August 29, 2007

Mr. Donis Shaw
Licensing Manager
Transnuclear, Inc.
7135 Minstrel Way, Suite. 300
Columbia, MD 21045

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR REVIEW OF AMENDMENT 10 TO THE STANDARDIZED NUHOMS® SYSTEM (TAC NO. L24052)

Dear Mr. Shaw:

By letter dated January 12, 2007, Transnuclear Inc. (TN) submitted an amendment request to the U.S. Nuclear Regulatory Commission (NRC) for Certificate of Compliance (CoC) No. 1004. This amendment proposes to include the following changes to the Standardized NUHOMS® storage system:

- addition of two new dry shielded canisters (DSCs) designated the NUHOMS®-61BTH DSC and the NUHOMS®-32PTH1 DSC

- allow storage of Westinghouse 15x15 Partial Length Shield Assemblies in the NUHOMS®-24PTH DSC and Control Components in the NUHOMS®-32PT DSC

- add an alternate high-seismic option of the horizontal storage module for storing the 32PTH1 DSC

On March 1, 2007, you were notified that the NRC staff had completed its acceptance review of your application and that your application contained sufficient information for staff to perform a detailed technical review. We also provided a proposed schedule for completing the technical review of your application.

The staff has determined that further information is needed to complete its technical review. The information requested is listed in the enclosure. Your response should be provided by November 5, 2007. If you are unable to meet this deadline, you must notify us in writing, at least two weeks in advance, of your new submittal date and the reasons for the delay. The staff will then assess the impact of the new submittal date and notify you of a revised schedule.

The staff believes that given the nature and the complexity of the request for additional information (RAIs) that a public meeting is warranted in order to answer any questions that you may have about the RAIs so that you can determine how best to respond to the RAIs. I will work with you to schedule a meeting at the earliest convenient time.

The staff notes that some of the RAIs in the structural review area could be considered resolved provided the applicant limits this amendment to 10 CFR Part 72 (storage) related issues only. An option that the staff is willing to discuss with TN is that only normal, off-normal and accident loads for storage and on-site transfer should be included in this amendment request. This option can be discussed during the public meeting mentioned above.

Please reference Docket No. 72-1004 and TAC No. L24052 in future correspondence related to this licensing action. If you have any questions, please contact me at (301) 492-3325.

Sincerely,

/RA/

Joseph M. Sebrosky, Senior Project Manager
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 72-1004
TAC No. L24052

Enclosure: Request for Additional Information

The staff notes that some of the RAIs in the structural review area could be considered resolved provided the applicant limits this amendment to 10 CFR Part 72 (storage) related issues only. An option that the staff is willing to discuss with TN is that only normal, off-normal and accident loads for storage and on-site transfer should be included in this amendment request. This option can be discussed during the public meeting mentioned above.

Please reference Docket No. 72-1004 and TAC No. L24052 in future correspondence related to this licensing action. If you have any questions, please contact me at (301) 492-3325.

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Docket No. 72-1004
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Enclosure: Request for Additional Information

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TRANSNUCLEAR INC.

DOCKET NO. 72-1004

REQUEST FOR ADDITIONAL INFORMATION

RELATED TO AMENDMENT 10 TO THE

STANDARDIZED NUHOMS® SYSTEM

By application dated January 12, 2007, Transnuclear Inc. (TN) requested approval of an amendment to Certificate of Compliance (CoC) No. 1004. This amendment proposes to add several items to the CoC including:

- addition of two new dry shielded canisters (DSCs) designated the NUHOMS®-61BTH DSC and the NUHOMS®-32PTH1 DSC

- allow storage of Westinghouse 15x15 Partial Length Shield Assemblies in the NUHOMS®-24PTH DSC and Control Components in the NUHOMS®-32PT DSC

- add an alternate high-seismic option of the horizontal storage module for storing the 32PTH1 DSC

This request for additional information (RAI) identifies additional information needed by the U.S. Nuclear Regulatory Commission (NRC) staff in connection with its review of the amendment. The requested information is listed by chapter number and title in the applicant's safety analysis report. NUREG -1536, "Standard Review Plan for Dry Cask Storage Systems," was used by the staff in its review of the amendment application.

Each individual RAI section describes information needed by the staff to complete its review of the application and the Safety Analysis Report (SAR) and to determine whether the applicant has demonstrated compliance with the regulatory requirements.

CHAPTER 1 General Discussion

1-1 Revise the SAR so that the base SAR drawings and descriptions are consistent with the drawing provided in Appendix T.1.5 and Appendix U.1.5. Appendix E of the Standardized NUHOMS SAR provides some drawings for some DSC models, some horizontal storage modules (HSM) models, and a model of the on-site transfer cask with a note providing direction on where other drawings for other models can be found. The note in Appendix E should be updated to reference the drawings that are contained in Appendix T and U for the 61BTH and 32PTH1 DSC models, the HSM-H and HSM-HS models, and th OS197FC-B and OS-200 onsite transfer casks.

This information is required by the staff to assess compliance with 10 CFR 72.236(b).

1-2 Correct inconsistencies in the base SAR with the design requirements contained in the Appendix U and Appendix T drawings. A review of the drawings contained in Appendix T and Appendix U of the SAR shows inconsistencies between the design

requirements in the drawings and the design requirements contained in the base safety analysis report with no accompanying explanation. For example SAR section 4.2.1 provides the HSM code of construction as ACI-383-83, and SAR Section 3.4.2 notes that the HSM is designed in accordance with ACI 349-85. Drawing NUH-03-7001-SAR sheet 1 provides codes of design for the HSM-H that are different than those cited in SAR section 4.2.1 and 3.4.2. Note 1 of NUH-01–7001-SAR sheet 1 states that "the reinforced concrete for the prefabricated HSM-H and shield walls is designed in accordance with ACI 349-97 and ACI 349R-97 and shall be constructed in accordance with ACI 318-95." Note 1 of NUH-01-7001-SAR is therefore inconsistent with the design requirement contained in SAR sections 4.2.1 and 3.4.2. SAR section 4.2.1 and 3.4.2 should be updated to be consistent with the drawings contained in Appendix U and T. In addition, other portions of the base SAR should be reviewed and updated as appropriate if they are inconsistent with the drawings contained in Appendix U and T.

This information is required by the staff to assess compliance with 10 CFR 72.236(b).

CHAPTER 2 Principal Design Criteria

2-1 Provide a discussion of the quality category for the HSM-H and the OS197FC-B onsite transfer cask that is associated with the NUHOMS®-61BTH System and for the HSM-HS and OS200 onsite transfer cask that is associated with the NUHOMS®-32PTH1 System. Section T.2.3.1, and U.2.3.1, of the SAR discuss the quality category of the components associated with the 61BTH DSC, and the 32PTH1 DSC, respectively. These SAR sections refer to the drawings contained in SAR Section T.1.5 and U.1.5 for a description of the quality category for the components. The description in SAR Section T.2.3.1 does not include a discussion of the quality categories for the HSM-H and the OS197FC-B associated with the 61BTH design. The description in SAR Section U.2.3.1 does not include a discussion of the quality categories for the HSM-HS or the OS200 associated with the 32PTH1 design.

This information is required by the staff to assess compliance with 10 CFR 72.236(b).

2-2 Update the base SAR to include a discussion of the quality categories for the components associated with the 61BTH and 32PTH1 Systems. SAR Table 3.4-1, "NUHOMS Major Components and Safety Classification," list the major components and their safety classification. The table includes a note of where the safety classification can be found for the NUHOMS®-61BT, 32PT, and 24PTH Systems. This table does not contain a note for where the safety classification can be found for the NUHOMS®-61BTH and 32PTH1 Systems. The safety classification discussion in the base SAR should also be reviewed to ensure that it is consistent with the safety classification discussion contained in SAR appendix T and U.

This information is required by the staff to assess compliance with 10 CFR 72.236(b).

2-3 Provide justification for why SAR Table U.2-18 and Technical Specification 1.2.18b are consistent or make the appropriate changes to the Technical Specification or SAR Table U.2-18. SAR Table U.2-18 shows the OS200 transfer cask being used for a Type 1 32PTH1 DSC and a maximum heat load of 31.2 kW per DSC for heat load zoning configuration 2 or 3. Technical Specification 1.2.18b, “Time Limit for Completion of 32PTH1 DSC Transfer Operation,” states the following:

> The time limit for completion of transfer of a loaded and welded 32PTH1 DSC from the cask handling area to the HSM-H is as follows:
>
> - No time limit if the DSC with Type1 Basket is loaded with intact fuel assemblies or 38 hours if it is loaded with damaged fuel assemblies arranged in Heat Load Zoning Configuration No. 2.

