NRC FORM 618
(8-2000)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIAL PACKAGES

a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. DOCKET NUMBER	d. PACKAGE IDENTIFICATION NUMBER	PAGE	PAGES
9279	9	71-9279	USA/9279/B(U)F-96	1 OF	7

2. PREAMBLE

a. This certificate is issued to certify that the package (packaging and contents) described in Item 5 below meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. ISSUED TO *(Name and Address)*

Department of Energy
Washington, DC 20586

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Nuclear Waste Partnership, LLC application dated August 3, 2020, as supplemented.

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

(1) Model No.: HalfPACT Waste Shipping Container

(2) Description

A stainless steel and polyurethane foam insulated shipping container designed to provide single containment for shipment of contact-handled transuranic waste. The packaging consists of an unvented, 1/4-inch thick stainless steel inner containment vessel (ICV), positioned within an outer confinement assembly (OCA) consisting of an unvented 1/4-inch thick stainless steel outer confinement vessel (OCV), an approximate 8-inch thick layer of polyurethane foam, a 1/4-inch thick layer of ceramic fiber paper and a 1/4 to 3/8-inch thick outer stainless steel shell. The package is a right circular cylinder with outside dimensions of approximately 94 inches diameter and 92 inches height. The package weighs not more than 18,100 pounds when loaded with the maximum allowable contents of 7,600 pounds.

The OCA has a domed lid which is secured to the OCA body with a locking ring. Although not part of the containment boundary, the OCV confinement seal is provided by an optional butyl rubber O-ring. The OCV is equipped with a seal test port and a vent port.

The ICV is a right circular cylinder with domed ends. The outside dimensions of the ICV are approximately 74 inches diameter and 69 inches height. The ICV lid is secured to the ICV body with a locking ring. The ICV containment seal is provided by a butyl rubber O-ring. The ICV is equipped with a seal test port and vent port. Aluminum

5. (a) (2) Description (continued)

spacers are placed in the top and bottom domed ends of the ICV during shipping. The cavity available for the contents is a cylinder of approximately 73 inches diameter and 45 inches height.

(3) Drawings

The packaging is constructed and assembled in accordance with the following Nuclear Waste Partnership, drawings:

(i) Drawing No. 707-SAR, “HalfPACT Packaging SAR Drawing,” sheets 1-12, Rev. 10;
(ii) Drawing No. 163-001, “Standard Pipe Overpack SAR Drawing,” sheets 1-3, Rev. 8;
(iii) Drawing No. 163-002, “S100 Pipe Overpack SAR Drawing,” sheets 1 and 2, Rev. 6;
(iv) Drawing No. 163-003, “S200 Pipe Overpack SAR Drawing,” sheets 1 and 2, Rev. 5;
(v) Drawing No. 163-004, “S300 Pipe Overpack SAR Drawing,” sheet 1, Rev. 3;
(vi) Drawing No. 163-006, “Compacted Puck Drum Spacers SAR Drawing,” sheet 1, Rev. 2; (Spacers needed for the purpose of maintaining subcriticality in 55-, 85-, and 100-gallon drums);
(vii) Drawing No. 163-008, “Shielded Container SAR Drawing,” sheets 1–6, Rev. 3; and
(viii) Drawing No. 163-009, “Criticality Control Overpack SAR Drawing,” sheets 1-2, Rev. 1.

(b) Contents

(1) Type and form of material

Byproduct, source, and special nuclear material in the form of dewatered, solid or solidified materials and wastes. Materials must be packaged in one of the following payload containers:

(i) 55-gallon drum,
(ii) standard waste box (SWB),
(iii) 85-gallon drum,
(iv) standard pipe overpack,
(v) S100 pipe overpack,
(vi) S200 pipe overpack,
(vii) S300 pipe overpack,
(viii) 100-gallon drum,
(ix) shielded container, or
(x) criticality control overpack (CCO).

5. (b) (1) Type and form of material (continue)

The payload containers are described in Section 2.9, "Payload Container/Assembly Configuration Specifications," of the CH-TRAMPAC, Rev. 5. Explosives, corrosives (pH less than 2 or greater than 12.5), nonradioactive pyrophorics, and compressed gases are prohibited. Within a payload container radioactive pyrophorics must not exceed 1 percent by weight and residual liquids must not exceed 1 percent by volume. Flammable organics and methane are limited along with hydrogen to ensure the absence of flammable gas mixtures in TRU waste payloads as described in Chapter 5.0 of the CH-TRAMPAC, Rev. 5. For payloads of content code LA 154 and SQ 154, the absence of flammable gas mixtures is ensured as described in Appendix 6.12 of the CH-TRU Payload Appendices, Rev. 4. For payload configurations with unvented heat-sealed bag layers, the absence of flammable gas mixtures is ensured as described in Appendix 6.13 of the CH-TRU Payload Appendices, Rev. 4. For Analytical Category payload containers containing puck drums, the absence of flammable gas mixtures is ensured as described in Appendix 6.14 of the CH-TRU Payload Appendices, Rev. 4.

(2) Maximum quantity of material per package

The package contents are limited to 7,600 pounds, including the weight of the payload containers and any other components of the payload assembly. Table 1 (below) includes the maximum gross weight for a payload container.

