

RENEWED CERTIFICATE OF COMPLIANCE NO. 1014

APPENDIX B

APPROVED CONTENTS AND DESIGN FEATURES

FOR THE HI-STORM 100 CASK SYSTEM

AMENDMENT NO. 0

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1.0 Definitions

----- NOTE -----

The defined terms of this section appear in capitalized type and are applicable throughout these Technical Specifications and Bases.

<u>Term</u>	<u>Definition</u>
CASK TRANSFER FACILITY (CTF)	The CASK TRANSFER FACILITY includes the following components and equipment: (1) a Cask Transfer Structure used to stabilize the TRANSFER CASK and MPC during lifts involving spent fuel not bounded by the regulations of 10 CFR Part 50, and (2) Either a stationary lifting device or a mobile lifting device used in concert with the stationary structure to lift the OVERPACK, TRANSFER CASK and MPC
DAMAGED FUEL ASSEMBLY	DAMAGED FUEL ASSEMBLIES are fuel assemblies with known or suspected cladding defects, as determined by a review of records, greater than pinhole leaks or hairline cracks, missing fuel rods that are not replaced with dummy fuel rods, or those that cannot be handled by normal means. Fuel assemblies which cannot be handled by normal means due to fuel cladding damage are considered FUEL DEBRIS.
DAMAGED FUEL CONTAINER (DFC)	DFCs are specially designed enclosures for DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS which permit gaseous and liquid media to escape while minimizing dispersal of gross particulates.
FUEL DEBRIS	FUEL DEBRIS is ruptured fuel rods, severed rods, loose fuel pellets or fuel assemblies with known or suspected defects which cannot be handled by normal means due to fuel cladding damage.

1.0 Definitions (continued)

INTACT FUEL ASSEMBLY

INTACT FUEL ASSEMBLIES are fuel assemblies without known or suspected cladding defects greater than pinhole leaks or hairline cracks and which can be handled by normal means. Partial fuel assemblies, that is fuel assemblies from which fuel rods are missing, shall not be classified as INTACT FUEL ASSEMBLIES unless dummy fuel rods are used to displace an amount of water greater than or equal to that displaced by the original fuel rod(s).

LOADING OPERATIONS

LOADING OPERATIONS include all licensed activities on an OVERPACK or TRANSFER CASK while it is being loaded with fuel assemblies. LOADING OPERATIONS begin when the first fuel assembly is placed in the MPC and end when the OVERPACK or TRANSFER CASK is suspended from or secured on the transporter. LOADING OPERATIONS does not include MPC transfer between the TRANSFER CASK and the OVERPACK.

MULTI-PURPOSE CANISTER
(MPC)

MPCs are the sealed spent nuclear fuel canisters which consist of a honeycombed fuel basket contained in a cylindrical canister shell which is welded to a baseplate, lid with welded port cover plates, and closure ring. The MPC provides the confinement boundary for the contained radioactive materials.

OVERPACK

OVERPACKs are the casks which receive and contain the sealed MPCs for interim storage on the ISFSI. They provide gamma and neutron shielding, and provide for ventilated air flow to promote heat transfer from the MPC to the environs. The OVERPACK does not include the TRANSFER CASK.

PLANAR-AVERAGE
INITIAL ENRICHMENT

PLANAR-AVERAGE INITIAL ENRICHMENT is the average of the distributed fuel rod initial enrichments within a given axial plane of the assembly lattice.

(continued)

1.0 Definitions (continued)

SPENT FUEL STORAGE
CASK (SFSC)

An SFSC is a container approved for the storage of spent fuel assemblies at the ISFSI. The HI-STORM 100 SFSC System consists of the OVERPACK and its integral MPC

TRANSFER CASK

TRANSFER CASKs are containers designed to contain the MPC during and after loading of spent fuel assemblies and to transfer the MPC to or from the OVERPACK. The HI-STORM 100 Cask System employs either the 125-Ton or the 100-Ton HI-TRAC TRANSFER CASK.

TRANSPORT OPERATIONS

TRANSPORT OPERATIONS include all licensed activities performed on an OVERPACK or TRANSFER CASK loaded with one or more fuel assemblies when it is being moved to and from the ISFSI. TRANSPORT OPERATIONS begin when the OVERPACK or TRANSFER CASK is first suspended from or secured on the transporter and end when the OVERPACK or TRANSFER CASK is at its destination and no longer secured on or suspended from the transporter. TRANSPORT OPERATIONS includes transfer of the MPC between the OVERPACK and the TRANSFER CASK.

UNLOADING OPERATIONS

UNLOADING OPERATIONS include all licensed activities on an SFSC to be unloaded of the contained fuel assemblies. UNLOADING OPERATIONS begin when the OVERPACK or TRANSFER CASK is no longer suspended from or secured on the transporter and end when the last fuel assembly is removed from the SFSC. UNLOADING OPERATIONS does not include MPC transfer between the TRANSFER CASK and the OVERPACK.

2.0 APPROVED CONTENTS

2.1 Fuel Specifications and Loading Conditions

2.1.1 Fuel To Be Stored In The HI-STORM 100 SFSC System

- a. INTACT FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, and FUEL DEBRIS meeting the limits specified in Table 2.1-1 may be stored in the HI-STORM 100 SFSC System.
- b. For MPCs partially loaded with stainless steel clad fuel assemblies, all remaining fuel assemblies in the MPC shall meet the decay heat generation limit for the stainless steel clad fuel assemblies.
- c. For MPCs partially loaded with DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS, all remaining Zircaloy clad INTACT FUEL ASSEMBLIES in the MPC shall meet the decay heat generation limits for the DAMAGED FUEL ASSEMBLIES.
- d. For MPC-68's partially loaded with array/class 6x6A, 6x6B, 6x6C, or 8x8A fuel assemblies, all remaining Zircaloy clad INTACT FUEL ASSEMBLIES in the MPC shall meet the decay heat generation limits for the 6x6A, 6x6B, 6x6C, and 8x8A fuel assemblies.

2.1.2 Preferential Fuel Loading

Preferential fuel loading shall be used whenever fuel assemblies with significantly different post-irradiation cooling times (≥ 1 year) are to be loaded in the same MPC. Fuel assemblies with the longest post-irradiation cooling times shall be loaded into fuel storage locations at the periphery of the basket. Fuel assemblies with shorter post-irradiation cooling times shall be placed toward the center of the basket.