Technical Specification 1.2.18b is only applicable to a 32PTH1 DSC when transferred in a OS200FC Cask. The OS200FC transfer cask has provisions to initiate air circulation in the Cask/DSC annulus by starting a blower provided on the OS200FC cask transfer skid. The OS200 transfer cask does not have this capability. SAR table U.2-18 does not appear to recognize that a OS200FC instead of the OS200 transfer cask must be used for a Type 1 basket when heat load zoning configuration No. 2 is used with damaged fuel assemblies.

This information is required by the staff to assess compliance with 10 CFR 72.236(a).

2-4 Specify the Codes and Standards for the 61BTH and 32PTH1 Systems in the Standardized NUHOMS technical specifications or provide a justification for why they are not needed. The staff notes that the Codes and Standards for the 61BTH System, and the 32PTH1 System (including the DSC, the DSC basket assemblies, the HSM-H, the HSM-HS, the OS-197FC and OS-200) are not captured in technical specifications. This is not consistent with the guidance contained in NUREG-1745, “Standard Format and Content for Technical Specifications for 10 CFR Part 72 Cask Certificates of Compliance.”

This information is required by the staff to assess compliance with 10 CFR 72.236(b).

Note: RAI 2-5 is related to the shielding review of the 32PT DSC change of contents

2-5 Revise Table M.2-1 to remove a repeated listing of neutron sources as authorized control components.

Neutron sources are listed twice as authorized control components in this table. The table should be revised to correct this typographical error.

This information is required by the staff to assess compliance with 10 CFR 72.11.

Note: RAI 2-6 is related to the shielding review of the 24PTH DSC change of contents

2-6 Revise Table P.2-7 of the SAR, and Table 1-3b of the Technical Specifications, to correct an inconsistency in the required cooling time for 3.4 weight-percent, 61 GWd/MTU burned fuel.

Tables P.2-7 of the SAR and 1-3b of the Technical Specifications report cooling times for 3.4 weight percent, 60 and 61 GWd/MTU burned fuel as 6.0 and 5.5 years, respectively. It is inconsistent with the methodology used to determine cooling times that a higher burnup fuel assembly would require a shorter cooling time to meet the design basis source term. Revise the table to correct this inconsistency.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.236(d).

CHAPTER 3 Structural Evaluation

3-1 Justify the assumptions made in modeling and application of the seismic loads to the basket finite element model. It is the staff's concern that the modeling approach, with the basket elements along the axial direction one-half the axial load may not have been captured.

The seismic loads were conservatively enveloped by a combined loading of 2g axial + 2g transverse + 2g vertical. The 2g vertical load and 2g transverse lateral load, resulting from the fuel assembly weight were applied as pressure on the horizontal and vertical faces of plates. The inertia load due to the basket, rails and canister dead weight was simulated using the density and appropriate 2g acceleration in the vertical and transverse directions. The poison plate weight was included by increasing the basket plate density. Since only a 3 in. length of the basket was modeled, the acceleration in the axial direction was increased to account for the entire 164" length.

Axial Acceleration = 2g x 164/3 = 109.3g

To simulate the axial stress due to the axial acceleration, only one end of the basket model was restrained in the Z - direction.

This information is required for compliance with 10 CFR 72.11.

3-2 Explain Footnote (2) to the table entitled, “Summary of the Basket Stresses due to Seismic Load,” on page T.3.6-14 which states "ANSYS plot results are scaled by 1.08 to conservatively account for un-modeled aluminum at the Type 2 R45 rails." This table lists a summary of the basket stresses due to seismic loads for the Type 2 DSC. It is not clear where the footnote applies, as it is not indicated in the table. Also, justify the scaling factor used to account for not modeling the aluminum.

This information is required for compliance with 10 CFR 72.11.

3-3 Justify the adequacy of the Type 1 canister for this Service Level, considering the actual stresses are very close to the allowable stresses.

The table on page T.3.6-16 titled "Summary of Basket Assembly Stress Analysis due to Operation/Storage Loads" shows primary membrane plus bending stress of 30.65 ksi for Type 1 DSC - Canister. The allowable stress for this component for Service Level C per ASME code is listed as 35.10 ksi. This will provide a factor of safety of 1.15. However, Footnote 6 to this table indicates that total stress of 30.65 ksi excludes stresses due to pressure loads.

This information is required for compliance with 10 CFR 72.11.

RAI 3-4 though 3-12 are pertinent to cladding integrity of high burn-up spent fuel.

3-4 Justify the use of fuel cladding mechanical properties which include only properties for cladding with circumferential hydrides and not a combination of radial and circumferential hydrides.

The mechanical properties of the cladding which are provided in the calculations are the properties for cladding material with circumferential hydrides only. The adverse impact of radial hydrides upon the cladding strength and ductility is well known but not addressed by the data provided. It is known that radial hydrides may precipitate within the cladding during storage, leading to greatly reduced mechanical properties. Therefore, the staff considers the assumptions and calculations provided by the applicant do not support their conclusions regarding performance of the cladding under the design conditions.

This information is required for compliance with 10 CFR 72.236.

3-5 Provide a published reference for the yield strength and modulus of elasticity for cladding properties for high burn-up spent fuel. The reference that is given in the SAR for the yield and modulus is an unpublished work by Beyer and Geelhood. The same information in graph form can be found in the published paper by the same authors in the Transactions of ANS Conference, Nov 2005.

This information is required for compliance with 10 CFR 72.236.

3-6 Provide a basis for the cladding yield stress value.

The staff finds that calculations of the modulus and yield stress are correct applications of the Beyer model. However, it should be noted that for the Zirc-2, Beyer's highest fluence is 8×10^{25} with the preponderance of the data below 2×10^{25}. The model under predicts the measured values at the higher fluence by 15 ksi. This deviation needs to be addressed in the results where the calculated stress is only 80 psi below the yield strength.

This information is required for compliance with 10 CFR 72.236.

3-7 Explain the relevance of SAR pages T.3.6-77 thru 83. If relevant, provide additional details explaining how the material of those pages supports the applicant's position regarding cladding material properties. The stated pages do not seem to be mentioned in the SAR text and do not contain sufficient information by themselves to be meaningful.

This information is required for compliance with 10 CFR 72.236.

3-8 Justify the statements on page T.3.5-8 which provide a range of strain to failure of 1.7 to 3%.

Provide a basis for the range of strain failure of 1.7% to 3% in Section T3.5.3.D, for the end drop analysis of high burn-up fuel rods. The strain failure range used by the applicant refers to a reference, which in turn refers to a Sandia document (SAND90-2460, 1992). It is the staff's understanding that the numbers presented in the SAND90-2460 are good for low burn-up fuel only, and they do not account for any irradiation hardening and hydrogen content. A recent work examining strain to failure data from irradiated Zircaloy indicates that the uniform elongation to failure for the range of temperature and hydrogen content typically associated with high burn-up nuclear spent fuel, might be limited to 0.5% to 1.5%. Therefore the applicant's conclusion that the rods yield and do not break may not be true.

This information is required for compliance with 10 CFR 72.236.

3-9 Provide clarification as to whether the end drop finite element model "gap" refers to the distance between the outside rod to the basket wall, or, the rod to rod spacing?

This information is required for compliance with 10 CFR 72.236.

3-10 Justify the internal rod pressures in the range of 2.3 to 3.8 psi listed in Table T.3.5-5. It is staff's understanding that high burn-up BWR fuel has been pressurized for some years.

This information is required for compliance with 10 CFR 72.236.

3-11 Justify why less than the full number of rods contained in a bundle are used in the analysis, as indicated in the note to Table T3.5-6.

This information is required for compliance with 10 CFR 72.236.

3-12 Revise the application for the high-burnup damaged fuel analysis to only address the on-site transfer and storage operations. The analyses presented do not provide sufficient information to approve the application in its current form. There is sufficient evidence to support the assumption that the higher hydrogen content of the high burn-up cladding may significantly lower the fracture toughness. However, until the hydrogen content of the cladding is accounted for in the model, NRC staff considers the TN analysis as unacceptable. The staff notes that it's specific position on TN-68

Amendment No. 1, regarding excluding damaged high burn-up fuel as authorized contents is documented in phone call summary dated November 14, 2006 (see ADAMS accession number ML063190148). The same arguments apply to this application.

This information is required for compliance with 10 CFR 72.236.

