



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
WASHINGTON, D.C. 2 0555-0001

**SAFETY EVALUATION REPORT
Docket No. 71-9979
Model No. 9979 Package
Certificate of Compliance No. 9979
Revision No. 3**

SUMMARY

By communication dated November 21, 2025 (Agencywide Documents Access and Management System [ADAMS] Accession No. ML25325A178), as supplemented on March 11, 2026, and May 5, 2026 (ML26211A001 and ML26211A184, respectively), Battelle Savannah River Alliance, LLC (BSRA or the applicant) applied for an amendment and renewal to Certificate of Compliance (CoC) No. 9979 for the Model No. 9979 package. The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the amendment requests using guidance in NUREG-2216, "Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material," dated August 2020 (ML20234A651).

Following staff review of the associated safety analysis reports (SAR), the staff finds that the requested changes do not affect the ability of the package to meet the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71, "Packaging and Transportation of Radioactive Material."

EVALUATION

1.0 GENERAL INFORMATION

1.1 Packaging Description

The Model 9979 Type AF packaging is originally designed as a drum-style radioactive material shipping system consisting of two main assemblies: an insulated 55-gallon steel-lined overpack and a centrally positioned 30-gallon inner drum that provides primary containment for solid radioactive or fissile materials totaling less than one A2. The overpack is filled with polyurethane foam to provide thermal protection and structural support and includes vent holes sealed with waterproof tape for accident-condition gas management. The inner drum is secured with a split-ring bolted closure and includes one mandatory bung hole containing a gasketed pressure-relief device, while a second bung hole exists as an optional, unused position in the original configuration. The package incorporates no engineered tie-down or lifting features, relies entirely on passive heat rejection, and has been demonstrated through analysis and testing to maintain containment and structural integrity under both normal conditions of transport (NCT) and hypothetical accident conditions (HAC).

The amendment introduces targeted design updates that modify this original configuration. Most notably, the optional Compact Augmented Permeation System (CAPS) may now be installed in the inner drum's second bung hole to permit hydrogen permeation while preventing radionuclide release during NCT. When CAPS is used, a corresponding small, barrier-protected vent opening is added to the 55-gallon overpack to allow hydrogen to diffuse safely to the external

Enclosure

environment. These additions are intended to address flammable gas generation for certain contents without altering the core structure or safety basis of the package, and NRC staff confirmed that all existing design features continue to meet regulatory performance requirements under NCT and HAC.

1.2 Package Contents

The amendment further expands allowable package contents by broadening the range of fissile and non-fissile solids (including metals, oxides, solid compounds under one A2) and by clarifying that certain non-radioactive materials (such as packing materials, insulation, and uranium-process waste streams) may also be included. Because some expanded contents may generate hydrogen, the application specifies conditions under which CAPS must be installed or alternatively defines loading constraints that prevent flammable hydrogen accumulation when CAPS is not used. NRC staff concluded that these changes do not adversely affect the package's ability to meet 10 CFR Part 71 requirements.

1.3 Drawings

With the application for these changes, BSRA submitted revisions to 12 drawings and one new drawing. Updates are as follows:

<i>R-R1-G-00026</i>	<i>9979 Type AF 30-Gallon Container Split Ring Assembly</i>	<i>Revision 8</i>
<i>R-R1-G-00027</i>	<i>9979 Type AF 55-Gallon Drum Lid Split Ring Assembly</i>	<i>Revision 7</i>
<i>R-R1-G-00028</i>	<i>9979 Type AF 30-Gallon Drum Assembly</i>	<i>Revision 9</i>
<i>R-R1-G-00029</i>	<i>9979 Type AF 55-Gallon Drum Assembly</i>	<i>Revision 6</i>
<i>R-R1-G-00030</i>	<i>9979 Type AF Packaging Assembly</i>	<i>Revision 5</i>
<i>R-R2-G-00057</i>	<i>9979 Type AF 55-Gallon Drum Sub-Assembly and Weldment</i>	<i>Revision 13</i>
<i>R-R2-G-00058</i>	<i>9979 Type AF 30-Gallon Drum</i>	<i>Revision 7</i>
<i>R-R2-G-00059</i>	<i>9979 Type AF 55-Gallon Drum Lid Sub-Assembly and Weldment</i>	<i>Revision 8</i>
<i>R-R2-G-00060</i>	<i>9979 Type AF 30-Gallon Drum Lid with Dual Bung Closures</i>	<i>Revision 8</i>
<i>R-R4-G-00062</i>	<i>9979 Type AF 30-Gallon Drum Lid Gasket</i>	<i>Revision 6</i>
<i>R-R4-G-00064</i>	<i>9979 Type AF Insulation Bag</i>	<i>Revision 5</i>
<i>R-R4-G-00065</i>	<i>9979 Type AF Insulation Cover Assembly for 30-Gallon Drum</i>	<i>Revision 5</i>

BSRA submitted one new drawing, for the package identification plate.

