CERTIFICATE OF COMPLIANCE NO. 1040

APPENDIX B

APPROVED CONTENTS AND DESIGN FEATURES

FOR THE HI-STORM UMAX CANISTER STORAGE SYSTEM

TABLE OF CONTENTS

1.0 Definitions

Refer to Appendix A for Definitions.

2.0 APPROVED CONTENTS

2.1 Fuel Specifications and Loading Conditions

2.1.1 Fuel to Be Stored in the HI-STORM UMAX Canister 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 UMAX Canister Storage System.

b. All BWR fuel assemblies may be stored with or without ZR channels.

2.1.2 Fuel Loading

Figures 2.3-1 through 2.3-7 and 2.3-12 define the unique cell numbers for the MPC-37 and MPC-89 models, respectively, and the maximum allowable heat load per fuel assembly for each cell under multiple loading conditions. 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.

Table 2.1-1 (page 1 of 4)
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
c. Post-irradiation Cooling Time and Average Burnup Per Assembly:	Cooling Time ≥ 3 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 4)
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 1, 3, 4, 8, 9, 15, 23, 29, 30, 34, 35, and 37 (see Figures 2.3-1 through 2.3-7). 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-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 locations 5 through 7, 10 through 14, 17 through 21, 24 through 28, and 31 through 33 (see Figures 2.3-1 through 2.3-7).

Table 2.1-1 (page 3 of 4)
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 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 4)
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 1, 3, 4, 10, 11, 19, 29, 39, 51, 61, 71, 79, 80, 86, 87, and 89 (see Figure 2.3-12). 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 2.1-2 (page 1 of 3)
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	≤ 0.3734	≤ 0.3880	≤ 0.3736	≤ 0.3640
Fuel Pellet Dia. (in.) (Note 3)	≤ 0.3444	≤ 0.3659	≤ 0.3805	≤ 0.3671	≤ 0.3570
Fuel Rod Pitch (in.)	≤ 0.556	≤ 0.556	≤ 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 3)
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
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 3)

PWR FUEL ASSEMBLY CHARACTERISTICS
(Note 1)

Fuel Assembly Array and Class	**16x16 A**	**17x17A**	**17x17 B**	**17x17 C**	**17x17 D**	**17x17 E**
No. of Fuel Rod Locations	236	264	264	264	264	265
Fuel Clad O.D. (in.)	≥ 0.382	≥ 0.360	≥ 0.372	≥ 0.377	≥ 0.372	≥ 0.372
Fuel Clad I.D. (in.)	≤ 0.3350	≤ 0.3150	≤ 0.3310	≤ 0.3330	≤ 0.3310	≤ 0.3310
Fuel Pellet Dia. (in.) (Note 3)	≤ 0.3255	≤ 0.3088	≤ 0.3232	≤ 0.3252	≤ 0.3232	≤ 0.3232
Fuel Rod Pitch (in.)	≤ 0.506	≤ 0.496	≤ 0.496	≤ 0.502	≤ 0.496	≤ 0.496
Active Fuel length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 170	≤ 170
No. of Guide and/or Instrument Tubes	5 (Note 2)	25	25	25	25	24
Guide/Instrument Tube Thickness (in.)	≥ 0.0350	≥ 0.016	≥ 0.014	≥ 0.020	≥ 0.014	≥ 0.014

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.
4. One Instrument Tube and eight Guide Bars (Solid ZR)

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
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
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
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)
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.

Table 2.1-4
CLASSIFICATION OF FUEL ASSEMBLY FOR MPC-37 IN THE HI-STORM UMAX ISFSI

MPC Type	Classification	Nominal Active Fuel Length
MPC-37	Short Fuel	128 inches $\leq$ L < 144 inches
	Standard Fuel	144 inches $\leq$ L < 168 inches
	Long Fuel	L $\geq$ 168 inches
Note 1: L means "nominal active fuel length".		

2.3 Decay Heat Limits

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

2.3.1 Fuel Loading Decay Heat Limits

Table 2.3-1 provides the maximum permissible decay heat under long-term storage for MPC-37 and MPC-89. Table 2.3-1 also lists the applicable figures providing the permissible decay heat per fuel storage location, including MPCs using the optional helium backfill pressure ranges permitted in Table 3-2 of Appendix A.

