

TABLE OF CONTENTS

1.0 DEFINITIONS..... 1-1

2.0 APPROVED CONTENTS..... 2-1

2.1 Fuel Specifications and Loading Conditions..... 2-1

2.2 Violations..... 2-1

2.3 Decay Heat Limits 2-~~24~~25

2.4 Burnup Credit 2-~~209~~209

Figure 2.1-1 MPC-37 Region-Cell Identification..... 2-2

Figure 2.1-2 MPC-89 Region-Cell Identification..... 2-3

Figure 2.1-3 MPC-32ML Cell Identification 2-4

Figure 2.1-4 MPC-31C Cell Identification..... 2-5

Table 2.1-1 Fuel Assembly Limits..... 2-~~74~~74

Table 2.1-2 PWR Fuel Assembly Characteristics 2-~~814~~814

Table 2.1-3 BWR Fuel Assembly Characteristics 2-~~194~~194

Table 2.1-4 Restrictions for Gadolinium Credit 2-24

Table 2.3-1A MPC-37 Heat Load Data..... 2-~~2516~~2516

Table 2.3-1B MPC-37 Heat Load Data..... 2-~~2516~~2516

Table 2.3-1C MPC-37 Heat Load Data..... 2-~~2617~~2617

Table 2.3-2A MPC-89 Heat Load Data..... 2-~~2617~~2617

Table 2.3-2B MPC-89 Heat Load Data..... 2-~~2618~~2618

Table 2.3-3 MPC-37 Heat Load Data..... 2-~~2718~~2718

Table 2.3-4 MPC-89 Heat Load Data..... 2-~~2718~~2718

Table 2.3-5 MPC-32ML Heat Load Data..... 2-27

Table 2.3-6 MPC-31C Heat Load Data 2-28

3.0 DESIGN FEATURES..... 3-1

3.1 Site 3-1

3.2 Design Features Important for Criticality Control..... 3-1

3.3 Codes and Standards..... 3-1

3.4 Site Specific Parameters and Analyses..... 3-9

3.5 Combustible Gas Monitoring During MPC Lid Welding and Cutting 3-12

Table 3-1 List of ASME Code Alternatives for Multi-Purpose Canisters (MPCs)..... 3-3

Table 3-2 REFERENCE ASME CODE PARAGRAPHS FOR HI-STORM FW OVERPACK and HI-TRAC VW TRANSFER CASK, PRIMARY LOAD BEARING PARTS 3-8

2.0 APPROVED CONTENTS

2.1 Fuel Specifications and Loading Conditions

2.1.1 Fuel to Be Stored in the HI-STORM FW MPC Storage System

- a. UNDAMAGED FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, FUEL DEBRIS, and NON-FUEL HARDWARE meeting the limits specified in Table 2.1-1 and other referenced tables may be stored in the HI-STORM FW MPC Storage System.
- b. All BWR fuel assemblies may be stored with or without ZR channels.

2.1.2 Fuel Loading

Figures 2.1-1 and 2.1-2 define the regions for the MPC-37 and MPC-89 models, respectively. Figures 2.1-3 and 2.1-4 define the cell identifications for the MPC-32ML and MPC-31C respectively. Fuel assembly decay heat limits are specified in Section 2.3.1. Fuel assemblies shall meet all other applicable limits specified in Tables 2.1-1 through 2.1-3.

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.

