



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

SAFETY EVALUATION REPORT
Docket No. 71-9305
Model No. TRUPACT-III

SUMMARY

By application dated January 28, 2014 (Agencywide Document Access and Management System (ADAMS) Accession No. ML14035A106), as supplemented on March 10 (ADAMS Accession No. ML15071A022), and August 19, 2015 (ADAMS Accession No. ML15254A328), September 16, 2015 (ADAMS Accession No. ML15280A350), March 14, 2016 (ADAMS Accession No. ML16077A013), and April 1, 2016 (ADAMS Accession No. ML16096A355), Nuclear Waste Partnership LLC. (NWP), Nuclear Waste Partnership (NWP or the applicant) requested an exemption, under Title 10 of the *Code of Federal Regulations* (10 CFR) 71.12, for approval of two shipments, each containing a single package from the Savannah River Site in Aiken SC to the Waste Isolation Pilot Plant (WIPP) near Carlsbad NM, using two Model No. TRUPACT-III package. Each TRUPACT-III package and its associated Standard Large Box 2 (SLB2), serial numbers SR215244413 and SR215244414, may contain approximately one-half of a B-Line plutonium-238 recovery transfer tank section, polyethylene plastic bags and sheeting, wood dunnage, and miscellaneous slings and metal parts. In addition to the exemption, NWP also requested an increase in both the A_2 quantity up to $2.1 \times 10^5 A_2$ and decay heat load up to 190 W, beyond those quantities currently authorized in Certificate of Compliance No. 9305, Rev. 9.

Certificate of Compliance No. 9305, Revision No. 9 authorizes "... contact-handled transuranic (CH-TRU) waste and other authorized payloads that do not exceed $10^5 A_2$ quantities." Since the proposed contents for these two shipments will exceed $10^5 A_2$, the applicant is required by 10 CR 71.61 to evaluate the package to show that its "...undamaged containment system can withstand an external water pressure of 2 MPa (290 psi) for a period of not less than 1 hour without collapse, buckling, or inleakage of water," (the deep water immersion test.)

In its exemption request, NWP stated that in the Federal Register Notice (69 FR 3698) issuing the Final Rulemaking to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 71 which added the requirements in 10 CFR 71.61, that the purpose of the deep water immersion test in 10 CFR 71.61 is to ensure package recoverability, since radioactive materials such as plutonium and high-level waste are increasingly being transported by sea in large quantities. The deep water immersion test external pressure of 2 MPa (290 psi) is equivalent to being submerged in 200-meter (660-ft) water depth and roughly corresponds to the depth of the continental shelf and to depths that the studies indicated radiological impacts could be important. The TRUPACT-III shipment proposed by NWP will take place via truck from Savannah River to WIPP.

The applicant has stated that, for these two shipments, the deepest body of water that the proposed route traverses is approximately 48 feet. In the application for a certificate of compliance dated June 30, 2007 (see ADAMS Package Accession Nos. ML16049A539 and ML071870325), Packaging Technology, Inc. (PacTec) evaluated the TRUPACT-III package for immersion in 15 m (50 ft) of water, as required by 10 CFR 71.73(c)(6). PacTec evaluated the package by determining the effects of applying a 150 kPa gauge pressure (as specified 10 CFR 71.73(c)(6)) to the outside of the containment structural assembly. The results shown in Section

2.7.6, "Immersion - All Packages" that the factor of safety against buckling is 4.41 for the containment structural assembly. Based on this evaluation, the authorization for this shipment is limited to a route that does not traverse water deeper than 50 feet. The staff evaluated the NWP's evaluation for the increased decay heat load and increased A₂ quantity.

In making its decision, the Commission has determined that the exemption is authorized by law and will not endanger life or property nor the common defense and security. The Commission has also determined that the TRUPACT-III shipment will not significantly affect the public health and safety or adversely impact the environment (81 FR 35387; June 2, 2016).

A. Authorized by Law

Pursuant to 10 CFR 71.12, the Commission may, upon application by any interested person or upon its own initiative, grant any exemption from the requirements of 10 CFR part 71 that it determines is authorized by law and will not endanger life or property nor the common defense and security.

