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Technical Review Report for the Justification for 9975 Gram Based Content Envelopes, C.10 and C.11

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Disclaimer

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Technical Review Report for the

Justification for 9975 Gram Based Content Envelopes, C.10 and C.11

Safety Analysis Report for Packaging

Model 9975

Addendum

S-SARA-G-00007, Revision 1

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Packaging and Transportation Safety Group
Global Security Principal Directorate
Lawrence Livermore National Laboratory

OVERVIEW

The Department of Energy (DOE) desires to ship Model 9975-85 and Model 9975-96 Packages loaded with Pu/U metal and Pu/U oxide materials as identified in new Content Envelopes C.10 and C.11. The new Content Envelopes C.10 and C.11 consist of radioisotopes and impurities that are similar to the existing C.3, Pu/U metal, and C.4, Pu/U oxide, Content Envelopes but that list the radioisotopes as gram values in lieu of the existing weight percent of radioactive material mass values listed for the C.3 and C.4 Content Envelopes.

Authorization for shipment requires acceptance of this report by the DOE-Headquarters (HQ) Certifying Official (EM-10/EM-2) as an Addendum to WSRC-SA-2002-00008, Revision 0, S-SARA-G-00001, Addendum 1, Revision 0, and S-SARA-G-00002 Addendum 2, Revision 1, of the *Model 9975-85 Package Safety Analysis Report for Packaging* (SARP). This Addendum also applies to S-SARP-G-00003, Revision 0, of the Model 9975-96 Package SARP. These documents are collectively referred to as the existing Model 9975 Package SARP. The safety basis described addresses specific supplements to the currently approved safety basis. Justification is made for shipping the new Content Envelopes C.10 and C.11 under this Addendum.

Following acceptance of this Addendum by EM-10/EM-2 and subsequent revision to the current Certificates of Compliance (CoCs), the new contents will be authorized for shipment in the Model 9975 Package. The new Content Envelopes will be incorporated into the next revision to the Model 9975-85 and Model 9975-96 Package SARPs.

Chapter 1: General Information

This Technical Review Report (TRR) documents the staff's review of *Justification for 9975 Gram Based Content Envelopes, C.10 and C.11, Safety Analysis Report for Packaging, Model 9975, Addendum*, [1]— the Submittal — prepared for the Department of Energy (DOE) by Savannah River Packaging Technology, Savannah River National Laboratory, Savannah River Nuclear Solutions, to support shipment of special nuclear materials in the Model 9975-85 Package and Model 9975-96 Package. This section of the TRR covers the review of the General Information provided in Chapter 1 of the Submittal.

The Submittal is an Addendum to WSRC-SA-2002-00008, Revision 0,[2] S-SARA-G-00001, Addendum 1, Revision 0,[3] and S-SARA-G-00002, Addendum 2, Revision 1,[4] of the Model 9975-85 Package Safety Analysis Report for Packaging (SARP). This Addendum also applies to S-SARP-G-00003, Revision 0, of the Model 9975-96 Package SARP.[5] These documents are collectively referred to as the existing Model 9975 Package SARP in the Submittal. The safety basis, described in the Submittal, addresses specific supplements to the currently approved SARP. Justification is made for shipping the new Content Envelopes C.10 and C.11 under this Addendum. The Model 9975-85 Package is currently certified by the DOE under Revision 21 to the Certificate of Compliance (CoC),[6] while the Model 9975-96 Package is certified by the DOE under Revision 1 to the CoC.[7]

The new Content Envelopes, C.10 and C.11, will assist with de-inventory of the Super Block at Lawrence Livermore National Laboratory (LLNL) and other facilities in the DOE Complex in that materials, characterized by a weight percent of radioactive materials exceeding Table 1.2 in the Model 9975-85 Package SARP and in the Model 9975-96 Package SARP, can now be shipped to other sites for disposition using a Content Envelope specified in grams.

