From: Saverot, Pierre
Sent: Friday, November 06, 2009 1:51 PM
To: 'Troy Hedger'; 'Bob Robnett'
Cc: 'Raul Pomares'; 'Schrag, Michael R. (GE Infra, Energy)'; Turner, David W. (GE Infra, Energy)
Subject: RE: AOS packaging system shielding RAIs

Dear Mr. Hedger,

As a follow-up to our October 28, 2009 teleconference call on a staggered Request for Additional Information (RAI) process during the review of this application, and to the Materials RAIs sent to you on November 2, 2009, you will find below our RAIs related to Shielding issues for the AOS-025, AOS-50 and AOS-100 packaging systems.

We request that you provide the information identified below in conjunction with your responses to our combined RAIs to be issued around December 15, 2009.

Sincerely,

Pierre Saverot
Project Manager, Licensing Branch

Request for Additional Information
for the
Model Nos AOS-025, AOS-050, and AOS-100 Packages
Docket No. 71-9316

By letter dated September 14, 2009, Alpha-Omega Services, Inc, (AOS) submitted an application for approval of the Model Nos. AOS-025, AOS-050, and AOS-100 packages.

This Request for Additional Information (RAI) identifies information needed by the U.S. Nuclear Regulatory Commission (NRC) staff in connection with its review of the "AOS Radioactive Material Transport Packaging System Safety Analysis Report," Revision No. C, dated September 2009. This RAI is exclusively related to Shielding issues at this time and will be followed by other RAIs in each technical discipline.

Each individual RAI below describes information needed by the staff to complete its review of the application and to determine whether the applicant has demonstrated compliance with the regulatory requirements.

Chapter 5 - Shielding Evaluation

5-1 Address staff's concerns that the gamma source term is non-conservative for certain nuclides or provide additional information demonstrating that the dose calculations are conservative given some possible non-conservative assumptions.

The application contains the following statement: *"Particles with a relative probability of emission less than 0.001 are not included in the shielding model. Particles with low relative probabilities are eliminated and the emission probabilities of the remaining particles are normalized, so that these probabilities sum to unity."*

The staff notes that this method is not necessarily conservative. In some cases, photons with very high energy are omitted. Although they have a low probability of emission, since they have high energy, they have a much higher probability of contributing to the dose rate outside the package. Rather than omitting these gammas, and increasing the probability of emission of all of the other lower energy gammas, the applicant should have increased the probability of higher energy, and more bounding, gammas.

The staff requests that the applicant provides additional and detailed information justifying that their gamma source term is conservative given this possible non-conservatism. The staff specifically requests that the applicant provides additional information for the following nuclides:

a. Ir-192 – It appears as though the decay chain to Os-192 has been neglected. This is a relatively low probability decay (~4.7%); however, it contains a high energy gamma (~884keV). Justify that neglecting the Os-192 decay chain is conservative.

b. Ho-166 – Several high energy gammas (1.6-1.8 MeV) are neglected. The staff realizes that these are very low probability; however, the staff believes that they may be a notable contributor to the dose. Justify the exclusion of these gammas in the shielding calculations.

c. Sb-124 – Several high energy gammas (on the order of 1 MeV or greater) are neglected. Separately these gammas have a very low probability but together comprise of about 5% of emissions and 0.1 gammas per decay. Justify the exclusion of the high energy gammas in the shielding calculation.

d. Sm-153 – Several of the higher energy gammas (~500-600 KeV) are neglected. The staff realizes that these are very low probability; however, the staff believes that they may be a notable contributor to the dose especially since the applicant does not have any bounding high energy gammas for this calculation. Justify the exclusion of these gammas in the shielding calculation.

This information is needed to verify that the applicant has satisfied the requirements in 10 CFR 71.47 and 10 CFR 71.51.

5-2 Justify transient equilibrium conditions for Zr/Nb-95.

In Section 5.5.1 of the application, the applicant provides information justifying the number of photons/decay assumed for Zr/Nb-95. The staff understands that these nuclides are assumed to be in transient equilibrium. Before the system reaches transient equilibrium, the total system activity reaches a maximum.

Specifically, provide information on how the Zr/Nb-95 is ensured to be in transient equilibrium (i.e., what controls on the Zr/Nb-95 are in place to ensure that the sample has decayed enough to reach transient equilibrium).

This information is needed to verify that the applicant has satisfied the requirements in 10 CFR 71.47 and 10 CFR 71.51.

5-3 Provide additional information to justify the use of the point source approximation.

A point source approximation is used to represent the geometry of the source material. The staff agrees that the point source can be limiting in that it eliminates self-shielding. Also, by placing it adjacent to the cavity wall, the distance to the detector is minimized and therefore the intensity of the emissions is maximized. However, the staff notes that, if the extent of the source is large with respect to the distance from the detector, then the point source approximation can be non-conservative. The angle at which the photons are emitted in a point source is isotropic. If the extent of source is large and a line source is used, it is possible for more photons to be seen by the detector (in comparison to a point source) via the angles at which they are emitted. It is generally accepted that the point source is a valid approximation as long as the distance to the detector is greater than three times the maximum source dimension.

Some examples of contents that may be shipped using the AOS packaging system are provided in response to a Request for Supplemental Information (RSI) from the staff, dated July 31, 2009. In the response to RSI 5-2 , an example of a Co-60 source that has an extent of 16 inches is provided. With the dose points at the personnel barrier or closer, the length of this source would exceed the length that is thought to be acceptable for the point source approximation.

