SAFETY EVALUATION REPORT
STORAGE OF SPENT FUEL WITH A BURN-UP LESS THAN 32 GWD/MTU
AND OF AN UNIRRADIATED ENRICHMENT IN EXCESS OF 1.45 PERCENT

DOCKET NO. 72-1004
MODEL NOS. STANDARDIZED NUHOMS®-24P, -52B, AND -61BT
TRANSNUCLEAR, INC.
CERTIFICATE OF COMPLIANCE NO. 1004

SUMMARY

Certificate of Compliance (CoC) No. 1004 for the Standardized NUHOMS®-24P, -52B, and -61BT System currently prohibits the storage of spent fuel with a burn-up less than 32 GWd/MTU and of an unirradiated enrichment in excess of 1.45 percent. By application dated February 23, 2001, the applicant requested an amendment to the CoC to allow the storage of spent fuel with the above noted characteristics in the NUHOMS®-24P dry shielded canister (DSC).

On June 8, 2001, the applicant revised the amendment to correct administrative errors in Tables 1-1a, and 1-1b of the technical specifications (TS) of the Standardized NUHOMS® System CoC that were introduced when Amendment 2 to the CoC became effective on September 5, 2000. In addition, on October 4, 2001, Transnuclear, Inc., (TN) the parent company of Transnuclear West, Inc. (TN-West) requested that the certificate holder for CoC No. 1004 be changed from TN-West to TN.

The staff performed a detailed criticality safety evaluation of the proposed amendment request which is documented in this safety evaluation report (SER). The amendment request did not affect the other technical areas (e.g., structural, thermal, shielding, etc.) of the staff's previous analyses of the Standardized NUHOMS® System. The staff's evaluation and conclusions regarding the acceptability of the amendment application are based on information submitted by Transnuclear West (TN-West) on February 23, and June 8, 2001.

The staff determined that the addition of the fuel characteristics changes meet the requirements of 10 CFR Part 72. The staff also determined that the administrative errors introduced in Amendment 2 to the CoC neither affect the use of the cask nor diminish the margin of safety of the Standardized NUHOMS® System.

CRITICALITY ANALYSIS

The applicant revised the following TS:

- TS 1.2.15 to add the minimum boron concentration for spent fuel with an equivalent unirradiated enrichment of greater than 1.45 percent.

- TS 1.2.1 to allow the storage of spent fuel with an equivalent unirradiated enrichment of greater than 1.45 percent.

- TS 1.2.1, Tables 1-1a to:

- change one of the physical parameters of the fuel from Maximum Assembly Width (unirradiated) to Nominal Cross Section, and

- allow the storage of fuel with a burn-up less than 32 GWD/MTU and a length of 171.96 inches.

- TS 1.2.1, Table 1-1b to change one of the physical parameters of the fuel from Maximum Assembly Width (unirradiated) to Nominal Cross Section.

- TS 1.2.1, Tables 1-2a, 1-2c and Figure1.1 to:

  - indicate the boron concentration must be a minimum of 2350 ppm to keep the k_{eff} below 0.95, and

  - to increase maximum PWR fuel assembly length for fuel assemblies containing burnable poison rod assemblies (BPRAs), and burnups less than 32 GWD/MTU, by 0.25 inches.

To justify the change to the TS, the applicant performed a criticality analysis for the B&W 15x15 fuel assemblies in the NUHOMS®-24P system. The applicant has shown in previous criticality evaluations for the Standardized NUHOMS® System that the B&W 15x15 fuel assemblies are the most reactive assemblies in the NUHOMS®-24P system. The applicant used the 44-GROUP ENDF/B-V cross section set with the KENO V.a code in the SCALE 4.4[1] system to perform the criticality evaluation. The applicant modeled the fuel assemblies in the NUHOMS®-24P cask with a soluble boron level of 2350 ppm in the borated water and a maximum fresh fuel enrichment of 4.0 weight percent. The applicant assumed that fresh water was in the gap region between the pellets and the fuel rod cladding. The applicant evaluated this configuration both with and without BRPAs. The applicant varied the water density to determine optimum moderation. The applicant's maximum calculated k_{eff} was 0.9357, including the Monte Carlo uncertainty, which is less than the upper subcritical limit of 0.9410, from the applicant's benchmarking evaluation.