The C.10 and C.11 Content Envelope changes do not affect either the Model 9975 packaging configurations or packaging components. The radioisotope gram weight limits in Addendum Table 1.1, *C.10 and C.11 Content Envelopes*, were derived to limit the quantities to be within existing elements (structural, thermal, containment) of the safety basis for the Packages as supported by the supplemental shielding and criticality analyses. For example, the gram quantities of ^{238}Pu and ^{241}Am in Addendum Table 1.1 are limited by the 19-W limit for the Model 9975 Package. Also, for Content Envelope C.10, gram quantities each of ^{240}Pu (m^{240}Pu) and ^{242}Pu (m^{242}Pu) are controlled by the following algorithm to keep the surface dose rate within the regulatory limit of 200 mrem/h:

$$m^{242}Pu + 0.596m^{240}Pu \leq 1290 \text{ g}$$

The existing operational controls and configuration requirements for the Content Envelope C.3 and Content Envelope C.4 materials also apply to the C.10 and C.11 Content Envelopes, as well, as can be seen in Addendum Table 1.2, *Summary of Requirements by Content and Configuration*. The same packaging configurations are used in the Addendum as used in Table 1.3, *Summary of Requirements by Content and Configuration*, for the Model 9975-85 Package and Model 9975-96 Package. For example, 3013 containers, food-pack cans, and hex-can configurations are used for both the Addendum and the Model 9975 Package. The C.10 and C.11 Content Envelope limits for Impurities and Total Mass are the same values as the existing

Content Envelope C.3 and Content Envelope C.4 limits. The Addendum Table 1.1, *Table Notes*, were revised to reflect the gram weight values (in lieu of existing SARP Table 1.2 weight percent of total radioactive material values) and to omit notes not applicable to the C.10 and C.11 Envelopes. A supplemental shielding analysis[8] and a supplemental criticality safety evaluation[9] were performed to support the Content Envelope C.10 and Content Envelope C.11 gram weight limits. These will be discussed in Chapter 5 and in Chapter 6 of this TRR.

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.[10]

Conditions of Approval
The staff has concluded that the following conditions of approval need to be added to the existing CoCs[6,7] for the approval of this request:

- Addendum Table 1.1, *C.10 and C.11 Content Envelopes*, and Addendum Table 1.1, *Table Notes*, and
- Addendum Table 1.2, *Summary of Requirements by Content and Configuration*.

Chapter 2: Structural Evaluation

This TRR covers the staff's findings regarding the review of the Submittal. This section covers the review 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.

The C.10 and C.11 Content Envelope additions do not modify or exceed the total payload mass certified for shipment in the Model 9975 package. The maximum content weight and packaging configuration authorized is the same as evaluated in the Model 9975 SARP. The package structural performance documented in the existing Model 9975 SARP is valid for the C.10 and C.11 Content Envelope additions.

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 structural requirements of 10 CFR 71.

Conditions of Approval
The staff has concluded that no additional structurally-related conditions of approval need to be added to the existing CoCs for the approval of this request.

Chapter 3: Thermal Evaluation

This TRR covers the staff's findings regarding the review of the Submittal. This section covers the review of the Thermal Evaluation information provided in Chapter 3 of the Submittal and Appendices of the Submittal.

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

The C.10 and C.11 Content Envelope additions maintain the existing 19-W decay heat limit, and the packaging configuration and requirements are the same as that evaluated for the existing C.3 Pu/U metal and C.4 Pu/U oxide Content Envelopes, so there is no adverse affect on the thermodynamic performance of the package.

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 thermally-related conditions of approval need to be added to the existing CoCs for the approval of this request.

Chapter 4: Containment

This TRR covers the staff's findings regarding the review of the Submittal. This section covers the review of the Containment information provided in Chapter 4 of the Submittal.

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

The C.10 and C.11 envelope additions do not increase the loading within the containment vessels, and do not increase the evaluated maximum temperature that must be sustained or the pressure that must be contained. Therefore, package containment *leaktight* performance (in accordance with ANSI Standard N-14.5[11]) as documented in the existing Model 9975 SARP is valid for the C.10 and C.11 Content Envelope additions.

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 containment-related conditions of approval need to be added to the existing CoCs for the approval of this request.

Chapter 5: Shielding Evaluation

This TRR covers the staff's findings regarding the review of the Submittal. This section covers the review of the Shielding Evaluation information provided in Chapter 5 of the Submittal.

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

The Model 9975 Package has a lead shield that provides gamma shielding. It does not have any neutron shielding features incorporated into the design and instead relies on the distance from source to external points of interest to attenuate the neutron dose rate. Other features, such as the Primary Containment Vessel (PCV) and Secondary Containment Vessel (SCV) walls, the lead shield, the Celotex®, and the drum walls, provide some additional attenuation for both neutrons and gammas. The material containers inside the PCV do not contribute much to attenuate the radiation and have not been included in the shielding analysis by the applicant. For the Hypothetical Accident Conditions (HAC) cases, only the PCV and SCV were assumed to be present, and the 1-m dose rates were estimated from the outer surface of the SCV.