Further, the staff does not find that the explanation provided in response to RSI 5-2 adequately addresses these concerns.

Please demonstrate that the point source approximation is always conservative as compared to any other source geometry for the AOS packaging system. Provide all calculations and sensitivity studies as needed.

This information is needed to verify that the applicant has satisfied the requirements in 10 CFR 71.47 and 10 CFR 71.51.

5-4 Provide additional information to justify the use of the bounding energy approach.

The staff understands that the energy distribution of certain nuclides is used to bound the energy of other nuclides, as described in 5.4.4.1 of the application, “Maximum Source Strength Calculation.” The staff agrees in principle with this approach, but requires additional information to justify this approach.

Two of the nuclides listed in Table 5-13 of the application (Se-75 and Sm-153) have higher energy gamma emissions than the nuclide listed as bounding. The staff understands that the average energy of the bounding nuclides is higher; however, since higher energy gammas have a much higher probability of penetrating the shield, they should not be neglected.

Provide additional information explaining how these nuclides were determined to be bounding despite neglecting the higher energy gammas.

This information is needed to verify that the applicant has satisfied the requirements in 10 CFR 71.47 and 10 CFR 71.51.

5-5 Provide additional information to confirm the design features of the AOS transport packaging system.

a. Drawing No. 105E9712 for the AOS-100 system does not contain all the necessary dimensions for the Cask cavity shield. However, these dimensions are included on Drawing No. 105E9719 for the AOS-100A-S. Please confirm that the dimensions for the cask cavity shell in Drawing No. 105E9719 are applicable for the AOS-100 packaging system, as represented by Drawing No. 105E9712. Provide revised drawings including all necessary dimensions.

b. The staff notes that the designation "TYP" (typical dimensions) is used for several parameters on the drawings (Section B-B and Lid Plug Assembly Detail). Per NUREG/CR-5502, the staff discourages the use of this designation. Explain why these dimensions are marked as "TYP" and what is done to ensure that the packaging system, as constructed, is within the parameters of the shielding analyses. Provide revised drawings with all required dimensions.

c. Provide the entire axial thickness of the tungsten portion of the axial plug in Drawing No. 183C8491 for Section D-D.

This information is needed to satisfy the requirements of 10 CFR 71.111.

5-6 Clarify the use of the additional shielding for the AOS-100A, AOS-100A-S, and AOS-100B packaging systems.

For Co-60 shipments in the AOS-100A, AOS-100A-S, and AOS-100B packaging systems, Table 1-6 of the application states that the use of the axial shielding plates "may" be used for "large-quantity" shipments. The analysis presented in the shielding section for Co-60 takes credit for the presence of the axial shielding plates.

With the current analysis, the staff will specify in the CoC that these plates are required when shipping any amount of Co-60 in the AOS-100A, AOS-100A-S, and AOS-100B packages. If the applicant wishes to make the use of these plates optional for lower amounts of Co-60, the applicant shall provide an analysis for the AOS-100A, AOS-100A-S, and AOS-100B systems without the shielding plates to demonstrate that a lower amount of Co-60 meets the dose rate limits specified in 10 CFR 71.47 and 10 CFR 71.51 for both Normal Conditions of Transport (NCT) and hypothetical accident conditions.

Otherwise please modify the text in Table 1-6 to state that the use of the axial shielding plates "shall" be used for "all" shipments of Co-60 for the AOS-100A, AOS-100A-S, and AOS-100B packaging systems.

This information is needed to verify that the applicant has satisfied the requirements in 10 CFR 71.47 and 10 CFR 71.51.

5-7 Provide additional information demonstrating that the minimum distance to the personnel barrier is preserved during NCT.

The dose point for NCT is calculated at the personnel barrier. It is not clear to the staff that normal conditions of transport provide no deformation to the impact limiter or personnel barrier such that the minimum distance from the cask to the personnel barrier is preserved.

The staff requests additional information justifying that there will be no damage to these structures during NCT as stated in Observation 3 submitted with the Request for Supplemental Information (RSI) dated July 31, 2009.

In response to Observation 3, the applicant said that it will submit an analysis demonstrating that the impact limiter and the personnel barrier remain intact during NCT. The staff did not locate this information in the revised application. Please provide this information.

This information is needed to verify that the applicant has satisfied the requirements in 10 CFR 71.47.

E-mail Properties

Mail Envelope Properties ()

Subject: RE: AOS packaging system shielding RAIs
Sent Date: 11/6/2009 12:28:51 PM
Received Date: 11/6/2009 1:51:00 PM
From: Saverot, Pierre

Created By: Pierre.Saverot@nrc.gov

Recipients:
th@alpha-omegaserv.com ('Troy Hedger')
Tracking Status: None
bobr@alpha-omegaserv.com ('Bob Robnett')
Tracking Status: None
rjpandassociates@comcast.net ('Raul Pomares')
Tracking Status: None
michael.schrag@ge.com ('Schrag, Michael R. (GE Infra, Energy)')
Tracking Status: None
davidw.turner@ge.com (Turner, David W. (GE Infra, Energy))
Tracking Status: None

Post Office:

Files	Size	Date & Time
MESSAGE	48218	11/6/2009

Options
Expiration Date:
Priority: olImportanceNormal
ReplyRequested: False
Return Notification: False

Sensitivity: olNormal
Recipients received: