June 13, 2008

Mr. Troy Hedger
CEO
Alpha-Omega Services, Inc.
9156 Rose Street
Bellflower, CA 90706

SUBJECT: RECEIPT OF WITHDRAWAL REQUEST FOR THE AOS TRANSPORT PACKAGING SYSTEM, CLOSURE OF TAC NO. L24142

Dear Mr. Hedger:

By letter dated October 17, 2007, supplemented November 28, 2007, Alpha-Omega Services, Inc. (AOS) submitted an application for a Certificate of Compliance (CoC) for the Model No. AOS Transport Packaging System, in accordance with the provisions of 10 CFR Part 71. The AOS Transport Packaging System is designed to transport Type B quantities of normal and special form of fissile and activated material.

In a conference call on April 7, 2008, NRC staff informed you of major technical deficiencies found in the application. By letter dated April 29, 2008, AOS informed the NRC staff of its withdrawal of the AOS Transport Packaging System application, and its intent to resubmit the application, upon revising it to address the open technical issues identified by NRC staff. The purpose of this letter is to acknowledge receipt of your request to withdraw the application and closure of TAC No. L24142.

A summary of the major and other open technical issues are provided in the enclosure. Please note that if you choose to resubmit your application it will be treated as a new request and should clearly identify all changes and any new analyses in response to all of the open technical issues identified by the NRC staff. Your resubmitted application may reference any pertinent information from the previous application or related NRC documents. Also, please note that addressing the open technical issues identified in this letter does not preclude the staff from issuing a request for additional information with regards to your resubmittal. We will notify you promptly of our new proposed review schedule, upon receipt of your resubmitted application.

Please refer to Docket No. 71-9316 and TAC No. L24142 in correspondence related to this action. If you have any questions regarding our review, you may contact me or Jessica Glenny of my staff at (301) 492-3285.

Sincerely,

/RA/
Eric J. Benner, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9316
TAC No. L24142

Enclosure: Open Technical Issues

Please refer to Docket No. 71-9316 and TAC No. L24142 in correspondence related to this action. If you have any questions regarding our review, you may contact me or Jessica Glenny of my staff at (301) 492-3285.

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Docket No. 71-9316
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Enclosure: Open Technical Issues

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DATE:	6/6/2008		6/9/2008		6/9/2008		6/9/2008		6/9/2008		6/10/2008	
OFC:	SFST		SFST		SFST		SFST		SFST		SFST	
NAME:	ABarto		VWilson		CRegan		MWaters		LCampbell		MDeBose	
DATE:	6/10/2008		6/10/2008		6/12/2008		6/10/2008		6/12/2008		6/13/2008	
OFC:	SFST											
NAME:	EBenner											
DATE:	6/13/2008											

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Open Technical Issues
Alpha-Omega Services, Inc.
Docket No. 71-9316
Model No. AOS Transport Packaging System

By application dated October 17, 2007, as supplemented November 28, 2007, Alpha-Omega Services, Inc. (AOS), requested approval of the Model No. AOS Transport Packaging System. As requested by AOS review of the package has been terminated due to open technical issues. The open technical issues have been identified below. The major open technical issues are identified below in a bulleted list followed by other open technical issues. The open technical issues have been listed by chapter number and title in AOS' safety analysis report (SAR). NUREG-1609, "Standard Review Plan for Transportation Packages for Radioactive Materials," was used by the staff in its review of the application.

Each individual inquiry describes information, which should be included in the resubmitted application in order for the staff to complete its review of the SAR and to determine whether AOS has demonstrated compliance with the regulatory requirements. The open technical issues are not all inclusive. Additionally, addressing the open technical issues below in a re-submittal does not preclude the staff from addressing other technical deficiencies or from issuing a request for additional information in the future.

Major Technical Issues

Materials

- The chemical composition and physical form of the contents are not specified in sufficient detail to determine if interactions with other materials will occur. The chemical form of the liquid contents dictates which interactions will take place. If there is polymer material surrounding the contents, such as metallographic mounts, gases could be generated. If the contents include bare metal, the size, shape, and chemical form dictates if pyrophoric or other reactions can occur.

- The location and properties of the neutron shielding "Boronated WEP/Polyethylene" have not been specified. No methodology has been provided to qualify: (a) the uniformity of the material; (b) the durability of the material for the environmental conditions of service; and (c) its absorption coefficient. Without this information, the staff is unable to assess the expected behavior and interactions of this absorber material.

- The safety analysis report (SAR) states that the cask is modeled to include a "fuel rod basket," and uses the densities and material properties presented in Table 5-26, along with the standard cask assembly. This is the only instance where "fuel rod basket" is described as an integral structural component within the cask. It is not clear to the staff, which among the seven different models contains this fuel rod basket. Details of the structure of the fuel rod basket have not been provided and an explanation of how the fuel rod basket, if used, was modeled, and also how its independence and structural integrity within the cavity was maintained. Additionally, there was insufficient evaluation of the interaction effects during the required drop scenarios for both normal condition of transportation and hypothetical accident condition.

Thermal

- The maximum decay heat values used for the thermal analysis were not consistent with the decay heat values provided in other sections of the SAR. A potential unit conversion error with respect to the decay heat values could lead to non-conservative thermal results.

- Temperature limits for the cask cavity and seals were exceeded. Seal temperature limits do not agree with the maximum service temperature reported by the seal manufacturer.

- LIBRA input and output files, as well as a comprehensive discussion of analysis models, were not provided per Interim Staff Guidance 21, "Use of Computational Modeling Software." Additional models, including those with liners, were not analyzed. The internal fuel rod basket was not modeled in the LIBRA analysis; therefore the model does not thermally represent the designed packages.

- Because of the magnitude of these issues and others, the staff cannot comprehensively apply NUREG-1609, "Standard Review Plan for Transportation Packages of Radioactive Materials," in all thermal review areas until they are resolved. The staff identified many technical discrepancies between information presented in various sections in the SAR, and significant thermal and containment design issues that question the fundamental performance of the proposed packages.

Criticality

- AOS did not specify the S (alpha, beta) data for the water. Without the S (alpha, beta) specification, the criticality code (MCNP) used by the applicant will treat a mixture of hydrogen and oxygen as a mixture of free gas rather than a water molecule. Neutrons will interact differently with the gas phases of hydrogen and oxygen than with a water molecule. Preliminary staff calculations show that this will cause the k-effective (k_{eff}) of the uranium-235 cases to increase. In some cases, this value exceeds the k_{eff} limit of 0.95. The applicant will have to repeat all of the criticality calculations with this specification. In many cases the k_{eff} value will increase slightly or not at all and there will be little impact. In some cases, the k_{eff} may not increase above the limit, but the behavior when applied to the sensitivity studies may be different enough to cause different limiting conditions. In other cases, this change may cause k_{eff} to increase above the limit and the applicant may have to make design changes by decreasing the allowed amount of fissile material, or taking credit for geometry aspects, presence of neutron poisons, burn-up, etc.

