July 3, 2002

Mr. Robert M. Grenier
Manager, Fremont Operations
Transnuclear, Inc.
39300 Civic Center Drive
Suite 280
Fremont, CA 94538

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING APPROVAL TO ADD NUHOMS®-32PT DRY STORAGE CANISTER TO THE STANDARDIZED NUHOMS® SYSTEM (TAC NO. L23343)

Dear Mr. Grenier:

By letter dated June 29, 2001, as supplemented June 3, 2002, Transnuclear, Inc. (TN) submitted a request to amend Certificate of Compliance No. 1004. TN requested approval to add the NUHOMS®-32PT dry storage canister (DSC) to the Standardized NUHOMS® System. The staff has determined that additional information is required to assess compliance with 10 CFR Part 72. Enclosed is the staff's second request for additional information (RAI) for the continued review of your request.

To the extent practicable, we request that TN respond to this RAI by providing a response to each item in the RAI. We would be willing to meet with you to discuss and clarify the enclosed RAI. Your response to the enclosed RAI is expected by August 5, 2002. If you are unable to meet the August 2002 milestone, you must notify us in writing, at least 2 weeks prior to August 5 of your new response date and the reasons for the delay. The staff will assess the impact of the new response date and issue a revised schedule. Please reference Docket No. 72-1004 and TAC No. L23343 in future correspondence related to this request.

If you have questions concerning this request, please contact me at 301-415-3781.

Sincerely,

/RA/
Mary Jane Ross-Lee, Senior Project Manager
Licensing Section
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Docket No. 72-1004

Enclosure: Request for Additional Information

July 3, 2002

Mr. Robert M. Grenier
Manager, Fremont Operations
Transnuclear, Inc.
39300 Civic Center Drive
Suite 280
Fremont, CA 94538

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING APPROVAL TO ADD NUHOMS®-32PT DRY STORAGE CANISTER TO THE STANDARDIZED NUHOMS® SYSTEM (TAC NO. L23343)

Dear Mr. Grenier:

By letter dated June 29, 2001, as supplemented June 3, 2002, Transnuclear, Inc. (TN) submitted a request to amend Certificate of Compliance No. 1004. TN requested approval to add the NUHOMS®-32PT dry storage canister (DSC) to the Standardized NUHOMS® System. The staff has determined that additional information is required to assess compliance with 10 CFR Part 72. Enclosed is the staff's second request for additional information (RAI) for the continued review of your request.

To the extent practicable, we request that TN respond to this RAI by providing a response to each item in the RAI. We would be willing to meet with you to discuss and clarify the enclosed RAI. Your response to the enclosed RAI is expected by August 5, 2002. If you are unable to meet the August 2002 milestone, you must notify us in writing, at least 2 weeks prior to August 5 of your new response date and the reasons for the delay. The staff will assess the impact of the new response date and issue a revised schedule. Please reference Docket No. 72-1004 and TAC No. L23343 in future correspondence related to this request.

If you have questions concerning this request, please contact me at 301-415-3781.

Sincerely,
/S/
Mary Jane Ross-Lee, Senior Project Manager
Licensing Section
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Docket No. 72-1004
Enclosure: Request for Additional Information
Distribution:
Docket NRC File Center NMSS r/f SFPO r/f BWetzel, NRR
CMiller WHodges EWBrach BJorgenson, RIII
RLandsman, RIII
C:\ORPCheckout\FileNET\ML021840755.wpd **ML021840755**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **OFC** | SFPO | e | SFPO | e | SFPO | e | SFPO | e | SFPO | e |
| **NAME** | MJRoss-Lee | | EZiegler | | CBajwa | | JGuttmann | | JMonninger | |
| **DATE** | 07/ /02 | | 07/ /02 | | 07/ /02 | | 07/ /02 | | 07/ /02 | |

**C = Cover E = Cover & Enclosure N = No copy**

**TRANSNUCLEAR, INC.**
**DOCKET NO. 72-1004**
**TAC NO. L23343**

## REQUEST FOR ADDITIONAL INFORMATION

This document, titled Request for Additional Information (RAI), contains additional information requirements identified by the U.S. Nuclear Regulatory Commission (NRC) staff during its review of Transnuclear, Inc. (TN) application to add the NUHOMS®-32PT dry storage canister (DSC) to the Standardized NUHOMS® System.

