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AFFIDAVIT PURSUANT TO 10 CFR 2.790

Craig Seaman (Affiant), Senior Vice President of NAC International, 3930 East Jones Bridge Road, Norcross, Georgia 30092, being duly sworn, deposes and says that:

1. Affiant has reviewed the information described in Item 2 and is personally familiar with the trade secrets and privileged information contained therein, and is authorized to request its withholding.

2. The information sought to be withheld is the following NAC International calculation package in support of the NAC-UMS® Universal Transport Cask submittal, which is being transmitted with NAC Letter No. ED20020530:

   - Calculation Package, EA790-3012, Revision 0, "Evaluation of Film Coefficient for UMS Transport Cask in a Horizontal Position."

   NAC International is the owner of this information; the information is considered proprietary to NAC International.

3. NAC International makes this application for withholding of proprietary information based upon the exemption from disclosure set forth in: the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4) and the Trade Secrets Act, 18 USC Sec. 1905, and NRC Regulations 10 CFR Part 9.17(a)(4), 2.790(a)(4), and 2.790(b)(1) for "trade secrets and commercial financial information obtained from a person, and privileged or confidential" (Exemption 4). The information for which exemption from disclosure is here sought is all "confidential commercial information," and some portions may also qualify under the narrower definition of "trade secret," within the meaning assigned to those terms for purposes of FOIA Exemption 4.

4. Examples of categories of information that fit into the definition of proprietary information are:

   a. Information which discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by NAC's competitors without license from NAC International constitutes a competitive economic advantage over other companies.

   b. Information which, if used by a competitor, would reduce their expenditure of resources or improve their competitive position in the design, manufacture, shipment, installation, assurance of quality or licensing of a similar product.

NAC INTERNATIONAL
AFFIDAVIT PURSUANT TO 10 CFR 2.790
(continued)

c. Information which reveals cost or price information, production capacities, budget levels or commercial strategies of NAC International, its customers, or its suppliers.

d. Information which reveals aspects of past, present or future NAC International customer-funded development plans and programs of potential commercial value to NAC International.

e. Information that discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in Items 4a, 4b, and 4d.

5. The information sought to be withheld is being transmitted to the United States Nuclear Regulatory Commission (NRC) in confidence.

6. The information sought to be withheld, including that compiled from many sources, is of a sort customarily held in confidence by NAC International, and is, in fact, so held. This information has, to the best of my knowledge and belief, consistently been held in confidence by NAC International. No public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in Items 7 and 8 following.

7. Initial approval of proprietary treatment of a document is made by the Project Manager and/or the Director of Licensing, the persons most likely to know the value and sensitivity of the information in relation to industry knowledge. Access to proprietary documents within NAC International is limited via "controlled distribution" to individuals on a "need to know" basis. The procedure for external release of NAC proprietary documents typically requires the approval of the Project Manager based on a review of the documents for technical content, competitive effect and accuracy of the proprietary designation. Disclosures of proprietary documents outside of NAC International are limited to regulatory agencies, customers and potential customers and their agents, suppliers, licensees and contractors with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

NAC INTERNATIONAL
AFFIDAVIT PURSUANT TO 10 CFR 2.790
(continued)

8. NAC International has invested a significant amount of time and money in the research, development, engineering and analytical costs to develop the information that is sought to be withheld as proprietary. This information is considered to be proprietary because it contains detailed descriptions of analytical approaches, methodologies, technical data and evaluation results not available elsewhere. The precise value of the expertise required to develop the proprietary information is difficult to quantify, but it is clearly substantial.

9. Public disclosure of the information that is sought to be withheld is likely to cause substantial harm to the competitive position of NAC International, as the owner of the information, and reduce or eliminate the availability of profit-making opportunities. The proprietary information is part of NAC International's comprehensive spent fuel storage and transport technology base, and its commercial value extends beyond the original development cost to include the development of the expertise to determine and apply the appropriate evaluation process. The value of this proprietary information and the competitive advantage that it provides to NAC International would be lost if the information were disclosed to the public. Making such information available to other parties, including competitors, without their having to make similar investments of time, labor and money would provide competitors with an unfair advantage and deprive NAC International of the opportunity to seek an adequate return on its large investment.

STATE OF GEORGIA, COUNTY OF GWINNETT

Mr. Craig Seaman, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information and belief.

Executed at Norcross, Georgia, this 12th day of August 2002.

Craig Seaman

Craig Seaman
Senior Vice President
NAC International

Subscribed and sworn before me this 12th day of August, 2002

Notary Public, Cobb County, Georgia
My Commission Expires Nov. 4, 2...

Yvonne Tombetta

NAC-UMST
Docket # 71-9270

NAC INTERNATIONAL

RESPONSE TO THE

UNITED STATES NUCLEAR REGULATORY COMMISSION

ISSUES RELATED TO NAC-UMS® TRANSPORT

(JULY 11, 2002)

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

Chapter 1	GENERAL INFORMATION	Page 3
Chapter 2	STRUCTURAL EVALUATION	Page 15
Chapter 3	THERMAL EVALUATION	Page 19
Chapter 4	CONTAINMENT EVALUATION	Page 29
Chapter 5	SHIELDING EVALUATION	Page 30
Chapter 6	CRITICALITY EVALUATION	Page 34
Chapter 7	OPERATING PROCEDURES	Page 39
Chapter 8	ACCEPTANCE TESTS AND MAINTENANCE PROGRAM	Page 42
	EDITORIAL AND INCONSISTENCIES IDENTIFIED IN THE REVIEW	Page 46

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 1: GENERAL INFORMATION

Drawing 790-502, Sheet 1, Cask Body

1.1 Revise the drawing as follows:

A. Indicate the containment boundary on the drawing.

B. Include the package weights including total gross weight, weight of contents, and the weights for each fuel class.

C. Include a material specification for the NS-4-FR neutron shielding material. This specification should include items such as density, chemical composition, and hydrogen contents which are consistent with the shielding and criticality analyses presented in the SAR.

NAC Response

A. Section 4.1 is revised to include a figure showing the containment boundary consistent with Section 4.5.1.1, Paragraph 2, of NUREG-1617. While all of the containment boundary components are shown on the License Drawings, these drawings do not include a figure that shows the components of the containment boundary in an assembled configuration suitable for indicating the containment boundary of the system.

B. Drawing 790-516 is revised to include gross and contents weights by fuel class. As shown, these weights are rounded up to account for minor deviations from calculated weights that could occur during fabrication.

C. Drawing 790-502 is revised to include the material specification of NS-4-FR.

NAC INTERNATIONAL RESPONSE TO NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 1: GENERAL INFORMATION

Drawing 790-502, Sheet 4, Cask Body

1.2 Revise Section J-J to include toleranced (not reference) thickness of the neutron shield and the lead gamma shield (see Issue 8.3).

NAC Response

Drawing 790-502 is revised to incorporate the design drawing tolerances for placement of the inner and outer shells that form the cavity for the lead gamma shield. The design drawings provide greater specificity than License Drawings for physical dimensions, placement and alignment. Use of the design drawing tolerances controls the placement of the inner and outer shells, providing the required gamma shield and neutron cavity thickness. On the license drawing, a reference dimension is specified for thickness, since adding a dimension and tolerance would require an inspection of the cavity that is not practical.