3-13 Provide proper reference for the load combinations nomenclatures. Table U.3.7-19 titled, "NUHOMS 32PTH1 DSC Enveloping Load Combinations Results for Accident Loads," is shown on page U.3.7-50. A footnote to this table refers to table U.3.7-21 for notes. Table U.3.7-21 note number (1) refers to Table U.2-14 for load combinations nomenclature. The staff finds this to be incorrect. There are no Load Combinations shown in Table U.2-14.

This information is required for compliance with 10 CFR 72.11.

3-14 As the actual factor of safety reported is 22.4 / 21.83 = 1.02, provide justification for using the allowable at 400 °F. Table U.3.7-19 titled, "NUHOMS 32PTH1 DSC Enveloping Load Combinations Results for Accident Loads," is shown on page U.3.7-50. The ASME Service Level C results for DSC shell are listed herein. For the primary Membrane the controlling load combination is listed as HSM-8 and the actual stress is 21.83 ksi, whereas the allowable stress is 22.4 ksi. The staff understands that the load combination is for earthquake loading-hot. Footnote (10) in table U.3.7-21 states that stress allowable is based on 400 °F.

This information is required for compliance with 10 CFR 72.236.

3-15 Justify the use of initial contact between the DSC shell and cask for the LS-DYNA drop analysis. Section U.3.7.4.3 presents Basket Assembly Drop Evaluation. A three dimensional finite element model of 32 PTH1 basket assembly and DSC shell was constructed using LS-DYNA computer program. The applicant specifies that a radial gap exists between the DSC shell and cask in an unperturbed state. During a drop event, the applicant states that depending on the drop orientation, the structural components nearest the impact location are in contact thereby reducing the effective gap to zero at the point of impact. The NRC staff believes that this may not be the most damaging orientation for drop events and that a maximum radial gap at the point of impact, rather than a minimum gap, is a more realistically conservative approach.

This information is required for compliance with 10 CFR 72.236.

CHAPTER 4 Thermal Evaluation

Note: RAI 4-1 through 4-5 applies to the DSC transfer analyses, contained in SAR Sections U.4.5 and T.4.5

4-1 Provide a justification for crediting a 100% helium environment in the DSC for the thermal analysis of the cask loading evolution. Add a Technical Specification (TS) that requires the use of helium during DSC blowdown.

Between the removal of the cask from the spent fuel pool, and the completion of the seal weld on the inner lid of the DSC (as described in Sections U.8.1.2 and T.8.1.2 for the 32 PTH1 and 61 BTH, respectively), a helium environment is being credited for the thermal analysis (Sections U.4.7.1 and T.4.7.1). Because the DSC is not leak-tight following the blowdown, there does not appear to be a mechanism to prevent leakage and therefore maintain a 100% helium environment in the DSC. In addition, there is no TS provided to specify the use of helium during blowdown of the DSCs, when the application states that helium is credited (in Sections U.4.7.1 and T.4.7.1) to maintain the fuel cladding below applicable temperature limits.

This information is needed to satisfy the provisions of 10 CFR 72.11 and 10 CFR 72.236(f).

4-2 Provide a complete description of, and any relevant calculation packages related to, the derivation of effective conductivity values for the liquid neutron shield of the OS200 and OS197 transfer casks (TCs). Include a discussion on how the orientation of the transfer cask during the transfer operation (horizontal vs. vertical) affects the conductivity values of the liquid neutron shield. Referencing calculation packages that have been previously submitted to the NRC is acceptable.

The values used for heat transfer coefficients across the liquid neutron shield for both the OS200 and OS197FC-B transfer casks were derived from a FLUENT CFD model that is not described in the SAR. In addition, there is no discussion of the effect of orientation on the conductivity values, which will vary due to the changes in convective heat transfer within the liquid neutron shield from the horizontal to the vertical orientation. If a bounding value is used for both orientations, then this should be justified.

This information is needed to satisfy the provisions of 10 CFR 72.236(f), and 10 CFR 72.11.

4-3 Provide a description of how the DSC shell temperature is maintained below the value used in the analysis (225°F) through operations involving the water-filled annulus between the DSC and the transfer cask during the sealing and vacuum drying evolutions. Provide a discussion of how the actual conditions (i.e., presence of a non-uniform DSC shell temperature) are accounted for in the analysis. Include a description of how temperatures are monitored during these evolutions to ensure that the temperatures used in the analysis are not exceeded. Updates to Chapter 8 operating procedures may be necessary.

The thermal analysis in Sections U.4.7.1 and T.4.7.1 describe a water temperature of 225°F maintained in the annular region during the DSC sealing and vacuum drying evolutions. This is the basis for the transient thermal analyses boundary conditions as described in those sections. The staff needs reasonable assurance that this temperature is bounding for actual DSC operations.

This information is needed to satisfy the provisions of 10 CFR 72.236(f), and 10 CFR 72.11.

4-4 Provide a summary of the conditions (ambient temperature, solar insolation, orientation, etc.) of operation for the DSC loading configurations for which the transfer time is limited, and for DSC loading configurations where there are no limit on transfer time operations. If the operation time exceeds the maximum allowed transfer time, clarify and provide a basis for whether "recovery operations" constitute "off-normal conditions," or "accident conditions." Finally, state the anticipated duration for possible "recovery operations," including when the transfer time clock is “reset” to resume and complete the transfer operation.

Sections U.4.5.5 and T.4.5.3 describe the limits on transfer times for selected DSCs based on heat load and basket type. This section does not include a detailed summary of the other conditions related to the reported transfer times (such as ambient temperature, solar insolation, orientation, etc.). A summary of all the conditions coupled with the DSC basket configurations is needed to evaluate the limits associated with the transfer operations.

This information is needed to satisfy the provisions of 10 CFR 72.236(f), and 10 CFR 72.11.

4-5. Provide a justification and further description of the analysis methods and models used to conclude that, for selected DSCs, transfer operations have no time limit.

Section U.4.5.2 in the SAR provides a general description of the analyses conducted to determine that there are no transfer time limits for certain DSC configurations. Staff confirmatory calculations indicate that all configurations for the 32PTH1 DSC have a time limit associated with transfer operations, based on the limits for the DSC shell temperature provided in the SAR Sections U.4.5.4.1 and U.4.5.4.2. The staff needs further justification and description of the analyses models used by the applicant to make these determinations.

This information is needed to satisfy the provisions of 10 CFR 72.236(f), and 10 CFR 72.11.

Note: RAI 4-6 through 4-8 applies to the DSC transfer accident conditions contained in SAR Sections U.4.5.3, U.4.5.4.2 and T.4.5.2, T.4.5.3.3

4-6 Provide the fire boundary conditions and discuss how they were applied to the thermal model of the DSC and TC to simulate fire conditions. Include a discussion of the values of the effective thermal conductivity for the liquid-filled neutron shield used for the fire analysis, and specify how this value is derived.

A description of the boundary conditions and how those conditions were applied to the thermal models of the DSCs and TCs is not provided in the SAR. The staff requires a more complete description to complete its review.

This information is needed to satisfy the provisions of 10 CFR 72.236(f), and 10 CFR 72.11.

4-7 Describe the material effects of exceeding the short term temperature limit for the bottom forging of the OS200 and OS197FC-B transfer casks.

As indicated in Tables U.4-14 and T.4-11, during the fire transient the bottom forging of both the OS200 and OS197FC-B transfer casks exceed the given short term temperature limit. No discussion of this is provided in the SAR.

This information is needed to satisfy the provisions of 10 CFR 72.236(f), and 10 CFR 72.11.

4-8 Provide a clarification of differing DSC shell temperature limits for the DSC transfer accident scenarios described in sections U.4.5.4.2 (32 PTH1) and T.4.5.3.3 (61 BTH) of the appropriate SARs. Discuss how the DSC shell temperature limits described in the SAR sections relate to the temperatures limits (long term and short term) in the results tables (such as Tables U.4-14 and T.4-11)

The first transfer accident described in the SAR assumes failure of the forced air circulation. The time limit for the transfer condition is calculated based on reaching a DSC shell temperature of 435°F for the 61 BTH and 420°F or 450°F for the 32 PTH1 Type 1 and Type 2 DSCs respectively, which corresponds to a cladding temperature close to the long-term temperature limit of 752°F. However, the maximum allowable DSC temperature is listed as 800°F (for long term) and 1000°F (for short term) in Tables T.4-10 and Table U.4-14, for example, rather than the lower DSC shell temperatures mentioned above. It is not clear in the SAR why different limits are used for the different accident scenarios or why different limits are listed in the text versus the results tables.

This information is needed to satisfy the provisions of 10 CFR 72.236(f), and 10 CFR 72.11.

