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DOE Packaging Certification Program

Safety Evaluation Report for Request to Amend Certificate of Compliance Number 9979 to Include a New Content Category for Low Enriched Uranium Metal

Docket No. 17-15-9979

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This Safety Evaluation Report (SER) documents the U.S. Department of Energy (DOE) Packaging Certification Program (PCP) independent technical review of the application submitted by the Savannah River Operations Office (SR) to amend DOE Certificate of Compliance (CoC) Number 9979, Revision 7, to authorize a new content category for Low Enriched Uranium (LEU) metal for transport in the Model 9979 packaging.

Summary

By a memorandum [1] dated March 14, 2017, the Savannah River Operations Office (SR) requested an amendment to DOE CoC Number 9979 to add a new content category for Low Enriched Uranium (LEU) metal with U-235 enrichment less than 1.25%. The SR request was supported by Revision 5a of the Safety Analysis Report for Packagings (SARP) Model 9979 Type AF Shipping Package [2], as supplemented by SARP page change Revisions 5b, 5c, and 5d.[3, 4, & 5] The SARP and supplements were prepared for SR by the Savannah River National Laboratory (SRNL). SARP Revisions 5a, 5b, 5c, and 5d were consolidated in SARP Revision 5.[6] The final supplements submitted to DOE PCP were a new hydrogen gas-generation calculation [7] and affected pages changes [8] to SARP Revision 5 to demonstrate compliance with §71.43(d).

SARP Revision 5a evaluated the new content category for LEU Metal with U-235 enrichment less than 1.25% and updated packaging design drawings for minor modifications to the packaging design to clarify component fabrication requirements.

SARP page change Revision 5b was submitted in response to questions from PCP staff during the review of Docket 17-09-9979 to implement a design change to authorize replacement silicone gasket material for 9979 30-Gallon Drum. Revision 7 of the CoC was issued in August 2017 to authorize this design change.

SARP page change Revisions 5c and 5d were submitted to correct numerical errors in Table 1-4 of SARP Revision 5a.

Near the conclusion of the review, PCP requested additional information [9] to confirm compliance with §71.43(d) for hydrogen-gas generation. SRNL prepared and submitted several revisions of a hydrogen gas-generation calculation in response and affected SARP page changes to supplement Revision 5 of the SARP.

Based on the statements and representations in consolidated SARP Revision 5, as supplemented, and PCP staff's confirmatory evaluation, as summarized in this Safety Evaluation Report (SER), staff finds the addition of LEU metal with U-235 enrichment less than 1.25% to the authorized contents for the package acceptable, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

Evaluation

1.0 General Information

1.1 Introduction

Detailed packaging description, drawings, and contents can be found in the SARP. The Model 9979 package consists of a 30-gallon confinement drum nested inside an internally insulated 55-gallon overpack drum. The 30-gallon confinement drum secures the package contents, thereby providing the capability (a) to prevent loss or dispersal of its radioactive contents when the package is exposed to the Normal Conditions of Transport (NCT), and (b) to ensure that the fissile material contents would remain subcritical when the package is exposed to both the NCT and the Hypothetical Accident Conditions (HAC), as required by 10 CFR 71.

The contents (a.k.a., payload) for the 9979 includes all radioactive (fissile and non-fissile) and non-radioactive materials contained within the 30-gallon drum. The radioactive material (RAM) and payload mass limits for the package are defined in SARP Revision 5, Table 1.2 for the highly enriched uranium (HEU) content with a maximum U-235 mass of 350 grams, in Table 1.3 for LEU content with a maximum uranium mass of 19.192 kg and maximum U-235 enrichment of 19.8%, and in Table 1.4 for LEU content with 1.25% or less U-235 enrichment.

The purpose of the application (SARP Revision 5) is to amend the DOE CoC for the addition of LEU metal with U-235 enrichment less than 1.25% as authorized contents for the package, and updated design drawings for minor modifications to the packaging to clarify component fabrication requirements.

The new contents, “LEU metal with U-235 enrichment less than 1.25%”, will hereafter be referred to as “LEU metal” and “SARP Revision 5” will be referred to as the “SARP” in the SER, unless otherwise stated.

