INTERIM STORAGE
PARTNERS

January 29, 2020
E-56011

Director, Division of Spent Fuel Management
Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
One White Flint North
11555 Rockville Pike
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Subject: Submission of ISP Updated Draft Responses for RAIs NP-8-1, NP-8-2 and Associated SAR Markups from First Request For Additional Information, Part 2, Docket 72-1050 CAC/EPID 001028/L-2017-NEW-0002

Reference: 1. Letter from John-Chau Nguyen (NRC) to Jeffery D. Isakson, "Interim Storage Partners LLC's License Application To Construct And Operate The Waste Control Specialists Consolidated Interim Storage Facility, Andrews County, Texas, Docket No. 72-1050 – First Request For Additional Information, Part 2," dated March 6, 2019

Interim Storage Partners LLC hereby submits its updated draft responses to RAIs NP-8-1 and NP-8-2 from Reference [1] in preparation for possible meetings to be scheduled with NRC staff for discussion. Enclosure 1 contains the updated draft responses to the RAIs and associated Safety Analysis Report (SAR) marked up pages.

Should you have any questions regarding this submission, please contact me by telephone at (410) 910-6955, or by email at jack.boshoven@orano.group.

Sincerely,

Jack Boshoven
Chief Engineer CISF, Licensing and Engineering
Interim Storage Partners LLC

NM5520
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cc: John-Chau Nguyen, Senior Project Manager, U.S. NRC
Jeff Isakson, ISP LLC
Elicia Sanchez, ISP LLC
Renee Murdock, ISP LLC

Enclosures:

1. Updated draft RAI NP-8-1 and NP-8-2 responses with associated SAR change pages

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 the. 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 of 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 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.

Table 1-2
Summary of WCS CISF Principal Design Criteria
(3 pages)

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards and Basis
Type of fuel	Commercial, light water reactor spent fuel	Normal	N/A
Storage Systems	Transportable canisters and storage overpacks docketed by the NRC	Normal	See Table 1-1
Fuel Characteristics	Criteria as specified in previously approved CoCs and licenses for included systems	Normal	See Table 1-1
Tornado (Wind Load)	Max translational speed: 40 mph Max rotational speed: 160 mph Max tornado wind speed: 200 mph Radius of max rotational speed: 150 ft Tornado pressure drop: 0.9 psi Rate of pressure drop: 0.4 psi/sec	Accident	Reg Guide 1.76 [1-5] NUREG-800[1-6]
Tornado (Missile)	Automobile 4000 lb, 112 ft/s Schedule 40 Pipe 287 lb, 112 ft/s Solid Steel Sphere 0.147 lb, 23 ft/s	Accident	NUREG-800[1-7]
Floods	The WCS CISF is not in a floodplain and is above the Probable Maximum Flood elevation, and will remain dry in the event of a flood.	Accident	Section 2.4.2.2
Seismic (Ground Motion)	Site-specific ground-surface uniform hazard response spectra (UHRS) with 1E-4 annual frequency of exceedance (AFE) having peak ground acceleration (PGA) of 0.250 g horizontal and 0.175 g vertical. (Table 1-5 and Figure 1-5)	Accident	AECOM Study Number WCS-12-05-100-001[1-10]
Vent Blockage	For NUHOMS® Systems: Inlet and outlet vents blocked 40 hrs For MPC and UMS Systems: Inlet and outlet vents blocked 24 hrs For MAGNASTOR Systems: Inlet vents blocked 58 hrs	Accident	N/A
Fire/Explosion	For NUHOMS® Systems: Equivalent fire 300 gallons of diesel fuel For Vertical Systems: Equivalent fire 50 gallons of fuel	Accident	N/A

Table 1-2
Summary of WCS CISF Principal Design Criteria
(3 pages)

