

**Robatel Technologies, LLC
RT-100 RAI Meeting
July 22, 2013**

RAI Dated March 28, 2013
TAC No. L24686
Docket No. 71-9365



▶ Agenda

- Introduction
- Opening statement
- Presentation
- RAI Schedule
- Closing



- ▶ RT-100 Certification Process Overview
 - Submitted CoC Application No. 9365 October 9, 2012 for Type B radioactive waste transport cask – RT-100
 - Received NRC RAI request dated March 28, 2013
 - 63 items to answer and/or clarify
 - Met with NRC on April 17 and June 18th / 19th, 2013 for preliminary review of several RAI comments
 - Two meetings to review RT's interpretation and path forward for NRC RAI
 - July 22 – Chapter 2 & 4 + Materials and leak testing
 - July 22 – Chapter 5 + Shielding related questions and RAI 7-2
 - Time permitting, review other RAI responses
 - Proposed approach and strategy for resolution

Chapter 2 + Materials

RAI 2-2:

Provide further justification that explains how and why the foam crush strength data, in the “densification region” for strains beyond 60%, is used. This is a follow-up to RSI 2.2.

Explain how lock-up is considered and evaluated in the analysis. In response to RSI 2.2, the applicant indicated that the extrapolated values used are considered to be conservative and yielded a conservative deceleration value when compared to the drop test results. In addition to this justification, also provide an explanation of why a deviation from the manufacturer’s recommended properties is required and appropriate. This deviation may be important in the analytical effort that considers variations in the package design that were not present in the scale model drop test.

RAI 2-2 Response

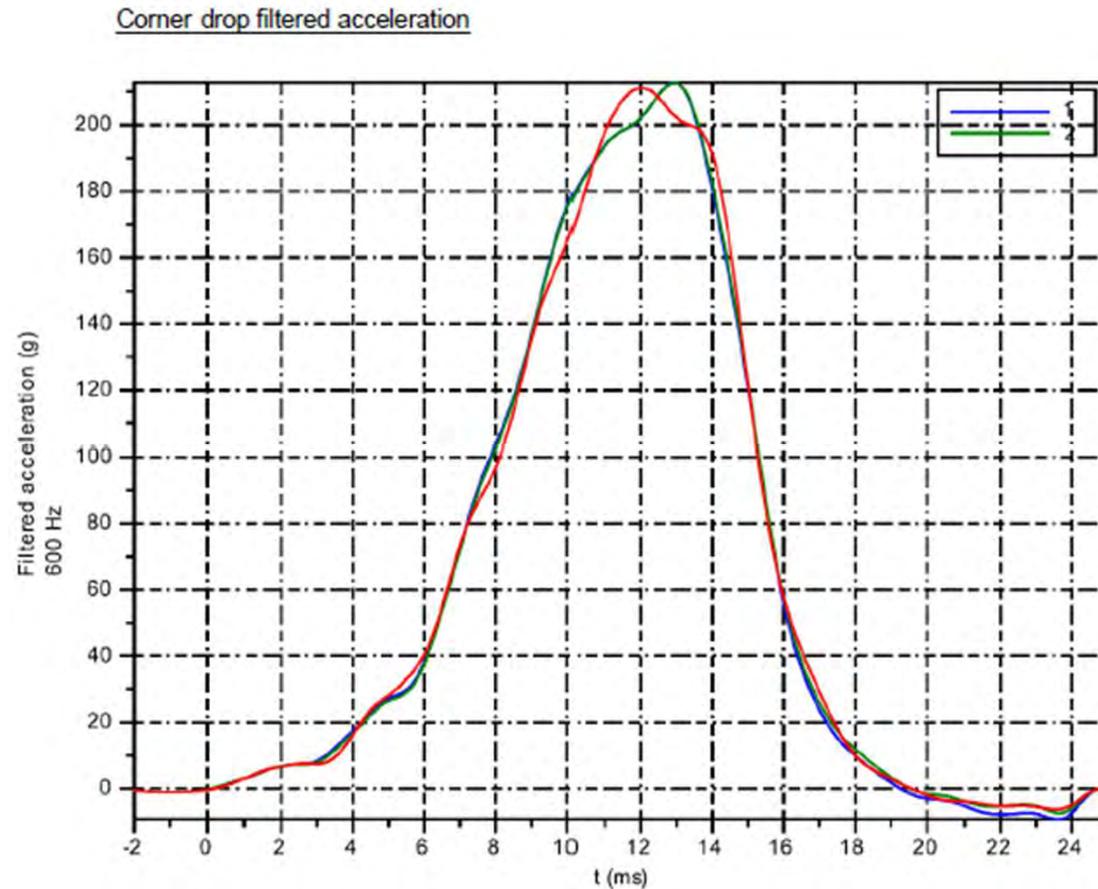


- ▶ Robatel imposed a tolerance range of $\pm 10\%$ on the foam material supplier as documented in Robatel Specification 102885 PAP-008
 - Densities are held to a tighter tolerance than the manufacturer's recommended values to allow the size of the impact limiter to be optimized
 - Decision made in consultation with the supplier, and is appropriate because the foam used in the RT-100 is poured and cured under controlled conditions rather than injected directly into the closed impact limiter shell
 - Supplier is required to provide test results of samples confirming compliance
 - Foam for both the actual cask and the drop test scale model is procured using the same specification requirements for density tolerance range
- ▶ Acceptable drop test results are defined as those values that will ensure that the cask body does not impact the ground
 - For the corner drop, the central portion of the foam along the line from point of initial impact to the corner of the cask body will exhibit high strains
 - Foam away from this central "axis" will incur lower strains
 - With each increment in crush depth, new foam material is brought into contact with the ground and begins to crush a new ring of material
 - While some portions of the foam may experience high strains, much of the energy of the impact is absorbed by foam with strains below 60% and the test results do not show indications of foam lock-up or cask body impact with the ground (see following page)
 - Additional discussion is provided in response to RAI 2-15

RAI 2-2 Response (cont)



- ▶ RT-100 3/10th Scale Model Corner Drop Test results demonstrate that the impact limiter foam does not lock up and the cask body does not impact the ground
 - Foam temperature during test: 78°C



RAI 2-9:

Provide/justify that the containment boundary final geometrical configuration (using a validated model) from the post normal conditions of transport (NCT) free drop and hypothetical accident conditions (HAC) tests correspond to the containment analysis assumptions.

Per RSI 4.2 response, there will be "minor" inelastic deformation on the inner shell (containment boundary).

Section 2.5.7 of NUREG-1609 states that "inelastic deformation is generally unacceptable for the containment evaluation." Also, Section 4.5.3.2 of NUREG-1609 states that the containment boundary, seal region, and closure bolts should not undergo any inelastic deformation.

RSI 4.2 response and Appendix 2.14 of the application discuss analysis of the closure bolts but do not provide complete insight regarding containment integrity (must remain elastic or the final geometry must correlate to the N14.5 containment analysis).

Staff notes the following statements in RSI 4.2 response: "While some localized areas of the inner shell have minor inelastic deformation, the stresses do not exceed the ultimate strength of the material. Therefore, the ability of the inner shell to maintain positive containment is not compromised." Staff does not agree with this approach, unless the final geometrical configuration is less severe than the assumptions included in the containment analysis.

RAI 2-9 Response



- ▶ The RT-100 containment boundary, seal region, and closure bolts do not undergo inelastic deformation
 - All reported stresses in the containment boundary are below the ASME allowables
 - Calculations based on NUREG/CR-6007 show that the closure bolts maintain a tight seal during NCT and HAC
- ▶ Under load, the O-ring grooves can cause a stress riser at the radius where the groove transitions from horizontal to vertical
 - For this evaluation, the load is in the form of a bending moment
 - For the primary and secondary lids, the stress concentration factors for these groove radii are 2.6 and 2.2, respectively
- ▶ For the lid gasket grooves, the linearized stress is calculated for each peak stress location and multiplied by the stress concentration factor

RAI 2-9 Response (cont)



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- ▶ The following table provides a summary of the resulting factored stress values
- ▶ As the table shows the minimum factor of safety is 1.2

Accident Condition	Yield Strength at Max NCT Seal Temp (MPa)	Stress Concentration	Linearized Stress in Primary Lid Primary Seal (MPa)	Maximum Stress (MPa)	Factor of Safety	Stress Concentration	Linearized Stress in Secondary Lid Primary Seal (MPa)	Maximum Stress (MPa)	Factor of Safety
Side Drop	184.2	2.6	15.0	38.9	4.7	2.2	66.1	145.3	1.3
End Drop	184.2	2.6	45.1	115.9	1.6	2.2	47.7	102.6	1.8
Puncture	184.2	2.6	59.1	153.6	1.2	2.2	71.8	158.0	1.2

- ▶ The RT-100 stress analysis is in compliance with Regulatory Guide 7.6, Section B and NUREG-1609, Section 4.5.3.2

RAI 2-14:

Justify and modify the assembled package lifting analysis.