TABLE 2.3-1
PERMISSIBLE HEAT LOAD FOR LONG-TERM STORAGE

MPC Type		Heat Load Chart	Helium Backfill Pressure Option (Notes 1,2)	Permissible Heat Load Per Storage Cell	Permissible Aggregate Heat Load, kW (Note 4)
MPC-37	Short Fuel (Note 3)	1	1	Figure 2.3-1	33.88
		2	2	Figure 2.3-2	33.70
		3	1	Figure 2.3-3	33.53
	Standard Fuel (Note 3)	1	1	Figure 2.3-1	33.88
		2	2	Figure 2.3-2	33.70
		3	1	Figure 2.3-4	35.30
	Long Fuel (Note 3)	1	1	Figure 2.3-5	35.76
		2	2	Figure 2.3-6	35.57
		3	1	Figure 2.3-7	37.06
	Short Fuel (Note 3)		3	Figure 2.3-8	34.28
			3	Figure 2.3-12	33.46
	Standard Fuel (Note 3)		3	Figure 2.3-8	34.28
			3	Figure 2.3-12	33.46
	Long Fuel (Note 3)		3	Figure 2.3-9	36.19
			3	Figure 2.3-12	33.46
MPC-89			1	Figure 2.3-10	36.32
			2	Figure 2.3-11	36.72
			2	Figure 2.3-13	34.75

Notes:

1. For helium backfill pressure option pressure ranges see Appendix A, Table 3-2
2. For the details on the use of VDS to dry High Burnup Fuel see Appendix A, Table 3-1
3. See Table 2.1-4 for fuel length data
4. Aggregate heat load is defined as the sum of heat loads of all stored fuel

assemblies. The permissible aggregate heat load is set to 80% of the design basis heat load.

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.

		1 0.873	2 0.873	3 0.873		
	4 0.873	5 1.602	6 1.602	7 1.602	8 0.873	
9 0.873	10 1.602	11 1.017	12 1.017	13 1.017	14 1.602	15 0.873
16 0.873	17 1.602	18 1.017	19 1.017	20 1.017	21 1.602	22 0.873
23 0.873	24 1.602	25 1.017	26 1.017	27 1.017	28 1.602	29 0.873
	30 0.873	31 1.602	32 1.602	33 1.602	34 0.873	
		35 0.873	36 0.873	37 0.873		

Legend

Cell ID Heat Load, kW

Figure 2.3-1
HI-STORM UMAX MPC-37 Permissible Heat Load Chart 1 for Long-term Storage for Short and Standard Fuel

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

		1 1.215	2 1.215	3 1.215		
	4 1.215	5 1.080	6 1.080	7 1.080	8 1.215	
9 1.215	10 1.080	11 1.080	12 1.080	13 1.080	14 1.080	15 1.215
16 1.215	17 1.080	18 1.080	19 1.080	20 1.080	21 1.080	22 1.215
23 1.215	24 1.080	25 1.080	26 1.080	27 1.080	28 1.080	29 1.215
	30 1.215	31 1.080	32 1.080	33 1.080	34 1.215	
		35 1.215	36 1.215	37 1.215		

Legend

Cell ID Heat Load, kW

Figure 2.3-2
HI-STORM UMAX MPC-37 Permissible Heat Load Chart 2 for Long-term Storage for Short and Standard Fuel

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

		1 0.922	2 0.922	3 0.922		
	4 0.922	5 1.520	6 1.520	7 1.520	8 0.922	
9 0.922	10 1.710	11 0.950	12 0.950	13 0.950	14 1.710	15 0.922
16 0.922	17 1.520	18 0.950	19 0.570	20 0.950	21 1.520	22 0.922
23 0.922	24 1.710	25 0.950	26 0.950	27 0.950	28 1.710	29 0.922
	30 0.922	31 1.520	32 1.520	33 1.520	34 0.922	
		35 0.922	36 0.922	37 0.922		

Legend

Cell ID Heat Load, kW

Figure 2.3-3
HI-STORM UMAX MPC-37 Permissible Heat Load Chart 3 for Long-term Storage for Short Fuel

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

		1 0.970	2 0.970	3 0.970		
	4 0.970	5 1.600	6 1.600	7 1.600	8 0.970	
9 0.970	10 1.800	11 1.000	12 1.000	13 1.000	14 1.800	15 0.970
16 0.970	17 1.600	18 1.000	19 0.600	20 1.000	21 1.600	22 0.970
23 0.970	24 1.800	25 1.000	26 1.000	27 1.000	28 1.800	29 0.970
	30 0.970	31 1.600	32 1.600	33 1.600	34 0.970	
		35 0.970	36 0.970	37 0.970		

Legend

Cell ID Heat Load, kW

Figure 2.3-4
HI-STORM UMAX MPC-37 Permissible Heat Load Chart 3 for Long-term Storage for Standard Fuel

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

		1 0.922	2 0.922	3 0.922		
	4 0.922	5 1.691	6 1.691	7 1.691	8 0.922	
9 0.922	10 1.691	11 1.074	12 1.074	13 1.074	14 1.691	15 0.922
16 0.922	17 1.691	18 1.074	19 1.074	20 1.074	21 1.691	22 0.922
23 0.922	24 1.691	25 1.074	26 1.074	27 1.074	28 1.691	29 0.922
	30 0.922	31 1.691	32 1.691	33 1.691	34 0.922	
		35 0.922	36 0.922	37 0.922		

Legend

Cell ID Heat Load, kW

Figure 2.3-5
HI-STORM UMAX MPC-37 Permissible Heat Load Chart 1 for Long-term Storage for Long Fuel

