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Table 2.1-1 (page 1 of 8)
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 ≥ ~~3~~ 2 years Assembly Average Burnup ≤ 68.2 GWD/MTU
d. Decay Heat Per Fuel Storage Location:	As specified in Section 2.3
e. Fuel Assembly Length:	≤ 199.2 inches (nominal design including NON-FUEL HARDWARE and DFC)
f. Fuel Assembly Width:	≤ 8.54 inches (nominal design)
g. Fuel Assembly Weight:	≤ 2050 lbs (including NON-FUEL HARDWARE and DFC)

Table 2.1-1 (page 2 of 8)
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), OR in fuel storage locations 2-1, 2-3, 2-4, 2-5, 2-8, 2-9, 2-10, and 2-12 (see Figure 2.1-1), depending on heat load pattern, see Section 2.3.1. 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 (including, but not limited to those with hafnium), 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 8)
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 ≥ 10 years and an assembly average burnup ≤ 27.5 GWD/MTU.
ii. All Other Array Classes	Cooling Time ≥ ~~3~~2 years and an assembly average burnup ≤ 65 GWD/MTU
e. Decay Heat Per Assembly	
i. Array/Class 8x8F	≤ 183.5 Watts
ii. All Other Array Classes	As specified in Section 2.3
f. Fuel Assembly Length	≤ 176.5 inches (nominal design)
g. Fuel Assembly Width	≤ 5.95 inches (nominal design)
h. Fuel Assembly Weight	≤ 850 lbs, including a DFC as well as a channel

Table 2.1-1 (page 4 of 8)
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), OR in fuel storage locations 2-1, 2-2, 2-6, 2-7, 2-13, 2-18, 2-23, 2-28, 2-34, 2-35, 2-39, and 2-40 (see Figure 2.1-2), depending on heat load pattern, see Section 2.3.1. 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 2.1-3 (page 4 of 4) BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)					
Fuel Assembly Array and Class	**10x10 C**	**10x10 F**	**10x10 G**	**10x10 I**	**11x11 A**
Maximum Planar-Average Initial Enrichment (wt.% ^{235}U) (Note 14)	≤ 4.8	≤ 4.7 (Note 13)	≤ 4.6 (Note 12)	≤ 4.8	≤ 4.8
Maximum Planar-Average Initial Enrichment with Gadolinium Credit(wt.% ^{235}U) (Note 15)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations	96	92/78 (Note 7)	96/84	91/79	112/92
Fuel Clad O.D. (in.)	≥ 0.3780	≥ 0.4035	≥ 0.387	≥ 0.4047	≥ 0.3701
Fuel Clad I.D. (in.)	≤ 0.3294	≤ 0.3570	≤ 0.340	≤ 0.3559	≤ 0.3252
Fuel Pellet Dia. (in.)	≤ 0.3224	≤ 0.3500	≤ 0.334	≤ 0.3492	≤ 0.3193
Fuel Rod Pitch (in.)	≤ 0.488	≤ 0.510	≤ 0.512	≤ 0.5100	≤ 0.4705
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 10)	5 (Note 9)	2	5 (Note 9)	1 (Note 5)	1 (Note 5)
Water Rod Thickness (in.)	≥ 0.031	≥ 0.030	≥ 0.031	≥ 0.0315	≥ 0.0340
Channel Thickness (in.)	≤ 0.055	≤ 0.120	≤ 0.060	≤ 0.100	≤ 0.100

Table 2.1-4 RESTRICTIONS FOR GADOLINIUM CREDIT	
Fuel Assembly Array and Class	**Restriction**
All 10x10 and 11x11A	The Gd rod loading is not less than 3.0 wt% Gd_2O_3;
All 10x10 and 11x11A	The Gd rods located in the peripheral row of the fuel lattice cannot be credited
10x10A, 10x10B, ~~and~~ 10x10F, 10x10I, and 11x11A	At least one Gd rod is required.
10x10C and 10x10G	Not less than two Gd rods are required.