The neutron shield analysis is based on a nominal thickness of NS-4-FR using the length of the cooling fin that extends through the neutron shield material. This distance represents the minimum width of the neutron shield cavity. A volume conserving radius for the neutron shield, which would provide a more representative shield for analysis of the limiting 2 meter dose points, adds approximately 0.125 inches to the modeled shield thickness. In some locations in each of the 24 sections that form the neutron shield, the neutron shield material may be thinner or thicker than the nominal value of 4.5 inches based on the "as rolled" dimension of the outer shell material and compressibility of the silicon foam insulation material. Since the half value layer of the neutron shield material of the spent fuel generated neutron energies is greater than 0.8 inches, the dose rate is relatively insensitive to small changes in the thickness of the neutron shield material. Consequently, variations from the nominal thickness of 4.5 inches (-0.125 to

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 1.2 (Continued)

+ 0.275 inches) at the thinnest portion of the multifaceted shield have no significant effect on the transport cask external dose rate. NAC considers the dimensions specified in Detail E – E of the drawing to adequately control the lower limit of neutron shield material thickness.

See the Response to Question 8.3.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 1: GENERAL INFORMATION

Drawing 790-502, Rev. 4, Cask Body Transport Cask, NAC-UMS®

1.3 In Drawing 790-502, Rev. 4, Cask Body Transport Cask NAC-UMS, View B-B (Sheet 2), Detail F-F (Sheet 4) and Section L-L (Sheet 4), clarify the drain port.

A. The drain port is not clearly identified in this drawing. Drawing 790-504, Rev. 1, Port Coverplate Assy NAC-UMS, appears to provide the details of the drain port, however, no reference to this drawing appears in Drawing 790-502.

NAC Response

Drawing 790-502, Sheet 4 of 5, is revised to identify View F – F as the Drain Port. Also on Sheet 4, the cross-section view of the drain port is shown in Section L – L.

Drawing 790-504 shows the Port Coverplate assemblies for the vent and drain ports, and the test port for the Coverplate o-rings. Since it does not show details of the vent or drain ports, it is not referenced on Drawing 790-502.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 1: GENERAL INFORMATION

Drawing 790-503, Rev. 1, Lid Assembly, NAC-UMS®

1.4 In Drawing 790-503, Rev. 1, Lid Assembly NAC-UMS, Detail J-J:

A. Clarify the seal groove dimensions. The dimensions for the groove width and height are shown as '.23/.24' and '.23/.24', respectively. If these are the minimum and maximum values for the groove size, then the drawing should clearly indicate this.

NAC Response

Drawing 790-503 is revised to list the groove dimensions as ".23 - .24", as specified in ASME Y14.5M-1994, Section 2.2(a), for limit dimensioning.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 1: GENERAL INFORMATION

Drawing 790-540, Rev. 1, Port Coverplate Assy, NAC-UMS®

1.5 In Drawing 790-540, Rev. 1, Port Coverplate Assy NAC-UMS, Detail B-B, Clarify the seal groove dimensions.

A. The dimensions for the groove width and height are shown as '.113/1' and '.1/.113', respectively. If these are the minimum and maximum values for the groove size, then the drawing should clearly indicate this.

B. The dimensions for the groove are shown as '2.4' and '3.1'. If these values are diameters, then the drawing should clearly indicate this.

<u>NAC Response</u>

Drawing 790-504 is revised to list the groove dimensions as ".100 - .113", as specified in ASME Y14.5M-1994, Section 2.2(a), for limit dimensioning.

The dimensions of the groove are also revised in accordance with the same section of ASME Y14.5M-1994 to include the symbol "∅" designating that the subject dimensions are diameters.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 1: GENERAL INFORMATION

Drawing 790-570, Sheet 1, BWR Fuel Basket Assembly

1.6 Revise the drawing to include the dimension along the length of the basket where the gap between the support discs changes from 3.2 in to 1.35 in.

NAC Response

Drawing 790-570 is revised to include reference dimensions from the bottom of the cask to the support disk where the gap size changes from 3.2 inches to 1.35 inches and from that support disk to the support disk where the gap size changes back to 3.2 inches.

Note that in the length of the basket in which the gap size changes, the gap size between support disks does not change. The change in gap size reflects the use of the heat transfer disks between the support disks.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 1: GENERAL INFORMATION

Drawings 790-571, -572, -573, -574, -575, -605, BWR 56 Element Fuel Basket

1.7 Drawings 790-571, -572, -573, -574,-575, -605, BWR 56 Element Fuel Basket

A. Provide the tolerance for reference dimensions of the fuel tube as shown on Section B-B of Drawing 790-575 with and without the boral sheet.

B. Verify that the tolerance and dimensions for the openings in heat transfer disk on Drawing 790-574 are sufficient considering differential thermal expansion.

The dimensions for the opening on the heat transfer disk are 6.28 in × 6.28 in ± 0.06. The fuel tube dimensions are 6.15 in × 6.15 in ± 0.06 (see Issue 1.4.A for question on fuel tube tolerances). Assuming the worst case tolerance for the heat transfer disk and the fuel tube, a clearance of 0.01 in would exist.

C. Revise the dimensions and tolerances for the oversized BWR fuel openings for the fuel tube, heat transfer disk, support disk, and top and bottom weldments (similar to 1.4.1 and 1.4.2 above) to assure proper fitup.

NAC Response

A. As described in ASME Y14.5-1994 and as applied by NAC, reference dimensions are used for information purposes and are derived from other dimensions that are shown either on the same drawing or on related drawings. The reference dimension is usually provided without tolerance because it is considered to be auxiliary information and does not govern production or inspection operations. In addition, since the reference dimension is based on other dimensions that are "held" during fabrication, applying a tolerance to a reference dimension has the effect of applying redundant tolerance to the item.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 1.7 (Continued)

For example, in the case of Section B-B on Drawing 790-575, the fuel tube dimension without Boral is controlled in fabrication to a value of 8.86 inches (as shown) and is not a "reference" value. In the case of the same section with Boral, a reference dimension is given. This is because the total width consists of the controlled value of 8.86 inches (toleranced as shown in the drawing Title Block) plus the thickness of the Boral (0.075 ± 0.005 inches), plus the thickness of the cover (0.018 inches). Note the thickness of the cover is specified as a reference value, since the cover is delivered in accordance with an ASME material specification that allows it to have a variation in thickness. Consequently, the cover material has a nominal "as-rolled" thickness that is not controlled in fabrication, as this would add fabrication costs without measurable benefit. The total tube width is then specified as a reference dimension, since it consists of two dimensions that are controlled (the outside width of the fuel tube without Boral – 8.86 inches and the thickness of the Boral – 0.075 ± 0.005 inches) and one that is used "as rolled" (the thickness of the cover – [0.018 inches]).

NAC believes that Drawing 790-575 shows the correct controlled and referenced dimensions.

B. NAC recognizes that the strict application of the dimensions and tolerances shown on the License Drawings for the fuel tubes and heat transfer disk could imply that an interference could exist during assembly. However, the fuel tubes and heat transfer disks are constructed using Design Drawings that provide more restrictive tolerances and dimensions than are shown in the License Drawings. Based on the Design Drawing dimensions and our experience in fabricating fuel tubes and disks for the MPC and UMS® Storage Systems, NAC does not expect that an interference during assembly would occur. Following assembly of the fuel tube, it is checked using dies that verify both the internal and external dimensions. Tubes not meeting the acceptance criteria or that cannot be installed are not used.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 1.7 (Continued)

The fit between the fuel tubes and the heat transfer disks is intentionally close, since heat is removed from the fuel tubes through the heat transfer (and support) disks to the canister shell where it is ultimately rejected to ambient. The coefficient of thermal expansion of the aluminum heat transfer disk is about twice that of the stainless steel used in the fuel tube. Consequently, the openings in the heat transfer disk increase in size more rapidly than do the fuel tubes during heat up of the basket.

