TRANSNUCLEAR
AN AREVA COMPANY

May 26, 2009
E-28168

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Subject: Revision 4 to Transnuclear, Inc. (TN) Application for Amendment 1 to the NUHOMS® HD System (Docket No. 72-1030; TAC NO. L24153)

References:
1. Letter from B. Jennifer Davis (NRC) to Donis Shaw (TN), "SECOND REQUEST FOR ADDITIONAL INFORMATION FOR REVIEW OF AMENDMENT 1 TO THE NUHOMS® HD SYSTEM (TAC NO. L24153)," April 3, 2009
2. Letter from Jayant Bondre (TN) to Document Control Desk, "Revision 3 to Transnuclear, Inc. (TN) Application for Amendment 1 to the NUHOMS® HD System, Response to Second Request for Additional Information (Docket No. 72-1030; TAC NO. L24153)," April 30, 2009

Reference 1 forwarded an NRC request for additional information (RAI) regarding Amendment 1 to the NUHOMS® HD System. Reference 2 provided Transnuclear's (TN) response to the RAI. Following submittal of Reference 2, NRC and TN discussed certain responses. Based on those discussions, this submittal provides proposed changes to the CoC 1030 Technical Specifications (TS) and to the NUHOMS® HD System UFSAR, Chapter 9 concerning neutron absorber qualification and testing.

Enclosure 1 provides discussion regarding the changes. Enclosure 2 provides a list of Amendment 1 Revision 4 TS and UFSAR replacement pages included herein. Enclosure 3 provides the TS and UFSAR Amendment 1 replacement pages.

In both the TS and the UFSAR, Amendment 1 Revision 0, Revision 1, Revision 2, Revision 3, and Revision 4 changes are shown using italics for inserted text and revision bars for changed areas; however, Revision 4 changes are shaded to distinguish these new changes from Revisions 0, 1, 2, and 3 changes. For the UFSAR, page footers for replacement pages are annotated as "Amendment 1, Rev. 4, 5/09."

Should the NRC staff require additional information to support review of this application, please do not hesitate to contact Mr. Don Shaw at 410-910-6878 or me at 410-910-6881.

Sincerely,

Jayant Bondre, Ph.D.
Vice President - Engineering

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cc: B. Jennifer Davis (NRC SFST) (six paper copies of this cover letter and Enclosures 1 through 3, provided separately)

Enclosures:

1. Discussion of Changes for CoC 1030 Amendment 1 Application Revision 4
2. List of Changed Pages for CoC 1030 Amendment 1 Application Revision 4
3. NUHOMS® HD Amendment 1 Application Revision 4, Changed Proposed Technical Specifications and Proposed Updated Final Safety Analysis Report Pages

## Discussion of Changes for CoC 1030 Amendment 1 Application Revision 4

Based on discussion of the response to RAI 1.5 in Reference 2, the first newly added sentence on UFSAR Page 9-9 is modified to more specifically describe calibration of standards, rather than refer to quality assurance procedures.

Based on discussion of the response to RAI 1.8 in Reference 2, visual acceptance criteria requiring rework are relocated from UFSAR Section 9.1.7.5 into Section 9.1.7.4, thereby incorporating the criteria into the Technical Specifications by reference.

Based on discussion of the responses to RAIs 1.3, 1.9, 1.10, 1.11, and 1.12 in Reference 2, UFSAR Section 9.5.3.4, regarding qualification tests and examinations to demonstrate mechanical integrity, is now incorporated into the Technical Specifications by reference. Section 9.5.3.4(c) is revised to specify 24 hour testing in a pre-heated oven.

Based on these changes, the UFSAR pages and Technical Specifications page which delineate UFSAR sections incorporated into the Technical Specifications by reference are also updated.

