TRANSNUCLEAR
AN AREVA COMPANY

October 8, 2008
E-27181

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

Subject: Revision 5 to Transnuclear, Inc. (TN) Application for Amendment 10 to the Standardized NUHOMS® System (Docket No. 72-1004; TAC NO. L24052)

Based on recent discussions with the NRC staff, this submittal provides revised discussions for the fuel drop analyses associated with proposed Amendment 10 to the Standardized NUHOMS® System, plus certain requested computer input and output files.

Enclosure 7 provides the recent NRC staff inquiries and TN responses. Enclosure 2 provides a list of Amendment 10 application SAR pages that changed and are included herein. Amendment 10 application SAR replacement pages are provided as Enclosure 3, annotated as Revision 5, with changes indicated by italicized text and revision bars. Enclosure 6 is a computer disk providing LS-DYNA input and output files associated with the 80-inch corner drop analysis for the CoC 1030 NUHOMS® HD System and input and output files for the fuel corner drop analysis for the Amendment 10 bounding case. Enclosure 5 provides a listing of the computer files contained on Enclosure 6.

This submittal includes proprietary information which may not be used for any purpose other than to support your staff's review of the application. In accordance with 10 CFR 2.390, I am providing an affidavit (Enclosure 1) specifically requesting that you withhold this proprietary information from public disclosure. Enclosure 4 provides a non-proprietary version of the changes to the Amendment 10 application SAR. Enclosure 8 provides a non-proprietary version of the recent NRC staff inquiries and TN responses.

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 410-910-6930.

Sincerely,

Robert Grubb
Senior Vice President - Engineering

cc: B. Jennifer Davis (NRC SFST) (11 paper copies of this cover letter, Enclosures 1 through 5 and Enclosure 7, plus one copy of Enclosure 6, all provided separately)

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Enclosures:

1. Affidavit Pursuant to 10 CFR 2.390
2. List of Changed Pages for CoC 1004 Amendment 10 Application Revision 5
3. Amendment 10 application Revision 5 SAR changes (Proprietary version)
4. Amendment 10 application Revision 5 SAR changes (Non-proprietary version)
5. Listing of the Files Contained in Enclosure 6
6. Computer Disc Containing Input and Output Files (Proprietary)
7. Recent NRC Staff Inquiries and TN Responses (Proprietary version)
8. Recent NRC Staff Inquiries and TN Responses (Nonproprietary version)

AFFIDAVIT PURSUANT
TO 10 CFR 2.390

Transnuclear, Inc.)
State of Maryland) SS.
County of Howard)

I, Robert Grubb, depose and say that I am Senior Vice President of Transnuclear, Inc. (TN), duly authorized to execute this affidavit, and have reviewed or caused to have reviewed the information which is identified as proprietary and referenced in the paragraph immediately below. I am submitting this affidavit in conformance with the provisions of 10 CFR 2.390 of the Commission's regulations for withholding this information.

The information for which proprietary treatment is sought is contained in Enclosures 3, 6, and 7, and is listed below:

1. Portions of Amendment 10 application SAR Appendix T.3, Section T.3.5
2. Portions of Amendment 10 application SAR Appendix U.3, Section U.3.5
3. Certain Computer Input and Output Files for Drop Analyses
4. Portions of Recent NRC Staff Inquiries and Responses which reflect Proprietary SAR information

These documents have been appropriately designated as proprietary.

I have personal knowledge of the criteria and procedures utilized by Transnuclear, Inc. in designating information as a trade secret, privileged or as confidential commercial or financial information.

Pursuant to the provisions of paragraph (b) (4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure, included in the above referenced document, should be withheld.

1) The information sought to be withheld from public disclosure are changed safety analysis report pages, related to the structural analyses of dry storage systems, plus computer input and output files associated with structural analyses of dry storage systems, which are owned and have been held in confidence by Transnuclear, Inc.

2) The information is of a type customarily held in confidence by Transnuclear, Inc. and not customarily disclosed to the public. Transnuclear, Inc. has a rational basis for determining the types of information customarily held in confidence by it.

3) The information is being transmitted to the Commission in confidence under the provisions of 10 CFR 2.390 with the understanding that it is to be received in confidence by the Commission.

