**Request for Additional Information Docket No. 71-9387**
**Model No. Outer Package-Raw Material Shipping Container (OP-RMSC)**

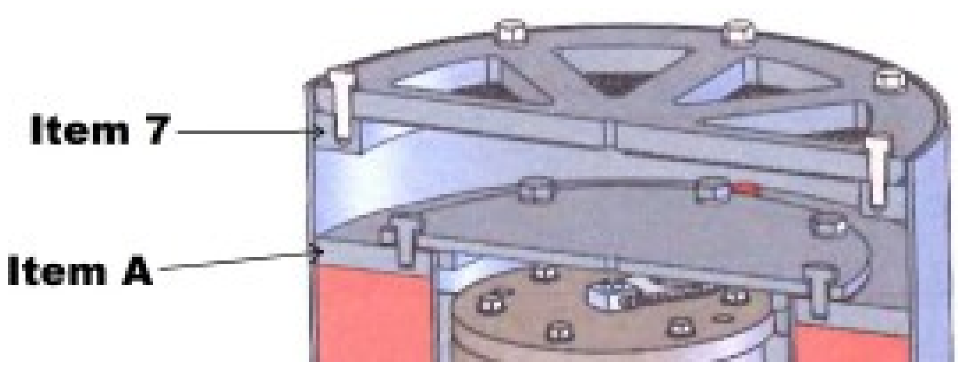
By letter dated December 18, 2020 (Agencywide Documents Access and Management System Accession [ADAMS] No. ML20363A167), Industrial Nuclear Company, Inc. (INC) submitted an application for a Certificate of Compliance (CoC) for the Model No. Outer Package-Raw Material Shipping Container (OP-RMSC) transport package. This request for additional information (RAI) letter identifies information needed by the staff in connection with its review of the safety analysis report (SAR). NUREG-2216, "Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material," was used by the staff in its review of the application.

Each individual RAI describes information needed by the U.S. Nuclear Regulatory Commission (NRC) staff to complete its review of the application to determine whether the applicant has demonstrated compliance with the regulatory requirements.

**General Information Review**

1.1. Provide component dimensions.

SAR Drawing OP-RMSC-SAR-TA, page 1 of 4 identifies seven stainless steel plates used to fabricate the Outer Pack-Raw Material Shipping Container (OP-RMSC). Based on staff's review of the drawings, two of the seven steel plates have both an outer diameter and an inner diameter. However, staff only identified one steel plate (i.e., Item 7) with both an inner and an outer diameter listed on drawing OP-RMSC-SAR-TA, page 1 of 4. Since the steel plate in question is also numbered incorrectly on OP-RMSC-SAR-TA, page 2 of 4 (see RAI 1.2), staff has identified the plate in question as "Item A" in the figure below. Staff needs this information to ensure correct fabrication of the package.




This information is necessary to satisfy the requirements in 10 CFR 71.33(a)(5).

**Response:** INC Drawing OP-RMSC-SAR-TA, Rev. 1 has been revised to correct and add the requested information. Item A in the above figure is Item 1, which now includes both the outer and inner diameter dimensions, on this drawing. The views on subsequent sheets have also been corrected.

1.2. Modify the package drawings, as appropriate, to ensure correctness, clarity and legibility.

a. In Drawing No. OP-RMSC-SAR-TA, multiple packaging components are identified using question marks in lieu of numbers (e.g., Sections A-A and B-B on Sheet 2 of 4). Also, multiple items are identified as Item 1 in Drawing No. OP-RMSC-SAR-TA (e.g., Detail Item 1 on Sheet 2 of 4 and Sections C-C and E-E on Sheet 3 of 4). The item identified with a 1 in Section E-E of Sheet 3 of 4 of that drawing cannot be item 1. Based on the bill of materials on Sheet 1 of 4, the item identified as Item 1 in Section E-E must be Item 2. Also, the item shown as item 2 in Section E-E must be some other item and appears to be item 5.

b. Drawing No. OP-RMSC-SAR-TA identifies where Item 14 is used on the packaging. The bill of materials for that drawing includes an Item 14; however, the drawing does not show the locations of that item on the packaging.

c. The outer diameter of Item 3 in Drawing No. OP-RMSC-SAR-TA is 8.63 inches. The dimension shown in the drawing's bill of materials is difficult to read, making the dimension unclear.

This information is necessary to satisfy the requirements in 10 CFR 71.33(a), 71.47, and 71.51(a).

**Response:** INC Drawing OP-RMSC-SAR-TA, Rev. 1 has been revised to correct and add the requested information. Section E-E on Sheet 3 has been revised to correctly identify the inner lid (Item 3) and the ring plate (Item 5) in that weldment. The diameter of Item 3 is 10.8 inches. Item 14 (silicone adhesive) has been added to Section A-A on Sheet 2 to identify that it secures the silicone gasket to Item 1. The errant question marks have been replaced with the correct item numbers (Items 15 and 16).

1.3. Modify Drawing No. OP-RMSC-SAR-TA to define the following dimensions as non-reference dimensions, or show they can be determined from non-reference dimensions:

a. the outer diameter of the tungsten body shield and its thickness below the cavity containing the capsule, and

b. the length and outer diameter of the tungsten cavity shield.

c. on Sheet 3, provide the length of item 8.

It is the staff's understanding that dimensions designated as reference dimensions (by enclosing the dimensions with parentheses) means that either the dimension may be determined from others on the drawing or the dimension is considered unimportant and so does not require inspection. However, the staff is unable to determine the dimensions of the identified components from other non-reference dimensions given on the drawings. In addition, the staff expects that gaps will exist between the tungsten and steel components; therefore, the steel components' dimensions do not translate into the tungsten components' dimensions.

The package drawings submitted with the application are incorporated by reference into the certificate of compliance that defines the authorized package design. The licensee using the package must maintain a copy of and follow the terms and conditions of the certificate, including those incorporated by reference (see 10 CFR 71.17(c)), and the terms and conditions of the certificate specify the components, contents, and operations of the package that assure the package meets the performance requirements in the regulations. Other information in the package application, of which the safety analysis is part, is not typically considered a condition of the package approval and simply provides the information that demonstrates the design meets the performance standards in the regulations.

Thus, the approval conditions, of which the package drawings are part, need to include sufficient information to ensure the package as fabricated and operated in accordance with the package approval will meet the performance requirements in the regulations. The drawings do not meet this standard of sufficient information with the dimensions identified in (a) and (b) above as reference dimensions only. They and the components to which they apply are important for shielding purposes to show compliance with the regulatory limits. Thus, the identified dimensions should be provided in the drawings but not as reference dimensions only. Alternatively, the applicant should evaluate the impacts on compliance with the shielding requirements due to variations that would be allowed in the affected components with these dimensions being specified as reference only.