A. Authorized by Law

This exemption would permit the applicant to transport, in two separate shipments, one-half of a B-Line plutonium-238 recovery transfer tank section, polyethylene plastic bags and sheeting, wood dunnage, and miscellaneous slings and metal parts, with each half in a single package. The provisions from which the NRC is granting the exemption require the certificate holder to evaluate an undamaged containment boundary of any Type B package containing more than 10⁵A₂ for a pressure equivalent to a depth of 200 m for a period of not less than 1 hour without collapse, buckling, or inleakage of water. Section 71.12 allows the Commission to grant exemptions from the requirements of 10 CFR Part 71 if the exemption is authorized by law and will not endanger life or property nor the common defense and security. Issuance of this exemption is consistent with the Atomic Energy Act of 1954, as amended, and not otherwise inconsistent with NRC's regulations or other applicable laws. Therefore, issuance of the exemption is authorized by law.

B. Will Not Endanger Life or Property or the Common Defense and Security

Staff reviewed NWP's application and concludes, as discussed below, that the operational and administrative controls that will be imposed on this shipment provide reasonable assurance that the TRUPACT-III will not encounter conditions beyond those for which it has been evaluated and demonstrated to meet the requirements of 10 CFR part 71.

1.0 GENERAL INFORMATION

1.1 Packaging Description

TRUPACT-III is a shipping container for transporting transuranic waste in a Standard Large Box 2 (SLB2) primarily by truck. The packaging body is a rectangular box with an external width of 2,500 mm (98.4 inches), external height of 2,650 mm (104.3 inches), and an external length of 4,288 mm (168.8 inches). The internal cavity dimensions are 1,840 mm (72.4 inches) wide, 2,000 mm (78.7 inches) tall, and 2,790 mm (109.8 inches) long.

The TRUPACT-III packaging is comprised of the containment structural assembly (CSA) made from 8-mm inner and outer stainless steel plates with 4-mm thick V-shaped stiffeners in

between. A debris shield receptacle is located all around the open end of the CSA inner cavity. The receptacle is a 26-mm by 38-mm cross section bar with a 15-mm wide by 20-mm deep groove cut along its length. The 109 - 120-mm polyurethane foam, 10-mm thick puncture resistant stainless steel plate, 60-mm balsa wood layer, and the 6-mm stainless steel skin form the integral energy-absorbing overpack structure. A 409-mm deep octagonal recess in the bottom end with 6-mm thick stainless steel plate, a 60-mm thick balsa wood layer, a 15-mm thick puncture-resistant stainless steel plate, and a 120-mm thick foam layer protect the bottom end of the packaging during drops or punctures.

A rectangular closure lid made from 4-mm thick V-shaped stiffeners sandwiched between an inner and an outer 12-mm thick stainless steel plates is attached to the packaging body by 44 socket head cap screws and contains two elastomer O-ring face seals. A sampling/vent port with O-ring seals are recessed into the closure lid. The inner stainless steel plates of the closure lid and the body along with the inner elastomer O-ring seal, the sampling/vent port insert, and the sampling/vent port inner O-ring seal form the single containment boundary.

An overpack cover is designed to protect the closure lid. The outer face of the overpack cover contains an octagon recess 393 mm deep. The cover structure consists of a 6-mm thick stainless steel cover plate encasing a 60-mm thick layer of balsa wood, a 15-mm thick puncture resistant stainless steel plate, a 120-mm thick layer of polyurethane foam, and a 6-mm thick inner stainless steel cover plate. The edges of the overpack cover consist of an inner 6-mm stainless steel plate, a 42-mm thick layer of calcium silicate insulation, a 16-mm thick puncture resistant stainless steel plate, a 380-mm thickness of 0.48 kg/dm³ polyurethane foam, a 6-mm thick puncture-resistant stainless steel plate, a 140-mm thick layer of 0.16 kg/dm³ polyurethane foam, and an 8-mm thick external stainless steel plate.

The approximate dimensions and weights of the package are as follows:

Overall package outside dimensions	
Width	2,500 mm (98.4 inches)
Length	4,288 mm (168.8 inches)
Height	2,650 mm (104.3 inches)
Maximum content weight	5,210 kg (11,486 lbs)
Maximum package weight (Including contents)	25,000 kg (55,116 lbs)

1.2 Packaging Drawings

The packaging is constructed in accordance with AREVA Federal Services LLC, Drawing No. 51199-SAR, Rev. 15, sheets 1 through 21.

1.3 Contents

Each package will contain approximately one-half of a "B-Line plutonium 238 recovery transfer tank" in an SLB2 waste box. The tank half may also contain polyethylene plastic bags and sheeting, wood dunnage, and miscellaneous slings and metal parts.

2.0 STRUCTURAL EVALUATION

The maximum weight of the loaded package will not exceed the maximum weight authorized in Certificate of Compliance No. 9305, Rev. 9.