The detailed assembled package lifting analysis is provided in Section 7.7 of report RTL-001-CALC-ST-0201 and Section 2.5.1.3.1 of the application.

As required by 10 CFR 71.45(a), any lifting attachment must be designed with a minimum safety factor of three against yielding, when used to lift the package in the intended manner.

Per ASME Section III, Division 1, Subsection NF-3323.2, the allowable (corresponding to yield for pure shear) for pure shear stress is $0.6S_m$. When considering this value, the new “yielding” or allowable is less than the S_y/f_{sy} value used.

(continued)

RAI 2-14 (continued):

Section 7.2 of ANSI standard 14.6 (ST-0201 reference 3.12), “Radioactive Materials – Special Lifting Devices for Shipping Containers Weighing 10000 Pounds (4500 kg) or More,” requires a dynamic load factor for the design of critical load lifting. Therefore, the applicant shall provide an analysis using an appropriate dynamic load factor and justify the value used.

It also appears that the analysis is not the same between the calculation package referenced ST-0201 and the application. For example the lifting pocket tear out stress safety margin is calculated to be 4.9 in the application, but only 1.27 in ST-0201. Also, the lifting pocket bearing stress is calculated in the application (safety margin of 1.73), but not in ST-0201.

Ensure consistency between all technical reports, e.g., ST-0201 and the application.

RAI 2-14 Response



- ▶ The safety criteria used in the lifting analysis is a factor of three against yielding in accordance with 10 CFR 71.45(a)
 - SAR presentation is revised to show that the lifting system has a minimum safety factor of 3 when compared to the yield strength of the material
 - SAR is also revised to show positive safety margins in accordance with NF-3223.2
 - In each case, shear stresses are evaluated using a reduction in the allowable of 0.6
- ▶ A Dynamic Load Factor of 1.35 is being utilized in the revised analysis
 - DLF value is obtained from the German Safety Standard KTA 3905
 - This standard typically specifies the use of a “live” or dynamic load factor of 1.35 in the calculation of lifting stresses
 - A review of other applications shows that values of 1.15 to 1.3 have been used
- ▶ The calculation document was found to have some inconsistencies and typographical errors when compared to the SAR. Both the SAR and the calculation are being revised to address these issues
- ▶ The DLF necessitated a minor design change to the size of the weld connecting the lifting block to the cask body

RAI 2-15:

Justify the 9m HAC corner drop test case being bound by the 9m end and side drop cases.

The applicant claims, in Section 2.7.1.3, that the 9m end and side drop HAC tests bound the 9m corner drop test. Appendix 2.13.3.4.1 of the application develops the impact limiter time history response for the 9m HAC corner drop case, and the impact limiter methodology was verified in Section 2.13.4.1 against a scaled NUPAC-125B package (Single Foam – Series FR3700 with a density of 12 pcf). However, the construction of the Model No. RT-100 package impact limiter design is fundamentally different from the NUPAC-125B design.

Per Table 2.13.4.2.1.3-2, the calculated crush depth is 534mm whereas the maximum crush depth is 544 mm, which gives only a 10 mm margin. Also, Appendix F of the RT-100 3/10 scale drop test report, referenced 102885 RES 001, does not provide a final impact limiter crush depth for the corner drop. See also RAI 2-17.

RAI 2-15 Response



▶ PROPRIETARY RESPONSE



▶ PROPRIETARY RESPONSE



▶ PROPRIETARY RESPONSE



▶ PROPRIETARY RESPONSE



▶ PROPRIETARY RESPONSE



▶ PROPRIETARY RESPONSE

RAI 2-16:

Justify the 9m HAC oblique drop test case being bound by the 9m end and side drop cases.

Section 2.7.1.4 states the following: “Based on the impact limiter analysis provided in Appendix 2.13, the oblique drop configuration is bounded by the end and side drop analyses. Therefore, no further analysis is required.” However, Appendix 2.13 of the application does not provide a justification for the bounding of the oblique drop orientation by the 9m end and side drop cases. Staff also notes that there was no physical data comparison for the oblique test orientation in the NUPAC-125B or RT-100 scale tests.

Justify how the statement in section 2.7.1.4 of the application was derived and verified.

RAI 2-16 Response



- ▶ The SAR is being revised to present in Section 2.7.1.4 an evaluation justifying that forces resulting from an oblique-angle drop configuration are bounded by the forces imposed on the cask from the side and end drop configurations
- ▶ Inertial equations are utilized to demonstrate that the oblique impacts are less severe than the side drop for casks with a length to diameter ratio of less than 1.37
- ▶ The length to diameter ratio of the RT-100 is 1.28

RAI 1–2:

Clarify items listed in the NUREG classification table in Chapter 1.

- a) Explain the different ASME subsection choice for the Helicoil M48 x 2D (listed as ITS, category A per ASME III Subsection NF) and O-ring (listed as ITS, category A per ASME III Subsection ND).

- b) Typically the NUREG classification table is listed in the licensing drawings to form part of the licensing basis.

RAI 1–2 Response



- ▶ The references to ASME Subsection ND and NF have been removed from the Bill of Materials
- ▶ Helicoils, O-rings and bolts are not procured in accordance with ASME requirements
 - These components are procured in accordance with commercial grade dedication plans that are based on ASTM or ISO standards
 - The revised Bill of Material includes the quality category of each item in accordance with NUREG/CR-6407
- ▶ The Bill of Materials for the RT-100, document RT100 NM 1000, is the formal listing of the materials of construction of the cask
 - This document is included in the SAR along with the other cask drawings and may be referenced in the NRC Certificate of Compliance
- ▶ Further details are provided in response to RAI 8-1

RAI 1–5:

Provide the basis for the O-ring compression and O-ring groove dimensions in the licensing drawings. Provide corresponding manufacturer data sheets.

- a) As stated on page 8–2 of the application, there are two seals associated with each of the primary lid, secondary lid, and quick–disconnect valve cover plate. Although some details of the groove dimensions and compression were provided on page 2–230, the basis for the O-ring compression and O-ring groove dimensions, such as from manufacturer data sheets, should be provided for the six seals.
- b) Provide the manufacturer and part number of the six O-rings on the licensing drawings.
- c) The drawings should indicate both the dimensions and tolerances of the groove dimensions and the O-rings to ensure compression of the O-rings.

RAI 1–5 Response



- ▶ Geometry details of the O–ring grooves are displayed on the drawings RT100 PE 1001–1 and RT100 PE 1001–2
- ▶ These drawings are being revised to provide more information on the surface roughness of the machined grooves and of the O–ring mating surface (upper flange) requirements (Ra 1.6)
- ▶ The basis of these dimensions are taken from the Parker data sheet and ROBATEL’s satisfactory performance of this groove design in other casks

RAI 1–5 Response (cont)



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- ▶ The percentage compression requirement is the following:
 - A minimum of 5% to ensure a sufficient compression and contact area (O-ring on upper flange) and a maximum of 30% to prevent damage on the O-ring
 - On both O-ring cross section diameters (5.33 mm and 12 mm) the RT-100 has been designed to achieve compression of approximately 20%.
- ▶ The table below presents the compression in each O-ring resulting from the worst-case tolerance stackup between the O-rings and the grooves

O-Ring	Percentage compression		
	Min	Mean	Max
Lid O-Ring	15.96%	20.46%	25.65%
Vent Port Coverplate O-Ring	15.36%	19.99%	25.3%

RAI 1–5 Response (cont)



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- ▶ The standard tolerances of the O-ring cross-sectional diameters are taken into account in the groove calculation, however the lengths of the O-rings are nonstandard
- ▶ The lengths are based on the actual cask lids and cover plate dimensions. As a result, no manufacturer part number can be assigned to the O-rings
- ▶ The O-rings are procured in accordance with a commercial dedication plan (102885 PR 006 provided with the RAI responses for information) and in the dimensions mentioned in the bill of material
 - Additional details provided in response to RAI 8-1
- ▶ Drawings RT100 PE 1001-1 and -2 are revised to include the dimensions and tolerances of the O-rings

RAI 7-6:

Clarify the use of fabrication, maintenance, periodic, and pre-shipment tests in Chapters 7 and 8.