This information is necessary to satisfy the requirements in 10 CFR 71.33(a), 71.47, and 71.51(a).

**Response:** Drawings OP-RMSC-SAR-TA and RMSC-SAR-TA have been revised to correct and add the requested information. On Drawing RMSC-SAR-TA, the tungsten body shield, Item 8, and the tungsten cavity shield, Item 7, have been re-dimensioned with tolerances to identify all of the dimensions to define both shields. The length of Item 8, which is 10 inches, has been added to drawing OP-RMSC-SAR-TA, Rev. 1.

1.4. Clarify the proposed content quantity specification for the package.

The applicant is requesting 2 Ci of Co-60 and 16,000 Ci for Se-75 and Ir-192, with a maximum of 4,000 Ci per capsule for the latter two nuclides. Unless indicated and evaluated otherwise, the staff will specify the contents' activity limits within the certificate of compliance to be based on their assigned activity as opposed to an activity determined by measurement, which includes the impact of self-attenuation and attenuation by the source's capsule. Note, that the activity determined by this latter method is often referred to as output activity and is only allowable for Ir-192 per Note c of Table A-1 of Appendix A to 10 CFR Part 71. The activities of the other two nuclides must be the assigned value, often referred to as content activity, which does not credit self-attenuation by the source or attenuation by the capsule.

This information is necessary to satisfy the requirements in 10 CFR 71.33(b), 71.47, and 71.51(a).

**Response:** The Ir-192 content quantity specified in Section 1.2.2, *Contents of Packaging*, identify the proposed content as a maximum Curie content per capsule and for the total content per package. INC relies on the assigned Curie content rather than a measured value to determine the curie content. Therefore, the assigned value for the Ir-192 isotope of the content's activity in the Certificate of Compliance is the preferred specification.

1.5. Address the following for the two tungsten alloys:

a. provide the allowable minimum densities, allowable minimum tungstenweight fractions, and the allowable dimensional tolerances (both over and under tolerances),

b. update the drawings, and

c. modify the shielding evaluations, if necessary, using the information provided in (a) above or address their impacts.

Unlike for most of the RMSC's steel components, Drawing No. OP-RMSC-SAR-TA provides a product or brand name for the material specifications and not a materials standard(s) for the two tungsten alloys components. ASTM B777 specifies ranges of densities as well as nominal compositions for tungsten alloys. Based on ASTM B777, it appears that the densities and compositions identified by the applicant and used in the applicant's shielding evaluation are nominal values. The applicant needs to provide the tungsten alloys' minimum densities and minimum compositions (i.e., tungsten alloy compositions with the minimum allowable weight fraction of tungsten for each alloy).

Also, with no other specification of tolerances in the package drawings, those given in the drawings' title block apply to the tungsten alloy components' dimensions. The applicant's shielding evaluations should use the minimum properties and dimensions based on the drawing tolerances for the two tungsten alloy components (see RAIs 5.2 and 5.3). With regard to the materials specification, one option is to specify on the drawings the ASTM standard (B777) and the applicable alloy class from that standard for each of the tungsten alloys used in the package. If no materials standard and class is specified in the drawings, the appropriate density and composition specifications for both alloys should be specified directly in the drawings. Specifying the ASTM standard and alloy class for each alloy will also help ensure the acceptance tests as described in SAR Section 8.1.1 are adequate to assure the fabricated components meet the specifications regarding composition and density.

This information is necessary to satisfy the requirements in 10 CFR 71.33(a), 71.47, and 71.51(a).

**Response:** Drawing RMSC-SAR-TA has been updated to include the appropriate tolerances for both the tungsten body and tungsten cavity shields. The manufacturer has confirmed that the tungsten shields are manufactured in accordance with ASTM B777, which has been added to the material specification for the tungsten shields on Drawing RMSC-SAR-TA, Rev. 1. Densimet® 176 is an ASTM B777 Class 2 alloy, and Densimet® 185 is an ASTM B777 Class 4 alloy.

Since the Co-60 isotope has been deleted from the application, a shielding analysis is no longer applicable for the RMSC. All shielding evaluations and demonstration of regulatory compliance were performed via prototypic testing with Ir-192 special form capsules.

**Materials Review**

2.1. Provide additional information to explain how the evaluation of the package under hypothetical accident conditions (HAC) was determined to meet the acceptance criteria of 10 CFR 71.51(a)(2), without first conducting the penetration test for normal conditions of transport (NCT) described in 10 CFR 71.71(c)(10).

SAR Section 2.6.10 of the application states that the penetration tests for NCT specified in 10 CFR 71.71(c)(10) were not conducted because the OP-RMSC package was puncture tested more severely in accordance with the HAC required by 10 CFR 71.73(c)(3). As stated in NUREG-2216, Section 2.4.6, and Regulatory Guide 7.9, Section 2.7, the NCT testing conducted under the specified conditions in 10 CFR 71.71 must not affect the package's ability to withstand the HAC tests. It is not clear how the effects of NCT testing conditions were accounted for in the HAC tests without conducting the NCT penetration test described in 10 CFR 71.71(c)(10).

This information is needed to determine compliance with the requirements of 10 CFR 71.51(a).

**<u>Response</u>:** The penetration test specified in §71.71(c)(10) is a free drop of 1¼ inch (3.2 cm) diameter, 13 pound (6 kg), hemispherical end steel rod dropped from a height of 40 inches (1 meter) onto the exposed surface of a package that is expected to be most vulnerable to puncture. For the OP-RMSC package, the most vulnerable exposed surface would be the expanded sheet metal on the outer lid. The free drop of the penetration bar could potentially strike the wire screen on the OP-RMSC outer lid and strike the 3/8-inch thick inner lid. However, the remaining impact energy from the steel rod would not cause any damage to the inner lid or any other component of the OP-RMSC package. Therefore, the NCT penetration test is of negligible consequence for the OP-RMSC package to withstand the subsequent HAC tests. The SAR has been revised to add clarification of this point.

2.2. Provide the following additional information to explain how the evaluation of the package was determined to meet the HAC acceptance criteria of 10 CFR 71.51(a)(2) without conducting the HAC thermal test that meets the requirements of 10 CFR 71.73(c)(4).

1. Provide an evaluation of the package component temperatures during and after the HAC thermal test assuming a payload with an initial steady state temperature of 752 °F (400 °C) based on the maximum decay heat load, as described in Sections 2.6.1 and 3.3.1 and Table 3.3.1-1 of the application.
2. Provide mechanical properties for the RMSC lid bolts including yield and tensile strength, allowable stress values and thermal expansion coefficient as a function of temperature. Provide test data or an analysis to show that the RMSC lid bolts would remain intact during and after the HAC thermal test. Include measured or calculated temperatures for the RMSC lid and the lid bolts.
3. Revise SAR Section 2.7.4 of the application to cite the correct regulatory requirement. SAR Section 2.7.4 currently states that the OP-RMSC package satisfies the requirements of 10 CFR 71.73(c)(4). The regulatory citation in this statement is incorrect. The regulatory requirements of 10 CFR 71.73(c)(4) pertain to the HAC thermal test conditions. The acceptance criteria for the performance of a non-fissile Type B package are in 10 CFR 71.51(a)(2).