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. The per cell limits in these tables apply to cells containing undamaged fuel or damaged fuel or fuel debris in DFCs.

Figures 2.3-1 through 2.3-11 provide alternative loading patterns for the MPC-37 and MPC-89, with either all undamaged fuel or a combination of undamaged fuel and damaged fuel and fuel debris in DFCs. The per cell limits in these figures are applicable when using FHD to dry moderate or high burnup fuel and when using VDS to dry moderate burnup fuel only. The MPC-37 patterns are based on the fuel length to be stored in the MPC, see Table 2.3-7.

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

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

TABLE 2.3-7 PWR FUEL LENGTH CATEGORIES	
Category	Length Range
Short Fuel	128 inches ≤ L < 144 inches
Standard Fuel	144 inches ≤ L < 168 inches
Long Fuel	L ≥ 168 inches
Notes: 1. "L" means "nominal active fuel length". The nominal, unirradiated active fuel length of the PWR fuel assembly is used to designate it as "short", "standard" and "long".	

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.

		0.45	0.45	0.45		
	0.45	3.2	0.5	3.2	0.45	
0.6	2.4	0.5	0.6	0.5	2.4	0.6
0.6	0.5	0.6	0.5	0.6	0.5	0.6
0.6	2.4	0.5	0.6	0.5	2.4	0.6
	0.45	3.2	0.5	3.2	0.45	
		0.45	0.45	0.45		

Figure 2.3-1: Alternative MPC-37 Loading Pattern for MPCs Containing Only Undamaged Fuel, “Short” Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW)

		0.45	0.45	0.45		
	0.45	3.2 (D)	Empty	3.2 (D)	0.45	
0.6	2.4 (D)	Empty	0.6	Empty	2.4 (D)	0.6
0.6	0.5	0.6	0.5	0.6	0.5	0.6
0.6	2.4 (D)	Empty	0.6	Empty	2.4 (D)	0.6
	0.45	3.2 (D)	Empty	3.2 (D)	0.45	
		0.45	0.45	0.45		

Figure 2.3-2: Alternative MPC-37 Loading Pattern for MPCs Containing Undamaged Fuel and Damaged Fuel in DFC, "Short" Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW, Undamaged Fuel or Damaged Fuel in a DFC may be stored in cells denoted by "D." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell)

		0.45	0.45	0.45		
	0.45	3.2 (D/F)	Empty	3.2 (D/F)	0.45	
0.6	2.4	Empty	0.6	Empty	2.4	0.6
0.6	0.5	0.6	0.5	0.6	0.5	0.6
0.6	2.4	Empty	0.6	Empty	2.4	0.6
	0.45	3.2 (D/F)	Empty	3.2 (D/F)	0.45	
		0.45	0.45	0.45		

Figure 2.3-3: Alternative MPC-37 Loading Pattern for MPCs Containing Undamaged Fuel and Damaged Fuel and/or Fuel Debris in DFCs, “Short” Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW, Undamaged Fuel or Damaged Fuel or Fuel Debris in a DFC may be stored in cells denoted by “D/F.” Cells denoted as “Empty” must remain empty regardless of the contents of the adjacent cell)

		0.55	0.55	0.55		
	0.55	3.2	0.55	3.2	0.55	
0.75	2.4	0.55	0.65	0.55	2.4	0.75
0.75	0.55	0.65	0.55	0.65	0.55	0.75
0.75	2.4	0.55	0.65	0.55	2.4	0.75
	0.55	3.2	0.55	3.2	0.55	
		0.55	0.55	0.55		

Figure 2.3-4: Alternative MPC-37 Loading Pattern for MPCs Containing Only Undamaged Fuel, “Standard” Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW)

		0.55	0.55	0.55		
	0.55	3.2 (D)	Empty	3.2 (D)	0.55	
0.75	2.4 (D)	Empty	0.65	Empty	2.4 (D)	0.75
0.75	0.55	0.65	0.55	0.65	0.55	0.75
0.75	2.4 (D)	Empty	0.65	Empty	2.4 (D)	0.75
	0.55	3.2 (D)	Empty	3.2 (D)	0.55	
		0.55	0.55	0.55		