Table 1. Maximum gross weight for a payload container

Type of Payload Container	Maximum Gross Weight
6-inch standard pipe overpack	328 pounds
12-inch standard pipe overpack	547 pounds
S100 pipe overpack	550 pounds
S200 pipe overpack	547 pounds
S300 pipe overpack	547 pounds
100-gallon drum	1,000 pounds
55-gallon drum	1,000 pounds
85-gallon drum	1,000 pounds
SWB	4,000 pounds
Shielded container	2,260 pounds
CCO	350 pounds

5. (b) (2) Maximum quantity of material per package (continue)

Maximum number of payload containers per package and authorized packaging configurations as follows:

(i) 7 55-gallon drums,
(ii) 7 standard pipe overpacks,
(iii) 7 S100 pipe overpacks,
(iv) 7 S200 pipe overpacks,
(v) 7 S300 pipe overpacks,
(vi) 4 85-gallon drums,
(vii) 3 100-gallon drums,
(viii) 1 SWB,
(ix) 3 shielded containers, or
(x) 7 CCOs.

Fissile material not to exceed the limits specified in CH-TRAMPAC, Rev. 5, Section 3.1, "Nuclear Criticality." Table 2 (below) includes limits related to CCOs and pipe overpacks.

Table 2. Maximum Fissile gram equivalent in CCOs and pipe overpacks and associated additional controls/limits.

Parameter	Payload Container	
	CCOs	Pipe Overpacks
Maximum Fissile gram equivalent of Pu-239 for non-machine compacted material	380	200
Additional limits/controls for non-machine compacted material	≤ 1% by weight Be/BeO*	for Be/BeO > 1 wt%, Be/BeO must be chemically or mechanically bound to the fissile material
Maximum Fissile gram equivalent of Pu-239 for machine compacted material	380	200
Additional limits/controls for machine compacted material	≤ 1% by weight Be/BeO & ≤ 2,000 grams plastic	≤ 1% by weight Be/BeO

* Be means beryllium and BeO means beryllium oxide.

All payloads shall meet the activity limits specified in CH-TRAMPAC, Rev. 5, Section 3.3, "Activity Limits." The payload is limited to 10^5 A_2 quantities.

5. (b) (2) Maximum quantity of material per package (continue)

Maximum decay heat per package not to exceed 30 watts. Decay heat per payload container not to exceed the values in Table 5.2-1 of the CH-TRAMPAC, Rev. 5, "List of Approved Alphanumeric Shipping Categories, Maximum Allowable Hydrogen Gas Generation Rates, and Maximum Allowable Wattages," or calculated for approved shipping categories in accordance with the methodology specified in Section 5.2.3 of the CH-TRAMPAC, Rev. 5. For content code LA 154 and SQ 154 payloads, decay heat per payload container not to exceed the values determined as specified in Appendix 6.12 of CH-TRU Payload Appendices, Rev. 4.

(c) Criticality Safety Index: 0.0

6. Physical form, chemical properties, chemical compatibility, configuration of waste containers and contents, isotopic inventory, fissile content, decay heat, weight and center of gravity, and radiation dose rate must be determined and limited in accordance with CH-TRAMPAC, Rev. 5.

7. Each payload container must be assigned to a shipping category in accordance with Section 5.1, "Payload Shipping Category" of CH-TRAMPAC, Rev. 5. Each payload container and payload assembly must not exceed the allowable wattage in accordance with Section 5.2.3, "Hydrogen Gas Generation Rate and Decay Heat Limits for Analytical Category," or must be tested for gas generation in accordance with Section 5.2.5, "Unified Flammable Gas Test Procedure," of CH-TRAMPAC, Rev. 5. For a payload made up of payload containers with different (nonequivalent) shipping categories, the flammability index of each payload container must not exceed 50,000 in accordance with CH-TRAMPAC, Rev. 5, Section 6.2.4, "Mixing of Shipping Categories," and Appendix 2.4 of the CH-TRU Payload Appendices, Rev. 4, "Mixing of Shipping Categories and Determination of the Flammability Index." For Analytical Category payload drums containing puck drums, the absence of flammable gas mixtures is ensured as described in Appendix 6.14 of the CH-TRU Payload Appendices, Rev. 4. Each content code LA 154 and SQ 154 payload container must be assigned to a shipping category in accordance with Appendix 6.12 of CH-TRU Payload Appendices, Rev. 4. Content code LA 154 and SQ 154 payload containers may only be assembled with other payload containers belonging to content code LA 154 and SQ 154, respectively, or dunnage in accordance with Appendix 6.12 of CH-TRU Payload Appendices, Rev. 4. For a payload of content code LA 154 or SQ 154 containers with different shipping categories, the flammability index of each payload container must not exceed 50,000 in accordance with Appendix 6.12 of CH-TRU Payload Appendices, Rev. 4.

8. Payload containers within a package shall be selected in accordance with Section 6.0, "Payload Assembly Requirements," of CH-TRAMPAC, Rev. 5. Payload containers of content code LA 154 and SQ 154 shall be assembled in accordance with Appendix 6.12 of CH-TRU Payload Appendices, Rev. 4.