SAR Section 2.7.4 of the application provides a justification for not conducting the thermal test based on the results of the free drop and puncture tests, and because the structural and shielding materials have melting temperatures greater than the fire temperature requirements of 71.73(c)(4). However, the justification provided in SAR Section 2.7.4 of the application does not include an analysis of the maximum temperatures of the components during and after the HAC thermal test with the maximum total decay heat load, nor does it provide sufficient information to address thermal effects other than melting such as differences in thermal expansion coefficients for the packaging component materials. ASME B&PV Code, Section II, Part D,

Table TE-1 shows that the thermal expansion coefficient for the RMSC lid bolts is lower than the thermal expansion coefficient for the RMSC lid top plate. The difference in thermal expansion coefficients may result in thermal stresses and failure of the lid bolts at elevated temperatures.

This information is needed to determine compliance with the requirements of 10 CFR 71.33(a)(4) and 71.51(a)(2).

**Response:** Table 3.3-1 has been expanded to present the maximum NCT hot temperature for both the OP-RMSC components and the RMSC payload. As shown in this table for the assembled package and maximum decay heat load, the maximum NCT temperature for any of the stainless steel structural materials is 689 °F (365 °C), which occurs in the RMSC body shell. The maximum NCT hot temperature of the outer shell of the OP-RMSC package is listed as 407 °F (208 °C), with the bulk temperature less than 215 °F (102 °C) (refer to Figure 3.3-3). With these maximum NCT hot temperatures as the initial condition for the subsequent 30-minute 1,475 °F (800 °C) fire, there will be no effect on the stainless steel structural or the tungsten shielding materials to retain their safety functions, i.e., confinement and gamma shielding, respectively. During and after the fire event, the maximum temperatures will be significantly below the materials' melting temperatures, which is the only condition that would affect the structural and shielding safety functions. As noted in Section 2.7.4, *Thermal*, the only combustible materials are the non-structural polyurethane foam and the silicone gasket. These two materials do not have a safety function for the OP-RMSC package.

Table 2.2-3 has been added to add the material properties for the ASTM A-320 Grades L43 and L7 alloy bolt materials. In addition, a thermal expansion analysis of the lid bolt/lid interfaces has been added to Section 2.7.4, *Thermal*. The analysis results demonstrated that there is no additional tensile force applied to any of the bolts due to the differential thermal expansion between the alloy bolt material and the stainless steel lid material for the maximum temperatures from the HAC thermal event.

Section 2.7.4 has been revised to cite the correct reference for the regulatory external dose rate (10 CFR §51(a)(2)) following exposure to the thermal event per 10 CFR §71.73(c)(4).

2.3. Provide additional information such as test data or an analysis to show that the operating temperature for the stainless steel components will be limited to a maximum temperature of 400 °F (204 °C) for NCT. Alternatively, revise SAR Table 3.3.1-1 to include material properties over the range of temperatures expected for all stainless steel components under NCT.

SAR Table 3.3.1-1 provides a summary of the maximum NCT component temperatures but it is not clear if this is limited to the OP-RMSC stainless steel components as described in Section 3.3.1 of the application, or if this summary also includes the stainless steel RMSC payload components. The thermal profiles provided in SAR Figures 3.3-3 and 3.3-4 suggest that the RMSC stainless steel shell, lid and baseplate may exceed 400 °F (204 °C) under NCT.

This information is needed to determine compliance with the requirements of 10 CFR 71.51(a).

**Response:** Table 3.3.1-1 in Chapter 3.0 has been revised to add the NCT temperatures for the RMSC payload. The material properties versus temperature are provided for all structural materials in Table 2.2-1 (Type 304 stainless steel), Table 2.2-2 (tungsten heavy metals), and Table 2.2-3 (ASTM A-320 L43/L7 alloy bolting materials) for the predicted range of NCT temperatures.

2.4. Provide additional information on the safety function of Item No. 11 in SAR Drawing OP-RMSC-SAR-TA and the range of operating temperatures for this component.

The bill of materials in sheet 1 of 4 identifies that this component could be fabricated from either ASTM A276 or ASTM A479. ASME Section II Part D does not include mechanical properties as a function of temperature for the A276 specification.

This information is needed to determine compliance with the requirements of 10 CFR 71.31(c).

**Response:** Material properties for the channels have been identified in Table 2.2-1 for ASTM A276 material up to and including 100 °F. The temperature of the channels for the NCT hot condition noted in Chapter 3.0, *Thermal Evaluation*, is 100 °F. The function of the channels, which are welded to the bottom plate of the OP-RMSC body, is to support the package during transport and operations rather than resting on the outer body pipe edge. With this arrangement, the potential wear-and-tear on the outer body pipe due to operations is reduced during the life of the package. The use of either specified ASTM material for the channels will provide the designed function for the OP-RMSC package.

2.5. Provide additional information on the safety function of the tungsten heavy alloys in the RMSC as follows:

a. Provide additional information on the elevated temperature performance of the tungsten heavy alloys used in the RMSC. SAR Sections 2.7.4, 3.2.1, 3.2.2, and 3.2.4 of the application states that tungsten has a melting temperature of 6,191°F. The melting temperature of pure tungsten is not applicable to the liquid phase sintered tungsten heavy alloys used in the RMSC.

b. Clarify the apparently contradictory statements in the application regarding the structural function of the tungsten heavy alloy shielding materials. Section 2.2.1 states, “Typical room temperature properties are provided in Table 2.2-2. Since the tungsten gamma shields are not a primary structural material for the RMSC payload, these typical properties are provided for information only.” Section 3.2.2 states, “The two primary structural materials are austenitic stainless steel and the tungsten gamma shielding.” If the tungsten heavy alloys are primary structural materials as stated in Section 3.2.2 of the application, provide the mechanical properties of these alloys as a function of temperature over the range of temperatures expected during NCT.

   This information is needed to determine compliance with the requirements of 10 CFR 71.33(a)(5) and 71.51(a).

**Response:** Material properties versus temperature have been added to Table 2.2-2 for the tungsten heavy metals up to 1,472 °F (800 °C). Per the manufacturer, the actual melting temperature for the sintered tungsten heavy metal is 2,732 °F (1,500 °C), which has been reflected in the revised SAR. The statement “*Since the tungsten gamma shields are not a primary structural material for the RMSC payload, these typical properties are provided for information only.*” has been revised to reflect the actual safety function of the tungsten gamma shields (shielding). Section 3.2.2 has also been revised to correct the apparent contradictory statements.