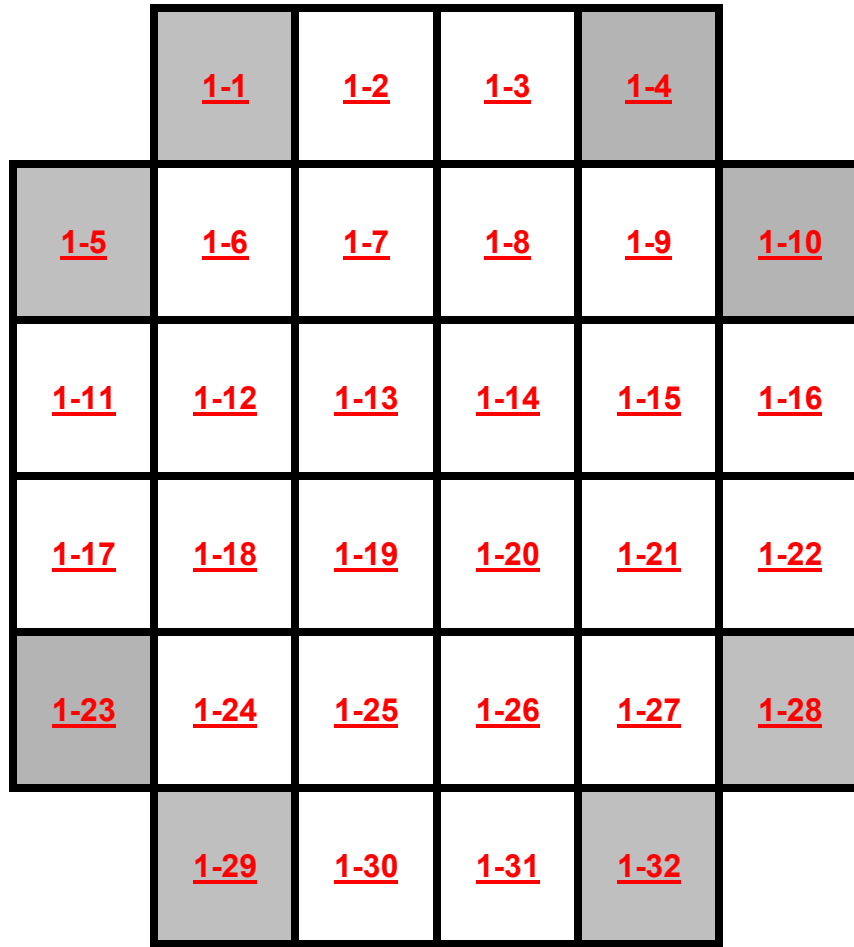
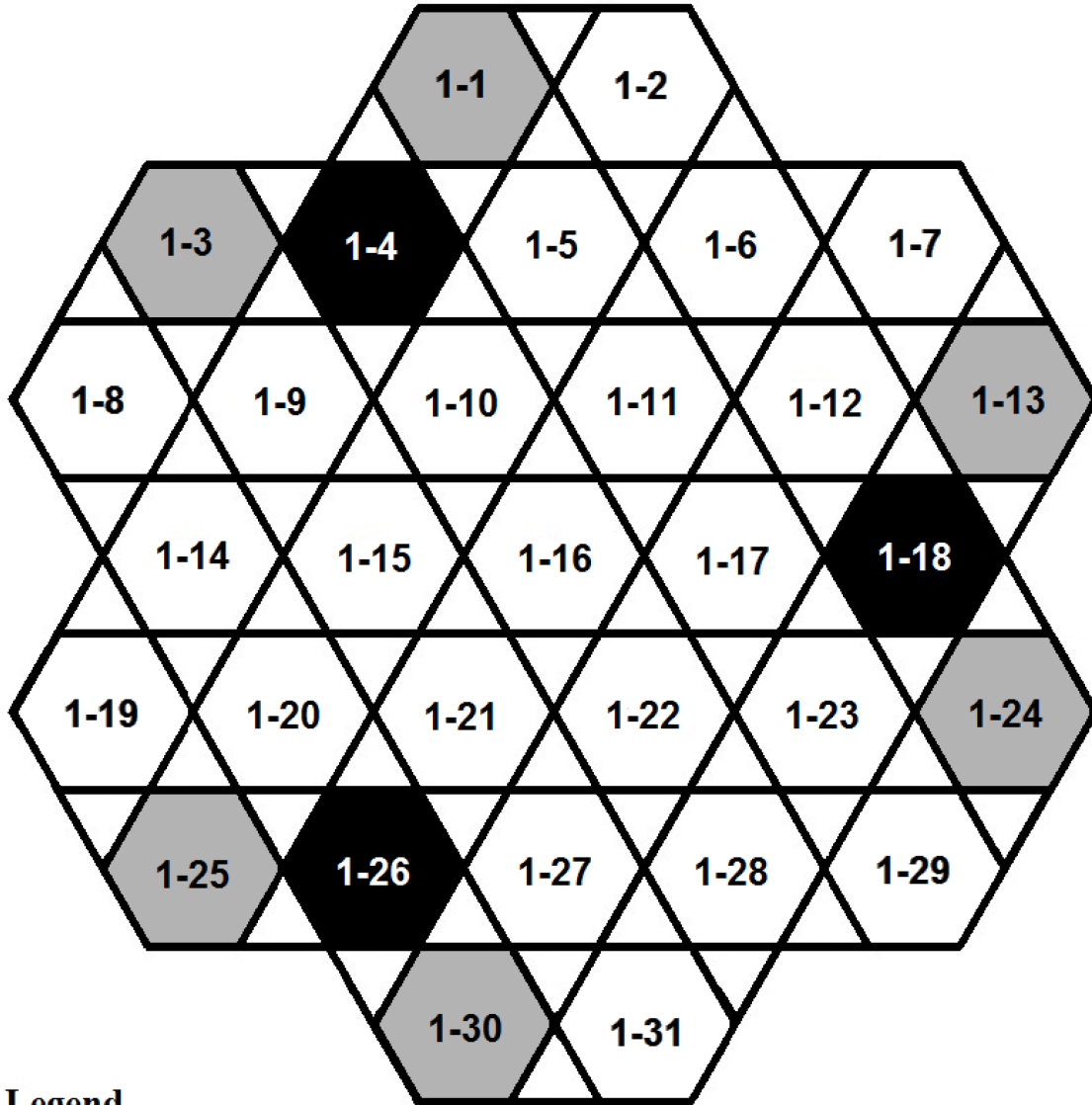