Note: RAI 4-9 and 4-10 apply to DSC Storage in HSM and HSM-H, SAR Sections U.4.4 and T.4.4.

4-9 Provide a detailed description of the correlation-based analysis method used for the DSCs within the HSM and HSM-H analyses, as discussed in Sections U.4.4.2 and T.4.4.4 of the SAR. Include a discussion of the correlations used, their applicability ranges, how they were applied to the analysis models in question, and any efforts to validate the correlations. If this information has been provided in documents previously submitted to the NRC, please provide references to those documents.

It is incumbent upon the applicant to provide a realistic analysis that captures the physical phenomenon involved in removal of heat from the DSC while stored in the HSM, and to provide the staff with reasonable assurance that the storage system will maintain structures, systems, and components important to safety below all applicable temperature limits. Use of correlations to model physical phenomena must be well documented and validated for use in a complex thermal analysis such as that presented in the SAR.

This information is needed to satisfy the provisions of 10 CFR 72.236(f), and 10 CFR 72.11.

4-10 Describe how the effects of changes in elevation (based on potential varied geographical locations of the storage system) were considered in the thermal analysis of the storage system. Provide an evaluation of how elevation might effect the thermal analysis results.

Changes in the properties of air due to changes in elevation may effect the removal of heat from a system that relies on natural (buoyant) convection as a primary mechanism for heat removal. This could increase the temperature of the cladding by several degrees depending on the importance of the air density in heat removal capacity.

This information is needed to satisfy the provisions of 10 CFR 72.236(f), and 10 CFR 72.11.

CHAPTER 5 Shielding Evaluation

5-1 Revise the shielding evaluation in Chapter M.5 of the SAR for the 32PT DSC to address the increased design-basis control component source term.

Table M.5-12 of the SAR indicates a large increase in the design-basis control component source term with no associated change in the external dose rates determined in Table M.5-3. It is not clear that the increased source term due to control components has been considered in the determination of external dose rates.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.236(d).

Note: RAI 5-2 through 5-5 are related to the addition of the 61BTH System

5-2 Revise the shielding evaluation in Chapter T.5 of the SAR to clarify why the Type 1 DSC is considered bounding with respect to external dose rates.

It is not clear that the Type 2 DSC, which has aluminum rails instead of the steel rails in the Type 1 DSC, would result in a lower dose rate for the same source term. Aluminum has a much lower shielding capacity than steel, and the SAR does not provide an analysis or a calculation to support the assumption that the Type 1 DSC provides less shielding, and is therefore more conservative, than a Type 2 DSC.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.236(d).

5-3 Revise the shielding analysis in Chapter T.5 of the SAR to determine the transfer cask top axial dose rates during closure operations without the consideration of supplemental shielding.

Neither the Technical Specifications for the 61BTH DSC nor the Operating Systems description of Chapter T.8 require the use of supplemental shielding during DSC closure operations. Although it is likely that licensees will use supplemental shielding to reduce

personnel doses around the top of the transfer cask, there are some closure operations (e.g., disconnecting top shield plug rigging in T.8.1.2 step 14) where supplemental shielding is not likely to be present. As personnel will be present in the top axial location for such operations, licensees should be aware of the potential dose rates in that area.

This information is needed to ensure that direct radiation levels from the transfer cask will meet as low as reasonably achievable objectives per 10 CFR 72.236(d).

5-4 Revise Section T.5.4.7.4 of the SAR to clarify the use of a neutron source adjustment factor of 1.326 to account for a non-conservative assumption regarding shielding density.

The last sentence of this section states that the neutron source term for transfer cask calculations is adjusted upward by a factor of 1.326 to account for non-conservatism associated with replacing structural steel with water in the shielding model. Although the staff agrees that the neutron source should be adjusted, it is not clear how the 1.326 factor was determined.

This information is needed to ensure that the shielding analysis is complete and accurate per the requirements of 10 CFR 72.11.

5-5 Revise the shielding analysis in Chapter T.5 of the SAR to justify the depletion parameters used in the SAS2H/ORIGEN-S calculations for the NUHOMS®-61BTH system.

Fuel assembly depletion parameters used in the SAS2H/ORIGEN-S calculations for the NUHOMS®-61BTH system, specifically the assumed assembly power, number of days burned, and down time between cycles, should bound the parameters for fuel assemblies to be stored. The shielding analysis should describe how these particular parameters were determined to be bounding.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.236(d).

Note: RAI 5-6 through 5-8 are related to the review of the 32PTH1 System

5-6 Revise the shielding evaluation in Chapter U.5 of the SAR to clarify why steel rails are considered bounding with respect to external dose rates.

It is not clear that steel rails in the transfer cask would result in a lower dose rate for the same source term. Aluminum has a much lower shielding capacity than steel, and the SAR does not provide an analysis or a calculation to support the assumption that the DSC with steel rails provides less shielding, and is therefore more conservative, than the DSC with aluminum rails.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.236(d).

5-7 Revise the shielding analysis in Chapter U.5 of the SAR to determine the transfer cask top axial dose rates during closure operations without the consideration of supplemental shielding.

Neither the Technical Specifications for the 32PTH1 DSC nor the Operating Systems description of Chapter U.8 require the use of supplemental shielding during DSC closure operations. Although it is likely that licensees will use supplemental shielding to reduce personnel doses around the top of the transfer cask, there are some closure operations (e.g., disconnecting top shield plug rigging in U.8.1.2 step 15) where supplemental shielding is not likely to be present. As personnel will be present in the top axial location for such operations, licensees should be aware of the potential dose rates in that area.

This information is needed to ensure that direct radiation levels from the transfer cask will meet as low as reasonably achievable objectives per 10 CFR 72.236(d).

5-8 Revise the shielding analysis in Chapter U.5 of the SAR to justify the depletion parameters used in the SAS2H/ORIGEN-S calculations for the NUHOMS®-32PTH1 system.

Fuel assembly depletion parameters used in the SAS2H/ORIGEN-S calculations for the NUHOMS®-32PTH1 system, specifically the assumed assembly power, number of days burned, and down time between cycles, should bound the parameters for fuel assemblies to be stored. The shielding analysis should describe how these particular parameters were determined to be bounding.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.236(d).

CHAPTER 6 Criticality Evaluation

6-1 This RAI relates to SAR Section U.6.4.1.3, Assumption 5. Justify how the analysis performed for Exxon 15x15 CE fuel assemblies in Appendix P applies to the analyzed B&W 15x15 Mark B-10 assemblies used as the bounding load out for the 32PTH1 DSC.

The applicant makes the assumption that the lattice average uniform enrichment assumption is justified and conservative when compared with variable axial or radial enrichment zones based on a study done in Appendix P, and assumes that this is valid for all assembly types, but no additional justification is provided.

This information is necessary to determine compliance with 10 CFR 72.236(c).

6-2 This RAI relates to SAR Table U.6-3, WE 14x14 Assembly Class. Identify whether the minus sign, "-" after two of the entries for basket type 1D or 2D indicate a missing notation or is just a formatting issue.

Since the applicant makes use of extensive notation in this table, it is unclear if this marking has any significance.

This information is necessary to determine compliance with 10 CFR 72.11.

6-3 This RAI relates to SAR Section T.6.4.1.3, Assumption 3. Justify why the lattice average uniform enrichment is a conservative assumption for intact fuel.

In Section T.6.4.2.A, the applicant refers to Appendix K for justification as to why this assumption is conservative, however, it is not explained how this applies to the 61BTH DSC configuration. As noted in Assumption 15, the applicant assumes the maximum peak pellet enrichment for damaged fuel scenarios.

This information is necessary to determine compliance with 10 CFR 72.236(c).

6-4 This RAI relates to SAR Section T.6.4.2.C, Page T.6-17, Second to last paragraph. Justify the use of one "Dancoff" factor for all of the damaged assembly calculations.

The applicant makes use of a standard Dancoff factor (2.6461172E-01) for the damaged assembly calculations that was obtained from the output files of intact assemblies. Since this factor is a strong function of the internal moderator density, and maximum reactivity may be at less than full density, this may affect the maximum calculated keff for damaged fuel.

This information is necessary to determine compliance with 10 CFR 72.236(c).

CHAPTER 7 Confinement Evaluation

7-1 Correct Figure U.3.1-1 “32 PTH1 DSC Confinement/Pressure Boundary” to label the weld joining the inner top cover plate to the DSC shell as part of the containment boundary.

As drawn, the subject figure identifies the siphon & vent port welds twice as containment boundary welds and does not identify the inner top cover plate to the DSC shell as such.