C. The dimensions and tolerances for the fuel tubes and heat transfer disks associated with the oversized BWR fuel basket positions are correctly dimensioned and toleranced, based on the previous discussion in Items A and B in this response. Similar concerns were addressed during the 10 CFR 72 review and approval process of the UMS® Universal Storage System (NRC Docket 72-1015). However, the satisfactory performance of the tube and disk design requires that these components fit closely. NAC has adequate fabrication and assembly controls in place to assure that the fuel tubes and heat transfer disk openings are correctly sized and correctly assembled.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 1: GENERAL INFORMATION

Drawings 790-581, -591, -592, -593, PWR 24 Element Fuel Basket

1.8 Drawings 790-581, -591, -592, -593, PWR 24 Element Fuel Basket

A. Provide the tolerances for the reference dimensions for the fuel tube as shown on Drawing 790-581 with and without the boral sheet.

B. Verify that the tolerance and dimensions for the opening in heat transfer disk on Drawing 790-574 are sufficient to assure proper fit (include differential thermal expansion). The dimensions of the heat transfer disk opening on Drawing 790-594 are 9.2 in × 9.2 in with a tolerance of ± 0.1 which may not allow the fuel tube to fit into the opening (9.08 in × 9.08 in with the tolerance as requested in Issue 1.5.1).

Additional guidance on engineering drawings can be found in the document entitled "Engineering Drawings for 10 CFR Part 71 Package Approvals," NUREG/CR 5502.

<u>NAC Response</u>

A and B See the Response to Question 1.7. For the reasons described in the NAC Response to Question 1.7, NAC considers the subject drawings to be correctly toleranced and dimensioned, with reference dimensions applied as is appropriate to the component. The fabrication of the components in accordance with the Design Drawings assures that the components have the form and fit required by the design and supporting analysis. The transportable storage canister and tube and basket components have been satisfactorily fabricated and assembled to support storage operations. Since there is no significant difference in component temperatures for the storage and transport conditions (due primarily to the lower heat load allowed for transport), satisfactory performance of the tube and disk basket is assured.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 1: GENERAL INFORMATION

1.9 Provide a separate table of enrichment, maximum burnup, minimum cooling time for the Maine Yankee Fuel described in Appendix 1.3.

It appears that the parameters provided in Table 1.2-6 also apply to Maine Yankee fuel, however, there is no provision for Maine Yankee spent fuel with burnups from 45,000 to 50,000 MWD/MTU. For clarity, a separate table for the Maine Yankee fuel should be included in Chapter 1. The NAC response to RAI 1.1 dated November 16, 2001, did not include a table for Maine Yankee spent fuel.

NAC Response

Section 1.3.1.1 of Appendix 1.3 is revised to include loading tables for the various configurations of Maine Yankee fuel.

Acceptable cool times for transport of Maine Yankee fuel without non-fuel material are shown in Table 1.3.1-2. Transport cool times for assemblies containing CEAs or ICI thimbles are given in Tables 1.3.1-3 and 1.3.1-4, respectively. Minimum cool times for the six assemblies containing stainless steel replacement rods are shown in Table 1.3.1-5. Cool times for damaged fuel assemblies loaded into Maine Yankee Damaged Fuel Cans are shown in Table 1.3.1-6. The minimum cool time for the two consolidated fuel assemblies, CN-1 and CN-10, is six years.

Additional cool time is not required for fuel assemblies loaded with additional hardware in the guide tubes such as CEA fingertips, an ICI segment, or startup neutron sources. These additional items do not contribute significantly to transport dose rates, as shown in the analysis in Chapter 5.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 2: STRUCTURAL EVALUATION

2.1 The regulatory requirements of 10 CFR 71.71 and 71.73 apply to 2.1 and 2.2.

Revise the SAR to include a complete discussion of the analysis of the impact limiters. For example, the following information should be included:

A. A description of the dynamic crush tests that were performed on the redwood and balsa specimens, including test parameters (e.g., grain direction, temperature, strain rate, and number of specimens, etc.).

B. A description of how wood crush fabrication tolerances were considered in the development of the stress-strain curves obtained from the dynamic crush tests for the LS-DYNA computer analyses of the package scale model drop tests.

C. A description of the material models, including those for modeling the redwood and balsa, for the LS-DYNA analysis of the 1/4-scale model and the package.

The SAR should be a standalone document that includes a complete and detailed discussion of the analysis and scale model testing that were performed on the impact limiters.

NAC Response

A. Sections 2.6.7.5.3 and 2.6.7.5.4 are revised to specifically address the properties of redwood and balsa wood used in the LS-DYNA analyses, including a discussion of the test parameters and test matrix and the specifications for the impact limiters. Section 2.6.7.5.4 includes the density and moisture requirements of redwood and

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 2.1 (Continued)

balsa wood used to fabricate the impact limiters and ensure the LS-DYNA analyses are bounded.

B. Section 2.6.7.5.5 is revised to include a discussion of how fabrication tolerances are considered in the LS-DYNA analyses. As described in that section, to account for crush strength fabrication tolerances, the -40°F cold case comparison stresses are factored by 1.10 and the +200°F hot case compression stresses are factored by 0.90.

C. Sections 2.10.1.2.1 and 2.10.1.2.2 are added to provide a description of the material models used in the quarter-scale and full-scale cask LS-DYNA analyses. These sections focus on the crushable foam materials used to model the redwood and balsa wood and the use of strain-rate dependent properties.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 2: STRUCTURAL EVALUATION

2.2 The regulatory requirements of 10 CFR 71.71 and 71.73 apply to 2.1 and 2.2.

Demonstrate that the data reduction criteria for processing peak deceleration values presented in SAR Section 2.10.3 (Confirmatory Testing Program for the Impact Limiters and Attachments) are appropriate and conservative.

The three independently recorded vertical accelerometers were likely to record somewhat varied time histories. The SAR is unclear as to whether the test results have conservatively been considered to have arrived at the peak deceleration values of the 1/4-scale model.

NAC Response

Figure 2.10.3-1 is revised to show the "bounding" acceleration time history of the quarter-scale model top end drop instead of a typical case. As shown in Figure 2.10.3-1, the unfiltered data has a significant response at the beginning of the impact in terms of a steep rise time as well a significant level of high frequency noise. The high frequency nature is observed in terms of the narrow width of the spikes in the acceleration traces. Section 2.10.3.3.2 reviews the top end drop accelerometer response and concludes that the initial response is noise due to the accelerometer itself and has no physical relationship to components in the cask.

The unfiltered data was filtered using the Butterworth filter in LS-DYNA. The calculation of the filter frequency is contained in Section 2.10.3.3.2, and is the same filter frequency used in the LS-DYNA analysis of the end drop condition. The use of this bounding curve results in a maximum peak acceleration of 220 g's, which is approximately 3% smaller than the peak acceleration computed using LS-DYNA.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 2.2 (Continued)

To verify that the acceleration time history curve is an accurate representation of the top end drop, the area under the curve was calculated to show that the maximum velocity was applied to the system. The area under the curve show that the initial velocity was approximately 529 in/sec, which exceeds the required 527.4 in/sec required for a 30-foot drop.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 3: THERMAL EVALUATION

3.1 Demonstrate and revise the application to show that the thermal analyses performed for the package applies to a cask that has been loaded and remains in the vertical position (as shown in SAR Section 7.2).

A. Include in the operating procedures any operating/administrative controls that may be needed to place the cask in the horizontal position within an allotted time after loading.

