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ENTERGY OPERATIONS, INC.

GRAND GULF NUCLEAR STATION

INDEPENDENT SPENT FUEL STORAGE INSTALLATION

EXEMPTION REQUEST FROM 10 CFR 72.212(a)(2) AND 10 CFR 72.212(b)(7) REQUIREMENTS

SUMMARY

This Staff Evaluation (SE) summarizes the thermal review for Entergy's request of a one-time exemption from the requirements of 10 CFR 72.212(a)(2) and 72.212(b)(7) for HI-STORM® 100 System, Model 68 Multi-Purpose Canisters (MPC) licensed under Certificate of Compliance (CoC) 1014, Amendment No. 2.

Appendix B, Section 2.1 of the CoC establishes maximum burnup limits and maximum decay heat limits for individual fuel assemblies (IFAs) that are authorized for loading into MPCs. Additionally, Appendix A, Section 3.1.4 of the CoC requires MPCs containing IFAs with burnup greater than 45,000 MWD/MTU to implement supplemental cooling within four hours of being placed in the transfer cask. However, the applicant inadvertently loaded four MPCs with fuel that exceeded individual decay limits in the CoC that did not have supplemental cooling during loading operations. These four casks were designated by the applicant as MPCs 045, 069, 214, and 215.

The applicant submitted Holtec Report HI-2084091 to demonstrate that the fuel cladding of loaded IFAs in MPC 045 would not exceed the design limit of 400^{o}C (or 752^{o}F) for high burnup fuel during fuel loading operations or during dry storage. The applicant identified MPC 045 as the most limiting condition. The applicant concluded that the safety and integrity of the mis-loaded fuel was not compromised, and the fuel stored in the MPCs is within safe operating thermal limits.

Therefore, the applicant submitted an exemption request to exceed the limits of the CoC, and to allow continued storage of MPCs 045, 069, 214, and 215. The staff reviewed the exemption request to evaluate its compliance with 10 CFR 72.7, 72.24(d), 72.122(h)(1), 72.128(a)(4), and 72.236(f).

EVALUATION

The applicant performed a two dimensional (2-D) analyses using FLUENT® thermal analysis software to estimate temperatures from decay heat at initial loading for MPC 045. The applicant stated that MPC 045 would result in bounding temperatures because MPC 045 contains more misloaded IFAs with burn-up greater than 45,000 MWD/MTU and a decay heat generation of greater than 0.414 kW at time of loading. The applicant assumed an initial inlet temperature of 100°F, a 100% solar absorbtivity, and conservatively neglected natural convection in water jacket of transfer cask (HI-TRAC) that bounds the thermal analysis of HI-STORM 100 storage overpack. The applicant performed the thermal evaluation with the total heat load of 21.898 kW that is slightly higher than the heat load of 21.857 kW present at time of initial loading. With 6.3 kW less than the acceptable design-basis heat load (28.18 kW) approved in the CoC, the applicant approximated the heat load distribution by a core region of heat load 1.532 kW and three outer regions of heat loads, 4.819, 6.864, and 8.683 kW, respectively, to provide a reasonably bounding evaluation. The applicant calculated a peak cladding temperature of 744.2°F which is below the established cladding limit of 752°F. Although the calculated margin is low, the applicant stated the actual temperatures are much lower because of the following conservative assumptions of inlet temperature, solar absorbtivity, and neglecting of natural convection in the water jacket. The applicant also stated that the 2-D model predicted significantly higher temperatures than a more sophisticated three dimensional (3-D) model.

The NRC staff evaluated Holtec Report HI-2084091 and verified that the MPC 045 loading bounded the other three MPC loadings and was adequately modeled. Based on the results presented by the applicant, the staff finds that a conservative maximum temperature was estimated for the spent nuclear fuel. The staff generally finds the conservative assumptions used in the model in this application to be acceptable. However, the staff did not agree with the statement that a significant conservatism existed because “the evaluation used 2-D axi-symmetric models to approximate 3-D heat transfer will be more conservative because of ignoring azimuthal cooling of storage cells, 3-D mixing, and heat transfer in the downcomer, top, and bottom plenum areas.” The applicant did not provide any evidence to support this statement, and the staff did not consider it in its evaluation.

However, the staff finds that this heat load was bounded by a confirmatory staff analysis that was determined to be acceptable for the CoC approval. This was based on a more sophisticated, realistic 2-D model with a higher total heat load. In addition, the applicant used a high inlet temperature of 100ºF in its analysis. This is a conservative assumption because the CoC approval was based on a lower maximum inlet temperature of 80ºF as this is the maximum average yearly temperature for cask users, including Grand Gulf Nuclear Station. Neglecting the cooling from the transfer cask provides additional conservatism.

Finally the CoC, Appendix A, Technical Specifications requires supplemental cooling to be initiated within four hours of the completion of MPC drying operations for fuel assembly with burnup greater than 45,000 MWD/MTU to ensure the fuel cladding temperatures remain within

limits. If supplemental cooling is lost while in use, it must be restored within seven days. MPC was 045 in the transfer cask for 26 hours, MPC 069 for 31 hours, MPC 214 for 27 hours, and MPC 215 for 33 hours, without being placed on supplemental cooling. The staff finds that these time periods for MPCs in the transfer cask are considerably less than the 7-day (=168 hours) limiting condition for restoring supplemental cooling to operable status per the CoC, Appendix A, TS 3.1.4 Required Action A.1.

3.3 Evaluation Findings

Based on the statements and thermal evaluation in the application, the staff finds that the applicant's safety analysis was conservative and performed within the bounds of the previously–approved analysis for the CoC with the design-basis maximum heat load specified. Therefore, the staff concludes the requested exemption to 10 CFR 72.212 for MPCs 045, 069, 214, and 215 for the continued storage of IFAs is acceptable. Based on the applicant's analyses, the four misloaded MPCs with the HI-STORM 100 cask systems provided adequate heat removal capacity under 10 CFR 72.236(f) at the time of loading and will provide adequate heat removal capacity for continued storage operations. The staff notes that this approval is only valid for MPC 045, 069, 214, and 215 at the Grand Gulf Nuclear Station ISFSI. This exemption approval does not constitute a generic approval of the specific analytical methodology used by Entergy for any future exemption requests or certificate amendment requests for the HI-STORM® 100 system.

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