SAFETY EVALUATION REPORT

Docket No. 72-1021
Transnuclear Storage Cask (TN-32)
Certificate of Compliance No. 1021
Revision No. 1

SUMMARY

This Safety Evaluation Report (SER) documents the review and evaluation of two amendment applications for the Transnuclear storage cask system (TN-32). By application dated April 23, 1999, as supplemented February 28 and May 22, 2000, and by application dated February 29, 2000, as supplemented April 20 and May 22, 2000, TN requested an amendment to the Certificate of Compliance No. 1021 for the TN-32 storage cask. TN requested that Mark BW fuel be incorporated into the allowable contents and that the seismic requirements be revised to allow the user some additional flexibility in storage pad design. For efficiency, the two amendments were combined for review and issuance.

The applications, as supplemented, included the necessary engineering analyses and proposed Safety Analysis Report (SAR) page changes. The proposed SAR revisions will be incorporated into the Final Safety Analysis Report (FSAR) that must be submitted within 90 days after the amendment has been approved (in accordance with 10 CFR 72.248(a)(1)).

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the applications, as supplemented, including the engineering analyses, proposed SAR revisions, and other supporting documents submitted with the applications. Based on the statements and representations in the applications, as supplemented, the staff concludes that the TN-32 storage cask system, as amended, meets the requirements of 10 CFR Part 72.

1.0 GENERAL INFORMATION

The applicant requested that the Mark BW 17x17 fuel (B&W/FCF 17x17 Mark BW) be added to the allowable contents for storage. The applicant also requested that the seismic requirements be revised to allow the user some additional flexibility in storage pad design. Due to the limited scope of the amendment requests, only those sections affected are addressed in this SER.

2.0 STRUCTURAL

The NRC staff review indicates that Mark BW 17x17 fuel with hardware may weigh more than the design weight (1533 lbs. per fuel assembly) for the TN-32 storage cask. However, the applicant elected to stay within the design weight by administrative controls. Technical Specification (TS) Section 2.1.f.v. and Table 2.1-1 of the SAR state that any combination of fuel and hardware which weighs more than 1533 lbs. is not acceptable for storage in the TN-32 storage cask. Therefore, storage of Mark BW 17x17 fuel in the TN-32 storage cask will not result in weight increase greater than previously analyzed.

As for the cask internal pressure, the bounding fuel authorized for storage in the TN-32 storage cask is the Westinghouse 15 x 15 fuel. This fuel bounds the Westinghouse Standard 17x17 fuel (W 17x17) which is comparable to the Mark BW 17x17 fuel. The cladding outside diameter (OD) is the same for both W 17x17 fuel and Mark BW 17x17 fuel. However, the cladding thickness is greater on the Mark BW 17x17 fuel (0.024 inch compared to 0.0225 for the W 17x17 fuel). The end of life pressure in the Mark BW 17x17 fuel is lower than that in the W 17x17 fuel for the following reasons:

(1) W 17 x 17 is prepressurized up to 500 psi, while Mark BW 17x17 fuel prepressurization is less than 500 psi.

(2)The UO_2 mass in W 17x17 is 0.364 lb/ft and in Mark BW 17x17 fuel is 0.360 lb/ft. Therefore, for a given mass-specific burnup, each Mark BW fuel assembly will have slightly fewer fission products than a W 17x17 fuel assembly.

(3)The Mark BW 17x17 fuel pellet density is 96%, compared to 95% for the Westinghouse fuel. Therefore, there will be slightly less fission gas release in the Mark BW 17x17 fuel.

By the above comparisons, the Westinghouse 15 x 15 fuel bounds the Mark BW 17x17 fuel for internal pressurization.

Based on the above, the staff concludes that the storage of Mark BW 17x17 fuel in the TN-32 storage cask will not change the structural analysis reported in the original TN-32 storage cask SAR.

The staff also reviewed the proposed change to the TS for seismic requirements. The original seismic requirements provide the horizontal and vertical seismic acceleration limits for TN-32 storage casks in a freestanding configuration. The revised seismic requirements merely express the relationship between the horizontal and vertical seismic acceleration in static equilibrium equations from which the original seismic limits were derived. To ensure against sliding and tipover, users of the TN-32 storage cask have the option to substitute the design basis seismic loads at the storage site into the two equations listed in revised Section 4.3.3. By satisfying these two equations, the TN-32 storage cask is assured of neither sliding nor tipover during the design basis earthquake at the storage site. Since the revised and the original seismic requirements are the same but expressed in different formats, the revised seismic requirements will not change the conclusions previously reached in the SER.

2.1 Materials

The inclusion of Mark BW 17x17 fuel to the fuel types that may be stored in the TN-32 storage cask does not introduce any new types of materials to the cask system. Additionally, since the burnup level of the Mark BW 17x17 fuel does not exceed an average assembly burnup of 45,000 MWD/MTU, there is no change to the loading temperature limits. The existing fuel cladding temperature limit bounds the maximum temperature limit for the Mark BW 17 x17 fuel. Consequently, this fuel would not create a new or unanalyzed galvanic or chemical reaction or

result in a cladding temperature adverse to the cladding integrity during loading, long-term storage, or design accident conditions.