- a) Section 4.4 of the application references ANSI N14.5 when discussing the fabrication, maintenance, periodic, and pre-shipment tests. However, for completeness and as an aid to the test personnel, it also should be stated in Chapters 7 and 8 that “the fabrication, maintenance, periodic, and pre-shipment tests are performed in accordance with ANSI N14.5.”
- b) The appropriate leakage rate test and sensitivity criteria should be listed in Chapters 7 and 8 for the fabrication, maintenance, periodic, and pre-shipment leakage tests.

RAI 7-6 Response



- ▶ Section 7.6 of the SAR will be deleted
 - Leak testing requirements for the cask will be provided in Sections 8.1.4 and 8.2.2
- ▶ Section 4.4 of the SAR is being revised to reference 8.1.4 and 8.2.2 for specific procedures regarding performance of leakage testing in accordance with ANSI N14.5
- ▶ Sections 8.1.4 and 8.2.2 are being revised to specify the fabrication, maintenance, periodic and preshipment leakage testing requirements per ANSI N14.5
 - Leakage Test acceptance criteria and its basis
 - Leakage Test sensitivity
 - Action to be taken if criteria not met

RAI 7–8:

Discuss the need to prevent contamination during unloading.

- a) The potential for release of radioactive gases, volatiles, etc., as well as combustible gases, from the package during unloading (such as a quick-disconnect valve failure, etc.) of contents should be discussed, especially in Sections 7.2.1 and 7.2.2.

- b) If available, provide “field data” that shows the activity from the void/ headspace from a package with the proposed contents.

- ▶ Section 7.2 of the SAR is being revised to include additional guidance information to users regarding potential contamination release
 - A requirement will be added to Section 7.2 ensuring that the user follows the requirements of 10 CFR 20.1906 as specified in 10 CFR 71.89
 - Users will be cautioned to consider potential releases of radioactive material consistent with the form of the radioactive contents
 - Guidance will be included for the initial opening of the package at the vent port coverplate to warn that releases of radioactive material could possibly occur due to failure of the quick disconnect valve
- ▶ A review of information from customers has indicated that release of radioactive materials during cask unloading has not been an issue for these types of shipments

RAI 8-1:

Clearly indicate the dimensions, materials used, design criteria, fabrication criteria, and acceptance tests required for all important to safety, non-standard materials and components. This is a follow-up to RSI 8.1.

The Bill of Materials indicates that several important to safety components are “commercial,” or described based on a manufacturer description. Some of these components, such as O-Rings, are not detailed in the drawings. In order to adequately describe the proposed design, provide either the detailed drawing showing dimensions or the materials of construction of the component, or include a specific reference to the desired part. If a reference is provided, enough detail is needed to understand the design details of the specific component.

Further, an understanding of the data that is used to develop material properties, design allowable, and acceptance tests for these components is needed. Section 8.1.5 discusses the Commercial Grade Dedication (CGD) Plan that will be prepared to ensure that the material meets all specifications critical to safety. However, a description of those tests that are required to ensure the safety of the packaging is needed in Chapter 8 of the application. This can be accomplished by detailing the tests in Chapter 8. For example, for the impact limiter foam, a test matrix of the formulation, batch and pour tests required to ensure that the desired material properties are achieved could be provided. Acceptance tests may also be proposed for the seals and the carbon fiber thermal shield. Alternatively, if this information is already contained in another document, such as a CGD Plan, that document can be referenced and provided as an appendix to Chapter 8.

RAI 8-1 Response



- ▶ Dimensions of important to safety non-standard components are displayed on the licensing drawings
 - Primary lid O-ring diameters are shown in detail view 1 of the drawing RT100 PE 1001-1
 - Secondary lid O-rings diameters are in detail view 2 of the drawing RT100 PE 1001-1
 - Vent port cover plate O-ring details are provided in section GG of drawing RT100 PE 1001-2
 - Impact limiter foam dimensions are shown on drawing RT100 PE 1001-1 and 2
- ▶ Section 8.1.5 of the SAR is being revised to provide additional details regarding the important to safety non-standard components
 - Critical characteristics for each material identified
 - Testing requirements for each material specified

RAI 8-1 Response (cont)



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- ▶ Materials are procured in accordance with ASME, ASTM or ISO requirements when possible
- ▶ The critical characteristics of materials not procured in accordance with one of these standards are documented in a procurement specification that is included in the procurement documentation
- ▶ Examples of critical characteristics for such materials are provided on the following slides
- ▶ All critical characteristics will be tested by QA-approved laboratories

▶ PROPRIETARY RESPONSE

▶ PROPRIETARY RESPONSE

RAI 8-2:

Clarify which components will be inspected during normal use and periodic maintenance. Clearly indicate the differences between the maintenance during normal use and the periodic maintenance every 12 months, as defined in Section 8.2.1 and 8.2.2 of the application, respectively.

A clear understanding of the maintenance approach is needed to verify that the packaging will continue to perform adequately during its licensed period. Based on the description provided, it is unclear whether, for example, the lid and lid seals are inspected each time the Model No. RT-100 package goes through a cycle of loading and unloading.

RAI 8-2 Response



- ▶ Chapter 8 of the SAR is being reorganized and revised to meet the format requirements of Reg Guide 7.9 including clarification of Leakage Testing Requirements
- ▶ Section 8.2 is being revised to specify the required maintenance tasks and their intervals, as applicable
 - Structural and Pressure Tests
 - Leakage Tests
 - Component and Material Tests
 - Thermal Tests
 - Miscellaneous Tests

RAI 8-4:

Clarify the parts to be leak tested before each loading.

The General Notes included in page 8-2 of the application state the following: "... This test is conducted when the cask is breached at either the primary lid, secondary lid or quick-disconnect valve cover. A leak test on these parts is not necessary if the secondary lid or quick-disconnect valve cover have not been opened." These sentences imply that a leak test of the primary lid, that has been opened, is not necessary if the secondary lid or quick-disconnect valve cover have not been opened. The intent of these sentences is unclear to staff and they should be re-written.

RAI 8-4 Response



- ▶ This statement will be removed in the revised SAR
- ▶ Sections 8.1.4 and 8.2.2 of the SAR are being revised to clearly specify leakage testing requirements as described in response to other RAI questions in Chapters 4 and 8

RAI 8-5:

Clarify that the pre-shipment leak test will be performed after loading of contents.

The General Notes included in page 8-2 of the application state that a leak test is performed before each loading. Page 8-9 states that a pre-shipment leakage test is required before each shipment of Type B material quantities. In order to prevent confusion between the tests described on pages 8-2 and 8-9, it should also be stated that the pre-shipment test is performed after the contents have been loaded, per ANSI N14.5, and as mentioned in Table 4.4-1.

RAI 8-5 Response



- ▶ Sections 8.1.4 and 8.2.2 of the SAR are being revised to clearly specify leakage testing requirements as described in response to other RAI questions in Chapters 4 and 8

RAI 8-7:

Clarify the seal replacement period discussed on pages 8-7 and 8-8 of the application.

- a) Section 8.2.1 indicates that records should "... ensure that seals are within the 24 month replacement period." The replacement period should reflect the 12-month period described on page 8-8.

- b) Provide the basis for the 50 cycle seal limited period stated on page 8-8.

RAI 8-7 Response



- ▶ Section 8.2.2 of the SAR is being revised to clarify that the periodic replacement interval for the O-ring seals is every 12 months in accordance with the requirements of ANSI N14.5

Chapter 4 + Leak Testing

RAI 4-1:

Demonstrate that the release calculations are bounding:

- a) The containment analysis focused on the activity associated with the resin as a powder, and its corresponding airborne release and respirable fractions. However, there is no discussion of the activity associated with the gases and volatiles of the void, or “head space,” within the package. The effect of the content isotopes’ volatiles and gases, including their quantities, activities, and higher release fractions compared to the solid content, should be detailed and included in the NCT and HAC containment discussion.
- b) The calculations in Sections 4.2.2 and 4.3 of the application should be expanded to show all of the potential sources of releasable activity, such as the gases/volatiles (from isotopes and their daughter products) and those leached out (from moisture content) and evolved at NCT and HAC temperatures, in addition to the sources associated with the solid resins and filters.
- c) Sections 4.2.2 and 4.3 should provide an additional explanation to justify the appropriateness of the airborne release and respirable fraction calculation methodology and how the resin and filter contents are bounded by it. The density of powder aerosol from NUREG/CR-6487 already takes into account the material suspended in air; thus, including the airborne release fraction (ARF) counts twice the aerosol-effect.