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

		1 1.283	2 1.283	3 1.283		
	4 1.283	5 1.140	6 1.140	7 1.140	8 1.283	
9 1.283	10 1.140	11 1.140	12 1.140	13 1.140	14 1.140	15 1.283
16 1.283	17 1.140	18 1.140	19 1.140	20 1.140	21 1.140	22 1.283
23 1.283	24 1.140	25 1.140	26 1.140	27 1.140	28 1.140	29 1.283
	30 1.283	31 1.140	32 1.140	33 1.140	34 1.283	
		35 1.283	36 1.283	37 1.283		

Legend

Cell ID Heat Load, kW

Figure 2.3-6
HI-STORM UMAX MPC-37 Permissible Heat Load Chart 2 for Long-term Storage for Long Fuel

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

		1 1.019	2 1.019	3 1.019		
	4 1.019	5 1.680	6 1.680	7 1.680	8 1.019	
9 1.019	10 1.890	11 1.050	12 1.050	13 1.050	14 1.890	15 1.019
16 1.019	17 1.680	18 1.050	19 0.630	20 1.050	21 1.680	22 1.019
23 1.019	24 1.890	25 1.050	26 1.050	27 1.050	28 1.890	29 1.019
	30 1.019	31 1.680	32 1.680	33 1.680	34 1.019	
		35 1.019	36 1.019	37 1.019		

Legend

Cell ID Heat Load, kW

Figure 2.3-7
HI-STORM UMAX MPC-37 Permissible Heat Load Chart 3 for Long-term Storage for Long Fuel

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

		1	2	3		
		0.785	0.785	0.785		
	4	5	6	7	8	
	0.785	1.441	1.441	1.441	0.785	
9	10	11	12	13	14	15
0.785	1.441	0.915	0.915	0.915	1.441	0.785
16	17	18	19	20	21	22
0.785	1.441	0.915	0.915	0.915	1.441	0.785
23	24	25	26	27	28	29
0.785	1.441	0.915	0.915	0.915	1.441	0.785
	30	31	32	33	34	
	0.785	1.441	1.441	1.441	0.785	
		35	36	37		
		0.785	0.785	0.785		

Legend

Cell ID
Heat Load, kW

Figure 2.3-8
HI-STORM UMAX MPC-37 Permissible Heat Load for Short and Standard Fuel for Helium Backfill Option 3 in Table 3-2 of Appendix A

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

		1 0.829	2 0.829	3 0.829		
	4 0.829	5 1.521	6 1.521	7 1.521	8 0.829	
9 0.829	10 1.521	11 0.966	12 0.966	13 0.966	14 1.521	15 0.829
16 0.829	17 1.521	18 0.966	19 0.966	20 0.966	21 1.521	22 0.829
23 0.829	24 1.521	25 0.966	26 0.966	27 0.966	28 1.521	29 0.829
	30 0.829	31 1.521	32 1.521	33 1.521	34 0.829	
		35 0.829	36 0.829	37 0.829		

Legend

Cell ID Heat Load, kW

Figure 2.3-9
HI-STORM UMAX MPC-37 Permissible Heat Load for Long Fuel for Helium Backfill Option 3 in Table 3-2 of Appendix A

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

				1 0.431	2 0.431	3 0.431				
		4 0.431	5 0.431	6 0.431	7 0.607	8 0.431	9 0.431	10 0.431		
	11 0.431	12 0.431	13 0.607	14 0.607	15 0.607	16 0.607	17 0.607	18 0.431	19 0.431	
	20 0.431	21 0.607	22 0.607	23 0.607	24 0.607	25 0.607	26 0.607	27 0.607	28 0.431	
29 0.431	30 0.431	31 0.607	32 0.607	33 0.431	34 0.431	35 0.431	36 0.607	37 0.607	38 0.431	39 0.431
40 0.431	41 0.607	42 0.607	43 0.607	44 0.431	45 0.431	46 0.431	47 0.607	48 0.607	49 0.607	50 0.431
51 0.431	52 0.431	53 0.607	54 0.607	55 0.431	56 0.431	57 0.431	58 0.607	59 0.607	60 0.431	61 0.431
	62 0.431	63 0.607	64 0.607	65 0.607	66 0.607	67 0.607	68 0.607	69 0.607	70 0.431	
	71 0.431	72 0.431	73 0.607	74 0.607	75 0.607	76 0.607	77 0.607	78 0.431	79 0.431	
		80 0.431	81 0.431	82 0.431	83 0.607	84 0.431	85 0.431	86 0.431		
				87 0.431	88 0.431	89 0.431				