Based on the above, the staff finds that inclusion of Mark BW 17x17 fuel into the TN-32 storage cask is acceptable.

3.0 THERMAL

This review assessed the specific impacts of the addition of the Mark BW 17x17 fuel to the authorized contents in the areas of (a) fuel cladding, (b) assembly thermal characteristics, and (c) cask internal pressure. The addition of the Mark BW 17x17 fuel to the authorized fuel types did not require any modification of the cask heat transfer design features or the design basis assumptions of the cask system. Consequently, the staff evaluated the general impact of the added fuel type on the cask and concluded that the basis for the cask heat transfer design features and the design basis assumptions had not been affected.

The temperatures of the fuel cladding (fission product barrier) are limited in the TN-32 storage cask for normal, off-normal, and accident conditions to protect the cladding against degradation which could lead to gross rupture. The TN-32 FSAR Revision 0[1] fuel cladding temperature limit for normal and off-normal conditions of storage is 622°F (328°C). The transient (e.g., accident and loading/unloading operations) temperature limit is 1058°F (570°C). The applicant concluded and the staff confirmed that the cladding temperature limits in effect for the currently approved fuels for the TN-32 storage cask bound the Mark BW 17x17 fuel allowable temperature limits. Therefore, use of the current cladding temperature limits for the Mark BW17x17 fuel is acceptable.

In FSAR Section 3.5.2, the applicant concluded that the quench analysis currently in effect for the Westinghouse 15x15 fuel bounded the Mark BW 17x17 fuel. The staff reviewed the information submitted by the applicant and agrees that the existing quench analysis is bounding and acceptable.

The applicant calculated a heat generation rate for the Mark BW 17x17 fuel assembly of 0.98 kW. This heat generation rate is bounded by the W 17x17 assembly heat generation rate of 0.99 kW. The applicant also clarified TS 2.1.f.iv to limit the maximum allowable heat load per assembly to less than or equal to 1.02 kW with or without burnable poison rod assemblies (BPRAs) or thimble plug devices (TPDs). The existing cask thermal analysis assumes the 1.02 kW/assembly (32.7 kW total per cask) heat generation rate and, therefore, the heat generation rate of the Mark BW 17x17 fuel is acceptable.

The applicant compared the physical characteristics of the Mark BW 17x17 fuel to the W 17x17 fuel. These assemblies have identical rod outside dimensions, pitch, and envelope dimensions. The Mark BW 17x17 fuel has about 1% less fuel mass than the W 17x17 fuel and, therefore, has a slightly lower heat generation rate as discussed above. The Mark BW 17x17 fuel also has a greater cladding thickness than the W 17x17 fuel. Based on this comparison, the applicant concluded that the effective conductivity for the W 17x17 fuel bounds the Mark BW 17x17 fuel. The staff reviewed the information submitted by the applicant and the effect of increased cladding thickness in the modified Wooton-Epstein correlation (which was used to

identify the bounding assembly type) and concluded that the W 17x17 fuel bounds the Mark BW 17x17 fuel.

In the revised SAR Section 7.2.2.2, the applicant compared the Mark BW 17x17 fuel with the W 17x17 fuel and concluded that the quantity (moles) of free gas in the Mark BW 17x17 fuel would be less than or equal to the W 17x17 fuel. This quantity of free gas is in turn bounded by the Westinghouse 15x15 fuel. Based on review and selected verifications of the information provided, the staff concludes that the Mark BW 17x17 fuel is bounded by the existing analysis and is acceptable.

4.0 SHIELDING

In the FSAR shielding analysis, the applicant established the W 17x17 fuel and associated BPRA as the content having the bounding source term and performed all subsequent calculations for that assembly type. For this amendment, the applicant showed that the source term for the W 17x17 fuel also bounds that of the Mark BW 17x17 fuel.

The Mark BW and W 17x17 fuel assemblies are physically very similar and, thus, are burned under very similar reactor operating conditions. This similarity results in nearly identical burnup profiles and actinide and fission product inventories per uranium mass for the same initial enrichment, cooling time, and burnup. Thus, the burnup profiles and source term production rates for the W 17x17 fuel can also be applied to the Mark BW 17x17 fuel.

The Mark BW fuel contains about 1% less uranium fuel mass than the Westinghouse fuel, and the source term from the active fuel will be a correspondingly 1% lower. The applicant's data also shows that the hardware in the top end fitting of the Mark BW fuel assembly has less mass than the Westinghouse fuel assembly, resulting in a smaller radioactive source term. Likewise, the BPRA spider hardware for the Mark BW fuel has less mass and, thus, a smaller source term than the Westinghouse fuel.