Each individual RAI describes information needed by the staff for it to complete its review of the application and determine whether TN has demonstrated compliance with the regulatory requirements. Where an individual RAI relates to TN's apparent failure to meet one or more regulatory requirements or where an RAI specifically focuses on compliance issues associated with one or more specific regulatory requirements (e.g., specific design criteria or accident conditions), such requirements will be specified in the individual RAI.

Note that RAI items may refer to the Spent Fuel Project Office's (SFPO) Interim Staff Guidance (ISG). The ISG was developed as a result of management decisions on several key issues related to the review and approval of spent fuel storage systems. The ISG will be incorporated into the next revision of NUREG-1536, "Standard Review Plan for Dry Cask Storage Systems (SRP)."

**Chapter 4 Thermal:**

The staff has determined that there are potential errors in the ANSYS® thermal models of the NUHOMS®-32PT Dry Shielded Canister (DSC). These potential errors primarily concern the calculation of effective conductivities of the materials in the basket. Attachment 1 provides a complete explanation of the potential errors discovered by the staff. The additional information requested below is needed by the staff to make a finding on the thermal performance of the NUHOMS®-32PT DSC.

1. Revise the thermal model of the NUHOMS®-32PT DSC to take into account the orthotropic nature of the basket materials, including the helium, aluminum, and neutron poison materials. The thermal conductivity of the basket materials will not be the same across the aluminum and neutron poison plates (serial path) as it would be along the aluminum and neutron poison plates (parallel path).

2. If, after the revision to the thermal model as described above is complete, fuel cladding temperatures are above the applicable limits, provide an alternative path for certification of the NUHOMS®-32PT DSC.

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

Attachment: As Stated

Description of Staff Findings on ANSYS® models of NUHOMS®-32PT DSC

The TN NUHOMS®-32PT ANSYS® model utilizes an effective conductivity for heat transfer from the fuel rods through the basket and associated components (i.e., the L-shaped aluminum plates and neutron poison plates lining the basket, and the stainless steel plates comprising the basket.) This effective conductivity is defined using a parallel-path (along the layers) algorithm of the functional form,

$$k_{eff-along} = \frac{\sum_{n=1}^{N} k_n w_n}{\sum_{n=1}^{N} w_n}$$

where $k_n$ = thermal conductivity of the nth material included in the parallel path
$w_n$ = thickness of the nth material in the direction of heat flow

When applied to heat transfer from the fuel elements in the NUHOMS®-32PT canister, the parallel paths are treated as illustrated in Figure 1.