RAI 4-1 Response



- ▶ The cask leak rate testing procedures are revised to be in accordance with the leaktight criteria of ANSI N14.5
- ▶ Therefore, 10 CFR 71.51 requirements will be met
- ▶ Chapter 8 of the SAR is being revised to describe the leak testing requirements in order to meet the leaktight criteria

RAI 4-2:

Discuss the form of the resin bead and filter contents.

The analysis in Section 4.2.2 assumes a powder content form (“density of powder aerosol”, etc.) but does not provide details of the resin bead and filter, such as the range of bead diameter, the powder size classification, etc.

RAI 4-2 Response



- ▶ As stated in responses to RAI 4-1, the cask will be demonstrated to meet leaktight criteria in accordance with ANSI N14.5. However, details of the form of the contents of resin beads and filters are provided in Chapters 1 and 4 of the SAR

RAI 4-3:

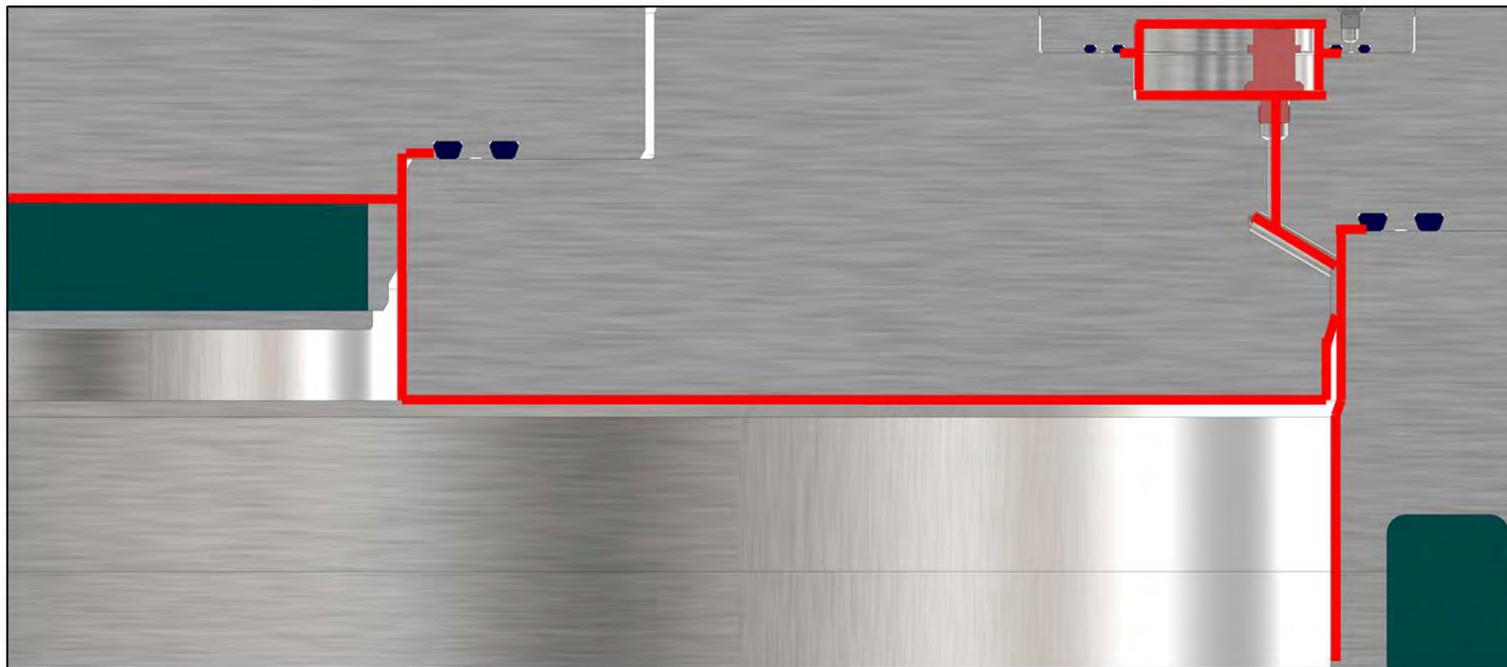
Provide a clearer picture and description of the containment boundary; the image and red line in Figures 4.1.2-1 and 4.1.2-2 on page 4-3 of the application do not clearly show the extent of the containment boundary in the upper right hand side figure.

The resolution of the line and image in Figures 4.1.2-1 and 4.1.2-2 is insufficient to clearly understand the containment boundary. A clearer image and description of the containment boundary should be provided.

RAI 4-3 Response



- ▶ Figures 4.1.2-1 and 4.1.2-2 are being replaced by higher resolution pictures to provide a better illustration of the containment boundary



RAI 4–7:

Justify that combustible gases generated in the package during the shipping period do not exceed 5%, by volume, of the free gas volume.

Section 1.2.2.6 states that the shipper must ensure that the hydrogen concentration within the container will be below 5%, by volume. In addition, page 1–8 states that the moisture content is limited to no more than 1% free water by volume. A bounding calculation of combustible gases that could form, based on the approved contents with their respective alphas, betas, etc., should be provided.

RAI 4-7 Response



- ▶ Section 7.8.2 of the SAR is being added to provide guidance to cask users regarding how to calculate the gas generation rate for the contents
- ▶ Complete instructions are provided regarding the gas generation factors for the contents, including any water in the container
- ▶ Hydrogen gas generation rate parameters from NUREG/CR-6673 are provided for all allowable materials comprising the resin and filter contents and thermoplastic secondary containers
- ▶ Cask users calculate the maximum allowable shipping time for the specific contents, ensuring that hydrogen generation would not result in a concentration in the free gas volume in excess of 5%

RAI 4-7 Response (cont)



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- ▶ Key parameters in the calculation include:
 - Mass of hydrogen generating materials (thermoplastic secondary containers, resins, filters, etc)
 - Mass of water in the cavity
 - Free volume in the cask cavity
 - Decay heat load
- ▶ Bounding calculations are prepared for a set of basic assumptions
 - Shipping time of 10 days (20 days used for hydrogen generation)
 - Maximum proposed quantity of hydrogen generating material
 - Loading curve establishes the allowable decay heat as a function of the free volume in the cavity
- ▶ Detailed calculations will be prepared by the user for contents that exceed any of the parameters used in the loading curve

- ▶ Hydrogen generation values for RT-100 contents

G Values for RT-100 Contents (mol/100 eV)		
Material	G(H₂)	G(flam gas)
Polyethylene	4.0	4.1
Polystyrene	0.2	0.2
Polyamides	1.1	1.2
Ion Exchange Resins	1.7	1.7
Nylon	-	1.6

- ▶ An equation characterizing the mole fraction of hydrogen in the RT-100 Transport Cask over time is shown on the following slide

RAI 4-7 Response (cont)



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$$X_H = \frac{n_H}{n_0 + n_H} = \frac{\frac{D_H \alpha_i G_i t}{100 A_N}}{\frac{P_0 V}{R_g T_0} + \frac{D_H G_i t}{100 A_N}}$$

X_H – mole fraction of hydrogen,

n_H – number of moles of hydrogen [gmol],

n_0 – initial number of gas moles in the container when the vessel was closed [gmol],

G_i – total radiolytic G value for ionic resin [molecules/100eV],

D_H – decay heat that is absorbed by the radiolytic materials [eV/s],

α_i – fraction of G_i that is equivalent to G_H , flammable gas released, for the ionic resin,

A_N – Avogadro's constant [6.022×10^{23} molecules/gmol],

P_0 – pressure when the container is sealed [atm],

T_0 – temperature when the container is sealed [K],

V – is the container void volume [cm^3],

R_g – gas law constant [$82.05 \text{ cm}^3 \text{ atm/gmolK}$],

t – time [seconds]

RAI 4–7 Response (cont)



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- ▶ Using the equation on the previous slide, the decay heat limit versus waste volume for a specific transport time (50% of gas generation time) and hydrogen buildup limit of 5.0 percent mole fraction can be determined
- ▶ The following slide provides a curve illustrating the waste volume as a function of decay heat that would result in the generation of the hydrogen buildup limit within 20 days
- ▶ If the waste volume and decay heat values for a cask fall below the curve, the load would not generate a flammable gas mixture within 20 days
- ▶ If the waste volume and decay heat values for a cask are above the curve, the load would generate a flammable gas mixture in less than 20 days