(continued)

2.0 Approved Contents (continued)

2.2 Violations

If any Fuel Specifications or Loading Conditions of 2.1 are violated, the following actions shall be completed:

2.2.1 The affected fuel assemblies shall be placed in a safe condition.

2.2.2 Within 24 hours, notify the NRC Operations Center.

2.2.3 Within 30 days, submit a special report which describes the cause of the violation, and actions taken to restore compliance and prevent recurrence.

Table 2.1-1 (page 1 of 15)
Fuel Assembly Limits

I. MPC MODEL: MPC-24

A. Allowable Contents

1. Uranium oxide, PWR INTACT FUEL ASSEMBLIES listed in Table 2.1-2 and meeting the following specifications:

- a. Cladding Type: Zircaloy (Zr) or Stainless Steel (SS) as specified in Table 2.1-2 for the applicable fuel assembly array/class

- b. Initial Enrichment: As specified in Table 2.1-2 for the applicable fuel assembly array/class.

- c. Post-irradiation Cooling Time and Average Burnup Per Assembly
 - i. Zr Clad: An assembly post-irradiation cooling time and average burnup as specified in Table 2.1-4.

 - ii. SS Clad: An assembly post-irradiation cooling time ≥ 8 years and an average burnup $\leq 40,000$ MWD/MTU.

Table 2.1-1 (page 2 of 15)
Fuel Assembly Limits

I. MPC MODEL: MPC-24 (continued)

d. Decay Heat Per Assembly

- i. Zr Clad An assembly decay heat as specified in Table 2.1-5 for the applicable post-irradiation cooling time
- ii. SS Clad ≤ 710 Watts

e. Fuel Assembly Length ≤ 176.8 inches (nominal design)

f. Fuel Assembly Width ≤ 8.54 inches (nominal design)

g. Fuel Assembly Weight $\leq 1,680$ lbs

B. Quantity per MPC: Up to 24 fuel assemblies.

C. Fuel assemblies shall not contain control components.

D. DAMAGED FUEL ASSEMBLIES and FUEL DEBRIS are not authorized for loading into the MPC-24.

Table 2.1-1 (page 3 of 15)
Fuel Assembly Limits

II. MPC MODEL: MPC-68

A. Allowable Contents

1. Uranium oxide, BWR INTACT FUEL ASSEMBLIES listed in Table 2.1-3, with or without Zircaloy channels, and meeting the following specifications:

- | | |
|--|---|
| a. Cladding Type: | Zircaloy (Zr) or Stainless Steel (SS) as specified in Table 2.1-3 for the applicable fuel assembly array/class. |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT: | As specified in Table 2.1-3 for the applicable fuel assembly array/class. |
| c. Initial Maximum Rod Enrichment: | As specified in Table 2.1-3 for the applicable fuel assembly array/class. |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly | |
| i. Zr Clad: | An assembly post-irradiation cooling time and average burnup as specified in Table 2.1-4, except for array/class 6x6A, 6x6C, and 8x8A fuel assemblies, which shall have a cooling time ≥ 18 years and an average burnup $\leq 30,000$ MWD/MTU. |
| ii. SS Clad: | An assembly cooling time after discharge ≥ 10 years and an average burnup $\leq 22,500$ MWD/MTU. |

Table 2.1-1 (page 4 of 15)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

e. Decay Heat Per Assembly

i. Zr Clad

An assembly decay heat as specified in Table 2.1-5 for the applicable post-irradiation cooling time, except for array/class 6x6A, 6x6C, and 8x8A fuel assemblies, which shall have a decay heat \leq 115 Watts.

ii. SS Clad

\leq 95 Watts

f. Fuel Assembly Length

\leq 176.2 inches (nominal design)

g. Fuel Assembly Width

\leq 5.85 inches (nominal design)

h. Fuel Assembly Weight

\leq 700 lbs, including channels

Table 2.1-1 (page 5 of 15)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

2. Uranium oxide, BWR DAMAGED FUEL ASSEMBLIES, with or without Zircaloy channels, placed in DAMAGED FUEL CONTAINERS. Uranium oxide BWR DAMAGED FUEL ASSEMBLIES shall meet the criteria specified in Table 2.1-3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

- | | |
|---|--|
| a. Cladding Type: | Zircaloy (Zr) |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT: | As specified in Table 2.1-3 for the applicable fuel assembly array/class. |
| c. Initial Maximum Rod Enrichment: | As specified in Table 2.1-3 for the applicable fuel assembly array/class. |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly: | An assembly post-irradiation cooling time ≥ 18 years and an average burnup $\leq 30,000$ MWD/MTU. |
| e. Decay Heat Per Assembly | ≤ 115 Watts |
| f. Fuel Assembly Length: | ≤ 135.0 inches (nominal design) |
| g. Fuel Assembly Width: | ≤ 4.70 inches (nominal design) |
| h. Fuel Assembly Weight: | ≤ 400 lbs, including channels |

Table 2.1-1 (page 6 of 15)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

3. Mixed oxide (MOX), BWR INTACT FUEL ASSEMBLIES, with or without Zircaloy channels. MOX BWR INTACT FUEL ASSEMBLIES shall meet the criteria specified in Table 2.1-3 for fuel assembly array/class 6x6B, and meet the following specifications:

- | | |
|---|--|
| a. Cladding Type: | Zircaloy (Zr) |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT: | As specified in Table 2.1-3 for fuel assembly array/class 6x6B. |
| c. Initial Maximum Rod Enrichment: | As specified in Table 2.1-3 for fuel assembly array/class 6x6B. |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly: | An assembly post-irradiation cooling time ≥ 18 years and an average burnup $\leq 30,000$ MWD/MTIHM. |
| e. Decay Heat Per Assembly | ≤ 115 Watts |
| f. Fuel Assembly Length: | ≤ 135.0 inches (nominal design) |
| g. Fuel Assembly Width: | ≤ 4.70 inches (nominal design) |
| h. Fuel Assembly Weight: | ≤ 400 lbs, including channels |

