ENCLOSURE 3

SAFETY EVALUATION REPORT

TRANSNUCLEAR, INC.

STANDARDIZED NUHOMS® HORIZONTAL MODULAR STORAGE SYSTEM FOR IRRADIATED NUCLEAR FUEL

DOCKET No. 72-1004

NUHOMS®-32 PT AND -24PHB SYSTEMS

AMENDMENT NO. 8

SAFETY EVALUATION REPORT

Docket No. 72-1004
Standardized NUHOMS® Modular Storage System for Irradiated Nuclear Fuel
Certificate of Compliance No. 1004
NUHOMS®-32PT and -24PHB SYSTEMS
Amendment No. 8

SUMMARY

By application dated April 21, 2004, as supplemented on May 28, 2004, September 23, 2004, October 8, 2004, October 26, 2004, November 29, 2004, June 10, 2005, and July 20, 2005, Transnuclear, Inc. (TN) submitted an amendment request. TN requested approval to amend Certificate of Compliance (CoC) No. 1004 for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, under the provisions of 10 CFR Part 72, Subpart K and L.

TN requested a change to the CoC, including its attachments, and revision of the Final Safety Analysis Report (FSAR). The amendment application included the necessary engineering analyses and proposed Safety Analysis Report (SAR) page changes. The SAR revisions will be incorporated into the Final Safety Analysis Report (FSAR). The primary changes were: (1) to revise the 32PT Dry Shielded Canister (DSC) Fuel Specification and Fuel Qualification Tables to include low enrichment and reconstituted fuel; (2) to revise the 32PT DSC Fuel Specification Tables to show minimum soluble boron loading concentration; (3) to expand the authorized contents for the 24PHB DSC; and (4) to revise the transfer cask (TC)/DSC handling and lifting height specifications. Additionally, a clarification was made to provide operational flexibility for DSC surface decontamination.

The Nuclear Regulatory Commission (NRC) staff has reviewed the SAR amendment application using the guidance provided in NUREG-1536, “Standard Review Plan for Dry Cask Storage Systems,” (SRP) January 1997. The staff performed a detailed evaluation of the changes which is documented in this safety evaluation report (SER). Only those SRP chapters with a corresponding applicant request for revision or changes are addressed in the staff’s SER. The staff did not review the two additional alternate basket configurations for the 32PT DSC design. The applicant added the 16 and 24 neutron absorbing plates configurations, as authorized under the provisions of 10 CFR 72.48.

Based on the statements and representations in the application, as supplemented, the staff concludes that the TN Standardized NUHOMS® System, as amended, meets the requirements of 10 CFR Part 72. The Amendment No. 8 changes to the CoC are indicated by vertical change bars in the margins.

STRUCTURAL EVALUATION

TN has evaluated and concluded that using the NUHOMS®-32PT and NUHOMS®-24PHB systems to store fuel assemblies with the revised fuel parameters as described in the Amendment No. 8 application will have no effects on structural safety. The application proposed the following changes in Technical Specifications 1.2.10 and 1.2.13 as described below:

Technical Specification 1.2.10

(a) Revise the title of Specification 1.2.10 to state "TC/DSC" instead of "DSC" to be consistent with the rest of the technical specifications.

The staff agrees that the change is an editorial correction and will have no adverse effect on safety.

(b) Revise Specification 1.2.10 to allow handling a loaded TC/DSC outside the spent fuel pool building at a height greater than 80 inches, if special lifting devices that have at least twice the normal stress design factor for handling heavy loads are employed, or if a single failure proof handling system is used.

The staff agrees with the applicant that using special lifting devices that meet the heavy loads requirements of NUREG-0612 or a single failure proof handling system will provide reasonable safety assurance against a hypothetical TC/DSC drop accident. The existing 80-inch height limit is not changed when a loaded NUHOMS® TC/DSC cask is outside the spent fuel building and is supported on a transfer skid in a horizontal orientation on route to the Independent Spent Fuel Storage Installation (ISFSI) pad.

(c) Insert the word "evaluated" in the Surveillance statement of the Specification.

The staff agrees that the omission of the word "evaluated" in the statement is a typographical error.

Technical Specification 1.2.13

(a) Revise TS 1.2.13 to be consistent with the change in item (b) TS 1.2.10 above.

