March 17, 2000

MEMORANDUM TO: Catherine Haney, Acting Chief
Rulemaking and Guidance Branch
Division of Industrial and Medical
Nuclear Safety, NMSS

FROM: Susan F. Shankman, Deputy Director
Licensing and Inspection Directorate
Spent Fuel Project Office, NMSS

ORIGINAL SIGNED BY /s/

SUBJECT: FORWARDING OF REVISED PAGES TO THE SAFETY EVALUATION REPORT FOR HI-STORM 100 CASK SYSTEM DESIGN

Attached are revised pages to the HI-STORM 100 Cask System Safety Evaluation Report. The SER was initially forwarded to you on February 22, 1999, for inclusion in the final rule. Subsequently, the staff made a minor change to Section 4.5.4 of the SER to clarify its thermal review in response to public comment I.22. Please replace pages 4-8 and 4-9 of the SER with these revised pages.

Docket No.: 72-1014

Attachment: Pages 4–8 and 4-9 of SER for the HI-STORM 100 Cask System

CONTACT: Marissa Bailey, NMSS/SFPO
(301) 415-8531

DISTRIBUTION:

NRC File Center	PUBLIC	DOCKET	SFPO r/f	NMSS r/f	LKokajko
MHorn	NJensen	VTharpe	PBrochman	PNarbut	JLyons
EWBrach	JGuttmann				

C:\MYFILES\WPDOCS\HI-STORM\fwd final CoC and SER.wpd

OFC:	SFL E	SFL	DD:SLID		
NAME:	MBailey	JRHall	SShankman		
DATE:	3/16/00	3/16/00	3/17/00		

OFFICIAL RECORD COPY

DF03

4.5.3 Pressure Analysis

The applicant presented HI-STORM 100 system MPC calculated pressures for normal, off-normal, and accident conditions in Section 4.4.4 of the SAR. The maximum internal pressure was calculated using the free volume of the MPC, ideal gas law, and accounted for the backfill helium gas along with a fraction of the stored fuel helium fill gas and fission product gas. The normal, off-normal, and accident conditions were differentiated by the assumption of the fraction of stored spent fuel which contributed fill gas and fission gas to the MPC. These fractions were 1%, 10%, and 100%, respectively for the normal, off-normal, and accident cases, which are in agreement with NUREG-1536. In each case, 100% of the fuel rod fill gas and 30% of all fission product gases were assumed to be released to the MPC interior volume. The resulting MPC-24 and MPC-68 pressures are summarized in Table 4-5.

Table 4-5
Calculated Maximum MPC Pressures for Normal, Off-Normal, and Accident Conditions

Condition	MPC-24 Pressure (psig)	MPC-68 Pressure (psig)
Normal (1% fuel failure)	59.3	57.6
Off-Normal (10% fuel failure)	62.8	60.3
Accident (100% fuel failure)	97.6	87.4

The calculated maximum pressure for both MPC designs and all conditions remains below its appropriate design pressure.

4.5.4 Confirmatory Analysis

The staff reviewed all inputs, assumptions, methodology, and results of the applicant's temperature and pressure analyses which were submitted in support of the SAR, including both the MPC and Overpack. All the assumptions were found to be in compliance with NUREG-1536, Section 4.V.5.(c). Input parameters are consistent with design values for the HI-STORM overpack. The applicant selected suitably bounding and appropriate boundary conditions for normal, off-normal, and accident conditions. In addition, the staff reviewed the results of a validation of the computer code and analytic method used by HOLTEC in the HI-STORM analyses; this validation compared the code results with test data performed by DOE and the Energy Power Research Institute (EPRI) on a full scale spent fuel cask instrumented and tested at the Idaho National Engineering and Environmental Laboratory. The results of Holtec's analytic method showed good agreement with the DOE/EPRI test data. Based on the Staff's review, these validation results, and the FLUENT code's recognized value as an analytic tool in conducting thermal analyses, the staff finds the HI-STORM analytic method acceptable. In addition, although not relied upon in this SER, the staff notes that previous staff evaluation of the applicant's HI-STAR 100 SAR's FLUENT computer code results, using the ANSYS finite element computer code, confirmed the temperature calculation results shown by Holtec's analysis. The staff also reviewed the form loss and friction loss coefficients used by the applicant to simulate the hydraulic characteristics of the internal air passage. The applicant's form loss coefficients were found to be suitably bounding and applicable to the specific geometry of the HI-STORM 100 air passages. The staff evaluated and accepted the applicant's selected heat transfer coefficients. The temperature and pressure results were found to be correctly calculated using the identified inputs, assumptions, and methodology.

The staff evaluated the applicant's peak fuel rod internal gas average temperature calculation, used to determine the long-term dry storage temperature limits for zircaloy clad fuel rods. To calculate the maximum fuel rod temperature limit for long-term storage, the applicant volume averaged the temperature of the gases within the gap and plenum of the limiting fuel rod. The volume averaged gas temperature was used in the CSFM method described in the PNL-6189 report. Using the derived pressure, a corresponding cladding stress was calculated and a fuel age dependent temperature limit was identified. The CSFM method has been used and accepted by the staff in previous ISFSI license applications. The staff performed confirmatory calculations for the dry storage temperature limits. Table 4-6 lists the permissible Fuel Temperature and Allowable Heat Loads for the MPC-24 and -68.

Table 4-6
Maximum Allowable MPC Decay Heat Limits and Heat Load As a Function of Fuel Decay Time

Fuel Decay Time (years)	PWR MPC-24 Fuel Temperature Limit (°C)	PWR Maximum MPC-24 Allowable Decay Heat Load (kW)	BWR MPC-68 Fuel Temperature Limit (°C)	BWR Maximum MPC-68 Allowable Decay Heat Load (kW)
5	366.6 (692 °F)	20.88	394.4 (742 °F)	21.52
6	358.6 (677 °F)	20.17	379.2 (714 °F)	20.31
7	335.6 (636 °F)	18.18	354.8 (671 °F)	18.41
10	330.2 (626 °F)	17.72	348.8 (660 °F)	17.95
15	323.8 (615 °F)	17.17	342.1 (648 °F)	17.45

The staff concludes that the MPC decay heat limits in Table 4-6 assure that all material temperature limits are not exceeded and no gross ruptures would occur in a dry helium storage environment for the license period of 20 years.

4.6 HI-TRAC Thermal Review

The HI-TRAC transfer cask is a short-term container used to load and unload the HI-STORM concrete storage overpack. HI-TRAC is used for various plant operations, such as, normal onsite transport of spent nuclear fuel, MPC cavity vacuum drying, post-loading wet transfer operations, and MPC cooldown and reflood required for unloading spent nuclear fuel. Holtec designed HI-TRAC to ensure that fuel integrity is maintained through adequate rejection of decay heat from the spent nuclear fuel. Heat generated from the MPC outer surface is transmitted across an air gap to an inner shell steel liner, through a lead-to-steel air gap, through a lead shield, through an outer shell steel liner, through a water jacket, through the enclosure