Table 2.1-1 (page 7 of 15)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

4. Mixed oxide (MOX), BWR DAMAGED FUEL ASSEMBLIES, with or without Zircaloy channels, placed in DAMAGED FUEL CONTAINERS. MOX BWR DAMAGED FUEL ASSEMBLIES shall meet the criteria specified in Table 2.1-3 for fuel assembly array/class 6x6B, and meet the following specifications:

- | | |
|---|--|
| a. Cladding Type: | Zircaloy (Zr) |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT: | As specified in Table 2.1-3 for array/class 6x6B. |
| c. Initial Maximum Rod Enrichment: | As specified in Table 2.1-3 for array/class 6x6B. |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly: | An assembly post-irradiation cooling time ≥ 18 years and an average burnup $\leq 30,000$ MWD/MTIHM. |
| e. Decay Heat Per Assembly | ≤ 115 Watts |
| f. Fuel Assembly Length: | ≤ 135.0 inches (nominal design) |
| g. Fuel Assembly Width: | ≤ 4.70 inches (nominal design) |
| h. Fuel Assembly Weight: | ≤ 400 lbs, including channels |

Table 2.1-1 (page 8 of 15)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

- B. Quantity per MPC: Any combination of DAMAGED FUEL ASSEMBLIES in DAMAGED FUEL CONTAINERS and INTACT FUEL ASSEMBLIES up to a total of 68.
- C. Fuel assemblies with stainless steel channels are not authorized for loading in the MPC-68.

Table 2.1-1 (page 9 of 15)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F

A. Allowable Contents

1. Uranium oxide, BWR INTACT FUEL ASSEMBLIES, with or without Zircaloy channels. Uranium oxide BWR INTACT FUEL ASSEMBLIES shall meet the criteria in Table 2.1-3 for fuel assembly array class 6x6A, 6x6C, 7x7A or 8x8A, and meet the following specifications:

- | | |
|---|--|
| a. Cladding Type: | Zircaloy (Zr) |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT: | As specified in Table 2.1-3 for the applicable fuel assembly array/class. |
| c. Initial Maximum Rod Enrichment: | As specified in Table 2.1-3 for the applicable fuel assembly array/class. |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly: | An assembly post-irradiation cooling time ≥ 18 years and an average burnup $\leq 30,000$ MWD/MTU. |
| e. Decay Heat Per Assembly | ≤ 115 Watts |
| f. Fuel Assembly Length: | ≤ 176.2 inches (nominal design) |
| g. Fuel Assembly Width: | ≤ 5.85 inches (nominal design) |
| h. Fuel Assembly Weight: | ≤ 700 lbs, including channels |

Table 2.1-1 (page 10 of 15)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

2. Uranium oxide, BWR DAMAGED FUEL ASSEMBLIES, with or without Zircaloy channels, placed in DAMAGED FUEL CONTAINERS. Uranium oxide BWR DAMAGED FUEL ASSEMBLIES shall meet the criteria specified in Table 2.1-3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

- | | |
|---|--|
| a. Cladding Type: | Zircaloy (Zr) |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT: | As specified in Table 2.1-3 for the applicable fuel assembly array/class. |
| c. Initial Maximum Rod Enrichment: | As specified in Table 2.1-3 for the applicable fuel assembly array/class. |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly: | A post-irradiation cooling time after discharge \geq 18 years and an average burnup \leq 30,000 MWD/MTU. |
| e. Decay Heat Per Assembly | \leq 115 Watts |
| f. Fuel Assembly Length: | \leq 135.0 inches (nominal design) |
| g. Fuel Assembly Width: | \leq 4.70 inches (nominal design) |
| h. Fuel Assembly Weight: | \leq 400 lbs, including channels |

Table 2.1-1 (page 11 of 15)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

3. Uranium oxide, BWR FUEL DEBRIS, with or without Zircaloy channels, placed in DAMAGED FUEL CONTAINERS. The original fuel assemblies for the uranium oxide BWR FUEL DEBRIS shall meet the criteria specified in Table 2.1-3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

- | | |
|--|---|
| a. Cladding Type: | Zircaloy (Zr) |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT: | As specified in Table 2.1-3 for the applicable original fuel assembly array/class. |
| c. Initial Maximum Rod Enrichment: | As specified in Table 2.1-3 for the applicable original fuel assembly array/class. |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly | A post-irradiation cooling time after discharge ≥ 18 years and an average burnup $\leq 30,000$ MWD/MTU for the original fuel assembly. |
| e. Decay Heat Per Assembly | ≤ 115 Watts |
| f. Original Fuel Assembly Length | ≤ 135.0 inches (nominal design) |
| g. Original Fuel Assembly Width | ≤ 4.70 inches (nominal design) |
| h. Fuel Debris Weight | ≤ 400 lbs, including channels |

Table 2.1-1 (page 12 of 15)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

4. Mixed oxide (MOX), BWR INTACT FUEL ASSEMBLIES, with or without Zircaloy channels. MOX BWR INTACT FUEL ASSEMBLIES shall meet the criteria specified in Table 2.1-3 for fuel assembly array/class 6x6B, and meet the following specifications:

- | | |
|---|--|
| a. Cladding Type: | Zircaloy (Zr) |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT: | As specified in Table 2.1-3 for fuel assembly array/class 6x6B. |
| c. Initial Maximum Rod Enrichment: | As specified in Table 2.1-3 for fuel assembly array/class 6x6B. |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly: | An assembly post-irradiation cooling time after discharge \geq 18 years and an average burnup \leq 30,000 MWD/MTIHM. |
| e. Decay Heat Per Assembly | \leq 115 Watts |
| f. Fuel Assembly Length: | \leq 135.0 inches (nominal design) |
| g. Fuel Assembly Width: | \leq 4.70 inches (nominal design) |
| h. Fuel Assembly Weight: | \leq 400 lbs, including channels |

Table 2.1-1 (page 13 of 15)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

5. Mixed oxide (MOX), BWR DAMAGED FUEL ASSEMBLIES, with or without Zircaloy channels, placed in DAMAGED FUEL CONTAINERS. MOX BWR DAMAGED FUEL ASSEMBLIES shall meet the criteria specified in Table 2.1-3 for fuel assembly array/class 6x6B, and meet the following specifications:

- | | |
|---|--|
| a. Cladding Type: | Zircaloy (Zr) |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT: | As specified in Table 2.1-3 for fuel assembly array/class 6x6B. |
| c. Initial Maximum Rod Enrichment: | As specified in Table 2.1-3 for fuel assembly array/class 6x6B. |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly: | A post-irradiation cooling time after discharge \geq 18 years and an average burnup \leq 30,000 MWD/MTIHM. |
| e. Decay Heat Per Assembly | \leq 115 Watts |
| f. Fuel Assembly Length: | \leq 135.0 inches (nominal design) |
| g. Fuel Assembly Width: | \leq 4.70 inches (nominal design) |
| h. Fuel Assembly Weight: | \leq 400 lbs, including channels |

Table 2.1-1 (page 14 of 15)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

6. Mixed Oxide (MOX), BWR FUEL DEBRIS, with or without Zircaloy channels, placed in DAMAGED FUEL CONTAINERS. The original fuel assemblies for the MOX BWR FUEL DEBRIS shall meet the criteria specified in Table 2.1-3 for fuel assembly array/class 6x6B, and meet the following specifications:

- | | |
|---|---|
| a. Cladding Type: | Zircaloy (Zr) |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT: | As specified in Table 2.1-3 for original fuel assembly array/class 6x6B. |
| c. Initial Maximum Rod Enrichment: | As specified in Table 2.1-3 for original fuel assembly array/class 6x6B. |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly: | A post-irradiation cooling time after discharge ≥ 18 years and an average burnup $\leq 30,000$ MWD/MTIHM for the original fuel assembly. |
| e. Decay Heat Per Assembly | ≤ 115 Watts |
| f. Original Fuel Assembly Length: | ≤ 135.0 inches (nominal design) |
| g. Original Fuel Assembly Width: | ≤ 4.70 inches (nominal design) |
| h. Fuel Debris Weight: | ≤ 400 lbs, including channels |

Table 2.1-1 (page 15 of 15)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

B. Quantity per MPC (up to a total of 68 assemblies):

Up to four (4) DFCs containing uranium oxide BWR FUEL DEBRIS or MOX BWR FUEL DEBRIS. The remaining MPC-68F fuel storage locations may be filled with array/class 6x6A, 6x6B, 6x6C, 7x7A, and 8x8A fuel assemblies of the following type, as applicable:

1. Uranium oxide BWR INTACT FUEL ASSEMBLIES;
2. MOX BWR INTACT FUEL ASSEMBLIES;
3. Uranium oxide BWR DAMAGED FUEL ASSEMBLIES placed in DFCs; or
4. MOX BWR DAMAGED FUEL ASSEMBLIES placed in DFCs.

C. Fuel assemblies with stainless steel channels are not authorized for loading in the MPC-68F.

Table 2.1-2 (page 1 of 4)

PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	14x14A	14x14B	14x14C	14x14D	15x15A
Clad Material (Note 2)	Zr	Zr	Zr	SS	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 402	≤ 402	≤ 410	≤ 400	≤ 420
Initial Enrichment (wt % ²³⁵ U)	≤ 4.6	≤ 4.6	≤ 4.6	≤ 4.0	≤ 4.1
No. of Fuel Rods	179	179	176	180	204
Clad O.D. (in.)	≥ 0.400	≥ 0.417	≥ 0.440	≥ 0.422	≥ 0.418
Clad I.D. (in.)	≤ 0.3514	≤ 0.3734	≤ 0.3840	≤ 0.3890	≤ 0.3660
Pellet Dia. (in.)	≤ 0.3444	≤ 0.3659	≤ 0.3770	≤ 0.3835	≤ 0.3580
Fuel Rod Pitch (in.)	≤ 0.556	≤ 0.556	≤ 0.580	≤ 0.556	≤ 0.550
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 144	≤ 150
No. of Guide Tubes	17	17	5 (Note 4)	16	21
Guide Tube Thickness (in.)	≥ 0.017	≥ 0.017	≥ 0.040	≥ 0.0145	≥ 0.0165

Table 2.1-2 (page 2 of 4)

PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	15x15B	15x15C	15x15D	15x15E	15x15F
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 464	≤ 464	≤ 475	≤ 475	≤ 475
Initial Enrichment (wt % ²³⁵ U)	≤ 4.1	≤ 4.1	≤ 4.1	≤ 4.1	≤ 4.1
No. of Fuel Rods	204	204	208	208	208
Clad O.D. (in.)	≥ 0.420	≥ 0.417	≥ 0.430	≥ 0.428	≥ 0.428
Clad I.D. (in.)	≤ 0.3736	≤ 0.3640	≤ 0.3800	≤ 0.3790	≤ 0.3820
Pellet Dia. (in.)	≤ 0.3671	≤ 0.3570	≤ 0.3735	≤ 0.3707	≤ 0.3742
Fuel Rod Pitch (in.)	≤ 0.563	≤ 0.563	≤ 0.568	≤ 0.568	≤ 0.568
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide Tubes	21	21	17	17	17
Guide Tube Thickness (in.)	≥ 0.015	≥ 0.0165	≥ 0.0150	≥ 0.0140	≥ 0.0140

Table 2.1-2 (page 3 of 4)

PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/ Class	15x15G	16x16A	17x17A	17x17B	17x17C
Clad Material (Note 2)	SS	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 420	≤ 430	≤ 450	≤ 464	≤ 460
Initial Enrichment (wt % ²³⁵ U)	≤ 4.0	≤ 4.6	≤ 4.0	≤ 4.0	≤ 4.0
No. of Fuel Rods	204	236	264	264	264
Clad O.D. (in.)	≥ 0.422	≥ 0.382	≥ 0.360	≥ 0.372	≥ 0.377
Clad I.D. (in.)	≤ 0.3890	≤ 0.3320	≤ 0.3150	≤ 0.3310	≤ 0.3330
Pellet Dia. (in.)	≤ 0.3825	≤ 0.3255	≤ 0.3088	≤ 0.3232	≤ 0.3252
Fuel Rod Pitch (in.)	≤ 0.563	≤ 0.506	≤ 0.496	≤ 0.496	≤ 0.502
Active Fuel Length (in.)	≤ 144	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide Tubes	21	5 (Note 4)	25	25	25
Guide Tube Thickness (in.)	≥ 0.0145	≥ 0.0400	≥ 0.016	≥ 0.014	≥ 0.020

Table 2.1-2 (page 4 of 4)

PWR FUEL ASSEMBLY CHARACTERISTICS

Notes:

1. All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a given array/class.
2. Zr designates cladding material made of zirconium or zirconium alloys.
3. Design initial uranium weight is the nominal uranium weight specified for each assembly by the fuel manufacturer or reactor user. For each PWR fuel assembly, the total initial uranium weight may be up to 2.0 percent higher than the design initial uranium weight due to manufacturer tolerances.
4. Each guide tube replaces four fuel rods.

