TRANSNUCLEAR
AN AREVA COMPANY

September 15, 2010
E-29853

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

Subject: Transnuclear, Inc. (TN) Application for the TN-40 Transportation Packaging for Spent Fuel, Revision 12, Docket No. 71-9313, TAC No. L24106

Based on discussions with the NRC Staff, changes have been made to the TN-40 Transportation Application Safety Analysis Report (SAR) in the area of the lid bolt analysis.

The changed SAR pages are provided herein as Enclosures 2 and 3, for the proprietary and non-proprietary SAR versions, respectively. Enclosure 1 provides instructions for SAR page removal and insertion.

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 4) specifically requesting that you withhold this proprietary information from public disclosure.

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

Sincerely,

Jayant Bondre

Jayant Bondre, PhD
Vice President - Engineering

cc: Meraj Rahimi (NRC SFST) as follows, provided in a separate mailing:

- 8 copies of this cover letter and Enclosures 1, 2, and 4

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NMSS01

Enclosures:

1. TN-40 Revision 12 SAR Page Replacement Instructions
2. Changed Pages for the TN-40 Application Safety Analysis Report, Revision 12, Proprietary Version
3. Changed Pages for the TN-40 Application Safety Analysis Report, Revision 12, Non-proprietary Version
4. Affidavit Pursuant to 10 CFR 2.390

TN-40 Revision 12 SAR Page Replacement Instructions

Proprietary Version

Old page	Revision 12 Replacement Page
Cover Page	Cover Page
TOC-4	TOC-4
2.10.2-1	2.10.2-1
2.10.2-19	2.10.2-19
2.10.2-21	2.10.2-21
2.10.11-i	2.10.11-i
2.10.11-5	2.10.11-5
2.10.11-6	2.10.11-6
2.10.11-7	2.10.11-7
2.10.11-8	2.10.11-8
2.10.11-9	2.10.11-9
None	2.10.11-29

Non-proprietary Version

Old page	Revision 12 Replacement Page
Cover Page	Cover Page
TOC-4	TOC-4
2.10.2-1	2.10.2-1
2.10.2-19	2.10.2-19
2.10.2-21	2.10.2-21
2.10.11-i	2.10.11-i

Enclosure 3 to TN E-29853

Changed Pages for the TN-40 Application Safety Analysis Report, Revision 12, Non-proprietary Version

NON-PROPRIETARY

AREVA

TRANSNUCLEAR, INC.

TN-40

TRANSPORTATION PACKAGING

SAFETY ANALYSIS REPORT

Revision 12
September 2010

7135 Minstrel Way, Suite 300 • Columbia, MD 21045

Figure 2-4 20° Slapdown, First Impact, Acceleration Diagram 2-78
Figure 2-5 20° Slapdown, Second Impact, Load Distribution 2-79
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2.10.2 LID BOLT ANALYSIS

2.10.2.1 Introduction

This Appendix evaluates the ability of the cask closure bolt to maintain a leak tight seal under events defined by Normal Conditions Transport (NCT) and the Hypothetical Accident Conditions (HAC). Also evaluated in this section are the bolt thread and internal thread stresses, and lid bolt fatigue. The stress analysis is performed in accordance with NUREG/CR-6007 [1].

The TN-40 cask lid closure arrangement is shown in Figure 2.10.2-1. The 4.5 in. thick lid with a 6.0 in. radiation shield is bolted directly to the shell flange by 48 high strength alloy steel 1.375 in. diameter bolts (with 1 ½ -8UN threaded portion). Close fitting alignment pins ensure that the lid is centered in the vessel. The bolt material is SA-540 Gr. B23 CL1.

The lid bolt analysis presented in this appendix is done in accordance with NUREG/CR-6007 and conservatively uses lid bolt material of SA-320 Grade L43 with yield strength of 105 ksi and tensile strength of 125 ksi at 70 °F. *One exception to this is the minimum engagement length determination in Section 2.10.2.9 where the higher strength bolt material is used.* The actual lid bolt material used is SA-540 Grade B23 CL1 with yield strength of 150 ksi and tensile strength of 165 ksi at 70 °F. The lid bolt evaluation due to delayed impact is presented in Appendix 2.10.11 and is based on the lid bolt material of SA-540 Grade B23 CL1.

The following ways to minimize bolt forces and bolt failures for shipping casks are taken directly from Reference [1], page xiii. All of the following design methods are employed in the TN-40 closure system.

- Protect closure lid from direct impact to minimize bolt forces generated by free drops (use impact limiters).
- Use materials with similar thermal properties for the closure bolts, the lid, and the cask wall to minimize the bolt forces generated by fire accident.
- Apply sufficiently large bolt preload to minimize fatigue and loosening of the bolts by vibration.
- Lubricate bolt threads to reduce required preload torque and to increase the predictability of the achieved preload.
- Use closure lid design which minimizes the prying actions of applied loads.
- When choosing a bolt preload, pay special attention to the interactions between the preload and thermal load and between the preload and the prying action.