Legend

Cell ID Heat Load, kW

Figure 2.3-10
HI-STORM UMAX MPC-89 Permissible Heat Load for Long-Term Storage

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

				1 0.387	2 0.387	3 0.387				
		4 0.387	5 0.387	6 0.387	7 0.546	8 0.387	9 0.387	10 0.387		
	11 0.387	12 0.387	13 0.546	14 0.546	15 0.546	16 0.546	17 0.546	18 0.387	19 0.387	
	20 0.387	21 0.546	22 0.546	23 0.546	24 0.546	25 0.546	26 0.546	27 0.546	28 0.387	
29 0.387	30 0.387	31 0.546	32 0.546	33 0.387	34 0.387	35 0.387	36 0.546	37 0.546	38 0.387	39 0.387
40 0.387	41 0.546	42 0.546	43 0.546	44 0.387	45 0.387	46 0.387	47 0.546	48 0.546	49 0.546	50 0.387
51 0.387	52 0.387	53 0.546	54 0.546	55 0.387	56 0.387	57 0.387	58 0.546	59 0.546	60 0.387	61 0.387
	62 0.387	63 0.546	64 0.546	65 0.546	66 0.546	67 0.546	68 0.546	69 0.546	70 0.387	
	71 0.387	72 0.387	73 0.546	74 0.546	75 0.546	76 0.546	77 0.546	78 0.387	79 0.387	
		80 0.387	81 0.387	82 0.387	83 0.546	84 0.387	85 0.387	86 0.387		
				87 0.387	88 0.387	89 0.387				

Legend

Cell ID Heat Load, kW

Figure 2.3-11
HI-STORM UMAX MPC-89 Permissible Heat Load for Helium Backfill
Option 2 in Table 3-2 of Appendix A

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

		1 0.97	2 0.97	3 0.97		
	4 0.97	5 0.97	6 0.97	7 0.97	8 0.97	
9 0.97	10 0.97	11 0.7	12 0.7	13 0.7	14 0.97	15 0.97
16 0.97	17 0.97	18 0.7	19 0.7	20 0.7	21 0.97	22 0.97
23 0.97	24 0.97	25 0.7	26 0.7	27 0.7	28 0.97	29 0.97
	30 0.97	31 0.97	32 0.97	33 0.97	34 0.97	
		35 0.97	36 0.97	37 0.97		

Legend

Cell ID Heat Load, kW

Figure 2.3-12
HI-STORM UMAX MPC-37 Permissible Threshold Heat Load for VDS High Burnup Fuel in Table 3-1 of Appendix A and Helium Backfill Option 3 in Table 3-2 of Appendix A

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

				1 0.44	2 0.44	3 0.44				
		4 0.44	5 0.44	6 0.44	7 0.35	8 0.44	9 0.44	10 0.44		
	11 0.44	12 0.44	13 0.35	14 0.35	15 0.35	16 0.35	17 0.35	18 0.44	19 0.44	
	20 0.44	21 0.35	22 0.35	23 0.35	24 0.35	25 0.35	26 0.35	27 0.35	28 0.44	
29 0.44	30 0.44	31 0.35	32 0.35	33 0.35	34 0.35	35 0.35	36 0.35	37 0.35	38 0.44	39 0.44
40 0.44	41 0.35	42 0.35	43 0.35	44 0.35	45 0.35	46 0.35	47 0.35	48 0.35	49 0.35	50 0.44
51 0.44	52 0.44	53 0.35	54 0.35	55 0.35	56 0.35	57 0.35	58 0.35	59 0.35	60 0.44	61 0.44
	62 0.44	63 0.35	64 0.35	65 0.35	66 0.35	67 0.35	68 0.35	69 0.35	70 0.44	
	71 0.44	72 0.44	73 0.35	74 0.35	75 0.35	76 0.35	77 0.35	78 0.44	79 0.44	
		80 0.44	81 0.44	82 0.44	83 0.35	84 0.44	85 0.44	86 0.44		
				87 0.44	88 0.44	89 0.44				

Legend

Cell ID Heat Load, kW

Figure 2.3-13
HI-STORM UMAX MPC-89 Permissible Threshold Heat Load for VDS High Burnup Fuel in Table 3-1 of Appendix A and Helium Backfill Option 2 in Table 3-2 of Appendix A

Note that this figure shows the per cell heat load limit for storage. The total permissible aggregate heat load may be less than the sum of each individual cell heat load. See Table 2.3-1 for corresponding permissible aggregate heat load.

3.0 DESIGN FEATURES

3.1 Site

3.1.1 Site Location

The HI-STORM UMAX Canister Storage System is authorized for general use by 10 CFR Part 50 license holders at various site locations under the provisions of 10 CFR 72, Subpart K.

3.2 Design Features Important for Criticality Control

3.2.1 MPC-37

1. Basket cell ID: 8.92 in. (min. nominal)
2. Basket cell wall thickness: 0.57 in. (min.nominal)
3. B_4C in the Metamic-HT: 10.0 wt % (min. nominal)

3.2.2 MPC-89

1. Basket cell ID: 5.99 in. (min.nominal)
2. Basket cell wall thickness: 0.38 in. (min.nominal)
3. B_4C in the Metamic-HT: 10.0 wt % (min. nominal)

3.2.3 Metamic-HT Test Requirements

1. The weight percentage of the boron carbide must be confirmed to be greater than or equal to 10% in each lot of Al/ B4C powder.