Chapter 1 General Information

1-1 Make the following editorial revisions:

a) Clarify the location of the shielding material in Figure 1.1. It appears that the shielding "tag" is in the wrong place and the arrow is not pointing to the shielding material.
b) Clarify the values in Table 1-6 by adding a space or two between the numerical value for activity limit and the superscript numeral for the footnote to assure activity limit values are clearly presented and distinct from the footnote.
c) Clarify that "Nuslet Number" should be "Nusselt Number." This is located throughout the SAR.

For consistency and clarity the corrections should be made to the application.

This information is needed to determine compliance with 10 CFR 71.7(a).

1-2 Revise the application to clearly state when the personnel barrier is to be used during shipment of the AOS package. Additionally, revise the application to include a general arrangement drawing showing the design of the personnel barrier, and to include a description of the personnel barrier design in the shielding evaluation (see 3-12).

Section 1.2.1.1, page 1-7, of the SAR states: "To meet temperature and dose rate regulation requirements, a Personnel Barrier structure can be added to the package assembly for certain types of shipments." However, a drawing and description of the personnel barrier are not included in the SAR. Additionally, it is not clear which types of shipments require the use of the personnel barrier.

This information is needed to determine compliance with 10 CFR 71.33.

1-3 Provide support for the upper useable temperature limit of 450°F for the elastomer seal.

Figure 1-2 indicates that the elastomer is EPDM compound. The staff's specification on this material (Specifications Seals Co.) is an upper usable temperature of 300°F.

This information is needed to determine compliance with 10 CFR 71.51(a)(1) and (2), and 71.73(c)(4).

1-4 Revise Table 1-5 of the SAR to include a fissile material decay heat limit for the AOS-100A package.

The "Content" row of this table indicates that this package is designed to transport fissile material, but no decay heat limit is provided for fissile material in this package.

This information is needed to determine compliance with 10 CFR 71.33.

1-5 Either justify or provide an analysis as to why the chosen representative model size is conservative.

There are seven models as presented in Table 1-1, "AOS Transport Packaging System Summary." The application should include seven sets of each NCT and HAC analysis, yet only four were provided - one for each model size. In Table 1-5, "AOS Transport

Packaging System Analyses Summary (continued)," on page 1-19, the thermal analysis was not performed for models AOS-100B, AOS-100A-S, and AOS-165B. There are at least three more models that have not been classified that should be analyzed (i.e., the AOS-025A, AOS-100A, and AOS-165B) which may or may not require a liner to convey certain quantities of radioactive material as stated on page 1-7 in the third paragraph.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

1-6 With regards to Table 1-6:

a) Specify if plutonium is included under the category fissile isotope in, "Activity Limits."
b) Define "U-235 mass equivalent," referenced in footnote 5.
c) Explain what is meant by "Unbounded" and "No Analysis" in the activity limits for various contents.

Section 1.3.2 of the application states that "[t]he criticality evaluation demonstrated that the Model AOS-100A and Model AOS-165A transport packages can transport up to 350 g and 300 g of 100% enriched Pu in solid form, without employing shielding liners or criticality control devices." Table 1-6 does not list plutonium on the isotope list. It is also unclear what is meant by the terms "U-235 mass equivalent" and "Unbound" or "No Analysis" in reference to the activity limits for various package types and radionuclide contents.

This information is needed to determine compliance with 10 CFR 71.33.

1-7 Clarify the discrepancy between Table 1-7, which currently lists AOS-165B as "N/A" regarding a liner and the 3rd paragraph on page 1-7, which states in part that, "[…] the Model AOS-025A, AOS-100A, and AOS-165B transport packages, require the use of a liner to convey certain quantities of radioactive materials."

The application should clearly state when liners are or are not used.

This information is needed to determine compliance with 10 CFR 71.35.

1-8 Specify the compression required on the port and lid sealing O-rings on details K and H of Drawing No. 105E9712, Revision No. 2, sheet 1 of 2.

The drawing does not explicitly state what the compression requirement is on the port and lid sealing O-rings.

This information is needed to determine compliance with 10 CFR 71.73.

1-9 Discuss the specifications of the foam used in the impact limiter, including its density, on Drawing Nos. 105E9713, Revision No. 2; 166D8138, Revision 1; and 105E9722, Revision 1.

The drawings mentioned above specify a FR-3212 foam; no such foam was identified by the staff in the General Plastics Catalogue. This does not correspond with the information presented in the application, which claims the foam is the General Plastics Last-a-Foams FR-3700 series.

This information is needed to determine compliance with 10 CFR 71.73.

1-10 Specify which type of polyurethane foam is used in the impact limiter for the AOS-165.

Drawing No. 1059709, Revision 4, identifies polyurethane foam for the impact limiter but does not specify the type of foam used. The only information presented in the drawing regarding this foam mentions the latest GE specification 2249420 for installation.

This information is needed to determine compliance with 10 CFR 71.43(d) and (f).

Chapter 2 Structural

2-1 Revaluate stress load combinations in Section 2.1.2 to assure they are being evaluated according to the design criteria in Section 2.1.2.

The design criteria for NCT includes $P_m + P_b + Q < 3.0\ S_m$, yet in Tables 2-152, 2-217, and 2-280 this is presented as the stress combination for hypothetical accident conditions of transport.

This information is needed to determine compliance with 10 CFR 71.35.

2-2 With regards to Table 2-3, "Design Criteria," consider the following revisions:
(a) Clarify the meaning of the "stress section" column with the values as shown in the table.
(b) Clarify the temperature values in the table. The columns are not correct as labeled. (i.e., 427°C = 800°F and 85°C = 185°F).
(c) Clarify the meaning of footnotes 1 and 2, as shown in the table.

The table should be revised for clarity and consistency.

This information is needed to determine compliance with 10 CFR 71.35.

2-3 With regards to the thermal expansion coefficient:
(a) Specify the source of the coefficients above 800°F.
(b) Indicate whether instantaneous or average values of the coefficient are stated.
(c) State the exact alloy that the yield strength refers to and provide a reference to the data pages from the most recent ASME Boiler Code.

