungsten-shielded containers in the 6CV were provided, and also that the polyethylene shielding container model is quite different from the actual container. A simple independent scoping calculation with Pu-239 enclosed with 12 inches of poly, lead or tungsten demonstrates that the reactivity with the polyethylene container will bound those from the other two types of shielding container. The polyethylene container model is judged to be conservative. It is also noted that beryllium, as a form of reflector, is more effective compared to mixing with the fissile material. This was demonstrated in the evaluation of the SARP for the Model 9975 Package.[12, 13, 14, 15]

A similar trend is also observed in this evaluation, as is shown in Table A.6.12 of the Submittal. Reactivity differences between four different types of fissile material are significant. However, only one type of fissile material is present in the Type 4 contents. All k_{eff} results are less than 0.3, as is shown in Table A.6.12 of the Submittal, which shows that there is a significant reactivity margin available, as the k_{safe} value is 0.931.

Single package solution calculations were provided without using any type of shielded container, which is conservative. The maximum reactivity (k_{eff} = 0.57) was near the Pu-239 concentration of 0.03 g/cc (see Table A.6.13 in the Submittal). The concentration of Pu-238 near the concentration of 0.03 g/cc will produce minimum critical mass,[16] assuming a spherical, homogeneous mixture of water with Pu-239. It is noted that the subcritical mass limit for Pu-239 in solution is 450 grams, as is shown in ANSI/ANS 8.1.[17]

NCT Analyses. The NCT analyses were performed with an infinite number of Model 9977-96 shipping containers. All k_{eff} results are less than 0.3, similar to those for the single package analyses. The analyses show that there is a significant reactivity margin available for the NCT scenarios, as the k_{safe} value is 0.931. The interaction between shipping containers is minimal, as demonstrated for the Model 9975 Package[12-15] and the Model 9978 Package.[18] The drum for the Model 9977-96 Package has the same dimensions as the drum for the Model 9975 Package, and, therefore, the separation distances among fissile materials are very similar between the two types of drums. It may also be noted that the subcritical mass limit for Pu-239 metal is 5.0 kg.

HAC Analyses. The HAC analyses were performed with an infinite number of Model 9977-96 shipping containers. A very conservative 2-cluster model was used. This model is conservative and very similar to those employed earlier for the Model 9975 and Model 9978 Packages. The HAC model correctly considered the damaged configuration by using the fire and drop test data. All k_{eff} results are less than 0.36. It shows that there is a significant reactivity margin available for HAC scenarios, as the k_{safe} value is 0.931.

Code Verification and Validation. Scale code verification and validation were properly performed and documented. The k_{safe} value of 0.931 is similar to the values employed for the Model 9975 and Model 9978 Packages.

Therefore, it is concluded that the Type 4 Content envelope for Model 9977-96 shipping container remains subcritical under the Single Package, NCT and HAC scenarios.

6.2 Findings

On the basis of the review of the statements and representations in the Submittal, DOE PCP has concluded that the packaging design and bounding analyses have been described adequately to meet the requirements of 10 CFR 71.

6.3 Conditions of Approval

DOE PCP has concluded that no additional criticality-related conditions of approval need to be added to the CoC for the approval of this application. DOE PCP has further concluded that the new Type 4 Content envelope for the Model 9977-96 Shipping Container can be shipped with a CSI of 0.0.

Chapter 7: Package Operations

This section of the SER covers the DOE PCP Staff's review of the Package Operations information provided in Chapter 7 of the Submittal.

Details of the items reviewed are listed in the introduction to Chapter 1. The results of the Package Operations review are discussed below.

7.1 Findings

The existing Model 9977 SARP provides the basic procedural steps for operating the Model 9977 Package for the previously accepted contents. For the Type 4 contents the requirements specified in Section 1.2.2.2.1 and in Tables A.1.1 and A.1.2 of the Submittal must also be followed, along with the specific procedures outlined in Steps 1-8, 10, 11, 12, 14, and 15 of Section 7.1.1.2 of the Submittal. Section 7.1.1.2 provides adequate information for the shipper however care is needed in reading these requirements because Addendum 3 was written to cover 5 content envelopes and only Type 5 (approved in an earlier revision) and Type 4 (this review) are approved for shipment.

7.2 Conditions of Approval

Because the requirements specified in the Operating Procedures Chapter of the SARP are normally incorporated, in their entirety, as Conditions of Approval in the CoC, the DOE PCP has concluded that, for the Type 4 Contents the requirements specified in Section 1.2.2.2.1, Tables A.1.1 and A.1.2, along with the specific procedures outlined in Steps 1-8, 10, 11, 12 , 14, and 15

of Section 7.1.1.2 of the Submittal must be included as new Conditions of Approval in the CoC for the approval of this request.

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 review are discussed below.

The addition of the Type 4 contents does not affect the Acceptance Testing of the packaging, nor does it affect the Maintenance Program requirements. Therefore, the package acceptance testing and basic maintenance program requirements, documented in the existing Model 9977-96 Package SARP, remain valid.

The Addendum states that the Small Gram Quantity Shielded Containers perform a function integral to the Package Safety performance and its compliance with the Code of Federal Regulations. As such, the Shielded Containers have required Quality ("Q") dimensional inspections listed in Addendum Appendix 8.2, which are documented per SARP Table 9.7, with the documentation issued to the Design Authority for retention."

8.1 Findings

On the basis of the review of the statements and representations in the Submittal, DOE PCP has concluded that the packaging design has been adequately described to meet the operational requirements specified in 10 CFR 71.

8.2 Conditions of Approval

Because other sites may fabricate the approved shielded containers, DOE PCP has concluded that the following additional condition of approval needs to be added to the existing CoC for the approval of this request:

- The documentation packages for the Q items, numbered as 17–30, in Table A.App.8.2.1 must be supplied by the Site directing fabrication, to Savannah River National Laboratory as the Design Authority/Design Agency.

The next revision of Addendum 3, which will be supporting the addition of Type 1, Type 2 and Type 3 contents, shall update Chapter 8 to include the above requirement.

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.

The Submittal describes that the QA Program for the Model 9977-96 Package is documented in the *SARP for the Model 9977-96 Packaging*.[2] Chapter 9 of the Submittal contains a revised Q-list adding the two Shielded Containers, one Engineered Container, two Spacers, and Cup. The DOE PCP Staff concurs that the addition of the sources, two Shielded Containers, one Engineered Container, two Spacers, and Cup do not affect the QA program as stated in Chapter 9 of the existing SARP, and that Chapter 9 of the existing SARP contains a reasonably up-to-date description of the applicant's QA program and packaging-specific QA requirements.

Findings

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

Conditions of Approval

DOE PCP has concluded that no additional QA-related conditions of approval need to be added to the existing CoC for the approval of this request.

References

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