March 31, 2006

Ms. Tara Neider
President and COO
Transnuclear, Inc.
7135 Minstrel Way, Ste. 300
Columbia, MD 21045

SUBJECT: NRC INSPECTION REPORT NO. 72-1004/2006-202

Dear Ms. Neider:

On February 13-16, 2006, the U.S. Nuclear Regulatory Commission (NRC) performed an announced inspection of Transnuclear, Inc. (TN) at its office in Columbia, MD. The purpose of this inspection was to determine if TN's design activities were being performed in accordance with the requirements of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-level Radioactive Waste, and Reactor-related Greater Than Class C Waste," and TN's NRC-approved quality assurance program. The inspection scope included management and design activities. The enclosed report presents the findings from the inspection.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

/RA/

Robert J. Lewis, Section Chief
Transportation and Storage Safety and
Inspection Section
Spent Fuel Project Office
Office of Nuclear Material Safety
and Safeguards

Docket No. 72-1004

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U.S. NUCLEAR REGULATORY COMMISSION
Office of Nuclear Material Safety and Safeguards
Spent Fuel Project Office

Inspection Report

Docket:	72-1004
Report:	72-1004/2006-202
Certificate Holder:	Transnuclear, Inc. 7135 Minstrel Way, Ste. 300 Columbia, MD 21045
Date:	February 13-16, 2006
Inspection Team:	Frank Jacobs, Team Leader, SFPO James Pearson, Safety Inspection Engineer, SFPO Robert Shewmaker, Senior Structural Engineer, SFPO
Approved by:	Robert J. Lewis, Section Chief Transportation and Storage Safety and Inspection Section Spent Fuel Project Office Office of Nuclear Material Safety and Safeguards

EXECUTIVE SUMMARY

Transnuclear, Inc.
NRC Inspection Report 72-1004/2006-202

On February 13-16, 2006, the U.S. Nuclear Regulatory Commission (NRC) performed an announced inspection of Transnuclear, Inc. (TN) at its office in Columbia, MD. The purpose of the inspection was to determine if TN's design activities were being performed in accordance with the requirements of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-level Radioactive Waste, and Reactor-related Greater Than Class C Waste," and TN's NRC-approved quality assurance (QA) program. The inspection scope included management and design activities. Within these areas, the inspection consisted of examinations of selected procedures and records and interviews with personnel. The results of the inspection are as follows:

Management Controls

Overall, the team assessed that TN's implementation of its QA program in the Management Controls areas reviewed was adequate. No findings of significance were identified. The team identified some minor discrepancies and opportunities for improvement. TN entered this information into the TN corrective action program for evaluation and appropriate action.

Design Controls

Overall, the team assessed that TN's implementation of its QA program in the Design Controls areas reviewed was adequate. No findings of significance were identified. The team identified some minor discrepancies and opportunities for improvement. TN entered this information into the TN corrective action program for evaluation and appropriate action.

REPORT DETAILS

1. Inspection Background and Scope

In TN responses to Requests for Additional Information (RAI) on an application for a Certificate of Compliance (CoC) for the NUHOMS HD design, NRC staff identified errors in the structural analysis. On August 29, 2005, staff met with TN to discuss corrective actions associated with the structural analysis, and in a letter dated September 30, 2005, TN addressed the results of a root cause evaluation, an extent of condition review, and associated corrective actions. The NRC had also recently identified an error in a structural analysis performed by TN for a specific licensee, and had been notified of a radiation streaming issue with a specific licensee's NUHOMS 32P design.

The purpose of this inspection was to determine if TN's design activities were being performed in accordance with the requirements of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-level Radioactive Waste, and Reactor-related Greater Than Class C Waste," and TN's NRC-approved QA program. The inspection scope included management and design activities. Within these areas, the inspection team reviewed procedures and instructions; inspected selected documents, records, and drawings; verified personnel training and qualifications; and interviewed personnel responsible for various activities. The results of the inspection are as follows:

1.1 Inspection Procedures Used

IP 60851, "Design Control of ISFSI Components"
NUREG/CR 6314, "Quality Assurance Inspections for Shipping and Storage Containers"

1.2 List of Acronyms Used

ASL	Approved Supplier List
CAR	Corrective Action Report
CFR	Code of Federal Regulations
CoC	Certificate of Compliance
NRC	U.S. Nuclear Regulatory Commission
QA	Quality Assurance
RAI	Request for Additional Information
RCA	Root Cause Analysis
SAR	Safety Analysis Report
SFPO	Spent Fuel Project Office
TIP	Transnuclear Implementing Procedure
TN	Transnuclear, Inc.