Figure 2.3-5: Alternative MPC-37 Loading Pattern for MPCs Containing Undamaged Fuel and Damaged Fuel in DFCs, "Standard" Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW, "D" Undamaged Fuel or Damaged Fuel in a DFC may be stored in cells denoted by "D." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell)

		0.55	0.55	0.55		
	0.55	3.2 (D/F)	Empty	3.2 (D/F)	0.55	
0.75	2.4	Empty	0.65	Empty	2.4	0.75
0.75	0.55	0.65	0.55	0.65	0.55	0.75
0.75	2.4	Empty	0.65	Empty	2.4	0.75
	0.55	3.2 (D/F)	Empty	3.2 (D/F)	0.55	
		0.55	0.55	0.55		

Figure 2.3-6: MPC-37 Heat Load Chart for MPCs Containing Undamaged Fuel and Damaged Fuel and/or Fuel Debris in DFCs, "Standard" Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW, Undamaged Fuel or Damaged Fuel or Fuel Debris in a DFC may be stored in cells denoted by "D/F." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell.)

		0.65	0.65	0.65		
	0.65	3.5	0.65	3.5	0.65	
0.85	2.6	0.65	0.75	0.65	2.6	0.85
0.85	0.65	0.75	0.65	0.75	0.65	0.85
0.85	2.6	0.65	0.75	0.65	2.6	0.85
	0.65	3.5	0.65	3.5	0.65	
		0.65	0.65	0.65		

Figure 2.3-7: Alternative MPC-37 Loading Pattern for MPCs Containing Only Undamaged Fuel, “Long” Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW)

		0.65	0.65	0.65		
	0.65	3.5 (D)	Empty	3.5 (D)	0.65	
0.85	2.6 (D)	Empty	0.75	Empty	2.6 (D)	0.85
0.85	0.65	0.75	0.65	0.75	0.65	0.85
0.85	2.6 (D)	Empty	0.75	Empty	2.6 (D)	0.85
	0.65	3.5 (D)	Empty	3.5 (D)	0.65	
		0.65	0.65	0.65		

Figure 2.3-8: Alternative MPC-37 Loading Pattern for MPCs Containing Undamaged Fuel and Damaged Fuel in DFCs, “Long” Fuel per Cell Heat Load Limits

(All storage cell heat loads are in kW, “D” means Undamaged Fuel or Damaged Fuel in a DFC may be stored in cells denoted by “D.” Cells denoted as “Empty” must remain empty regardless of the contents of the adjacent cell)

		0.65	0.65	0.65		
	0.65	3.5 (D/F)	Empty	3.5 (D/F)	0.65	
0.85	2.6	Empty	0.75	Empty	2.6	0.85
0.85	0.65	0.75	0.65	0.75	0.65	0.85
0.85	2.6	Empty	0.75	Empty	2.6	0.85
	0.65	3.5 (D/F)	Empty	3.5 (D/F)	0.65	
		0.65	0.65	0.65		

Figure 2.3-9: Alternative MPC-37 Loading Pattern for MPCs Containing Undamaged Fuel and Damaged Fuel and/or Fuel Debris in DFCs, “Long” Fuel per Cell Heat Load Limit

(All storage cell heat loads are in kW, Undamaged Fuel or Damaged Fuel or Fuel Debris in a DFC may be stored in cells denoted by “D/F.” Cells denoted as “Empty” must remain empty regardless of the contents of the adjacent cell)

				0.25	0.25	0.25				
		0.25	0.25	0.25	1.45	0.25	0.25	0.25		
	0.25	0.25	1.45	0.9	0.9	0.9	1.45	0.25	0.25	
	0.25	1.45	0.32	0.32	0.32	0.32	0.32	1.45	0.25	
0.25	0.25	0.9	0.32	0.32	0.32	0.32	0.32	0.9	0.25	0.25
0.25	1.45	0.9	0.32	0.32	0.32	0.32	0.32	0.9	1.45	0.25
0.25	0.25	0.9	0.32	0.32	0.32	0.32	0.32	0.9	0.25	0.25
	0.25	1.45	0.32	0.32	0.32	0.32	0.32	1.45	0.25	
	0.25	0.25	1.45	0.9	0.9	0.9	1.45	0.25	0.25	
		0.25	0.25	0.25	1.45	0.25	0.25	0.25		
				0.25	0.25	0.25				