## List of Changed Pages for CoC 1030 Amendment 1 Application Revision 4

Note: In both the TS and the UFSAR, Amendment 1 Revision 0, Revision 1, Revision 2, Revision 3, and Revision 4 changes are shown using italics for inserted text and revision bars for changed areas; however, Revision 4 changes are shaded to distinguish these new changes from Revision 0, Revision 1, Revision 2 and Revision 3 changes.

| Page | Associated RAI(s) |
|---|---|
| Tech Specs Page 4-2 | RAIs 1.3, 1.9, 1.10, 1.11, and 1.12 |
| SAR Page 9-5 | RAI 1.8 |
| SAR Page 9-8 | The CAUTION text box regarding UFSAR Sections 9.5.2.a and 9.5.3.3.1 is revised. Section 9.5.3.3.1 is covered in a new text box under Section 9.5.3. |
| SAR Page 9-9 | RAI 1.5 |
| SAR Page 9-10 | A new CAUTION text box is added regarding UFSAR Sections 9.5.3.3.1, 9.5.3.4, and 9.5.3.5. |
| SAR Page 9-11 | RAIs 1.3, 1.9, 1.10, 1.11, and 1.12<br><br>Also, the CAUTION text box regarding UFSAR Section 9.5.3.5 is removed and Section 9.5.3.5 is included in a new text box under Section 9.5.3 on Page 9-10. |

**Enclosure 3 to TN E-28168**

**NUHOMS® HD Amendment 1 Application Revision 4, Changed Proposed Technical Specifications and Proposed Updated Final Safety Analysis Report Pages**

4.0 Design Features (continued)

4.3 Canister Criticality Control

The NUHOMS®-32PTH is designed for unirradiated fuel with an assembly average initial enrichment of less than or equal to 5.0 wt. % U-235 taking credit for soluble boron in the DSC cavity water during loading operations and the boron content in the poison plates of the DSC basket. The 32PTH DSC has multiple basket configurations, based on the material type and boron content in the poison plates, as listed in Table 6. Table 7 defines the requirements for boron concentration in the DSC cavity water as a function of the DSC basket type for the various intact and damaged fuel classes (most reactive) authorized for storage in the 32PTH DSC.

A Type I basket contains poison plates that are either borated aluminum or MMC while a Type II basket contains Boral® poison plates. The basket types are further defined by the B-10 areal density in the plates, ranging from the lowest, Type A to the highest, Type E.

4.3.1 Neutron Absorber Tests

Borated Aluminum, MMCs, or Boral® shall be supplied in accordance with FSAR Sections 9.1.7.1 *through* *9.1.7.4,* 9.5.2.*a*, *9.5.3.3.1,* *9.5.3.4,* 9.5.3.5, *9.5.4.1* and *9.5.4.2*, with the minimum B10 areal density specified in Table 6. These sections of the FSAR are hereby incorporated into the NUHOMS® HD CoC.

4.4 Codes and Standards

4.4.1 Horizontal Storage Module (HSM-H)

The reinforced concrete HSM-H is designed to meet the requirements of ACI 349-97. Load combinations specified in ANSI 57.9-1984, Section 6.17.3.1 are used for combining normal operating, off-normal, and accident loads for the HSM-H.

If an independent spent fuel storage installation site is located in a coastal salt water marine atmosphere, then any load-bearing carbon steel DSC support structure rail components of any associated HSM-H shall be procured with a minimum 0.20 percent copper content for corrosion resistance.

4.4.2 Dry Shielded Canister (32PTH DSC)

The 32PTH DSC is designed, fabricated and inspected to the maximum practical extent in accordance with ASME Boiler and Pressure Vessel Code Section III, Division 1, 1998 Edition with Addenda through 2000, Subsections NB, NF, and NG for Class 1 components and supports. Code alternatives are discussed in 4.4.4.

4.4.3 Transfer Cask (OS187H)

The OS187H Transfer Cask is designed, fabricated and inspected to the maximum practical extent in accordance with ASME Boiler and Pressure Vessel Code Section III, 1998 Edition with Addenda through 2000, Subsection NC for Class 2 vessels.

