

PROPOSED CERTIFICATE OF COMPLIANCE NO. 1014

APPENDIX A

TECHNICAL SPECIFICATIONS

FOR THE HI-STORM 100 CASK SYSTEM

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
<p>SR 3.1.2 Verify all OVERPACK inlets and outlets are free of blockage from solid debris or floodwater.</p> <p><u>OR</u> For OVERPACKS with installed temperature monitoring equipment, verify that the difference between the average OVERPACK air outlet temperature and ISFSI ambient temperature is $\leq 155^{\circ}\text{F}$ for OVERPACKS containing PWR MPCs, $\leq 137^{\circ}\text{F}$ for OVERPACKS containing BWR MPCs (except MPC-68M) and $\leq 164^{\circ}\text{F}$ for OVERPACKS containing MPC-68M. For sites that have loaded in accordance with the Topical Report HI-2200343-A, verify that the difference between the average OVERPACK air outlet temperature and ISFSI ambient temperature is less than or equal to the value computed using the topical report methodology.</p>	<p>Table 3-5</p> <p>Table 3-5</p>

Table 3-1a
MPC Cavity Drying Limits for all MPC Types for VENTILATED OVERPACK ^{Note 9}

Fuel Burnup (MWD/MTU)	MPC Heat Load (kW)	Method of Moisture Removal (Notes 1, 2 and 3)
All Assemblies \leq 45,000	\leq 26 (MPC-24/24E/24EF, MPC-32/32F, MPC-68/68F/68FF)	VDS ^{Note 5} or FHD ^{Note 6}
	\leq 36.9 (MPC-68M) ^{Note 6}	VDS or FHD
	\leq 42.8 (MPC-68M) ^{Note 7}	VDS or FHD
All Assemblies \leq 45,000	\leq 36.9 (MPC-24/24E/24EF, MPC-32/32F, MPC-68/68F/68FF) ^{Note 6}	VDS ^{Note 8} or FHD
One or more assemblies $>$ 45,000	\leq 29 (MPC-68M)	VDS ^{Note 4}
One or more assemblies $>$ 45,000	\leq 36.9 (MPC-24/24E/24EF/MPC-32/32F/MPC-68/68F/68FF) ^{Note 6}	VDS ^{Note 8} or FHD
	\leq 36.9 (MPC-68M) ^{Note 6}	VDS ^{Note 8} or FHD
	\leq 42.8 (MPC-68M) ^{Note 7}	VDS ^{Note 8} or FHD

Notes:

- VDS means a vacuum drying system. The acceptance criterion when using a VDS is MPC cavity pressure shall be \leq 3 torr for \geq 30 minutes.
- FHD means a forced helium dehydration system. The acceptance criterion when using an FHD system is the gas temperature exiting the demoinsturizer shall be \leq 21°F for \geq 30 minutes or the gas dew point exiting the MPC shall be \leq 22.9°F for \geq 30 minutes.
- Vacuum drying of the system must be performed with the annular gap between the MPC and the TRANSFER CASK filled with water.
- The maximum allowable decay heat per fuel storage location is 0.426 kW.
- Maximum allowable storage cell heat load is 1.083 kW (MPC-24/24E/24EF), 0.812 kW (MPC-32/32F) and 0.382 kW (MPC-68/68F/68FF).
- Maximum per assembly allowable heat loads under uniform or regionalized storage defined in Appendix B, Section 2.4.1 or 2.4.2.
- Maximum per assembly allowable heat loads defined in Appendix B Figures 2.4-1 through 2.4-4.

MPC Helium Backfill Limits
Table 3-2

8. Vacuum drying of the MPC must be performed using cycles of the drying system, according to the guidance contained in ISG-11 Revision 3. The time limit for these cycles shall be determined based on site specific conditions. Applies when any one assembly heat load is greater than 0.426 kW.
9. Alternative heat load limits may be developed following the methodology in Topical Report HI-2200343-A, Revision 2. These patterns must have a total MPC heat load less than or equal to 50 kW. Dryness criteria are still as specified in Notes 1 or 2 as applicable to the selected drying process, and Note 3 still applies to vacuum drying.

