

SAR Chapter 8, “Thermal Evaluation”**RAI NP-8-1:**

Provide bounding site specific ambient temperatures which account for seasonal variations.

Seasonal variations must be accounted for as ambient temperatures may persist for periods of time sufficient for the cask systems to reach steady state conditions, which may differ from the use of an annual average, as analyzed in the respective FSARs.

The applicant has not clearly defined an ambient temperature which considers seasonal variations. According to the monthly averaged values provided, Table 1-2 of the license application seems to provide a value that bounds seasonal variations. The applicant needs to clearly state how a bounding site-specific ambient temperature which considers seasonal variations is obtained.

This information is needed to determine compliance with 10 CFR 72.122 and 72.128.

Response to RAI NP-8-1:

The NAC and NUHOMS[®] storage systems cover a more than 20-year licensing history. Over that time, the NRC has approved each amendment and system. This results in not only differences in the data and values in certificates of compliance (CoCs) and materials licenses themselves, but also in differences in approaches concerning the basis and data used to license the individual storage systems.

NAC and NUHOMS[®] storage systems have different approaches to defining the specific ambient temperature for normal, off-normal and accident conditions. Table NP-8-1-1 summarizes how site normal, off-normal and accident temperatures are calculated, and then compares the limits defined in each CoC or Material License Technical Specifications. As shown in the table, the NUHOMS[®] storage systems included in the WCS CISF License Application, as a rule, use high and low measured temperatures that are evaluated and compared. NAC systems have used the approach that the normal, off-normal and accident temperatures must be calculated using measured temperatures over different periods of time.

The site-specific ambient temperatures are derived from meteorological data presented in Safety Analysis Report (SAR) Table 2-2, Summary of Maximum and Minimum Temperatures for Andrews, TX (Period of Record: 1962 to 2010). The table includes the seasonal variation in ambient temperatures.

The ambient temperature range presented in Table 1-2 is 44.1 to 81.5 °F. These values represent the lowest mean monthly temperature at Andrews (from Table 2-2), which occurs in January (44.1 °F), and the highest mean monthly temperature (81.5 °F), which occurs in July.

The design and licensing basis incorporated by reference into the WCS CISF SAR for the NAC storage casks use the yearly average temperature to evaluate the system for normal ambient environmental conditions. SAR Sections E.3.1.1.6, E.3.2.1.6, F.3.1.1.6, and G.3.1.1.6 have been revised to clearly demonstrate how the design basis thermal analysis incorporated by reference from each of the NAC General Licenses remain bounding for the site-specific temperature data included in Chapter 2 of the SAR.

Going beyond the design and licensing basis, ISP reviewed NUREG-2174, which looked at the use of yearly average temperature for the normal condition ambient temperature, which is accepted by the NRC, and reviewed the effects on vertical and horizontal storage systems using this more conservative approach for normal ambient conditions by use of higher maximum summer temperatures such as those listed in Table 1-2 of the WCS CISF. NUREG-2174 determined that for every 10 °F increase in ambient temperature; there is an associated 14.4 °F increase in the peak cladding temperature (PCT) for systems similar to the NAC vertical systems. Table NP-8-1-2 lists the resulting maximum PCT for each system and compares it to the PCT when the 14.4 °F PCT increase per 10 °F ambient is applied.

Finally, the thermal analysis incorporated by reference into the WCS CISF SAR for the NAC systems includes conservatism. For instance, for the MAGNASTOR system the associated thermal analyses utilized a 35.5 kW design basis heat load, as authorized in CoC 1031. However, the highest heat load that can be transported in the MAGNATRAN transportation cask is 23 kW. Thus, transporting a MAGNASTOR canister to the WCS CISF will result in a canister having a minimum heat load margin of 12.5 kW when placed back into storage at the WCS CISF (i.e., 35.5 kW minus 23 kW). This is a reduction of heat load by 35% when compared to the licensing basis analytical heat load value. Taking this into consideration, it can be concluded that margins for MAGNASTOR will be higher when a canister is shipped and received at the WCS CISF for normal conditions of storage. Because the NAC-MPC and NAC-UMS systems are licensed for legacy fuel that has all been loaded and in storage for a significant amount of time, the margins will be even higher for these systems with respect to analyzed heat load and what will eventually be shipped to the WCS CISF.