The ASME Boiler Code Part D only goes up to 800°F. The values in ASME Boiler Code Part D values do not seem to match with either instantaneous or average values of thermal expansion. Additionally, the values of the yield strength in the ASME Boiler Code Part D are close to the values provided by the applicant in Table 2-11 but do not match any particular Type 182- 316 alloy.

This information is needed to determine compliance with 10 CFR 71.7(a) and 71.73.

2-4 Provide evidence of AOS' experience showing that interactions between the designated payloads and similar casks do not occur.

Section 2.2.2 of the application states in part that, "AOS' experience in operating other transport packages with similar arrangements indicate that neither chemical, galvanic, nor other reactions between the cask cavity surface and radioactive material containers,

nor between these containers and their solid contents, occur." A major part of AOS' justification that no chemical, galvanic, or other interactions occur is their experience base with similar systems. To be valid the staff must be able to evaluate the same data and come to similar conclusions.

This information is needed to determine compliance with 10 CFR 71.39.

2-5 State the radiation dose rate at the location of the polymer seal.

Section 2.2.3 of the application states that there is no effect of radiation on the closure and port polymer seals. The staff needs the expected dose rates at the seal position to independently determine if the seals will degrade and/or emit gases.

This information is needed to determine compliance with 10 CFR 71.43(d) and (f).

2-6 Provide the source of data used to determine the stress strain relationship for the impact limiter foam shown in Table 2-58 of the application. Also provide a data source for Poisson's ratio.

The staff could not find the requested data in Table 2-58 in the supplier's data sheets for the indicated foam material.

This information is needed to determine compliance with 10 CFR 71.73

2-7 Clarify the discrepancy in Table 2-63 between the title "Maximum Cavity Pressure Due to Fire Conditions" and footnote 1, "Temperature listed is the maximum value obtained throughout Normal condition of transport events."

For consistency and clarity the corrections should be made to the application.

This information is needed to determine compliance with 10 CFR 71.7.

2-8 Provide summary tables (similar to Tables 2-151, 2-152, 2-216, 2-217, 2-279, and 2-280) reporting the minimum margin of safety related to stress combinations for normal conditions of transport (NCT) and hypothetical accident conditions (HAC) for the AOS-100.

The application should clearly provide and summarize minimum margin of safety for all analysis.

This information is needed to determine compliance with 10 CFR 71.35.

2-9 Re-evaluate all load combinations to ensure Regulatory Guide 7.8 is being properly applied to determine the load combinations.

For example, to create the hot environment load combination for NCT, from the applicant's load cases, the staff should see a combination that includes load cases 102, 201, and 211. The staff does not specifically see that load combination in Tables 2-151, 2-216, or 2-279.

This information is needed to determine compliance with 10 CFR 71.33(b)(3) and 71.43(d).

2-10 With regards to the neutron shielding/absorber material for the Model No. AOS Transportation Packages:

a) Specify the location and properties of the neutron shielding "Boronated WEP/Polyethylene."
b) Provide the dimensions and the tolerances of construction and the structural components that maintain the position of the absorber material within the package.
c) Describe the methodology to qualify the uniformity and durability of the absorber material for the environmental conditions of service. Also describe the methodology for measuring the material's absorption coefficient.
d) Provide data sheets on the absorber material.

Without additional information the staff is unable to assess the expected behavior and interactions of this absorber material.

This information is needed to determine compliance with 10 CFR 71.47.

2-11 Describe the material and form of the container that will hold the various contents within the cask cavity.

The extent of interaction of the contents can not be assessed without knowing the container material.

This information is needed to determine compliance with 10 CFR 71.33(b)(3) and 71.43(d.)

Chapter 3 Thermal

3-1 Verify that "cask component" should be "impact limiter" in Section 3.1.

The first paragraph, fourth sentence, in Section 3.1 reads, "[t]he cask component consists of a thin-walled cylindrical shell, with a flat disk at one end and a dish head at the other end." For consistency and clarity the corrections should be made to the application.

This information is needed to determine compliance with 10 CFR 71.7.

3-2 Review all unit conversions in the entire application and associated analysis files and correct and report any discrepancies found.

In Table 3-1, “AOS Transport Packaging System Summary,” the unit conversion from Watts to BTU/hr is incorrect. The staff would recommend placing the “Watts” label over the Watts column for easier understanding.

This information is needed to determine compliance with 10 CFR 71.33(b)(7).

3-3 Clarify the discrepancy in decay heat values taking note of the following:

a) The decay heat values in BTU/hr in Table 1-5, “AOS Transport Packaging System Analyses Summary,” do not match the values in Table 3-1, “AOS Transport Packaging System Summary.”
b) The decay heat value for the AOS-050A in Table 3-1, “AOS Transport Packaging System Summary,” (100 Watts) does not match the decay heat value for the AOS-050A in Table 1-5, “AOS Transport Packaging System Analyses Summary” (200 Watts).

The application needs to use the maximum decay heat in the thermal analyses.

This information is needed to determine compliance with 10 CFR 71.33(b)(7).

3-4 Verify that the values in Table 3-3 are for the AOS-025A, AOS-050A, AOS-100A, and AOS-165A, as opposed to the models currently listed in the table.

The application needs to clearly state which models are associated with which thermal results.

This information is needed to determine compliance with 10 CFR 71.35.

3-5 Clarify the discrepancy between the following decay heat values:

a) Table 3-4, “Transport Package Temperature Summary (Continued),” on page 3-6, footnote 3, “Maximum Decay Heat of 2.5 kW.”
b) Table 3-1, “AOS Transport Packaging System Summary,” for the AOS-165 which is 1,500 Watts.
c) Table 1-5, “AOS Transport Packaging System Analyses Summary,” for the AOS-165 which is 1.2 kW.
d) Section 5.2.1.3.2, the decay heat, 1,200 g source = 1,051 Watts.

The staff needs to be assured the maximum decay heat is being used in the analysis.

This information is needed to determine compliance with 10 CFR 71.33(b)(7).

3-6 Provide references for the seal temperature limits stated in Table 3-4, “Transport Package Temperature Summary.” If references are not available (due to the references being a proprietary test report or other non-public document) provide a copy of the reference cited.

The staff must have reasonable assurance that the thermal limits provided for seal performance are based on sufficient testing and data. The limits listed in Table 3-4 are not referenced. Table 3-4 indicates, for example, that the limit for the metallic helicoflex seals used in the AOS-165 with a 7 kW heat load is 800°F. This does not agree with the maximum service temperatures reported by the seal manufacturer.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

3-7 Describe the effects of exceeding the seal temperature limit for the AOS-165 package with the 2.5 kW decay heat load, as indicated in Table 3-4, “Transport Package Temperature Summary,” page 3-6, for the “Cask Seal Area.”