The staff agrees with the change.

(b) Replace "available" with "unavailable" in the Action statement of this specification.

The staff agrees that the change is to correct a typographical error.

SHIELDING EVALUATION

TN application requested amending the authorized contents of the NUHOMS®-32PT and -24PHB systems, which included revised shielding analysis to support the following SAR and technical specification changes:

1. For the 32PT DSC, The Fuel Specification and Fuel Qualification Tables that were previously approved in Amendment No. 5 are expanded to include reconstituted fuel and fuel with low initial enrichment levels (between 1.1 and 2.0 wt% U-235). The Fuel Qualification Tables were also modified to provide cooling time requirements for these additional fuel types.

2. For the 24PHB system, the authorized contents are expanded to include CE 14X14, WE 14X14, WE 15X15, and WE 17X17 class PWR assemblies.

A reconstituted fuel assembly acceptable for storage in the NUHOMS®-32PT DSC is one in which up to 56 enriched fuel rods have been replaced with stainless steel rods or any number of enriched rods have been replaced with zircaloy clad rods containing depleted, natural, or lower enriched uranium oxide.

The original Fuel Qualification Tables were based on bounding calculations utilizing the code SAS2H to calculate the minimum required cooling times as a function of initial enrichment and burnup for each decay heat limit. The expanded Fuel Qualification Tables are bounded by the design basis source terms.

The surface dose rates for the original Fuel Qualification Tables were generated using ANISN (a one-dimensional discrete ordinates code). ANISN coupled with the CASK-81 22 neutron, 18 gamma-ray energy group, coupled cross section library and the ANS/ANSI 6.1.1 -1977, "Neutron and Gamma-Ray Flux-to-Dose Rate Factors," flux-to-dose conversion factors were used to determine design basis source terms.

For the expanded Fuel Qualification Tables, individual ANISN runs were not developed for each burnup, decay heat, and enrichment combination. Rather, ANISN was used to develop a "response function" to calculate the gamma and neutron dose rates. All entries in the expanded Fuel Qualification Tables result in decay heat less than the respective thermal limit and dose rates less than the dose rates of the design basis source. The cooling times were increased in increments in the calculations to ensure that this is true.

The applicant also proposed revising TS 1.2.12 to clarify the intent of the Action Statement a. The optional surface decontamination action provides licensees with greater operational flexibility. The staff agrees that this change is a clarification.

Based on review of the statements and representations in the SAR amendment application, the staff concludes that the shielding design of the NUHOMS® system with the revised contents has been adequately described and evaluated and that the package meets the requirements of 10 CFR Part 72.

CRITICALITY EVALUATION

The applicant proposed modifications to TS 1.2.1 including:

- additional fuel assemblies (WE 17x17, WE 15x15, CE 14x14 and WE 14x14) as authorized contents for 24PHB DSC;

- revised minimum soluble boron concentrations as a function of enrichment for CE 14x14, WE 14x14 and CE 15x15 fuel assemblies in the 32PT DSC; and

- Type A, B, C, and D designations for the 32PT DSC for configurations of 0, 4, 8, and 16 poison rod assemblies (PRAs), respectively.

The 32PT DSC has three alternative configurations for the number of fixed poison plates within the basket. TS 1.2.15a was also modified to refer to Table 1-1g of TS 1.2.1 for the minimum amount of soluble boron.

To justify the changes, the applicant performed a criticality analysis using the 44GROUPNDFB5 cross section set with the KENO V.a code in the SCALE 4.4 system. The applicant's criticality models for the transfer cask are the same as those approved in NUHOMS® Amendment No. 5 (dated January 14, 2004) for the 32PT DSC, with the exception of adding the 16 and 24 poison plate options. The 16 and 24 poison plate options were evaluated by the applicant, as authorized under the provisions of 10 CFR 72.48 and, therefore, were not reviewed by the staff. The applicant explicitly modeled the fuel assemblies inside the transfer cask with a variable amount of soluble boron in the water, based on the enrichment level. The applicant took 90% credit for boron in the poison plates and 75% credit for the poison in the PRAs. The applicant modeled fresh water in the gap between the pellets and the fuel rod cladding. Additionally, the applicant explicitly evaluated all combinations of fuel assembly class, basket type, and number of poison plates, in the 32PT DSC with the revised boron concentration. The applicant's maximum calculated k_{eff} for the 32PT DSC, including the Monte Carlo uncertainty, are shown below in Table 6-1. All of the k_{eff} calculations provided by the applicant were less than the upper subcritical limit of 0.9411, which was derived in the applicant's benchmarking evaluation.