Figure 2.1-3
MPC-32ML Cell Identification



Legend

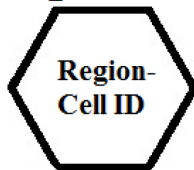


Figure 2.1-4
MPC-31C Cell Identification

Table 2.1-1 (page 1 of 48)
Fuel Assembly Limits

I. MPC MODEL: MPC-37

A. Allowable Contents

1. Uranium oxide PWR UNDAMAGED FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, and/or FUEL DEBRIS meeting the criteria in Table 2.1-2, with or without NON-FUEL HARDWARE and meeting the following specifications (Note 1):

a. Cladding Type:	ZR
b. Maximum Initial Enrichment:	5.0 wt. % U-235 with soluble boron credit per LCO 3.3.1 OR burnup credit per Section 2.4
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling Time \geq 3 years Assembly Average Burnup \leq 68.2 GWD/MTU
d. Decay Heat Per Fuel Storage Location:	As specified in Section 2.3
e. Fuel Assembly Length:	\leq 199.2 inches (nominal design including NON-FUEL HARDWARE and DFC)
f. Fuel Assembly Width:	\leq 8.54 inches (nominal design)
g. Fuel Assembly Weight:	\leq 2050 lbs (including NON-FUEL HARDWARE and DFC)

Table 2.1-1 (page 2 of ~~f48~~)
Fuel Assembly Limits

I. MPC MODEL: MPC-37 (continued)

- B. Quantity per MPC: 37 FUEL ASSEMBLIES with up to twelve (12) DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS in DAMAGED FUEL CONTAINERS (DFCs). DFCs may be stored in fuel storage locations 3-1, 3-3 through 3-7, 3-10 through 3-14, and 3-16 (see Figure 2.1-1). The remaining fuel storage locations may be filled with PWR UNDAMAGED FUEL ASSEMBLIES meeting the applicable specifications. For MPCs utilizing burnup credit, the MPC and DFC loading configuration must also meet the additional requirements of Section 2.4.
- C. One (1) Neutron Source Assembly (NSA) is authorized for loading in the MPC-37.
- D. Up to thirty (30) BRPAs are authorized for loading in the MPC-37.

Note 1: Fuel assemblies containing BPRAs, TPDs, WABAs, water displacement guide tube plugs, orifice rod assemblies, or vibration suppressor inserts, with or without ITTRs, may be stored in any fuel storage location. Fuel assemblies containing APSRs, RCCAs, CEAs, CRAs, or NSAs may only be loaded in fuel storage Regions 1 and 2 (see Figure 2.1-1).

Table 2.1-1 (page 3 of 48)
Fuel Assembly Limits

II. MPC MODEL: MPC-89

A. Allowable Contents

1. Uranium oxide BWR UNDAMAGED FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, and/or FUEL DEBRIS meeting the criteria in Table 2.1-3, with or without channels and meeting the following specifications:

- | | |
|--|--|
| a. Cladding Type: | ZR |
| b. Maximum PLANAR-AVERAGE INITIAL ENRICHMENT(Note 1): | As specified in Table 2.1-3 for the applicable fuel assembly array/class. |
| c. Initial Maximum Rod Enrichment | 5.0 wt. % U-235 |
| d. Post-irradiation Cooling Time and Average Burnup Per Assembly | |
| i. Array/Class 8x8F | Cooling time \geq 10 years and an assembly average burnup \leq 27.5 GWD/MTU. |
| ii. All Other Array Classes | Cooling Time \geq 3 years and an assembly average burnup \leq 65 GWD/MTU |
| e. Decay Heat Per Assembly | |
| i. Array/Class 8x8F | \leq 183.5 Watts |
| ii. All Other Array Classes | As specified in Section 2.3 |
| f. Fuel Assembly Length | \leq 176.5 inches (nominal design) |
| g. Fuel Assembly Width | \leq 5.95 inches (nominal design) |
| h. Fuel Assembly Weight | \leq 850 lbs, including a DFC as well as a channel |

Table 2.1-1 (page 4 of ~~84~~)
Fuel Assembly Limits

II. MPC MODEL: MPC-89 (continued)

B. Quantity per MPC: 89 FUEL ASSEMBLIES with up to sixteen (16) DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS in DAMAGED FUEL CONTAINERS (DFCs). DFCs may be stored in fuel storage locations 3-1, 3-3, 3-4, 3-9, 3-10, 3-13, 3-16, 3-19, 3-22, 3-25, 3-28, 3-31, 3-32, 3-37, 3-38, and 3-40 (see Figure 2.1-2). The remaining fuel storage locations may be filled with BWR UNDAMAGED FUEL ASSEMBLIES meeting the applicable specifications.

Note 1: The lowest maximum allowable enrichment of any fuel assembly loaded in an MPC-89, based on fuel array class and fuel classification, is the maximum allowable enrichment for the remainder of the assemblies loaded in that MPC.