The thermal analyses performed analyzed the transportation cask in the horizontal orientation with contact surfaces modeled (e.g., contact between the basket and canister, and contact between the canister and the transport cask). This approach is not bounding for a transportation cask that has been loaded and remains in the vertical position for potentially a time period approaching one year (the shipping period).

The requirements of 10 CFR 71.71 apply to this issue.

<u>NAC Response</u>

Section 7.2 is revised to include a "vertical orientation" time limit of 600 hours (25 days). This allowable time is determined based on the test time of 30 days for abnormal regimes from PNL-4835, "Technical Basis for Storage of Zircaloy-Clad Fuel in Inert Gases."

NAC notes that the procedure provided in Section 7.2 has no steps that imply that the transport cask is in the vertical position for any extended period. The vertical orientation is an artifact of how the cask is loaded and closed.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 3: THERMAL EVALUATION

3.2 Revise the application to demonstrate that the analysis methods and assumptions used result in calculated temperatures that are conservative or have an adequate margin of safety, since the calculated maximum cladding temperature is within 6% of the stated temperature limit (i.e. 716 - 673 = 43°F).

The NAC Response to RAI 3.9 dated November 16, 2001, analyzed the variation thermal properties of emissivity and the convective heat transfer coefficient on the thermal analysis of the transport cask. However, the RAI requested the applicant to perform a sensitivity study and analyze the two properties independent of each other. The response did not address the overall concern regarding the accuracy of the results or that the approach is conservative. Demonstration that the approach that was used was conservative is an acceptable alternative to performing a more detailed sensitivity study. Examples of other areas that need clarification with regard to a sensitivity study are: a) assumption of the contact surface area; b) the variance with temperature of the thermal conductivity of the Fiberfrax; c) the model size and the effect of increasing the number of elements; d) the differences between storage and transportation material properties (e.g. conductivity of helium from Table 3.2-6, emissivity of copper lead from Table 3.2-4, etc.); and e) gap tolerances.

The requirements of 10 CFR 71.71 apply to this issue.

NAC Response

Section 3.4.1.1.1 is revised to describe the conservatism of the thermal models and to include the results of additional sensitivity studies. A series of analyses were performed to assess the effect on maximum temperatures of the fuel cladding and the basket for the variations of the following parameters, which are considered to be critical in the main heat transfer path.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 3.2 (Continued)

1. Emissivity of stainless steel (fuel tube, support disks, canister shell, cask shells) and aluminum (heat transfer disk)
2. Convection heat transfer coefficient at transport cask outer surface
3. Contact area between the disks and canister shell
4. Heat transfer disk thickness
5. Gap between the disks and canister shell
6. Gap between the canister shell and the cask inner shell
7. Cask radial neutron shield copper fin thickness
8. Emissivity of copper lead

Note that a sensitivity study is not performed for the Fiberfrax conductivity, the model size/element number, or the helium conductivity. The Fiberfrax is not included in the model for the thermal analysis for the normal condition of transport. The Fiberfrax is located at the axial ends of the lead, which is outside the active fuel region; therefore, it has an insignificant effect on the maximum temperatures of the fuel and basket components. A very conservative conductivity is used for the Fiberfrax for the analysis of the fire accident (see Response to Question 3.4). The model size and the number of elements have an insignificant effect on the temperature results since the analysis is solved as a conduction problem. It is conservative to use a slightly lower helium thermal conductivity for the thermal analysis for the transport conditions (see Response to Question 3.3).

A total of eight thermal analyses were performed using the thermal model described in Section 3.4.1.1.1. The changes in the model and the temperature results for the eight cases are shown in the following table. The analysis results indicate that the increase in the maximum fuel cladding and basket temperature is ≤ 8°F for each of the cases. Therefore, the effect of variation of these parameters is not significant. Additionally, an analysis is performed (Case 9) to evaluate the combined effect of Cases 1, 3, 4, 5, 7 and 8. Note that Case 5 and Case 6 do not exist at the same time and, therefore, only the more critical one (Case 5) is included. Also note Case 2 is not included because the

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 3.2 (Continued)

convection heat transfer coefficient at the transport cask outer surface ($0.00132\Delta T^{0.33}$ Btu/hr-inch-°F) used in the original thermal model is conservative based on the evaluation of thermal test data for the NAC-LWT transport cask. This evaluation is contained in NAC proprietary Calculation EA790-3012, which is provided separately. The increase in the maximum fuel cladding and basket temperature for the combined case (no. 9) is ≤ 17°F. The maximum fuel cladding and basket temperatures remain below their allowable temperatures for the combined case. Based on the discussion on the conservatism in the model and the results of the sensitivity study, it is concluded that the calculated temperatures using the thermal models are conservative and the system has an adequate margin of safety.

Case No.	Description	Maximum Temperature (°F)		
		Fuel Cladding	Support Disks	Heat Transfer Disks
Base	Original analysis.	673	608	605
1	10% reduction in emissivity of stainless steel and aluminum.	678	613	610
2	10% reduction of the heat transfer coefficient at cask outer surface.	678	614	610
3	Reduced contact area between disks and canister shell (reduced from 2° to 1° in the half-symmetry model).	673	608	605
4	8% reduction in heat transfer disk thickness based on the plate thickness tolerance.	680	616	613
5	Increased gap between disks and canister shell based on the tolerance of the diameter of disks and canister shell and the canister shell thickness.	676	611	608
6	Increased gap between canister shell and cask inner shell based on the tolerance of the diameter of canister shell and the cask inner shell.	675	610	607
7	6% reduction of the cask radial neutron shield copper fin thickness based on the plate thickness tolerance.	674	609	606
8	10% reduction of the lead emissivity.	673	608	605
9	Combined (1+3+4+5+7+8).	689	625	622

The results of the sensitivity study are added to Section 3.4.1.1.1.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 3: THERMAL EVALUATION

3.3 Explain why the conductivity of helium, as shown in Table 3.2-6, is generally less than that used in NAC-UMS Storage SAR and address the impact on the analyses performed for NCT and HAC. Revise the application to correct this apparent inconsistency.

The requirements of 10 CFR 71.71 apply to this issue.

NAC Response

The thermal conductivity of helium used in the thermal analyses for transport, as shown in Table 3.2-6, is from the reference "Kreith." The thermal conductivity of helium used in the thermal analysis for storage is from the reference "Vargaftik."

It is conservative to use a lower thermal conductivity in the transport thermal analysis, since a lower thermal conductivity results in higher component temperatures.

For the fire accident condition, the fuel basket and fuel are not explicitly modeled. As shown in Section 3.5.1.1, the maximum temperatures of the basket components and fuel cladding are calculated by adding the maximum temperature difference (ΔT) between the cask inner shell and the component of interest from the normal condition results, to the peak temperature of the inner shell from the transient analysis results. The peak temperature of the cask inner shell is not affected by the helium conductivity. Therefore, the temperature results for the fuel basket and fuel cladding for the fire accident condition are conservative since the ΔT (from analysis results for normal condition) is determined using the lower helium conductivity.

Therefore, it is conservative to use the lower helium conductivity in the thermal analysis for both normal conditions of transport and the fire accident condition.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 3: THERMAL EVALUATION

3.4 Justify the use of the single thermal conductivity value for Fiberfrax Ceramic Fiber Paper as shown on Table 3.2-13 or revise the analysis to evaluate the reported range of values.