### *9.1.7.4 Visual Inspections of Neutron Absorbers*

***Neutron absorbers shall be 100% visually inspected in accordance with the Certificate Holder's QA procedures. Material that does not meet the following acceptance criteria shall be reworked, repaired, or scrapped. Blisters shall be treated as non-conforming. Inspection of MMCs with an integral aluminum cladding shall also include verification that the matrix is not exposed through the faces of the aluminum cladding and that solid aluminum is not present at the edges. For Boral, visual inspection shall verify that there are no cracks through the cladding, exposed core on the face of the sheet, or solid aluminum at the edge of the sheet.***

### *9.1.7.5 Other Visual Inspections Criteria (non-Technical Specifications)*

*For borated aluminum and MMCs, visual inspections shall follow the recommendations in Aluminum Standards and Data, Chapter 4 "Quality Control, Visual Inspection of Aluminum Mill Products and Castings"[5]. Local or cosmetic conditions such as scratches, nicks, die lines, inclusions, abrasion, isolated pores, or discoloration are acceptable.*

## 9.2 Maintenance Program

The NUHOMS® HD System is designed to be totally passive with minimal maintenance requirements. The 32PTH DSC does not require any maintenance once it is loaded into the HSM-H. The HSM-H does not require any maintenance other than that indicated in off-normal operations, Chapter 11, such as clearing of blocked air inlets. Periodic inspection is therefore limited to the Transfer Cask.

### 9.2.1 Inspection

The following inspections of the transfer cask should be performed prior to each fuel loading or unloading campaign:

A. Visual inspection of the transfer cask trunnions for damaged bearing surfaces

B. Visual or functional inspection of all taps, threaded inserts, and bolts

C. Functional inspection of all quick-connect fittings

D. Visual inspection of the interior surface of the cask for any indications of excessive wear.

E. Visual inspection of the neutron shield jacket for indications of damage

F. Visual inspection of all Transfer Cask o-rings for indications of damage

Within the year prior to any loading or unloading campaign, the top trunnion bearing surfaces and accessible welds shall be examined by dye penetrant. No linear indications shall be acceptable other than surface scratches and wear.

### 9.2.2 Tests

The Transfer Cask lid and ram access cover o-rings, vent and drain quick connect fittings, and neutron shield fittings shall be leak tested within the year before the start of any fuel loading or unloading campaign. If bubble leak testing is used, no leak indication is allowed. If pressure

alloy (e.g., from 6000 to 1000 series aluminum), or if the boron content is reduced without changing the boron phase.

The thermal analysis in Chapter 4 assumes a 3/16 inch thick neutron absorber paired with a 5/16 inch aluminum 1100 plate. The specified thickness of the neutron absorber may vary, and the thermal conductivity acceptance criterion for the neutron absorber will be based on the nominal thickness specified. The minimum thermal conductivity shall be such that the total thermal conductance (sum of conductivity * thickness) of the neutron absorber and the aluminum 1100 plate shall equal the conductance assumed in the analysis, as shown in Table 9-3, where the acceptance criterion is highlighted.

The aluminum 1100 plate does not need to be tested for thermal conductivity; the material may be credited with the values published in the ASME Code Section II part D. The neutron absorber material need not be tested for thermal conductivity if the nominal thickness of the aluminum 1100 plate is 0.425 inch or greater. This case is examined explicitly in chapter 4, where no credit is taken for the thermal conductivity of Boral®.

9.5.2 Specification for Acceptance Testing of Neutron Absorbers by Neutron Transmission

*CAUTION*

*Section 9.5.2.a is incorporated by reference into the NUHOMS® CoC 1030 Technical Specifications (paragraph 4.3.1) and shall not be deleted or altered in any way without a CoC amendment approval from the NRC. The text of this section is shown in bold type to distinguish it from other sections.*

*a.* **Neutron Transmission acceptance testing procedures shall be subject to approval by the Certificate Holder. Test coupons shall be removed from the rolled or extruded production material at locations that are systematically or probabilistically distributed throughout the lot. Test coupons shall not exhibit physical defects that would not be acceptable in the finished product, or that would preclude an accurate measurement of the coupon's physical thickness.**