2.6. Provide additional information to support the statement that the tungsten shielding material is not subject to brittle fracture at low temperatures.

Application SAR Sections 2.1.2.2.1 and 3.2.2 state that the tungsten shield material is not susceptible to brittle fracture at temperatures as low as −20 °F (−29 °C) and that, based on the low temperature testing of the OP-RMSC package, brittle fracture of the tungsten gamma shields in the RMSC payload is not a concern. Based on the information provided in the application, it is not clear to the staff if the performance of the tungsten heavy alloy shield materials are a result of acceptable impact toughness of these materials or a result of impact absorption by the packaging including the foam used for impact protection of the RMSC.

Information provided by the alloy manufacturer shows that the notched impact strength of the Densimet-Tungsten alloys decreases with temperatures, and is below 3 $J/cm^2$ (14 ft $lb/in^2$) at temperatures of 0 °C (32 °F)[1]. The fracture toughness and impact toughness of liquid phase sintered tungsten heavy alloys has been shown to be a function of processing and alloy composition.[2,3]

This information is needed to determine compliance with the requirements of 10 CFR 71.31(c) and 71.51(a).

**Response:** The recorded CTU temperatures that are noted in Appendix 2.12.1, *Certification Testing*, were measured on the outside surface of the OP-RMSC inner shell, which is very close to the RMSC payload. By thermally soaking the CTU in a cold chamber over the 3-day July 4th holiday weekend, the RMSC payload with the tungsten shields were essentially at the same temperature as the inner shell, which was measured as -22 °F for both the NCT 1-foot and HAC 30-foot free drop tests. As demonstrated by the pre- and post-test radiation surveys of the RMSC payload, the impacts from the free drops and the follow on puncture drop tests had no effect on the shielding performance on the Densimet® tungsten heavy metal shields.

In addition to the free drop tests, Plansee performed Charpy impact tests of the Densimet® D176 and D185 materials in accordance with ISO Standards 148-1 and 5754. Three test coupons of each alloy were tested at each temperature: room temperature, -20 °F (-29 °C), and -40 °F (-40 °C). The average Charpy energy values of the three test coupons at each test temperature are as follows:

| Densimet® Alloy | Test Temperature (°F) | Average Impact Energy ($ft\text{-}lb_f/in^2$) |
|---|---|---|
| D176 | Room Temperature | 21.23 |
| | -20 | 22.07 |
| | -40 | 20.81 |
| D185 | Room Temperature | 4.76 |
| | -20 | 2.87 |
| | -40 | 3.01 |

Based on these test results, the Plansee Densimet® tungsten heavy metal shields are not susceptible to brittle fracture at temperatures as low as -40 °F (-40 °C). This test data information has been added to Section 2.1.2.2.1, *Brittle Fracture*.

The Plansee Densimet® heavy metal shields are sintered tungsten alloyed with 3% to 6.5% iron and nickel. The effect of the iron and nickel alloying significantly increases ductility and brittle fracture resistance over pure tungsten. Because the metal is sintered and not cast, there is no possibility of a void forming in the manufacture of the shields.

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[1] Plansee, "Refractory Metals for the Foundry Industry," http://www.foundry-planet.com/uploads/tx_browserdirectory/Download_Brochure_Refractory_metals_for_the_foundry_industry.pdf.

[2] Gurwell, W.E., Nelson, R.G., Dudder, G.B., and Davis, N.C, "Fabrication and Properties of Tungsten Heavy Metal Alloys Containing 30% to 90% Tungsten," PNL-5218, September 1984.

[3] Spencer. J.R. and. Mullendore, J.A., "Relationship Between Composition, Structure, Properties, Thermo-Mechanical Processing and Ballistic Performance of Tungsten Heavy Alloys," MTL-TR-91-44, GTE Products Corporation, Towanda, PA, November 1991.

2.7. Provide additional information to justify the classification of the foam as a not important to safety (NITS) component. SAR Section 2.1 identifies the foam as one of the four major fabricated components of the OP-RMSC. In addition, SAR Section 2.1.1 states that the rigid polyurethane foam provides limited impact protection of the payload. If the polyurethane foam is an important to safety component, provide a material specification and properties for the foam and update the bill of materials in INC drawing OP-RMSC-SAR-TA.

This information is needed to determine compliance with the requirements of 10 CFR 71.33(a)(5).

**Response:** The polyurethane foam that is poured into the annular space between the inner and outer pipes of the OP-RSMC package does not have a safety function. The foam is not relied upon to provide protection of the RMSC payload from the NCT and HAC free drops, and the subsequent HAC fire event. The only requirement for the rigid polyurethane foam is having a nominal density of 20 $lb_m/ft^3$ (pcf), which is specified on Drawing OP-RSMC-SAR-TA. For this design function, the NITS classification is appropriate for this polyurethane foam.

2.8. Provide additional information to show that there will be no detrimental galvanic reactions between the tungsten heavy alloy shielding and the stainless steel components.

The information provided in SAR Section 2.2.2 appears to have incorrectly compared tungsten to active stainless steel rather than passive stainless steel. In the passive state, there is a significant difference between tungsten and stainless steel with tungsten being the anodic material.[4]

This information is needed to determine compliance with the requirements of 10 CFR 71.43(d).

**Response:** Section 2.2.2 of the SAR has been revised to note that there is a potential galvanic potential between stainless steel (either active or passive), and the tungsten heavy metal. For a composition galvanic corrosion cell to form, there two requirements: a electromotive potential between two dissimilar metals, and an electrolyte. Although there is electromotive potential for these dissimilar metals, there is no electrolyte present since the tungsten is contained within a welded stainless steel assembly of RMSC, and is not submerged in package operations. Therefore, a composition galvanic corrosion cell will not form between the stainless steel and the tungsten heavy metal in the RMSC payload.

[4] Forman, C.M. and Verchot, E.A., "Practical Galvanic Series,", Report No. RS-TR-67-11, U. S. Army Missile Command, Redstone Arsenal, Alabama, October 1967.

**Thermal Review**

3.1 Clarify how the maximum decay heat limit was determined for the OP-RMSC package. The applicant states, in Section 3.1.2 "Content's Decay Heat," of the SAR, that the OP-RMSC package may contain up to 16,000 Ci of Ir-192 in special form and that the maximum decay heat allowed for this content is 100 W. However, with a radiolytic decay heat of $7.03 \times 10^{-3}$ W/Ci for Ir-192, the total decay heat in the package would be112.5 W (i.e., $7.03 \times 10^{-3}$ W/Ci x 16,000 Ci = 112.5W). The applicant should clarify the inconsistency between the prescribed decay heat limit (i.e., 100 W) and the allowed Ir-192 amount limit of 16,000 Ci in the OP-RMSC package.