<i>R-R4-G-00066</i>	<i>9979 Type AF Package Identification Plate</i>	<i>Revision 2</i>
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Based on review of the statements and representations in the application, the NRC staff concludes that the transportation package design has been adequately described and evaluated and that the package continues to meet the requirements of 10 CFR Part 71.

2.0 STRUCTURAL EVALUATION

The objective of the structural review is to verify that the applicant has adequately evaluated the structural performance of the transport package and demonstrated that it satisfies the regulations in 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

The staff evaluated the proposed changes in the SAR, revision 2, in accordance with the guidance of NUREG-2216, *Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material*, US NRC, 2020 (ML20234A651). This section documents the staff's review, evaluation, and conclusions with respect to the structural safety aspects of the proposed transport package, as well as specific material property definitions.

2.1 Description of Structural Design

2.1.1 Discussion

The Type AF shipping package consists of a foam-insulated 55-gallon drum overpack containing a 30-gallon inner drum, wherein the payload contents are enclosed during shipping. Licensing drawings provided in SAR appendix 1.1 indicate the dimensions and materials of construction of the various components of the packaging system.

The SRNL 9979 Type AF transportation package structural configuration, design and analysis remains essentially unchanged from the original application submitted and licensed in 2016. The staff reviewed the applicant's proposed changes in payload content and the addition of the CAPS to the package. Based on the information provided in the application, the NRC staff determined that these changes have no effect on the structural performance or integrity of the package and therefore are found to be acceptable.

2.1.2 Identification of Codes and Standards for Package Design

The applicant states in SAR section 2.1.4 that the drawings cited in SAR appendix 1.1 identify the specific codes and standards that apply to package production. Although the applicant satisfies the majority of the loading conditions specified for NCT and HAC via physical testing of the package, some imposed loading conditions are determined through structural analysis. Per SAR section 2.1.4, the specific Codes and Standards employed for package structural analysis and design are as follows: ASME BPVC Section III, Subpart NB for pressure effects, National Nuclear Security Administration "Design and Development Guide for NNSA Type B Packages," SG-100 for vibration and shock effects, and the limits prescribed in ASME BPVC Section II, Part D are adhered to for thermal design.

The NRC staff has reviewed SAR section 2.1.4 and finds that since the codes and standards employed for package structural design are cited, the application meets the requirements of 10 CFR 71.31(c).

2.2 Evaluation Findings

- F2-1 The staff has reviewed the package structural design description and evaluation and concludes that the contents of the application satisfy the requirements of 10 CFR 71.31(a) and (b).
- F2-2 The staff has reviewed the structural codes and standards used in package design and finds that they are acceptable and therefore satisfy the requirements of 10 CFR 71.31(c).

Based on review of the statements and representations in the application amendment request, the NRC staff concludes that the SRNL 9979 Type AF package has been adequately described and evaluated to demonstrate that it satisfies the structural integrity and material performance requirements of 10 CFR Part 71.

3.0 THERMAL EVALUATION

The objective of the NRC staff review of Model 9979 shipping package is to verify that the thermal performance of the package has been adequately evaluated for the tests specified under NCT and HAC, in accordance with 10 CFR Part 71.

The application seeks approval of Aerojet-General Nucleonics (AGN) fuel components and AGN packing materials. The applicant made changes to the thermal evaluation to address the new contents and packing materials. The applicant performed two thermal analyses to bound all 9979 content configurations. One analysis evaluates the thermal performance of 9979 with the AGN fuel components, which emit negligible decay heat. A second analysis evaluates the thermal performance of 9979 with a more generic content configuration and bounding decay heat.

