**From:** Saverot, Pierre
**Sent:** Thursday, December 10, 2009 6:41 PM
**To:** 'Troy Hedger'; 'Bob Robnett'
**Cc:** Raul Pomares; Michael Scharg; Turner, David W. (GE Infra, Energy)
**Subject:** AOS application structural 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 and Shielding RAIs sent to you on November 2 and November 6, 2009, respectively, you will find below our RAIs related to Structural 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

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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.

**ST-1**: Explain how the structural integrity of the personnel barrier is maintained during the NCT event. Provide details regarding the deformed shape following the event and the structural analysis that was performed of the personnel barrier.

Simply referring to tables and appendices does not describe the deformed shape of the personnel barrier subjected to NCT loads. Modify and add details that describe the shape of the barrier into Section 2.6.7 of the SAR.

This information is needed for compliance with 10 CFR 71.71.

**ST-2**: Provide the structural material, codes, analysis, etc., and details of the construction of the AOS package in order to qualify it to contain “special form” radioactive material.

The applicant has indicated that the package will include “special form” radioactive material. The staff found no evidence of any test results documented in the SAR. The staff needs this information to determine whether it will meet the requirements of the intended function.

This information is needed for compliance with10 CFR 71.75.

**ST-3**: Provide justification(s), validated by test data presented in Chapter 8, for reduction in impact limiter deformation values for head-on, corner and side drop events. Reconcile results with those described in SAR Section 3.4 (pg 3-97).

The current documentation provided in the SAR for justification of reduction in deformation for the AOS-25, AOS-50 and AOS-100 models is not adequate, especially since the density of the foam material for the AOS-50 and AOS-100 model is approximately one-half to two-thirds the density of AOS-165 model.

This information is needed for compliance with10 CFR 71.35.

**ST- 4:** Provide documentation verifying that the AOS-50 packaging was subjected to a crush test. Provide the numerical value(s) of the deformation to the packaging due to the crush load applied to AOS-25 and AOS-50 models.

Section 2.7.2 of the SAR only describes the required crush test for Model AOS-25. The gross weight of AOS-50 is 157 lbs, which is less than 1,100 lbs. Therefore the AOS-50 package needs to be subjected to the crush test per regulation requirements and relevant deformation results provided in the SAR.

This information is needed for compliance with10 CFR 71.73(c)(2).

**ST-5**: Provide hard copies of the catalog “General Plastics- LAST-A-FOAM” that includes properties of the polyurethane foam used in the various AOS models.

The staff could not verify the properties of the polyurethane foam material used for the impact limiters for the various AOS models. This is needed to verify the adequacies of the impact limiters under regulatory drop conditions.

This information is needed for compliance with10 CFR 71.33 and 10 CFR 71.35.

**ST-6** Explain the discrepancy between the package weights shown in Section 2, Table 2-1, page 2-3 of the SAR and those corresponding details shown in Drawings 166D8137, 105E9711, 105E9712, etc. Reconcile the differences and provide revised pages to the staff.

The package weights for AOS-50A, AOS-100A, AOS-100B and AOS-100S shown in Table 2-1 are different than those shown on Drawings 166D8137, 105E9711, 105E9712, etc. This information is needed to verify the structural adequacy of various AOS models described in this application.

This information is needed for compliance with10 CFR 71.71.

**ST-7**: Provide structural design details of the axial shield plate shown on Drawing Number 105E9711 Revision A, Section A-A. Explain how this plate is assembled and discuss the behavior of this plate inside the cask when the package is subjected to the regulatory drops for NCT and HAC events.

The staff found no evidence of the applicant addressing the design details of this component.

This information is needed for compliance with10 CFR 71. 33.

**ST-8** Provide a justification for using the formula from Reference # 2.7 referred to on page 2-22 of the SAR. This formula is used to perform the buckling analysis.

The staff needs justification for using the formula from the reference titled, "Flügge, Wilhelm, Ed., *Handbook of Engineering Mechanics*, McGraw-Hill Higher Education, New York, 1962, pp. 44-40, Case 4", in order to verify the adequacy of the buckling analysis used for the transport packaging system.

This information is needed for compliance with 10 CFR 71.35.

**ST-9** Provide a complete stand-alone description of the summary of damage to the various structural components (including the personnel barrier, etc.) for all AOS Models.

The staff needs this information to evaluate any potential cross cutting issues with other disciplines such as shielding.

This information is needed for compliance with 10 CFR 71.35.

**ST-10** Clarify the bolt size reported on page 2-40 of the SAR. The SAR reports lid bolts 7/8-9 UNC-1A ASME SB-637 UNS N07750 Type 3. The relevant drawings specify 3/4 bolts.