Exceeding temperature limits of seals may lead to seal failure. Performance of the package seals must be demonstrated for the duration of package transportation.

This information is needed to determine compliance with 10 CFR 71.73.

3-8 Describe the effects of exceeding the cask cavity limit for the AOS-165 package with the 7 kW decay heat load, as indicated in Table 3-4, “Transport Package Temperature Summary,” for the “Cask Cavity.”

Exceeding the temperature limit of the cavity may lead to cask failure or material damage. Performance of the package must be demonstrated for the duration of package transportation.

This information is needed to determine compliance with 10 CFR 71.73.

3-9 Describe the effects of exceeding the cask test port temperature limit for the AOS-165 package with the 2.5 kW decay heat load, as indicated in Table 3-4, “Transport Package Temperature Summary,” for the “Cask Test Port.”

Exceeding temperature limits of the cask test port may lead to failure.

This information is needed to determine compliance with 10 CFR 71.73.

3-10 Clarify that the units in Table 3-6 for Specific Heat, which are “KT/(kg-°C),” should be “KJ/(kg-°C).”

For consistency and clarity the corrections should be made to the application.

This information is needed to determine compliance with 10 CFR 71.7.

3-11 Provide temperature values for all components that affect structural integrity, containment, shielding, and criticality for both NCT and HAC.

The application needs to clearly state all component temperatures that affect structural integrity, containment, shielding, and criticality for both NCT and HAC.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

3-12 Provide a clear description of which packages and under which conditions personnel barriers are required for shipment. Clearly describe which shipments will be made as "exclusive use" and which will not. Additionally, for exclusive use shipments demonstrate that the surface of the personnel barrier remains below 185°F for NCT. Similarly, for non-exclusive use shipments demonstrate that the accessible package surfaces or personnel barrier surfaces remain below 122°F (see 1-2).

This information is needed to determine compliance with 10 CFR 71.43(g).

3-13 Either reference or provide Table 2-63, "Maximum Cavity Pressure Due to Fire Conditions, in Section 3 of the application.

This information is needed to determine compliance with 10 CFR 71.35.

3-14 Incorporate pressure values in Table 4-6, "Model AOS-100 and AOS-165 Transport Package Fission Gas Inventory and Resulting Pressure," into Chapter 3.

This information is needed to determine compliance with 10 CFR 71.35.

3-15 Provide further description as to how pressure values were calculated in Table 3-3, "Transport Package Pressure," as well as a sample calculation.

It is not clear from the information presented in the SAR how the pressure values were calculated for NCT.

This information is needed to determine compliance with 10 CFR 71.71.

3-16 Provide references for all material properties and equations used in the analysis. For example, references are not given for the following (this is not a comprehensive list):

a) Section 3.2.1.1, Table 3-5 "Tungsten Thermophysical Properties"
b) Section 3.2.1.2, Table 3-6 "Stainless Steel (SS304) Thermophysical Properties"
c) Section 3.2.1.3, Table 3-7 "Air Thermophysical Properties"
d) Section 3.2.1.4, Table 3-8 "Last-A-Foam Thermophysical Properties"
e) Section 3.2.1.4, Table 3-9 "Transport Package Foam Density"
f) Section 3.3.1, page 3-12, third paragraph, packed stainless steel wool thermal properties (or the assumption that they are 10% of SS304)
g) Section 3.3.1.3, Table 3-13 "Polynomial Coefficients Used in Equivalent Convective Property of Ambient Temperature and External Surface"

The applicant should reference all material properties used in the application.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

3-17 Confirm that the minimum allowable service temperature of all components is less than or equal to -40°C (-40°F) as referenced in Section 3.2 of the application.

The application needs to allow for verification that all components are able to withstand -40°C (-40°F).

This information is needed to determine compliance with 10 CFR 71.35.

3-18 Confirm that all equations provided for material properties produce results in the provided tables. Provide units of temperature if temperature is an input value in a given equation.

The staff tried to reproduce the Prandtl Number for air from Table 3-7, "Air Thermophysical Properties," using the given equation and with all possible units of input for temperature without success.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

3-19 With regards to the information provided in Table 3-8:

a) Explain why Last-A-Foam thermophysical properties are given for FR-3706, FR-3712, and FR-3718.
b) Provide the reference used to determine the conductivity values for FR-3710 and FR-3720.

It is not clear to the staff why thermophysical properties were provided for FR-3706, FR-3712, and FR-3718 when they were not used in the models mentioned in the application. Additionally, the conductivity values for FR-3710 and FR-3720 do not agree with the values provided in the "Design Guide for Last-A-Foam FR-3700 for Crash & Fire Protection of Radioactive Material Shipping Containers."

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

3-20 Re-evaluate the tungsten material properties in Table 3-5 (i.e., density, specific heat, conductivity).

The values given in Table 3-5 do not match values found in MATPRO NUREG/CR-6150 Volume 4, Revision 2.

This information is needed to determine compliance with 10 CFR 71.35.

3-21 Provide the absorptivity for SS304 during NCT in Section 3.2.1.2 (i.e., the outer surface absorbing insolation).

The application should contain the thermal absorptivity values for all outer surfaces.

This information is needed to determine compliance with 10 CFR 71.71.

3-22 Rewrite the following statement in Section 3.2.2, "[o]ther package materials used are stainless steel and tungsten. The melting points of these materials are 1,430°C (2,606°F) and 3,370°C (6,098°F), respectively. All temperatures resulting from Normal and Accident thermal conditions fall within these temperatures."

This statement could be interpreted to mean that melting points are acceptable temperature limits for NCT when they are not acceptable limits.

This information is needed to determine compliance with 10 CFR 71.71.

3-23 With regards to Section 3.3.1, "Analytical Model:"

a) Provide a comprehensive discussion of the development of analysis models for the NCT and HAC analyses of the package in Section 3.3.1. Include descriptions of the analysis methodology and development of analysis inputs. In addition, analysis input and output files should be provided, with sufficient description of the content of these files.

(b) Provide documentation that describes the validation or benchmarking of the LIBRA code for thermal analysis of radioactive material packages.

Guidance on what information should be provided is available in Interim Staff Guidance (ISG) 21, "Use of Computational Modeling Software," (ADAMS Accession # ML061080669).

This information is needed to determine compliance with 10 CFR 71.35.