This information is necessary to satisfy the requirements in 10 CFR 71.33(b)(7).

**Response:** The noted decay heat watts per Curie conversion inadvertently included the decay heat from the isotope Ir-192m, which has a half-life of 1.45 minutes. Since this metastable isotope will be absent in the special form capsules when they are loaded into the RMSC cavity, the 0.151 W/Ci decay heat is no longer applicable to the package decay heat load during transportation. The correct conversion value for the Ir-192 material is 6.14 × $10^{-3}$ W/Ci, which results in a total decay heat load of 98.24 Watts for the 16,000 Ci content. For the OP-RMSC package, this total heat load value was rounded upward to an even 100 W for additional conservatism.

3.2 Provide information on the personnel barrier configuration and the derivation of the maximum accessible package surface temperature from the thermal analysis with the personnel barrier installed. Include a description of how the minimum open area of the personnel barrier is determined and verified prior to shipment.

The applicant stated in SAR Section 3.3.1, "Heat and Cold," that "…an expanded metal personnel barrier with a minimum open area of 75% is installed over the OP-RMSC after the package is secured to the transport pallet. With the personnel barrier installed, the maximum accessible surface temperature is 115 °F (46 °C) which allows the package to be shipped as a non-exclusive use shipment." However, the applicant did not provide details on how the personnel barrier allowed the package to meet the non-exclusive use transport temperature limits.

The applicant should provide additional information about how the maximum accessible surface temperature of 115 °F (46 °C) is determined from the thermal analysis (computer code or hand-calculation). The description provided should include the configuration of all components, materials used, the personnel barrier dimensions, and personnel barrier modeling assumptions.

Provide a description of how the minimum open area of the personnel barrier is determined and verified prior to shipment.

This information is necessary to satisfy the requirements in 10 CFR 71.43(g).

**Response:** The NCT ANSYS® thermal model was revised to include the personnel barrier, as shown in Figure 3.3-1. The analysis results demonstrate that the maximum accessible surface temperature with insolation is 109 °F (43 °C), which satisfies the temperature limit of 122 °F (50 °C) for a non-exclusive use shipment.

The minimum open area for the expanded metal of the personnel barrier is inherent to the size of the openings and wire size of the material. The open area is determined and verified by the manufacturer of the expanded metal. A typical reference for this flattened expanded material may be found at www.mcnichols.com/expanded-metal/flattened, which specifies the open area for each expanded metal size. The requirement for the minimum area of 75% has been now been specified in Flag Note 8 on Drawing OP-RMSC-SAR-TA Rev. 1.

**Shielding Review**

5.1 Clarify the condition of the bolt hole in the RMSC's tungsten cavity shield as prepared for transport. Ensure the package description, package operations descriptions, and package evaluations (e.g., shielding) are consistent with that condition.

It is unclear from the SAR whether or not the bolt hole in the RMSC's tungsten cavity shield is filled or empty in the package's transport configuration. The descriptions and drawings in SAR Chapter 1 are not clear in this regard but seem to indicate the bolt hole is empty. The package operations description in SAR Chapter 7 also indicates this space is empty during transport (e.g., SAR Section 7.1.2, paragraphs 3-4 and 6-7 and SAR Section 7.2.2, paragraphs 8-9). However, SAR Figure 5.3-1 and SAR Appendix 5.5 indicate that the shielding analysis assumes this space is filled with steel.

The SAR descriptions and evaluations need to be clear and consistent with the package design and how it is operated for shipments. If the bolt hole in the tungsten cavity shield is empty, then the shielding analysis should also model that space as empty. While the steel bolt of the RMSC's hoist ring is present in design, the drawings provide no information on its dimensions and appear to show it does not extend through the full thickness of the RMSC lid. Thus, it is not clear that it provides the same amount of steel that would be necessary to fill the empty bolt hole in the tungsten cavity shield and the RMSC lid thickness. The staff's evaluations indicate that package radiation levels for the top surface above this location, when also accounting for the dimensional tolerances and minimum density of the tungsten alloy, could result in surface radiation levels that exceed the regulatory limit for non-exclusive use. If the bolt hole is filled during transport, the drawings should clearly show this and provide the information for the component filling the hole. Also, the package operations descriptions should correctly reflect the use of that component.

This information is necessary to satisfy the requirements in 10 CFR 71.33(a), 71.47, 71.51(a), and 71.87.

**Response:** Since the Co-60 isotope has been deleted from the application, a shielding analysis is no longer applicable for the RMSC. All shielding evaluations were performed via prototypic testing with Ir-192 special form capsules.

5.2 Provide the following information regarding the measurements of package radiation levels that were used to demonstrate compliance with the non-exclusive use limits in 10 CFR 71.47(a) and NCT and HAC limits in 10 CFR 71.51(a) for a package with Ir-192:

a. description of the methods used to perform the radiation measurements for a package containing Ir-192 sources.

   The SAR shielding chapter should sufficiently describe the measurement methods, equipment, and techniques to demonstrate that they are appropriate for the measurements. The description should also address any geometric correction factors for ensuring the results are for the surface and show appropriate considerations have been made related to detector size and averaging radiation levels over the detector probe area. Sections 5.4.4.1 and 5.4.4.4 of NUREG-2216 provide a discussion on information that should be included to describe the measurement methods.

b. confirmation of the package configuration and conditions for which the radiation levels in SAR Table 5.1-1 were measured.

   SAR Chapter 5 should clearly indicate the test conditions (NCT and HAC tests) the package experienced prior to the radiation measurements as well as the package components that were present or included in the radiation measurements. While there are some indications in the SAR that at least some measurements were done on packages that had experienced both NCT and HAC tests, and that the measurements were with the RMSC only, the descriptions for all the radiation measurements should be clear and consistent.

c. ensure radiation levels reported in SAR Table 5.1-1, and in other locations of the SAR, are correct and consistent.

   SAR Sections 2.12.1.7.1.5, 2.12.1.7.2.6, and 5.4.4 include radiation level measurement results that have some differences versus the SAR Table 5.1-1 radiation levels even though they appear to be measurements for the same package configuration and conditions.

d. source strength used in the measurements.

   Typically, the source used in the measurements has a lower activity than the maximum authorized activity proposed for a package; however, it should be an activity for which scaling measured radiation levels to represent radiation levels for the maximum authorized contents is appropriate. The shielding evaluation chapter should provide information about the source strength used in the measurements for demonstrating the package meets the regulatory requirements for shielding.

e. maximum radiation levels for package top, bottom, and side surfaces and at one meter from each of those surfaces as well as information that clearly identifies the location of the maximum radiation level on each package top, bottom, and side surface and at one meter from each surface.

SAR Table 5.1-1 only provides a single radiation level for the package surface and at one meter from the package, but it does not identify the package surface for which these radiation levels were measured. While SAR Sections 2.12.1.7.1.5 and 2.12.1.7.2.6 provide multiple surface and one meter radiation levels, they do not identify the package surfaces for which they were measured or whether they are different points of the same package surface. Given the axial and radial variations in the package's shielding (in the RMSC), and the lack of information about the measurements, it is not clear that the maximum package radiation levels have been identified and measured for the package. The information should be adequate to demonstrate that, as stated in the regulations, the radiation levels at any point on the package surface and at one meter from the package surface will not exceed the stated limits for non-exclusive use.

f. descriptions of dimensional and material properties (e.g., tungsten alloy components' densities and weight fractions of tungsten in the alloys) of the prototypes used in the measurements and how dimensional and material property tolerances could impact the measured radiation levels.

   The shielding evaluation should consider the impacts of the allowed material property variations and dimensional tolerances, as defined in the drawings, of the packaging components (e.g., the tungsten alloy components) present in the measurements. Staff evaluations indicate that consideration of these items could lead to significant increases in radiation levels versus a prototype that was fabricated with nominal properties and had the measured radiation levels stated in the SAR. The increases could be large enough that the non-exclusive use dose rate limits are exceeded.

g. description of how source capsule position is accounted for if movement of the source capsules within the RMSC cavity is possible. Source position changes may also contribute to increased package radiation levels in addition to the impact of the items described in (e) above.

   SAR Chapter 5 indicates that the applicant measured radiation levels on package prototypes to demonstrate regulatory compliance with the package radiation level limits for the Ir-192 contents and, by extension, Se-75 contents. However, Chapter 5 provides very little information regarding these measurements and the package prototype(s) on which the measurements were performed. Since Chapter 5 is for evaluating the package's shielding function, this chapter should include the necessary information, as identified in (a) through (g) above, to describe the measurements and to clearly demonstrate that the measurements address compliance with the limits and requirements in 10 CFR 71.47(a) for non-exclusive use shipments and 10 CFR 71.51(a) for NCT and HAC.

This information is necessary to satisfy the requirements in 10 CFR 71.47 and 71.51(a).

**Response:** As noted in Appendix 2.12.1, *Certification Tests*, each certification test unit, CTU-1 and CTU-2, was prototypic of the license package design delineated on the drawings in Appendix 1.3.1, *General Arrangement Drawings*. The Plansee as-manufactured data sheets for the CTU shields demonstrated were nominal, i.e., dimensionally and density in accordance with the ASTM B777 standard. Utilizing an INC experienced qualified radiological technician and a calibrated radiation meter (INC Model 4), radiation surveys of each CTU RMSC were performed for both pre- and post-test conditions. Utilizing the calibrated radiation meter, the technician scanned each surface (side, top, and bottom) of each CTU to detect the maximum measured reading at the specified distance (surface, 1-meter, and 2-meters). Once the maximum reading from each surface was noted, which was witnessed by the Orano Test Engineer and the Orano

QA representative, the maximum reading was recorded on the appropriate data sheet. When completed, the data sheet was signed by the INC technician and the Orano QA representative. The documentation of the certification test records are provided in the Orano Federal Services test report TR-3023626-000, which is referenced in SAR §2.1.2.2.1. Note that at the request of the NRC Project Manager, a copy of this test report was provided to the NRC.

Table 5.1-1 has been expanded to include the maximum post-test measured dose rates for the top, bottom, and side surfaces, which was delineated in Appendix 2.12.1, *Certification Tests*.

As noted in SAR Section 1.1, *Introduction*, only the RMSC payload with the tungsten heavy metal shields is relied upon for demonstrating compliance to the regulatory radiation limits. Even though it is part of the transportation package, the OP-RMSC outer package is excluded from any demonstration of regulatory radiation compliance as additional safety margin for the package design.

The special form capsules (SPFC), which have dimensions of ∅0.50 inch × 2.00 inch high, are placed in a 4-capsule stainless steel holder that fits within the ∅1.50 inch × 3.00 inch high cavity. The body of the capsule holder, which has been added to SAR Appendix 1.4.1, *General Arrangement Drawings*, is 1.25 inches high, and has (2) 2-inch high stainless steel separator sheets that maintain each SPFC in position within the cavity. Vertical and horizontal movement of the SPFCs is severely restricted by the holder and the physical dimensions of the cavity, which may be viewed in SAR Figure 2.12.1-12. Since the measured surface dose rates on the top/bottom of the RMSC payload were less than 10% (15 and 19 mrem/hr) and on the side 61.5% (123 mrem/hr) of the regulatory surface dose rate limit of 200 mrem/hr, the limited movement of the SPFCs will never result in exceeding the regulatory limits of §71.47(a) or §71.51(a)(2). Note that the measured dose rates included the effects of the open threaded hole in the cavity shield.

The dimensional tolerances for the tungsten shield are specified on INC Drawing RMSC-SAR-TA, Rev. 1. The material specification for the tungsten heavy metals, ASTM B777 and the appropriate class, are also specified on the revised drawing. The dimensional and material density tolerances are not expected to significantly increase the surface dose rate that would exceed the regulatory limit of 200 mrem/hr. However, a shielding test is performed as required by Section 8.1.6, *Shielding Tests*, of each tungsten shield assembly prior to being utilized in a RMSC payload.

5.3 Modify the shielding analysis for the proposed Co-60 contents to address the following:

a. identify and justify the locations of the maximum radiation levels on each surface of the RMSC (i.e., top, side, and bottom) and at one meter from each surface.

   The applicant's analysis needs to demonstrate compliance with the regulatory radiation level limits for non-exclusive use shipments in 10 CFR 71.47(a). These limits apply to any point on the external surface of the package. While the applicant conservatively neglects the outer components of the packaging (the OP-RMSC) and applies the evaluation of these limits to the RMSC, the applicant's analysis does not provide information that identifies where the maximum radiation level for each surface of the RMSC is located. Given the non-uniform shielding (both radially across the top and axially along the side), it is not clear that the applicant has identified the maximum radiation levels for each surface and at one meter from each surface or where those locations are.

b. account for the impacts of dimensional tolerances, minimum density and composition specifications for the tungsten alloy components.