10CFR 72.11 requires that, in part, that information provided to the Commission must be complete and accurate in all material aspects.

7-2 Show the confinement redundant sealing boundary on Figure U.3.1-1 as was done on Figure T.3.1-1, “61 BTH DSC Confinement Boundary”

For consistency, identify the redundant sealing boundary as required by 72.236(e).

10CFR 72.11 requires that, in part, that information provided to the Commission must be complete and accurate in all material aspects

7-3 Show the test port plug (located over the vent port) on Figure T.3.1-1.

Section T.7.1.2 “Confinement Penetration” discusses the test port plug and as such it should be shown on the drawing as was done on Figure U.3.1-1.

10CFR 72.11 requires that, in part, that information provided to the Commission must be complete and accurate in all material aspects

7-4 Remove use of terminology for the test port plug being labeled ‘optional’ or ‘if used’. Refer to Figure U.3.1-1, Section T.7.1.2, Section U.7.1.2, Section T.8.1.3, Section U.8.1.3, and elsewhere in the SAR. The way it is written is misleading in that it sounds as though the plug itself is optional rather than the leak test method.

Since the siphon & port cover plate has the possibility of being pressurized at the time of welding ISG-18 suggests leak testing be performed.

10CFR 72.11 requires that, in part, that information provided to the Commission must be complete and accurate in all material aspects

7-5 Explain why no weld is shown between the siphon/vent block and the DSC shell on Sections E-E and F-F of Drawing NUH61BTH-2000-SAR, Sheet 4.

Without a weld specified at this location there appears to be no seal of the confinement boundary between the siphon/vent block and the DSC shell and gases could migrate from the basket fuel region to the outer top cover plate unrestricted.

10CFR 72.236(e) requires that the spent fuel storage cask must be designed to provide redundant sealing of the confinement system.

7-6 Add weld symbols, stipulating type and size of the weld attaching the siphon/vent block to the DSC shell, to Section B-B of Drawing NUH32PTH1-1001-SAR, Sheet 2.

As submitted the subject drawing does not specify this confinement boundary weld when it does specify all other confinement boundary welds.

10CFR 72.11 requires that, in part, that information provided to the Commission must be complete and accurate in all material aspects

7-7 Correct the maximum internal pressures listed in Section U.7.2.2 for normal and off normal conditions (i.e., 7.6 and 12.1 psig respectively) that do not agree with the values identified in Tables U.4-19 and U.4-23 (i.e., 8.5 and 18.7 psig, respectively)

10CFR 72.11 requires that, in part, that information provided to the Commission must be complete and accurate in all material aspects.

CHAPTER 8 Operating Systems

8-1 Verify that the 61BTH DSC pressure of 22.5 to 23.5 psig contained in SAR T.8.1.3.28 is the correct pressure for the 61BTH DSC Type 1 basket. SAR Section T.9.1.2 indicates

that the inner top cover/shield plug to the DSC shell weld is pressure tested between 16.5 to 18.0 psig for the 61BTH DSC with a Type 1 basket. The pressure provided in SAR T.8.1.3.28 is inconsistent with the discussion contained in SAR Section T.9.1.2.

This information is required by the staff to assess compliance with 10 CFR 72.236(b)

8-2 Justify why Technical Specification 1.2.8b “HSM-H Maximum Air Exit Temperature with a Loaded 61BTH DSC,” and Technical Specification 1.2.8c, “HSM-H Maximum Air Exit Temperature with a Loaded 32PTH1 DSC,” are not mentioned in Chapters T.8 and U.8 of the SAR, respectively. Alternatively, the applicant can reference these Technical Specifications in the appropriate place in Chapter T.8 and U.8 for the 61BTH and 32PTH1, respectively. These Technical Specifications apply following initial DSC transfer to the HSM-H. Consistent with other references to Technical Specification requirements contained in Chapters T.8 and U.8, it would appear that a mention of Technical Specification 1.2.8b, and 1.2.8c would be appropriate.

This information is required by the staff to assess compliance with 10 CFR 72.236(f).

8-3 Justify why step U.8.2.2.18 which describes filling the 32PTH1 DSC with water from the spent fuel pool does not refer to Technical Specification 1.2.15d, “Boron Concentration in the DSC Cavity Water for the 32PTH1 Design Only.” Section U.8.2.2 describes the process for removing fuel from the DSC. Section U.8.1.1 describes preparations of the TSC and DSC. Step U.8.1.1.11 mentions Technical Specification 1.2.15d when the DSC cavity is originally filled with water. Step U.8.2.2.18 is not consistent with step U.8.1.1.11 in that step U.8.2.2.18 does not refer back to the requirements contained in Technical Specification 1.2.15d when the 32PTH1 DSC is filled with water from the spent fuel pool.

This information is required by the staff to assess compliance with 10 CFR 72.236(b).

8-4 Verify that the caution contained in T.8.2.2.18(a) to ensure that the DSC vent pressure does not exceed 20.0 psig is applicable to the 61BTH DSC Type 1 basket. Section T.9.1.2. of the SAR indicates that the 61BTH DSC is pressure tested to between 16.5 psig to 18.0 psig. It would appear that the pressure contained in T.8.2.2.18(a) should be for a lower pressure for the 61BTH Type 1 basket.

This information is required by the staff to assess compliance with 10 CFR 72.236(b).

Note: RAI 8-5 is related to the thermal review of the application.

8-5 Provide a thermal analysis of the 32 PTH1 and 61 BTH DSCs with 900 and 1100 gallons of water, respectively, drained from the casks following removal from the spent fuel pool, demonstrating that peak fuel cladding temperature limits are not exceeded for the maximum heat loads for the respective DSCs.

Section U.8.1.2 and T.8.1.2 allow for up to 900 and 1100 gallons of water, respectively, to be drained from the applicable DSC, prior to sealing of the DSC, in order to accommodate removal with cranes that may have a weight limit imposed. The SAR does not provide an analysis of this operating condition. The staff requires such an

analysis to have reasonable assurance that fuel cladding temperatures are not exceeded.

This information is needed to satisfy the provisions of 10 CFR 72.11 and 10 CFR 72.236(f).

Note: RAI 8-6 is related to the shielding review of the 61BTH System

8-6 Revise the operating procedures in Section T.8.1.2 of the SAR to include a step ensuring that the transfer cask dose rates are compliant with limits specified in Technical Specification 1.2.11d.

The operating procedures for the NUHOMS®-61BTH system do not include a step after lifting the transfer cask out of the pool to measure dose rates to ensure compliance with the limits in the Technical Specifications. This step is necessary to ensure that fuel is properly loaded, the cask is adequately performing its intended radiation shielding function, and that dose rates around the cask can be kept as low as reasonably achievable.

This information is needed to ensure that direct radiation levels from the transfer cask will meet as low as reasonably achievable objectives per 10 72.236(d).

Note: RAI 8-7 is related to the shielding review of the 32PTH1 System

8-7 Revise the operating procedures in Section U.8.1.2 of the SAR to include a step ensuring that the transfer cask dose rates are compliant with limits specified in Technical Specification 1.2.11e.

The operating procedures for the NUHOMS®-32PTH1 system do not include a step after lifting the transfer cask out of the pool to measure dose rates to ensure compliance with the limits in the Technical Specifications. This step is necessary to ensure that fuel is properly loaded, the cask is adequately performing its intended radiation shielding function, and that dose rates around the cask can be kept as low as reasonably achievable.

This information is needed to ensure that direct radiation levels from the transfer cask will meet as low as reasonably achievable objectives per 10 CFR 72.236(d).

CHAPTER 9 Materials Evaluation

9-1 Page A-117 of the TS specifies helium leak rate testing of the inner seal weld. However it specifies a leak rate limit of less than 10 exp -4 cc/sec. Discuss why a welded canister design should have this leak rate limit instead of a “leak tight” rate of 10 exp -7 cc/sec.

This information is required for compliance with 10 CFR 72.236(j).

9-2 Provide amended TS wording (TS page A-117) to include helium leak rate testing of the vent and siphon port cover welds.

Page A-117 of the TS specifies a helium leak rate test of the inner top cover seal weld. However, the TS are silent with regard to helium leak testing the vent and siphon port covers (welds). Leak testing of the vent and siphon port cover welds are required in accordance with NRC staff guidance contained in ISG-18, rev. 1.

Some parts of the SAR, for instance SAR section U.8.1.4., para. 4, are worded in accordance with the staff guidance but is in conflict with the TS as presently written.