1.3 Persons Contacted

The team held an entrance meeting with TN personnel on February 13, 2006, to present the scope and objectives of the NRC inspection. On February 16, 2006, the team held an exit meeting with TN personnel to present the results of the inspection. The individuals present at the entrance and exit meetings are listed below in Table 1.

Table 1
Entrance and Exit Meetings Attendance

NAME	AFFILIATION	ENTRANCE	EXIT
Frank Jacobs	NRC	X	X
Robert Lewis	NRC	X	
James Pearson	NRC	X	X
Robert Shewmaker	NRC	X	X
Jayant Bondre	TN	X	X
Jack Boshoven	TN		X
William Bracey	TN		X
Richard Flinn	TN	X	X
Jeff Gagne	TN	X	X
Glenn Guerra	TN		X
Dan Kurtz	TN		X
Daniel Mahoney	TN		X
Prakash Narayanan	TN		X
Tara Neider	TN	X	X
Joe Schmidberger	TN		X
Don Shaw	TN		X
Peter Shih	TN	X	X
William Sutherland	TN		X
Steven White	TN	X	X

2. Inspection Details

2.1 Management Controls

2.1.1 Scope

The inspection of management controls focused on activities that could be associated with the design issues identified above. The team reviewed procedures and records and interviewed TN personnel.

2.1.2 Observations and Findings

2.1.2.1 Quality Assurance Policy

In August 2005, TN reorganized its engineering organization as shown in its NRC-approved QA program on a functional rather than geographical basis. TN expects this will eliminate problems caused by multiple reporting chains in engineering projects. TN continues on its plan to consolidate Part 72 activities and personnel at its Columbia office. As corrective actions in response to Corrective Action Report (CAR) 2005-093 and the associated root cause analysis (RCA), TN conducted specific training for analysts and managers concerning roles and responsibilities during engineering analyses and reinforcing expectations for verbatim compliance with quality requirements. TN also provided training to management concerning the use of personnel for technical assignments that go beyond their normal activities and expertise.

TN discussed with the inspection team their current efforts to increase their technical staff. The team reminded TN of the importance, particularly when hiring new personnel, of having adequate procedures, providing appropriate training, and requiring compliance with procedures.

The inspector reviewed a sample of training records for TN staff. The inspector verified through a review of TN's required reading training matrix that all TN structural engineering personnel were current with the required reading assignments. The inspector found the training records were acceptable and met the requirements of the applicable Transnuclear Implementing Procedure (TIP). The inspector noted that much of the TN training was required reading with no process for assessing retention of the material.

The inspector reviewed a sample of attendance records for TN engineering staff developed on TN Form 2.1-3 from TIP 2.1, "Indoctrination and Training," revision 5. The attendance records provided evidence that the "Roles and Responsibilities during Engineering Analysis" training was provided as indicated in the September 30, 2005, letter from TN to NRC addressing TN's corrective actions regarding errors in the structural evaluation of fuel rods. The inspector determined that all applicable personnel had received the training.

The inspector reviewed training histories printed from TN's database for the engineering analyst, checker, and approver, for calculations developed by TN for the NUHOMS 32 PTH normal fuel cladding structural evaluation for accident side drops. No concerns were noted.

The inspector reviewed a sample of Registered Professional Engineer Certifications (TN Form 2.4-1) as required by TIP 2.4, "Qualification and Certification of Registered Professional Engineers for ASME Code Activities," revision 0, section 5.0, step 5.1. All of the forms reviewed were found to be acceptable.

The team interviewed multiple TN staff members to determine their perception of the TN training program and expectations of management in regard to ethics and activities affecting quality. The team interviewed multiple engineers in regard to training requirements and their awareness of TN Management's expectations for the handling and completion of required reading assignments as required by TIP 2.1, step 5.11. While the results of the interviews did not reveal any obvious procedural violations, the review of procedures and the interviews combined indicated that stronger procedural guidance could improve performance of design activities. The team noted that procedures had been recently modified to direct that any unresolved engineering issues be moved up the management chain for resolution.

2.1.2.2 Nonconformance Controls

The inspector observed that TN did not have a process for reviewing errors in calculations and comments made by reviewers and approvers of calculation packages. TN issued CAR 2006-018 to consider the establishment of measures to evaluate available feedback from review of design documents in order to identify opportunities for improvement in process and personnel performance.