9. Each payload container must be vented in accordance with Section 2.5, "Filter Vents," of CH-TRAMPAC, Rev. 5. Payload containers which were not equipped with filtered vents during storage must be aspirated in accordance with Section 5.3, "Venting and Aspiration," of CH-TRAMPAC, Rev. 5.

10. For close-proximity and controlled shipments meeting the conditions specified in Appendices 3.5 and 3.6, respectively, of CH-TRU Payload Appendices, Rev. 4, shipping periods of 20 days and 10 days may be applicable. The shipping period for any mode of transport is not to exceed 60 days. For content code LA 154 and SQ 154 shipments, the shipping period as defined in Appendix 6.12 of the CH-TRU Payload Appendices, Rev. 4 is not to exceed 5 and 10 days, respectively.

11. In addition to the requirements of Subpart G of 10 CFR Part 71:

    (a) Each package must be prepared for shipment and operated in accordance with the procedures described in Chapter 7.0, "Operating Procedures," of the application, as supplemented. For content code LA 154 and SQ 154 payloads, each package must be prepared for shipment and operated in accordance with the procedures described in Chapter 7.0 of the application, as modified by Appendix 6.12 of CH-TRU Payload Appendices, Rev. 4.

    (b) Each package must be tested and maintained in accordance with the procedures described in Chapter 8.0, "Acceptance Tests and Maintenance Program," of the application, as supplemented.

    (c) All free standing water must be removed from the inner containment vessel cavity and the outer confinement vessel cavity before shipment.

12. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR 71.17.

13. Transport by air of fissile material is not authorized.

14. Revision 8 of this certificate may be used until November 30, 2020.

15. Expiration date: November 30, 2025.

REFERENCES

Nuclear Waste Partnership, LLC, application dated August 3, 2020.

As supplemented on: September 24 and September 28, 2020.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

John B. McKirgan

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Date: 2020.11.23 08:16:46 -05'00'

John McKirgan, Chief
Storage and Transportation Licensing Branch
Division of Fuel Management
Office of Nuclear Material Safety
and Safeguards

Date: 11/23/2020

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION REPORT

Model No. HalfPACT, Docket No. 71-9279
Certificate of Compliance No. 9279
Revision 9
Model No. TRUPACT-II, Docket No. 71-9218
Certificate of Compliance No. 9218
Revision 25

Enclosure 3

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION REPORT

Model No. HalfPACT, Docket No. 71-9279
Certificate of Compliance No. 9279
Revision 9
Model No. TRUPACT-II, Docket No. 71-9218
Certificate of Compliance No. 9218
Revision 25

SUMMARY

By letter dated August 3, 2020 (NWP, 2020a), and supplemented on September 28, 2020 (NWP, 2020e), Nuclear Waste Partnership LLC, on behalf of the U.S. Department of Energy, submitted applications to revise Certificate of Compliance (CoC) No. 9218 for the Model No. TRUPACT-II package and CoC No. 9279 for the Model No. HalfPACT package. The applicant requested to add machine compacted waste as acceptable contents in the pipe overpack and criticality control overpack (CCO) payloads. The applicant also requested design changes to the CCO design. The purpose of this revision is to support the near-term and future transport and disposal of approximately 22,000 CCOs.

By letter dated September 24, 2020 (NWP, 2020d), the applicant also requested the renewal of the Model No. HalfPACT package and to concurrently issue this renewal with the action requested by letter dated August 3, 2020 (NWP, 2020a). The CoC No. 9279 for the Model No. HalfPACT package has been renewed for a five-year term.

NRC staff reviewed the application, including its supplement, using the guidance in NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Material." Based on the statements and representations in the application, as supplemented, and the conditions listed below, the staff concludes that the packages meet the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71, "Packaging and Transportation of Radioactive Material."

1.0 GENERAL INFORMATION

The applicant requested the following changes as part of this revision to the design of the Model Nos. TRUPACT-II and HalfPACT packages:

1) Allow machine compacted waste in:

   a. the pipe overpack payloads

   b. the CCO payloads, with the added control that limits the amount of plastic to no more than 2,000 grams in each CCO.

2) Changes in drawing tolerances to facilitate fabrication.

1.1 Packaging

Sections 1.2, 2.0, 5.2, and 6.4 of this safety evaluation report (SER) include a description and discussion of the changes to the packaging.

1.2 Drawings

The staff reviewed the applicant's proposed changes to drawing tolerances to facilitate fabrication and found them to be an adequate representation of the package. The drawings included dimensions, materials of construction, and the codes and standards used to design the package. Based on the review of the package design, including the drawings, as described in the technical sections of this SER, the staff finds the description of materials and fabrication in the drawings to be acceptable.

1.3 Contents

The TRUPACT-II and HalfPACT packages are designed to transport contact-handled transuranic waste materials and other authorized payloads. The "CH-TRU Payload Appendices," Revision 4, (NWP, 2020b) and "CH-TRAMPAC," Revision 5, (NWP, 2020c) include the description of the allowable contents in Model Nos. TRUPACT-II and HalfPACT packages.