3.0 THERMAL EVALUATION

The applicant, NWP, requested an increase in the design decay heat limit (80 W) for one-time transport of two Standard Large Box 2 (SLB2) waste boxes in the TRUPACT-III package. Each SLB2 contains a half-section of Pu-238 recovery transfer tank, polyethylene, plastic bags and sheeting, wood dunnage, and miscellaneous sling and metal parts. The applicant requested an increase in the decay heat limit up to 190 W for these two shipments.

3.1 Description of the Thermal Design

The two SLB2s have the maximum heat loads of 187.3 W and 142.0 W, respectively, which exceed the 80-W package design limit in the certificate of compliance. NWP evaluated an SLB2 with a heat load of 190 W, which bounds the actual heat loads of the two packages. The thermal model, material properties and heat transfer mechanism for this application remain the same as those documented in TRUPACT-III safety analysis report dated August 19, 2013 (see ADAMS Accession No. ML13273A612), that was the basis for initial issuance of the certificate of compliance and future revisions.

3.2 Thermal Evaluation for Normal Conditions of Transport

The applicant stated in the application that the thermal transient evaluation for the normal conditions of transport assumes a constant ambient temperature of 38°C and sine-curve insolation loads on the top, sides, and ends of the package. The bottom surface of the package is assumed to be adiabatic.

The applicant developed the thermal model with Thermal Desktop and SINDA/FLUINT computer programs and predicted a maximum temperature of 110°C at the waste tank assembly surface under the heat test for normal conditions of transport (with insolation) which is below the maximum allowable limit of 230°C. The containment O-ring seal has a maximum temperature of 57.5°C which is well below the maximum allowable limit of 107°C. The maximum balsa wood temperature in the overpack is 86.3°C, which remains within the normal conditions of transport maximum allowable limit of 100°C. The maximum temperature of the polyethylene used in the debris shield, is close to 110°C which is below its melting point of 135°C. The temperatures from the normal conditions of transport heat test are listed in Table 7-1 in Calculation Document No. CALC-3009687-001 in the application.

The maximum normal operating pressure (MNOP) is 25 psig (172 kPa gauge), as described in section 3.3.2 of the safety analysis report. The pressure developed in the package includes the initial quantity of gas in the containment vessel, the quantity of gas generated by radiolysis of the contents, and the quantity of water vapor. The low temperatures within the CSA, less than 61°C, indicate there is no offgassing from the payload and package components. As stated by the applicant that while the maximum heat loads are increased from 80 W up to 190 W (187.3 W for SLB2 number SR21524413 and 142.0 W for SLB2 number SR21524414), the maximum pressure in the containment system is still limited by administrative controls in the certificate of compliance to 172 kPa gauge (25.0 psig).

After reviewing the package description, the SLB2 configuration and the thermal evaluations described in the application, the staff finds that (a) the package material and component temperatures will not exceed the specified allowable limits during the normal conditions of transport and (b) the maximum temperatures of all accessible surfaces are below the allowable limit of 50°C to meet the requirements in 10 CFR 71.43(g), for a nonexclusive use shipment.

The staff concludes that the transport of the two SLB2s, with a decay heat load up to 190 W, should not cause impacts beyond those described in TRUPACT-III SAR when evaluated for the tests for normal conditions of transport specified in 10 CFR 71.71.

3.3 Thermal Evaluation of Hypothetical Accident Conditions

As described in the Calculation Document No. CALC-3009687-001 in the application, the package initial conditions prior to the fire test in 10 CFR 71.73 are based on the normal conditions of transport with solar insolation. An ambient temperature of 1475°F (800°C) was used for the fire test for hypothetical accident condition. The applicant modeled the payload using the specific knowledge of its configuration addressed in Appendix A of the application, taking full credit for heat flow to the ambient, and eliminating the conservative assumption that the effective thermal conductivity of the payload is equivalent to that of the still air. Even with the heat load of 190 W, the applicant predicted a maximum waste tank assembly payload temperature of 112°C, which is below the maximum allowable limit of 230°C during hypothetical accident conditions. As stated by the applicant, the staff agrees that the presence of outer skin, the balsa wood, polyurethane foam, and calcium silicate insulation transient provides the significant thermal protection to the CSA and its payload because of insulation effects of these materials.