The inspector reviewed CAR 2005-093, which addressed the deficient calculation found by NRC during the staff review of the NUHOMS HD application. The CAR described the condition, in part, as, "Calc 10494-94 was prepared, checked and approved but was not technically correct." The CAR was assigned a higher significance level than required by TN procedure so that a root cause analysis would be performed to evaluate the programmatic issues related to the calculation errors. The corrective action also included the performance of alternate calculations and the determination of extent of condition. The alternate calculations are discussed elsewhere in this report.

The inspector reviewed the "Root Cause Analysis of Transnuclear NUHOMS HD Fuel Pin Drop Calculation Condition" dated October 2005, and interviewed the author of the report. The report identified root causes, causal factors, and contributing factors, and provided several recommendations. The root causes were determined to be time pressure and overconfidence by the technical team that the actual results of detailed analysis would confirm the acceptability of the calculation. The author of the RCA report had not previously reviewed the corrective actions taken by TN to determine if he considered all findings and recommendations had been adequately addressed, but performed a review during the inspection. He provided some additional comments to TN after his review. The inspector noted that TN procedures did not address the training or qualification requirements for individuals performing root cause analyses, or provide detail for the RCA process. TN issued CAR 2006-022 to address provisions for qualification of individuals performing root cause analyses, development of formal guidance, and review of completed analyses by the responsible manager to assure any required actions are documented in the associated CAR for followup.

For the extent of condition determination in CAR 2005-093, TN contracted an engineering firm to provide third-party review of a representative sample of TN structural calculations associated with the TN-68 cask, NUHOMS HD system, and NUHOMS-32P canister. The review of 31 calculations resulted in one major comment and 60 minor comments. In Calculation 972-174, the fuel rod buckling analysis may have omitted certain buckling modes, and the boundary conditions used did not adequately model the fuel/basket interface. This major comment was resolved by performing two new calculations with the results provided to NRC for review and approval in TN-68 Amendment 1, RAI 1. Of the 60 minor comments, nine had no impact on

results and required no response. The other minor comments were addressed in individual responses. Only one minor comment warranted additional consideration, but no design or licensing changes were required due to resolution.

The inspector reviewed CAR 2005-098, pertaining to an RAI for the NUHOMS-32P. The corrective action on CAR 2005-098 for a NUHOMS-32P calculation error referenced CAR 2005-093 and its associated RCA. Because CAR 2005-093 and the RCA focused on the NUHOMS HD issue, and because the errors described in CAR 2005-098 appeared to be of a different nature from those in CAR 2005-093, it was not clear that the apparent causes for the NUHOMS-32P errors were adequately addressed. TN issued CAR 2006-021 to review the apparent cause determination regarding the NUHOMS-32P. The actions taken to determine the extent of condition for CAR 2005-093 appeared to be applicable to CAR 2005-098.

The inspector noted that CAR 2005-098 was signed by the QA Manager on 8/24/05 with a response due date of 9/24/05. The inspector observed that, contrary to the requirements of TIP 16.1, "Corrective Action," revision 2, the signature by the responsible manager acknowledging receipt and concurrence with the assigned significance level was dated 10/26/05. This was also the same date the corrective action response was submitted by the responsible manager. TN noted that this was not an isolated case and issued CAR 2006-020 to address the issue.

The inspector reviewed TN information on a recent radiation streaming issue involving a NUHOMS-32P canister at Calvert Cliffs Nuclear Power Plant. TN had issued CAR 2006-015 on 2/3/06 and the CAR was still open. TN stated the design change had been requested by the specific licensee customer to make welding of the lid easier and to reduce the time required for blowdown of the canister. TN only made the design change as requested and had not been asked to review licensee procedures. TN was separately requested to perform a shielding evaluation of the new design, which was documented as Calculation 1095-60. The request was to perform dose calculations the same as had been performed for the NUHOMS-24P by another vendor. Input files for the calculations were provided to TN by the licensee. The NUHOMS-24P calculations did not include dose estimates above the drain opening, and therefore, TN did not perform dose estimates above the opening for the NUHOMS-32P.

2.1.2.3 Documentation Controls

During the inspection and the review of the calculation process, TIP 3.2, "Calculations," revision 1, was reviewed. It included Appendix A - Calculation Process Flow, that was a flow diagram. In addition to depicting the calculation flow process, it also integrated functions related to the considerations as to whether a "Licensed Product" was impacted by the calculation. For one path it appeared that the checking operation could be omitted. The text of the TIP appeared to correctly describe the calculation flow process in all cases. TN included this observation in CAR 2006-019 initiated during the inspection.