Table 2.1-3 (page 1 of 5)

BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	6x6A	6x6B	6x6C	7x7A	7x7B	8x8A
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 108	≤ 108	≤ 108	≤ 100	≤ 195	≤ 120
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (wt.% ²³⁵ U)	≤ 2.7	≤ 2.7 for the UO ₂ rods. See Note 4 for MOX rods	≤ 2.7	≤ 2.7	≤ 4.2	≤ 2.7
Initial Maximum Rod Enrichment (wt.% ²³⁵ U)	≤ 4.0	≤ 4.0	≤ 4.0	≤ 4.0	≤ 5.0	≤ 4.0
No. of Fuel Rods	36	36 (up to 9 MOX rods)	36	49	49	64
Clad O.D. (in.)	≥ 0.5550	≥ 0.5625	≥ 0.5630	≥ 0.4860	≥ 0.5630	≥ 0.4120
Clad I.D. (in.)	≤ 0.4945	≤ 0.4945	≤ 0.4990	≤ 0.4200	≤ 0.4990	≤ 0.3620
Pellet Dia. (in.)	≤ 0.4940	≤ 0.4820	≤ 0.4880	≤ 0.4110	≤ 0.4880	≤ 0.3580
Fuel Rod Pitch (in.)	≤ 0.694	≤ 0.694	≤ 0.740	≤ 0.631	≤ 0.738	≤ 0.523
Active Fuel Length (in.)	≤ 110	≤ 110	≤ 77.5	≤ 79	≤ 150	≤ 110
No. of Water Rods	0	0	0	0	0	0
Water Rod Thickness (in.)	N/A	N/A	N/A	N/A	N/A	N/A
Channel Thickness (in.)	≤ 0.060	≤ 0.060	≤ 0.060	≤ 0.060	≤ 0.120	≤ 0.100

Table 2.1-3 (2 of 5)

BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	8x8B	8x8C	8x8D	8x8E	9x9A	9x9B
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 185	≤ 185	≤ 185	≤ 180	≤ 173	≤ 173
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (wt.% ²³⁵ U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.2
Initial Maximum Rod Enrichment (wt.% ²³⁵ U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rods	63	62	60	59	74/66 (Note 5)	72
Clad O.D. (in.)	≥ 0.4840	≥ 0.4830	≥ 0.4830	≥ 0.4930	≥ 0.4400	≥ 0.4330
Clad I.D. (in.)	≤ 0.4250	≤ 0.4250	≤ 0.4190	≤ 0.4250	≤ 0.3840	≤ 0.3810
Pellet Dia. (in.)	≤ 0.4160	≤ 0.4160	≤ 0.4110	≤ 0.4160	≤ 0.3760	≤ 0.3740
Fuel Rod Pitch (in.)	≤ 0.641	≤ 0.641	≤ 0.640	≤ 0.640	≤ 0.566	≤ 0.569
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods	1	2	1 - 4 (Note 6)	5	2	1 (Note 7)
Water Rod Thickness (in.)	≥ 0.034	> 0.00	> 0.00	≥ 0.034	> 0.00	> 0.00
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.120	≤ 0.100	≤ 0.120	≤ 0.120

Table 2.1-3 (page 3 of 5)

BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	9x9C	9x9D	9x9E	9x9F	10x10A
Clad Material (Note 2)	Zr	Zr	Zr	Zr	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 173	≤ 170	≤ 170	≤ 170	≤ 182
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (wt.% ²³⁵ U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.2
Initial Maximum Rod Enrichment (wt.% ²³⁵ U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rods	80	79	76	76	92/78 (Note 8)
Clad O.D. (in.)	≥ 0.4230	≥ 0.4240	≥ 0.4170	≥ 0.4430	≥ 0.4040
Clad I.D. (in.)	≤ 0.3640	≤ 0.3640	≤ 0.3590	≤ 0.3810	≤ 0.3520
Pellet Dia. (in.)	≤ 0.3565	≤ 0.3565	≤ 0.3525	≤ 0.3745	≤ 0.3455
Fuel Rod Pitch (in.)	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.510
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods	1	2	5	5	2
Water Rod Thickness (in.)	≥ 0.020	≥ 0.0305	≥ 0.0305	≥ 0.0305	≥ 0.0300
Channel Thickness (in.)	≤ 0.100	≤ 0.100	≤ 0.100	≤ 0.100	≤ 0.120

Table 2.1-3 (page 4 of 5)

BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	10x10B	10x10C	10x10D	10x10E
Clad Material (Note 2)	Zr	Zr	SS	SS
Design Initial U (kg/assy.) (Note 3)	≤ 182	≤ 180	≤ 125	≤ 125
Maximum PLANAR-AVERAGE INITIAL ENRICHMENT (wt.% ²³⁵ U)	≤ 4.2	≤ 4.2	≤ 4.0	≤ 4.0
Initial Maximum Rod Enrichment (wt.% ²³⁵ U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rods	91/83 (Note 9)	96	100	96
Clad O.D. (in.)	≥ 0.3957	≥ 0.3790	≥ 0.3960	≥ 0.3940
Clad I.D. (in.)	≤ 0.3480	≤ 0.3294	≤ 0.3560	≤ 0.3500
Pellet Dia. (in.)	≤ 0.3420	≤ 0.3224	≤ 0.3500	≤ 0.3430
Fuel Rod Pitch (in.)	≤ 0.510	≤ 0.488	≤ 0.565	≤ 0.557
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 83	≤ 83
No. of Water Rods	1 (Note 7)	5 (Note 10)	0	4
Water Rod Thickness (in.)	> 0.00	≥ 0.034	N/A	≥ 0.022
Channel Thickness (in.)	≤ 0.120	≤ 0.055	≤ 0.080	≤ 0.080