The approach taken by the applicant was to estimate the neutron and gamma source terms, based on 1 g of each isotope that could be part of the payload as presented in Table 5.2, *Content Envelope Composition*, of the Addendum.[1] Source terms for the neutrons and the gammas were calculated based on 1 g of the isotope without any impurities for both the metallic contents (Content Envelope C.10) and for the oxide form (Content Envelope C.11). Where appropriate, the isotopes were decayed to produce a bounding source term. Since subcritical multiplication was not included in the neutron source term, the neutron dose-rate calculations included 4,400 g of ^{239}Pu in metallic form for C.10 and oxide form for C.11 as a conservative way of accounting for these additional neutrons and their progeny. The gamma dose-rate calculations also included the 4,400 g of ^{239}Pu. Therefore, the self-shielding by the ^{239}Pu mass was accounted for, especially in the gamma dose-rate calculations. This is a reasonable assumption because contents of this mass can typically be present in the PCV.

The neutron, neutron-induced gamma, and gamma dose rates on a per gram basis were calculated for all the isotopes listed in Table 5.2, *Content Envelope Composition*, of the Addendum. The 3-sigma upper bound of the individual dose rates was determined and added up to give the total dose rate at the various measurement points. The applicant ranked these on a per gram basis by isotope.[8] Following this, starting with the highest contributing isotope, the contribution per gram was multiplied by the total mass of that isotope until a total mass of 4,400 g was reached for that Content Envelope. For Content Envelope C.10, the combination of ^{240}Pu and ^{242}Pu at 2,200 g each gave rise to dose rates exceeding the regulatory limits. As a result, the mass limits for ^{240}Pu and ^{242}Pu were reduced to 1,450 g and 400 g, respectively, for Content Envelope C.10. To maintain dose rates within regulatory limits, the masses of these two isotopes will be required to comply with the following criterion:

$$m^{242}\text{Pu} + 0.596m^{240}\text{Pu} \leq 1290 \text{ g}$$

The mass limit of 188.9 g of ^{241}Pu/^{241}Am, used by the applicant, was based on the assumption that the maximum mass of ^{241}Am would be limited to 168 g to comply with the 19-W decay heat limit of the package. To achieve this mass, which would occur at approximately 73 years from the decay of ^{241}Pu, the initial mass of ^{241}Pu would have to be 188.9 g, i.e., peak ^{241}Am = 0.89^{241}Pu. The staff notes that the actual decay heat per gram of ^{241}Am is approximately 0.114 W, so the mass equivalent to 19 W would be 166.7 g of this isotope. However, the inclusion of 188.9 g of ^{241}Pu/^{241}Am, though not possible from the decay heat limitation of the package, has been confirmed by the staff to be compliant with external dose-rate levels when included in the payload. This finding will be discussed in more detail later in this Chapter of the TRR.

For the case with impurities, the applicant included 500 g of Be as a bounding impurity and determined that the dose rates with 34 g of ^{238}Pu or with 188.9 g of ^{241}Am would far exceed regulatory limits. The applicant concluded that, in case of impurities being present, acceptability for shipment must be demonstrated by measurements on a case-by-case basis as described in the Model 9975 Package SARP.[2,3,4,5]

The tables presented by the applicant in the Addendum[1] and in Reference 5.1 to the Addendum[8] show different mass limits for Normal Conditions of Transport (NCT) and for HAC cases for the same contents. This seeming inconsistency is caused by using the ranking procedure that the applicant applied to achieve a bounding set of isotopes with a total mass of 4,400 g for both NCT and HAC.

The staff performed selected calculations on a per gram basis to confirm the applicant's results and found them to be correct. Furthermore, the staff combined the mass limits, presented in Table 5.2 of the Addendum[1] with the per gram dose rates of each isotope, to demonstrate that the regulatory external dose-rate limits for non-exclusive shipment can still be met. Table 5.1 of this TRR lists the dose rates at the package surface (regulatory limit of 200 mrem/h) and at 1 m from the package surface for NCT (regulatory limit of 10 mrem/h) and the dose rate at 1 m from the SCV surface for HAC (regulatory limit of 1000 mrem/h) as calculated by the staff. Table 5.1 indicates that surface dose rates at NCT are close to the regulatory limits for these very conservative estimates. However, the conditions of mass limit for actinides of 4,400 g, combined with the 19-W decay heat limit, would produce much lower values of dose rates. The staff, based on this bounding analysis, concludes that a combination of all the isotopes at their mass limits would still meet the regulatory requirements.