2. The areal density of the B-10 isotope corresponding to the 10% min. weight density in the manufactured Metamic HT panels shall be independently confirmed by the neutron attenuation test method by testing at least one coupon from a randomly selected panel in each lot.

3. If the B- 10 areal density criterion in the tested panel fails to meet the specified minimum, then the manufacturer has the option to reject the entire lot or to test a statistically significant number of panels and perform statistical analysis to show that the minimum areal density in the panels (that comprise the lot) is satisfied with 95% confidence.

4. All test procedures used in demonstrating compliance with the above requirements shall conform to the cask designer's QA program which has been approved by the USNRC under docket number 71-0784.

3.3 Codes and Standards

The American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), 2007, is the governing Code for the HI-STORM UMAX system MPC as

clarified in Specification 3.3.1 below, except for Code Sections V and IX. However, the HI-STORM UMAX VVM is structurally qualified per the newer 2010 ASME code. The ASME Code paragraphs applicable to the manufacturing of HI-STORM UMAX VVM 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 applicable edition (including addenda) specified above, is performed by the certificate holder. American Concrete Institute ACI-318 (2005) is the governing Code for both plain concrete and reinforced concrete as clarified in Chapter 3 of the Final Safety Analysis Report for the HI-STORM 100 UMAX System.

3.3.1 Alternatives to Codes, Standards, and Criteria

Table 3-1 lists approved alternatives to the ASME Code for the design of the MPCs of the HI-STORM UMAX Canister Storage System.

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

Proposed alternatives to the ASME Code, Section III, 2007 Edition, including modifications to the alternatives allowed by Specification 3.3.1 may be used on a case-specific basis 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, 2007 Edition, would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Requests for alternatives shall be submitted in accordance with 10 CFR 72.4.

(continued)

3.0 DESIGN FEATURES (continued)

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

MPC Enclosure Vessel	Subsection NCA	General Requirements. Requires preparation of a Design Specification, Design Report, Overpressure Protection Report, Certification of Construction Report, Data Report, and other administrative controls for an ASME Code stamped vessel.	Because the MPC is not an ASME Code stamped vessel, none of the specifications, reports, certificates, or other general requirements specified by NCA are required. In lieu of a Design Specification and Design Report, the HI-STORM FSAR includes the design criteria, service conditions, and load combinations for the design and operation of the MPCs as well as the results of the stress analyses to demonstrate that applicable Code stress limits are met. Additionally, the fabricator is not required to have an ASME-certified QA program. All important-to-safety activities are governed by the NRC-approved Holtec QA program. Because the cask components are not certified to the Code, the terms “Certificate Holder” and “Inspector” are not germane to the manufacturing of NRC-certified cask components. To eliminate ambiguity, the responsibilities assigned to the Certificate Holder in the Code, as applicable, shall be interpreted to apply to the NRC Certificate of Compliance (CoC) holder (and by extension, to the component fabricator) if the requirement must be fulfilled. The Code term “Inspector” means the QA/QC personnel of the CoC holder and its vendors assigned to oversee and inspect the manufacturing process.
MPC Enclosure Vessel	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.

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-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.

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

MPC Enclosure Vessel	NB-4220	Requires certain forming tolerances to be met for cylindrical, conical, or spherical shells of a vessel.	The cylindricity measurements on the rolled shells are not specifically recorded in the shop travelers, as would be the case for a Code-stamped pressure vessel. Rather, the requirements on inter-component clearances (such as the MPC-to-transfer cask) are guaranteed through fixture-controlled manufacturing. The fabrication specification and shop procedures ensure that all dimensional design objectives, including inter-component annular clearances are satisfied. The dimensions required to be met in fabrication are chosen to meet the functional requirements of the dry storage components. Thus, although the post-forming Code cylindricity requirements are not evaluated for compliance directly, they are indirectly satisfied (actually exceeded) in the final manufactured components.
MPC Enclosure Vessel	NB-4122	Implies that with the exception of studs, bolts, nuts and heat exchanger tubes, CMTRs must be traceable to a specific piece of material in a component.	MPCs are built in lots. Material traceability on raw materials to a heat number and corresponding CMTR is maintained by Holtec through markings on the raw material. Where material is cut or processed, markings are transferred accordingly to assure traceability. As materials are assembled into the lot of MPCs being manufactured, documentation is maintained to identify the heat numbers of materials being used for that item in the multiple MPCs being manufactured under that lot. A specific item within a specific MPC will have a number of heat numbers identified as possibly being used for the item in that particular MPC of which one or more of those heat numbers (and corresponding CMTRS) will have actually been used. All of the heat numbers identified will comply with the requirements for the particular item.
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.