Table 2.1-3 (page 5 of 5)

BWR FUEL ASSEMBLY CHARACTERISTICS

Notes:

1. All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a given array/class.
2. Zr designates cladding material made of zirconium or zirconium alloys.
3. Design initial uranium weight is the nominal uranium weight specified for each assembly by the fuel manufacturer or reactor user. For each BWR fuel assembly, the total initial uranium weight may be up to 1.5 percent higher than the design initial uranium weight due to manufacturer tolerances.
4. ≤ 0.612 wt. % ^{235}U and ≤ 1.578 wt. % total fissile plutonium (^{239}Pu and ^{241}Pu).
5. This assembly class contains 74 total rods; 66 full length rods and 8 partial length rods.
6. Variable.
7. Square, replacing nine fuel rods.
8. This assembly contains 92 total fuel rods; 78 full length rods and 14 partial length rods.
9. This assembly class contains 91 total fuel rods; 83 full length rods and 8 partial length rods.
10. One diamond-shaped water rod replacing the four center fuel rods and four rectangular water rods dividing the assembly into four quadrants.

Table 2.1-4

FUEL ASSEMBLY COOLING AND AVERAGE BURNUP (Note 1)

Post-irradiation Cooling Time (years)	MPC-24 PWR Assembly Burnup (MWD/MTU)	MPC-68 BWR Assembly Burnup (MWD/MTU)
≥ 5	≤ 31,300	≤ 29,900
≥ 6	≤ 35,400	≤ 32,800
≥ 7	≤ 35,600	≤ 33,100
≥ 8	≤ 37,700	≤ 35,200
≥ 9	≤ 39,400	≤ 36,600
≥ 10	≤ 40,600	≤ 37,800
≥ 11	≤ 41,700	≤ 38,700
≥ 12	≤ 42,600	≤ 39,600
≥ 13	≤ 43,400	≤ 40,400
≥ 14	≤ 44,100	≤ 41,100
≥ 15	≤ 44,700	≤ 41,700

Note 1: Linear interpolation between points is permitted.

Table 2.1-5

FUEL ASSEMBLY COOLING AND DECAY HEAT (Note 1)

Post-irradiation Cooling Time (years)	MPC-24 PWR Assembly Decay Heat (Watts)	MPC-68 BWR Assembly Decay Heat (Watts)
≥ 5	≤ 870.0	≤ 314.7
≥ 6	≤ 840.4	≤ 298.7
≥ 7	≤ 757.5	≤ 270.7
≥ 8	≤ 751.1	≤ 268.5
≥ 9	≤ 744.7	≤ 266.2
≥ 10	≤ 738.3	≤ 264.0
≥ 11	≤ 733.8	≤ 262.5
≥ 12	≤ 729.2	≤ 261.0
≥ 13	≤ 724.5	≤ 259.6
≥ 14	≤ 720.0	≤ 258.1
≥ 15	≤ 715.4	≤ 256.6

Note 1: Linear interpolation between points is permitted.

3.0 DESIGN FEATURES

3.1 Site

3.1.1 Site Location

The HI-STORM 100 Cask System is authorized for use at various site locations under the general license provisions of 10 CFR 72, Subpart K.

3.2 Design Features Important for Criticality Control

3.2.1 MPC-24

- J. Flux trap size: ≥ 1.09 in.
- K. ^{10}B loading in the Boral neutron absorbers: ≥ 0.0267 g/cm²

3.2.2 MPC-68

- 1. Fuel cell pitch: ≥ 6.43 in.
- A. ^{10}B loading in the Boral neutron absorbers: ≥ 0.0372 g/cm²

3.2.3 MPC-68F

- 1. Fuel cell pitch: ≥ 6.43 in.
 - B. ^{10}B loading in the Boral neutron absorbers: ≥ 0.01 g/cm²
-

3.3 Codes and Standards

The American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), 1995 Edition with Addenda through 1997, is the governing Code for the HI-STORM 100 Cask System, as clarified in Specification 3.3.1 below. American Concrete Institute (ACI) 349-85 is the governing Code for plain concrete as clarified in Appendix 1.D of the Topical Safety Analysis Report for the HI-STORM 100 Cask System.

(continued)

DESIGN FEATURES

3.3 Codes and Standards (continued)

3.3.1 Exceptions to Codes, Standards, and Criteria

Table 3-1 lists approved exceptions to the ASME Code for the design of the HI-STORM 100 Cask System.

3.3.2 Construction/Fabrication Exceptions to Codes, Standards, and Criteria

Proposed alternatives to the ASME Code, Section III, 1995 Edition with Addenda through 1997 including exceptions allowed by Specification 3.3.1 may be used when authorized by the Director of the Office of Nuclear Material Safety and Safeguards or designee. The request for such alternative should demonstrate that:

1. The proposed alternatives would provide an acceptable level of quality and safety, or
2. Compliance with the specified requirements of the ASME Code, Section III, 1995 Edition with Addenda through 1997, would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Requests for exceptions shall be submitted in accordance with 10 CFR 72.4

(continued)

DESIGN FEATURES

Table 3-1 (page 1 of 5)

LIST OF ASME CODE EXCEPTIONS FOR HI-STORM 100 CASK SYSTEM

Component	Reference ASME Code Section/Article	Code Requirement	Exception, Justification & Compensatory Measures
MPC	NB-1100	Statement of requirements for Code stamping of components.	MPC enclosure vessel is designed and will be fabricated in accordance with ASME Code, Section III, Subsection NB to the maximum practical extent, but Code stamping is not required.
MPC	NB-2000	Requires materials to be supplied by ASME-approved material supplier.	Materials will be supplied by Holtec-approved suppliers with Certified Material Test Reports (CMTRs) in accordance with NB-2000 requirements.
MPC Lid and Closure Ring Welds	NB-4243	Full penetration welds required for Category C Joints (flat head to main shell per NB-3352.3).	MPC lid and closure ring are not full penetration welds. They are welded independently to provide a redundant seal. Additionally, a weld efficiency factor of 0.45 has been applied to the analyses of these welds.
MPC Lid to Shell Weld	NB-5230	Radiographic (RT) or ultrasonic (UT) examination required	Only UT or multi-layer liquid penetrant (PT) examination is permitted. If PT alone is used, at a minimum, it will include the root and final weld layers and each approximately 3/8 inch of weld depth.
MPC Closure Ring, Vent and Drain Cover Plate Welds	NB-5230	Radiographic (RT) or ultrasonic (UT) examination required	Root and final liquid penetrant examination to be performed in accordance with NB-5245. The MPC vent and drain cover plate welds are leak tested. The closure ring provides independent redundant closure for vent and drain cover plates.