A confirmatory analysis shows that the larger bolt size is needed. Staff could not ascertain the correct size of the bolt used for the package to verify its adequacy.

This information is needed for compliance with 10 CFR 71.73(c)(1).

**ST- 11** Specify the equation used for the definition of "Margins of Safety" as stated in Section 2.1.5 of the SAR.

To verify the adequacies of the various packages proposed to be used in this application, staff need to know how the "safety margins" in the analysis are defined.

This information is needed for compliance with 10 CFR 71.73(c)(1).

**ST-12** Figure 2-25 on page 2-138 does not have dimensions A or B labeled as referenced on page 2-137 of the SAR. Also, the caption for this figure reads AOS-100. Is the test comparison to an AOS-165 or AOS-100 model? What are dimensions A and B as it relates to this figure?

These details are needed by the staff to verify the adequacies of the impact limiters on various packages proposed to be used in this application.

This information is needed for compliance with 10 CFR 71.73(c)(1).

**ST-13** Provide the numeric value of the scaled height change for the 30 ft. drop discussed in Section 2.7.1.1.3 "Correlation of Head-On Drop Analysis and Test" on page 2-137,.

The regulatory drops were performed on AOS-165 package. However, the applicant withdrew the package AOS-165 from the current application. Correlation for the packages within the scope of this application, namely AOS-25, AOS-50, and AOS-100 were done based on the tests performed on AOS-165. Staff needs to know the actual numerical values for the AOS-100 package to verify the adequacy of the impact limiters used in various packages.

This information is needed for compliance with 10 CFR 71.73(c)(1).

**ST-14** In Section 2.7.1.1.3 (page 2-137) the SAR states that "Analysis and test values differ by 19%." Provide the numerical values used to arrive at the 19% difference in maximum displacements. Also indicate the locations of these displacements along the package.

Staff need to know these details to verify the adequacy of the impact limiters for the packages within the scope of this application.

This information is needed for compliance with 10 CFR 71.73(c)(1).

**ST-15** Provide relevant pages of the manual for the LIBRA program that describes what each command in the input files does.

The applicant has performed finite element analysis of the package using the computer code LIBRA. Staff need the relevant descriptions from the program manual to verify the accuracy of the input commands that were used in the regulatory drop condition analysis to establish the adequacy of the impact limiters for various packages within the scope of the application.

This information is needed for compliance with 10 CFR 71.73(c)(1).

**ST- 16** Provide chart comparisons between the FE model and the actual material stress-strain properties. The validity of the displacements utilized in the analyses presented in Sections 2.6 and 2.7 of the SAR depend on accurate modeling of the impact limiter properties.

A chart comparison of the actual material stress-strain properties reported by the vendor, and those properties used as an input in the finite element analysis model is required so that staff can verify the accuracy of the analysis performed for the impact limiters.

This information is needed for compliance with 10 CFR 71.73(c) (1).

**ST-17** Provide the numerical values for loads P (total impact force) and q (pressure load) in the equation used on SAR page 2-136 (Section 2.7 Hypothetical Accident Conditions of Transport) to compute the load intensity in the 2-D cask model.

It is essential for the staff to know these values to verify the appropriateness of the analysis presented for Head-On Free-Drop for the Cask.

This information is needed for compliance with 10 CFR 71.73(c)(1).

**ST-18** SAR Section 2.7.1.1.2 (page 2-136) states that "In addition to the impact load, an opposing inertia body force is applied to the cask. Displacements are fixed along the cask base to account for non-equilibrium of pressure and inertia forces." Describe the form that the inertia body force takes. Also, provide the magnitude of this force. Show where the fixed nodes are located and list the magnitudes of the reaction resultants at each node.

It is essential for the staff to have all these information to verify the appropriateness of the analysis presented for Head-On Free-Drop for the cask.

This information is needed for compliance with 10 CFR 71.73(c)(1)

**ST- 19** Justify comparing maximum analysis displacement to the post-test deformation reported in Section 8 of the SAR. The implication by the applicant is that there is no elastic behavior of the impact limiter.

The staff did not find sufficient and accurate justification for the applicant to assume a totally inelastic behavior of the impact limiter materials. A justification is required to determine the magnitude of the damage sustained by the package subjected to regulatory drops, and to verify the adequacy of the impact limiter design.

This information is needed for compliance with 10 CFR 71.73(c)(1).

**ST- 20** Provide the leak-rate test values for the drop tests discussed in Section 8.3.2 of the SAR "Impact (Free-Drop) Test Report".

The leak-rate values subsequent to the regulatory drop tests were not shown in the application. Staff needs these values to determine if these leak rate values are acceptable to insure the leak tightness of the package.

This information is needed for compliance with 10 CFR 71.73(c)(1).

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