Request for Additional Information
Docket No. 71-3082
Model No. 1860A Package

By letter dated February 6, 2014, the U.S. Department of Transportation (DOT) submitted a request for review of the Australian Certificate of Approval No. AUS/2007-13/B(U)-96, Revision 1, for the Model No. 1860A package.

This request for additional information (RAI) identifies information needed by the U.S. Nuclear Regulatory Commission staff in connection with its review of the Model No. 1860A package to determine whether the applicant has demonstrated compliance with the International Atomic Energy Agency (IAEA), "Regulations for the Safe Transport of Radioactive Material," TS-R-1, 2009 Edition.

## II Structural and Materials Evaluation

2.1 Clarify the various structural items described in the text of the safety analysis report (SAR), and on the fabrication drawings included in the SAR.

In order to provide consistency, the identification of the structural components, such as end cap, end cover plate, end shield plate, end crumple shield plate, end crumple shield cover plate, etc., should be uniformly done for the same components throughout the SAR. The current inconsistencies in the SAR are leading to some confusion as to which particular component is analyzed for verification of its structural adequacy in compliance with the applicable IAEA regulations.

This information is required to determine compliance with the requirements of paragraphs 714 and 715 of IAEA TS-R-1.

2.2 Provide a table listing each individual component, specified bolt (or socket set screw) size and required torque, during the various phases of transportation, i.e., empty or loaded package, in order to ensure that there will be no breach in containment.

There is conflicting information throughout the SAR regarding topics such as bolt size or the required torque on bolts of same size, etc. For example:

- On page 428 of 745, it is indicated that the end cap is attached to the package via six bolts each tensioned to 60 Nm. However, page 411 of 745 indicates that the end plates are connected by six M8 socket set screws tightened to a torque of 20 Nm.

- On page 66 of 475, it is indicated that the bolt on the cover plate attaches to the end crumple shield with six M6 bolts. However, Drawing No. 1860A-02-061-00 indicates six M8 bolts.

This information is required to determine compliance with the requirements of paragraphs 612, 633, and 650 of IAEA TS-R-1.

2.3 Provide the required torque for the end crumple shield cover plate.

For the end crumple shield cover plate, the required torque for six M8 socket set screws is not specified in the SAR.

This information is required to determine compliance with the requirements of paragraphs 612, 633, and 650 of IAEA TS-R-1.

2.4 Remove the text and drawings, from the previous 2009 submittal(s), no longer needed for fabricating the new package design.

Multiple “green stamped” drawings for the same structural component lead to confusion, as to which one is relevant to the current application.

This information is required to determine compliance with the requirements of paragraphs 714 and 715 of IAEA TS-R-1.

## III Thermal Evaluation

3.1 Clarify how the value of 2.708 kW was calculated on page 166 of the application.

In order to calculate the time of the worst case scenario of the solar insolation of 800 $W/m^2$ being applied to the entire surface area of the attenuator in order to comply with the requirements of TS-R-1 728(b) during accident conditions, Q has to be calculated. One of the values used in the calculation, on page 166 of the application, was 2.708 kW. Clarify how this value was calculated.

This information is required to determine compliance with the requirements of paragraph 728(b) of IAEA TS-R-1.

## V Shielding Evaluation

5.1 Justify that the package orientation, for the NCT and HAC free drop tests, results in the greatest damage to the package with respect to the package’s shielding performance.

Pictures included in the SAR indicate that the package is oriented such that, when dropped, the package skid will impact the target first. The package’s shielding does not rely on the skid. The shielding performance is affected by the deformation of the crumple shield and any damage the attenuator case might also suffer from the NCT and HAC drop tests.

Thus, it would seem that the crumple shield and attenuator case would sustain greater damage in drop tests where the package is oriented so that the crumple shield impacts the target first, i.e., the package is flipped upside down from the orientation apparently used in the applicant’s drop tests, see SAR page 459, Pic. 3. The tests should be done with the package orientation resulting in the greatest impact to the package’s shielding capabilities for both the NCT and the HAC free drop tests.

This information is required to determine compliance with the requirements of paragraphs 722, 727(a), 646(b), and 657(b)(ii)(i) of IAEA TS-R-1.

5.2 Modify the shielding analyses for source drawers with multiple source locations to include dose rate calculations for the maximum allowable sources in the most limiting source locations, or modify the maximum allowable contents specification on page 27 of the SAR.

The package drawings include source drawers into which multiple sources may be loaded. These include source drawers SD-R-03, 06, 07, and 10. The current application places no limits on how the maximum allowed contents may be distributed among the multiple source locations within these drawers.

For the first three drawers, the shielding analysis assumes the total source is located in the position at, or closest to, the axial midpoint of the source drawer. This location is at the center of the package. Thus, the shielding analysis is not adequate for the allowable contents, as proposed.

For the last drawer, the source is uniformly distributed over the multiple pencil sources. However, the source may be a single pencil in one of the outermost pencil locations. The analysis does not address this configuration.

The staff has performed some independent calculations. Based on those calculations, the applicant may choose to, in lieu of the analyses, add the following limits to the contents descriptions on page 27 of the SAR:

a. For Drawer SD-R-06 in Package Configuration C, the maximum allowable contents in the outermost source location on either end of the drawer is 40TBq of Cobalt-60.

b. For Drawer SD-R-07 in Package Configurations C and D, the outermost source location on either end of the drawer must be empty (i.e., no source is allowed in this location).

The staff's analysis indicates that these limits are necessary in order to meet the non-exclusive use dose rate limits. The staff's analysis indicates that no additional limits on the contents are needed for the drawers with multiple source locations.

This information is required to determine compliance with the requirements of paragraphs 530 and 531 of IAEA TS-R-1.

5.3 Modify the package operations descriptions to:

a. Clarify that at, a minimum, the descriptions on pages 410 through 419 of the SAR will be followed, along with the other actions mentioned in this RAI.

b. Include confirmation that the contents meet the limits on page 27 of the SAR, as modified in response to these RAIs.

c. Clarify that dose rate surveys will cover the whole package surface, both at the package surface and at 1 meter from the package.

d. Include installation of the end shield cover plates in the end crumple shields, with the attachment bolts/screws torqued to at least 20 Nm.

e. The end cap plugs for packages containing drawer SD-R-06 must be the tungsten plug (Drawing No. 1860A-02-312-00).

f. Include the following two conditions on the use of a source drawer other than one that was analyzed in the SAR:

   1) Confirm that the source drawer and any needed spacers used with the drawer is bounded by one of the drawers analyzed in the SAR with respect to the source position within the drawer (and thus the package) and with respect to the minimum shielding specifications.
   2) Confirm that the source drawer and any needed spacers used with the drawer meets the limits on source position, source quantity, and packaging configuration that apply to the analyzed, bounding source drawer.

For Item c, the survey map included in the SAR, for example on page 406, implies that dose rates will only be measured at specific locations. However, based on the shielding analysis, these specific locations may not be the locations of the maximum package dose rates. The package operations should be clear and include the operations described above.

For Item f, the limits in item f.2 include the limits in the SAR as modified in response to these RAIs. The applicant has proposed to allow the use of source drawers along with spacers, as needed, that were not analyzed in the SAR and for which drawings are not provided.

This is acceptable as long as the source drawer and spacer configuration is bounded by one of the source drawers that were analyzed and for which drawings were provided in the SAR. The configuration must be bounded in terms of the minimum shielding capability and the positioning of the source within the package. The spacers may be credited for both source position and shielding, as the applicant has described in the pages 601 and 602 of the SAR. The spacers may include lead filled stainless steel canisters or tungsten, as described by the applicant.

This information is required to determine compliance with the requirements of paragraphs 530 and 531 of IAEA TS-R-1.

5.4 Modify the operations for the first use of the package (i.e., shielding acceptance testing) to state that fabricated packages that cannot meet the radiation limits for non-exclusive use transport for the allowed contents cannot be used.

The SAR includes operations for the first use of a fabricated package, as mentioned on pages 117, 118, 401, and 402. Current statements indicate that the package maximum allowable contents may be adjusted based on dose rate measurements if the measurements for the contents limits in the SAR exceed the non-exclusive use dose

rate limits. The current descriptions also include another option for the package to be reclassified to a different configuration. The meaning of this second option is not clear.

Both options do not meet the requirement of TS-R-1, paragraph 501(b). For a package to be used under the approved certificate, the shielding effectiveness must be demonstrated to be within the limits specified for the approved design. For the Model No. 1860A, that means that the dose rates for a package loaded with the maximum allowed contents must meet the non-exclusive use dose rate limits. A package that does not meet those limits for the maximum allowed contents indicates a problem with the package's shielding and the package also does not meet the requirement of 501(b).