TIP 3.2, paragraph 5.3.3, stated that Form 3.2-2, "Calculation Review Checklist," shall be used to document the checker's judgment of adequacy. Paragraph 5.3.4 stated that after comments are resolved, the checker shall sign and date the calculation review checklist. The checklist provided 14 items to be marked as either "Yes," "No," or "NA." The inspector noted in some calculation packages that the checker did not complete the checklist until all items could be marked "Yes." With this practice, a checklist item would never be marked "No," thereby questioning the intent of the form or the clarity of the procedure. TN included this observation in CAR 2006-019 for evaluation.

2.1.2.4 Audit Program

The inspector reviewed the TN Approved Supplier List (ASL) to verify appropriate acceptance of multiple companies supplying engineering support and services under the requirements of TIP 4.1, "Procurement Document Control," revision 3, as well as TIP 7.1, "Supplier Evaluations," revision 2. The inspector found all applicable suppliers to be appropriately listed on the TN ASL and noted that audit requirements for those suppliers were current.

2.1.3 Conclusions

Overall, the team assessed that TN's implementation of its QA program in the Management Controls areas reviewed was adequate. No findings of significance were identified. The team identified some minor discrepancies and opportunities for improvement. TN entered this information into the TN corrective action program for evaluation and appropriate action.

2.2 Design Controls

2.2.1 Scope

The inspection of design controls focused on activities associated with analyses and calculations supporting applications for CoCs and amendments of CoCs. The team reviewed procedures and records and interviewed TN personnel.

2.2.2 Observations and Findings

The inspector reviewed one of the original structural calculations supporting the NUHOMS HD System Safety Analysis Report (SAR). The completion of the calculation package (10494-60, revision 0, NUHOMS 32 PTH - Normal Fuel Cladding Structural Evaluation Under Accident Condition), as indicated by the signature of the originator on 2/10/05, was after information from the calculation package had been presented in the NUHOMS HD System SAR, revision 0, 4/04, in Table 3-12. Checking of the same calculation was completed on 3/3/05 with an approval date of 4/12/05. The SAR contents at the time of submittal (5/5/04) to NRC were attested to having undergone a record review by the use of Form 5.4-1 by signature of the engineering discipline lead, however the records indicated on the cover/control sheet that the calculation had not been completed, checked, or approved. Computer output within the calculation package, however, indicated that the computations were performed 3/31/04 prior to the revision 0 date of the SAR. During the SAR review process an RAI was made by NRC relative to these analyses on 12/13/04 and responses were provided on 2/18/05 and supplemented by additional analyses on 3/25/05. A second round of RAIs was issued by NRC on 4/21/05 related to this subject area. A revised calculation package (10495-94, revision 0) was completed to replace calculation 10494-60, revision 0 (this calculation was voided on 2/2/06), and the results were included in the supplemental SAR information. The completion of this new calculation was dated 5/2/05, the check date was 5/10/05, and the approval date was 5/11/05. The response to the RAI was provided on 5/20/05 and the 75g side drop issues were subsequently resolved leaving the end drop analysis for resolution. Calculation 10494-94 was then revised to revision 1 to support the final analysis of the 75g side drop analysis and a new calculation, 10494-95, revision 0, was performed for the 75g end drop analysis. Revision 1 of 10494-94 was signed as completed on 2/2/06, and checked and approved on 2/10/06. Revision 0 of 10494-95 was signed as completed on 2/2/06, checked on 2/2/06, and approved on 2/2/06. Revisions to the SAR reflecting the 10494-95, revision 0 calculation were incorporated into the SAR as revision 4, dated 1/06.

TIP 3.2, paragraph 5.3.1, stated the originator shall complete Form 3.2-1, "Calculation Cover Sheet," and forward a review copy to the checker. The inspector noted that the dates being placed on the calculation cover sheet did not in all cases reflect the date of completion of the calculation. As noted above, some of the dates reflect dates of completion, checking, and approval that are after the dates when the results of the calculations were incorporated into the SAR. In addition, there are instances of completion dates being the same as the checking dates for a complex calculation when the checking process is to be an independent process. TN was able to demonstrate that in most cases there was a check copy of the calculation in the records that demonstrated the calculation had been given to the checker prior to the actual date shown on Form 3.2-1 that would have allowed time for a checker to accomplish a review. As a result of these observations, TN initiated CAR 2006-019 to clarify the procedure outlined in TIP 3.2 so that the time line of the calculation process is adequately reflected in the records. TN also issued CAR 2006-023 to better control approval of calculations prior to submittal of SARs.