Table 5.1. Dose Rates for Non-Exclusive Shipments based on Total Limits for Isotopes

Isotope	Mass in grams		NCT dose rate at surface in mrem/h		NCT dose rate at 1 m in mrem/h		HAC dose rate at 1 m in mrem/h	
	C.10	C.11	C.10	C.11	C.10	C.11	C.10	C.11
^{238}Pu	34	34	7.14E+00	1.41E+01	2.03E-01	4.73E-01	2.92E-01	6.83E-01
^{239}Pu	4400	4400	2.35E-01	4.80E+00	6.86E-03	1.61E-01	1.24E-01	5.02E-01
^{240}Pu	1450	2200	1.18E+02	5.90E+01	3.39E+00	1.98E+00	4.70E+00	2.86E+00
^{242}Pu	400	2200	5.48E+01	8.54E+01	1.56E+00	2.88E+00	2.16E+00	4.16E+00
$^{241}Pu/^{241}Am$	188.9	188.9	5.57E-01	1.41E+01	1.63E-02	4.74E-01	1.68E-01	1.21E+00
^{243}Am	1	1	6.76E-04	4.20E-03	1.94E-05	1.42E-04	2.76E-03	4.12E-03
^{244}Cm	0.0044	0.0044	3.78E+00	1.09E+00	1.08E-01	3.66E-02	1.49E-01	5.24E-02
^{237}Np	220	220	1.83E-01	3.56E-01	6.91E-03	1.08E-02	2.75E-01	6.71E-01
^{232}U	0.00044	0.00044	1.22E+01	1.96E+01	3.69E-01	6.95E-01	9.50E-01	1.94E+00
^{233}U	427	427	2.93E-03	5.64E-02	1.08E-04	1.89E-03	6.11E-03	1.73E-02
^{234}U	4400	4400	2.67E-03	3.31E-01	7.74E-05	1.12E-02	2.40E-03	2.17E-02
^{235}U	4400	4400	1.28E-03	1.21E-03	2.73E-05	3.72E-05	3.31E-03	8.01E-03
^{236}U	2640	2640	2.30E-03	3.75E-03	6.57E-05	1.28E-04	5.10E-05	1.05E-04
^{238}U	4400	4400	4.75E-03	1.35E-03	1.35E-04	4.49E-05	1.87E-04	6.56E-05
^{232}Th	4400	4400	4.22E-08	2.49E-06	1.21E-09	8.36E-08	4.80E-08	2.25E-07
Total	**27360.90**	**29910.90**	**1.97E+02**	**1.99E+02**	**5.66E+00**	**6.73E+00**	**8.83E+00**	**1.21E+01**

Note: Maximum actinide mass is limited to 4,400 g and the decay heat is limited to 19 W.

Findings

The staff observed that the applicant had inconsistent masses for an isotope in the NCT and in the HAC cases for the same contents. Nonetheless, the overall conclusions as presented in the Addendum are satisfactory. The staff has confirmed that the Model 9975 Package with the gram-based limits presented in Table 1.1 of the Addendum for the metallic contents and the oxide contents without any impurities will comply with the external radiation dose-rate limits set forth in 10 CFR Part 71. Any contents with impurities will require measurements on a case-by-case basis to ensure compliance with 10 CFR Part 71.

Conditions of Approval

The CoCs must also contain the restriction that the contents be bounded by Table 1.1 of the Addendum.

For Content Envelopes C.10 and C.11 with impurities, measurements must be made as described in Appendix 5.1 to the Model 9975-85 SARP[2] and to the Model 9975-96 SARP[5] on a case-by-case basis to ensure compliance with regulatory limits on external radiation.

Chapter 6: Criticality Evaluation

This TRR covers the staff's findings regarding the review of the Submittal. This section covers the review of the Criticality Evaluation information provided in Chapter 6 of the Submittal.

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

Criticality Evaluation

Two new Content Envelopes, C.10 and C.11, were evaluated as a part of this Model 9975 Package SARP *Justification for Gram Based Content* Addendum. The Content Envelopes C.10 and C.11 are very similar to previously analyzed Content Envelopes C.3 and C.4, respectively. The isotopic contents for C.3 and C.4 were specified as weight percent of total radioactive materials mass. On the other hand, the isotopic contents for C.10 and C.11 were specified as the gram amount of material in the Content Envelope, as shown directly below in Table 6.1 of this TRR.