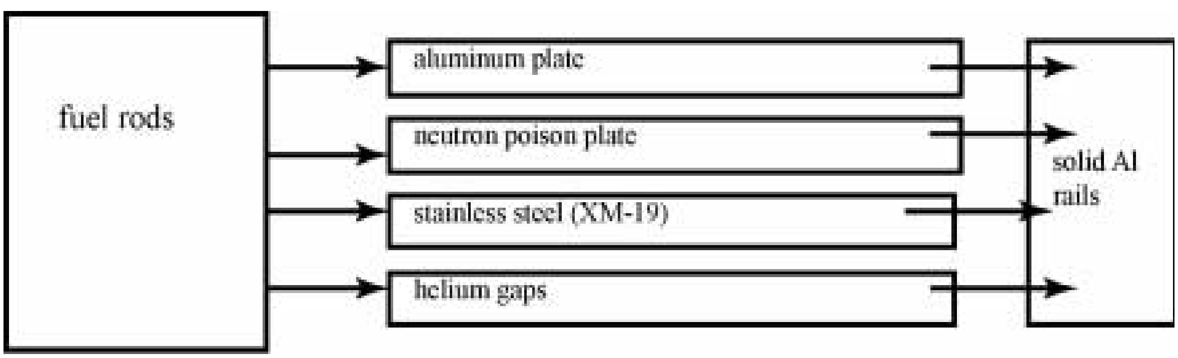


**Figure 1. Illustration of parallel paths $k_{eff-along}$ assumed in TN's ANSYS® model for the basket and associated components**

This approach can be used to represent the heat flow path along the layers and along the length of the canister (although in this direction these components do not connect directly to the support rails). However, axial heat transfer is capable of removing only a small part of the heat from the canister. This is by design; the structure of the storage module in which the canister sits requires that the canister design allow the bulk of the heat to be removed through the sides of the canister. This means that most of the heat transfer is in the radial direction.

Heat transfer in the radial direction from the fuel to the outer surface of the canister does not follow a parallel path (along the layers) from the fuel rod arrays through the aluminum plates, neutron

poison plates, and stainless steel basket structure. This is obvious from inspection of the cross-section of the NUHOMS®-32PT canister internals. On two of the sides of the basket enclosure for any given fuel assembly, the rods will see only the stainless steel plates, and on these faces, heat transfer is directly from the fuel assembly to the basket, by radiation to the stainless steel and conduction through the helium gas surrounding the fuel rods. (Convection can also occur in the fill gas, but in the horizontal configuration it plays an insignificant role.) On the two other sides, the fuel rods see the aluminum liner plates. Heat transfer on these faces therefore must follow a serial path (through the layers), first to the aluminum liner plate, then across the small helium gap between the Al and neutron poison plates, then through the poison plate, and across the next helium gap into the stainless steel basket.

Figure 2 is a conceptual representation of these radial heat transfer paths through the basket. In no case can the heat flow be treated as following a parallel path (along the layers) exclusively, as described by the equation above. The effect of using a $k_{eff\text{-}along}$ as defined as in the above equation for radial heat transfer through the basket, results in a significant overestimation of the effective thermal conductivity of the basket structure.