4) The information, to the best of my knowledge and belief, is not available in public sources, and any disclosure to third parties has been made pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence.

5) Public disclosure of the information is likely to cause substantial harm to the competitive

position of Transnuclear, Inc. because:

a) A similar product is manufactured and sold by competitors of Transnuclear, Inc.

b) Development of this information by Transnuclear, Inc. required expenditure of considerable resources. To the best of my knowledge and belief, a competitor would have to undergo similar expense in generating equivalent information.

c) In order to acquire such information, a competitor would also require considerable time and inconvenience related to the development of a design and analysis of a dry spent fuel storage system.

d) The information required significant effort and expense to obtain the licensing approvals necessary for application of the information. Avoidance of this expense would decrease a competitor's cost in applying the information and marketing the product to which the information is applicable.

e) The information consists of descriptions of the design and analysis of dry spent fuel storage systems, plus computer input and output data, the application of which provide a competitive economic advantage. The availability of such information to competitors would enable them to modify their product to better compete with Transnuclear, Inc., take marketing or other actions to improve their product's position or impair the position of Transnuclear, Inc.'s product, and avoid developing similar data and analyses in support of their processes, methods or apparatus.

f) In pricing Transnuclear, Inc.'s products and services, significant research, development, engineering, analytical, licensing, quality assurance and other costs and expenses must be included. The ability of Transnuclear, Inc.'s competitors to utilize such information without similar expenditure of resources may enable them to sell at prices reflecting significantly lower costs.

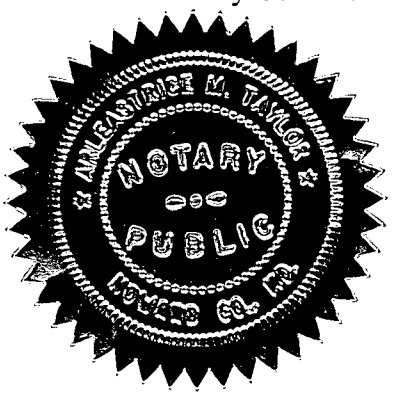
Further the deponent sayeth not.

Robert Grubb
Senior Vice President, Transnuclear, Inc.

Subscribed and sworn to ~~me~~ before this 8th day of October, 2008.

Notary Public

My Commission Expires 10 / 14 / 2008



List of Changed Pages
for CoC 1004 Amendment 10 Application Revision 5

Pages for Proprietary Version

- T.3.5-1
- T.3.5-6
- T.3.5-7
- T.3.5-8
- T.3.5-9
- T.3.5-15
- T.3.5-15A
- T.3.5-20
- T.3.5-22
- T.3.5-24
- T.3.5-30

Pages for Nonproprietary Version

- T.3.5-15
- T.3.5-15A
- T.3.5-20
- T.3.5-22
- T.3.5-24
- T.3.5-30

- U.3.5-1
- U.3.5-3
- U.3.5-4
- U.3.5-5
- U.3.5-6
- U.3.5-7
- U.3.5-8
- U.3.5-14
- U.3.5-15
- U.3.5-21
- U.3.5-23
- U.3.5-26
- U.3.5-28

- U.3.5-1
- U.3.5-3
- U.3.5-4
- U.3.5-14
- U.3.5-15
- U.3.5-21
- U.3.5-23
- U.3.5-26
- U.3.5-28

Enclosure 4 to TN E-27181

Amendment 10 application Revision 5 SAR changes
(Non-proprietary version)

Table T.3.5-6
Finite Element Model Data for *Corner* Drop

Proprietary Information withheld under10FR2.390

Table T.3.5-7
Results Summary – Top End *Corner* Drop

Proprietary Information withheld under 10CFR2.390

Proprietary Information withheld under 10 CFR 2.390

Figure T.3.5-5
Finite Element Model for Top End *Corner* Drop Analysis

Proprietary Information withheld under 10CFR2.390

Figure T.3.5-7

BWR 8x8 (GE9, GE10) – Lateral Displacement at Midspans of Top Three Spans
(Top End Corner Drop)

Proprietary Information withheld under 10CFR2.390

Figure T.3.5-9

BWR 8x8 (GE9, GE10) – Maximum Total Axial Strain (Top End *Corner* Drop)

Proprietary Information withheld under 10CFR2.390

Figure T.3.5-15

Vertical Acceleration Time Histor*ies* of the Transfer Cask Corner Drop

U.3.5 Fuel Rods

The handling of spent fuel within the nuclear plant will be conducted in accordance with existing fuel handling procedures.