RAI 4-7 Response (cont)



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- ▶ For example, assume the waste volume for a particular shipment was 70 ft³
- ▶ This would result in a free gas volume of 62.27 ft³ (determined by the net free gas volume in the cavity with a secondary container, 132.27 ft³, minus 70 ft³)
- ▶ Based on the 62.27 ft³ (1.76 x 10⁶ cm³) free gas volume, the equation shown on the previous slide can be solved for decay heat as follows

$$D_H = \frac{100A_N X_H \frac{P_0 V}{R_g T_0}}{(G_i t (\alpha_i - X_H))}$$

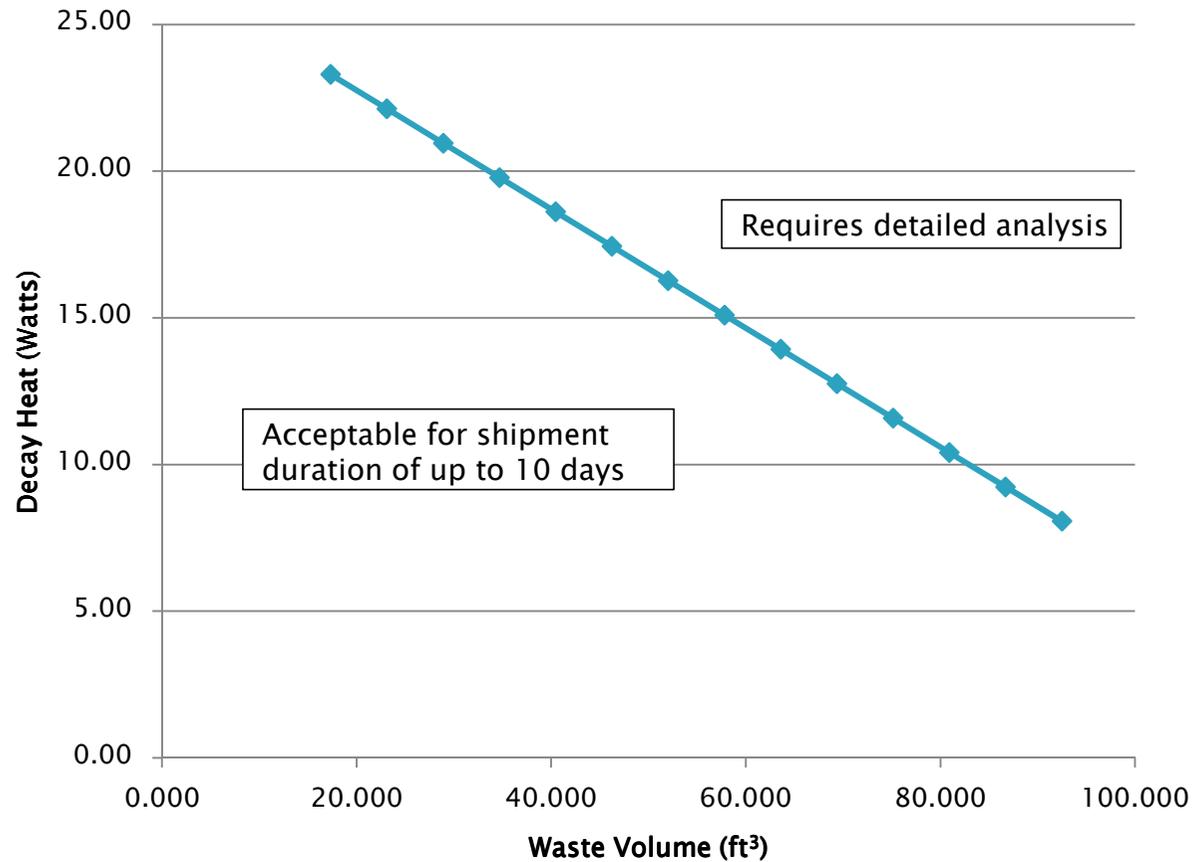
$$D_H = \frac{100(6.022 \times 10^{23})(0.05) \frac{(1 \text{ atm})(1.76 \times 10^6 \text{ cm}^3)}{\left(82.05 \frac{\text{cm}^3 \text{ atm}}{\text{gmolK}}\right)(298 \text{ K})}}{(2.1)(1728000 \text{ s})(0.81 - 0.05)}$$

$$D_H = 7.9 \times 10^{19} \text{ eV} = 12.6 \text{ W}$$

RAI 4-7 Response (cont)



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RAI 7-3:

Confirm the appropriateness of leakage test procedures and leakage test personnel qualifications.

The leak testing discussion in Chapters 7 and 8 lacks details, as evidenced further in subsequent RAI comments. Confirm that appropriate leak test procedures (i.e., detailed procedures are found in lower tier documents, etc.) and test personnel qualifications (i.e., ASNT certified) are established, per quality assurance requirements.

RAI 7-3 Response



- ▶ Section 7.6 of the SAR will be deleted
 - References in Chapter 7 procedures to Section 7.6 are being revised to reference the appropriate tests specified in Section 8.2.3
- ▶ Structure of Chapter 8 is being reworked in accordance with Reg Guide 7.9
- ▶ Section 8.1.4 Leakage Tests (Acceptance Testing following fabrication) is being revised to describe the following activities:
 - Leakage Testing Procedure
 - Leakage Testing Acceptance Criteria and its basis, test sensitivity, and action if criteria not met
 - Test Personnel Qualifications
- ▶ Section 8.2.2 Leakage Tests (Pre-shipment Testing, Periodic Testing, and Maintenance Testing) is being revised to describe the following activities:
 - Leakage Testing Procedure
 - Leakage Testing Frequency
 - Leakage Testing Acceptance Criteria and its basis, test sensitivity, and action if criteria not met
 - Test Personnel Qualifications

RAI 7-4:

Clarify the appropriate periodic and maintenance leakage tests discussed in Chapter 7.

a) Sections 7.1.1.4, 7.1.1.5, 7.1.1.6, 7.1.2.2, 7.1.2.3, and 7.1.2.4 of the application appear to refer to the ANSI N14.5 periodic and maintenance leakage tests of the seals and containment. If so, these tests should be explicitly stated so that the appropriate components, acceptance criteria and sensitivity criteria are known to the test personnel.

b) These periodic and maintenance tests refer to a pressure rise leakage test found in Section 7.6 of the application. According to ANSI N14.5, the pressure rise test sensitivity is between $1E-1$ to $1E-5$ ref-cm³/sec, which is not sufficient to meet the $3.077E-6$ ref-cm²/sec sensitivity described on page 4-11 of the application. An appropriate leakage test procedure is required for the periodic and maintenance leakage tests.

RAI 7-4 Response



- ▶ Sections 7.1.2.2, 7.1.2.3, and 7.1.2.4 are being revised to reference the preshipment Leakage Test procedure, criteria, and sensitivity of Sections 8.1.4 and 8.2.2
- ▶ Sections 8.1.4 and 8.2.2 are being revised to explicitly state use of ANSI N14.5 requirements
- ▶ Section 7.6 of the SAR will be deleted

RAI 7-5:

Clarify whether the leakage test described in Section 7.1.3 of the application represents the ANSI N14.5 pre-shipment leakage test.

Section 7.1.3 “Preparation for Transport” lists tasks to be performed “... prior to final assembly of the RT-100.” One listed task is leak rate testing. It should be clarified whether this leak rate testing refers to the ANSI N14.5 pre-shipment test, which occurs after the contents are loaded and the package is closed. The corresponding acceptance leakage rate and sensitivity criteria should also be provided.

RAI 7-5 Response



- ▶ Section 7.1.3 of the SAR is being revised to remove the reference to leak testing
- ▶ Preshipment leak testing of the cask is described in Section 7.1.2 for the primary lid, secondary lid and vent port cover plate O-ring seals
 - Section 7.1.2 will reference Section 8.2.2 for the specific leak testing requirements, including ANSI N14.5 leak testing requirements

RAI 7-7:

Confirm the appropriate use of the pressure rise leakage test.