Table 6.1. Comparison of Isotopic Content Specifications for C.3/C.4 and C.10/C.11

	C.3/C.4 (Pu/U Metal or Pu/U Oxide), wt%	C.3/C.4, grams	C.10/C.11 (Pu/U Metal or Pu/U Oxide), grams
Fissile			
^{239}Pu	100	4,400	4,400
^{241}Pu	15	660	188.9
^{235}U	100	4,400	4,400
^{233}U	*0.5*	*22*	*427*
Fissionable			
^{238}Pu	2	88	34
^{240}Pu	50	2,200	1,450 (2,200 for C.11)
^{242}Pu	*5*	*220*	*400 (2,200 for C.11)*
^{243}Am	*1×10^{-4}*	*4.4×10^{-3}*	*1*
^{244}Cm	1×10^{-4}	4.4×10^{-3}	4.4×10^{-3}
^{237}Np	5	220	220
^{232}U	1×10^{-5}	4.4×10^{-4}	4.4×10^{-4}
^{234}U	100	4,400	4,400
^{236}U	*40*	*1,760*	*2,640*
^{238}U	100	4,400	4,400
^{232}Th	*23*	*1012*	*4,400*

The important differences are noted for isotopes ^{233}U, ^{242}Pu, ^{243}Am, ^{236}U, and ^{232}Th, where the mass of the isotopes increased. Only one out of these five isotopes is fissile, (^{233}U); the rest are fissionable. The four fissionable isotopes (^{242}Pu, ^{243}Am, ^{236}U, and ^{232}Th) have subcritical mass limits in the tens of kilograms, or more.[12,13] The subcritical mass limit of ^{233}U is larger than that of ^{239}Pu. For example, the subcritical mass limit for an aqueous solution of ^{233}U is 500 g versus 450 g for ^{239}Pu.[12] The subcritical mass limit for ^{233}U metal is 6,000 g versus 5,000 g for ^{239}Pu.[12] Therefore, ^{233}U is bounded by ^{239}Pu. It may be noted that 100 wt% of ^{239}Pu (4,400 g)

was used as the bounding value for criticality analyses in the Model 9975 Package SARP. This was justified, provided that the amount of ^{240}Pu is greater than the amount of ^{241}Pu. This condition remains unchanged for the new contents. Therefore, any increase in mass value for ^{242}Pu, ^{243}Am, ^{236}U, and ^{232}Th will, in fact, reduce the system reactivity so long as the total radioactive material mass remains at 4,400 g for each Model 9975 Package.

Therefore, it is concluded that the new Content Envelopes C.10 and C.11 for the Model 9975 Package SARP are bounded by the original criticality evaluations for Content Envelopes C.3 and C.4, respectively. The Model 9975 Package SARP with the new Content Envelopes C.10 and C.11 can be used with a Criticality Safety Index (CSI) of 2.0 without any detailed, explicit criticality analyses.

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 new Content Envelopes C.10 and C.11 for the Model 9975 Package can be shipped with a CSI of 2.0. The staff has concluded that no additional criticality-related conditions of approval need to be added to the existing CoCs for approval of the Submittal.

Chapter 7: Operating Procedures

This TRR covers the staff's findings regarding the review of the Submittal. This section covers the review of the Operating Procedures information provided in Chapter 7 of the Submittal.

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

The existing Model 9975 SARP provides the required procedural steps for operating the Model 9975 package. The procedural steps found in Chapter 7 of the Model 9975 SARP shall be complied with as if the C.10 metal content were the same as the existing C.3 metal content and the C.11 oxide content were the same as the existing C.4 oxide content. Content verifications will comply with the Addendum Table 1.1, *C.10 and C.11 Content Envelopes*, and Addendum Table 1.1, *Table Notes*, as identified in Chapter 1 of this document. Content Envelopes C.10 and C.11 will comply with the configuration and spacer materials of Addendum Table 1.2, *Summary of Requirements by Content and Configuration*, and requirements as identified in Chapter 1 of the Submittal.

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
Because the requirements specified in the Operating Procedures Chapter of the SARP are normally incorporated, in their entirety, as Conditions of Approval in the CoCs, the staff has

concluded that the new procedural steps specified in Chapter 7 of the Submittal, specifically that Addendum Tables 1.1 and 1.2 must be complied with for content verifications and configuration and spacer materials, must be included as new Conditions of Approval in the CoCs for the approval of this request.