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards and Basis
Cask Drop	For NUHOMS® Systems: Transfer Cask Horizontal side drop or slap down 80 inches VCCs for MPC Systems: Drop height 6 inches VCCs for UMS and MAGNASTOR Systems: Drop height 24 inches	Accident	N/A
Transfer Load	For NUHOMS® Systems only: Normal insertion load 60 kips Normal extraction load 60 kips	Normal	NA
Transfer Load	For NUHOMS® Systems only: Maximum insertion load 80 kips Maximum extraction load 80 kips	Off-Normal/ Accident	N/A
Ambient Temperatures	Normal temperature *range* 44.1 – 81.5°F	Normal	Section 2.3.3.1
Off-Normal Temperature	Maximum temperature 113°F	Off-Normal	Section 2.3.3.1
Extreme Temperature	Maximum temperature 113°F	Accident	Section 2.3.3.1
Solar Load (Insolation)	Horizontal flat surface insolation 2949.4 BTU/day-ft^2 Curved surface solar insolation 1474.7 BTU/day-ft^2	Normal	10 CFR Part 71
Snow and Ice	Snow Load 10 psf	Normal	Section 2.3.2.4
Dead Weight	Per design basis for systems listed in Table 1-1	Normal	N/A
Internal and External Pressure Loads	Per design basis for systems listed in Table 1-1	Normal	N/A
Design Basis Thermal Loads	Per design basis for systems listed in Table 1-1	Normal	N/A
Operating Loads	Per design basis for systems listed in Table 1-1	Normal	N/A
Live Loads	Per design basis for systems listed in Table 1-1	Normal	N/A

All Indicated Changes are in response to RAI NP-8-2

Table 1-2
Summary of WCS CISF Principal Design Criteria
(3 pages)

Design Parameter	Design Criteria	Condition	Applicable Codes, Standards and Basis
Radiological Protection	Public wholebody ≤ 5 Rem Public deep dose plus individual organ or tissue ≤ 50 Rem Public shallow dose to skin or extremities ≤ 50 Rem Public lens of eye ≤ 15 Rem	Accident	10 CFR 72.106
Radiological Protection	Public wholebody ≤ 25 mrem/yr (1) Public thyroid ≤ 75 mrem/yr (1) Public critical organ ≤ 25 mrem/yr (1)	Normal	10 CFR 72.104
Confinement	Per design basis for systems listed in Table 1-1	N/A	N/A
Nuclear Criticality	Per design basis for systems listed in Table 1-1	N/A	N/A
Decommissioning	Minimize potential contamination	Normal	10 CFR 72.130
Materials Handling and Retrieval Capability	Cask/canister handling system prevent breach of confinement boundary under all conditions Storage system allows ready retrieval of canister for shipment off-site	Normal	10 CFR 72.122(1)
Cask Handling Building	Prevent building collapse *under design-basis tornado and tornado-generated missile loading, prevent building collapse under design-basis seismic loading*	Accident	*Section 7.5.3.2*

Note:

1. In accordance with 10 CFR 72.104 (a)(3) limits include any other radiation from uranium fuel cycle operations within the region.

Measurements for all parameters, listed in Table 2-11, are taken at 10-minute, 60-minute and 24-hour averages and recorded/stored on a dedicated Campbell Scientific data logger at each station. Routinely the data loggers automatically download their content to a server in Dallas, TX for long-term storage. Data loggers can be remotely accessed via password protected radio telemetry; and the server can be securely accessed via a password protected Internet connection. Table 2-11 lists the meteorological parameters measured and at what heights. Information for the Met One Towers and the WeatherHawk Series regarding range, accuracy, and resolution is listed in Table 2-12.

2.3.3.1 Maximum and Minimum Temperatures

The Western Regional Climate Center (www.wrcc.dri.edu) has historic temperature data for Andrews, TX. The temperature data currently available spans from 1962 until 2010. The average maximum and minimum temperatures, the record high temperature and low temperature for each month, and the annual high and low temperature for these years is shown on Table 2-2. Table 2-2 was used to provide normal, off-normal, and extreme temperature information for the WCS CISF site.

Normal Temperature (NUHOMS® System): The normal temperature range is taken as the low and high mean monthly temperature (44.1°F to 81.5°F).

Normal Temperature (NAC System): The normal ambient temperature is taken as the maximum yearly average temperature. In addition to the temperature information provided in Table 2-2, temperature data from the Midland-Odessa monitoring station between 2000 and 2015 was used to provide yearly average temperatures (Table 2-13). The maximum yearly average temperature is 67.1°F.

Off-Normal Temperature (NUHOMS® System): The NUHOMS® System uses the extreme high temperature to evaluate that system for off-normal temperature conditions. That value is taken as the highest temperature recorded over the time period (113°F) in the data set represented in Table 2-2. The off-normal minimum temperature is 30.1°F, which is the minimum mean daily temperature shown in Table 2-2.