To calculate the maximum cavity pressure, the applicant used the average temperatures of SLB2 waste container (64°C) and CSA containment sheet (62°C) for the pre-fire condition and applied the peak temperatures of SLB2 waste container (79°C) and CSA containment sheet (234°C) during the fire test for hypothetical accident condition. The applicant calculated a peak pressure during the fire test for hypothetical accident condition of 248 kPa gauge which is 1.3 kPa less than that predicted in the August 19, 2013 safety analysis report.

The staff reviewed the calculations for hypothetical accident condition and agrees that the package material and component temperatures will not exceed the specified allowable limits during the fire test for hypothetical accident condition and the transport of the high heat-load SLB2s will not cause over-pressurization under hypothetical accident conditions, consistent with the tests specified in 10 CFR 71.73.

3.4 Evaluation Findings

Based on review of the statements and evaluations in the application, the staff concludes that thermal analyses for normal conditions of transport and hypothetical accident conditions for the two SLB2 waste boxes in the TRUPACT-III package demonstrate compliance with the thermal-related requirements as specified in 10 CFR Part 71.

4.0 CONTAINMENT EVALUATION

There is no change to the containment boundary thus no evaluation is necessary.

4.1 Combustible-Gas Generation

The hydrogen generated in the TRUPACT-III will be limited to a molar quantity less than 5% by volume of the innermost layer of confinement if present at standard temperature of 32°F and pressure of 14.7 psia, based on flammable gas measurement.

NWP stated in the application for this exemption and increased quantity and decay heat load authorization that compliance with the flammable gas generation rate limit, independent of heat load, will ensure compliance with the total gas generation rate. The applicant measured the headspace flammable gases of 0.0026% by volume for the SLB2 with heat load of 187.3 W and 0.0136% by volume for SLB2 with heat load of 142.0 W. The applicant concluded that although the heat load is increased in SLB2, it is largely present as contamination of the inner wall of the dual-wall recovery transfer tank and is comprised of inorganic material, which does not generate gas by the radiolysis. The applicant provided the flammable gas analysis results in Attachment 3 of Calculation Document No. CALC-3009687-001.

4.2 Evaluation Findings

The staff reviewed the Attachment 3 in Calculation Document No. CALC-3009687-001 and finds that the headspace flammable gas measurement results for both SLB2 boxes are well below the 5% hydrogen concentration limit identified in NUREG-1609 and meet the flammable gas generation rate limits for both SLB2s.

5.0 SHIELDING EVALUATION

There have been no changes to shielding design so no shielding evaluation is needed.

6.0 CRITICALITY EVALUATION

There have been no changes to the fissile material limits in the certificate of compliance so no criticality evaluation is necessary.

7.0 OPERATING PROCEDURES EVALUATION

There have been no changes to the operating procedures so no evaluation is needed.

8.0 ACCEPTANCE TESTS AND MAINTENANCE REVIEW

There have been no changes to the acceptance tests so no evaluation of acceptance tests and maintenance is necessary.

CONDITIONS

1. All conditions of Certificate of Compliance No. 9305 shall remain in effect, except:
 - a. the maximum A_2 quantity shall not exceed 2.1×10^5 per package.
 - b. the maximum decay heat shall not exceed 190 Watts per package.
 - c. the contents of both TRUPACT-III package and its associated Standard Large Box 2 (SLB2), serial numbers SR215244413 and SR215244414, may contain approximately one-half of a B-Line plutonium-238 recovery transfer tank section, polyethylene plastic bags and sheeting, wood dunnage, and miscellaneous slings and metal parts. In making its decision, the Commission has determined that the exemption is authorized by law and will not endanger life or property nor the common defense and security.
2. The shipments must be in compliance with a special permit issued by the U.S. Department of Transportation.

3. The route utilized for shipment shall not traverse water deeper than 50 feet.
4. This authorization does not relieve the shipper from compliance with any requirements in the Department of Transportation 's regulations in Title 49 of the *Code of Federal Regulations*, unless those requirements are specifically waived by the Department of Transportation.
5. This authorization expires on December 31, 2019.

CONCLUSION

Staff concludes that the operational and administrative controls that will be imposed on this shipment provide reasonable assurance that the TRUPACT-III will not encounter conditions beyond those for which it has been evaluated and demonstrated to provide protection. The staff believes that the risk to the public from this shipment is low, and comparable to that of other activities regulated by the Commission. Considering the statements and representations contained in the application, as supplemented, and the exemptions and conditions listed in the approval letter, and for the reasons listed above, the NRC staff has concluded that the TRUPACT-III, as exempted and conditioned, meets the requirements of 10 CFR Part 71.