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

MPC Closure Ring, Vent and Drain Cover Plate Welds	NB-5230	Radiographic (RT) or ultrasonic (UT) examination required.	Root (if more than one weld pass is required) and final liquid penetrant examination to be performed in accordance with NB-5245. The closure ring provides independent redundant closure for vent and drain cover plates. Vent and drain port cover plate welds are helium leakage tested.
MPC Lid to Shell Weld	NB-5230	Radiographic (RT) or ultrasonic (UT) examination required.	Only progressive liquid penetrant (PT) examination is permitted. PT examination will include the root and final weld layers and each approx. 3/8" of weld depth.
MPC Enclosure Vessel and Lid	NB-6111	All completed pressure retaining systems shall be pressure tested.	The MPC vessel is welded in the field following fuel assembly loading. After the lid to shell weld is completed, the MPC shall then be pressure tested as defined in Chapter 10. Accessibility for leakage inspections precludes a Code compliant pressure test. Since the shell welds of the MPC cannot be checked for leakage during this pressure test, the shop leakage test to 10^{-7} ref cc/sec provides reasonable assurance as to its leak tightness. All MPC enclosure vessel welds (except closure ring and vent/drain cover plate) are inspected by volumetric examination. The MPC lid-to-shell weld shall be verified by progressive PT examination. PT must include the root and final layers and each approximately 3/8 inch of weld depth. The inspection results, including relevant findings (indications) shall be made a permanent part of the user's records by video, photographic, of other means which provide an equivalent 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 and the closure ring welds are 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.

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

MPC Enclosure Vessel	NB-7000	Vessels are required to have overpressure protection.	No overpressure protection is provided. Function of MPC enclosure vessel is to contain radioactive contents under normal, off-normal, and accident conditions of storage. 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-STORM UMAX 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.

Table 3-2
REFERENCE ASME CODE PARAGRAPHS FOR VVM PRIMARY LOAD BEARING PARTS

	Item	Code Paragraph [2.6.1]	Explanation and Applicability
1.	Definition of primary and secondary members	NF-1215	-
2.	Jurisdictional boundary	NF-1133	The VVM's jurisdictional boundary is defined by the bottom surface of the SFP, the top surface of the ISFSI pad and the SES side surfaces.
3.	Certification of material(structural)	NF-2130(b) and (c)	Materials shall be certified to the applicable Section II of the ASME Code or equivalent ASTM Specification.
4.	Heat treatment of material	NF-2170 and NF-2180	-
5.	Storage of welding material	NF-2400	-
6.	Welding procedure	Section IX	-
7.	Welding material	Section II	-
8.	Loading conditions	NF-3111	-
9.	Allowable stress values	NF-3112.3	-
10.	Rolling and sliding supports	NF-3424	-
11.	Differential thermal expansion	NF-3127	-
12.	Stress analysis	NF-3143 NF-3380 NF-3522 NF-3523	Provisions for stress analysis for Class 3 plate and shell supports and for linear supports are applicable for Closure Lid and Container Shell, respectively.
13.	Cutting of plate stock	NF-4211 NF-4211.1	-
14.	Forming	NF-4212	-
15.	Forming tolerance	NF-4221	Applies to the Container Shell
16.	Fitting and Aligning Tack Welds	NF-4231 NF-4231.1	-
17.	Alignment	NF-4232	-
18.	Storage of Welding Materials	NF-4411	-
19.	Cleanliness of Weld Surfaces	NF-4412	Applies to structural and non-structural welds
20.	Backing Strips, Peening	NF-4421	Applies to structural and non-

Table 3-2
REFERENCE ASME CODE PARAGRAPHS FOR VVM PRIMARY LOAD BEARING PARTS

	Item	**Code Paragraph [2.6.1]**	**Explanation and Applicability**
		NF-4422	structural welds
21.	Pre-heating and Interpass Temperature	NF-4611 NF-4612 NF-4613	Applies to structural and non-structural welds
22.	Non-Destructive Examination	NF-5360	Invokes Section V
23.	NDE Personnel Certification	NF-5522 NF-5523 NF-5530	-