Off-Normal Temperature (NAC System): The NAC System uses a rolling average temperature to evaluate that system for the off-normal temperature condition. In addition to the temperature information provided in Table 2-2, temperature data from the Midland-Odessa monitoring station between 2000 and 2015 was used to provide 3-day average ambient temperatures. These temperatures are determined by taking the daily average temperature averaged over three consecutive days for each day of the year. The lowest average 3-day temperature and the highest average 3-day temperature is shown in Table 2-13. The minimum average and maximum average values averaged over the data set represented in Table 2-13 are 27.9°F and *93.5*°F.

E.3.1.1.6 Environmental Temperatures

A temperature of 75°F was selected to bound all annual average temperatures in the United States, except the Florida Keys and Hawaii, *with full insolation. The annual average temperature takes into account day and night and summer and winter temperatures throughout the year. The annual average temperature is the principle design parameter in the NAC-MPC design analysis, because it establishes the design basis for demonstration of long term spent fuel integrity. The long term integrity of the spent nuclear fuel cladding is a function of the average ambient temperature over the entire storage period, which is assumed to be at the maximum annual average temperature in every year of storage for conservatism.* The evaluation of this environmental condition is discussed along with the thermal analysis models in Chapter 4.0 of Reference E.3-1. The thermal stress evaluation for the normal operating conditions is provided in Section 3.4.4 of Reference E.3-1. Normal temperature fluctuations are bounded by the severe ambient temperature cases that are evaluated as off-normal and accident conditions.

Off-normal, severe environmental conditions were defined as -40°F with no solar loads and 100°F with solar loads. An extreme environmental condition of 125°F with maximum solar loads is evaluated as an accident case to show compliance with the maximum heat load case required by ANSI-57.9 (Section 11.2.10). Thermal performance was also evaluated for the cases of: (1) half the air inlets blocked; and (2) all air inlets and outlets blocked. Thermal analyses for these cases are presented in Sections 11.1.1 and 11.2.8 of Reference E.3-1. The evaluation based on ambient temperature conditions is presented in Section 4.4 of Reference E.3-1. Solar insolance is as specified in 10 CFR 71.71 and Regulatory Guide 7.8.

Per the NAC-MPC Certificate of Compliance (CoC), the environmental conditions that are required to be met are the following:

- *the maximum average yearly temperature allowed is 75°F*
- *the maximum 3-day average temperature extremes shall be greater than -40°F and less than 125°F*
- *the maximum 3-day average ambient temperature allowed is 100°F*

All of these conditions are met at the WCS site and are addressed in WCS SAR Section 2.3.3.1 and WCS SAR Tables 2-2 and 2-13. Specifically, SAR Table 2-2 gives a maximum yearly average temperature for the site of 63.5°F, which is less than the 75°F limit. This table also gives the maximum temperature extremes for the site of -1.0°F and 113°F, which is within the 3-day average temperature extreme limits of -40°F and 125°F. WCS SAR Table 2-13 gives a maximum 3-day average temperature of 93.5°F, which is less than the 100°F limit. Therefore, all environmental temperature limits for the NAC-MPC system at the WCS facility are met.

E.3.2.1.4 Snow and Ice Loadings

The snow and ice loadings design criteria that are defined in Section 2.2 of Reference E.3-1 for the NAC-MPC apply to the MPC-LACBWR system in their entirety. These design criteria are described in WCS CISF SAR Appendix E, Section E.3.1.1.4. Therefore, no further site-specific evaluations are required.

E.3.2.1.5 Combined Load Criteria

The combined load design criteria that are defined in Section 2.2 of Reference E.3-1 for the NAC-MPC apply to the MPC-LACBWR system in their entirety. These design criteria are described in WCS CISF SAR Appendix E, Section E.3.1.1.5. Therefore, no further site-specific evaluations are required.

E.3.2.1.6 Environmental Temperatures

The 75°F normal temperature was used as the base for thermal evaluations with full insolation. The annual average temperature takes into account day and night and summer and winter temperatures throughout the year. The annual average temperature is the principle design parameter in the NAC-MPC (MPC-LACBWR) design analysis, because it establishes the design basis for demonstration of long term spent fuel integrity. The long term integrity of the spent nuclear fuel cladding is a function of the average ambient temperature over the entire storage period, which is assumed to be at the maximum annual average temperature in every year of storage for conservatism.