1.2 Packaging (Design Modifications)

The following design drawings in Table 1-1 below were modified for amendment to the DOE CoC:

Table 1-1 List of Modified Drawings Pertaining to the 9979 Packaging

Drawing No.	CoC Rev 7	SARP Rev 5	Title	Reason for Changes
R-R1-G-00026	4	6A	9979 Type AF 30-Gallon Container Split-Ring Assembly (U)	**Rev 5** – Clarify welding information on Notes 3, 9, and Detail B. **Rev 6A** – Add patent number (Note 11)
R-R1-G-00027	4	6A	9979 Type AF 55-Gallon Drum Lid Split-Ring Assembly (U)	**Rev 5** – Clarify welding information on Note 3 and Detail B. **Rev 6A** – Add patent number (Note 10)

Drawing No.	CoC Rev 7	SARP Rev 5	Title	Reason for Changes
R-R1-G-00028	5	6A	9979 Type AF 30-Gallon Drum Assembly (U)	**Rev 6A** – Item 5 on the Parts Lists revised to allow option to use 30-gallon drum lid gasket R-R4-G-00062-A or R-R4-G-00062-B. Added note to Item 7 on the Parts List to only require the bung (Item 7) if the drum lid (Item 3) has a bung flange.
R-R1-G-00030	3	4A	9979 Type AF Packaging Assembly (U)	**Rev 4A** – Add patent number (Note 3)
R-R2-G-00057	7	9	9979 Type AF 55-Gallon Drum Sub-Assembly and Weldment (U)	**Rev 8** – Note 1 simplified; new Note 4 inserted to allow the option to fabricate Item 5 by welding 16 gauge material or spin as one piece from 14 gauge material; new Notes 6-7 inserted to clarify welding information and implemented on the drawing; Notes 7-15 renumbered as Notes 8-14; and Items 6-7 (R-R2-G-00057-E *Liner Shelf* and R-R2-G-00057-F *Upper Liner Cyinder*) deleted from Parts List. **Rev 9** – Note 3 revised to reduce the minimum foam mass from 54 to 52 pounds.
R-R2-G-00058	3	4	9979 Type AF 30-Gallon Drum (U)	**Rev 4** – Notes 1-3 revised to clarify requirements; Note 7 revised to clarify welding information and implemented on the drawing.
R-R2-G-00059	5	6	9979 Type AF 55-Gallon Drum Lid Sub-Assembly and Weldment (U)	**Rev 6** – Notes 1-3 revised to clarify requirements; Note 11 revised to clarify welding information and implemented on the drawing.
R-R2-G-00060	4	5A	9979 Type AF 30-Gallon Drum Lid with Dual Bung Closures (U)	**Rev 5A** – Note 8 revised to make Parts Listed Item 2 (Flange) optional.

1.3 Contents (Addition)

The applicant revised Section 1.2.2 of SARP Revision 4 to describe the new contents, “Low Enriched Uranium Content Envelope with 1.25% or less U-235”, and also revised Table 1-1 of SARP Revision 4 to include “metal waste forms” in the Non-Combustible Payload Category for the Solid Compound and Metal Material Forms in the General Description of this table. Table 1-4 was added to SARP Revision 5 to include the radioisotope limits, the maximum total mass of radioactive material (RAM), and the total mass for the new package contents, LEU metal. The maximum mass of RAM material and the maximum content mass for the LEU metal content envelope are both 90 kg. The applicant noted, for conservatism, that the LEU metal content envelope was evaluated at 160 kg in the Criticality Evaluation, Chapter 6, of the SARP. PCP staff notes that the applicant also used 160 kg in the Shielding Evaluation, Chapter 5, of the SARP.

Based on a review of the statements and representations in SARP Revision 5, PCP staff concludes that the package has been adequately described in sufficient detail to provide the basis for its evaluation under 10 CFR Part 71.

2.0 Structural Evaluation

PCP staff reviewed the SARP for the new LEU metal content category and the modifications to the packaging design and concluded that these changes do not affect the structural evaluation in the SARP.

Based on the statements and representations in SARP Revision 5, PCP staff finds that the structural evaluation described in Chapter 2 of the SARP is acceptable and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

3.0 Thermal Evaluation

PCP staff reviewed the SARP for the new LEU metal content category and the modifications to the packaging design, including reducing the minimum foam weight from 54 to 52 pounds, and concluded that these changes do not affect the structural evaluation in the SARP.