The baseline thermal analysis pre-fire thermal HAC model was the same as for the NCT model except that the insolation heat flux was omitted. The applicant stated that although pre-fire insolation is not explicitly required in 10 CFR 71.73(b), it should be considered in the evaluation for consistency with the Maximum Normal Operating Pressure (MNOP) initial condition requirement, which assumes insolation. Accordingly, SAR Chapter 3 adjusts the temperature values reported in the baseline thermal analysis to account for the previously unanalyzed insolation for the pre-fire HAC condition. The maximum difference in temperatures in the NCT with insolation and NCT without insolation models is provided in the SAR. The applicant accounted for this difference by increasing the initial temperatures. Although the subsequent transient post-fire HAC temperatures will increase by an amount less than this initial offset (due to increased heat transfer from a greater temperature differential with the ambient temperature), the same temperature increase was conservatively added to all the temperatures reported from this calculation. The maximum HAC temperatures reported in the SAR are all below the limiting component temperatures. Therefore, the thermal evaluations presented in SAR Chapter 3 thermal evaluation during NCT and HAC demonstrate compliance with the thermal performance requirements of 10 CFR Part 71. To limit hydrogen generation during transport, the package is designed with a material that allows any gas generated in the package to permeate and dissipate to the open environment.

The staff reviewed the Model 9979 shipping package design, construction, and preparations for shipment and found reasonable assurance that the package material and component temperatures will not exceed the specified allowable short-time limits during HAC, consistent with the tests specified in 10 CFR Part 71.

3.1 Evaluation Findings

- F3-1 The staff has reviewed the package description and evaluation and concludes that they satisfy the thermal requirements of 10 CFR Part 71.
- F3-2 The staff has reviewed the material properties and component specifications used in the thermal evaluation and concludes that they are sufficient to provide a basis for evaluation of the package against the thermal requirements of 10 CFR Part 71.
- F3-3 The staff has reviewed the methods used in the thermal evaluation and concludes that they are described in sufficient detail to permit an independent review, with confirmatory calculations, of the package thermal design.

- F3-4 The staff has reviewed the accessible surface temperatures of the package as it will be prepared for shipment and concludes that they satisfy 10 CFR 71.43(g) for packages transported by exclusive-use vehicle.
- F3-5 The staff has reviewed the package design, construction, and preparations for shipment and concludes that the package material and component temperatures will not extend beyond the specified allowable limits during normal conditions of transport consistent with the tests specified in 10 CFR 71.71.
- F3-6 The staff has reviewed the package design, construction, and preparations for shipment and concludes that the package material and component temperatures will not exceed the specified allowable short-term limits during hypothetical accident conditions consistent with the tests specified in 10 CFR 71.73.

4.0 CONTAINMENT EVALUATION

The applicant did not propose any changes that affect the staff's containment evaluation provided with the application. Therefore, the staff determined that a new evaluation was not required.

5.0 SHIELDING EVALUATION

5.1 Review Objective

The objective of this evaluation is to verify that the revision to the 9979 Type AF Packaging Safety Analysis Report submitted by BSRA meets the external radiation requirements of 10 CFR Part 71.

5.2 Shielding Evaluation

The staff reviewed the applicant's radiation-shielding calculations for the proposed contents to be transported in the Model 9979 package. The applicant established predetermined content limits to demonstrate compliance with the external radiation requirements in 10 CFR 71.47(a) and 49 CFR 173.441(a) for non-exclusive-use shipments. These limits are based on the activity of each individual radioisotope contained within 15 grams of uranium isotopes (U-233, U-234, U-235, U-236, or U-238), in either metal or oxide form, for shielding evaluation purposes.

As described in Section 1.2.2.1 of the application, the applicant used a sum-of-the-fractions methodology to determine allowable limits for mixtures of radioisotopes. The staff determined that this methodology is acceptable because it is a recognized regulatory approach for evaluating mixtures of radionuclides against established safety thresholds. The method appropriately accounts for the material properties, geometries, and configurations of the package components and contents, as well as the source-term characteristics of the material.

The applicant used ORIGEN-S (ORNL/TM-2005/39) to determine the neutron and photon source strengths for each energy group. The applicant then used the MCNP 6.1 code package (LA-CP-13-00634) to perform three-dimensional Monte Carlo transport calculations to determine absorbed dose rates external to the Model 9979 package. Table 1.1 of the application provides the corresponding radioactive-material limits and payload mass limits.