Impact:

SAR Sections E.3.1.1.6, E.3.2.1.6, F.3.1.1.6, and G.3.1.1.6 have been revised as described in the response.

**Table NP-8-1-1
Licensing Basis Temperature Data for NAC and NUHOMS® Storage Systems**

Condition	System	NUHOMS®- MP187 Cask System (°F)	Standardized Advanced NUHOMS® System (°F)	Standardized NUHOMS®- 61BT System (°F)	Standardized NUHOMS®- 61BTH Type 1 System (°F)	NAC- MPC (°F)	NAC- UMS (°F)	NAC- MAGNASTOR (°F)	CISF Site Data (°F)
	Design Parameter	Incorporation By Reference Temperatures							Temperature
Normal	Normal Temperature	0 – 101	0 – 104	0 – 100	0 – 100	X	X	X	44.1 – 81.5
	Average Annual Ambient Temperature	X	X	X	X	75	76 °F	76	67.1
Off-Normal	Minimum temperature	-20.0	-40.0	-40.0	-40.0	X	X	X	30.1
	Maximum temperature	120	117	125	125	X	X	X	113
	Minimum 3-day avg. temperature	X	X	X	X	-40	-40	-40	27.9
	Maximum 3-day avg. temperature	X	X	X	X	100	106	106	89.4
Accident	Maximum temperature	120	120	125	125	125	133	133	113

**Table NP-8-1-2
Calculated PCT Using NUREG-2174 Methodology**

System	Yearly Average Normal Ambient (°F)	Calculated PCT Normal Ambient (°F)	Calculated PCT for 81.5 °F Normal Ambient (°F)	PCT Allowable for Normal Conditions (°F)
MPC-LACBWR	75	449	458.4	806 (SS)
MPC-CY	75	629	638.4	752(Zr) / 806 (SS)
MPC-Yankee	75	563	572.4	644 (Zr) / 644 (SS)
UMS (PWR Fuel)	76	648	655.9	752 (Zr)
MAGNASTOR (PWR Fuel)	76	718	725.9	752 (Zr)

Zr = Zircalloy Clad Fuel

SS = Stainless Steel Clad Fuel

RAI NP-8-2:

Provide thermal evaluation, analysis, and results to demonstrate that all cask systems meet the WCS CISF site specific environmental conditions.

WCS CISF SAR Appendices A.8, B.8, C.8, and D.8 of the application provide a normal ambient temperature design criteria for the NUHOMS[®]-MP187, Standardized Advanced NUHOMS[®], Standardized NUHOMS[®]-61BT, and Standardized NUHOMS[®]-61BTH Type 1 cask systems, respectively. Appendices E.8, F.8, and G.8 of the application state that for the NAC-MPC, NAC-UMS, and MAGNASTOR, the maximum average yearly temperatures allowed are 75°F, 76°F, and 76°F, respectively. A definition of normal ambient temperature for the site is not clear in the application but according to the monthly averaged values provided (mean monthly temperature of 81.5°F [considering seasonal variations] on SAR Table 2-2, "Summary of Maximum and Minimum Temperatures for Andrews, TX, Period of Record: 1962 to 2010"), SAR Table 1-2 would provide a value that seems to bound seasonal variations and the value seems to bound storage systems described in Appendices A-D of the application; however, Table 1-2 is not bounded by the systems described in Appendices E.8, F.8, and G.8. Therefore, a thermal evaluation is needed for these systems based on the normal ambient temperature presented in Table 1-2.

The NRC staff needs this information to verify that no thermal limits are exceeded for any of the cask systems stored at WCS CISF.

This information is needed to determine compliance with 10 CFR 72.122 and 72.128.

Response to RAI NP-8-2:

As described in the response to RAI NP-8-1, SAR Sections E.3.1.1.6, E.3.2.1.6, F.3.1.1.6, and G.3.1.1.6 have been revised to more clearly demonstrate how the design basis thermal analysis incorporated by reference from each of the NAC general licenses remain bounding for the site specific temperature data included Chapter 2 of the SAR. SAR Table 1-2 has been revised to report system independent temperatures for the WCS CISF site. The maximum three-day average temperature cited in SAR Section 2.3.3.1 has also been corrected to be consistent with the value reported in SAR Table 2-13.

Impact:

SAR Section 2.3.3.1 and Table 1-2 have been revised as described in the response.