   The applicant's analysis uses nominal tungsten alloy densities and composition for the analysis. For the composition, the alloying metals (iron and nickel) are assumed to be in equal amounts. The dimensional tolerances applied in the model are also much smaller in magnitude than appear to be allowed by the drawings. Staff evaluations indicate that accounting for the appropriate minimum values of these aspects of the tungsten alloy components can result in package radiation levels that are significantly higher and that exceed the non-exclusive use limits. The staff evaluations also indicate that assuming the alloying metals in the tungsten alloys to be all iron further increases package radiation levels.

c. analyze the top surface radiation levels for the source positioned at the top of the RMSC cavity and directly underneath the bolt hole in the tungsten cavity shield, with the bolt hole modeled correctly as empty or void (see RAI 5.1).

   The applicant modeled the bolt hole in the tungsten cavity shield as filled with steel whereas the package operations indicate that the spot is empty in the package's transport configuration. It is also not clear that the applicant considered the source positioned at the top of the RMSC cavity under that bolt hole. Thus, maximum radiation levels at the top surface of the RMSC could be significantly higher than the applicant's analysis indicates.

d. account for the impacts of modeling the source as a cylinder with capsule materials credited, considering the dimensions and thicknesses of the smallest source and capsule for which shipment with this package is anticipated.

   Dimensions of the source and capsule also affect package radiation levels. The applicant states that the assumed specifications are based on typical values.

   However, dimensionally smaller sources and capsules could be transported in the package. A point source would bound the variation in source and capsule geometry and dimensions for potential Co-60 source contents. With very little margin to the regulatory limit (about one percent), a source and capsule specification that appropriately bounds the authorized source configurations should be used.

e. revise the azimuthal, or rotational, tally subdivision to appropriately calculate the maximum radiation level for the side, top, and bottom surfaces and at one meter

   The applicant has divided the detector tallies rotationally (i.e., azimuthally) into 90° segments. Such wide azimuthal tally divisions cannot appropriately capture the maximum radiation levels on the RMSC side, top and bottom surfaces for a source that is fairly confined in terms of cross-sectional area for each of these surfaces.

   Such wide azimuthal tally divisions would artificially reduce maximum radiation levels by averaging the radiation levels over too large an area.

This information is necessary to satisfy the requirements in 10 CFR 71.47 and 71.51(a).

**Response:** Since the Co-60 isotope has been deleted from the application, a shielding analysis is no longer applicable for the RMSC. All shielding evaluations were performed via prototypic testing with Ir-192 special form capsules to demonstrate regulatory dose rates were not exceeded.

5.4. Modify the shielding acceptance test in SAR Section 8.1.6 of the application to adequately demonstrate performance of the tungsten shielding components as described below.

SAR Section 8.1.6 describes an acceptance test for the tungsten shielding components. It indicates that a radiation profile is performed on each component. The results are ratioed to determine the expected radiation levels for the proposed Ir-192 source, with the acceptance criteria being that the results show the radiation levels for the maximum authorized contents will not exceed the limits in 49 CFR 173.441 (the same as in 10 CFR 71.47).

It is not clear that this test is adequate to demonstrate the tungsten shielding components perform their function as designed for all the proposed contents. First, the test description does not include enough information about the source that is used for the radiation profile measurement. For the described ratioing to be appropriate, it would seem this source should be an Ir-192 source of adequate source strength vs. the allowable limit so that measurements and ratioing are appropriate and don't introduce error.

Second, the proposed acceptance criteria do not relate to these components' shielding performance as designed and evaluated. The applicant's shielding analysis shows the maximum radiation levels for the RMSC are significantly below the non-exclusive use regulatory limits for the proposed Ir-192 source. The same is true for the Co-60 source except for the location of maximum surface radiation level, which the current analysis shows to be nearly equal to the regulatory limit. In all other instances, the maximum radiation levels for the RMSC, as designed, are significantly below the limits. The acceptance test should use acceptance criteria that are based on the performance of the RMSC as designed and evaluated. Thus, appropriate acceptance criteria would be more like the radiation levels and associated radiation profiles in the applicant's shielding analysis (adjusted to neglect the steel RMSC components if those are not present in the test), with the components at their minimum allowed properties and dimensions. Also, based on the applicant's shielding analysis, the RMSC with the proposed Ir-192 could pass the currently proposed test and acceptance criteria but fail with the proposed Co-60 source.

Alternately, if the applicant specifies a materials standard for the tungsten alloys in the package drawings and can show the standard adequately controls material composition and porosity and precludes voids in fabricated tungsten alloy components, it may be possible for the confirmation of compliance with the material and dimensional specifications in the package drawings to adequately fulfill the purpose of the shielding acceptance test.

This information is needed to confirm compliance with 10 CFR 71.85 and ensure the package will perform as designed to demonstrate that it meets the requirements of 10 CFR 71.47.

**Response:** The shielding test of the tungsten shields specified in Section 8.1.6, *Shielding Tests*, are a standard INC test that is performed on all gamma shields prior to assembly in a NRC-licensed radioactive material package (RAM). The radioactive sources that are utilized for these shielding tests are those sources that are available in the licensed INC office at the time of the acceptance test. The available radioactive sources, which are normally Ir-192 sources, are within the licensed radioactive material limits for the INC facility. As specified in that section, the shield assembly must not exceed the regulatory radiation limits of 49 CFR §173.441, which states a dose rate surface limit of 200 mrem/hr and a transportation index (TI) of 10. Any shielding assembly that exceeds this limit is rejected, and not utilized in a NRC-licensed RAM.

The Plansee Densimet® heavy metal shields are sintered tungsten alloyed with 3% to 6.5% iron and nickel. The effect of the iron and nickel alloying of the tungsten significantly increases ductility and brittle fracture resistance over pure tungsten. Because the metal is sintered and not cast, there is no possibility of a void forming in the manufacture of the shields. Verification of the absence of voids or porosity is physically verified by the shielding acceptance test of each tungsten shield assembly required by Section 8.1.6, *Shielding Test*.

Since The Co-60 isotope has been deleted from the application, no analytical shielding analysis is applicable for the RMSC payload. The radiation measurements utilizing actual prototypic Ir-192 special form capsules demonstrated the shielding safety function of the prototypic RMSC payloads, which included all of the effects of the HAC free and puncture drops documented in Appendix 2.12.1, *Certification Tests*, satisfied the regulatory dose rate limits.

5.5. Revise the acceptance criteria for the shielding maintenance test in SAR Section 8.2.5 to use radiation levels that are consistent with the as-designed performance of the tungsten shielding components.

The shielding maintenance test described in SAR Section 8.2.5 specifies the regulatory limits for radiation levels in 49 CFR 173.441 (the same as in 10 CFR 71.47) as acceptance criteria to confirm the continued performance of the tungsten shielding components. As described in RAI 5.4 for shielding acceptance tests, the regulatory limits are not adequate to confirm the performance of the as-fabricated components versus the design. Acceptance criteria should be based on the performance of the as- designed components similar to the acceptance test criteria as discussed in RAI 5.4. Alternatively, if the applicant determines that a maintenance test is not needed for the tungsten shielding components, then the applicant should provide adequate justification for not having a shielding maintenance test for these components.