The staff noted that the Model 9979 package does not incorporate dedicated radiation-shielding features. Dose-rate attenuation is provided by self-shielding of the contents and by the distance between the contents and external surfaces of the package. The shipper remains responsible for preparing each shipment in accordance with the external radiation limits in 49 CFR 173.441 and 10 CFR 71.47.

5.3 Conclusion

The staff reviewed the application submitted by the applicant, along with reports N-CLC-A-00108, *Shielding Analysis for the 9979 Shipping Package with 15*, and N-CLC-G-00165, *Shielding Analysis for TAMU Fuel in 9979*. Based on the review and evaluation of these reports, the staff determined that the dose rates associated with the proposed contents, which include HEU material currently authorized under the DOE-EM CoC for the 9979, are acceptable.

The application demonstrates that the package design meets the requirements of 10 CFR 71.71 for NCT and complies with 10 CFR 71.43(f) and 10 CFR 71.51(a)(1). Under these evaluations, the external radiation levels remain within the applicable regulatory limits.

5.4 Evaluation Findings

- F5-1 The staff has reviewed the application and finds that it adequately describes the package contents and the package design features that affect shielding in compliance with 10 CFR 71.31(a)(1), 71.33(a), and 71.33(b), and provides an evaluation of the package's shielding performance in compliance with 10 CFR 71.31(a)(2), 71.31(b), 71.35(a), and 71.41(a). The descriptions of the packaging and the contents are adequate to allow for evaluation of the package's shielding performance. The evaluation is appropriate and bounding for the packaging and the package contents as described in the application.
- F5-2 The staff has reviewed the application and finds that it demonstrates the package has been designed so that under the evaluations specified in 10 CFR 71.71 (NCT), and in compliance with 10 CFR 71.43(f) and 10 CFR 71.51(a)(1), the external radiation levels do not significantly increase.
- F5-3 The staff has reviewed the application and finds that it demonstrates that under the evaluations specified in 10 CFR 71.71 (NCT), external radiation levels do not exceed the limits in 10 CFR 71.47(a) for nonexclusive-use shipments or 10 CFR 71.47(b) for exclusive-use shipments, as applicable.
- F5-4 The staff has reviewed the application and finds that it includes operations descriptions, acceptance tests, and maintenance programs that will ensure that the package is fabricated, operated, and maintained in a manner consistent with the applicable shielding requirements of 10 CFR Part 71.

Based on its review of the information and representations provided in the application, the staff has reasonable assurance that the proposed package design and contents satisfy the shielding requirements and the radiation level limits in 10 CFR Part 71. The staff also considered the regulation itself, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices in reaching this finding.

6.0 CRITICALITY EVALUATION

The objective of this review is to verify that the Model No. 9979 type AF transportation package continues to meet the criticality safety requirements of 10 CFR Part 71 under both NCT and HAC.

6.1 Evaluation

This amendment expands the allowable package contents by adding additional fissile and non-fissile solids (including metals, oxides, and solid compounds under one A_2 value) and adds clarification that certain non-radioactive materials (e.g., packing materials, insulation, and uranium-process waste streams) may also be included as allowable contents. The Model No. 9979 package is a drum package consisting of a 30-gallon containment drum in a 55-gallon drum overpack as defined by drawings R-R1-G-00028 and R-R1-G-0029 in the SAR. The package is limited to a maximum radioactive payload of 200 lbs. which includes the radioactive material and any handling conveniences. The allowable fissile content is delineated in SAR table 1.1 and is limited to a maximum of 350 grams of ^{235}U equivalent fissile mass, which may be of any enrichment. This package is not evaluated for air transport.

Based on the fissile material type, the fuel is placed into the containment drum utilizing polyurethane foam as a spacer between the various fuel disks, rods, and fuse, however, the applicant conservatively assumes that all materials are consolidated into a single sphere of U^{235} and water at the optimal H/X ratio, with no spacing credited in the evaluation. There is no limitation on the amount of polyethylene allowed in a package. Based on the array sizes for NCT and HAC, the calculated CSI is 1.0.