SAR page T.9-2, paragraph T.9.1.3 is also worded in accordance with the NRC staff guidance.

This information is required for compliance with 10 CFR 72.236(j).

9-3 Provide amended TS wording for TS page A-118, to include helium leak rate testing of the vent and siphon port cover welds.

As in question 2 above, page A-118 of the TS fails to mention leak rate testing of the vent and siphon port cover welds.

This information is required for compliance with 10 CFR 72.236(j).

9-4 Provide wording to incorporate into the TS a hydrogen gas monitoring or alleviating measure in accordance with the staff guidance provided in ISG-15.

Hydrogen gas may be evolved during wet loading (or unloading) operations and must be monitored or controlled to preclude the possibility of creating a flammable mixture inside the canister during welding or cutting operations.

This information is required for compliance with 10 CFR 72.236(b).

Note: RAI 9-5 through 9-10 has a note prior to the question that indicates which chapter of SAR Appendix T or Appendix U that originated the question.

Chapter T.1

9-5 Discuss the application, limits, and controls imposed upon Note 14 on drawing no. NUH61BTH-2001-SAR, sheet 2 of 2, and drawing no. NUH61BTH-2000-SAR, sheet 1 of 4. Specify whether or not the Note applies to important-to-safety component materials. If so, show that the proposed substitute material(s) will provide an equivalent margin of safety as the originally specified code material. Specify the critical characteristics of the material and show how these characteristics will be met by the substitute material(s).

Drawing No. NUH61BTH-2001-SAR, sheet 2 of 2, Note 14, states: “Alternate material specifications .... to those specified maybe used provided mechanical properties are equal to or greater than material specified and chemical composition is the same.”

Drawing no. NUH61BTH-2000-SAR. Sheet 1 of 4, note 14, accepts alternatives to ASME Code materials from other foreign standards. The ASME Code does not accept

such substitutions. The NRC staff periodically reviews and endorses portions of the ASME Code. The NRC staff does not review or endorse foreign codes or standards. Therefore, the NRC staff must review foreign codes, standards, or materials on a case-by-case basis.

Material substitutions for important-to-safety components must be discussed and explained in the body of the SAR, and reflected in the “Alternatives to the Code” table, if applicable, and controlled by the Technical Specifications.

This information is required for compliance with 10 CFR 72.236(b).

9-6 Discuss how the QA/QC aspects of substitutions allowed under Note 14 of drawing no. NUH61BTH-2001-SAR, sheet 2 of 2, and, drawing no. NUH61BTH-2000-SAR, sheet 1 of 4, would be controlled to assure equivalent levels of quality for any “equivalent” materials.

The staff appreciates the desirability for flexibility in manufacturing and material suppliers. However no indication is made regarding how any alternative materials would be assured to have equivalent quality as Code approved materials.

Material substitutions for important-to-safety components must be discussed and explained in the body of the SAR, and reflected in the “Alternatives to the Code” table, if applicable, and controlled by the Technical Specifications.

This information is required for compliance with 10 CFR 72.234(b).

SAR Chapter U.1

9-7 Provide a definition of damaged fuel that considers the structural integrity of the entire assembly, not simply the leak-tightness of the cladding and missing rods as with the currently proposed definition contained on SAR page U.1-3.

A staff accepted definition of damaged fuel is provided below. Note that this definition at present only applies to fuel in storage. This definition should be used throughout the amendment 10 SAR, including the sections related to the 61 BTH, 32 PTH, 24 PTH and 32PT designs.

The staff accepted definition:

> Damaged Fuel Assemblies are fuel assemblies with known or suspected cladding defects, as determined by a review of records, greater than pinhole leaks or hairline cracks, empty fuel rod locations that are not filled with dummy rods, missing structural components such as grid spacers, assemblies whose structural integrity has been impaired such that geometric rearrangement of fuel or gross failure of the cladding is expected based on engineering evaluations, or assemblies that cannot be handled by normal means. Fuel assemblies that cannot be handled by normal means due to fuel cladding damage are considered Fuel Debris.

This information is required for compliance with 10 CFR 72.236(b).

9-8 Explain how a top and bottom end cap (referenced on SAR page U.1-1) complies with the requirements of 10 CFR 72.236(m) and the NRC staff guidance provided in ISG-1.

The staff has provided guidance in ISG-1 which states that spent fuel must be readily retrievable from any storage or transportation canister by normal fuel handling means, e.g., grapple and hook. Damaged fuel bundles which may not be handled by normal means or damaged fuel which contains loose pieces such as rod segments or damaged fuel in the form of debris must be enclosed in a damaged fuel container which confines any fine particulates during loading, unloading, storage, or transportation operations. The damaged fuel canister also must allow handling of the damaged fuel by normal means, e.g., grapple and hook.

The confinement method proposed by the applicant would require unusual means to retrieve damaged fuel in the form of fuel debris, etc. and does not comply with the letter or intent of the regulations or staff guidance.

This information is required for compliance with 10 CFR 72.236 (m).

9-9 Discuss the application, limits, and controls imposed upon Note 11 of SAR Chapter U.1, drawing NUH32PTH1-1001-SAR, sheet 1 of 3. Specify whether or not it applies to important-to-safety component materials.

As a rule, material substitutions for important-to-safety components should be discussed and explained in the body of the SAR, reflected in the "Alternatives to the Code" table(s) as applicable, and controlled by the Technical Specifications.

This information is required for compliance with 10 CFR 72.236(b).

SAR Chapter U.3

9-10 Show that the extrapolated value for the stress allowable mentioned in Table U.3.1-2, page U.3.1-10 (bottom) is no higher than the stress allowable for a comparable type 304 stainless steel that is found in ASME Code, Section II, part D, Table 1A (which lists stress limits at higher temperatures than those for Table 2A).

The staff does not accept extrapolation of stress limits to higher temperatures because of potential non-conservative results. Instead, the applicant should make use of stress limits from the ASME Code, other nationally recognized Codes and Standards, producers literature, or provide material property data in accordance with the requirements of the ASME Code, Section II, Part D, Appendix 1.

This information is required for compliance with 10 CFR 72.236(b).

Note: RAI 9-11 through 9-18 are concerned with the material property values employed in the analyses of the various aluminum components, except neutron poison plates, used in all of the canister designs. The first question is general and the follow-on questions are directed to specific deficiencies in the SAR.

9-11 Provide revised stress calculations which employ creep properties (creep stress allowables) for the respective aluminum alloy components used in the fuel canister. Describe how potential creep distortion of fuel basket aluminum components (except neutron poison plates), which operate at temperatures above approximately 200 degrees F, would affect criticality, heat transfer, structural, and operational (e.g., unloading fuel bundle) issues, for ALL canister designs (61BTH, 32PTH1, 24PTH DSC, and 32PT DSC).

Calculations must consider the creep properties of aluminum when operating temperatures are above approximately 200 degrees F. The staff cannot make a finding given the data and structural analyses submitted, using annealed material tensile and yield properties, instead of the creep stress limits provided by the ASME Code (or, possibly, a proposed alternative source, subject to review).

For any creep property data obtained from a non-Code source, show that the data meets the requirements of the ASME Code, Section II, Part D, Appendix 1, paragraph 1-100(b) and (c). Conversely, provide detailed discussion supporting an alternative allowable creep-strain acceptance criteria, considering the long-term physical effects of creep strain upon the component geometry, its function, and the impact such creep distortion may have on the component's function and adjacent/surrounding components of the fuel basket/canister.

This information is required for compliance with 10 CFR 72.236(b).

Note: RAI 9-12 through RAI 9-17 which follow, address specific areas of the SAR which do not consider the creep properties of the various aluminum alloys and/or aluminum components employed in the various cask designs.

9-12 With consideration of the question above concerning the creep properties of aluminum, defend the use of SAR Tables U.3.3-4 and U.3.3-5. Also, provide a reference for Table U.3.3-5 if continued use of this table is justified.

This information is required for compliance with 10 CFR 72.236(b).

9-13 Provide a creep strain analysis of the canister basket rails and show that the accumulated creep strains over the design life will not adversely impact the integrity or performance of important-to-safety components or create operational difficulties should future handling of the fuel basket or fuel bundles be required.

SAR Table U.3.1-2, second entry, SAR page U.3.1-10, lists a proposed Code alternative for using type 6061 aluminum at temperatures above the Code allowable. However, the Table and the SAR do not address creep properties nor does the SAR discuss in detail the consequences of creep induced distortion of the rails. Mention is made that

deformation will not adversely affect the basket structure, but no creep strain analysis is provided and no discussion is provided regarding any other potential effects.