Table 6-1 Maximum k_{eff} for 32PT

	16 poison plates	20 poison plates	24 poison plates
Type A	0.9377	0.9410	0.9378
Type B	Not Authorized	0.9409	0.9380
Type C	Not Authorized	0.9397	0.9356

*Type D basket is not authorized for usage with the CE 14x14, WE 14x14 and CE 15x15 fuel assemblies in the 32PT basket

For the 24PHB DSC, similar models to those used for the B&W 15x15 fuel assemblies in NUHOMS® Amendment No. 6, dated January 12, 2004, were used to evaluate the additional fuel assemblies. The applicant compared the reactivity of the additional fuel assemblies with the reactivity of the previously approved storage cask contents (B&W 15x15). The results of the

applicant's evaluation demonstrated that the B&W 15x15 Mark B10 fuel assembly is the most reactive fuel assembly to be stored in the 24PHB basket.

The staff performed confirmatory criticality calculations using KENO V.a with the 238GROUPNDFB5 cross section set in the SCALE 5 system. The staff's model is similar to the applicant's in that it included fresh water in the fuel rod gap, instead of borated water and used 90% credit for the poison in the PRAs and 75% credit for the poison in the fixed plates. The staff selected the most reactive case from the three fuel assemblies that the applicant evaluated for the 32PT basket. The staff's maximum k_{eff} was consistent with that of the applicant. The staff also evaluated the reactivity of the fuel assemblies the applicant proposed adding as authorized contents for the 24PHB basket. The staff found that the B&W15x15 Mark B10 fuel assembly was the most reactive. The staff's evaluation confirmed the applicant's calculations because the resulting k_{eff} was within one-half percent of the applicant's k_{eff}.

The applicant performed a benchmarking analysis for the SCALE 4.4 system for both baskets. The applicant chose 121 critical experiments for the 32PT basket and 125 critical experiments for the 24PHB basket, all of which are included in NUREG/CR-6361, "Criticality Benchmark Guide for Light-Water-Reactor Fuel in Transportation and Storage Packages." The applicant determined the Upper Subcritical Limit (USL) using method 1 from NUREG/CR-6361. The applicant evaluated the USL for a number of parameters, such as enrichment, fuel rod pitch, water/fuel volume ratio, assembly separation, and average energy group causing fission. The most limiting USL was calculated based on the limiting value for each parameter and the lowest USL was taken to be the bounding value. The applicant determined the bounding USL to be 0.9411 for the 32PT basket and 0.9413 for the 24PHB basket.

The staff reviewed the applicant's benchmark analysis and agrees that the critical experiments chosen are relevant to the cask design. The staff found the applicant's method for determining the USL acceptable. The staff also verified that only biases that increase k_{eff} have been applied.

Based on the information provided in the application and the staff's own confirmatory analyses, the staff concludes that the NUHOMS system with the revised contents for the 32PT DSC and the 24PHB DSC meets the acceptance criteria specified in 10 CFR Part 72.

CONCLUSION

The NRC staff has reviewed the amendment to the SAR for the TN Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel. The staff considered the regulation, appropriate regulatory guides, applicable codes and standards, and accepted engineering practices in reaching this conclusion. Only the affected SRP sections were included in the SER. The Certificate of Compliance has been revised to include the changes requested by TN. Those changes include (1) expanding 32PT Fuel Specification and Fuel Qualification Tables to include low enrichment and reconstituted fuels; (2) revising 32PT Fuel Specification Table to reflect minimum boron loading concentration; (3) expanding 24PHB authorized contents requirements; (4) revising the TC/DSC handling and lifting height specification; and (5) clarifying DSC surface contamination actions. Based on the statements and representations contained in the application, as supplemented, the staff concludes that these changes do not adversely affect the ability of the TN NUHOMS® storage system to meet the requirements of 10 CFR Part 72.

Issued with Certificate of Compliance No. 1004, Amendment No. 8 on December 5, 2005.