This information is required to determine compliance with the requirements of paragraph 501(b) of IAEA TS-R-1.

5.5 Modify the package drawings as follows:

a. Drawing No. 1860A-A1-000-00, "Transport Cask Assembly," replaces Part No. 1860A-01-061 with Part No. 1860A-02-061, "End Crumple Shield."
b. Drawing No. 1860A-B1-000-00, "Transport Cask Assembly," replaces Part Nos. 1860A-01-061, 1860A-B1-016, 1860A-B1-028, 1860A-B1-108, and 1860A-B1-109 with Part Nos. 1860A-01-062, "End Crumple Shield," 1860A-B2-016, "End Cap Assembly," 1860A-B2-028, "End Cap," 1860A-B2-108, "Shine Shield," and 1860A-B2-109, "End Cap Flange," respectively.
c. Drawing No. 1860A-C1-000-00, "Transport Cask Assembly," makes the same replacements as stated above for Drawing No. 1860A-B1-000-00. In addition, Part No. 1860A-02-312, "Tungsten Test Port Plug," is also added to the parts list on sheet 4 of 4 of the drawing.
d. Drawing No.1860A-D1-000-00, "Transport Cask Assembly," makes the same replacements and additions to the parts list as stated above for Drawing No. 1860A-C1-000-00.
e. Drawing No. 1860A-E1-000-00, "Transport Cask Assembly," replaces Part Nos. 1860A-01-061, 1860A-E1-016, 1860A-E1-028, 1860A-E1-108, and 1860A-E1-109 with Part Nos. 1860A-01-062, "End Crumple Shield," 1860A-E2-016, "End Cap Sub Assembly," 1860A-E2-028, "End Cap Assembly," 1860A-E2-108, "Shine Shield," and 1860A-E2-109, "End Cap," respectively.
f. Drawing No. 1860A-F1-000-00, "Transport Cask Assembly," makes the same replacements as stated above for Drawing No. 1860A-E1-000-00.
g. Drawing No. 1860A-B2-109-00 on SAR pages 638 and 639 should be labeled as Drawing No. 1860A-E2-109-00 since it is for Part No. 1860A-E2-109.
h. The relevant drawing numbers for each package configuration (i.e., the "Transport Cask Assembly" drawings for each package configuration) specify the lead alloy and its density used for the package's lead shielding.
i. The drawings for the source drawers should specify the lead alloy and its density used for the source drawers' lead shielding.
j. Specify the relevant drawing numbers for the package configurations and parts. For the source drawers that use tungsten for shielding, specify the tungsten alloy density along with the alloy specification.

These modifications are necessary to ensure that the package configuration is fabricated and used in accordance with how the package is analyzed and approved for use. For

Items h and i, based on the shielding analyses, the lead alloy should be pure lead, or very nearly pure lead (e.g., alloy is at least 99.9% lead), with a density of 11.34 g/cc.

If the drawing specifications for the lead allow for alloying, the shielding analysis should be modified to address alloying of the lead at the proposed specification.

This information is required to determine compliance with the requirements of paragraphs 530, 531, 646(b), and 657(b) of IAEA TS-R-1.

**Editorial Comments:**

1. Clarify the apparent discrepancy, on page 109 of the application, between the values used in determining the total energy.

   The value used on page 109 of the application to determine the total energy is 1eV = 1.6 x $10^{-19}$ Joules. When the calculation was done to calculate the total energy, the value used was 1.6 x $10^{19}$ Joules. Revise the application to reflect the value in the calculation for total energy to be 1.6 x $10^{-19}$ Joules.

2. Change the spelling of the word “minuets” to “minutes.”

   On pages 104, 129, 388, 390, and 396 of the application, the word “minuets” was used. Revise the application to reflect the correct spelling of “minutes” on those pages.

3. Remove the extra step 14 listed in the “Thermal Test Procedure.”

   On page 396 in the “Thermal Test Procedure” section of the application, steps 14 and 15 are identical. Revise the application to reflect the removal of the extra listing of the same step.

4. Add an additional step in the calculation of the total energy, “h”, on page 166 of the application.

   In the calculation of the total energy conducted during a 30-minute exposure, the thermal conductivity is calculated by using its definition, which is 36 (W/m*K). However, it was not obvious that the value calculated was h = 36x0.5x1073 = 19314 W. Add an additional step, for example h = 36x(1/ (0.5x1073)) W, to show that h = 19314 W.