3-24 Provide a copy of the reference [3.10], *Heat Transfer Data Book*, in Section 3.5, cited for the value of a thermal contact resistance (0.03 hr-in^2 °F/BTU). Alternatively, a portion of this reference including a relevant discussion of the source of the contact resistance value may be submitted.

The staff requires a clear explanation and discussion of values used for contact resistances in the analyses models of the package.

This information is needed to determine compliance with 10 CFR 71.35.

3-25 Provide descriptions, including drawings, of the internal basket assemblies used in the various designs in Section 3.3.1. Describe how the payload will thermally interact with the internal surfaces of the inner canister

The assumption that the heat on internal surfaces is evenly distributed may not be conservative. The temperature distribution within the inner cavity will be dependent on the arrangement of the contents. While the overall decay heat generated may be represented, the distribution of this heat load is not captured by applying it uniformly on the inner surface of the canister. The staff requires reasonable assurance that the decay heat generated by the contents is appropriately modeled in relation to the interior of the package.

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

3-26 Provide a direct comparison of the thermal test results and the NCT analysis models. Highlight any differences between the results of the experiments and the analyses and provide explanations of any differences between the two. Describe how the experiments provide a validation of the analysis models developed.

The staff recommends that all methods used for analysis of a package design be validated with experimental data. A comparison of the thermal test conducted and the analyses results would provide reasonable assurance that the analyses methods employed in the application are sound.

This information is needed to determine compliance with 10 CFR 71.35.

3-27 Provide a reference for:

a) oxidized SS304, emissivity = 0.52, mentioned in Section 3.3.1.2, on page 3-18, and,
b) the emissivity value of 0.20 stated for the cask's outer surface in Section 3.3.1.3, page 3-21.

The applicant should reference all materials properties used in the SAR.

This information is needed to determine compliance with 10 CFR 71.35.

3-28 Clarify why each of the surfaces listed in Table 3-12, "Cask Assembly External Surface Orientation and Size," have length and width dimensions that are equal.

The staff would like clarification regarding the length and width dimensions listed in Table 3-12 to ensure that the proper dimensions are being used to calculate the cask assembly external surface size.

This information is needed to determine compliance with 10 CFR 71.35.

3-29 Clarify the statement in Section 3.3.1.3.4, "[i]n the evaluation, the values averaged over a 12-hour period in a steady-state solution."

Based on the above statement, it is not clear to the staff how the solar heat load is applied.

This information is needed to determine compliance with 10 CFR 71.71(c)(1).

3-30 Reevaluate the maximum temperatures provided in Section 3.3.4 for NCT, page 3-25, and HAC, page 3-46. This applies to all AOS models.

It appears that samples of nodes were chosen from the analysis and then the temperature of those nodes was monitored to provide maximum temperatures. The staff has not been assured that maximum temperatures have been provided for package components based upon the entire set of nodes.

This information is needed to determine compliance with 10 CFR 71.35.

3-31 Provide a summary of the results of thermal stress evaluation under NCT and HAC in Sections 3.3 and 3.4, respectively.

The application should include an evaluation of thermal stresses caused by constrained interfaces among package components resulting from temperature gradients and differential thermal expansion. This should be provided for normal conditions and transport and hypothetical accident conditions of transport.

This information is needed to determine compliance with 10 CFR 71.71 and 71.73.

3-32 Provide the heat transfer coefficient used for the convective heat input to the package for the HAC analysis.

In Section 3.4, page 3-43, the convective heat input to the package for the HAC condition is described as “based on still ambient air” when the fire environment is actually characterized as turbulent with hot gasses driven by the combustion process. A convective coefficient for HAC analyses should take the presence of combustion-driven gas flow into account.

This information is needed to determine compliance with 10 CFR 71.73(c)(4).

3-33 Provide either a summary, table, or a graph of the maximum component temperature performance against the time at which they occur after the fire in Section 3.4.

The application should provide a summary of the maximum component temperature performance against time performance of all the packages analyzed in Section 3. If a graph is provided, the figures should contain a meaningful legend that lists the components of interest for the package design.

This information is needed to determine compliance with 10 CFR 71.73.

Chapter 4 Containment

4-1 Provide a list of the ASME Boiler and Pressure Vessel Code requirements that are met by the AOS series of packages.

Section 4.1.1 states, “[…]containment vessel and cask meet the ASME Boiler and Pressure Vessel Code requirements.” This statement is vague and more specificity is needed.

This information is needed to determine compliance with 10 CFR 71.31(b).

4-2 Clarify Figure 4-2 by providing a clearer representation of what component is being featured in the figure.

Placing the detail in the context of location on a representation of a complete package may add additional clarity.

This information is needed to determine compliance with 10 CFR 71.31(b).

4-3 Provide additional explanation of the placement of the seals using four small screws, as mentioned on page 4-5.

It is unclear from the application whether or not the use of screws to secure the seals is a standard configuration.

This information is needed to determine compliance with 10 CFR 71.31(b).

4-4 Correct the reference to Table 3-2 in Section 4.3, page 4-8.

Section 4.3 states: "Temperatures at the lid seal and port cover seals are also below the temperature criteria for the applicable seal material listed in Chapter 3, Table 3-2, 'Transport Package Thermal Environment Conditions,' on page 3-3." Table 3-2 does not contain the information stated.

This information is needed to confirm compliance with 10 CFR 71.31(b).

4-5 Provide additional details on the leakage rate test described in Section 4.4.

The description of the leakage rate test done on the AOS packages does not provide any specific information or results. A discussion of how the leak test demonstrates that all the different AOS packages will remain leak tight under all loading configurations should be included. If the AOS packages were tested to demonstrate that it is leak tight in accordance to ANSI N14.5, further description of how the package was tested and what the results were are needed.

This information is needed to confirm compliance with 10 CFR 71.31(b).

4-6 Provide a description of how the test provided for the seals in Appendix 4.5 demonstrates how the seals installed on the AOS packages allow those packages to meet the ANSI N14.5 leaktight criteria.

It is not clear how the test flange used in the helium leak test is representative of the AOS cask design closure, and if the seals tested are representative of the seals that will be utilized for the AOS packages.

This information is needed to confirm compliance with 10 CFR 71.31(b).

4-7 Justify the validity of the test and new higher seal temperature limits for the Garlock Helicoflex metallic seals in the AOS-165 for the highest 7kW heat load (Section 4.5.1).