- a) Section 7.6 states that a pressure rise leakage test is performed on the containment seals for the primary lid, secondary lid, and quick-disconnect valve cover plate. Although the procedure applies to the primary lid, secondary lid, and quick-disconnect valve cover plate, the initial listed task is for the vacuum pump to be positioned on the primary lid leak test port. The drawings indicate that the primary, secondary, and quick-disconnect valve cover plate leak test ports are independent. Would not the vacuum pump be positioned on the appropriate port that is to be tested, i.e., primary, secondary, or quick-disconnect valve cover plate?
- b) The fourth step of the procedure indicates that the vacuum pump should be isolated. It is recognized that a running vacuum pump can pull vacuum across "closed" valves. The procedure should also provide guidance to physically disconnect the pump from the arrangement and/or turn the pump off.
- c) Explicit instruction should be provided as it relates to the pressure rise leakage test. Therefore, the following statement should be removed: "Another type of leakage rate testing is acceptable if it complies with the RT-100 design, and ensures every leakage testing requirement is met."

RAI 7-7 Response



- ▶ As described in previous RAI responses, Section 7.6 of the SAR will be deleted, with references to Section 7.6 replaced by Sections 8.1.4 and 8.2.2 as appropriate
- ▶ Section 8.2.2 is being revised to clarify that the pressure rise test will be performed by attaching the vacuum pump to the appropriate test port in the primary lid, secondary lid or vent port cover plate as appropriate
- ▶ Section 8.2.2 is being revised to state that the Operator/ Inspector shall turn-off the vacuum pump prior to disconnect
- ▶ Section 8.2.2 is being revised to delete reference to using an equivalent leakage testing procedure

RAI 8-3:

Specify the details of an appropriate fabrication, periodic and maintenance leak test that meets the acceptable leakage criteria.

- a) Sections 8.1.4 and 8.2.3.1 provide information on a leakage test. It appears that the leakage test method relies on sniffer or spray methods, which are qualitative techniques. These methods are not appropriate for leak-testing the entire containment boundary (welds, base material, seals, etc.) for a fabrication leak test or for the periodic and maintenance leak tests which must meet a quantifiable, allowable leak rate, as specified in Table 4.4-1 of the application. An appropriate leak test method should be specified.
- b) Sections 8.1.4 and 8.2.3.1 state: "... or in accordance with other approved procedures using different leak detector gases." Explicit instruction should be provided as it relates to a leakage test. In addition, the different gases and resulting leak rate criteria should be specified.
- c) Section 8.2.3 states: "The leakage rate testing is performed in accordance with Chapter 4 requirements." This sentence should be clarified with further discussion and details.

RAI 8-3 Response



- ▶ Chapter 8 of the SAR is being reorganized and revised to meet the format requirements of Reg Guide 7.9 including clarification of Leakage Testing Requirements. Based on the new format, Section 8.2.3 will change to 8.2.2
- ▶ Sections 8.1.4 and 8.2.2 are being revised to define each Leakage Test in accordance with ANSI N14.5 requirements
 - Frequency
 - Components to be tested
 - Testing procedure
 - Acceptance criteria
 - Actions to be taken if test fails



- ▶ SAR sections 8.1.4 and 8.2.2 are being revised
 - Instructions are given to clearly indicate the leakage test method, the gas used and its dedicated acceptance leak rate criteria
 - The fabrication, periodic and maintenance leakage tests are performed using a helium leakage test to demonstrate compliance with the leaktight criteria of 1×10^{-7} ref·cm³/sec for an upstream pressure of 1 atm and a downstream pressure of 0.01 atm or less in accordance with ANSI N14.5
 - The preshipment leakage tests are performed using an air pressure test to meet the preshipment leakage rate criteria demonstrated no leakage at a sensitivity of 1×10^{-3} ref·cm³/sec or better in accordance with ANSI N14.5

RAI 8-6:

Provide additional details in Section 8.1.4.2 Leakage Test Procedure.

Additional details associated with the fabrication leakage test should be included in the procedure in order to provide appropriate guidance to the person performing the test. Some issues to address include the following:

- a) The leakage test procedure stated that a substitute-sealed plate may be used if the cask lid(s) are unavailable. There is no mention of when the actual cask lid(s) [primary, secondary, quick disconnect cover plate] would be tested and how the leakage rates would be accounted for in the total package leakage rate.
- b) The need to leak test the entire containment boundary must be explicitly stated so that the leak rate can be compared correctly to the acceptable leakage rate criteria.
- c) The origin and intent of the “sealed metal cavity filler canister” was not adequately discussed. Further information on this canister should be provided in the section.

RAI 8-6 Response



- ▶ Section 8.1.4 is being revised to describe the leakage rate criteria of each containment boundary and of the entire containment boundary
 - Discussion is added to state that the cask body containment boundaries are only tested once during fabrication
 - Criteria for the containment boundary in the cask body is leak tight
 - Leakage testing of the cask body will be performed prior to lead pouring to enable the welds of the inner shell, bottom forging and upper forging to be inspected
 - Additional leakage testing will be performed on the final fabricated cask testing the O-ring seals in the primary lid, secondary lid and vent port cover plate
- ▶ The acceptance criteria for the fabrication verification leakage test will be no detectable leakage in any seal or weld at the required test sensitivity in accordance with ANSI N14.5
- ▶ The “sealed metal cavity filler canister” is a component optionally used during leakage testing to reduce the free volume in the cask cavity to minimize the time needed to fill the cavity with helium
 - Section 8.1.4 of the SAR is being revised to provide additional discussion and details

Chapter 5 + Shielding related questions

RAI 5-2:

Confirm that the packaging is used to ship only wastes with a uniform source distribution and that sources with a “point source” geometry are not authorized as contents at this time. Provide specific operating procedures that can determine and assure the uniform distribution of the source in the contents.

The application indicates that (i) the Model No. RT-100 package is designed for shipping general wastes from reactors, (ii) the radioactive sources are assumed to be uniformly distributed, and (iii) the contents are restricted in terms of Curie/gram concentration to assure homogeneity. For these reasons, the application does not provide any shielding analysis for concentrated sources and indicates that the sources will be defined in terms of Curie per gram of content. However, the application does not include clear guidance and/or operating procedures regarding the appropriate determination of authorized contents.

(continued)

RAI 5-2 (continued):

The applicant needs to both confirm the intended contents and develop loading procedures that can determine the eligibility of the contents based on the source concentration (i.e., Curie/gram or Becquerel/gram). The applicant also needs to develop operating procedures to determine the maximum and minimum allowed density of the contents. With respect to the density limits, an average density obtained by dividing the total weight by the total volume should not be used because this method cannot provide information on the uniformity of the contents and of the source in the package cavity. The same principle applies to the source term distribution in the contents, i.e., the user must be given specific instructions to assure uniform distribution of the source in the contents as well.

- ▶ Shielding evaluations are performed to determine the maximum allowable content activity density in curies per gram that may be present in the cask for each radionuclide
 - The cask user is responsible for ensuring that their contents are sampled, and that the maximum content activity density of any individual waste stream are assumed in the calculation of the Loading Table as described in Section 7.8.1 of the SAR
 - Requirements for waste homogeneity are established in the NRC Branch Technical Position on Concentration Averaging and Encapsulation
 - Section 5.3.1 of the SAR is revised to clarify that the “uniform distribution” of the waste means that it is assumed for the purposes of the shielding evaluation to be uniformly distributed throughout the cask cavity at the maximum activity density
 - This is conservative because it ignores the possibility that portions of the contents will have activity densities lower than the maximum assumed in the analysis
 - The assumptions stated above ensure that the dose rates predicted for a specific waste shipment will bound the actual measured values taken prior to shipment
- ▶ As addressed in response to RAI 5-6 and 7-1, Section 7.8.1 of the SAR is being revised to provide additional examples of how the Loading Table is utilized to demonstrate compliance with the individual nuclide activity density limits specified in Section 5.6.3

RAI 5-2 Response (cont)



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- ▶ Concerning the range of allowed densities of the material, the analysis in Calculation RTL-001-CALC-SH-0201, Rev. 1 demonstrates that resin at 0.65 g/cm^3 produces the lowest maximum allowable Ci/g for each radionuclide
 - Thus, higher and lower density concentrations of resin in the package are bounded by the current evaluations

RAI 5-3:

Explain the basis for assuming the additional 1 mm annular air gap between the lead shield layer and the shells housing the lead layer of the Model No. RT-100 package; justify the adequacy of the subsequent 2.478 cm lead slump assumption; recalculate the lead slump if necessary, and provide an updated loading table for various contents based on the updated lead slump.