Table 2.1-1 (page 5 of 8)
Fuel Assembly Limits

III. MPC MODEL: MPC-32ML

A. Allowable Contents

1. Uranium oxide PWR UNDAMAGED FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, and/or FUEL DEBRIS meeting the criteria for array/class 16x16D in Table 2.1-2, with or without NON-FUEL HARDWARE and meeting the following specifications (Note 1):

<u>a. Cladding Type:</u>	<u>ZR</u>
<u>b. Maximum Initial Enrichment:</u>	<u>5.0 wt. % U-235 with soluble boron credit per LCO 3.3.1</u>
<u>c. Post-irradiation Cooling Time and Average Burnup Per Assembly:</u>	<u>Cooling Time \geq 3 years</u> <u>Assembly Average Burnup \leq 68.2 GWD/MTU</u>
<u>d. Decay Heat Per Fuel Storage Location:</u>	<u>As specified in Section 2.3</u>
<u>e. Fuel Assembly Length:</u>	<u>\leq 193 inches (nominal design including NON-FUEL HARDWARE and DFC)</u>
<u>f. Fuel Assembly Width:</u>	<u>\leq 9.04 inches (nominal design)</u>
<u>g. Fuel Assembly Weight:</u>	<u>\leq 1858 lbs (including NON-FUEL HARDWARE and DFC)</u>

Table 2.1-1 (page 6 of 8)
Fuel Assembly Limits

III. MPC MODEL: MPC-32ML (continued)

B. Quantity per MPC: 32 FUEL ASSEMBLIES with up to eight (8) DAMAGED FUEL ASSEMBLIES or FUEL DEBRIS in DAMAGED FUEL CONTAINERS (DFCs). DFCs may be stored in fuel storage locations 1-1, 1-4, 1-5, 1-10, 1-23, 1-28, 1-29, and 1-32 (see Figure 2.1-3). The remaining fuel storage locations may be filled with PWR UNDAMAGED FUEL ASSEMBLIES meeting the applicable specifications.

C. One (1) Neutron Source Assembly (NSA) is authorized for loading in the MPC-32ML.

D. Up to thirty-two (32) BRPAs are authorized for loading in the MPC-32ML.

Note 1: Fuel assemblies containing BPRAs, TPDs, WABAs, water displacement guide tube plugs, orifice rod assemblies, or vibration suppressor inserts, with or without ITTRs, may be stored in any fuel storage location. Fuel assemblies containing APSRs, RCCAs, CEAs, CRAs, or NSAs may only be loaded in fuel cells 1-6 through 1-9, 1-12 through 1-15, 1-18 through 1-21, and 1-24 through 1-27.

Table 2.1-1 (page 7 of 8)
Fuel Assembly Limits

IV. MPC MODEL: MPC-31C

A. Allowable Contents

1. Uranium oxide PWR UNDAMAGED FUEL ASSEMBLIES, DAMAGED FUEL ASSEMBLIES, and/or FUEL DEBRIS meeting the criteria for array/class V10A or V10B in Table 2.1-2, with or without NON-FUEL HARDWARE and meeting the following specifications (Note 1):

<u>a. Cladding Type:</u>	<u>ZR</u>
<u>b. Maximum Initial Enrichment:</u>	<u>5.0 wt. % U-235</u>
<u>c. Post-irradiation Cooling Time and Average Burnup Per Assembly:</u>	<u>Cooling Time \geq 3 years</u> <u>Assembly Average Burnup \leq 60 GWD/MTU</u>
<u>d. Decay Heat Per Fuel Storage Location:</u>	<u>As specified in Section 2.3</u>
<u>e. Fuel Assembly Length:</u>	<u>\leq 179.9 inches (nominal design including NON-FUEL HARDWARE and DFC)</u>
<u>f. Fuel Assembly Width:</u>	<u>\leq 9.213 inches (nominal design)</u>
<u>g. Fuel Assembly Weight:</u>	<u>\leq 1650 lbs (including NON-FUEL HARDWARE and DFC)</u>

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

III. MPC MODEL: MPC-31C (continued)

B. Quantity per MPC: 31 FUEL ASSEMBLIES with up to six (6) DAMAGED FUEL ASSEMBLIES in DAMAGED FUEL CONTAINERS (DFCs). DFCs may be stored in fuel storage locations 1-1, 1-3, 1-13, 1-24, 1-25, and 1-30 (see Figure 2.1-4). The remaining fuel storage locations may be filled with PWR UNDAMAGED FUEL ASSEMBLIES meeting the applicable specifications.

OR

Quantity per MPC: 31 FUEL ASSEMBLIES with up to six (6) DAMAGED FUEL OR FUEL DEBRIS in DFCs. DFCs may be stored in fuel storage locations 1-1, 1-3, 1-13, 1-24, 1-25, and 1-30 (see Figure 2.1-4). If a DFC is stored in cells 1-1 or 1-3, cell 1-4 must be empty, if a DFC is stored in cells 1-13 or 1-24, cell 1-18 must be empty, if a DFC is stored in cells 1-25 or 1-30, cell 1-26 must be empty. The remaining fuel storage locations may be filled with PWR UNDAMAGED FUEL ASSEMBLIES meeting the applicable specifications.