The seal temperature limit is specified as 800°F (Tables 2-3 and 3-4 of the application) while the manufacturer limit is 536°F. It appears that the seal was tested in a mock-up configuration at 800°F, and demonstrated a maximum leak rate of 2.2×10^{-7} cc/sec when the acceptance criterion was 2.4×10^{-7} cc/sec. The test duration was stated as three minutes in Table 1 in Section 4.5.1. It is possible that, had the test duration been longer, the seal could have leaked greater than the acceptance criteria. Stating that the seal temperature limit is 800°F, based on the tests conducted, is not correct, and would not be supported by the seal manufacturer.

This information is needed to determine compliance with 10 CFR 71.45(f).

4-8 Provide a basis for the amount of fission gas available to be released from the spent fuel to the transport cavity as quoted in Table 4-6.

Since neither the amount of spent fuel, nor its characteristics are given, the staff could not verify the values given. This information is needed to determine if the cavity will pressurize.

This information is needed to determine compliance with 10 CFR 71.51(2).

4-9 Either describe the effects of exceeding the design pressure limit for the AOS-100A-S when transporting spent fuel or state that you will not be using the AOS-100A-S to transport spent fuel.

Table 4-6 states the pressure from fission gas inventory and the resulting pressure for the AOS-100 is 15.37 atm (the staff converted that to 1557 kPa). This value alone, excluding pressure from heated air in the cavity, exceeds the design pressure in Table 2-1, which states that the design pressure limit for the AOS-100A-S is 517 kPa. Additionally, Table 1-6 on page 1-24, states that fissile material will be placed in the AOS-100A.

This information is needed to determine compliance with 10 CFR 71.73.

4-10 Describe the effects of exceeding the design pressure limit for the AOS-165 when transporting spent fuel.

Table 4-6 states the pressure from fission gas inventory and the resulting pressure for the AOS-165 is 13.57 atm (the staff converted that to 1375 kPa). The pressure from the fission gas inventory along with the pressure from the HAC heated air (Table 2-63: 235 kPa) is 1610 kPa which exceeds the design pressure in Table 2-1, which states that the design pressure limit for the AOS-165 is 1517 kPa. Additionally, Table 1-6 on page 1-24, states that fissile material will be placed in the AOS-165A.

This information is needed to determine compliance with 10 CFR 71.73.

Chapter 5 Shielding

5-1 Explain and elaborate the details and structure of the fuel rod basket.

Section 5.2.2.2 of the SAR states, “[t]he cask is modeled to include the fuel rod basket, and uses the densities and material properties presented in Table 5-26, along with the standard cask assembly.” This is the only instance where the fuel rod basket is described as an integral structural component within the cask. It is not clear to the staff, which among the seven different models contains this fuel rod basket. Explain how the fuel rod basket, if used, was modeled. Also, explain how its independence and structural integrity was maintained within the cavity. Elaborate on how the interaction effects during the required drop scenarios for both NCT and HAC were evaluated.

This information is needed to determine compliance with 10 CFR 71.33, 71.71, and 71.73.

5-2 Provide references to support the tungsten data in Table 3-5 and the tungsten density in Table 5-3, 5-29.

According to the CRC Handbook, the density of tungsten is 19.13 g/cc not 18.11 g/cc. The specific heat in the table is 20% higher than MATPRO and the conductivity is 60% lower than that in MATPRO at the same temperatures. Correct information is needed as input to the shielding and thermal calculations. The staff could not find values of the diffusivity.

This information is needed to determine compliance with 10 CFR 71.7(a) and 71.47.

5-3 Either revise Section 5.0 to specifically evaluate liquid radioactive contents or revise Table 1-5 to delete the reference to liquid contents for the AOS-025A and AOS-050A packages or specifically valuate liquid radioactive contents in the criticality evaluation.

The shielding evaluation in Section 5.0 evaluates the contents either as a point source or as a uniformly distributed source throughout the package cavity. Table 1-5 states that the form of the contents for the AOS-025A and AOS-050A packages may be liquid, in which case the contents could potentially relocate in a region of the package to cause a much higher external dose rate, e.g., the seal region or in a corner where streaming through the axial and radial shields is more likely. The application should be revised to either 1) demonstrate that relocated liquid contents will not result in a dose rate exceeding those specified in 10 CFR 71.47; 2) demonstrate that liquid contents will not relocate such that the source geometry assumed in the calculation is invalid; or 3) remove liquid contents as an allowable form in Table 1-5.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

5-4 Revise Table 5-4 and the associated analysis in Section 5.0 to justify the source geometry used in the external dose rate determination.

It is not clear that the source geometries identified in Table 5-4 for the various analyses are the most limiting for the package. The contents may be able to relocate under NCT and HAC into a position in the package to produce a higher external dose rate than for contents centered within the shielding of the package. The analysis should either demonstrate that relocated contents will not result in an external dose rate higher than those specified in 71.47 and 71.51, or that the various contents to be shipped will not relocate under NCT and HAC.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

5-5 Revise the application to clearly state which contents are to be shipped in which package.

Tables 5-4 through 5-9 of the application list the source strength assumed for each of the radiation shielding evaluations performed for the AOS system (the accompanying proposed wording for the CoC, however, only gives a decay heat limit for the contents), which is not a sufficient limit to describe the contents evaluated in the application (if AOS decides to submit proposed wording for the CoC it should include a table, similar to Tables 5-4 through 5-9 of the application, which will appropriately limit the allowable contents of the package).

This information is needed to determine compliance with 10 CFR 71.33.

5-6 Revise the shielding evaluation in Section 5.0 to discuss the adequacy of the margins on regulatory radiation dose rate limits calculated for each of the contents.

Tables 5-4 through 5-9 of the SAR give calculated external dose rates for each content to be shipped in the AOS system. Some of the dose rates are equal to or very near the allowable external dose rates specified in §71.47, leaving little or no margin for calculation uncertainties. The shielding evaluation should be revised to either show that the margins included in the analysis are appropriate given the level of conservatism in the calculation, or reduce the allowable contents to provide additional margin on the allowable external dose rates.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

5-7 Revise the application to include drawings and descriptions of the package cavity shielding inserts to be used for various contents.

Tables 5-4 through 5-9 state that, for certain contents, additional cavity shielding inserts are required to meet external dose rate limits. The application should be revised to include a description of these inserts, including drawings and a clear indication of which contents require the inserts.

This information is needed to determine compliance with 10 CFR 71.33.

5-8 Revise Section 5.0 of the application to clarify the bounding energy spectra used in some parts of the shielding analysis.