The one area where the Mark BW fuel assembly has greater mass than the Westinghouse fuel assembly is the fuel cladding. Since the applicant did not attempt to quantify the effect of this difference, staff performed its own calculations and estimated that the thicker Mark BW cladding has a larger mass by about 6.95 kgs of zircaloy clad per assembly. Staff further estimated that this greater mass results in a 0.1% increase in the cobalt source term in the fuel region of the assembly. The expected dose from the increase in cladding source term is more than offset by the decrease in source term from the smaller uranium fuel mass in the Mark BW fuel assemblies. Staff agrees with the applicant's conclusion that the W 17x17 fuel assembly continues to bound the shielding source term in the storage cask even when BPRAs are included.

Based on the information and representations presented by the applicant and on its own review and calculations, staff has reasonable assurance that the system can meet the regulatory shielding requirements under normal, off-normal, and accident conditions.

5.0 CRITICALITY

The applicant submitted a criticality analysis which demonstrates that storage of Mark BW 17x17 fuel in the TN-32 storage cask is bounded by the criticality safety analysis performed for the FSAR.

The Mark BW 17x17 fuel is described in SAR Table 6.2-1. There were no proposed changes to the storage cask or the spent fuel pool boron concentration requirements. The maximum assembly average burnup and initial enrichment limits are identical to the limits for the Westinghouse fuel.

The modeling assumptions used to determine the most reactive assembly are given in SAR Section 6.4.2.A. The cask and fuel assemblies are explicitly modeled. The models are identical to those previously reviewed except that the assemblies were replaced with Mark BW 17x17 fuel assemblies. For the Mark BW 17x17 fuel assembly, the active fuel length, including the natural uranium blankets, was modeled as fresh fuel (i.e., no burnup) and enriched to 4.05 wt% U-235. The applicant's results are given in Table 6.4-1 of the SAR. The applicant's calculations demonstrate that the W 17x17 fuel assembly bounds the Mark BW 17x17 fuel assembly and that the TN-32 criticality design criterion is met. The TN-32 criticality design criterion is that k_{eff}, including bias and uncertainty, $\leq$ 0.95 so that subcriticality is maintained for all credible normal, off-normal, and accident conditions. Further benchmark analysis was not performed as the previous benchmark calculations are appropriate for this system.

The applicant utilized the CSAS modules of the SCALE computer codes and the accompanying 27-group cross section library for the TN-32 storage cask analysis and the benchmark calculations. The staff agrees that these codes and cross-section sets are appropriate for this particular application and fuel system.

The staff performed confirmatory calculations using the same assumptions as those given in SAR Section 6.4.2.A. The staff's results are in close agreement with the applicant's results. For the confirmatory analysis, the staff used the CSAS modules of the SCALE version 4.4 computer code and the accompanying 44-group cross-section library. These codes are standards in the industry for performing criticality analyses and are appropriate for this particular application and fuel system.

Based on the staff's review of the information provided by the applicant and the staff's own confirmatory calculations, the staff has reasonable assurance that the TN-32 will allow safe storage of intact Mark BW 17x17 fuel assemblies and the system will remain subcritical under all credible normal, off-normal, and accident conditions.

6.0 CONFINEMENT EVALUATION

This confinement evaluation reviews the addition of the Mark BW 17x17 fuel to the allowable fuel types authorized for storage in the TN-32 storage cask. The addition of the Mark BW 17x17 fuel to the authorized fuel types did not require any modification of the cask confinement design or the design basis assumptions of the cask system.

The applicant compared the Mark BW 17x17 fuel to the approved W 17x17 fuel and concluded that the Mark BW 17x17 fuel is bounded by the W 17x17 fuel. The staff reviewed the information provided by the applicant, assessed the impact of the Mark BW fuel on the confinement design, and performed selected confirmatory calculations. The staff concluded that the Mark BW 17x17 fuel is bounded by the existing analysis and is acceptable.

7.0 CONDITIONS FOR CASK USE - OPERATING CONTROLS AND LIMITS OR TECHNICAL SPECIFICATIONS

The proposed certificate changes for this amendment are as follows:

1. TS 2.1, "Fuel to be stored in the TN-32 Cask," changed to include the B&W/FCF 17x17 Mark BW assembly and associated bounding characteristics; and

2. TS 4.3.3, "Site Specific Parameters and Analyses," changed to allow an analysis to provide verification that loads associated with a design basis seismic event do not cause the cask to slide or to tipover.

The staff has reviewed these changes, as discussed in the SER, and have found them to be acceptable.

REFERENCES

1. Transnuclear, Inc., TN-32 Dry Storage Cask Final Safety Analysis Report, Revision 0, January 2000.

CONCLUSION - EVALUATION FINDINGS

The staff has reviewed the TN-32 storage cask system amendment applications, as supplemented, including the engineering analyses, proposed SAR revisions, and other supporting documents submitted with the applications. Based on the information provided in the applications, as supplemented, the staff concludes that the TN-32 storage cask system, as amended, meets the requirements of 10 CFR Part 72.

Issued with Certificate of Compliance No. 1021, Amendment No. 1,
on February 12, 2001.