C. One (1) Neutron Source Assembly (NSA) is authorized for loading in the MPC-31C.

D. Up to thirty-one (31) BRPAs are authorized for loading in the MPC-31C.

Note 1: Fuel assemblies containing BPRAs may be stored in any fuel storage location. Fuel assemblies containing NSAs may only be loaded in fuel cells 1-10, 1-11, 1-15, 1-16, 1-17, 1-21, or 1-22.

Table 2.1-2 (page 1 of 54) PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)					
Fuel Assembly Array/ Class	14x14 A	14x14 B	14x14 C	15x15 B	15x15 C
No. of Fuel Rod Locations	179	179	176	204	204
Fuel Clad O.D. (in.)	≥ 0.400	≥ 0.417	≥ 0.440	≥ 0.420	≥ 0.417
Fuel Clad I.D. (in.)	≤ 0.3514	≤ 0.374	≤ 0.3880	≤ 0.3736	≤ 0.3640
Fuel Pellet Dia. (in.) (Note 3)	≤ 0.3444	≤ 0.367	≤ 0.3805	≤ 0.3671	≤ 0.3570
Fuel Rod Pitch (in.)	≤ 0.556	≤ 0.566	≤ 0.580	≤ 0.563	≤ 0.563
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	17	17	5 (Note 2)	21	21
Guide/Instrument Tube Thickness (in.)	≥ 0.017	≥ 0.017	≥ 0.038	≥ 0.015	≥ 0.0165

Table 2.1-2 (page 2 of 45) PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)					
Fuel Assembly Array/Class	15x15 D	15x15 E	15x15 F	15x15 H	15x15 I
No. of Fuel Rod Locations	208	208	208	208	216 (Note 4)
Fuel Clad O.D. (in.)	≥ 0.430	≥ 0.428	≥ 0.428	≥ 0.414	≥ 0.413
Fuel Clad I.D. (in.)	≤ 0.3800	≤ 0.3790	≤ 0.3820	≤ 0.3700	≤ 0.3670
Fuel Pellet Dia. (in.) (Note 3)	≤ 0.3735	≤ 0.3707	≤ 0.3742	≤ 0.3622	≤ 0.3600
Fuel Rod Pitch (in.)	≤ 0.568	≤ 0.568	≤ 0.568	≤ 0.568	≤ 0.550
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	17	17	17	17	9 (Note 4)
Guide/Instrument Tube Thickness (in.)	≥ 0.0150	≥ 0.0140	≥ 0.0140	≥ 0.0140	≥ 0.0140

Table 2.1-2 (page 3 of <u>54</u>) PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)				
Fuel Assembly Array and Class	16x16 A	16x16B	16x16C	<u>16x16D</u> (Note5)
No. of Fuel Rod Locations	236	236	236	<u>236</u>
Fuel Clad O.D. (in.)	≥ 0.382	≥ 0.374	≥ 0.374	<u>≥ 0.423</u>
Fuel Clad I.D. (in.)	≤ 0.3350	≤ 0.3290	≤ 0.3290	<u>≤ 0.366</u>
Fuel Pellet Dia. (in.) (Note 3)	≤ 0.3255	≤ 0.3225	≤ 0.3225	<u>≤ 0.359</u>
Fuel Rod Pitch (in.)	≤ 0.506	≤ 0.506	≤ 0.485	<u>≤ 0.563</u>
Active Fuel length (in.)	≤ 150	≤ 150	≤ 150	<u>≤ 154.5</u>
No. of Guide and/or Instrument Tubes	5 (Note 2)	5 (Note 2)	21	<u>20</u>
Guide/Instrument Tube Thickness (in.)	≥ 0.0350	≥ 0.04	≥ 0.0157	<u>≥ 0.015</u>

Table 2.1-2 (page 4 of 45) PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)					
Fuel Assembly Array and Class	17x17A	17x17 B	17x17 C	17x17 D	17x17 E
No. of Fuel Rod Locations	264	264	264	264	265
Fuel Clad O.D. (in.)	≥ 0.360	≥ 0.372	≥ 0.377	≥ 0.372	≥ 0.372
Fuel Clad I.D. (in.)	≤ 0.3150	≤ 0.3310	≤ 0.3330	≤ 0.3310	≤ 0.3310
Fuel Pellet Dia. (in.) (Note 3)	≤ 0.3088	≤ 0.3232	≤ 0.3252	≤ 0.3232	≤ 0.3232
Fuel Rod Pitch (in.)	≤ 0.496	≤ 0.496	≤ 0.502	≤ 0.496	≤ 0.496
Active Fuel length (in.)	≤ 150	≤ 150	≤ 150	≤ 170	≤ 170
No. of Guide and/or Instrument Tubes	25	25	25	25	24
Guide/Instrument Tube Thickness (in.)	≥ 0.016	≥ 0.014	≥ 0.020	≥ 0.014	≥ 0.014