**A lot is defined as all the pieces produced from a single ingot or heat *or from a group of billets from the same heat.* If this definition results in lot size too small to provide a meaningful statistical analysis of results, an alternate larger lot definition may be used, so long as it results in accumulating material that is uniform for sampling purposes.**

**The sampling rate for neutron transmission measurements shall be such that there is at least one neutron transmission measurement for each 2000 square inches of final product in each lot.**

**The B10 areal density is measured using a collimated thermal neutron beam of *no more than 1 inch* diameter.**

**The neutron transmission through the test coupons is converted to B10 areal density by comparison with transmission through calibrated standards. These standards are composed of a homogeneous boron compound without other significant neutron absorbers. For example, boron carbide, zirconium diboride or titanium diboride**

**sheets are acceptable standards. These standards are paired with aluminum shims sized to match the effect of neutron scattering by aluminum in the test coupons. Uniform but non-homogeneous materials such as metal matrix composites may be used for standards, provided that testing shows them to provide neutron attenuation equivalent to a homogeneous standard.** ***Standards will be calibrated, traceable to nationally recognized standards, or by attenuation of a monoenergetic neutron beam correlated to the known cross section of boron 10 at that energy.***

**Alternatively, digital image analysis may be used to compare neutron radioscopic images of the test coupon to images of the standards. The area of image analysis shall be** ***no more than 0.75 sq. inch.***

**The minimum areal density specified shall be verified for each lot at the 95% probability, 95% confidence level or better.** ***If a goodness-of-fit test demonstrates that the sample comes from a normal population, the one-sided tolerance limit for a normal distribution may be used for this purpose. Otherwise, a non-parametric (distribution-free) method of determining the one-sided tolerance limit may be used. Demonstration of the one-sided tolerance limit shall be evaluated for acceptance in accordance with the Certificate Holder's QA procedures.***

*b.* The following illustrates one acceptable method *and is intended to be utilized as an example. Therefore, the following text is not part of the Technical Specifications.* The acceptance criterion for individual plates is determined from a statistical analysis of the test results for their lot. The B10 areal densities determined by neutron transmission are converted to volume density, i.e., the B10 areal density is divided by the thickness at the location of the neutron transmission measurement or the maximum thickness of the coupon. The lower tolerance limit of B10 volume density is then determined, defined as the mean value of B10 volume density for the sample, less K times the standard deviation, where K is the one-sided tolerance limit factor with 95% probability and 95% confidence [7].

Finally, the minimum specified value of B10 areal density is divided by the lower tolerance limit of B10 volume density to arrive at the minimum plate thickness which provides the specified B10 areal density.

Any plate which is thinner than this minimum or the minimum design thickness, whichever is greater, shall be treated as non-conforming, with the following exception. Local depressions are acceptable, so long as they total no more than 0.5% of the area on any given plate, and the thickness at their location is not less than 90% of the minimum design thickness.

Non-conforming material shall be evaluated for acceptance in accordance with the Certificate Holder's QA procedures.

9.5.3 Specification for Qualification Testing of Metal Matrix Composites

*CAUTION*

*Section 9.5.3.3.1, Section 9.5.3.4, and Section 9.5.3.5 are incorporated by reference into the NUHOMS® CoC 1030 Technical Specifications (paragraph 4.3.1) and shall not be deleted or altered in any way without a CoC amendment approval from the NRC. The text of these sections is shown in bold type to distinguish them from other sections.*

9.5.3.1 Applicability and Scope

Metal matrix composites (MMCs) *acceptable for use in the 32PTH DSC are described in Section 9.1.7.2.*

Prior to initial use in a spent fuel dry storage or transport system, such MMCs shall be subjected to qualification testing that will verify that the product satisfies the design function. Key process controls shall be identified per Section 9.5.4 so that the production material is equivalent to or better than the qualification test material. Changes to key processes shall be subject to qualification before use of such material in a spent fuel dry storage or transport system.

ASTM test methods and practices are referenced below for guidance. Alternative methods may be used with the approval of the certificate holder.

