Enclosure 2 to E-56069

SAR Changed Pages

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

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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.

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

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 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 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 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 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:

- *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*

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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. 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.