<u>Table 2.1-2 (Page 5 of 5)</u>		
<u>PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)</u>		
<u>Fuel Assembly Array and Class</u>	<u>V10A (Note 6)</u>	<u>V10B (Note 6)</u>
<u>No. of Fuel Rod Locations</u>	<u>311</u>	<u>312</u>
<u>Fuel Clad O.D. (in.)</u>	<u>≥ 0.358</u>	<u>≥ 0.358</u>
<u>Fuel Clad I.D. (in.)</u>	<u>≤ 0.304</u>	<u>≤ 0.304</u>
<u>Fuel Pellet Dia. (in.) (Note 3)</u>	<u>≤ 0.298 (Note 7)</u>	<u>≤ 0.299 (Note 7)</u>
<u>Fuel Rod Pitch (in.)</u>	<u>≤ 0.5020</u>	<u>≤ 0.5020</u>
<u>Active Fuel length (in.)</u>	<u>≤ 138.98</u>	<u>Active Core with Blanket Rods: ≤ 138.98 Upper Blanket with Blanket Rods: ≤ 1.46 Lower Blanket with Blanket Rods: ≤ 4.45 Without Blankets: ≤ 144.88</u>
<u>No. of Guide and/or Instrument Tubes</u>	<u>20</u>	<u>19</u>
<u>Guide/Instrument Tube Thickness (in.)</u>	<u>≥ 0.0395</u>	<u>≥ 0.0395</u>

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. Each guide tube replaces four fuel rods.
3. Annular fuel pellets are allowed in the top and bottom 12" of the active fuel length, except as noted below.
4. Assemblies have one Instrument Tube and eight Guide Bars (Solid ZR). Some assemblies have up to 16 fuel rods removed or replaced by Guide Tubes
5. This fuel array/class only allowable for loading in the MPC-32ML.
6. This fuel array/class only allowable for loading in the MPC-31C.
- 4.7. Annular fuel pellets are allowed along the entire active fuel length

Table 2.1-3 (page 1 of 4) BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)					
Fuel Assembly Array and Class	7x7 B	8x8 B	8x8 C	8x8 D	8x8 E
Maximum Planar-Average Initial Enrichment (wt.% ²³⁵ U) (Note 14)	≤ 4.8	≤ 4.8	≤ 4.8	≤ 4.8	≤ 4.8
<u>Maximum Planar-Average Initial Enrichment with Gadolinium Credit (wt.% ²³⁵U) (Note 15)</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
No. of Fuel Rod Locations (Full Length or Total/Full Length)	49	63 or 64	62	60 or 61	59
Fuel Clad O.D. (in.)	≥ 0.5630	≥ 0.4840	≥ 0.4830	≥ 0.4830	≥ 0.4930
Fuel Clad I.D. (in.)	≤ 0.4990	≤ 0.4295	≤ 0.4250	≤ 0.4230	≤ 0.4250
Fuel Pellet Dia. (in.)	≤ 0.4910	≤ 0.4195	≤ 0.4160	≤ 0.4140	≤ 0.4160
Fuel Rod Pitch (in.)	≤ 0.738	≤ 0.642	≤ 0.641	≤ 0.640	≤ 0.640
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 10)	0	1 or 0	2	1 - 4 (Note 6)	5
Water Rod Thickness (in.)	N/A	≥ 0.034	> 0.00	> 0.00	≥ 0.034
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.120	≤ 0.120	≤ 0.100

Table 2.1-3 (2 of 4) BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)					
Fuel Assembly Array and Class	8x8F	9x9 A	9x9 B	9x9 C	9x9 D
Maximum Planar-Average Initial Enrichment (wt.% ²³⁵ U) (Note 14)	≤ 4.5 (Note 12)	≤ 4.8	≤ 4.8	≤ 4.8	≤ 4.8
<u>Maximum Planar-Average Initial Enrichment with Gadolinium Credit (wt.% ²³⁵U) (Note 15)</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>
No. of Fuel Rod Locations	64	74/66 (Note 4)	72	80	79
Fuel Clad O.D. (in.)	≥ 0.4576	≥ 0.4400	≥ 0.4330	≥ 0.4230	≥ 0.4240
Fuel Clad I.D. (in.)	≤ 0.3996	≤ 0.3840	≤ 0.3810	≤ 0.3640	≤ 0.3640
Fuel Pellet Dia. (in.)	≤ 0.3913	≤ 0.3760	≤ 0.3740	≤ 0.3565	≤ 0.3565
Fuel Rod Pitch (in.)	≤ 0.609	≤ 0.566	≤ 0.572	≤ 0.572	≤ 0.572
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 10)	N/A (Note 2)	2	1 (Note 5)	1	2
Water Rod Thickness (in.)	≥ 0.0315	> 0.00	> 0.00	≥ 0.020	≥ 0.0300
Channel Thickness (in.)	≤ 0.055	≤ 0.120	≤ 0.120	≤ 0.100	≤ 0.100