The application indicates that lead slump was considered in the HAC shielding analysis. On pages 26-27, the applicant calculated the lead slump for both side and end drop impacts. However, the basis for the air gap formed by the lead slump is unclear. In its response to RSI 5-1, the applicant did not provide any basis for its determination and simply replaced the axial 1.62 mm with a lead slump gap of 2.478 cm in the application. In addition, the applicant characterized the gap as manufacturing tolerance.

(continued)

RAI 5-3 (continued):

It is unclear if the manufacturing tolerances include lead shrinkage. More importantly, it is unclear if the stainless steel shells housing the lead layer have the same tolerances. If so, the space available for lead slump will be much larger when the tolerances move in opposite directions. Further, the staff was unable to find any update to the maximum allowable design basis contents, Table 5.4.4-4, for a package under HAC as a result of this change. The maximum allowable contents in this table are identical to what was presented in Revision 0 of the application.

The staff requests the applicant to provide: (1) a justification for the assumed lead gaps under both NCT and HAC, (2) correct the data if necessary, and (3) recalculate the dose rates for the package under both NCT and HAC.

RAI 5-3 Response



▶ PROPRIETARY RESPONSE

- ▶ PROPRIETARY RESPONSE

RAI 5–6:

Demonstrate that the approach used to calculate the maximum allowable content is accurate and reliable for all actual contents.

Table 7.8.1–1 lists maximum allowable contents for each potential isotope in a typical resin waste composition. The application states that this approach is an inverse calculation approach and that the method attempts to determine the maximum allowable quantity for each isotope of interest for the given regulatory dose rate limits. Since a pure nuclide was used in each calculation, it is unclear if the results are applicable to a content that is a mixture of multiple nuclides. The applicant needs demonstrate that this approach is accurate and reliable for determining the maximum allowable content with consideration of the differences between the materials used in the model and the actual contents.

RAI 5-6 Response



- ▶ A one curie source dose rate response is computed for each isotope with a greater than 1-day half life
- ▶ Self shielding by the nuclide or other nuclides present in the resin is conservatively neglected
 - Only resin or filter materials are modeled as the source material
- ▶ The dose rate contributions from multiple nuclides are based on the principle of superposition
 - Mixtures of multiple nuclides are conservatively evaluated
- ▶ Different resin/filter materials: i.e. carbon, polystyrene, etc., have been appropriately evaluated as source materials and their differing self-shielding effects have been considered in Calculation RTL-001-CALC-SH-0201, Rev. 1
- ▶ Section 5.2 of the SAR is being revised to provide additional clarifying information
- ▶ Section 7.8.1 is also revised to provide additional examples of the loading table process which ensures compliance with regulatory dose rate requirements



- ▶ Instruction Checklist for RT-100 Loading Table:
 - Input the nuclide into "Actual Content Nuclide" column. Format is element symbol in lower case letters, followed by mass number with no spaces or dashes
 - If "N/A" appears in any of the columns for the isotope entered, isotope is not applicable to the RT-100 Loading Table or it is incorrectly inputted into the spreadsheet
 - Input the nuclide's activity (in Curies) in the "Actual Content Activity (Curie)" column
 - If multiple waste streams are to be combined in a shipment, ensure that the maximum activity concentration in any single waste stream is considered for the entire contents of the shipment for each radionuclide
 - Repeat process until all neutron and gamma emitting isotopes and associated activities are listed



- ▶ Instruction Checklist for RT–100 Loading Table (cont):
 - In top left corner of the Loading Table, input the inventory mass in grams (the cell is highlighted in yellow, beside the cell stating "Content Mass (g)")
 - Once all relevant inventory inputs (inventory mass, radioisotopes, and activity of each radioisotope) are entered into the table, check cells at the end of the evaluation columns, beside "Passed Criteria" cells
 - If the cell is green and states "TRUE", inventory has passed that particular set of criteria (for example, passed the shielding criteria)
 - If the cell is red and states "FALSE", inventory has failed that particular set of criteria
 - An inventory must pass all test criteria before it can be shipped in an RT–100 cask

RAI 5-6 Response (cont)



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Project	RT-100 Transport Cask						
Task	Sample Loading Table Based on St. Lucie LLW Assay						
1.95E+06	Content Mass (g)	Actual Content Loading Evaluation					
Gamma Emitting Nuclides		Shielding Evaluation		Containment Evaluation		Heat Load Evaluation	
Actual Content Nuclide	Maximum Allowable Activity Concentration (Curies/gram)	Maximum Content Activity Concentration (Curies/gram)	% of Maximum	A2 (Curie)	Activity(i) / A2(i)	Q Value (Watts/Curie)	Heat Load (Watts)
h3	1.11E+06	3.90E-09	0.00	1100	6.91E-06	3.37E-05	2.57E-07
c14	1.11E+06	1.55E-08	0.00	81	3.73E-04	2.93E-04	8.86E-06
fe55	1.11E+06	3.65E-06	0.00	1100	6.47E-03	3.40E-05	2.42E-04
ni63	1.11E+06	3.00E-05	0.00	810	7.22E-02	1.02E-04	5.94E-03
sr89	1.11E+06	9.20E-09	0.00	16	1.12E-03	3.46E-03	6.20E-05
sr90	1.32E+03	2.86E-09	0.00	8.1	6.89E-04	6.70E-03	3.74E-05
tc99	1.11E+06	2.70E-09	0.00	24	2.19E-04	5.02E-04	2.64E-06
pu238	6.87E+03	5.70E-11	0.00	0.027	4.12E-03	3.31E-02	3.68E-06
pu239	5.10E+03	5.90E-11	0.00	0.027	4.26E-03	3.11E-02	3.58E-06
pu241	1.11E+06	4.00E-09	0.00	1.6	4.88E-03	3.18E-05	2.48E-07
am241	1.26E+03	4.10E-11	0.00	0.027	2.96E-03	3.34E-02	2.67E-06
cm242	2.14E+03	1.56E-11	0.00	0.27	1.13E-04	3.65E-02	1.11E-06
cm243	1.19E+03	2.44E-10	0.00	0.027	1.76E-02	3.66E-02	1.74E-05
i129	1.11E+06	2.45E-10	0.00	Unlimited		4.68E-04	2.23E-07
cr51	2.30E+00	1.46E-06	0.00	810	3.51E-03	2.20E-04	6.27E-04
mn54	9.82E-03	8.35E-07	0.01	27	6.03E-02	4.98E-03	8.11E-03
co57	1.11E+06	3.21E-07	0.00	270	2.32E-03	8.53E-04	5.34E-04
co58	9.69E-03	1.59E-06	0.02	27	1.14E-01	5.99E-03	1.85E-02

RT-100 RAI Response Review Meeting

July 22, 2013

RAI 5–9:

Clarify exactly what material density was used in the models for the impact limiter polyurethane foam and provide justification for the material property used in the analyses and updated results based on the new assessment.

Page 5–19 of the application states in Note 1 to Table 5.3.2–1 that “NCT model assumes the impact limiter polyurethane foam is reduced in density from 40 to 35 lbs/ft³ and from 20 to 15 lbs/ft³.” The applicant needs to clarify exactly what material density (35 or 15 lbs/ft³) was used in the models for the impact limiter polyurethane foam and provide (i) justification for the material property used in the analyses and (ii) updated results based on this new assessment.

RAI 5-9 Response



▶ PROPRIETARY RESPONSE

RAI 5-9 Response (cont)



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- ▶ PROPRIETARY RESPONSE

- ▶ PROPRIETARY RESPONSE

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- ▶ PROPRIETARY RESPONSE

RAI 7-1:

Provide operating procedures and/or instructions for the user to calculate the maximum allowable contents for a mixture of some of the isotopes listed in Appendix 5 of the application.

The applicant provides a list of Gamma Nuclides with Greater than 1 Day Half Life, a list of Gamma Dose Rate Response (NCT) (5.6.2-1), a list of Gamma Dose Rate Response (HAC) (Table 5.6.2-2), and a list of Nuclide Maximum Ci/g Loading Limits (Table 5.6.3-1) in Appendix 5 of the application. However, the applicant did not provide any instructions regarding the use of this data to determine the maximum allowable quantity of contents that are typically mixtures of some of the nuclides. The applicant needs to develop operating procedures and/or instructions for the users to determine the maximum allowable quantity if the contents are mixtures of some of the nuclides.