Chapter 8: Acceptance Tests and Maintenance Program

This TRR covers the staff's findings regarding the review of the Submittal. This section 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 above in Chapter 1. The results of the acceptance tests and maintenance review are discussed below.

The addition of the C.10 and C.11 Content Envelopes does not affect the maintenance of the packaging and does not affect acceptance testing. Therefore, the package acceptance testing and maintenance program documented in the existing Model 9975 Package SARP remains valid.

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 operational requirements specified in 10 CFR 71.

Conditions of Approval
The staff has concluded that no additional conditions of approval need to be added to the existing CoCs for the approval of this request.

Chapter 9: Quality Assurance

This TRR covers the staff's findings regarding the review of the Submittal. This section 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 above in Chapter 1. The results of the quality assurance review are discussed below.

The Submittal describes that the QA Program for the Model 9975 Packaging is described in *SARPs for the Model 9975 Packaging*.[2,5] The staff concurs that the addition of contents C.10 and C.11 do not affect the QA program as stated in Chapter 9 of the existing SARPs, and that those Chapter 9s contain reasonably up-to-date descriptions of the applicant's QA program and packaging-specific QA requirements.

Findings
Based on review of the statements and representations in the Submittal, the staff concludes that 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 that 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 QA-related conditions of approval need to be added to the existing CoCs for the approval of this request.

References

[1] *Justification for 9975 Gram Based Content Envelopes, C.10 and C.11, Safety Analysis Report for Packaging, Model 9975, Addendum*, S-SARA-G-00007, Revision 1, Savannah River Packaging Technology, Savannah River National Laboratory, Savannah River Nuclear Solutions, Savannah River Site, Aiken, SC (August 2009).

[2] *Safety Analysis Report for Packaging, Model 9975*, WSRC-SA-2002-00008, Revision 0, Radioactive Materials Packaging Technology, Savannah River Technology Center, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC (December 2003).

[3] *Safety Analysis Report for Packaging, Model 9975, Addendum 1, Justification for Modified Contents Parameters*, S-SARA-G-00001, Revision 0 (April 2005).

[4] *Safety Analysis Report for Packaging, Model 9975, Addendum 2, Justification for U233 Content Envelope*, S-SARA-G-00002, Revision 1, Savannah River Packaging Technology, Savannah River National Laboratory, Washington Savannah River Company, Savannah River Site, Aiken, SC (May 2008).

[5] *Safety Analysis Report for Packaging, Model 9975*, S-SARP-G-00003, Revision 0, Savannah River Packaging Technology, Savannah River National Laboratory, Washington Savannah River Company, Savannah River Site, Aiken, SC (January 2008).

[6] USA/9975/B(M)F-85 (DOE), *United States Department of Energy Certificate of Compliance for Radioactive Materials Packages, Model 9975*, Revision 21, United States Department of Energy, Washington, DC, expires March 31, 2011.

[7] USA/9975/B(M)F-96 (DOE), *United States Department of Energy Certificate of Compliance for Radioactive Materials Packages, Model 9975*, Revision 1, United States Department of Energy, Washington, DC, expires June 30, 2013.

[8] *Shielding Analysis of LLNL Contents for Addendum to 9975 Shipping Package SARP*, N-CLC-G-00133, Revision 1, A.H. Bridges and S.J. Nathan, Savannah River Nuclear Solutions, August 2009.

[9] *Nuclear Criticality Safety Evaluation 9975 Shipping Package for LLNL Contents Addendum*, N-NCS-G-00129, S.J. Nathan and J.A. Schlesser, Savannah River Nuclear Solutions, March 19, 2009.

[10] Nuclear Regulatory Commission, 10 CFR Part 71, *Compatibility with IAEA Transportation Standards (TS-R-1) and Other Transportation Safety Amendments*; Final Rule, 69 F.R. 3698, pp. 3698–3814, January 26, 2004, as amended.

[11] American National Standards Institute, *American National Standard for Radioactive Materials-Leakage Tests on Packages for Shipment*, ANSI N14.5-1997, New York, New York, 10036.

[12] ANSI/ANS-8.1-1998, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, American Nuclear Society, La Grange Park, Illinois (1998).

[13] ANSI/ANS-8.15-1981, *Nuclear Criticality Control of Special Actinide Elements*, American Nuclear Society, La Grange Park, Illinois (1981).