The applicant requested to allow machine-compacted materials in the pipe overpacks and the criticality control overpack (CCO) with a limit of a maximum of 2,000 grams of plastic content in each CCO. A maximum 380 fissile gram equivalent (FGE) of Pu-239 per CCO and a maximum 200 FGE of Pu-239 per pipe overpack is justified for waste forms meeting these requirements. Sections 5.0 and 6.0 of this SER include the staff's assessment of the applicant's analyses and their adequacy to address the proposed content changes.

1.4 Evaluation Findings

The staff reviewed documentation provided by the applicant including package and packaging descriptions as well as design drawings to verify that statements presented by the applicant are acceptable for the review and approval of the revision of the CoCs for the Model Nos. TRUPACT--II and HalfPACT packages, as required by 10 CFR 71.33. Based on the review of the statements and representations provided by the applicant, the staff concludes that the package, packaging, and contents have been adequately described to meet the requirements of 10 CFR Part 71.

2.0 STRUCTURAL EVALUATION

The purpose of this evaluation is to verify that the proposed changes to the TRUPACT-II and HalfPACT packages provide adequate protection against loss or dispersal of radioactive contents and to verify that the package design meets the requirements of 10 CFR Part 71 under NCT and HAC.

2.1 Description of Structural Design

Structurally, the applicant made small minor changes to the licensing drawings of the TRUPACT-II and HalfPACT packages to ease fabrication. The minor changes in the licensing drawings for the CCO included:

1) allowing for the substitution of mechanically equivalent A240 Type 304/304L for ASTM A182 Grade F304/F304L for several components such as the blind flange;

2) allowing for larger diameter wood screws used to fabricate dunnage;

3) allowing for slightly greater bore depths for screws in the lid; and

4) revising the pipe dimensions to be measures in 1/10s of an inch rather than 100's of an inch.

The applicant stated that these minor changes do not impact safety determinations in the past. The NRC staff reviewed the package structural design description and agrees that these changes do not impact safety, and that the package will continue to perform its safety function. Therefore, the staff concludes that the contents of the application will continue to satisfy the requirements of 10 CFR 71.33(a), and the changes are acceptable.

2.3 Evaluation Findings

The staff reviewed the changes proposed by the applicant to the TRUPACT-II and HalfPACT packages. Based on the review of the statements and representations in the application, the staff concludes that the structural design has been adequately described and evaluated and that the package continues having adequate structural integrity to meet the requirements of 10 CFR Part 71.

5.0 SHIELDING EVALUATION

The purpose of the shielding review is to confirm that the packages together with their contents meet the external radiation requirements in 10 CFR Part 71. The applicant requested to revise the certificates and designs of the packages to incorporate various changes, as described in Section 1.0 of this SER and the sections below. While the focus of the application was on the impacts on the packages' criticality safety function, the staff also considered whether the changes had any impacts on the shielding capabilities of the packages. The staff used the guidance in the standard review plan (NUREG-1609), to conduct this review.

The staff identified the proposed changes which could have a potential impact on package shielding performance. These changes include allowing machine compacted materials with appropriate limits and controls in the pipe overpacks and the CCO. The changes also include modifications to various features of the CCO as described in the packages' design drawings in the application, some of which could result in changes in component tolerances and thicknesses.

5.1 Contents Changes

In evaluating the potential impact of the contents change to allow machine compacted materials in the pipe overpacks and the CCO, the staff considered the existing shielding analyses in the applications for the packages with these overpacks and the nature of the contents as described in the CH-TRAMPAC for each overpack. The change in compaction method has the potential to increase the radiation source density. Thus, the staff evaluated whether the existing shielding analyses would be adequate to cover higher density sources.

The shielding analysis for three of the pipe overpacks (the S100, S200, and S300) used either a point source method or a source with a volume that is very small versus the pipe overpack cavity volume (less than 3 percent), with the source placed in positions that maximize package radiation levels. Thus, for these pipe overpacks, the staff determined that greater source compaction (machine versus manual) will be adequately covered by the current shielding analyses for these pipe overpacks. The source configurations in the analyses would reasonably bound the source concentration possible from both compaction methods.

For the remaining pipe overpack (the standard pipe overpack) and the CCO, the analyses include both a concentrated and a distributed source. The concentrated source is a very small volume source, and the staff determined that the conclusions for the S100, S200, and S300 pipe overpacks apply to the concentrated source evaluations for the standard pipe overpack and the CCO. For the distributed source, the analysis addresses a range of densities with the use of a density conversion factor by which the limits for the contents' radiation sources are adjusted according to the contents' density. Thus, whichever compaction method is used, the resulting density of the contents is accounted for in determining the acceptability of the contents in terms of shielding. Therefore, based on these considerations, the staff finds that allowing machine compacted material as contents in the pipe overpacks and the CCO is acceptable.

5.2 Packaging Changes

In evaluating the potential impacts of the changes to the CCO design as defined in the packages' design drawings, the staff considered the existing shielding analysis for this overpack and how the design changes could affect that analysis. One change affects the tolerance on the length of the overpack's criticality control container in which the radioactive contents are contained. The change could, along with recessing in the upper dunnage, have an impact on the axial proximity or positioning of the radioactive contents versus the package top; however, the impact would be quite small. The analysis for radiation levels from the package side would still be expected to be limiting.