In addition, staff reviewed the supplemental hydrogen gas-generation calculation, M-CLC-A-00631, for SARP Content Tables 1.2, 1.3, and 1.4, and affected SARP Chapter 3 page changes to confirm that hydrogen gas resulting from radiolytic decompostion of materials or other reactions does not change the maximum normal operating pressure of the package, or produce a flammable gas mixture greater than 5% by volume of the total gas inventory in any confined volume, for 1-year. For several cases, void volume restrictions are required to meet the criteria for flammable gases: for Table 1.2 of the SARP, the 30-gallon drum must have a minimum void volume 8.4%. For Table 1.4, the 30-gallon drum must have a minimum void volume 3.7% to meet the criteria; however, this void volume is assured due to Table 1.4 content weight restrictions and packing efficiency (i.e., the drum cannot be 96.3% full). A minimun void volume restriction is not applicable to the Table 1.3 contents. The applicant provided a page-change to SARP Chapter 7 for loading the 30-gallon drum to implement the void volume restriction for Table 1.2.

Based on the statements and representations in SARP Revision 5, as supplemented by M-CLC-A-00631 and SARP Chapter 3 page changes, and PCP staff's confirmatory evaluation, staff finds that the thermal design and performance in Chapter 3 of the SARP, as supplemented, is acceptable, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

4.0 Containment

PCP staff reviewed the SARP for the new LEU metal content category and modifications to the packaging design and concluded that these changes do not affect the containment evaluation in the SARP. LEU metal is less then an A_2.

Based on the statements and representations in SARP Revision 5, PCP staff finds that the containment evaluation described in Chapter 4 of the SARP is acceptable, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

5.0 Shielding Evaluation

PCP staff reviewed the shielding evaluation of the package as described in Chapter 5 of the SARP and the shielding calculations for shipment of 160 kg (no more than 2.0 kg of U-235) of LEU metal. Staff calculated the neutron and photon source terms using ORIGEN of SCALE v6.2.2 software-package and performed Monte Carlo analyses using MCNP 6.1 to independently confirm the applicant's shielding calculations under both NCT and HAC.

5.1 Shielding Design

The package consists of an insulated 55-gallon drum overpack surrounding a 30-gallon drum. The package does not contain materials that are specifically designed for shielding gamma rays (photons) which are the primary contributor to the external package dose rates for the specified source configurations. For the NCT shielding calculations, the radiation source is modeled as a single spherical or cylindrical source and the packaging material and the drum walls are conservatively not modeled (i.e., omitted from the model). The package under HAC was not explicitly addressed because the spacing difference between damaged and undamaged package is not significant. The HAC dose rates are bound by the NCT surface dose rates due to the package material not being credited.

5.2 Source Specification

The isotopic content of the LEU metal waste used for the source term calculations is shown in Table 5.5 in Chapter 5 of the SARP. PCP staff calculated the neutron and the photon source terms using the ORIGEN module of SCALE v6.2.2 and the ENDF/B-VII.1 decay data. The gamma and neutron source terms were calculated after 50-year decay.

5.3 Shielding Model

The NCT calculations performed by the applicant were based on MCNP 6.1 models of the package using the ENDF/B-VII.1 nuclear data library. The source was modeled as a sphere (12.61 cm in radius) of U-235 and U-238 metal, with a density of 19.05 g/cc, corresponding to a mass limit of 160 kg U. The source spectrum was calculated as enriched to 1.25 weight % U-235, equating to a bounding mass of 2 kg U-235. In addition, the source was conservatively modeled as an artificial cylinder (48.26 cm in diameter by 73.66 cm high), with 160 kg U (U-235 and U-238). The uranium was modeled as filling the 30-gallon drum at a density (1.19 g/cm^3) calculated as the total mass divided by the volume of the drum (1.35 x 105 cm^3).

PCP staff concurred that the shielding analysis model in the SARP is conservative because the packaging material and the drum walls are not modeled.

5.4 Shielding Analysis Results

MCNP 6.1 was used for shielding analyses in the SARP and by PCP staff for the confirmatory analyses. The cross section library used in the evaluations was based on ENDF/B-VII.1. The ANSI/ANS-6.1.1-1977 Neutron and Gamma-Ray Flux-to-Dose-Rate Factors were used to calculate the dose rates. Table 5-1 below is a summary comparing the SARP and staff's calculation results of the external radiation levels for the package containing no more than 160 kg of LEU metal with 1.25% U-235. The results are comparable and significantly lower than the regulatory limits in 10 CFR 71.