The structural integrity of fuel rod cladding during a side and *corner* drop *is* evaluated in this section. Presented below is a description of the material properties used, the analyses performed and results obtained which form the basis to conclude that the fuel rod cladding will maintain structural integrity and retain the fuel pellets during these accident scenarios.

U.3.5.1 Material Properties of High Burnup Fuel

The fuel cladding is evaluated based on the mechanical properties obtained from References [3.51] and [3.68]. Reference [3.51] provides expressions to calculate the modulus of elasticity and yield strength for both Zircaloy-2 (BWR cladding) and Zircaloy-4 (PWR cladding). These expressions were derived from correlations of experimental results of several different investigations. Assumptions used include the following:

- Neutron fluence is assumed to be 1.2×10^{26} n/m^2. This is above the highest threshold given in Reference [3.51] (7.5×10^{25} n/m^2) and can thus be considered in the high burnup regime. Note that the coefficient for this regime is a constant.
- The strain rate used for this calculation is 0.5 s^{-1} as recommended in Reference [3.32].
- The cold work ratios used (0.0 for Zircaloy-2, 0.5 for Zircaloy-4) are taken from Reference [3.51].
- Oxygen content ratio of the Zircaloy is assumed to be 0.0012 as recommended by Beyer [3.51].

Temperature is a significant factor in the derivation of Zircaloy properties. These properties are calculated over a range of temperatures for both Zircaloy-2 and Zircaloy-4. An example calculation is shown in Appendix T, Section T.3.5 for the NUHOMS® 61BTH system.

The results for Zircaloy-4 (PWR) are presented in Table U.3.5-3.

U.3.5.2 Side Drop Analysis

A. Methodology

A single rod of the fuel assemblies is analyzed for side drop. The model is subjected to lateral loads due to the cladding tube mass and the fuel pellets mass. However, no credit is taken for fuel pellets moment of inertia and the loads are entirely taken by the cladding tube. The fuel cladding was constrained in the lateral direction at the spacer grid locations. The maximum calculated bending plus pressure axial stress is compared with the dynamic yield strength of fuel cladding material Zircaloy-4 at maximum operating temperature.

D. Material Properties

The following fuel cladding material properties (at 750°F) are used for the side drop analysis:

$E = 9.93 \times 10^6$ psi
$\nu_{xy} = 0.404$
$S_y = 92000$ psi

E. Loading

The accident on-site transfer side drop load is 62.9g [3.1]. The calculated dynamic factors are 0.75 for the 14x14, 15x15, and 17x17 fuel assemblies and 1.7 for 16x16 assemblies. Conservatively 75g acceleration is applied in the lateral direction for accident drop condition. For the 16x16 fuel assembly the results are scaled up to 125g.

F. Results

The resulting detailed displacements, forces and stresses in the model are given in ANSYS result files. Typical bending stress contour plots for the WE 14x14 STD/ZCA are shown on Figure U.3.5-4.

The fuel gas internal pressure is also considered in the calculation. The cladding axial tensile stress due to the gas pressure is added to the bending stress from the side drop analyses. The combined maximum stresses in the cladding are tabulated in Table U.3.5-4, and compared to material yield strength at 750° F. All the calculated stresses are less than the fuel cladding yield strength.

U.3.5.3 *Corner* Drop Analysis

Proprietary Information withheld under 10CFR2.390

Table U.3.5-5
Finite Element Model Data for *Corner* Drop

Proprietary Information withheld under 10CFR2.390

Table U.3.5-6
Summary of *Corner* Drop Analysis

Proprietary Information withheld under 10CFR2.390

Proprietary Information withheld under 10CFR2.390

Figure U.3.5-5
Typical Finite Element Model for *Corner* Drop Analysis

Proprietary Information withheld under 10CFR2.390

Figure U.3.5-7
Vertical Acceleration Time Histor*ies* of the Transfer Cask Corner Drop

Proprietary Information withheld under 10CFR2.390

Figure U.3.5-10
CE 16x16 SCE Fuel Assembly Top End *Corner* Drop - Lateral Displacement at Midspans of Top Three Spans