(continued)

3.0 DESIGN FEATURES

Table 3-1 (page 2 of 5)

LIST OF ASME CODE EXCEPTIONS FOR HI-STORM 100 CASK SYSTEM

Component	Reference ASME Code Section/Article	Code Requirement	Exception, Justification & Compensatory Measures
MPC Enclosure Vessel and Lid	NB-6111	All completed pressure retaining systems shall be pressure tested.	The MPC enclosure vessel is seal welded in the field following fuel assembly loading. The MPC enclosure vessel shall then be hydrostatically tested as defined in Chapter 9. Accessibility for leakage inspections preclude a Code compliant hydrostatic test. All MPC enclosure vessel welds (except closure ring and vent/drain cover plate) are inspected by volumetric examination, except the MPC lid-to-shell weld shall be verified by volumetric or multi-layer PT examination. If PT alone is used, at a minimum, it must include the root and final layers and each approximately 3/8 inch of weld depth. For either UT or PT, the maximum undetectable flaw size must be demonstrated to be less than the critical flaw size. The critical flaw size must be determined in accordance with ASME Section XI methods. The critical flaw size shall not cause the primary stress limits of NB-3000 to be exceeded.

(continued)

DESIGN FEATURES

Table 3-1 (page 3 of 5)

LIST OF ASME CODE EXCEPTIONS FOR HI-STORM 100 CASK SYSTEM

Component	Reference ASME Code Section/Article	Code Requirement	Exception, Justification & Compensatory Measures
MPC Enclosure Vessel and Lid (continued)	NB-6111	All completed pressure retaining systems shall be pressure tested.	The inspection process, including findings (indications), shall be made a permanent part of the user's records by video, photographic, or other means which provide an equivalent retrievable record of weld integrity. The video or photographic records should be taken during the final interpretation period described in ASME Section V, Article 6, T-676. The vent/drain cover plate weld is confirmed by leakage testing and liquid penetrant examination and the closure ring weld is confirmed by liquid penetrant examination. The inspection of the weld must be performed by qualified personnel and shall meet the acceptance requirements of ASME Code Section III, NB-5350 for PT or NB-5332 for UT.

(continued)

DESIGN FEATURES

Table 3-1 (page 4 of 5)

LIST OF ASME CODE EXCEPTIONS FOR HI-STORM 100 CASK SYSTEM

Component	Reference ASME Code Section/Article	Code Requirement	Exception, Justification & Compensatory Measures
MPC Enclosure Vessel	NB-7000	Vessels are required to have overpressure protection	No overpressure protection is provided. The function of the MPC enclosure vessel is to contain the radioactive contents under normal, off-normal, and accident conditions. The MPC vessel is designed to withstand maximum internal pressure considering 100% fuel rod failure and maximum accident temperatures.
MPC Enclosure Vessel	NB-8000	States requirements for nameplates, stamping and reports per NCA-8000.	The HI-STORM100 Cask System is to be marked and identified in accordance with 10CFR71 and 10CFR72 requirements. Code stamping is not required. QA data package to be in accordance with Holtec approved QA program.
MPC Basket Assembly	NG-2000	Requires materials to be supplied by ASME-approved material supplier.	Materials will be supplied by Holtec-approved supplier with CMTRs in accordance with NG-2000 requirements.
MPC Basket Assembly	NG-8000	States requirements for nameplates, stamping and reports per NCA-8000.	The HI-STORM100 Cask System is to be marked and identified in accordance with 10CFR71 and 10CFR72 requirements. Code stamping is not required. The MPC basket data package to be in accordance with Holtec approved QA program.

(continued)

DESIGN FEATURES

Table 3-1 (page 5 of 5)

LIST OF ASME CODE EXCEPTIONS FOR HI-STORM 100 CASK SYSTEM

Component	Reference ASME Code Section/Article	Code Requirement	Exception, Justification & Compensatory Measures
OVERPACK Steel Structure	NF-2000	Requires materials to be supplied by ASME-approved material supplier.	Materials will be supplied by Holtec-approved supplier with CMTRs in accordance with NF-2000 requirements.
TRANSFER CASK Steel Structure	NF-2000	Requires materials to be supplied by ASME-approved material supplier.	Materials will be supplied by Holtec-approved supplier with CMTRs in accordance with NF-2000 requirements.
OVERPACK Baseplate and Lid Top Plate	NF-4441	Requires special examinations or requirements for welds where a primary member of thickness 1 inch or greater is loaded to transmit loads in the through thickness direction.	The large margins of safety in these welds under loads experienced during lifting operations or accident conditions are quite large. The OVERPACK baseplate welds to the inner shell, pedestal shell, and radial plates are only loaded during lifting conditions and have a minimum safety factor of > 12 during lifting. The top lid plate to lid shell weld has a safety factor > 6 under a deceleration of 45 g's.
OVERPACK Steel Structure	NF-3256	Provides requirements for welded joints.	Welds for which no structural credit is taken are identified as "Non-NF" welds in the design drawings by an "*". These non-structural welds are specified in accordance with the pre-qualified welds of AWS D1.1. These welds shall be made by welders and weld procedures qualified in accordance with AWS D1.1 or ASME Section IX.