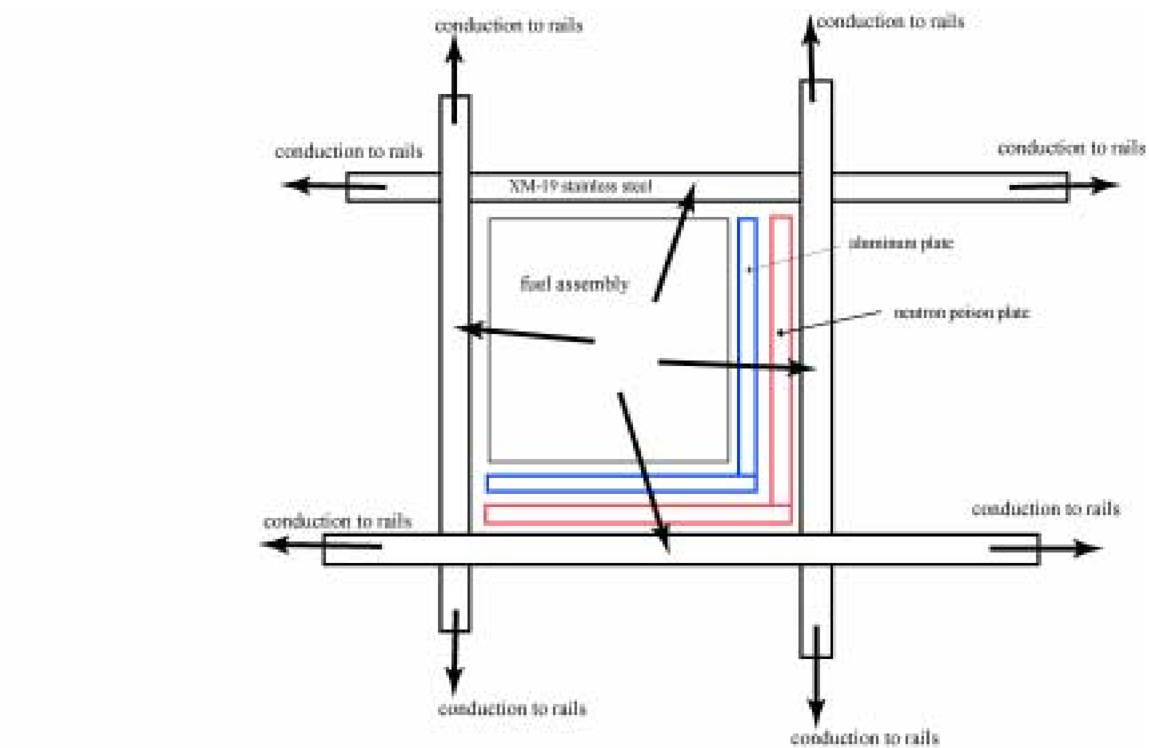


**Figure 2. Conceptual diagram of radial heat flow through the basket region**

In this case, for the direction passing through the right or lower wall of the "cell" depicted in Figure 2, the applied effective thermal conductivity ($k_{eff\text{-}along}$) works out to be a little more than four times that which should have been applied ($k_{eff\text{-}through}$) as illustrated by the following calculation.

$$k_{eff-through} = \frac{k_{Al}w_{Al} + k_{He}w_g + k_{NP}w_{NP} + k_{He}w_g + k_{SST}w_{SST}}{w_{Al} + 2w_g + w_{NP} + w_{SST}}$$

where $k_{Al}$ = thermal conductivity of aluminum
$w_{Al}$ = thickness of the Al plate
$k_{He}$ = thermal conductivity of helium
$w_g$ = width of gas gaps assumed between plates in intimate contact
$K_{np}$ = thermal conductivity of the neutron poison plate
$w_{np}$ = thickness of the neutron poison plate
$k_{SST}$ = thermal conductivity of XM-19 stainless steel
$w_{SST}$ = thickness of the basket steel plates or tubes

Inserting appropriate values for these thermal conductivities and using the specified dimensions of the various components yields a value for $k_{eff\text{-}along}$ that works out to be approximately 4.3 to 4.7 times larger than $k_{eff\text{-}through}$.

$$k_{eff-along} \cong 4.5 \cdot k_{eff-through}$$

A value of $k_{eff\text{-}along}$ was applied in all directions in the ANSYS® model supplied by TN, to define the effective thermal conductivity in the bodies representing the basket region. The different materials in the basket region were not modeled in ANSYS® with separate material orientation (orthotropic) and property definitions for aluminum, neutron poison, stainless steel, or gaps. Instead, the entire structure of the basket was represented as a 'uniform' material in which all bodies had the same effective thermal conductivity, calculated in the manner described above for $k_{eff\text{-}along}$. Hence, the same value of $k_{eff\text{-}along}$ was applied in both the "along" and "through" directions. This is an incorrect approach as heat transfer must pass serially through the aluminum and neutron plates and associated gas gaps and then into and through the stainless steel to reach the support rails.

This modeling error is similar to the previous modeling error in the approach to representing the material properties of the stainless steel support rails in the extremities of the canister. In that case, the stainless steel and aluminum components of the rails were represented as a single homogeneous material, using an effective conductivity that was supposed to represent parallel heat transfer paths through the stainless steel and the aluminum. As with the case of the basket, the heat transfer paths are parallel <u>only</u> in the axial direction. In the radial direction, there is no continuous path for conduction through the aluminum. Virtually all of the heat flowing radially must go through the stainless steel alone.