The referenced table shows the thermal conductivity of the Fiberfrax to be 0.40 BTU in/hr ft^2°F. The applicants' response to RAI 3-5 dated November 16, 2001, shows that the aforementioned thermal conductivity corresponds to a temperature of 500°F. The same response also shows a value of 0.79 BTU in/hr ft^2°F for Fiberfrax at 1000°F. Since the Fiberfrax is in contact with the outer cask shell which has a maximum temperature of approximately 760°F for HAC fire, explain why a thermal conductivity that varies with temperature wasn't utilized and evaluate any associated impacts on material temperatures during the fire. The NAC response to RAI 3.5 dated November 16, 2001, did not justify a single thermal conductivity value for Fiberfrax.

NAC Response

The Fiberfrax Ceramic Fiber Paper insulator material is positioned at the end of the lead gamma shield. The thermal conductivity is a function of temperature, as shown:

Property (units)	Temperature 500°F	Temperature 1000°F	Temperature 2000°F
Conductivity (Btu/hr-in-°F)	0.0028	0.0055	0.0090
Density (lbm/in^3)	0.0058		

In this table, the thermal conductivity reported is the highest among Grades 550, 880, and 970 and the density reported is the lowest among the same grades, as shown in the product specifications for Fiberfrax Ceramic Fiber Paper.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 3.4 (Continued)

The finite element model used for the fire accident modeled the insulator explicitly. The thermal conductivity applied in the analysis for the Fiberfrax is 0.0081 Btu/hr-in-°F, which corresponds to a temperature much higher than the maximum temperature that the Fiberfrax will reach for the hypothetical accident fire event. Higher conductivity will conduct more heat into the lead and other components. Therefore, the analysis results presented in Section 3.5.3 are conservative.

Table 3.2-13, showing the thermal conductivity of Fiberfrax Ceramic Fiber Paper, is revised to show the temperature dependence of the Fiberfrax thermal conductivity.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 3: THERMAL EVALUATION

3.5 Correct the statement in Section 3.4.1.1.1, last paragraph, that the calculated temperature rise of < 6°F, is from the combined effects of reducing emissivity and reducing the convection coefficient.

Contrary to this statement, the NAC Response to RAI 3.9 (attached to their letter dated 11/16/01) shows a combined temperature rise of 10°F (i.e. 5°F for each of the effects of reducing emissivity and reducing the convection coefficient).

NAC Response

The discussion for the sensitivity study is revised as described in the NAC Response to Question 3.2.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 3: THERMAL EVALUATION

3.6 Correct statement in Section 3.1, 6^{th} paragraph that a singular temperature limit of 716°F is used for 5 year cooled PWR and BWR fuel.

Rather, a temperature range should be given that shows variance in burn-up and fuel type, consistent with Table 3.4-15 "Maximum Allowable Cladding Temperature for PWR and BWR Fuel."

NAC Response

Section 3.1, 6^{th} paragraph is revised to refer to Table 3.4-15 for the maximum allowable cladding temperatures for PWR and BWR fuel. The singular temperature limit of 716°F has been deleted.

NAC INTERNATIONAL RESPONSE TO NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 3: THERMAL EVALUATION

3.7 Provide the actual calculation of pressures for both the Transportable Storage Cask (TSC) and the package in SAR Section 3.4.4.1.

The staff's confirmatory analysis of internal pressures are higher than those described in the text of Section 3.4.4.1. The regulation 10 CFR 71.33(b)(5) requires an evaluation of MNOP.

NAC Response

An ideal gas calculation is added to Section 3.4.4.1 for PWR fuel and to Section 3.4.4.2 for BWR fuel to provide the transport cask and transportable storage canister pressure in normal conditions of transport.

The calculation shows that for PWR fuel, the maximum transport cask cavity pressure is 6.91 psig and the maximum canister pressure is 6.15 psig. For the BWR case, the maximum transport cask cavity pressure is 3.65 psig and the maximum canister pressure is 3.47 psig.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 4: CONTAINMENT EVALUATION

4.1 Provide an evaluation that demonstrates that the transportable storage canister used for the site specific Maine Yankee damaged fuel meets the requirements of 10 CFR 71.63 (special requirements for plutonium shipments).

The requirements of 10 CFR 71.63 are applicable to damaged fuel with plutonium contents greater than 20ci.

NAC Response

The transportable storage canister (canister) is designed and analyzed to demonstrate that it maintains its structural integrity in accordance with the 10 CFR 71.63(b) requirement for a separate inner container for damaged fuel or fuel debris, which may contain more than 20 curies of plutonium.

Sections 2.7.7 and 2.7.8 provide the analysis of the canister and basket to show that they retain their integrity and that the canister maintains its containment function in design basis accident events. The Maine Yankee damaged fuel configuration is evaluated in Section 2.11.1.1. This section shows that in the design basis accident events, the basket support disks and damaged fuel cans do not fail.

Section 4.1 is revised to include a statement that the canister meets the requirements of a separate inner container as described by 10 CFR 71.63.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 5: SHIELDING EVALUATION

5.1 Provide an evaluation for BWR fuel with a maximum burnup of 50,000 MWD/MTU and 6 year cooling time and ensure that the package, with this contents, meet the shielding requirements of 10 CFR 71. The applicants response to RAI 1.2 and 5.1 in the November 16, 2001, response did not adequately address the following:

A. In Section 1.2.3, on page 1.2-15 of Revision UMST-02A of the SAR, the general spent fuel contents for the BWR Cask is listed with a maximum burnup of 50,000 MWD/MTU and 6 year cooling time, however in Section 5.2.4 the BWR design basis fuel is identified as GE 9×9 fuel assemblies, with a burnup of 40,000 MWD/MTU and 10 year cooling time.

B. Table 1.2-7, "Loading Table for BWR Fuel", shows a maximum burnup of 45,000 MWD/MTU. There should be supporting calculations for burnups greater than 40,000 MWD/MTU.

C. A previous RAI (1.2 from the NRC request dated June 14, 2001) asked the applicant to justify the shipment of fuels with a burnup greater than 45,000 MWD/MTU. The response to that RAI dealt specifically with Maine Yankee spent fuel and PWR fuels burned up to 50,000 MWD/MTU. The November 16, 2001, response did not address BWR fuel or the fact the design basis BWR fuel is 40,000 MWD/MTU.

The regulatory requirements of 10 CFR 71.47, external radiation doses, apply to this Issue.

NAC Response

Item 8 of Section 1.2.3 is revised to correct the maximum assembly average BWR burnup to 45,000 MWD/MTU. The loading table for BWR fuel having burnups to 45,000 MWD/MTU is provided in Table 1.2-7. With the exception of Maine Yankee PWR fuel

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 5.1 (Continued)

assemblies, all PWR and BWR fuel assemblies are limited to a maximum assembly average burnup of 45,000 MWD/MTU.

Minimum cool times for fuel assemblies with initial enrichments and burnups different from the BWR design basis values of 3.25 wt % ^{235}U and 40,000 MWD/MTU are considered in the one-dimensional cool time analysis documented in Section 5.4.3.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 5: SHIELDING EVALUATION

5.2 Revise the application to show that the radiation doses on any point on the external surface of the package are below 200 mrem/hr. The SAR states that the doses are above 200 mrem/hr in the narrow inaccessible gap between the neutron shield and lower impact limiter in the BWR case and in an analysis of the PWR case with no spacer employed. The SAR does not specifically show the location of the elevated doses. The locations of the maximum dose rates for BWR and PWR fuel should be shown in Figure 5.1-1, "Location of Maximum Dose Rates for Normal Conditions of Transport." Provide an explanation as to whether these locations are on the external surface of the package. Regulation 10 CFR 71.47 states that the external radiation dose at any point on the external surface of the package must not exceed 200 mrem/hr.