The applicant's NCT model assumed an 8x8x8 rectangular array with thick water reflection on all sides and reduced the radii of the drums by 7% to simulate a triangular-pitch array, which they demonstrated to be equivalent with respect to k_{eff} values using the guidance of NUREG/CR-5661. This reduction reduced the effective mass of carbon steel in the package, which is a conservative assumption. The spheres were arranged internally in each drum assuming no restriction of movement and were either shifted to the left or right of the package to place the most fissile material in a position of maximum interaction with the adjacent packages. The maximum $k_{\text{eff}} + 2\sigma$ was found to be below 0.95 for all modeled configurations in the NCT array.

For the HAC model, the applicant again assumed a 7% reduction in drum radii to simulate a close packed triangular pitch array of 6x6x3 packages, which assumes complete radial crushing of the overpack during accident conditions. This array was modeled with 60cm of water on all sides and utilized the same optimally moderated spherical model used in the NCT analysis with the same shifting of spheres to cause maximum neutronic communication between adjacent packages. The maximum $k_{\text{eff}} + 2\sigma$ was found to be below 0.95 for all modeled configurations in the HAC array.

For both the NCT and HAC analysis the applicant evaluated internal reflectors that may be present and conservatively addressed the impact of carbon or beryllium on the multiplication factor of the system. The applicant also evaluated the effects of internal moderators that may be present, and made conservative assumptions that staff agrees are adequate for the 9979 modeling assumptions.

For all computer modeling, the applicant used the SCALE5 / KENO-V.a code system with the 238-group ENDF/B cross section set to calculate k_{eff} values for their evaluation. The applicant bounded the single Model No. 9979 package evaluation with the NCT and HAC evaluations.

Staff evaluated the representative modeling inputs provided by the applicant and constructed an independent model of the Model 9799 NAC and HAC package arrays using the SCALE 6.2 code package with continuous energy cross section. The resulting calculated k_{eff} values agreed closely with those of the applicant in all cases.

6.2 Evaluation Findings

- F6-1 The staff has reviewed the package and concludes that the application adequately describes the package contents and the package design features that affect nuclear criticality safety in compliance with 10 CFR 71.31(a)(1), 71.33(a), and 71.33(b) and provides an appropriate and bounding evaluation of the package's criticality safety performance in compliance with 10 CFR 71.31(a)(2), 71.31(b), 71.35(a), and 71.41(a).
- F6-2 The staff has reviewed the package and concludes that the application specifies the number of packages that may be transported in the same vehicle through provision of an appropriate CSI in compliance with 10 CFR 71.35(b).
- F6-3 The staff has reviewed the package and concludes that the applicant used packaging features and package contents configurations and materials properties in the criticality safety analyses that are consistent with and bounding for the package's design basis, including the effects of the normal conditions of transport and the relevant accident conditions in 10 CFR 71.55. The applicant has adequately identified the package configurations and material properties that result in the maximum reactivity for the single package and package array analyses.
- F6-4 The staff has reviewed the package and concludes that the criticality evaluations in the application of a single package demonstrate that it is subcritical under the most reactive credible conditions, in compliance with 10 CFR 71.55(b), 71.55(d), and 71.55(e). The evaluations in the application also demonstrate that the effects of the normal conditions of transport tests do not result in a significant reduction in the packaging's effectiveness in terms of criticality safety, in compliance with 10 CFR 71.43(f) and 10 CFR 71.55(d)(4). The evaluations in the application also demonstrate that the geometric form of the contents is not substantially altered under the normal conditions of transport tests, in compliance with 10 CFR 71.55(d)(2).
- F6-5 The staff has reviewed the package and concludes that the criticality evaluation in the application of the most reactive array of 5N undamaged packages demonstrates that it is subcritical under normal conditions of transport to meet the requirements in 10 CFR 71.59(a)(1). The staff also concludes that the criticality evaluation in the application of the most reactive array of 2N packages subjected to the tests in 10 CFR 71.73 demonstrates that the array of 2N packages is subcritical under hypothetical accident conditions in 10 CFR 71.73 to meet the requirements in 10 CFR 71.59(a)(2).
- F6-6 The staff has reviewed the package and concludes that the applicant's evaluations include an adequate benchmark evaluation of the calculations. The applicant identified and evaluated experiments that are relevant and appropriate for the package analyses and performed appropriate trending analyses of the benchmark calculation results. The

applicant has determined an appropriate bias and bias uncertainties for the criticality evaluation of the package.