9.5.3.2 Design Requirements

In order to perform its design functions the product must have at a minimum sufficient strength and ductility for manufacturing and for the normal and accident conditions of the storage/ transport system. This is demonstrated by the tests in Section 9.5.3.4. It must have a uniform distribution of boron carbide. This is demonstrated by the tests in Section 9.5.3.5.

9.5.3.3 Durability

There is no need to include accelerated radiation damage testing in the qualification. Such testing has already been performed on MMCs, and the results confirm what would be expected of materials that fall within the limits of applicability cited above. Metals and ceramics do not experience measurable changes in mechanical properties due to fast neutron fluences typical over the lifetime of spent fuel storage, about $10^{15}$ neutrons/cm$^2$.

*Thermal damage and corrosion (hydrogen generation) testing shall be performed unless such tests on materials of the same chemical composition have already been performed and found acceptable. The following paragraphs illustrate two cases where such testing is not required.*

Thermal damage testing is not required for *unclad* MMCs consisting only of boron carbide in an aluminum 1100 matrix, because there is no reaction between aluminum and boron carbide below 842°F, well above the basket temperature under normal conditions of storage or transport[3].

Corrosion testing is not required for MMCs *(clad or unclad)* consisting only of boron carbide in an aluminum 1100 matrix, because testing on one such material has already been performed by Transnuclear[4].

[3] Sung, C., "Microstructural Observation of Thermally Aged and Irradiated Aluminum/Boron Carbide (B4C) Metal Matrix Composite by Transmission and Scanning Electron Microscope," 1998

[4] Boralyn testing submitted to the NRC under docket 71-1027, 1998

#### *9.5.3.3.1 Delamination Testing of Clad MMC*

***Clad MMCs shall be subjected to thermal damage testing following water immersion to ensure that delamination does not occur under normal conditions of storage.***

**9.5.3.4 Required Qualification Tests and Examinations to Demonstrate Mechanical Integrity**

**At least three samples, one each from *approximately* the two ends and middle of the *qualification* material run shall be subject to:**

**a) room temperature tensile testing (ASTM-B557[5]) demonstrating that the material has the following tensile properties:**

- **Minimum yield strength, 0.2% offset: 1.5 ksi**
- **Minimum ultimate strength: 5 ksi**
- **Minimum elongation in 2 inches: 0.5%**

***As an alternative to the elongation requirement, ductility may be demonstrated by bend testing per ASTM E290[6]. The radius of the pin or mandrel shall be no greater than three times the material thickness, and the material shall be bent at least 90 degrees without complete fracture.***

**b) *Testing* to verify more than 98% of theoretical density *for non-clad MMCs and 97% for the matrix of clad MMCs*. Testing or examination for interconnected porosity *on the faces and edges of unclad MMC, and on the edges of clad MMC* shall be performed by a means to be approved by the Certificate Holder. *The maximum interconnected porosity is 0.5 volume %, and for at least one sample.***

**c) *For MMCs with an integral aluminum cladding, thermal durability testing demonstrating that after a minimum 24 hour soak in either pure or borated water, then insertion into a preheated oven at approximately 825°F for a minimum of 24 hours, the specimens are free of blisters and delamination and pass the mechanical testing requirements described in test 'a' of this section.***

**9.5.3.5 Required Tests and Examinations to Demonstrate B10 Uniformity**

**Uniformity of the boron distribution shall be verified either by:**

**(a) Neutron radioscopy of material from the ends and middle of the test material production run, verifying no more than 10% difference between the minimum and maximum B10 areal density, or**

**(b) Quantitative testing for the B10 areal density, B10 density, or the boron carbide weight fraction, on locations distributed over the test material production run, verifying that one standard deviation in the sample is less than 10% of the sample mean. Testing may be performed by a neutron transmission method similar to that specified in Section 9.5.2, or by chemical analysis for boron carbide content in the composite.**

9.5.3.6 Approval of Procedures

Qualification procedures shall be subject to approval by the Certificate Holder.

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[5] ASTM B557 Standard Test Methods of Tension Testing Wrought and Cast Aluminum and Magnesium-Alloy Products

[6] *ASTM E290, Standard Methods for Bend Testing of Materials for Ductility*