Table 2.1-3 (page 3 of 4) BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)					
Fuel Assembly Array and Class	9x9 E (Note 2)	9x9 F (Note 2)	9x9 G	10x10 A	10x10 B
Maximum Planar-Average Initial Enrichment (wt.% ²³⁵ U) (Note 14)	≤ 4.5 (Note 12)	≤ 4.5 (Note 12)	≤ 4.8	≤ 4.8	≤ 4.8
<u>Maximum Planar-Average Initial Enrichment with Gadolinium Credit (wt.% ²³⁵U) (Note 15)</u>	<u>N/A</u>	<u>N/A</u>	<u>N/A</u>	<u>≤ 5.0</u>	<u>≤ 5.0</u>
No. of Fuel Rod Locations	76	76	72	92/78 (Note 7)	91/83 (Note 8)
Fuel Clad O.D. (in.)	≥0.4170	≥0.4430	≥0.4240	≥0.4040	≥0.3957
Fuel Clad I.D. (in.)	≤0.3640	≤0.3860	≤0.3640	≤ 0.3520	≤ 0.3480
Fuel Pellet Dia. (in.)	≤0.3530	≤0.3745	≤0.3565	≤ 0.3455	≤ 0.3420
Fuel Rod Pitch (in.)	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.510	≤ 0.510
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 10)	5	5	1 (Note 5)	2	1 (Note 5)
Water Rod Thickness (in.)	≥0.0120	≥0.0120	≥0.0320	≥0.0300	> 0.00
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.120	≤ 0.120	≤ 0.120

Table 2.1-3 (page 4 of 4) BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)			
Fuel Assembly Array and Class	10x10 C	10x10 F	10x10 G
Maximum Planar-Average Initial Enrichment (wt.% ²³⁵ U) (Note 14)	≤ 4.8	≤ 4.7 (Note 13)	≤ 4.6 (Note 12)
<u>Maximum Planar-Average Initial Enrichment with Gadolinium Credit (wt.% ²³⁵U) (Note 15)</u>	<u>≤ 5.0</u>	<u>≤ 5.0</u>	<u>≤ 5.0</u>
No. of Fuel Rod Locations	96	92/78 (Note 7)	96/84
Fuel Clad O.D. (in.)	≥ 0.3780	≥ 0.4035	≥ 0.387
Fuel Clad I.D. (in.)	≤ 0.3294	≤ 0.3570	≤ 0.340
Fuel Pellet Dia. (in.)	≤ 0.3224	≤ 0.3500	≤ 0.334
Fuel Rod Pitch (in.)	≤ 0.488	≤ 0.510	≤ 0.512
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 10)	5 (Note 9)	2	5 (Note 9)
Water Rod Thickness (in.)	≥ 0.031	≥ 0.030	≥ 0.031
Channel Thickness (in.)	≤ 0.055	≤ 0.120	≤ 0.060

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. This assembly is known as "QUAD+." It has four rectangular water cross segments dividing the assembly into four quadrants.
3. For the SPC 9x9-5 fuel assembly, each fuel rod must meet either the 9x9E or the 9x9F set of limits or clad O.D., clad I.D., and pellet diameter.
4. This assembly class contains 74 total rods; 66 full length rods and 8 partial length rods.
5. Square, replacing nine fuel rods.
6. Variable.
7. This assembly contains 92 total fuel rods; 78 full length rods and 14 partial length rods.
8. This assembly class contains 91 total fuel rods; 83 full length rods and 8 partial length rods.
9. One diamond-shaped water rod replacing the four center fuel rods and four rectangular water rods dividing the assembly into four quadrants.
10. These rods may also be sealed at both ends and contain ZR material in lieu of water.
11. Not used.
12. When loading fuel assemblies classified as DAMAGED FUEL, all assemblies in the MPC are limited to 4.0 wt.% U-235.
13. When loading fuel assemblies classified as DAMAGED FUEL, all assemblies in the MPC are limited to 4.6 wt.% U-235.
14. In accordance with the definition of UNDAMAGED FUEL, certain assemblies may be limited to 3.3 wt.% U-235. When loading these fuel assemblies, all assemblies in the MPC are limited to 3.3 wt.% U-235.
15. Additional restrictions as described in Table 2.1-4 apply.

<u>Table 2.1-4</u>	
<u>RESTRICTIONS FOR GADOLINIUM CREDIT</u>	
<u>Fuel Assembly Array and Class</u>	<u>Restriction</u>
<u>All 10x10</u>	<u>The Gd rod loading is not less than 3.0 wt% Gd₂O₃.</u>
<u>All 10x10</u>	<u>The Gd rods located in the peripheral row of the fuel lattice cannot be credited</u>
<u>10x10A, 10x10B, and 10x10F</u>	<u>At least one Gd rod is required.</u>
<u>10x10C and 10x10G</u>	<u>Not less than two Gd rods are required.</u>

2.3 Decay Heat Limits (Changes in blue are due to RAI response)

This section provides the limits on fuel assembly decay heat for storage in the HI-STORM FW System. The method to verify compliance, including examples, is provided in Chapter 13 of the HI-STORM FW FSAR.