Figure 2.3-10: Alternative MPC-89 Loading Pattern for MPCs Containing Only Undamaged Fuel per Cell Heat Load Limits

(All Storage cell heat loads are in kW)

				0.25	0.25	0.25				
		0.25	0.25	0.25	1.45 (D/F)	0.25	0.25	0.25		
	0.25	0.25	1.45 (D/F)	0.9	0.9	0.9	1.45 (D/F)	0.25	0.25	
	0.25	1.45 (D/F)	Empty	0.32	0.32	0.32	Empty	1.45 (D/F)	0.25	
0.25	0.25	0.9	0.32	0.32	0.32	0.32	0.32	0.9	0.25	0.25
0.25	1.45 (D/F)	0.9	0.32	0.32	0.32	0.32	0.32	0.9	1.45 (D/F)	0.25
0.25	0.25	0.9	0.32	0.32	0.32	0.32	0.32	0.9	0.25	0.25
	0.25	1.45 (D/F)	Empty	0.32	0.32	0.32	Empty	1.45 (D/F)	0.25	
	0.25	0.25	1.45 (D/F)	0.9	0.9	0.9	1.45 (D/F)	0.25	0.25	
		0.25	0.25	0.25	1.45 (D/F)	0.25	0.25	0.25		
				0.25	0.25	0.25				

Figure 2.3-11: MPC-89 Loading Pattern for MPCs Containing Undamaged and Damaged Fuel and/or Fuel Debris in DFCs, per Cell Heat Load Limits

(All Storage cell heat loads are in kW, Undamaged Fuel or Damaged Fuel or Fuel Debris in a DFC may be stored in cells denoted by "D/F." Cells denoted as "Empty" must remain empty regardless of the contents of the adjacent cell.)

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

MPC basket supports and lift lugs	NB-1130	NB-1132.2(d) requires that the first connecting weld of a non-pressure retaining structural attachment to a component shall be considered part of the component unless the weld is more than 2t from the pressure retaining portion of the component, where t is the nominal thickness of the pressure retaining material. NB-1132.2(e) requires that the first connecting weld of a welded nonstructural attachment to a component shall conform to NB-4430 if the connecting weld is within 2t from the pressure retaining portion of the component.	The lugs that are used exclusively for lifting an empty MPC are welded to the inside of the pressure-retaining MPC shell, but are not designed in accordance with Subsection NB. The lug-to-Enclosure Vessel Weld is required to meet the stress limits of Reg. Guide 3.61 in lieu of Subsection NB of the Code.
MPC Enclosure Vessel	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 Enclosure Vessel	NB-2121	Provides permitted material specification for pressure-retaining material, which must conform to Section II, Part D, Tables 2A and 2B	Certain duplex stainless steels are not included in Section II, Part D, Tables 2A and 2B. These stainless steel alloys are evaluated in the HI-STORM FW FSAR and meet the required design criteria for use in the HI-STORM FW system.
MPC Enclosure Vessel	NB-3100 NF-3100	Provides requirements for determining design loading conditions, such as pressure, temperature, and mechanical loads.	These requirements are subsumed by the HI-STORM FW FSAR, serving as the Design Specification, which establishes the service conditions and load combinations for the storage system.
MPC Enclosure Vessel	NB-4120	NB-4121.2 and NF-4121.2 provide requirements for repetition of tensile or impact tests for material subjected to heat treatment during fabrication or installation.	In-shop operations of short duration that apply heat to a component, such as plasma cutting of plate stock, welding, machining, and coating are not, unless explicitly stated by the Code, defined as heat treatment operations.