Proprietary Information withheld under 10CFR2.390

Figure U.3.5-12
CE 16x16 SCE Fuel Assembly – Maximum Total Axial Strain (Top End *Corner* Drop)

Listing of the Files Contained in Enclosure 6
(all files are Proprietary)

Disk ID No. (size)	Discipline	System	File Series (topics)	Number of Files
DISK 1 (DVD) (1.6 GB)	Structural	-	README.txt (detailed list of the files)	1
	Structrual	NUHOMS® HD	1001-OS187He1.k to 1105-OS187He1_d3plot101 (Input and output Files for the LSDYNA corner drop analysis)	A total of 105 files
	Structural	Standardized NUHOMS®	2001-ce16x16sce_ted_cc1_f.inp to 2007-ce16x16sce_ted_cc1_f.rst.zip (Input and output Files for the fuel corner drop analysis of the bounding case)	A total of 7 files

Recent NRC Staff Inquiries and TN Responses

1. Please revise the drop test discussion(s) in the Standardized NUHOMS® SAR to:

(a.) Clarify that the drop analysis represents a corner drop from 80" (and not an end drop).

Response:

The titles of Sections T.3.5.3 and U.3.5.3 in Appendices T and U, respectively, will be changed from "End Drop Analysis" to "Corner Drop Analysis". Similarly, any reference made to "end drop" throughout these sections will be changed to "corner drop". The following discussion provides the rationale for the postulated corner drop analysis.

The following paragraph will be added to Appendix T, Section T.3.5.3 and Appendix U, Section U.3.5.3

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(b.) Describe the rationale for an 80" drop.

Response:

The following paragraph also will be added to Appendix T, Section T.3.5.3

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The following paragraph also will be added to Appendix U, Section U.3.5.3

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(c.) Clearly describe the link to the drop test analyses in the NUHOMS® HD SAR, or revise the discussion in the NUHOMS® HD SAR to accommodate 1.a. and 1.b. above, and include the full discussion in the Standardized NUHOMS® SAR.

Response:

The following paragraphs also will be added to Appendix T, Section T.3.5.3 and Appendix U, Section U.3.5.3

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2. Provide the LS-DYNA input and output files for the 80" corner drop analysis (supporting the NUHOMS® HD Appendixes 3.9.10 and 3.9.11).

Response:

LS-DYNA input and output files for the 80" corner drop analysis are included in the CD for reference.

3. Consider the axial modes of cask vibration for selecting a BW filter cut-off frequency for obtaining the cask deceleration time history that is suitable for evaluating structural integrity of the fuel rod subject to end-drop accidents. The fuel clad structural integrity should be re-evaluated for a properly defined cask drop environment.

Response:

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Follow-up to Item 3:

With respect to the mode shape displayed in Figure 3.9.10-18 for the dominant axial vibration frequency of 141.07 hz, post-process the corner drop results by considering only the lid center for nodal averaging acceleration responses to ensure that a bounding forcing function input is used for the fuel clad evaluation.

SAR Pages 3-9.10-11 through -13 describe post-processing of the LS-DYNA results, which suggest that the Figure 3.9.10-22 time-history response was a nodal average over the entire transfer cask lid. The staff notes that, per the Figure 3.9.10-18 mode shape, the vibratory component of the cask lid axial response may contribute significantly to the fuel clad impact response. As such, the nodal averaging associated with the entire lid or for the nodes in the immediate vicinity of the point of impact at the corner of the cask may be inadequate, and it should only be performed for the lid center with the highest modal coefficients to capture the maximum fuel clad response. Section 10 CFR 72.11(a) requires complete and accurate information be provided for staff review.

Response to Follow-up to Item 3:

TN has performed the post processing of the corner drop analysis to calculate the nodal deceleration response time histories at the center region of the lid. The magnitude of the

peak of this response time history is approximately the same as the one corresponding to the nodes in the immediate vicinity of the region of impact, but the duration of the peak deceleration is slightly longer. Both of these response time histories are shown on Figure 1 of this response.

This bounding forcing function is used for calculating the fuel clad total strain.

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Figure - 1

Proprietary Information Withheld Pursuant to 10 CFR 2.390