The environmental temperatures design criteria that are defined in Section 2.2 of Reference E.3-1 for the NAC-MPC apply to the MPC-LACBWR system in their entirety with exception to the maximum extreme heat limit, which is 105°F. The applicable design criteria are described in WCS CISF SAR Appendix E, Section E.3.1.1.6.

Per the NAC-MPC Certificate of Compliance (CoC), the environmental conditions that are required to be met are the following:

- *the maximum average yearly temperature allowed is 75°F*
- *the maximum 3-day average temperature extremes shall be greater than -40°F and less than 125°F*
- *the maximum 3-day average ambient temperature allowed is 100°F*

All Indicated Changes are in response to RAI NP-8-1

All of these conditions are met at the WCS CISF and are addressed in SAR Section 2.3.3.1 and SAR Tables 2-2 and 2-13. Specifically, SAR Table 2-2 gives a maximum yearly average temperature for the site of 63.5°F, which is less than the 75°F limit. This table also gives the maximum temperature extremes for the site of -1.0°F and 113°F, which is within the 3-day average temperature extreme limits of -40°F and 125°F. SAR Table 2-13 gives a maximum 3-day average temperature of 93.5°F, which is less than the 100°F limit. Therefore, all environmental temperature limits for the NAC-MPC system at the WCS CISF are met.

The transfer cask is a special lifting device. The lifting trunnions and supports are designed and fabricated to the requirements of ANSI N14.6 and NUREG-0612. The remainder of the structure is designed and fabricated to ANSI/ANS-57.9. The combined shear stress or maximum tensile stress during the lift (with 10 percent load factor) shall be $\leq S_y/6$ and $S_u/10$ for a nonredundant load path, or shall be $\leq S_y/3$ and $S_u/5$ for redundant load paths. The ferritic steel material used for the load bearing members of the transfer cask shall satisfy the material toughness requirements of ANSI N14.6, paragraph 4.2.6. The structural evaluations presented in Reference F.3-1 demonstrate that the transfer cask meets all of the design criteria. Therefore, no further site-specific evaluations are required.

F.3.1.1.6 Environmental Temperatures

A temperature of 76°F was selected to bound all annual average temperatures in the United States, except the Florida Keys and Hawaii. The 76°F normal temperature was used as the basis for thermal evaluations *with full insolation. The annual average temperature takes into account day and night and summer and winter temperatures throughout the year. The annual average temperature is the principle design parameter in the NAC-UMS design analysis, because it establishes the design basis for demonstration of long term spent fuel integrity. The long term integrity of the spent nuclear fuel cladding is a function of the average ambient temperature over the entire storage period, which is assumed to be at the maximum annual average temperature in every year of storage for conservatism*. The evaluation of this environmental condition is discussed along with the thermal analysis models in Chapter 4.0 of Reference F.3-1. The thermal stress evaluation for the normal operating conditions is presented in Section 3.4.4 of Reference F.3-1. Normal temperature fluctuations are bounded by the severe ambient temperature cases that are evaluated as off-normal and accident conditions.

Off-normal, severe environmental conditions are defined as -40°F with no solar loads and 106°F with solar loads. An extreme environmental condition of 133°F with maximum solar loads is evaluated as an accident case (Section 11.2.7 of Reference F.3-1) to show compliance with the maximum heat load case required by ANSI-57.9. Thermal performance is also evaluated for the cases of: (1) half the air inlets blocked; and (2) all air inlets and outlets blocked. Thermal analyses for these cases are presented in Sections 11.1.2 and 11.2.13 of Reference F.3-1. The evaluation based on ambient temperature conditions is presented in Section 4.4 of Reference F.3-1. Solar insolance is as specified in 10 CFR 71.71 and Regulatory Guide 7.8.