Specific mention of dose rates greater than 200 mrem/hr are found in the application as stated below:

A. For the BWR cask, the dose rate at the 1.25 inch wide gap between the neutron shield and lower impact limiter was determined to be 225.6 mrem/hr, which is greater than the limit of 200 mrem/hr. This location is not indicated on Figure 5.1-1.

B. In Section 5.1.3.1 (page 5.1-5) the sentence reads, "Furthermore, the dose rate at the gap opening is well below 200 mrem/hr as demonstrated in Section 5.4.2.2." This sentence appears to contradict the sentence in that paragraph where the dose rate at this location was specified to be 225.6 mrem/hr.

C. Section 5.4.2.2 describes the bounding evaluation for Class 3 canister fuel, which is PWR fuel not BWR. Additionally, the dose at the gap from Class 3 canister fuel is calculated to be 393 mrem/hr, which is also not identified on Figure 5.1-1.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response

Section 5.0 is revised to clarify that the UMS® transport cask is an exclusive use system. As such, the surface dose rates are subject to a limit of 1000 mrem/hr per 10 CFR 71.47. Figure 5.1-1 and Table 5.1-1 have both been revised to clarify the locations and magnitudes of the maximum dose rates for both PWR and BWR fuel. Also revised is the text in Section 5.1.3.1 clarifying that while the surface dose rate is 225.6 mrem/hr, the dose rate coplanar with the neutron shield shell is well below 200 mrem/hr, as shown in Figure 5.1-1.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 6: CRITICALITY EVALUATION

6.1 The regulatory requirements of 10 CFR 71.55 apply to Issue's 6.1 through 6.3.

Revise the application to show that the critical benchmark modeling for MONK8A was performed using modeling techniques and code input options similar to those employed in modeling the package.

It is not clear that the data used to calculate the bias and uncertainty associated with the calculations performed using MONK8A were obtained from critical benchmarks modeled by the applicant. Individual modeling techniques and selection of code input options are possible sources of uncertainty due to the analyst, and should be considered in the establishment of calculation bias and uncertainty. The establishment of bias and uncertainty is discussed further in Section 5.2 of NUREG/CR-5661, "Recommendations for Preparing the Criticality Safety Evaluation of Transportation Packages."

NAC Response

The MONK8A (code) benchmark evaluations were obtained from critical experiments modeled by SERCO Assurance (previously AEA Technology) personnel. NAC verification and validation calculations repeated selected validation runs on the computer systems employed in the spent fuel cask evaluations, to assure repeatability of the MONK8A benchmark evaluations. The results of the critical benchmark evaluations were employed in the establishment of the criticality upper safety limit (USL) for the analysis. As indicated in NUREG/CR-5661, individual modeling techniques, in particular, code input options may influence the code bias and bias uncertainty. Since NAC personnel did not construct the critical benchmark models, a comparison of key model features and code options was performed. This comparison was designed to

**NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT**

NAC Response to Question 6.1 (Continued)

provide reasonable assurance on the adequacy of the code bias as applied to the evaluation.

Key features of a MONK8A Monte Carlo evaluation are the neutron cross-section set employed, the geometry features implemented in the specific model, any result or neutron tracking biasing included in the evaluation, and the boundary conditions applied to the model.

The most significant code features impacting the evaluation results are the choice of the neutron cross-section library set and the geometry options employed. The cross-section set chosen for both bias establishment and cask criticality evaluation is the JEF 2.2 data set. By retaining the same cross-section set for biasing and cask evaluations, the most likely cause for a differential in code bias is eliminated.

While not every critical benchmark model employed all fractal geometry features available in MONK8A, a review of the entire benchmark set indicates that all key features of the cask analysis models are included in the complete benchmark set. Features employed are NEST, CLUSTER, and General Geometry PARTS that are composed primarily of BOX, ROD, and PLANE bodies, identical to those employed in the cask evaluation. Special geometry features repeated in both critical benchmark models and the cask evaluations are HOLEs and ARRAYs. The ARRAY function provides for a simple repetition of smaller units while the HOLE function invokes a "Woodcock" tracking algorithm. "Woodcock" tracking involves a different approach to particle tracking from the typical ray-tracing in Monte Carlo models and is, therefore, required to be included in both benchmarks and models to find the bias acceptable.

Certain specific geometry features such as the ZCONE and PRISM bodies are not specifically included in the benchmarking, but these features are outside the fuel region and are, therefore, not expected to impact criticality results. Further, while the ZCONE and PRISM bodies themselves are not included in the benchmarks, the basic tracking

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 6.1 (Continued)

algorithm and the application of the surfaces are identical to those of the remaining model bodies.

No biasing is employed in either the neutron tracking or the result evaluation of the cask evaluation or the critical benchmarks. This eliminates neutron tracking bias and result biasing from influencing the code benchmarking. Spent fuel storage cask criticality evaluations are typically performed with a reflecting (mirror) boundary condition to simulate an infinite array of casks. This differs from the benchmark evaluations where complete system geometry is modeled. As indicated in the KENO-Va result sections of the storage and transport Safety Analysis Reports, the large storage cask systems with their extensive structural and shield shells show no statistical difference in results between cask enclosures and single cask versus array evaluations. As such, the difference in boundary conditions has no impact on the applicability of the MONK8A bias evaluation.

Given that all relevant MONK8A modeling options and the cross-section library used in the analyses were also used in the benchmark analyses, no additional sources of uncertainty are expected from the use of the SERCO provided benchmarks.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 6: CRITICALITY EVALUATION

6.2 The regulatory requirements of 10 CFR 71.55 apply to Issue's 6.1 through 6.3.

Revise Section 6.4.5 of the SAR to ensure that the k-eff calculated in determining the end impact accident condition effect on system reactivity is less than the calculated upper subcritical limit (USL).

In this section of the SAR, the USL is reported to be 0.9361, including the code bias, uncertainty in the bias, and a 0.05 subcritical margin. The maximum calculated system k-eff is reported as 0.9357, with a monte carlo uncertainty of $\Phi = 0.0008$. K-eff + 2Φ would therefore be 0.9357 + 2(0.0008) = 0.9373, which is greater than the reported USL. Assurance that the maximum k-eff under hypothetical accident conditions is less than the calculated USL is necessary to ensure that the UMS Universal Transport Cask system meets the requirements of 10 CFR 71.55(e).

NAC Response

Section 6.4.5 is revised to refer to the MONK USL of 0.9426 as described in Section 6.5.5. There is sufficient margin to the USL based on a $k_{eff} + 2\sigma$ value of 0.9373.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 6: CRITICALITY EVALUATION

6.3 The regulatory requirements of 10 CFR 71.55 apply to Issue's 6.1 through 6.3.

Revise Section 6.6.1 of the SAR to include a criticality evaluation for damaged Maine Yankee fuel.

Section 1.3 of the SAR lists damaged fuel as an acceptable Maine Yankee site specific fuel configuration, but Section 6 does not provide a criticality analysis for this configuration. The criticality analysis for the Maine Yankee damaged fuel can should consider rearrangement of fissile material within the can, as well as the possibility of an uneven drain down condition between the can and the main canister cavity. This analysis is necessary to ensure that the UMS Universal Transport Cask meets the criticality safety requirements of 10 CFR Part 71.

<u>NAC Response</u>

Section 6.6.1 is revised to include the criticality analyses of damaged fuel and fuel debris, and fuel assemblies with an inserted start-up source or other non-fuel component. Section 6.6.1.1.8 summarizes the analysis of damaged fuel and fuel debris loaded in a Maine Yankee damaged fuel can, including a preferential flooding evaluation of the damaged fuel can. Section 6.6.1.1.9 provides the analysis of fuel assemblies with startup sources or other non-fuel components inserted in a guide tube. Section 6.6.1.1.10 is the revised analysis of the end-drop event and Section 6.6.1.1.11 summarizes the Maine Yankee criticality results and the relevant fuel loading restrictions. Sections 6.6.1.1.9 and 6.6.1.1.10 were not specifically included in the question. The addition of these sections is required to form a complete submittal.