The shielding analysis only models the portions of the criticality control container that radially are within the outer diameter of the pipe portion of the container. Ends of flanges that extend beyond this point are neglected. Therefore, any changes to the flanges outside of this radial zone have no impact on shielding. Changes in the specifications of the flanges (to provide optional material specifications) have the potential for changing the tolerances of the flanges, including their thickness. Since they are steel, which is a good gamma shield, the staff considered there was a potential for impacts. However, in evaluating the specification changes, the staff determined that the specification changes would result in tighter tolerances on thickness than the current specification allows. In terms of shielding, this would be better, since it would mean that the presence of a greater minimum amount of material would be assured. Other changes involved localized areas in the criticality control container's lid where material may be slightly thinner than previously. Given these are localized areas and various

conservatisms in the shielding analysis, the staff finds that these changes will not have an effect on the shielding analysis or package shielding performance.

5.3 Evaluation Findings

Based on a review of the information and representations provided in the application, the staff has reasonable assurance that the TRUPACT-II and HalfPACT packages with the proposed contents and design changes, will continue to satisfy the shielding requirements and radiation level limits in 10 CFR Part 71.

6.0 CRITICALITY SAFETY EVALUATION

The purpose of the criticality review is to confirm that the packages together with their contents meet the requirements in 10 CFR Part 71 for criticality safety. The applicant requested to revise the certificates and designs of the packages to incorporate various changes, as described in Section 1.0 of this SER and the sections below. The staff used the guidance in the standard review plan (NUREG-1609), to conduct this review.

The staff identified the proposed changes which could have a potential impact on package criticality safety performance. These changes include allowing machine compacted materials as contents in the pipe overpacks as long as the amount of special reflector materials do not exceed 1 percent by weight of a pipe overpack's radioactive contents. The limit on special reflector materials does not apply if these materials are chemically or mechanically bound to the fissile material in the contents or the reflector thickness or packing fraction is less than the reference polyethylene-water reflector (see Table 6.2-1 of each package's safety analysis report). These changes also include allowing machine compacted materials as contents in the CCO with the same conditions for special reflector materials as for the pipe overpacks with the additional condition that the amount of plastic in the overpack's contents not exceed 2,000 grams. The changes also include modifications to the CCO design as described in the packages' design drawings.

6.1 Pipe Overpack Contents Changes and Analyses

The TRUPACT-II and HalfPACT packages include four pipe overpacks, the standard, S100, S200, and S300 pipe overpacks. The currently approved contents are limited to manually compacted materials. The criticality analyses for these overpacks are labeled as "Case E" in the packages' safety analysis reports and CH-TRU Payload Appendices (Appendices 4.1 through 4.4). In proposing to add machine compacted materials to the allowable contents of the pipe overpacks, the applicant stated that the existing Case E analyses support the inclusion of machine compacted material, and no modification to the analysis is needed.

To evaluate the request for the pipe overpacks' contents, the staff reviewed the current Case E criticality analyses. The staff also looked at the analyses in the other cases that support the other overpacks, or payloads, in the packages to inform its review of the Case E analyses. The other cases include analyses for both manually compacted and machine compacted materials. The other cases also include analyses for the different amounts of special reflector materials to address overpack and package fissile material limits for different amounts of these special reflector materials. In looking through these other cases, the staff identified that the difference between the cases for manual compacted materials and machine compacted materials was the amount of polyethylene assumed in the moderator and the reflector material surrounding the

moderated fissile material. Cases for manually compacted materials used a combination of polyethylene and water for both the moderator and reflector that bounded the amount and packing fraction of plastic that would be in the waste stream, as determined by physical testing, for manually compacted materials. Because machine compaction can raise the packing fraction of the plastic to high amounts, cases for machine compacted materials assume the moderator and reflector is only polyethylene. The applicant's evaluations, reviewed by the staff in previous revision requests, indicated that polyethylene is a better moderator than water.

Thus, for Case E to be applicable to machine compacted waste without controls (see the table on page 6.4-10 of the safety analysis reports for both packages), the moderator and reflector should be polyethylene only, with the amount of beryllium to account for the special reflector materials allowed to be present. The current Case E analyses match this criterion. Also, since the pipe overpacks are also credited in the analysis, the criterion only applies to the cavity of the pipe overpack where the contents are contained. The staff also considered whether or not the change in applicability of the Case E analyses to machine compacted materials could impact its use in regard to the quantity and configuration limits for special reflector materials and their impact on the fissile material limits for the pipe overpack contents. The staff did not identify anything that would affect that applicability in its review.

Thus, the staff finds that the proposed addition of machine compacted material to the pipe overpacks' contents is acceptable. The staff finds that the current criticality analysis for the pipe overpacks is acceptable and demonstrates the TRUPACT-II and HalfPACT packages containing pipe overpacks with machine compacted materials will be subcritical. Since the analyses demonstrate subcriticality for both single packages and infinite arrays of packages for both normal conditions of transport and hypothetical accident conditions, the staff also finds the analysis demonstrates that the criticality safety index of 0.0 is appropriate for these packages.