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3.0 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. The temperature of 80^{o} F is the maximum average yearly temperature.
2. The allowed temperature extremes, averaged over a 3-day period, shall be greater than -40^{o} F and less than 125^{o} F.
3. The resultant zero period acceleration at the top of the grade and at the elevation of the Support Foundation Pad (SFP) at the host site (computed by the Newmark's rule as the sum of A+0.4*B+0.4*C, where A, B, C denote the free field ZPA's in the three orthogonal directions in decreasing magnitude, i.e., A ≥ B ≥ C) shall be less than or equal to 1.3 and 1.214, respectively.
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.
5. The potential for fire and explosion shall be based on site-specific considerations. The user shall demonstrate that the site-specific potential for fire is bounded by the fire conditions analyzed by the Certificate Holder, or an analysis of the site-specific fire considerations shall be performed.
6. The moment and shear capacities of the ISFSI Structures shall meet the structural requirements under the load combinations in Table 3.4-1.
7. Radiation Protection Space (RPS) as defined in Subsection 5.3.9 of Appendix A, is intended to ensure that the subgrade material in and around the lateral space occupied by the VVMs remains essentially intact under all service conditions including during an excavation activity adjacent to the RPS.
8. The SFP for a VVM array established in any one construction campaign shall be of monolithic construction, to the extent practicable, to maximize the physical stability of the underground installation.
9. Excavation activities contiguous to a loaded UMAX ISFSI on the side facing the excavation can occur down to the depth of the bottom surface of the SFP of the loaded ISFSI (i.e. within the area labeled "Space B" in Figure 3-1) considering that there may be minor variations in the depth due to normal construction practices. For excavation activities which are contiguous to the loaded ISFSI (within a distance "W," see Figure 3-1) and below the depth of the bottom surface of the SFP (i.e. within the area labeled "Space D" in Figure 3-1), a site-specific seismic analysis will be performed to demonstrate the stability of the RPS boundary and structural integrity of the ISFSI structure. This analysis shall be submitted to Holtec International to be incorporated in an amendment request for NRC review and approval prior to any excavation taking place.

10. 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.

11. LOADING OPERATIONS, TRANSPORT OPERATIONS, and UNLOADING OPERATIONS shall only be conducted with working area Ambient Temperature ≥ 0^{o} F.

12. For those users whose site-specific design basis includes an event or events (e.g., flood) that result in the blockage of any VVM inlet or outlet air ducts for an extended period of time (i.e., longer than the total Completion Time of LCO 3.1.2), an analysis or evaluation may be performed to demonstrate adequate heat removal is available for the duration of the event. Adequate heat removal is defined as fuel cladding temperatures remaining below the short term temperature limit. If the analysis or evaluation is not performed, or if fuel cladding temperature limits are unable to be demonstrated by analysis or evaluation to remain below the short term temperature limit for the duration of the event, provisions shall be established to provide alternate means of cooling to accomplish this objective.

13. Users shall establish procedural and/or mechanical barriers to ensure that during LOADING OPERATIONS and UNLOADING OPERATIONS, either the fuel cladding is covered by water, or the MPC is filled with an inert gas.

14. The entire haul route shall be evaluated to ensure that the route can support the weight of the loaded transfer cask and its conveyance.

15. The loaded transfer cask and its conveyance shall be evaluated to ensure, under the site specific Design Basis Earthquake, that the cask and its conveyance does not tipover or slide off the haul route.

(continued)

DESIGN FEATURES (continued)

Table 3-3
LOAD COMBINATIONS FOR THE TOP SURFACE PAD, ISFSI PAD, AND SUPPORT FOUNDATION PAD PER ACI-318 (2005)

Load Combination Case	Load Combination
LC-1	1.4D
LC-2	1.2D + 1.6L
LC-3	1.2D + E + L

where:
D: Dead Load including long-term differential settlement effects.
L: Live Load
E: DBE for the Site

DESIGN FEATURES (continued)

Table 3-4
Values of Principal Design Parameters for the Underground ISFSI

Thickness of the Support Foundation Pad, inch (nominal)	≥33
Thickness of the ISFSI Pad, inch (nominal)	≥34
Thickness of the Top Surface Pad, inch (nominal)	≥30
Rebar Size* (min.) and Layout* (max)	#11 @ 9" each face, each direction
Rebar Concrete Cover (top and bottom)*, inch	per 7.7.1 of ACI-318 (2005)
Compressive Strength of Concrete at ≤28 days*, psi	≥4500
Compressive Strength of Self-hardening Engineered Subgrade (SES), psi	≥1,000
Lower Bound Shear Wave Velocity in the Subgrade lateral to the VVM (Figure 3-1 Space A), fps**	≥1,300
Depth Averaged Density of subgrade in Space A. (Figure 3-1)[1]	120
Depth Averaged Density of subgrade in Space B. (Figure 3-1)[1]	110
Depth Averaged Density of subgrade in Space C. (Figure 3-1)[2]	120
Depth Averaged Density of subgrade in Space D. (Figure 3-1)[3]	120
Lower Bound Shear Wave Velocity in the Subgrade below the Support Foundation Pad (Figure 3-1 Space C & D), fps**	≥485
Lower Bound Shear Wave Velocity in the Subgrade laterally surrounding the ISFSI (Figure 3-1 Space B), fps**	≥450

* Applies to Support Foundation Pad and ISFSI Pad.

** Strain compatible effective shear wave velocities shall be computed using the guidance provided in Section 16 of the International Building Code, 2009 Edition. Users must account for potential variability in the subgrade shear wave velocity in accordance with Section 3.7.2 of NUREG-0800.

Notes:

1. A lower average density value may be used in shielding analysis per FSAR Chapter 5 for conservatism.
2. Not required for shielding.
3. This space will typically contain native soil. Not required for shielding.