The following lid bolt evaluations are presented in this section:

- Lid bolt torque
- Bolt preload
- Gasket seating load
- Pressure load
- Temperature load
- Impact load
- Puncture load

2.10.2.8.1 Assumptions

- CG over corner lid impact with internal pressure is the worst case condition.
- The force to seat the seals is 1399 lbs./in [2] and 2198 lbs/in [6]. The total load to seat the seal is 660,142 lbs or 1,037,164 lbs, but 700,000 lbs and 1,040,000 lbs will be used conservatively.
- The maximum allowable decompression of the seal is 0.040" [2].

2.10.2.8.2 Analysis

The finite element model from Appendix 2.10.1 is modified to include contact elements (CONTAC52) at the lid/cask axial interface, internal pressure, bolt preload, seal load and 30 foot drop conditions.

Gap elements (CONTAC52) were used to model the lid/cask axial interface. To get an accurate contact representation a 60 mil axial gap was included radially outwards of Ø77.25" (closest node at Ø78.10") between the lid/cask axial interface. Figure 2.10.2-1 shows the lid/cask axial interface.

A pressure of 100 psi was applied to all internal surfaces. Bolt shank prestrain was calculated based on $\varepsilon = \sigma/E$, where σ is the bolt prestress (50 ksi per Section 2.10.2.2 above). The seal loads of 700,000 lbs and 1,040,000 lbs were applied via CONTAC52 elements. The stiffness for the gap element was calculated based on F=kx. The accident drop conditions were kept consistent with Appendix 2.10.1.

2.10.2.8.3 Results

Figure 2.10.2-2 plots the decompression of the seal as a function of circumferential location. The maximum decompression is 0.003 in. which is less then the allowable seal decompression of 0.040 in.

From the analysis results presented in the Figures and discussion, it can be concluded that during the CG over corner drop lid impact loading with internal pressure, the metal-to-metal contact exists at the Helicoflex seal. Since a seal exists around the circumference of the TN-40 vessel, the internal contents will not leak during a worst case loading condition.

2.10.2.9 Minimum Engagement Length for Bolt and Flange

For a 1½ – 8UN bolt, the material is SA-*540* GR *B23 CL1*, with

Su = *165* ksi, and
Sy = 15*0* ksi (at room temperature)

An = 3.1416 (8) (1.09) (1.4978) [1 / (2 x 8) + .57735 (1.4978 – 1.4283)]
= 4.21 in.^{2}

So,

$$J = \frac{2.96(165.0)}{4.21(70.0)} = 1.66$$

Therefore, the minimum required engagement length,

Q = J L_e = 1.*66* x 1.09 = 1.*81* in.

The actual minimum engagement length

= (6.50 bolt length – 4.50 lid thickness) = 2.00 in. > 1.*81* in.

The above calculation bounds the minimum required engagement length if inserts are used because S_u of inserts is higher than the S_u for the lid thus lowering the J value.

2.10.2.10 Conclusions

- A lid bolt torque range of 1,100 to 1,150 ft. lb. is recommended to achieve the desired preload stress of 50,000 psi.
- Lid bolt stresses meet the acceptance criteria of NUREG/CR-6007 "Stress Analysis of Closure Bolts for Shipping Casks" [1].
- For the recommended preload, a positive (compressive) load is maintained during all load combinations, except for the accident condition impact plus pressure load case.
- Closure of the TN-40 Cask lid is evaluated in Section 2.10.2.8 above and the seal remains closed during a worst case impact.
- The bolt and flange thread engagement length is acceptable.

Appendix 2.10.11

Proprietary information on pages A.2.10.11-i and A.2.10.11-1 through A.2.10.11-29 withheld pursuant to 10 CFR 2.390

AFFIDAVIT PURSUANT
TO 10 CFR 2.390

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

I, Jayant Bondre, depose and say that I am a Vice President of Transnuclear, Inc., 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 Enclosure 2 and is listed below:

- Portions of Safety Analysis Report Appendix 2.10.11

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 involves certain safety analysis report analyses related to the design of the TN-40 transportation cask, 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) Public disclosure of the information is likely to cause substantial harm to the competitive position of Transnuclear, Inc. because the information consists of descriptions of the design and analysis of dry spent fuel transportation systems, 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.

Further the deponent sayeth not.

Jayant Bondre
Vice President, Transnuclear, Inc.

Subscribed and sworn to me before this 15th day of September, 2010.

Arleastrice M. Taylor
Notary Public

My Commission Expires 10 / 14 / 2012

ARLEASTRICE M. TAYLOR
NOTARY
PUBLIC
HOWARD COUNTY, MD