6.2 Pipe Overpack Contents Analysis and Limits, Greater Than 1wt. % Beryllium and Beryllium Oxide

While reviewing the proposed changes for pipe overpack contents, the staff noticed that the Case E analysis and fissile material limits for waste materials with less than 1 weight (wt.) percent (%) beryllium (Be) and beryllium oxide were also being applied to waste materials with greater amounts of beryllium and beryllium oxide (BeO) in not machine compacted waste instead of the analysis and limits that were developed for such materials (i.e., Case F). While Section 6.4.3.3 of the packages' safety analyses explains that the beryllium present in the pipe overpack contents will be present in waste materials such that it is completely bound to the fissile material in the source, this section of the safety analyses is not included in the certificate, neither directly nor by reference nor by inclusion in Section 2.9 of the CH-TRAMPAC, which is included by reference in the certificate and specifies content form.

The staff recognizes that Conditions 6 and 8 of the certificates do incorporate the CH-TRAMPAC in its entirety to, among other things, limit the content's properties, such as physical form and chemical properties. This includes ensuring that materials to be loaded in the packages' various overpacks, including the pipe overpacks, are consistent with the CH-TRU Waste Content Codes that are authorized for shipment. Each code provides specific information on the content's properties such as its form, how it is processed, and its chemistry. These codes are consistent with the package limits specified in the certificates as derived from the analyses to support those limits. This includes the information described in Section 6.4.3.3 of the safety analyses, which is itself a summary of a survey of the TRU Waste Baseline Inventory Database, which contains specific information about all CH-TRU waste that would be

shipped in the packages. This information is provided by the waste generators (see pages B-29 through B-35 of the May 14, 2004 RAI response letter for Revision 20 of the TRUPACT-II certificate and Revision 3 of the HalfPACT certificate at ADAMS Accession No. ML041460007).

Based on the information in the TRU Waste Baseline Inventory Database, the form of the pipe overpacks' contents matches the configuration that beryllium and beryllium oxide is always bound to the fissile material. The current allowed waste content codes for the pipe overpacks are also based on this condition. Thus, if waste material that did not match this configuration were identified and proposed to be loaded in the packages, per the CH-TRAMPAC, a new waste content code would need to be obtained from the CH-TRU payload engineer, who would be cognizant of and use the safety analyses of the packages to determine whether to approve a new content code for such waste. Identification of material that did not fit within the safety analyses would result in a new content code not being approved until a certificate revision was obtained to allow it. This process triggered the current revision request with respect to allowing machine compacted materials in the pipe overpacks. Based on this process and that the process is incorporated into the certificates by reference (i.e., Conditions 6 and 8), the staff expects that for pipe overpacks with contents to be shipped under the category of not machine compacted waste with beryllium or beryllium oxide in amounts greater than 1 wt. percent of the contents, the beryllium or beryllium oxide will be mechanically or chemically bound to the fissile material and so application of the Case E limit (in place of Case F and its limits) would be acceptable for such contents. However, to ensure that pipe overpack contents that are not machine compacted and contain more than 1 wt. percent beryllium or beryllium oxide will always meet the basis for using the Case E limit, that basis is added as a part of the CoC condition that specifies the pipe overpack fissile mass limits.

6.3 Criticality Control Overpack Contents Changes and Analyses

The TRUPACT-II and HalfPACT packages include a CCO. The currently approved contents are limited to manually compacted materials. The criticality analyses for this overpack are labeled as "Case I" in the packages' safety analysis reports and CH-TRU Payload Appendices (Appendix 4.6). In proposing to add machine compacted materials to the allowable contents of the CCO, the applicant has not modified the Case I analyses. Instead, the applicant has provided a supplemental analysis that uses the results of the Case I analyses for manually compacted materials to develop an additional control on machine compacted material for this overpack and justify that with this control the packages loaded with these overpacks containing machine compacted materials will be subcritical.

The applicant's proposed additional control is to limit the amount of plastic in the machine compacted materials loaded in a CCO to 2,000 grams. This amount is based on the amount of polyethylene in the moderator for the Case I analysis with the hydrogen to Plutonium-239 ratio that maximizes reactivity for the manually compacted material, which is a ratio of 650 for the hypothetical accident conditions array of packages. The Case I analyses use a moderator that is 25 percent polyethylene, 74 percent water, and 1 percent beryllium. For the fissile limit amount of Plutonium-239, the amount of polyethylene in the moderator for this scenario is a little more than 2,000 grams. With machine compaction, there is less and less space for water to mix with the materials and act as a moderator for the fissile materials. Thus, the moderation and reactivity for manually compacted materials would be bounding for machine compacted materials.

For its review, the staff reviewed the descriptions of the criticality analyses that had been done for the CCO and evaluated the supplemental analysis provided in this revision request. With

only 2,000 grams of plastic in the CCO's contents, that would be the only moderator for the fissile material at the maximum compaction and would result in a significantly smaller ratio of hydrogen to Plutonium-239 than the most reactive scenario for the manually compacted material. This would result in a lower reactivity versus that manually compacted material case. Though the polyethylene was found to be a more effective moderator than water; by limiting the amount of polyethylene to less than the amount in the most reactive Case I scenario, the polyethylene's better moderation capability is accounted for by the supplemental evaluation.