Tables 5-4 through 5-9 include comments that for some contents, the gamma energy spectrum for a different content was used in the shielding analysis, because it was determined to be bounding. The shielding evaluation should be revised to include a discussion of how each gamma energy spectrum was determined to be bounding, and how this source term was used to model different contents.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

5-9 Revise the shielding evaluation of Section 5.0 to adequately describe the fissile material contents to be transported in the AOS package system.

It is not clear if the 400 g and 1,200 g ^{235}U limits specified in the analysis, in Tables 5-10 and 5-11, respectively, are pre- or post-irradiation. Additionally, it is not clear if the 4% enrichment assumed in the analysis is intended to be a minimum limit for the package. If the package is intended to ship ^{235}U enriched to less than 4%, this material will have to be evaluated in the shielding analysis. Additionally, it is not clear if the package is intended to ship fuel types other than GE14. The application should be revised to either: 1) state that the package is only intended to ship GE14 fuel; 2) show that GE14 fuel bounds the other spent fuel contents to be shipped with respect to shielding; or 3) evaluate all spent fuel contents to be shipped in the package.

This information is needed to determine compliance with 10 CFR 71.33.

5-10 Revise the application to justify all depletion parameters used to determine the spent fuel composition of the fissile material contents.

Section 5.2.1 state that the composition was determined assuming GE14 fuel at 4% ^{235}U enrichment, irradiated for 3,872 days, but does not discuss the basis for using these parameters. Additionally, the shielding analysis should be revised to justify the specific power assumptions given in Table 5-12.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

5-11 Revise the application to justify the use of the ORIGEN-2 depletion code for determining the contents radiation source terms.

The ORIGEN-2 isotopic depletion code is no longer supported by the code developer and is no longer the industry standard for such calculations. Any use of this code should be thoroughly benchmarked against actual isotopic assay data from spent nuclear fuel.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

5-12 Revise the application to justify the use of the spontaneous fission energy spectrum for ^{244}Cm in the MCNP model, as opposed to the energy spectrum provided by the depletion code.

The application should justify that the energy spectrum used in the external dose calculation is conservative with respect to the external doses calculated.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

5-13 Provide a list of components in the model, the absence of which provides a more conservative dose estimate.

Page 5-1 of the application states, “the absence of other components in the model provides a more-conservative dose estimate.” However, there is no further information about these other components.

This information is needed to determine compliance with 10 CFR 71.33.

5-14 Clarify the inconsistency of the dimensions for the cavity shown on Table 5-1 and the technical drawing for the models AOS-025, AOS-050, and AOS-165.

On Table 5-1 of the application, the applicant states that the half-height of the cavity for Models AOS-025, AOS-050, and AOS-165 are 2.50 inches (full-height 5.00 inches), 5.00 inches (full-height 10.00 inches), and 16.50 inches (full-height 33.00 inches), respectively. However, Drawing Nos. 166D8143, 105E9718, and 105E9707 show full height measurements for the cavity as follows: 4.65 inches for the AOS-025, 9.92 inches for the AOS-050, and 32.76 inches for the AOS-165.

This information is needed to determine compliance with 10 CFR 71.33.

5-15 Clarify how a geometrical source with a diameter of 1.1 cm could fit into a tungsten liner with an inner diameter of 0.4 inch (1.01 cm).

Table 5-4 states that for the Model AOS-025, a source of Ir-192 with a cylindrical geometry has 1.1 cm diameter. This source is placed into a tungsten liner. However, Drawing No. 183C8485 shows that the diameter of the tungsten liner is about 0.4 inch (1.01 cm).

This information is needed to determine compliance with 10 CFR 71.33.

5-16 Clarify how a tungsten liner with a full-height of 4.9 inches could fit into the cavity of the Model AOS-025 with a full-height of 4.65 inches.

Drawing No. 183C8485 shows that the height of the tungsten liner is about 4.9 inches. However, Drawing No. 166D8143 shows that the cavity has a height of 4.65 inches.

This information is needed to determine compliance with 10 CFR 71.33.

5-17 Revise the application to clarify which flux-to-dose conversion factors were used to obtain the gamma dose. Additionally, provide a table of these factors in the shielding analysis of Section 5.0.

Page 5-43 states that ANSI/ANS 6.1.1 was used for flux-to-dose conversion factors for gammas (Reference 5.6). However, Reference 5.6 on page 5-207 states that the conversion factors are dated 1972. Flux-to-dose conversion factors should be based on ANSI/ANS 6.1.1-1977.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

5-18 Clarify the total of the neutron source presented in Table 5-13 for 64 GWd/MTU burned fuel.

Table 5-13 of the application notes that the total neutron source for 64 GWd/MTU burned fuel is given as 6.16E+08 n/s; however, plotting that number on the graph presented on Figure 5-3 gives a different curve and power trend line equation.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

5-19 Provide the MCNP input file and output file for the shielding calculations for the bounding fissile material cases.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

5-20 Revise the application to specify how many pin slots are used for the Model AOS-165.

Page 5-34 states that the inner five (5) pin slots are used for the Model AOS-100 transport package design. However, there is no further information about how many pin slots are used for the Model AOS-165.

This information is needed to determine compliance with 10 CFR 71.47 and 71.51.

Chapter 6 Criticality

6-1 List any other materials that will be present in the casks with fissile material.

The staff is particularly interested in any materials that may act as a moderator. The description of the materials is necessary to evaluate the extent of reflection, the amount and identity of non-fissile materials used as neutron absorbers or moderators, and the atomic ratio of moderator to fissile constituents.

This information is needed to determine compliance with 10 CFR 71.33.

6-2 Either identify any established codes and standards used, or provide justification for formulating the criticality design and control.

The application must identify the established codes and standards used for the criticality design.

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

6-3 Describe which aspects of the material or geometry (i.e., pitch, mixture height or water density, etc.) change when varying the water-to-fuel (W/F) ratio for the heterogeneous and mixed homogenous/heterogeneous cases. Also provide the results demonstrating the most reactive W/F ratio for the heterogeneous and mixed homogeneous/heterogeneous cases.

Tables 6-8 and 6-9 of the application show the various W/F ratios used for these cases. Other cases use 5 and 6 for the W/F ratio for the AOS-100A and AOS-165 (models A and B), respectively. The staff assumes it is because these are the most reactive scenarios but cannot conclusively make this determination based on the information provided. The staff requires the above information to determine that the maximum reactivity of the system has been evaluated.

This information is needed to determine compliance with 10 CFR 71.55(b)(1).

6-4 Clarify the statement in Section 6.6.1.1, Case 3, of the application, which makes a reference to U-235. This statement is inconsistent with the calculations performed on the Model No. AOS-100A since U-235 is not discussed in any of the calculations.