Based on review of the statements and representations in the application, the staff has reasonable assurance that the Model No. 9979 package design and contents satisfy the nuclear criticality safety requirements in 10 CFR Part 71. In making this finding, the staff considered the regulation itself, appropriate regulatory guides, applicable codes and standards, accepted engineering practices, and the staff's own independent confirmatory calculations.

7.0 MATERIALS EVALUATION

The purpose of the staff's materials evaluation is to assess whether the applicant adequately described and evaluated the materials used in the Model 9979 shipping package to ensure that the package meets the requirements of 10 CFR Part 71. The Model 9979 package is a Type AF package that is designed and constructed to transport Type A quantities of solid radioactive fissile and non-fissile materials. The staff's review addressed material properties and performance for the new components of the packaging and changes to the materials included in the package contents.

With respect to packaging components, the application proposed to add a new optional device, the CAPS, to the lid of the 30-gallon drum internal containment enclosure. If this option is used, the CAPS would prevent a flammable concentration of hydrogen gas from collecting in the package cavity during normal conditions of transport (NCT). The application also described the addition of a small hole in the 55-gallon drum overpack enclosure to enable the flow of hydrogen gas from the CAPS to the outside environment if the CAPS is installed in the 30-gallon drum. This hole is covered with a waterproof barrier to prevent water entry during NCT. The staff verified that the addition of the optional CAPS in the lid of the 30-gallon drum and associated flow hole in the 55-gallon drum are the only significant changes to the packaging components and materials. Further, there are no changes to normal service conditions (temperature, interior and exterior environments, service loadings) that would alter the material properties and performance for existing packaging components.

The application also proposed several changes to the package contents. These changes are addressed in further detail below.

7.1 Package Contents and Content Reactions

The package contents for the Model 9979 includes Type A quantities of solid radioactive fissile and non-fissile materials, and specified non-radioactive materials, all of which are contained within the 30-gallon drum. The staff's materials review addressed the physical and chemical form of the package contents, the associated potential for content reactions, and the adequacy of the CAPS for protecting against a hazardous accumulation of hydrogen gas in the 30-gallon drum. The staff's thermal and containment reviews, documented in sections 3.0 and 4.0, respectively, of this SER, addressed content reactions that generate heat and hydrogen gas and their associated impact on thermal and containment safety performance of the package for NCT and HAC.

The application proposes to expand on the physical and chemical form of the package contents allowed for transport inside the 30-gallon drum. The expanded fissile and non-fissile radioactive contents include metals, oxides, and other solid compounds totaling less than one A_2 , as defined in 10 CFR Part 71. Non-radioactive contents include packing/dunnage, insulating materials, and materials from uranium process and waste streams. Non-radioactive materials are composed of hydrocarbons (plastics, synthetic polymer foams), elastomers, cellulose (wood, paper, and textiles), elemental carbon (i.e., graphite), aluminum, beryllium, ceramics, glasses, inorganic compounds and retained moisture. The application defines mass limits for specific radioisotopes and non-radioactive elements and compounds. The application prohibits pyrophoric materials, cryogenic liquids, compressed gasses, visible liquids, and chemically reactive substances.

The staff reviewed the description of the package contents and confirmed that, with the exception of potential hydrogen gas generation by radiolysis, the limits and restrictions on the

physical and chemical form of the contents are sufficient to protect against significant chemical, galvanic, and other reactions that could adversely affect the safety of the package for NCT. The staff confirmed that the application adequately demonstrates that there is no unacceptable material outgassing or pressure increase in the 30-gallon drum, and, contingent upon no hazardous accumulation of hydrogen gas in the 30-gallon drum, no combustion reactions that could result in a loss of containment integrity for the HAC thermal test.

The application documents that flammable hydrogen gas is generated by the contents of the package during transport. The staff noted that the hydrocarbons, water from retained moisture in the solid contents, and other hydrogenous materials and compounds can undergo radiolysis during NCT to generate potentially flammable quantities of hydrogen gas. If the CAPS is not installed on the 30-gallon drum, the application requires that the package must be loaded and configured such that a flammable concentration of hydrogen gas is not generated within the 30-gallon drum during shipment. The staff's thermal and containment reviews and its review of package operations evaluate the content loading process and loading configurations to ensure they provide adequate protection against the accumulation of a flammable concentration of hydrogen gas in the 30-gallon drum for NCT if CAPS is not installed.