Table 5-1 Summary of Calculated External Radiation Levels with no more than 160 kg of LEU Metal with 1.25% U-235 in the Package

NCT Dose Rate – Package Surface: mSv/h (mrem/h)*			
Source	**SARP**	**Staff**	**10 CFR 71 Limit**
Gamma	0.0410 (4.08)	0.0487 (4.87)	--
Neutrons	0.0002 (0.02)	0.0002 (0.02)	--
Total	0.0411 (4.11)	0.0489 (4.89)	2 (200)
NCT Dose Rate – 1 meter from Package Surface: mSv/h (mrem/h)*			
Source	**SARP**	**Staff**	**10 CFR 71 Limit**
Gamma	0.0024 (0.24)	0.0028 (0.28)	--
Neutrons	0.13×10^{-4} (0.0013)	0.13×10^{-4} (0.0013)	--
Total	0.0024 (0.24)	0.0028 (0.28)	0.1 (10)
HAC Dose Rate – 1 meter from damaged Package Surface: mSv/h (mrem/h)			
HAC not analyzed, bounded by the NCT surface dose			10 (1000)

* Dose rates include three standard deviations

5.5 Conclusion

Based on the statements and representations in SARP Revision 5 and PCP staff's confirmatory evaluation, staff finds that the shielding design and performance in Chapter 5 of the SARP are acceptable and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

6.0 Criticality Evaluation

PCP staff reviewed the criticality safety design and performance of the package described in Chapter 6 of the SARP for shipment of 160 kg (no more than 2.0 kg of U-235) of LEU metal. Staff performed an independent confirmatory analyses using MCNP6.1 for the criticality safety under the most reactive conditions.

6.1 Criticality Safety Design

The package does not incorporate any specific criticality-control features; therefore, subcriticality is assured by limiting the package contents and maintaining a minimum distance between adjacent fissile material sources. The SARP provides the dimensions and material specifications of the relevant packaging components, including identification of packaging materials, densities and compositions of packaging materials, and the fissile/fissionable material forms, masses, and isotopic compositions of the payloads. PCP staff confirmed that criticality-related information in the SARP is complete and representative of the actual materials specified for the package.

6.2 Contents (LEU metal)

The LEU metal contents consist of miscellaneous scrap metals. Although only 90 kg is authorized in the DOE CoC 9979 Revision 7, the applicant analyzed uranium mass up to and including 160 kg, enriched to 1.25% U-235, as shown in Table 6.8 of the SARP.

6.3 Summary of SARP and Staff's Criticality Safety Analyses

The LEU metal is in the form of miscellaneous metal pieces. To address the unspecified nature (size, shape, etc.) of the contents, two different models are used bounding the various configurations. First, the contents are modeled as a solid sphere of radius 12.61 cm, corresponding to a 160 kg mixture of U-235 and U-238. The sphere is then reflected with the maximum credible amount of water based on the geometry of the inner 30-gallon drum. The LEU metal was modeled as a mixture of U-235 (1.25 wt.%) and U-238 (98.75 wt. %) with a density of 19.05 g/cm^3. To account for the possibility of the content being in small pieces of LEU metal, a second model was created with the contents homogenized with water filling the volume of the 30-gallon drum. PCP staff concurred that while neither of these configurations are considered credible to attain, they are judged to be conservative and bounding for any credible configurations and conditions.

A single package was modeled with the content sphere on the bottom center of the inner drum and the package surrounded with 30 cm of water on all sides for a variety of cases. The same model was analyzed with the content sphere against the wall of the inner drum. Table 6-1 below is a summary comparing the SARP (Table 6.22) and staff's criticality safety analysis results for a single package.