The proposed alternative suggests that annealed properties of 6061 are adequate for describing the properties of 6061 operating above 400 degrees F. However, since this is well into the creep range for aluminum, the creep properties of the material govern. Consequently, reference to creep stress allowables for 6061 at the proposed operating temperature are required.

The NRC staff cannot accept stress analysis arguments which are based upon annealed material properties when the material in question is operating in the creep regime. Under such conditions, the long-term creep strength governs material behavior and mechanical properties. Short-term properties such as yield and tensile cease to have practical meaning in long-term operation under creep conditions.

This information is required for compliance with 10 CFR 72.236(b).

9-14 Clarify the material grades and properties of aluminum that are used in the structural analyses. Revise the structural analyses to incorporate the appropriate creep properties of the various aluminum alloys and grades employed.

SAR page U.3.7-15, paragraph B states that type 6061 aluminum (annealed) is employed. However, no mention is made regarding which temper of type 6061 is employed. SAR table U.3.3-5 suggests that type 6061, temper O is employed, whereas, Table U.3.3-4 suggests other tempers are employed.

Additionally, neither table references the long-term creep properties of the material, which would govern all structural analyses.

This information is required for compliance with 10 CFR 72.236(b).

9-15 Discuss whether or not compressive creep deformation will occur in the type 1100 aluminum basket plates and describe in detail the consequences, considering heat transfer, criticality, structural, and/or other areas.

SAR page U.3.1-3 mentions that the aluminum heat transfer plates are loaded in thru-the-thickness bearing loads. However, it is not clear how the operating temperatures and stresses compare to Code stress allowables for this material. The staff is concerned that a substantial loss of heat conducting capacity may result if the material deforms in creep under the normal compressive loads at temperature.

This information is required for compliance with 10 CFR 72.236(b).

9-16 Discuss the potential for (and consequences of) creep deformation of the type 2 basket transition rails given that two widely different aluminum alloys are specified on SAR drawing NUH32PTH1-1004-SAR, sheet 1 of 4. In the discussion, show how the design loads comply with the creep stress limits for the design operating temperature.

The drawing specifies both types 1100 and 6061 aluminum (no temper specified for the type 6061). The Aluminum Association reference reveals substantial differences in the creep strength of these different alloys, with the type 1100 being the lower bound for strength, not the type 6061.

This information is required for compliance with 10 CFR 72.236(b).

9-17 Discuss the potential for (and consequences of) creep deformation of the type 1 basket transition rails given that they are operating in the creep regime for any aluminum alloy. In the discussion, show how the design loads compare with the creep stress limit for the design operating temperature.

This information is required for compliance with 10 CFR 72.236(b).

9-18 Provide a Technical Specification for boron neutron absorber supply and testing for other Standardized NUHOMS® DSC designs similar to the Technical Specification controls proposed for the 32PTH1 and 61BTH DSCs. Amendment 10 proposes to add the following to Technical Specification 1.2.1 for the 32PTH1 DSC regarding boron neutron absorber supply and testing:

> For the 32PTH1 DSC, Borated Aluminum, MMC, or Boral® shall be supplied in accordance with UFSAR Section U.9.1.17.1, U.9.1.7.2, U.9.1.7.3, U.9.1.7.5, U.9.1.7.6.5, and U.9.1.7.7.3 with the minimum B10 areal density specified in Table 1-1ff. These sections of the FSAR are hereby incorporated into the NUHOMS® 1004 CoC.

Similar changes were made to Technical Specification 1.2.1 for the 61BTH DSC. The staff is not sure why these Technical Specification controls do not apply to other DSCs (e.g., 24PTH, 32PT, etc) that use similar boron neutron absorber materials in their construction.

This information is required for compliance with 10 CFR 72.236(c).

Note: RAI 9-19 through RAI 9-22 are based upon Chapter U.9, but apply to all of the canisters. Thus the responses should address all designs, although the questions are phrased per the SAR for the 32PTH1.

Section U.9.1.7.5

9-19 Clarify the logic in subsection U.9.1.7.5. The fourth paragraph after the caution indicates that a 1.7 inch neutron beam diameter may be used for testing the neutron poison material for acceptance. With this neutron beam size, it is not clear how the confidence and probability levels can be adjusted so as to produce the equivalent rates for the material as when a 1.2 cm beam diameter is employed. With a uniform 1.2 cm beam size, a uniformity criterion can be established, the 95/95 criterion. The argument provided in the SAR appears to address the aspect of computational K (effective), not the uniformity of the product.

This information is required for compliance with 10 CFR 72.236(c).

Section U.9.1.7.5

9-20 Justify the statement in U.9.1.7.5 which indicates that “digital image analysis may be used to compare neutron radioscopic images of the test coupon to images of the standards.” Show that the sensitivity/precision of the method proposed is adequate for this task.

This information is required for compliance with 10 CFR 72.236(c).

Section U.9.1.7.6.1

9-21 Provide documentation/discussion which demonstrates that neutron poison material produced by the direct chill process is uniform throughout the entire plate, and thus the sampling plan is valid for a plate of material produced by this process.

The acceptance requirements of section 9.1.7.5 assume that the product has been previously qualified for uniformity. It is not clear to the staff that a plate of material produced by the direct chill process was used to demonstrate that this process will produce uniform plate material. Instead, it appears that an existing production QA/QC method is applied to verify the uniformity of the plate in question without first demonstrating separately that this material is in fact uniform and that the sampling plan is therefore valid.

This information is required for compliance with 10 CFR 72.236(c).

Section U.9.1.7.6.1

9-22 Show that random sample selection will be used and that the edges of the neutron poison plates will be adequately sampled for flaws to ensure that cracks that may be present at the plate edges would be detected.

A principle question for qualification of neutron poisons at the high-weight-percent levels is that flaw formation during rolling of the product shall not lead to insufficient B-10 content locally due to crack formation at edges of the plates. This cracking would produce areas lean in poison material. The propensity for crack formation along the plate edges increases as either the finish rolling temperature decreases or the percent boron carbide is increased. These considerations must be reviewed to determine when re-qualification of the poison plate material is required.

This information is required for compliance with 10 CFR 72.236(c).

CHAPTER 11 Accident Analysis

11-1 Change the reference in SAR section T.11.2.1 from SAR section 8.2.10 to SAR section 8.2.1. Section T.11.2.1 of the SAR describes the reduced HSM air inlet and outlet shielding event. This section references section 8.2.10 of the SAR for HSM models 80/102. The reference in Section T.11.2.1 should be to SAR section 8.2.1.

This information is required by the staff to assess compliance with 10 CFR 72.11.

11-2 Justify the addition of the very high ambient temperature 133°F accident analysis for the 32PTH1DSC contained in SAR T.11.2.11. This very high-temperature accident condition is not provided for the 61BTH DSC. It is unclear to the staff why this accident analysis is provided for the 32PTH1 DSC and not the 61BTH DSC.

This information is required by the staff to assess compliance with 10 CFR 72.236(f).

11-3 Justify the statement contained in SAR section U.11.2.12 that the 133°F ambient temperature is bounded by the blocked vent accident analysis documented in SAR Section U.11.2.7 because the inlet and outlet vents are functioning normally for the 133°F event. The blocked vent analysis contained in SAR Section U.4.4.1 is analyzed for an ambient temperature of 117°F. It is unclear to the staff why the blocked vent analysis is not analyzed for ambient temperatures of 133°F to support the statements made by TN in SAR section U.11.2.12. In addition, it appears that SAR section U.11.2.12 should be labeled U.11.2.11.2 to be consistent with the numbering scheme used throughout SAR Chapter U.11.

This information is required by the staff to assess compliance with 10 CFR 72.236(f).

Note: RAI 11-4 and 11-5 are related to the shielding review of the 61BTH System

11-4 Revise the accident dose calculations for tornado missile impact to consider the dose implication of loss of concrete shielding due to missile impact.

Section T.11.2.3.3 does not discuss the potential dose consequences of loss of concrete shielding due to tornado missile impact. It is possible that there could be localized increases in HSM external dose rates at and around the site of an impact, due to loss of concrete, and these potential dose rate increases should be addressed in this Section.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.106.

11-5 Revise Section T.11.2.5.3 of the SAR to discuss the source term used in the accident dose calculations for loss of the transfer cask neutron shield.

The design basis source term was determined in Chapter T.5 of the SAR based on an intact neutron shield. The resulting source term was one dominated by gammas, since the neutron dose rate is substantially reduced by the neutron shield. Using this same source term in the loss of neutron shield calculations may not result in the highest external dose, since a source term dominated by neutrons would seem to be bounding. The SAR should include a discussion of the source term used in this analysis and why it is considered to be bounding.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.106.