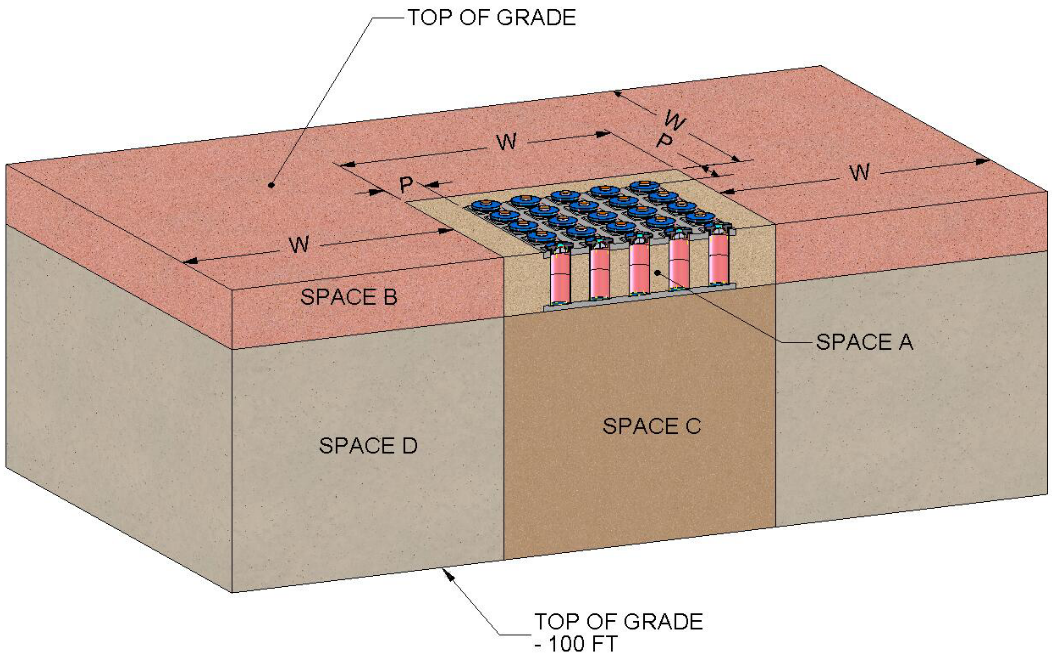

Figure 3-1 - SUBGRADE AND UNDERGRADE SPACE NOMENCLATURE

3.0 DESIGN FEATURES (continued)

3.5 Combustible Gas Monitoring During MPC Lid Welding and Cutting

During MPC lid-to-shell welding and cutting operations, combustible gas monitoring of the space under the MPC lid is required, to ensure that there is no combustible mixture present.

3.6 Periodic Corrosion Inspections for Underground Systems

HI-STORM UMAX VVM ISFSIs not employing an impressed current cathodic protection system shall be subject to visual and UT inspection of at least one representative VVM to check for significant corrosion of the CEC Container Shell and Bottom Plate at an interval not to exceed 20 years. The VVM chosen for inspection is not required to be in use or to have previously contained a loaded MPC. The VVM considered to be most vulnerable to corrosion degradation shall be selected for inspection. If significant corrosion is identified, either an evaluation to demonstrate sufficient continued structural integrity (sufficient for at least the remainder of the licensing period) shall be performed or the affected VVM shall be promptly scheduled for repair or decommissioning. Through wall corrosion shall not be permitted without promptly scheduling for repair or decommissioning. Promptness of repair or decommissioning shall be commensurate with the extent of degradation of the VVM but shall not exceed 3 years from the date of inspection.

If the representative VVM is determined to require repair or decommissioning, the next most vulnerable VVM shall be selected for inspection. This inspection process shall conclude when a VVM is found that does not require repair or decommissioning. Since the last VVM inspected is considered more prone to corrosion than the remaining un-inspected VVMs, the last VVM inspected becomes the representative VVM for the remaining VVMs.

Inspections

Visual Inspection: Visual inspection of the inner surfaces of the CEC Container Shell and Bottom Plate for indications of significant or through wall corrosion (i.e., holes).

UT Inspection: The UT inspection or an equivalent method shall be used to measure CEC shell wall thickness to determine the extent of metal loss from corrosion. A minimum of 16 data points shall be obtained, 4 near the top, 4 near the mid-height and 4 near the bottom of the CEC Container Shell all approximately 0, 90, 180, and 270 degrees apart; and 4 on the CEC Bottom Plate near the CEC Container Shell approximately 0, 90, 180, and 270 degrees apart. Locations where visual inspection has identified potentially significant corrosion shall also receive UT inspection. Locations suspected of significant corrosion may receive further UT inspection to determine the extent of corrosion.

Inspection Criteria

General wall thinning exceeding 1/8” in depth and local pitting exceeding 1/4" in depth are conditions of significant corrosion.