Section 6.6.1.1 of the application lists the most limiting configurations used for the determination of thickness and density of the reflector surrounding each package. Under Case 3 for the AOS-100A the application states: "200 g of U-235 in LWR fuel in a homogeneous solution with an H/U-235 ratio of 800 and 1,000 g of U-235 in LWR fuel in a heterogeneous square lattice with a W/F ratio of 6." The staff believes that this statement is in error as this amount of U-235 is not listed in any of the preceding discussions for the calculations performed on AOS-100A. Please confirm if this is an error. If so, provide the limiting conditions for Case 3 for the AOS-100A.

This information is needed to determine compliance with 10 CFR 71.7(a) and 71.55(b).

6-5 Provide additional information on the benchmark calculations used for MCNP4 for use in the AOS system criticality evaluations.

Section 6.7 of the application lists the cases used to benchmark MCNP4 for use in the AOS system criticality evaluations. Provide Reference 6.2, in Section 6.9 of the application, NEDO-32028, "MCNP – Light Water Critical Benchmarks," March 1992. In addition provide additional information regarding the "internal study" mentioned in Section 6.7.2.3 when discussing the bias determination for "Case 3."

This information is needed to determine compliance with 10 CFR 71.31(a)(2) and 71.35.

6-6 Please clarify if the axial and radial shield is made of the same material.

The drawings seem to indicate that the radial and the axial shield are made of different materials; however Section 1.1 of the application states that the A and B designation for the cask labels refers to the shielding material and does not state that this is specific for the axial or radial shield.

This information is needed to determine compliance with 10 CFR 71.7(a).

6-7 Provide the exact conditions used to perform the calculations for criticality cases in Tables 6-3 through 6-5.

Although the application provides a discussion on certain parameters' effects on criticality, it is also not clear as to the exact conditions used when determining the limiting k-eff for the various cases. Specifically the staff needs:

a) final thickness and density of the water used as a reflector for the single package evaluations
b) distance between packages, and density of the water used as interspersed reflection for the array evaluations
c) dimensions of the mixture within the cavity.
d) H/fissile ratio of the homogeneous mixtures and the W/F ratio for the heterogeneous cases.
e) lattice (square or hexagonal) for the heterogeneous cases.

This information is needed to determine compliance with 10 CFR 71.7(a).

6-8 Provide representative output files for the AOS-165 and AOS-100 limiting criticality calculations.

This information was not provided in the application. The staff reviews the output files to ensure that the code was properly converged and that the calculated multiplication factors from the output files agree with those reported in the evaluation.

This information is needed to determine compliance with of 10 CFR 71.7 and 71.55(b).

6-9 Provide additional information on the use of the term “equivalent mass” in the proposed wording of the CoC. Address the possible non-conservatisms when substituting Pu-239 “equivalent mass” for U-235. Provide the definition of “equivalent mass” for Pu-239.

The analyses provided show that for the AOS-100A that an “equivalent mass” of Pu-239 can give higher k-eff than the U-235 case. Although the staff understands that the cases will have different optimum H/fissile ratios, there exists a possibility for an un-analyzed non-conservative mixture. The staff also notes that using the “equivalent mass” calculation for the AOS-165, the Pu-239 “equivalent mass” may exceed that of the 350 g limit.

This information is needed to determine compliance with 10 CFR 71.33(b)(2) and 71.55(b).

6-10 Provide additional information on the specific form and amount of the material that will be shipped in the Model No. AOS-165. Justify that the form of uranium analyzed is the most conservative for the contents that are to be transported. Explain how the integrity will be controlled.

The proposed wording for the CoC provided by AOS states that multiple forms of special nuclear material (including metal) are to be transported in the AOS systems. Although the analyses cover up to 100% enriched U-235 metal, the proposed wording for the CoC limits this to 5 weight percent enriched. The maximum analyzed amount of uranium metal and metal alloy is 600 g. The analyses supporting the 1200 g U-235 in UO_2 assume some integrity of the form of the material. Since the proposed wording in the draft CoC conflicts with the analysis, the staff is unsure as to what the intended contents of the package are.

This information is needed to determine compliance with 10 CFR 71.33(b)(2).

6-11 Provide the heights that were used in the calculations for each of the H/fissile ratios. Explain how you determined the density of the mixture for the homogeneous regions and justify that it is conservative.

Page 6-8 of the application states, “the mixture’s height was varied depending upon the H/fissile ratio, and whether the solution is centrally located within the cask cavity.” The staff does not know how this was done and would like to verify that it is conservative.

This information is needed to determine compliance with 10 CFR 71.55(b).

6-12 Justify the treatment of hydrogen as a free gas in the MCNP calculations.

The staff has reviewed the MCNP input decks submitted in the Appendix to Section 6 of the application. The MCNP input decks show that the hydrogen and oxygen mixture are being treated as a free gas. Staff independent calculations show that when specifying the S(α, β) data for the water phase (i.e., "ltwr" card) in the materials section that the k-effective results increase by about 2 - 3% and in some cases the result is higher than 0.95.

This information is needed to determine compliance with 10 CFR 71.55.

Chapter 7 Package Operations

7-1 Provide operating procedures on the loading and unloading of the cask contents.

Operating procedures are necessary to assure the package will be operated in a manner consistent with the staff's evaluation for approval. Include any special steps necessary to ensure safety of the personnel and non-combustibility of the contents.

This information is needed to determine compliance with 10 CFR 71.127.

Chapter 8 Acceptance Tests and Maintenance Program

8-1 Describe what is meant by "referee testing" for the sensitization test in Table 8-2.

The staff does not have experience with this procedure. Clarify using standard recognized terminology.

This information is needed to determine compliance with 10 CFR 71.7(a).

8-2 Indicate how the crush strengths in Table 8.6 were obtained.

Using data in the General Plastics Manufacturing Co. Design Guide for the use of Last-A-Foam FR-3700, page 11, the staff could not duplicate the stresses stated in Table 8.6.

This information is needed to determine compliance with 10 CFR 71.35.

8-3 Provide additional details on the leakage rate test described in Sections 4.4 and 8.1.4.

Section 4.4 states, "[t]he leakage rate test for Type B package is performed by pressurizing the cavity of the cask to 15 to 17 psia with helium[…]" Section 8.1.4 states, "[t]he assembled cask is leak-tested by pressurizing the cavity to 15 psig with helium." It is not clear to the staff what pressurization the cavity is subjected to for the helium leak test.

This information is needed to determine compliance with 10 CFR 71.31(b).