RAI 7-1 Response



- ▶ Section 7.8.1 provides the procedure to be followed by cask users to ensure that the contents are within regulatory limits
 - This section is being revised to provide additional discussion and reference to the appropriate sections of Chapter 5 of the SAR as described in response to RAI 5-6
 - Specific procedures will be provided to guide the user in completing the Loading Table and demonstrating that the contents comply with the loading restrictions for the cask
 - Chapter 7 will contain all information necessary for end users to prepare the loading table for their contents
- ▶ Section 7.8.1 will also provide numerous examples of the Loading Table for specific content descriptions
 - Several examples provided with for RAI 5-6 response

RAI 7–9:

Provide instructions in Chapter 7 that indicate contents are limited such that the concentration of combustible gases must be below 5%, by volume, at the end of the shipping period.

Chapter 7 should provide instructions to indicate that contents are limited such that the concentration of combustible gases must be below 5%, by volume, at the end of the shipping period. In addition, the shipping period should be explicitly stated.

- ▶ Section 7.8.2 of the SAR is being added to provide guidance to cask users regarding how to calculate the gas generation rate for their contents
 - Details of this guidance are provided in the RAI 4-7 response
- ▶ Section 7.8.2 will provide complete instructions regarding the gas generation factors for the contents
 - The maximum combustible gas generation within the cask will be required to be limited to less than 5% in the free volume for a period of time that is twice the expected shipping time after closure of the cask

RAI 7-2

RAI 7-2:

Clarify or modify the removal and replacement procedures for the impact limiters.

Following the procedures in sections 7.1.1.2 ("Lower Impact Limiter Removal") and 7.1.1.3 ("Upper Impact Limiter Removal") of the application, as sequentially written, it is unclear whether the impact limiters can be removed in this order. If the lower impact limiter can be removed prior to the upper impact limiter, indicate how the package will be lifted.

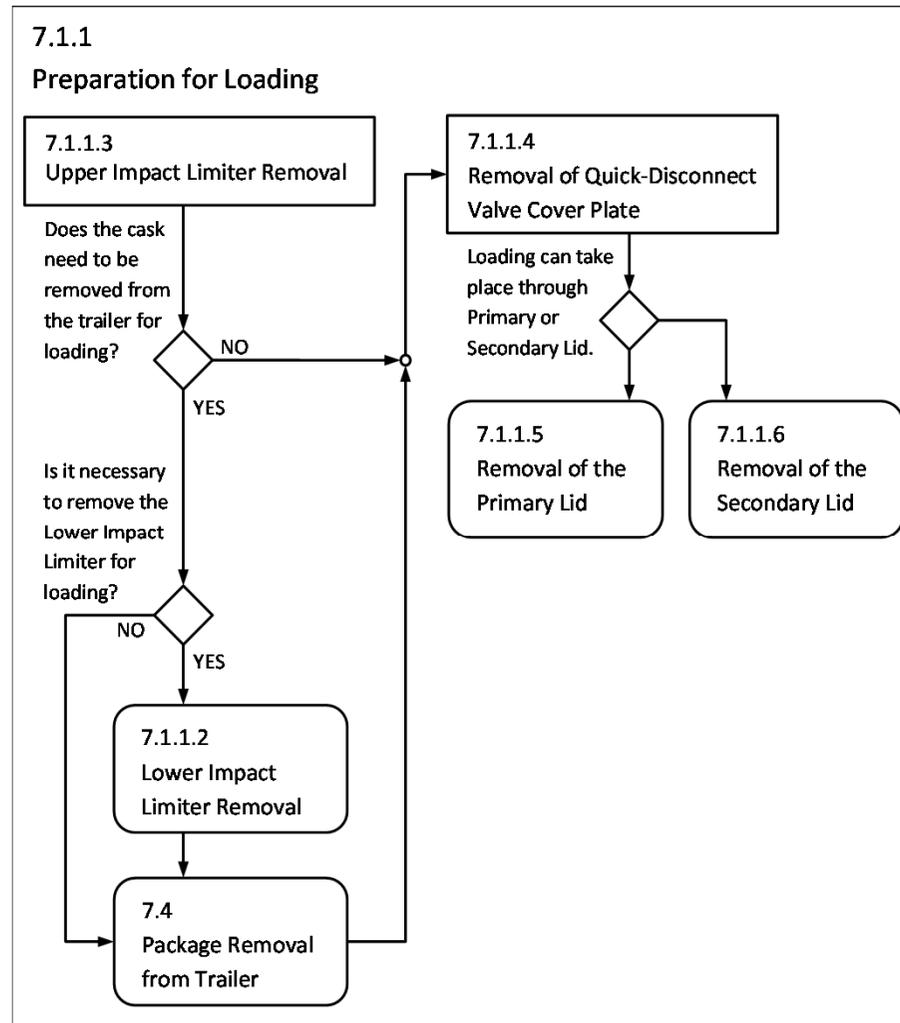
Section 7.1.1.1 "Package Removal from Trailer," directs to section 7.4 of the application. Staff notes that the first bullet on page 7-16 of the application states, "With or without the lower impact limiter attached, lift the RT-100 cask from the transport trailer (Figure 7.4-4)." Staff also notes that there is no reference to a specific set of procedures pertaining to the removal of the lower impact limiter in section 7.4 of the application.

RAI 7-2 Response

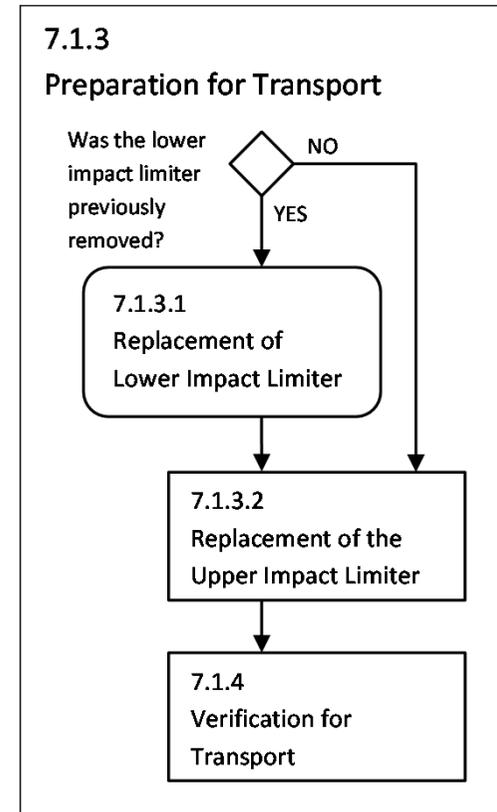
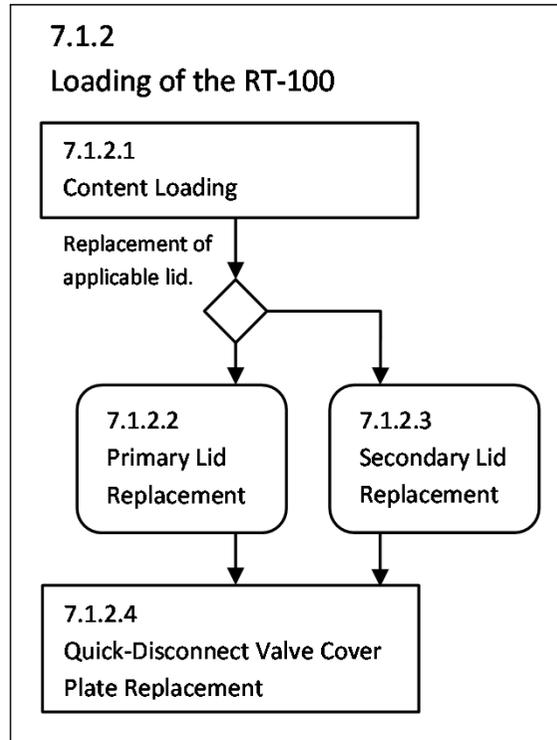


- ▶ Section 7.1.1.2 and Section 7.1.1.3 of the SAR are being revised to state that the upper impact limiter must be removed prior to removal of the lower impact limiter
- ▶ Section 7.4 of the SAR is being revised to describe the option of lower impact limiter removal prior to removing the cask from the trailer
- ▶ Section 7.4 of the SAR will also be revised to describe the specific procedures for lower impact limiter removal
- ▶ The flow charts on the following slides illustrate the general sequence for cask operations

RAI 7-2 Response (cont)



RAI 7-2 Response (cont)



- ▶ RAI schedule
 - Discussion
- ▶ Closing statements
- ▶ Next steps