Table 6-1 SARP and Staff's Criticality Safety Analysis Results for a Single Package (160 kg of LEU, 1.25 weight% of U-235)

Case	$k_{eff} + 2\sigma$	
	SARP (KENO-VI)	**Staff (MCNP6.1)**
Both drums dry, insulation intact, and sphere centered	0.354	0.348
Both drums dry, insulation intact, and sphere at side of inner drum	0.368	0.361
Inner drum flooded, insulation intact, and sphere centered	0.470	0.464
Inner drum flooded, insulation intact, and sphere at side of inner drum	0.468	0.461
Both drums flooded, insulation replaced with water, and sphere centered	0.469	0.464
Both drums flooded, insulation replaced with water, and sphere at side of inner drum	0.466	0.460
Inner drum dunnage as poly, insulation intact, and sphere centered	0.481	0.476
Inner drum dunnage as poly, insulation intact, and sphere at side of inner drum	0.478	0.473
Inner drum dunnage as poly, insulation replaced with water, and sphere centered	0.483	0.476
Inner drum dunnage as poly, insulation replaced with water, and sphere at side of inner drum	0.476	0.471
Inner drum filled with fissile mixture and insulation intact.	0.718	0.716
Inner drum filled with fissile mixture and insulation replaced with water	0.717	0.716

In the NCT model, an infinite, triangular pitched array of undamaged drums was analyzed. Infinite arrays do not allow escape of neutrons and generally result in a maximized neutron multiplication factor. The triangular pitch array model places fissile material units (drums) as close as possible to maximize the areal density of the fissile units, and thereby increasing the reactivity effect due to interaction. A single package was modeled inside a tight-fitting hexagonal prism with mirror boundary conditions defined for the six vertical faces and periodic boundary conditions defined for the z-axis faces to model an infinite height. The infinite, triangular-pitched, NCT array model uses the same configuration as the single package model without the water reflection surrounding the package. Table 6-2 below summarizes the SARP (Table 6.26) and PCP staff's criticality safety analysis results for the NCT infinite array.

Table 6-2 SARP and Staff's Criticality Safety Analysis Results for an NCT Infinite Array of Packages (160 kg of LEU, 1.25 weight% of U-235 for each package)

Case	$k_{eff} + 2\sigma$	
	SARP (KENO-VI)	Staff (MCNP6.1)
Both drums dry, insulation intact, and sphere centered	0.380	0.378
Both drums dry, insulation intact, and sphere at side of inner drum	0.405	0.387
Inner drum flooded, insulation intact, and sphere centered	0.471	0.466
Inner drum flooded, insulation intact, and sphere at side of inner drum	0.473	0.463
Both drums flooded, insulation replaced with water, and sphere centered	0.469	0.466
Both drums flooded, insulation replaced with water, and sphere at side of inner drum	0.472	0.462
Inner drum dunnage as poly, insulation intact, and sphere centered	0.482	0.477
Inner drum dunnage as poly, insulation intact, and sphere at side of inner drum	0.481	0.474
Inner drum dunnage as poly, insulation replaced with water, and sphere centered	0.481	0.477
Inner drum dunnage as poly, insulation replaced with water, and sphere at side of inner drum	0.482	0.473
Inner drum filled with fissile mixture and insulation intact	0.728	0.723
Inner drum filled with fissile mixture and insulation replaced with water	0.733	0.725

For the HAC array model, only the 30-gallon drum is modeled, on the conservative assumption that damage to the outer drum eliminates the spacing provided by the outer drum and the insulating material (this also conservatively removes any parasitic absorption due to the steel of the drum). For HAC array analysis an infinite, triangular-pitched array of packages was modeled.

The infinite triangular-pitched array was modeled by enclosing the 30-gallon drum in a hexagonal prism. A single package was modeled inside a tight fitting hexagonal prism with mirror boundary conditions defined for the six vertical faces and periodic boundary conditions defined for the z-axis faces to model an infinite height. Table 6-3 below summarizes the SARP (Table 6.32) and of PCP staff's criticality safety analysis results for the HAC infinite array of packages.

Table 6-3 SARP and Staff's Criticality Safety Analysis for HAC Infinite Array of Packages (160 kg of LEU, 1.25 weight% of U-235 for each package)

Case	$k_{eff} + 2\sigma$	
	SARP (KENO-VI)	Staff (MCNP6.1)
Drum dry and sphere centered	0.494	0.483
Drum dry and sphere at side of inner drum	0.494	0.483
Drum flooded and sphere centered	0.472	0.514
Drum flooded and sphere at side of inner drum	0.522	0.504
Drum dunnage as poly and sphere centered	0.483	0.521
Drum dunnage as poly and sphere at side of inner drum	0.526	0.511
Drum filled with fissile mixture	0.864	0.862

6.4 Conclusion

Based on the statements and representations in SARP Revision 5 and PCP staff's confirmatory evaluation, staff finds that the criticality safety design and performance described in Chapter 6 of the SARP are acceptable and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

7.0 Operating Procedures

PCP staff reviewed the SARP for the new LEU metal content category and the modifications to the packaging design and concluded that these changes do not affect the operating procedures of the package. The applicant added new information to Section 7.1.1.2 of the SARP to prepare the LEU metal content configuration (Table 1-4) for loading in the packaging and added more detail in the warning "Note" on the process for relieving drum pressure (if any) in Section 7.2.2, Step 7 of the SARP, when removing the 30-gallon drum lid from a package.