Text describing the shielding analysis of Maine Yankee damaged fuel, fuel debris, startup sources, and other non-fuel components, is added to Section 5.5.1.1.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 7: OPERATING PROCEDURES

7.1 Revise the operating procedures to include the loading of the transportable storage canister (TSC). The UMS transport application should be a standalone document from the UMS storage application as storage is not a precondition for transportation.

The regulations in 10 CFR 71.87 require that the package be opened and closed in accordance with written operating procedures.

NAC Response

The operating procedures for loading the transportable storage canister have been previously removed at the request of the NRC (RAI-1, April 20, 2001, Docket 71-9235). At the time, NAC concurred with the NRC position and continues to believe that inclusion of the transportable storage canister loading procedures in Chapter 7 of the transport application is not appropriate.

While storage (i.e., placement of a loaded canister in a concrete cask on an ISFSI pad for several years) is not a condition of transport, the canister must be loaded, closed and sealed in accordance with the constraints and requirements of the Certificate of Compliance issued under Docket 72-1015. No period of storage is required, however, the canister may be loaded and closed and immediately loaded into the transport cask. In this sense, the canister is the "contents" presented for loading into the transport cask. However, two other requirements must be met.

The first is that the canister be loaded in accordance with all of the conditions specified in the Certificate of Compliance issued under Docket 72-1015. These conditions include Limiting Conditions of Operation that protect fuel cladding and long-term fuel integrity, which are not appropriate to include in Chapter 7. Because of the separation of the

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

NAC Response to Question 7.1 (Continued)

transport and storage Safety Analysis Reports both in calendar time and in approval space, the procedures that are reported typically have minor differences. However, addressing these differences in real time is administratively difficult.

Second, the fuel cool times and total heat load must conform to the Certificate of Compliance for transport under Docket 71-9270. While it is possible that a canister could be loaded, closed and immediately placed in the transport cask, this condition is unlikely because of the restraint on minimum cool time for all of the fuel in the canister and the restraint on canister total heat load. These conditions are expected to routinely result in a requirement for some period of storage prior to transport.

Because a procedure included in Chapter 7 for loading and closing the canister would be anecdotal with respect to the requirements and significant detail of the procedure presented in Chapter 8 of the UMS® Storage System Final Safety Analysis Report (FSAR [Docket 72-1015]), NAC prefers to refer to the storage FSAR for the procedures that are related to closing the canister, for its intermediate handling and for opening the canister.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 7: OPERATING PROCEDURES

7.2 Justify that holding a pressure of 15 psig on the inner lid seal for 10 minutes for the pressure drop test is adequate for the pre-shipment leakage test.

ANSI N14.1 requires a pre-shipment verification leakage rate of less than 1×10^{-3} ref cm^3/sec. Provide a calculation demonstrating that this leakage test meets the pre-shipment requirements of ANSI N14.1.

<u>NAC Response</u>

Step 27 of Section 7.1.3 and Step 30 of Section 7.3.3 are revised to show a pressure hold time of 15 minutes. The revised time is required based on the inclusion of the volume of the standard pressure test fixture and the volume of the passage in the lid in Equation B-14 of ANSI N14.5-1997. The pressure gauge used has a sensitivity of 0.25 psig. The total volume of the o-ring annulus, drilled passage and test fixture is 53 cm^3. Since the pressure test is performed at 1 atmosphere, the result is a reference value as defined by the standard in Section 2.1.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 8: ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

8.1 Revise the acceptance tests to include the steps for accepting the TSC. This should include steps such as dimensional and material verifications, visual inspections, structural tests, weld verifications, and any others that are appropriate for the TSC.

NAC Response

The transportable storage canister is fabricated, inspected, accepted for loading, loaded and closed in accordance with the programs, procedures and Limiting Conditions of Operation (LCOs) that are described in its Certificate of Compliance issued under 10 CFR 72, Docket 72-1015. There are no operations performed on the TSC for transport, other than those associated with the installation and removal of lifting gear used to move the sealed TSC to the transport cask using the transfer cask.

There are no inspections, measurements, tests or physical verifications of the TSC that can be performed once it is loaded and sealed due to the high radiation field associated with the loaded canister, the inaccessibility of components and the absence of accessible penetrations.

The analyses provided in Chapters 3 and 11 of the Final Safety Analysis Report for the UMS® Storage System (Docket 72-1015) and in Chapter 2 of the Safety Analysis Report for transport show that the TSC retains its integrity in all of the evaluated normal and accident conditions of storage and transport.

The Transportable Storage Canister is considered to be acceptable for transport, provided that the transport limits for heat load and fuel cool time are met and provided that the canister has been in a normal storage condition since loading.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 8: ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

8.2 Revise Section 8.1.2.4 to remove references to a neutron shield tank. The UMS uses NS-4-FR as neutron shielding material and does not have a neutron shield tank.

NAC Response

Section 8.1.2.4 is revised to delete "tank" from the neutron shield description.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 8: ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

8.3 Section 8.1.5.1, Assure that the tolerance for the lead gamma shielding material (-3%) is placed on the licensing drawing for the cask in 790-502, sheet 2.

NAC Response

Drawing 790-502 is revised to incorporate the design drawing tolerances for placement of the inner and outer shells that form the cavity for the lead gamma shield. The design drawings provide greater specificity than do License Drawings for physical dimensions, placement and alignment. Use of the design drawing tolerances provides the required gamma shield and neutron cavity thickness.

Consequently, a reference dimension is specified for thickness, since adding a dimension and tolerance would require an inspection of the cavity that is not practical.

By incorporating the design drawing tolerances and dimensions, the placement of the inner and outer shell ensures the required minimum thickness of the gamma shield.

See the Response to Question 1.2.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

CHAPTER 8: ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

8.4 Revise chapter 8 to include the maintenance program for the impact limiters. This should include items such as verification of the condition of the impact limiter (e.g., rusting or cracking) and the moisture content of the wood.

<u>NAC Response</u>

Because of the importance of the impact limiters to cask accident event performance, the impact limiters must be inspected for defects prior to each use, and repaired if necessary (see Section 8.2.6). Repairs must restore the impact limiter to the conditions as described in the (proprietary) License Drawings 790-506 (Upper Impact Limiter) and 790-507 (Lower Impact Limiter).

Since the impact limiters are inspected prior to each use, an additional inspection in accordance with a periodic maintenance program is not considered to add to the assurance that the impact limiters function as intended.

To increase the assurance that the impact limiters function as intended, the pressure test port in the impact limiter is closed by welding once acceptance pressure testing of the impact limiter shell is completed. This precludes the introduction of moisture into the impact limiter that could alter the impact response of the wood. Since the impact limiter is sealed by design, there is no practical way to test the moisture content of the wood and there is no credible basis for the moisture content to change.

NAC believes that the required "each use" inspection of the impact limiters is adequate to ensure their continued capability to perform their design function.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

EDITORIAL AND INCONSISTENCIES IDENTIFIED IN THE REVIEW

9.1 Clarify, on page 2.1-3, the last sentence of the last paragraph, which states: "No credit is taken for the canister containment function during transport operations."

The staff notes that damaged fuels held by Maine Yankee Fuel Cans will be placed inside the canister. Per 10 CFR 71.63 (b)(1), the canister, as a separate inner container within outer packaging, must have a containment function.