2.3.1 Fuel Loading Decay Heat Limits

Tables 2.3-1A, 2.3-1B, and 2.3-1C provide the maximum allowable decay heat per fuel storage location for MPC-37. Tables 2.3-2A and 2.3-2B provide the maximum allowable decay heat per fuel storage location for MPC-89. The limits in these tables are applicable when using FHD to dry moderate or high burnup fuel and when using VDS to dry moderate burnup fuel only. Tables 2.3-3 and 2.3-4 provide the maximum allowable decay heat per fuel storage location for MPC-37 and MPC-89, respectively, when using VDS to dry high burnup fuel. Tables 2.3-5 and 2.3-6 provide the maximum allowable decay heat per fuel storage location for the MPC-32ML and MPC-31C for both FHD and VDS drying.

TABLE 2.3-1A MPC-37 HEAT LOAD DATA (See Figure 2.1-1)					
Number of Regions:		3			
Number of Storage Cells:		37			
Maximum Design Basis Heat Load (kW):		44.09 (Pattern A); 45.0 (Pattern B)			
Region No.	Decay Heat Limit per Cell, kW		Number of Cells per Region	Decay Heat Limit per Region, kW	
	Pattern A	Pattern B		Pattern A	Pattern B
1	1.05	1.0	9	9.45	9.0
2	1.70	1.2	12	20.4	14.4
3	0.89	1.35	16	14.24	21.6

TABLE 2.3-1B MPC-37 HEAT LOAD DATA (See Figure 2.1-1)			
Number of Regions:		3	
Number of Storage Cells:		37	
90% of Pattern A - Sub-design Heat Load (kW):		39.68	
Region No.	Decay Heat Limit per Cell, kW	Number of Cells per Region	Decay Heat Limit per Region, kW
1	0.945	9	8.505
2	1.530	12	18.36
3	0.801	16	12.816

TABLE 2.3-3 MPC-37 HEAT LOAD DATA (See Figure 2.1-1)			
Number of Regions: 3			
Number of Storage Cells: 37			
Maximum Heat Load: 29.6			
Region No.	Decay Heat Limit per Cell, W	Number of Cells per Region	Decay Heat Limit per Region, kW
1	800	9	7.2
2	800	12	9.6
3	800	16	12.8

TABLE 2.3-4 MPC-89 HEAT LOAD DATA (See Figure 2.1-2)			
Number of Regions: 3			
Number of Storage Cells: 89			
Maximum Heat Load: 30.0kW			
Region No.	Decay Heat Limit per Cell, W	Number of Cells per Region	Decay Heat Limit per Region, kW
1	337	9	3.03
2	337	40	13.48
3	337	40	13.48

TABLE 2.3-5 MPC-32ML HEAT LOAD DATA		
<u>Number of Regions: 1</u>		
<u>Number of Storage Cells: 32</u>		
<u>Pattern</u>	<u>Maximum Heat Load, kW</u>	<u>Decay Heat Limit per Cell, kW</u>
<u>Pattern A</u>	<u>44.16</u>	<u>1.380</u>
<u>Pattern B</u>	<u>28.70</u>	<u>0.897</u>

<u>TABLE 2.3-6</u>		
<u>MPC-31C HEAT LOAD DATA</u>		
<u>Number of Regions: 1</u>		
<u>Number of Storage Cells: 31</u>		
<u>Pattern</u>	<u>Maximum Heat Load, kW</u>	<u>Decay Heat Limit per Cell, kW</u>
<u>Pattern A</u>	<u>32.98</u>	<u>1.064</u>
<u>Pattern B</u>	<u>17.36</u>	<u>0.560</u>
<u>Pattern C</u>	<u>43.4</u>	<u>1.400</u>

2.3.2 When complying with the maximum fuel storage location decay heat limits, users must account for the decay heat from both the fuel assembly and any NON-FUEL HARDWARE, as applicable for the particular fuel storage location, to ensure the decay heat emitted by all contents in a storage location does not exceed the limit.

3.2.4 MPC-32ML

1. Basket cell ID: 9.53 (min.)
2. Basket cell wall thickness: 0.57 in (min.)
3. B₄C in the Metamic-HT: 10.0wt% (min.)

3.2.5 MPC-31C

1. Basket cell ID: 9.65 (min.)
2. Basket cell wall thickness: 0.34 in (min.)
3. B₄C in the Metamic-HT: 10.0wt% (min.)

3.3 Codes and Standards

The American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), 2007 Edition, is the governing Code for the HI-STORM FW System MPC as clarified in Specification 3.3.1 below, except for Code Sections V and IX. The ASME Code paragraphs applicable to the HI-STORM FW OVERPACK and TRANSFER CASK are listed in Table 3-2. The latest effective editions of ASME Code Sections V and IX, including addenda, may be used for activities governed by those sections, provided a written reconciliation of the later edition against the 2007 Edition, including any addenda, is performed by the certificate holder. American Concrete Institute (ACI) 349-85 is the governing Code for plain concrete as clarified in Appendix 1.D of the Final Safety Analysis Report for the HI-STORM 100 Cask System.