In addition, staff reviewed the supplemental hydrogen gas-generation calculation, M-CLC-A-00631, for SARP Content Tables 1.2, 1.3, and 1.4, and affected SARP pages changes to confirm that hydrogen resulting from radiolytic decompostion of materials or other reactions does not change the maximum normal operating pressure of the package, or produce a flammable gas mixture greater than 5% by volume of the total gas inventory in any confined volume, for 1-year.

For Tables 1.2 and 1.4, shipping period and minimum void volume restrictions are required to meet the criteria for flammable gases: for Table 1.2 of the SARP, the 30-gallon drum must have a minimum void volume 8.4%. For Table 1.4, the 30-gallon drum must have a minimum void volume 3.7% to meet the criteria; however, this void volume is assured due to Table 1.4 content weight restrictions and packing efficiency (i.e., the drum cannot be greater 96.3% full). A minimun void volume restriction is not applicable to the Table 1.3 contents. The applicant provided a page change to SARP Chapter 7 for loading the 30-gallon drum to implement the void volume restriction for Table 1.2.

Based on the statements and representations in SARP Revision 5, as supplemented by M-CLC-A-00631 and SARP Chapter 7 page change, and PCP staff's confirmatory evaluation, staff finds that the package operations described in Chapter 7 of the SARP, as supplemented, are acceptable and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

8.0 Acceptance Tests and Maintenance Program

PCP staff reviewed the SARP for the new LEU metal content category and the modifications to the packaging design, and clarifications to the acceptance test requirements in Chapter 8 and concluded that these changes do not affect the acceptance tests and maintenance program of the 9979 package.

Based on the statements and representations in SARP Revision 5, PCP staff finds that the acceptance tests and maintenance program described in Chapter 8 are acceptable and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

9.0 QUALITY ASSURANCE

PCP staff reviewed the SARP for the new LEU metal content category and the modifications to the packaging design and concluded that these changes do not affect does not affect the quality assurance program of the package.

Based on the statements and representations in SARP Revision 5, PCP staff finds that the quality assurance program described in Chapter 9 is acceptable, and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met.

Conditions of Approval

The 9979 certificate revision was changed from Revision 7 to Revision 8, with the following changes:

- Description 5.(a)(2)
  - Revised callout on Figure 1 to " ¾-inch Blind Plug (optional)"
  - Revised 30-gallon drum lid to "…The lid incorporates two standard commercially stamped and threaded bung hole flanges, one is ¾ inch in diameter and the other is 2 inches in diameter: the ¾ inch bung hole is optional."
  - Revised to add Table 4 for LEU metal, "…The content envelope limits, listed in Tables 2, 3, and 4, restrict package contents to materials with low decay-heat rates."
- Drawings 5.(a)(3) -
  - R-R1-G-00026 revised from Revision 4 to Revision 6A.
  - R-R1-G-00027 revised from Revision 4 to Revision 6A.
  - R-R1-G-00028 revised from Revision 5 to Revision 6A.
  - R-R1-G-00030 revised from Revision 3 to Revision 4A.
  - R-R2-G-00057 revised from Revision 7 to Revision 9A.
  - R-R2-G-00058 revised from Revision 3 to Revision 4.
  - R-R2-G-00059 revised from Revision 5 to Revision 6.
  - R-R2-G-00060 revised from Revision 4 to Revision 5A.
- Contents 5.(b)(1) –
  - Revised to add LEU metal "Low enriched uranium (LEU) is limited to two forms. The first form, under Table 1 Material Form 'Sources and Standards' is a 10 cm cube assembly of steel encapsulated metal plates, or up to four individual plates, approximately 10 cm square by 2 cm thick each, per package. The cube assembly or plates may be packed in a 3-quart stainless steel convenience can. The second form, under Table 1 Material Form "Solid Compounds" are LEU metal waste. The radioactive limits for both forms of LEU are specified in Tables 3 and 4 respectively."
  - Revised Table 1, column 2, row 7, from "Solid Compounds" to "Solid Compounds and Metal".
  - Revised Table 1 to add LEU metal to non-combustible solid compounds "Uranyl Fluoride, UO_4, ammonium diuranate and residues and solid mixtures; scraped unirradiated fuel rods and pellets [e.g., size-reduced light-water breeder reactor (LWBR) fuel rods]; and LEU metal waste forms."
- Contents 5.(b)(2) –
  - Revised text for LEU metal Table 4 "The radioactive material and payload mass limits for the 9979 package are defined in Tables 2, 3, and 4."
  - Revised Table 3 title to "Content Envelope Limits for LEU Cube or Plates"
  - Added Table 4, "Content Envelope Limits for LEU Metal Waste."
- Contents 5.(c) was revised to add the Criticality Safety Index (CSI) for LEU Metal: CSI=0.0
- Condition 5.(d)(6)(a) was revised to "The package must be prepared for shipment and operated in accordance with the Operating Procedures in Chapter 7 of the SARP, as supplemented by 5.(e) of this certificate."