The applicant performed a benchmarking analysis for the SCALE 4.4 system. The applicant chose 125 critical experiments, which are included in NUREG/CR-6361, "Criticality Benchmark Guide for Light-Water-Reactor Fuel in Transportation and Storage Packages."[2] 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 distance, 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 0.9410.

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.
The staff performed confirmatory criticality calculations using KENO V.a with the 27-GROUP ENDF/B-IV and the 238-GROUP ENDF/B-V cross section sets in the SCALE 4.4 system. The staff's model is similar to the applicant's. The staff's model included borated water in all

locations containing water. One difference between the staff's model and the applicant's is the evaluation of water in the fuel rod gap. The staff evaluated the reactivity of the system with and without the borated water in the fuel rod gap to determine if a void gap was more reactive than one containing borated water.

The k_{eff} for the staff's evaluation with borated water in the fuel rod gap is approximately 1.5 percent lower than the applicant's. The staff then replaced the borated water in the gap with fresh water, similar to the applicant's model. The staff's k_{eff} agreed with the applicant's. Based on the information provided in the application and the staff's own confirmatory analyses, the staff concludes that the NUHOMS®-24P system meets the acceptance criteria specified in 10 CFR Part 72.

Increasing the length for assemblies with burnups less than 32 GWD/MTU will have no effect on either the off site dose rates or the maximum temperature of the fuel rods, since the bounding fuel assemblies have a burnup of 45 GWD/MTU. The applicant evaluated the maximum length of the fuel assemblies for thermal expansion and determined that a minimum of 0.73 inches of clearance exists for the longer fuel assemblies.

References

1. Oak Ridge National Laboratory, "SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluations," NUREG/CR-0200, Vol. 1-3, Revision 6, May 2000.

2. Oak Ridge National Laboratory, Criticality Benchmark Guide for Light-Water-Reactor Fuel in Transportation and Storage Packages, NUREG/CR-6361, March 1997.

ADMINISTRATIVE CHANGES

To correct administrative errors, the applicant revised TS 1.2.1, Tables 1-1a, 1-1b, 1-1c, and 1-1d, to change one of the physical parameters of the fuel from Maximum Assembly Width (unirradiated) to Nominal Cross Section.

The staff has reviewed the technical and safety bases supporting the approval of Amendment 2 to CoC No. 1004 and has determined that the maximum fuel assembly widths are not critical values affecting the basis for the safety analysis. The original certificate and Amendment 1 to CoC No. 1004, approved by the NRC, both specified the "nominal" fuel assembly width of 8.536 in the fuel specification table. Amendment 2 approved the storage of higher burnup fuel and burnable poison rod assemblies in the NUHOMS®-24P system, and the fuel specification tables were revised to reflect those changes; however, those changes did not involve any change to the "nominal" fuel assembly width previously accepted by the staff. Likewise, calculations to support Amendment 3 to CoC No. 1004 which added the NUHOMS®-61BT DSC did not include the assembly width dimension and an input to the criticality evaluation.

The staff has determined that storing spent fuel assemblies with nominal widths of 8.536 inches in the NUHOMS®-24P, 5.545 inches in the NUHOMS®-52B, and 5.44 inches in the NUHOMS®-61BT DSCs is consistent with the design basis and would not be inimical to public health and safety or reduce the safety margin.

The staff reviewed the request from TN dated October 4, 2001, that the certificate holder be changed from TN-West to TN. The staff concluded that, since both entities perform 10 CFR Part 71 and 10 CFR Part 72 related activities under the same NRC approved quality assurance program (Docket No. 71-0250, Revision 10), that the changes would not result in an effect on public health and safety or reduce the safety margin.

CONCLUSIONS

The staff performed a detailed safety evaluation of the proposed CoC amendment request and found that the storage of spent fuel with a burn-up less than 32 GWd/MTU and of an unirradiated enrichment in excess of 1.45 percent, and the correction of administrative errors, does not reduce the safety margin for the Standardized NUHOMS® System. The areas of review addressed in NUREG 1536, "Standard Review Plan for Dry Cask Storage Systems," January 1997 are not affected by the applicant's amendment request. Based on the statements and representations contained in the applicant's safety analysis report and the conditions in the CoC, the staff concluded that the storage of spent fuel with a burn-up less than 32 GWd/MTU and of an unirradiated enrichment in excess of 1.45 percent, and correction of administrative errors, meet the requirements of 10 CFR Part 72.

Issued with Certificate of Compliance No. 1004, Amendment No. 4,
effective on February 12, 2002.