Per the NAC-UMS Certificate of Compliance (CoC), the environmental conditions that are required to be met are the following:

All Indicated Changes are in response to RAI NP-8-1

- *the maximum average yearly temperature allowed is 76°F*
- *the maximum 3-day average temperature extremes shall be greater than -40°F and less than 133°F*
- *the maximum 3-day average ambient temperature allowed is 106°F*

All of these conditions are met at the WCS CISF and are addressed in SAR Section 2.3.3.1 and SAR Tables 2-2 and 2-13. Specifically, SAR Table 2-2 gives a maximum yearly average temperature for the site of 63.5°F, which is less than the 76°F limit. This table also gives the maximum temperature extremes for the site of -1.0°F and 113°F, which is within the 3-day average temperature extreme limits of -40°F and 133°F. SAR Table 2-13 gives a maximum 3-day average temperature of 93.5°F, which is less than the 106°F limit. Therefore, all environmental temperature limits for the NAC-UMS system at the WCS CISF are met.

F.3.1.2 Safety Protection Systems

The NAC-UMS relies upon passive systems to ensure the protection of public health and safety, except in the case of fire or explosion. As discussed in Section 2.3.6 of Reference F.3-1, fire and explosion events are effectively precluded by site administrative controls that prevent the introduction of flammable and explosive materials into areas where an explosion or fire could damage installed NAC-UMS systems. The use of passive systems provides protection from mechanical or equipment failure.

F.3.1.2.1 General

The NAC-UMS is designed for safe, long-term storage of spent nuclear fuel. The NAC-UMS will survive all of the evaluated normal, off-normal, and postulated accident conditions without release of radioactive material or excessive radiation exposure to workers or the general public. The major design considerations that are incorporated in the NAC-UMS to assure safe long-term fuel storage are:

1. Continued confinement in postulated accidents.
2. Thick concrete and steel biological shield.
3. Passive systems that ensure reliability.
4. Inert atmosphere to provide corrosion protection for stored fuel cladding and enhanced heat transfer for the stored fuel.

G.3.1.1.6 Environmental Temperatures

A temperature of 76°F is defined as the design base normal operations temperature for MAGNASTOR in storage. This temperature conservatively bounds the maximum average annual temperature in the 48 contiguous United States, specifically, Miami, FL, at 75.6°F, *with full insolation,* and meets the normal condition thermal boundary defined in NUREG-1536. *The annual average temperature takes into account day and night and summer and winter temperatures throughout the year. The annual average temperature is the principle design parameter in the MAGNASTOR design analysis, because it establishes the design basis for demonstration of long term spent fuel integrity. The long term integrity of the spent nuclear fuel cladding is a function of the average ambient temperature over the entire storage period, which is assumed to be at the maximum annual average temperature in every year of storage for conservatism.* Use of this design base establishes a bounding condition for existing and potential ISFSI sites in the United States. The evaluation of this environmental condition along with the thermal analysis models are presented in Chapter 4 of Reference G.3-1. The thermal stress evaluation for the normal operating conditions is included in Chapter 3 of Reference G.3-1. Normal temperature fluctuations are bounded by the severe ambient temperature cases that are evaluated as off-normal and accident events.

Off-normal, severe environmental events are defined as -40°F with no solar loads and 106°F with solar loads. An extreme environmental condition of 133°F with maximum solar loads is evaluated as an accident case to show compliance with the maximum heat load case required by ANSI/ANS-57.9. Thermal performance is also evaluated assuming both the half blockage of the concrete cask air inlets and the complete blockage of the air inlets. Solar insolation is as specified in 10 CFR 71.71 and Regulatory Guide 7.8.

Per the MAGNASTOR Certificate of Compliance (CoC), the environmental conditions that are required to be met are the following:

- *the maximum average yearly temperature allowed is 76°F*
- *the maximum 3-day average temperature extremes shall be greater than -40°F and less than 133°F*
- *the maximum 3-day average ambient temperature allowed is 106°F*

All of these conditions are met at the WCS CISF and are addressed in SAR Section 2.3.3.1 and SAR Tables 2-2 and 2-13. Specifically, SAR Table 2-2 gives a maximum yearly average temperature for the site of 63.5°F, which is less than the 76°F limit. This table also gives the maximum temperature extremes for the site of -1.0°F and 113°F, which is within the 3-day average temperature extreme limits of -40°F and 133°F. SAR Table 2-13 gives a maximum 3-day average temperature of 93.5°F, which is less than the 106°F limit. Therefore, all environmental temperature limits for the MAGNASTOR system at the WCS CSIF are met.