- Condition 5.(d)(9) was revised to "The shipping periods and/or minimum package void volume in the 30-gallon drum apply for each contents as follows (Note – Shipping period begins when the 30-gallon drum is closed):
    (a) Table 2 – shipping period is 180 days with a minimum void volume 9%;
    (b) Table 3 – shipping period is unlimited and with no minimum void volume; and
    (c) Table 4 – shipping period is 360 days and with a minimum void volume 3.7%.
- Condition 5.(d)(14) was revised to "Revision 7 of this certificate may be used until December 31, 2018, subject to Condition 5.(d)(9)."
- Supplement 5.(e)(3) was revised to "*Safety Analysis Report for Packaging – Model 9979 Type AF-96*, S-SARP-G-00006, Revision 5, January 2018 (consolidation of SARP Rev 5a through 5d)."
- Supplement 5.(e)(4) added, "*Safety Analysis Report for Packaging – Model 9979 Type AF-96*, S-SARP-G-00006, Revision 5, Pages-changes 3-20, 3-32, and 7-5, July 26, 2018."
- Supplement 5.(e)(5) added, "Hydrogen Gas Generated from the Contents in the 9979 Package, M-CLC-A-00631, Revision 2, July 26, 2018."

Conclusion

Based on the statements and representations in SARP Revision 5, as supplemented by M-CLC-A-00631 and SARP Chapter 3 and 7 pages changes, and PCP staff's confirmatory evaluation, staff finds that the changes do not affect the performance of the package and will provide reasonable assurance that the regulatory requirements of 10 CFR Part 71 have been met, subject to the conditions above.

References

[1] *Submittal of the Safety Analysis Report for Packaging (SARP) Model 9979 Revision 5A – New Content Category for Low Enriched Uranium (LEU) Metal,* Memorandum from J. Hynes to J. Shuler, March 14, 2017
[2] *Safety Analysis Report for Packaging – Model 9979 Type AF-96*, S-SARP-G-00006, Revision 5a, March 2017
[3] *Safety Analysis Report for Packaging – Model 9979 Type AF-96*, S-SARP-G-00006, Revision 5b, April 26, 2017
[4] *Safety Analysis Report for Packaging – Model 9979 Type AF-96*, S-SARP-G-00006, Revision 5c, November 15, 2017
[5] *Safety Analysis Report for Packaging – Model 9979 Type AF-96*, S-SARP-G-00006, Revision 5d, November 30, 2017
[6] *Safety Analysis Report for Packaging – Model 9979 Type AF-96*, S-SARP-G-00006, Revision 5, December 2017
[7] *Hydrogen Gas Generated from the Contents in the 9979 Package*, M-CLC-A-00631, Revision 2, July 26, 2018
[8] Safety Analysis Report for Packaging – Model 9979 Type AF-96, S-SARP-G-00006, Revision 5, December 2017, Page-Changes 3-20, 3-32, and 7-5, July 26, 2018
[9] *Q1 for 9979 Package Review – Docket 17-15-9979,* Memorandum from J. Shuler to .D. Nicholson, April 27, 2018