The team interviewed the preparer, the checker, and the approver of Calculation 10494-94, Revision 0, to determine the level of independence, as well as collaboration, which may have occurred between the personnel prior to the final approval of the calculation. It appeared that the originator was nearly done with the calculations prior to his knowledge of the designated checker. As indicated in TIP 3.2, the Director of Engineering/Engineering Manager is responsible for assigning a technically competent individual to accomplish the necessary design calculations as well as the competent individual to review/check the calculations and design documents. This instance indicates there was a high degree of independence possible between the originator and the checker even though the dates on the package could be interpreted differently. A review or check version of the calculation indicated that there were discussions between the originator and the checker as the checker's comments were resolved.

Calculation 10494-94 used quasi-static analyses that contained results used in the submittals to NRC that identified the critical buckling load of the fuel cladding as being 88g when that load was actually associated with the second mode of buckling. Information provided by the reviewer and the checker indicated that the originator had identified that the results had indicated first mode buckling at approximately 11g and that he had completed a simplified hand calculation that gave nearly the same result, but that previous work by others as well as related test data had not indicated buckling at such a low g-level. This was information made known to the reviewer. As a result of the checking process the reviewer recommended that smaller time/load increments should be used in the analysis. The results did not show much change as a result of this suggestion. Contacts were made by TN to the distributor and technical support company through which the TN ANSYS computer software was licensed to ascertain whether there were any known problems with the software. No known software problems were identified to TN. As related by the involved individuals, it appears that the collective decision was that they were convinced there was not a safety issue but their analysis could not demonstrate that fact. With schedule deadlines that appear to have been self-imposed based on concerns for their client's schedule, they elected to ignore the first mode result obtained by their simplified hand calculation as well as the computer calculation based on a quasi-static approach and reported on the second mode result. At the time these events transpired, the structural group consisted of the originator, the checker, and the supervisor and it appears that this issue was discussed little outside of this group. The chief engineer who was the approver of the calculation was apparently not informed of this issue.

In the final resolution of the issue, it became apparent that the approach to the problem required a more sophisticated analysis be performed that could truly be characterized as a dynamic analysis. The structural group apparently believed that given additional time they

would be able to demonstrate that the fuel cladding would not fail under a 75g side drop. A new staff member with experience in dynamic analysis was added to the structural staff in early 2005 to work as a structural analyst. The new staff member's background experience included application of LS-DYNA to mechanical and structural systems functioning under dynamic loading conditions as well as severe operating environmental conditions. This individual became the originator of a new calculation, 10494-95, revision 0, addressing the 75g end drop loading on the fuel cladding. The calculation package was accepted on 2/2/06.

The inspector reviewed the implementation of TIP 3.3, "Computer Software Test Control," and TIP 3.4, "Identification and Control of Computer Software Error Messages." The current listing of all computer software controlled under TIP 3.3 was reviewed and included the following software packages: ADOC, DADiSP, ISOSHLD, LS-DYNA, MCNP, ORIGEN, QAD-CDDP, SCALE, SCALIAS, SKYSHINE, and USLSTATS. A sample from the test plans was selected for review. The specific test plan was identified as, "Test Plan for Verification of ANSYS 6.0 on WINDOWS NT Workstations," E-19196, dated 6/20/03. A series of 14 test case analysis problems contained in the ANSYS Verification Manual were identified as requiring successful completion with the installed software on the specifically identified workstation. These test cases involved structural analysis and thermal analysis. The Verification Test Report for ANSYS 8.0 on TN-TNYWK07-CPU Pentium 4 was reviewed to determine if the test plan had been successfully completed. The results reported that all computations resulted in matching the published test cases results. A specific Error Report, dated 5/6/04 addressing ANSYS 8.1 errors identified as 2004-01 through 2004-07 was selected for review. Each reported error was addressed as to whether or not it would impact completed or in-process calculations. No adverse conditions were identified in these samples and the procedures appear to have been followed.

2.2.3 Conclusions

Overall, the team assessed that TN's implementation of its QA program in the Design Controls areas reviewed was adequate. No findings of significance were identified. The team identified some minor discrepancies and opportunities for improvement. TN entered this information into the TN corrective action program for evaluation and appropriate action.

3. Exit Meeting

An exit meeting was conducted by the team with TN personnel on February 16, 2006. The team's findings and assessments were presented at the meeting. TN management personnel at the meeting acknowledged the team's observations and comments.