Note: RAI 11-6 and 11-7 are related to the shielding review of the 32PTH1 System

11-6 Revise the accident dose calculations for tornado missile impact to consider the dose implication of loss of concrete shielding due to missile impact.

Section U.11.2.3.3 does not discuss the potential dose consequences of loss of concrete shielding due to tornado missile impact. It is possible that there could be localized increases in HSM external dose rates at and around the site of an impact, due to loss of concrete, and these potential dose rate increases should be addressed in this Section.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.106.

11-7 Revise Section U.11.2.5.3 of the SAR to discuss the source term used in the accident dose calculations for loss of the transfer cask neutron shield.

The design basis source term was determined in Chapter U.5 of the SAR based on an intact neutron shield. The resulting source term was one dominated by gammas, since the neutron dose rate is substantially reduced by the neutron shield. Using this same source term in the loss of neutron shield calculations may not result in the highest external dose, since a source term dominated by neutrons would seem to be bounding. The SAR should include a discussion of the source term used in this analysis and why it is considered to be bounding.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.106.

CHAPTER 12 Technical Specifications

12-1 Correct the TS table of contents on page 1 for entry 1.2.4a and 1.2.11.d. Currently TS table of contents for 1.2.4a is titled “61BT, 32PT, 24PHB, 24PTH, and 61BTH DSC Helium Leak Rate of Inner Seal Weld.” This title does not match the title of the TS found on page A-118. The TS title for 1.2.4.a found on page A-118 is “61BT, 32PT, 24PHB, 24PTH, 61BTH and 32PTH1 DSC Helium Leak Rate of Inner Seal Weld.” The table of contents entry is missing the 32PTH1 in its title. Currently TS table of contents 1.2.11d limits the TS to a Type 2 61BTH DSC. The title and applicability of TS 1.2.11d contained on page A-140 mentions the 61BTH DSC and does not limit this TS to the Type 2 61BTH DSC.

This information is required by the staff to assess compliance with 10 CFR 72.11.

Note: RAI 12-2 through RAI 12-5 were developed as part of the thermal review of the application

12-2 Justify the definition of transfer time provided in Sections 1.2.18, 1.2.18a, and 1.2.18b of the Technical Specifications.

The 'transfer time' is defined as the time from draining the TC/DSC annulus (in the fuel handing building) to unbolting the TC top cover with the transfer trailer parked "a few inches" in front of the HSM-H. This implies that the transfer time does not include the time required to jack the trailer up into position, perform the final alignment of the DSC with the HSM-H door, and actually insert the DSC into the module by means of a hydraulic ram. During nearly all of this interval, the DSC is still within the TC, and is subject to the heat transfer conditions of transit. If the time required to insert the DSC into the HSM-H is to be considered negligible, this must be justified.

This information is needed to satisfy the provisions of 10 CFR 72.11 and 10 CFR 72.236(f).

12-3 Clarify the meaning of the transfer time limit as defined in Sections 1.2.18, 1.2.18a, and 1.2.18b of the Technical Specifications.

The time limit is defined as "the time elapsed after the initiation of draining of Cask/DSC annulus water and bolting of the transfer cask top cover plate until it is unbolted for insertion of the DSC into the HSM-H." It is unclear whether this means that the time limit starts from the moment the plug on the annulus drain port is removed, or if it starts when the last bolt on the TC top cover has been secured. The time taken in the process of draining the annulus and bolting the lid should be included in the time limit, as there will be thermal effects on the DSC, because it is in the transfer cask environment for the full duration of this evolution.

This information is needed to satisfy the provisions of 10 CFR 72.11 and 10 CFR 72.236(f).

12-4 Provide more detailed description and analysis of the alternate means of cooling the transfer cask if forced air circulation is unavailable as described in Sections T.4.5.3.1 of the SAR and 1.2.18(b) of the Technical Specifications.

If the transfer time limit is exceeded, the list of possible actions that can be taken includes initiating external cooling of the cask by means of forced air circulation, or "by other means." The thermal analyses described in the SAR do not provide details of any other means of cooling the DSC than natural convection or forced air circulation. The SAR does not describe how the effectiveness of these 'other means' will be evaluated or how much more time they would provide before the fuel cladding temperature limit is reached.

This information is needed to satisfy the provisions of 10 CFR 72.11 and 10 CFR 72.236(f).

12-5 Provide an explanation of how ambient temperatures will be measured during transfer of a loaded DSC. If the ambient temperature during the transfer operation exceeds 106°F, state what actions would be taken to shield the transfer cask within the DSC.

In the Action portion of Technical Specification (TS) 1.2.14(a) it states that the solar shield is to be used during transfer "if ambient temperature is expected to exceed 106°F." The Surveillance section of this TS prescribes measuring the ambient

temperature "before transfer of the TC/DSC," but does not require any other measurement. It is not clear in the SAR whether the actual ambient temperature during the transfer operation is being measured or not, and if not, how it is determined whether the ambient temperature exceeds 106°F at any time during the transfer operation.

This information is needed to satisfy the provisions of 10 CFR 72.236(f), and 10 CFR 72.11.

Note: RAI 12-6 is related to the shielding review of the change of contents to the 32PT DSC.

12-6 Revise the Technical Specifications for the 32PT DSC to address the source term energy distribution limits for individual control components.

Section M.5 of the SAR states that "Any CC to be stored in a 32PT DSC must be bounded" by the source term shown in Table M.5-12. This table gives the bounding source term energy distribution for any individual control component loaded in the DSC. The Technical Specifications, however, give a control component source term limit in Table 1-1ee based on the cumulative source from all control components in the DSC. The Technical Specifications should be revised to include the individual control component source term energy distribution limit. Alternatively, the shielding evaluation should be revised either to address the potential for uneven distribution of the control component source term, or to discuss how the current Technical Specification limits will otherwise prevent uneven distribution of the control component source term.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.236(d).

Note: RAI 12-7 is related to the shielding review of the change of contents to the 24PTH DSC.

12-7 Revise the Technical Specifications for the 24PTH DSC to include a statement in the fuel specifications requiring that partial length shield assemblies (PLSAs) are authorized for storage if they have only ever been irradiated in peripheral core locations.

The shielding analyses for PLSAs includes an assumption that these assemblies have only been irradiated in peripheral core locations, and thus have been exposed to a reduced neutron flux. This assumption is invalid if the assemblies have been irradiated in anything other than a peripheral core location.

This information is needed to ensure that the storage system continues to meet the external dose rate requirements of 10 CFR 72.236(d).

Note: RAI 12-8 is related to the shielding review of the 61BTH System

12-8 Revise the Technical Specification for transfer cask dose rates with a loaded 61BTH DSC in Section 1.2.11d to state that the dose rates should be measured as soon as possible after the transfer cask is removed from the spent fuel pool.

Measuring the transfer cask dose rates is necessary to ensure that fuel is properly loaded, the cask is adequately performing its intended radiation shielding function, and

that dose rates around the cask can be kept as low as reasonably achievable. Prolonging dose rate measurement until the cask is being downended onto the transfer trailer could result in significant personnel exposures before there is recognition that the cask does not meet the Technical Specification dose rate limits. Additionally, measuring the dose rates after the DSC is sealed, drained, dried, and placed on the transfer trailer, will make corrective measures in the event of a transfer cask failing the dose rate limit exceedingly difficult.

This information is needed to ensure that direct radiation levels from the transfer cask will meet as low as reasonably achievable objectives per 10 CFR 72.236(d).

Note: RAI 12-9 is related to the shielding review of the 32PTH1 System

12-9 Revise the Technical Specification for transfer cask dose rates with a loaded 32PTH1 DSC in Section 1.2.11e to state that the dose rates should be measured as soon as possible after the transfer cask is removed from the spent fuel pool.

Measuring the transfer cask dose rates is necessary to ensure that fuel is properly loaded, the cask is adequately performing its intended radiation shielding function, and that dose rates around the cask can be kept as low as reasonably achievable. Prolonging dose rate measurement until the cask is being downended onto the transfer trailer could result in significant personnel exposures before there is recognition that the cask does not meet the Technical Specification dose rate limits. Additionally, measuring the dose rates after the DSC is sealed, drained, dried, and placed on the transfer trailer, will make corrective measures in the event of a transfer cask failing the dose rate limit exceedingly difficult.

This information is needed to ensure that direct radiation levels from the transfer cask will meet as low as reasonably achievable objectives per 10 CFR 72.236(d).