For packages that rely on the CAPS to protect against the accumulation of a flammable concentration of hydrogen gas in the 30-gallon drum for NCT, the application included a brief description of the CAPS and a reference for the CAPS technical requirements document. The CAPS technical requirements document is also referenced in the notes on the drawing for the 30-gallon drum. The staff determined that it needed to review the detailed CAPS technical requirements to ensure that this device is adequately designed, constructed, tested, and maintained to prevent a flammable concentration of hydrogen gas from collecting in the 30-gallon drum during NCT without venting radionuclides to the outside environment, and to ensure that the 30-gallon drum containment integrity is adequately maintained for NCT and HAC loading.

In its response to the staff's request for additional information (RAI M-1), the applicant provided the CAPS technical requirements document and additional information addressing the design, construction, performance, qualification, and maintenance of the CAPS. The staff's review of this information determined the following:

- The staff reviewed information addressing the design and construction of the CAPS, including a drawing of the device and its constituent parts and materials used to fabricate each of the parts. The staff determined that the parts and associated materials used to construct the CAPS are suitable for ensuring that the device can adequately perform its safety function of facilitating permeation of hydrogen gas from inside the 30-gallon drum without venting any significant quantities of radionuclides to the outside environment.
- The staff reviewed information addressing the compatibility of the CAPS parts and materials with package service environments (NCT temperatures, interior atmosphere, and exterior environment of the 30-gallon drum) and NCT and HAC service loadings. The staff confirmed that the CAPS is constructed from parts and materials that are compatible with package service environments during NCT, and the structural materials used to construct the CAPS support structures and housing are compatible with service loadings for NCT and HAC. The staff determined that this information provides reasonable assurance that the CAPS performs as designed for NCT, and the installation

of the CAPS in the 30-gallon drum lid will not introduce any significant potential for a loss of containment integrity as a result of NCT and HAC loadings.

- The staff reviewed information addressing CAPS design qualification requirements, acceptance test, procurement, and maintenance requirements to ensure CAPS functionality for NCT throughout its service life. The staff noted that the CAPS technical requirements document specifies that compliance with all requirements for design, construction, performance, and installation of the device shall be verified through review of procurement records, oversight, independent testing, or other method specified in the procurement documents, and evidence of compliance with each technical requirement shall be submitted during the procurement process. Maintenance of the CAPS consists of visual inspections of the device for damage during package loading operations to verify that its condition is unimpaired. The staff determined that these quality requirements are adequate to ensure that that CAPS will function properly for NCT throughout its service life.
- The staff reviewed information addressing potential failure modes of the CAPS during NCT and the means by which they are prevented or mitigated. The applicant's RAI response noted that since CAPS is designed to passively mitigate hydrogen gas accumulation, potential failure modes are limited to blockages that may impede gas permeation through the membrane, and a failure of the CAPS membrane that may cause a release of radioactive material. Since hydrogen gas is highly diffusible, a complete blockage of the porous support structure encasing the permeable membrane would need to occur to significantly inhibit flow of hydrogen. The staff verified the applicant's conclusion that such a blockage is not credible since CAPS is located at the top of the 30-gallon drum away from the solid radioactive contents in the drum. The staff also verified that a failure of the CAPS membrane is mitigated by the use of a porous support structure to protect the membrane from mechanical damage during NCT. Therefore, the staff determined that the design, construction, and location of the CAPS in the 30-gallon drum lid ensures that the device is adequately protected against potential failure modes for NCT.
- Finally, the staff reviewed information in the RAI response to substantiate that the waterproof barrier covering the new diffusion hole in 55-gallon drum overpack will allow for the passage of hydrogen gas that permeates through the CAPS. The staff verified that the barrier material is compatible with package service environments (NCT temperatures, interior, and exterior environments of the 55-gallon drum), and is suitable to ensure the flow of hydrogen from the CAPS to the outside environment.

Based on the evaluation above, the staff found that the applicant's technical requirements for the CAPS are sufficient to ensure that this device is adequately designed, constructed, tested, and maintained to prevent a flammable concentration of hydrogen gas from collecting in the 30-gallon drum during NCT without venting radionuclides to the outside environment, and to ensure that the 30-gallon drum containment integrity is adequately maintained for NCT and HAC loading. Therefore, the staff determined that the design change to allow the use of the CAPS to protect against hydrogen gas accumulation inside the package is acceptable.