The staff also performed calculations (using SCALE 6.2.3 and the continuous energy cross sections from ENDF/B-VII.1) to confirm the conclusion of the supplemental evaluation. As part of these calculations, the staff also confirmed the amount of polyethylene determined by the applicant. Since the analysis and the resulting limit are also to have the same conditions regarding special reflector materials as for the manually compacted material, the staff also confirmed that such conditions are acceptable for machine compacted material. In all cases, the most reactive scenario for the manually compacted waste bounded the reactivity of the machine compacted waste. Furthermore, inclusion of different amounts of beryllium mixed with the fissile material and polyethylene further reduced reactivity, as did consideration of different reflection scenarios (e.g., water in only portions of the package or all the package). Thus, the trends in reactivity for the Case I analyses for maximizing reactivity were the same for the machine compacted material cases evaluated by the staff.

Thus, based on the information provided by the applicant and the staff's confirmatory analysis, the staff finds the addition of machine compacted materials to the CCO's contents to be acceptable and that the TRUPACT-II and HalfPACT packages containing these overpacks with machine compacted materials will be subcritical. Since the analyses demonstrate subcriticality for both single packages and infinite arrays of packages for both normal conditions of transport and hypothetical accident conditions, the staff also finds the analysis demonstrates that the criticality safety index of 0.0 is appropriate for these packages.

6.4 Criticality Control Overpack Design Changes and Analyses

The staff also evaluated the proposed design changes in the drawings for the CCO for their potential impacts on criticality safety. Per the application, the criticality calculations show very little difference in package reactivity due to the dunnage in these overpacks. Also, the maximum reactivity case (the hypothetical accident conditions array of packages) is with the package dry. In other words, in the most reactive scenario, everything but the moderated fissile material, the steel pipe component of the overpacks and the steel shells of the inner containment vessel and the outer confinement assembly is void. Therefore, the proposed changes to the dunnage have no effect on criticality safety.

The staff evaluated whether the other changes, which affect material thicknesses and tolerances of the steel criticality control component (a steel pipe with steel flanges for a base and lid) in the CCO, had the potential to impact the criticality analyses for these overpacks. In reviewing the analyses, the staff identified that the most reactive cases are with moderated fissile material volumes that are less than the volume and height of the criticality control component's cavity in which the radioactive materials are loaded. Thus, differences in tolerance for the cavity length have no effect on criticality safety.

Other changes result in localized thinning of the criticality control component's steel (in the lid) and differences in tolerances in the component's steel flanges (lid and base). The staff evaluated these changes because steel can be a good neutron absorber. Changes in thickness

can, therefore, impact the steel's effect on reactivity. For the flanges, the changes included addition of an optional material specification. For this optional material specification, the staff reviewed the standards associated with the current and the proposed optional specification and determined that the proposed optional specification would result in tighter tolerances on thickness than the current specification allows. This would ensure a greater minimum amount of steel and will have a lesser impact on package reactivity than the tolerances for the current specification. Thus, the staff finds that change to be acceptable.

Since changes that result in thinning of the steel flange lid are localized, the staff expects their effects to be small. The staff, as part of its confirmatory calculations did consider a uniform reduction of thickness for the whole lid that represents the changes in the specifications of these localized areas. These confirmatory calculations showed a slight increase in reactivity, which was a relatively small fraction of the margin to the applicant's upper subcritical limit. Thus, the staff finds these changes to be acceptable in terms of criticality safety as well.

Based on these considerations, the staff finds the analyses for the CCOs to be acceptable for these overpacks with the proposed design changes. The staff finds that the TRUPACT-II and HalfPACT packages containing these overpacks will be subcritical and that a criticality safety index of 0.0 remains appropriate for these packages.

6.5 Air Transport Certificate Condition

Since the revision to 10 CFR Part 71 in January 2004, the regulations have included requirements for package tests and evaluations for packages that are intended to allow transport by air. These requirements are in 10 CFR 71.55(f). In its review of the TRUPACT-II (for certificate revision 19) and HalfPACT (for certificate revision 5) packages, dated May 15, 2009, the staff determined that the TRUPACT-II and HalfPACT packages are not authorized for shipment by air and so the requirements of 10 CFR 71.55(f) do not apply. However, in making that determination, a condition should have been added to these packages' certificates that states these packages are not authorized for air transport of fissile material as has been done with other fissile material packages for which air transport is not authorized. The safety analyses for these packages do not include the needed tests and evaluations to demonstrate compliance with the requirements for transport by air of fissile material; thus, the staff's determination from 2009 is unchanged.

The staff recognizes that the package operations, as described in Chapter 7 of the application for each package only describe operations in terms of loading and unloading a package onto or off of a trailer or railcar and that this portion of the application is incorporated into the certificate by reference as a condition of the certificate. However, it is not clear that the descriptions of operations for these packages are all that different from the package operations descriptions for other fissile material packages, which are incorporated by reference into their certificates, that also have a specific condition explicitly precluding air transport. Thus, the staff determined that this condition should be added to the certificates for the TRUPACT-II and HalfPACT packages as well. Therefore, to bring the certificates for these packages into harmony with the staff's May 15, 2009, determination and ensure consistency with the regulations, a condition is being added to each package's certificate that states: "Transport by air of fissile material is not authorized."