This information is needed to confirm the maintenance program is adequate to ensure the package will be maintained consistent with the design to meet the requirements in 10 CFR Part 71 Subparts E and F.

**Response:** The shielding design limit for the RSMC payload has always been the NCT §71.73(a) regulatory limits, i.e., 200 mrem/hr on the surface and 10 mrem/hr at 1 meter, which are more limiting than the HAC §71.73(a)(2) regulatory limit of 1,000 mrem/hr at 1 meter. The fact that the actual dose rate measurements of the RMSC payload were significantly lower than the regulatory limits demonstrated the margin of safety for shielding of the 16,000 Ci of Ir-192 or Se-75 special form capsules. As specified in Step 9 of Section 7.1.2, *Loading the Special Form Contents into the RMSC*, verification of the dose rates are within the NCT regulatory limits each time the special form capsules are loaded in the assembled RMSC payload demonstrates the continued shield capability of the tungsten heavy metal shields during operations. This required operational step exceeds any shielding test for a periodic test that would be included in the maintenance program, which is delineated in Section 8.2, *Maintenance Program*.

**Package Operations Review**

7.1 Modify the package operations descriptions in SAR Chapter 7 to address the following:

a. include a step in Section 7.1.1 to check the condition of the OP-RMSC cavity after removing the RMSC. This check is needed to ensure compliance with 10 CFR 71.87(b) to confirm the package is in unimpaired physical condition,

b. clarify or define the “acceptable limits” for RMSC radiation levels in Section 7.1.2 paragraph 9; based on the shielding analysis; these limits should be the same as the analyzed radiation levels in the SAR,

c. clarify or define “acceptable” for both the RMSC radiation levels and the smear test in Section 7.2.2 paragraph 5; for the radiation levels; it would seem that the limits should be the same as for Section 7.1.2 paragraph 9 as noted in item (b) above,

d. clarify or define “acceptable” for both the RMSC radiation levels and the smear test in Section 7.2.2 paragraph 13; if this step is in preparation for shipping the package as an empty package, the limits of 49 CFR 173.428 would be the criteria for determining acceptability,

e. include operations with the silicone seal that is associated with the OP-RMSC’s inner closure lid; it appears that activities related to this seal should be included in Section 7.1.1 paragraph 3 or 4, Section 7.1.3 paragraph 2, and Section 7.2.2 paragraphs 3 and 15. Per 10 CFR 71.87(c), the package operations should include steps that ensure that each closure device, including any gasket, is properly installed, secured and free of defects,

f. include a smear test, or contamination check, of the RMSC in Section 7.1.2 upon removal from the hot cell and prior to loading into the OP-RMSC similar to what is done in Section 7.2.2. The operations should also define the criteria for what is "acceptable" for this test. Contamination from loading of the RMSC in a hot cell could be a concern,

g. include in Section 7.2.2, between existing paragraphs 10 and 11, an operations step to re-install the tungsten cavity shield into the RMSC and to remove the package user's lifting device from the RMSC after the radioactive contents have been removed. The operations steps appear to be missing from among those steps that are necessary to return the package to its designed transport configuration, and

h. include appropriate operations descriptions in Section 7.3. It would appear that operations similar to those in Section 7.1.3 paragraphs 5 through 7 and 9 through 11 are necessary, with appropriate regulations cited for an empty package.

   Section 8.4.3 of NUREG-2216 includes a discussion of the kinds of information that should be included.

This information is necessary to satisfy the requirements in 10 CFR 71.87 and to ensure the package is operated consistent with the application's analyses that demonstrate the package meets the requirements in 10 CFR 71.47.

**Response:** Step 5 in Section 7.1.1, *Preparation of the OP-RMSC for Loading*, has been revised to include inspection of the OP-RMSC cavity after removal of the RMSC payload. Step 3 of Section 7.1.1 has been revised to require a visual inspection of the silicone gasket for damage. Step 9 of Section 7.1.2, *Loading the Special Form Contents into the RMSC*, has been revised to verify that dose rates and surface contamination of the loaded RMSC are within the NCT regulatory limits of §71.47(a) and §49 CFR 173.443, respectively. Note that the design dose rates for the RMSC payload are the NCT regulatory limits. Step 5 in Section 7.2.3, *Removal of Special Form Contents from the RMSC*, has been revised to verify that the radiation survey and smear test comply with the requirements of 49 CFR §173.428. Section 7.2.2 has been revised to add Step 11 to re-insert the cavity tungsten shield into the RMSC body.

Since the empty RMSC payload has been verified to meet the radiation limits per 49 CFR §173.428 in Section 7.2.2, and there is no decay heat within the RMSC cavity from a radiation source, there is no regulatory requirement for a tamper-indicating seal or the personnel barrier for the empty OP-RMSC package to be transported. Additionally, the required steps to assemble the empty OP-RSMC package are delineated in Section 7.2.3, *Removal of Special Form Contents from the RMSC*. Therefore, additional operation steps in Section 7.3, *Preparation of Empty OP-RMSC Package for Transport*, are unnecessary, provided the requirements of the referenced Department of Transportation (DOT) regulations are met.

**Acceptance and Maintenance Review**

8.1 Modify the acceptance tests described in SAR Section 8.1.1 to include verification that the package components' dimensions meet the specifications in the package drawings and, for the tungsten alloy components, to include verification that there are no visible defects (e.g., cracks or pinholes).

SAR Section 8.1.1 includes confirmation that the materials of construction meet the requirements in the package drawings. However, that is only one part of the checks needed for ensuring the package's safety functions. The components' dimensions are also important and should be verified to conform to the requirements, including tolerances, in the package drawings as part of the acceptance tests described in SAR Section 8.1.1. SAR Section 8.1.1 should be clear and explicit regarding dimension verification. Additionally, for the tungsten alloy shielding components, it seems that the visual inspections and measurements should include a visual check to confirm that there are no visible defects (e.g., cracks or pinholes).

This information is necessary to satisfy the requirements in 10 CFR 71.85.

**<u>Response</u>:** Clarification of what is to be examined, including the observable surfaces of the tungsten shields, has been included in Section 8.1.1 of the SAR.

**Quality Assurance Review**

9.1 Provide a quality assurance program description, as required by 10 CFR 71.37, or a reference to a previously approved quality assurance program in the transportation package application.

This information is necessary to satisfy the requirements in 10 CFR 71.31(a)(3).

**<u>Response</u>:** Reference to INC's NRC-approved quality assurance program, Docket Number 71-062, has been added to Section 1.1, *Introduction*, of the Safety Analysis Report.