7.2 Evaluation Findings

- F7-1 The staff has reviewed the package and concludes that the applicant has met the requirements of 10 CFR 71.33 and 10 CFR 71.35(a). The applicant described the materials used in the transportation packaging and the chemical and physical form of the package contents in sufficient detail to demonstrate that the package satisfies the applicable standards specified in subparts E and F of 10 CFR Part 71.
- F7-2 The staff has reviewed the package and concludes that the applicant has met the requirements of 10 CFR 71.43(f) and 10 CFR 71.55. The applicant demonstrated effective materials performance of packaging components under normal conditions of transport and hypothetical accident conditions.
- F7-3 The staff has reviewed the package and concludes that the applicant has met the requirements of 10 CFR 71.85(a). The applicant has determined that there are no significant cracks, pinholes, uncontrolled voids, or other defects that could significantly reduce the effectiveness of the packaging.
- F7-4 The staff has reviewed the package and concludes that the applicant has met the requirements of 10 CFR 71.43(d), 10 CFR 71.85(a), and 10 CFR 71.87(b) and (g). The applicant has demonstrated that there will be no significant corrosion, chemical reactions, or radiation effects that could impair the effectiveness of the packaging. In addition, the package will be inspected before each shipment to verify its condition.
- F7-5 The staff has reviewed the package and concludes that the applicant has met the requirements of 10 CFR 71.43(e) and (h). The applicant has demonstrated that package devices are adequately protected against unauthorized operation and will not allow continuous venting during transport.

Based on review of the statements and representations in the application, the NRC staff concludes that the materials used in the transportation package design have been adequately described and evaluated and that the package meets the requirements of 10 CFR Part 71.

8.0 OPERATIONS EVALUATION

The NRC staff conducted a thorough review of the applicant's proposed changes to the operational procedures for the Model No. 9979 Type A fissile radioactive material package. This evaluation focused on verifying that the operational procedures adequately address all necessary steps and requirements for safe package management. The staff reviewed the description of the amended generic operating procedures to ensure that the applicant covered the fundamental steps required for loading the radioactive contents, handling the package, receipt, and unloading of the package. Additionally, the review included an evaluation of the operational steps necessary for preparing empty packagings for transport and the corresponding storage requirements. The staff noted that the applicant presented the generic procedural steps in a sequential for users to create customized, site-specific procedures that fulfill both regulatory and facility-specific requirements.

8.1 Evaluation Findings

Based on this review of the information in the application, the NRC staff finds that the operating procedures have been adequately described and meet the requirements of 10 CFR Part 71.

F8-1 The staff has reviewed the generic operating procedures for the package and concludes that the applicant has met applicable regulatory requirements. The applicant described the operations for package loading, unloading, and preparation of an empty package for transport that are consistent with the package design.

CONDITIONS

In addition to editorial changes for readability, the following conditions were revised in the CoC:

- Condition No. 3(b) was revised to reflect a consolidated SAR submitted on May 12, 2026.
- Condition No. 5(a)(2) "Description," has been revised to include details about the CAPS system.
- Condition No. 5(a)(3) "Drawings," has been revised to reflect revisions to the drawings and the introduction of one new drawing.
- Condition No. 5(b)(1) has been revised to remove the AGN fuel table and replace it with a broad expanded content envelope, including fissile/non-fissile solids, and non-radioactive materials.
- Condition No. 5(b)(2) has been revised to reflect the new content envelope mass and moderation limits.
- Condition No. 5(b)(4) has been revised to reflect a decay heat which accounts for the new HEU contents of 163 milliwatts.
- Condition No. 7 was edited because the revised evaluation bounds any percentage of moisture.
- Condition No. 8 was revised to only require a thermal insulation bag for combustible radioactive contents and to clarify that the insulation cover (R-R4-G-00065) is always required.
- Condition No. 9 has been updated to include CAPS installation and inspection requirements for when CAPS is used.
- Condition No. 13 reflects a new expiration date of five years from the previous date of expiration.

The date of the consolidated SAR is now reflected in the REFERENCES section.

CONCLUSION

Based on the statements and representations in the application, as supplemented, and the conditions listed above, the staff concludes that the Model No. 9979 package design has been adequately described and evaluated, and that these changes do not affect the ability of the package to meet the requirements of 10 CFR Part 71.

Issued with Certificate of Compliance No. 9979, Revision No. 3.