(continued)

DESIGN FEATURES (continued)

3.4 Site-Specific Parameters and Analyses

Site-specific parameters and analyses that will require verification by the system user are, as a minimum, as follows:

- 1.01 The temperature of 80° F is the maximum average yearly temperature.
2. The allowed temperature extremes, averaged over a 3-day period, shall be greater than -40° F and less than 125° F.
3. The resultant horizontal acceleration (vectorial sum of two horizontal ZPA's at a three-dimensional seismic site), G_H , and vertical acceleration, G_V , expressed as fractions of 'g', shall satisfy the following inequality:

$$G_H + \mu G_V \leq \mu$$

where μ is the Coulomb friction coefficient for the HI-STORM 100/ISFSI pad interface. Unless demonstrated by appropriate testing that a higher value of μ is appropriate for a specific ISFSI, the value of μ used shall be 0.53. Representative values of G_H and G_V combinations for $\mu = 0.53$ are provided in Table 3-2.

Table 3-2

Representative DBE Acceleration Values to Prevent HI-STORM 100 Sliding ($\mu = 0.53$)

Equivalent Vectorial Sum of Two Horizontal ZPA's (G_H in g's)	Corresponding Vertical ZPA (G_V in g's)
0.445	0.160
0.424	0.200
0.397	0.250

(continued)

DESIGN FEATURES

3.4 Site-Specific Parameters and Analyses (continued)

- 4. The analyzed flood condition of 15 fps water velocity and a height of 125 feet of water (full submergence of the loaded cask) are not exceeded.
- E. The potential for fire and explosion shall be addressed, based on site-specific considerations. This includes the condition that the on-site transporter fuel tank will contain no more than 50 gallons of diesel fuel while handling a loaded OVERPACK or TRANSFER CASK.
- F. In addition to the requirements of 10CFR72.212(b)(2)(ii), the cask storage pads and foundation shall include the following characteristics as applicable to the drop and tipover analyses.

1.01 Concrete Thickness: \leq 36 inches

1.02 Concrete Compressive Strength: \leq 4,200 psi at 28 days

1.03 Reinforcement top and bottom (both directions):

Reinforcement area and spacing determined by analysis

Reinforcement shall be 60 ksi yield strength ASTM material

1.02 Soil Effective Modulus of Elasticity: \leq 28,000 psi (measured prior to installation of ISFSI)

An acceptable method of defining the soil effective modulus of elasticity applicable to the drop and tipover analyses is provided in Table 13 of NUREG/CR-6608 (February, 1998) with soil classification in accordance with ASTM D2487-93, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System, USCS) and density determination in accordance with ASTM D1586-84, Standard Test Method for Penetration Test and Split/Barrel Sampling of Soils.

(continued)

DESIGN FEATURES

3.4 Site-Specific Parameters and Analyses (continued)

7. In cases where engineered features (i.e., berms and shield walls) are used to ensure that the requirements of 10CFR72.104(a) are met, such features are to be considered important to safety and must be evaluated to determine the applicable Quality Assurance Category.
8. **LOADING OPERATIONS, TRANSPORT OPERATIONS, and UNLOADING OPERATIONS** shall only be conducted with working area ambient temperatures $\geq 0^{\circ}$ F.

(continued)

DESIGN FEATURES

3.5 CASK TRANSFER FACILITY (CTF)

3.5.1 TRANSFER CASK and MPC Lifters

Lifting of a loaded TRANSFER CASK and MPC outside of structures governed by 10 CFR Part 50 shall be performed with a CTF that is designed, operated, fabricated, tested, inspected and maintained in accordance with the guidelines of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants" and the below clarifications. The CTF Structure requirements below do not apply to heavy loads bounded by the regulations of 10 CFR Part 50.

3.5.2 CTF Structure Requirements

3.5.2.1 Cask Transfer Facility and Stationary Lifting Devices

1. The metal weldment structure of the CTF structure shall be designed to comply with the stress limits of ASME Section III, Subsection NF, Class 3 for linear structures. The applicable loads, load combinations, and associated service condition definitions are provided in Table 3-3. All compression loaded members shall satisfy the buckling criteria of ASME Section III, Subsection NF.
2. If a portion of the CTF structure is constructed of reinforced concrete, then the factored load combinations set forth in ACI-318 (89) for the loads defined in Table 3-3 shall apply.
3. The TRANSFER CASK and MPC lifting device used with the CTF shall be designed, fabricated, operated, tested, inspected and maintained in accordance with NUREG-0612, Section 5.1.
4. The CTF shall be designed, constructed, and evaluated to ensure that if the MPC is dropped during inter-cask transfer operations, its confinement boundary would not be breached. This requirement applies to CTFs with either stationary or mobile lifting devices.

(continued)

DESIGN FEATURES

3.5.2.2 Mobile Lifting Devices

If a mobile lifting device is used as the lifting device, in lieu of a stationary lifting device, it shall meet the guidelines of NUREG-0612, Section 5.1, with the following clarifications:

1. Mobile lifting devices shall have a minimum safety factor of two over the allowable load table for the lifting device in accordance with the guidance of NUREG-0612, Section 5.1.6(1)(a) and shall be capable of stopping and holding the load during a Design Basis Earthquake (DBE) event.
2. Mobile lifting devices shall conform meet the requirements of ANSI B30.5, "Mobile and Locomotive Cranes," in lieu of the requirements of ANSI B30.2, "Overhead and Gantry Cranes."
3. Mobile cranes are not required to meet the requirements of NUREG-0612, Section 5.1.6(2) for new cranes.
4. Horizontal movements of the TRANSFER CASK and MPC using a mobile crane are prohibited.

(continued)

DESIGN FEATURES

Table 3-3

Load Combinations and Service Condition Definitions for the CTF Structure (Note 1)

Load Combination	ASME III Service Condition for Definition of Allowable Stress	Comment
D* D + S	Level A	All primary load bearing members must satisfy Level A stress limits
D + M + W' (Note 2) D + F D + E D + Y	Level D	Factor of safety against overturning shall be ≥ 1.1

D = Dead load
D* = Apparent dead load
S = Snow and ice load for the CTF site
M = Tornado missile load for the CTF site
W' = Tornado wind load for the CTF site
F = Flood load for the CTF site
E = Seismic load for the CTF site
Y = Tsunami load for the CTF site

- Notes:
1. The reinforced concrete portion of the CTF structure shall also meet the factored combinations of loads set forth in ACI-318(89).
 2. Tornado missile load may be reduced or eliminated based on a PRA for the CTF site.