6.6 Evaluation Findings

Based on a review of the information and representations provided in the application and the staff's confirmatory calculations, the staff has reasonable assurance that the TRUPACT-II and

HalfPACT packages with the proposed contents and design changes, will continue to satisfy the criticality safety requirements in 10 CFR Part 71.

7.0 MATERIALS EVALUATION

The changes proposed by the applicant to the TRUPACT-II and HalfPACT did not impact the previous materials degradation and gas generation evaluations that have been performed. The existing analyses in the previous SER for CoC Nos. 9218 and 9279 for Revision Nos. 21 and 7 (NRC, 2013), respectively, remain applicable for this submittal (NRC, 2020 and NWP, 2020e).

Based on the review of the statements and representations in the application for TRUPACT-II and HalfPact, the staff finds that the applicant adequately described and evaluated the materials performance of the package, and they are acceptable. Therefore, the staff concludes that there is reasonable assurance that the package meets the materials requirements of 10 CFR 71.31.

CONDITIONS

The staff made some editorial changes as well as changes to the conditions of approval to the CoCs for the Model Nos. TRUPACT-II and HalfPACT packages. The following items summarize the changes to both certificates:

1) Changed references to CH-TRU Payload Appendices from Revision 3 (Rev. 3) to Rev. 4.

2) Changed references to CH-TRAMPAC from Rev. 4 to Rev. 5.

3) Condition No. 3.b., “Title and Identification of Report or Application,” includes the date of the application.

4) Condition No. 5.(a)(3), “Drawings,” contains the latest revision of the licensing drawings as well as “Nuclear Waste Partners as the owner of the drawings. Reorganized the drawings as a list with the corresponding titles.

5) Condition No. 5.(b)(1), “Type and Form of Material,” was revised to list the payload containers authorized to pack the contents. This was an editorial change to the certificates to improve their use and readability.

6) Condition No. 5.(b)(2) was revised to add Table 1 and 2. Table 2 allows machine compacted material in the pipe overpacks and CCOs and limits the amount of plastic to 2,000 grams in machine compacted material in CCOs.

7) A new condition, Condition 13 is added, which states the following:

> “Transport by air of fissile material is not authorized.”

Condition(s) after Condition No. 13 (is) are renumbered accordingly.

8) The “REFERENCES” Section of each certificate was revised as to include the date of the application and its supplement(s).

In addition, for the Model No. HalfPACT package, the CoC was renewed for 5 years. Therefore, the expiration date of the certificate was changed to November 30, 2025. Also, Condition No. 13 was renumbered as Condition No. 14 and revised to allow using Revision 8 of the HalfPACT's certificate until November 30, 2020.

Besides the conditions applicable to both package's certificates, for the Model No. TRUPACT-II package, Condition No. 13 was renumbered as Condition No. 14 and revised to allow using Revision 24 of the Model No. TRUPACT-II certificate until November 30, 2020.

CONCLUSIONS

Based on the statements and representations contained in the application, as supplemented, and the conditions listed above, the staff concludes that the designs have been adequately described and evaluated, and the Model Nos. TRUPACT-II and HalfPACT packages meet the requirements of 10 CFR Part 71.

Issued with Certificates of Compliance No. TRUPACT-II and HalfPACT packages, Revisions 25 and 9, respectively, on November 23, 2020.

REFERENCES

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(NRC, 2020) U.S. Nuclear Regulatory Commission, "Summary, Conference Call-Clarification Questions to Requests for Additional Information for the Criticality Safety and Material Evaluation, Model Nos. TRUPACT-II and HalfPACT," September 28, 2020, ADAMS Accession No. ML20290A755.

(NUREG-1609) U.S. Nuclear Regulatory Commission, "Standard Review Plan for Transportation Packages for Radioactive Material," NUREG-1609, March 1999.

(NWP, 2020a) Sellmer, T.E., Nuclear Waste Partnership, LLC, (NWP) letter to Director, Spent Fuel Project Office (SFPO), U.S. Nuclear Regulatory Commission, August 3, 2020, ADAMS Accession No. ML20216A494.

(NWP, 2020b) Nuclear Waste Partnership, LLC, "CH-TRU Payload Appendices Safety Analysis Report," Revision 4, August 2020, ADAMS Accession No. ML20216A497.

(NWP, 2020c) Nuclear Waste Partnership, LLC, "CH-TRAMPAC Appendices Safety Analysis Report," Revision 5, August 2020, ADAMS Accession No. ML20216A499.

(NWP, 2020d) Sellmer, T.E., Nuclear Waste Partnership, LLC, (NWP) letter to Director, Spent Fuel Project Office (SFPO), U.S. Nuclear Regulatory Commission (NRC), September 24, 2020, ADAMS Accession No. ML20269A188.

(NWP, 2020e) Email from Kyle Moyant, Nuclear Waste Partnership, LLC, (NWP) to Norma Garcia Santos, U.S. Nuclear Regulatory Commission (NRC), September 28, 2020, ADAMS Accession No. ML20316A001.