<u>NAC Response</u>

Page 2.1-3 of Section 2.1.1.2 is revised to clarify that the canister meets the requirements of 10 CFR 71.63(b) as a separate inner container for the purpose of transporting spent fuel classified as damaged. Analyses presented in Sections 2.6.12 and 2.6.14 for normal conditions of transport of PWR and BWR fuel, respectively, show that the canister retains its leaktight containment in the evaluated conditions. Similarly, hypothetical accident conditions are evaluated in Sections 2.7.7 and 2.7.9 for PWR and BWR fuel, respectively. These sections also show that the canister maintains its leaktight containment function in the evaluated conditions.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

EDITORIAL AND INCONSISTENCIES IDENTIFIED IN THE REVIEW

9.2 In SAR Section 2.10.3.3.4.1, Static Test Results, (1) correct the typos for Figures 2.10.3-3 and 2.10.3-4; and (2) clarify the wording, "dynamic load factors...1.058..."

(1) Figures 2.10.3-2 and 2.10.3-3 should have been called out instead; (2) the footnotes in Figures 2.10.3-2 and 2.10.3-3 suggest that a multiplier, rather than a dynamic load factor, of 1.058 was used to account for the dynamic crush strength of redwood.

NAC Response

The figure references in Section 2.10.3.3.4.1 are corrected and the term "multiplier" is used in place of dynamic load factor. Section 2.10.3.3.4.1, paragraph 3, is revised as follows:

"The force-deflection curves for the model impact limiter sections used in Static Test 1 and Static Test 2 are shown in Figures 2.10.3-2 and 2.10.3-3, respectively. These curves include the previously discussed geometry and multiplier of 8 and 1.058, respectively."

For consistency, the footnotes for Figure 2.10.3-2 and 2.10.3-3 have been revised as follows:

"Forces correspond to a full quarter-scale model of the UMS® upper impact limiter. The forces have been multiplied by 1.058 to account for the dynamic crush strength of redwood."

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

EDITORIAL AND INCONSISTENCIES IDENTIFIED IN THE REVIEW

9.3 Clarify, on page 2.10.3-19, the wording, " the model...polar moment of inertia of the cask body..."

A polar moment inertia, as a cross sectional property, is commonly related to rotation of the cask body about its longitudinal axis. In addition to the center of gravity location, the mass distribution along the length, thus the rotary mass moment inertia, of the cask body must also be considered in designing scale models for drop tests.

NAC Response

As noted, the term "polar moment of inertia" was incorrectly used. The second to last sentence on page 2.10.3-19 is revised as follows:

"The thickness of the top and bottom plates weas adjusted to allow the model CG and moment of inertia of the cask body about the axis of rotation to be scaled to the full-scale design."

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

EDITORIAL AND INCONSISTENCIES IDENTIFIED IN THE REVIEW

9.4 Verify the measured crush depth for the top end-drop test of the 1/4-scale model.

The table in SAR page 2.10.3-3 lists a crush depth of 2.00 inches while page 2.10.3-9 reports a crush depth of 2.04 inches.

NAC Response

The crush depth value of 2.00 inches was incorrectly reported. The crush depth value is revised to the correct value of 2.04 inches as given on page 2.10.3-9.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

EDITORIAL AND INCONSISTENCIES IDENTIFIED IN THE REVIEW

List of Effective Pages

9.5 Chapter 7, lists pages that apparently have been deleted.

NAC Response

The List of Effective Pages is revised to delete reference to Pages 7.5-2 through 7.5-12, and to Page 7.6-1. These pages were removed from Chapter 7 in our submittal UMST-01D in response to the set of RAIs dated June 14, 2001, but not removed from the List of Effective Pages. This revision corrects this oversight.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

EDITORIAL AND INCONSISTENCIES IDENTIFIED IN THE REVIEW

9.6 Clarify the SAR, including the operating procedures, to state that spent fuel loaded into a canister may not be suitable for immediate transport because the loading cooling times required for transport are longer than the loading cooling times required for storage.

NAC Response to RAI 1-2, dated November 16, 2001, stated: "It is noted that no particular period of storage is required for a canister before it can be loaded in the UMS Universal Transport Cask. If all the fuel meets the loading table requirements provided in Section 1.2.3, the canister may be closed and immediately placed in the transport cask." This statement is misleading and contrary to the information contained in the respective SARs. Specifically, the Loading Tables 1.2-6 and 7 of the UMS Transport SAR have significantly longer required cooling times than the Loading Tables 2.1.1-2 and 2.1.2-2 of the UMS Storage SAR.

NAC Response

Section 7.1.3 is revised to incorporate a provision that all of the spent fuel in a canister must meet the cool times shown in Tables 1.2-6 and 1.2-7 for PWR and BWR fuel, respectively, prior to loading the canister in the cask. GTCC waste must have a minimum five-year cool time from March 1998. Contents must be in accordance with the transport Certificate of Compliance (71-9270) prior to being loaded into the transport cask.

NAC did not intend that the Response to RAI 1-2 be misleading in any way. Due to the lower allowable heat load of contents for transport (versus the storage), minimum allowable cool times are typically longer for the transport system than those specified for the storage system. However, a site may have fuel in pool storage that meets both the storage and transport cool time requirements. This fuel may be loaded into a canister for either placement into a concrete cask for storage or into the transport cask for transport. Fuel not meeting the transport requirements may only be placed into the storage system.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

EDITORIAL AND INCONSISTENCIES IDENTIFIED IN THE REVIEW

9.7 Justify the 250°F canister gas temperature used in Section 3.4.4.1.

The text states that the canister gases are at a temperature of 250°F and that the initial fill pressure is 1 atm. Typically, initial fill temperatures are assumed to be at ambient temperatures (approximately 68°F). The application does not explain why 250°F is an appropriate value to use for this evaluation. The regulatory requirements of 10 CFR 71.33 (b)(5) relate to this Issue.

NAC Response

The canister backfill gases are conservatively assumed to be at 250°F based on the transient analysis results for the transfer operation as shown in the NAC-UMS® Storage Safety Analysis Report, Section 4.4.5.1. That analysis shows that the canister shell maximum temperature is 285°F after 9 hours of vacuum drying. The gases, which have insignificant masses, are expected to be rapidly heated from 68°F to an average temperature higher than 250°F. Section 3.4.4.1 is revised to include the justification to be consistent with the NAC-UMS® Universal Storage System Safety Analysis Report.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

EDITORIAL AND INCONSISTENCIES IDENTIFIED IN THE REVIEW

9.8 Correct statement in Section 3.1, 8th paragraph that maximum fuel rod cladding temperature remain below 1058°F for NCT.

The cladding temperature limit for NCT must be below 716°F and depending on cooling time, burn-up and fuel type may be much lower than 716°F.

NAC Response

Section 3.1, 8th paragraph is revised to state that the allowable cladding temperature for Normal Conditions of Transport is established in Table 3.4-15 based on different burnup and cooling time.

NAC INTERNATIONAL RESPONSE
TO
NRC ISSUES FOR NAC-UMS® TRANSPORT

EDITORIAL AND INCONSISTENCIES IDENTIFIED IN THE REVIEW

9.9 Revise the application to explain how preferential loading configurations and mixed loading configurations have been bounded by the design basis thermal analysis.

NAC Response 3.14 (attached to their letter dated 3/30/01) addressed mixed loadings and preferential loading arrangements, but did not add it to the SAR.

NAC Response

The thermal evaluation for the preferential loading and mixed loading configurations is added to Section 3.4.2.1.