Table 3-2a
MPC Helium Backfill Limits for VENTILATED OVERPACK^{Note 1,2}

MPC MODEL	LIMIT
MPC-24/24E/24EF	
i. Cask Heat Load ≤ 27.77 kW (MPC-24) or ≤ 28.17 kW (MPC-24E/EF) - uniformly distributed per Table 3-4 or regionalized loading per Table 3-3	0.1212 +/-10% g-moles/l <u>OR</u> ≥ 29.3 psig and ≤ 48.5 psig
ii. Cask Heat Load >27.77 kW (MPC-24) or > 28.17 kW (MPC-24E/EF) - uniformly distributed or greater than regionalized heat load limits per Table 3-3	≥ 45.5 psig and ≤ 48.5 psig
MPC-68/68F/68FF	
i. Cask Heat Load ≤ 28.19 kW - uniformly distributed per Table 3-4 or regionalized loading per Table 3-3	0.1218 +/-10% g-moles/l <u>OR</u> ≥ 29.3 psig and ≤ 48.5 psig
ii. Cask Heat Load > 28.19 kW - uniformly distributed or greater than regionalized heat load limits per Table 3-3	≥ 45.5 psig and ≤ 48.5 psig
MPC-32/32F	
i. Cask Heat Load ≤ 28.74 kW - uniformly distributed per Table 3-4 or regionalized loading per Table 3-3	≥ 29.3 psig and ≤ 48.5 psig
ii. Cask Heat Load >28.74 kW - uniformly distributed or greater than regionalized heat load limits per Table 3-3	≥ 45.5 psig and ≤ 48.5 psig
MPC-68M	
i. Cask Heat Load ≤ 28.19 kW - uniformly distributed per Table 3-4	0.1218 +/-10% g-moles/l

or regionalized loading per Table 3-3	OR ≥ 29.3 psig and ≤ 48.5 psig
ii. Cask Heat Load > 28.19 kW - uniformly distributed or greater than regionalized heat load limits per Table 3-3	≥ 45.5 psig and ≤ 48.5 psig
iii. Cask Heat Load ≤ 42.8 kW QSHL Loading Pattern shown in Appendix B, Figure 2.4-1	≥ 43.5 psig and ≤ 46.5 psig
QSHL patterns shown in Appendix B, Figures 2.4-2 through 2.4-4	≥ 45.5 psig and ≤ 48.5 psig

Notes

1. Helium used for backfill of MPC shall have a purity of $\geq 99.995\%$. Pressure range is at a reference temperature of 70°F
2. For heat load patterns developed in accordance with Table 3-1, Note 9, helium backfill limits shall be calculated in accordance with Topical Report HI-2200343-A Revision 2

Table 3-3: Regionalized Storage^{Note 2} Cell Heat Load Limits

MPC Type	Number of Cells in Inner Region ^{Note 1}	Storage Cell Heat Load (Inner Region) (kW)	Number of Cells in Outer Region ^{Note 1}	Storage Cell Heat Load (Outer Region) (kW)
MPC-24	4	1.470	20	0.900
MPC-24E/EF	4	1.540	20	0.900
MPC-32/32F	12	1.131	20	0.600
MPC-68/68F/68FF/68M	32	0.500	36	0.275

Note 1: The location of MPC-32 and MPC-68 inner and outer region cells are defined in Appendix B Figures 2.1-3 and 2.1-4 respectively.
The MPC-24 and MPC-24E/EF cell locations are defined below:
Inner Region Cell numbers 9, 10, 15, 16 in Appendix B Figures 2.1-1 and 2.1-2 respectively.
Outer Region Cell numbers 1-8, 11-14, 17-24 in Appendix B Figures 2.1-1 and 2.1-2 respectively.

Note 2: The storage cell regionalization is defined in Note 1 in accordance with safety analyses under the heat load limits of this Table. For heat load patterns developed in accordance with Table 3-1a, Note 9, these limits do not apply.

Table 3-4: Uniform Storage Cell Heat Load Limits

MPC Type	Heat Load (kW)
MPC-24	1.157
MPC-24E/EF	1.173
MPC-68/68F/68FF/68M	0.414
MPC-32	0.898

Note: For heat load patterns developed in accordance with Table 3-1a, Note 9, these limits do not apply.

LCO Completion Time Table 3-5

Table 3-5: Completion Time for Actions to Restore SFSC Heat Removal System Operable ^{Note 2}

MPC Material	MPC Type	Decay Heat Limits per Storage Location	Condition B Completion Time	Condition C Completion Time	Surveillance Frequency
Alloy X Except Duplex ¹	MPC-24/24E/24EF	Appendix B, Section 2.4	8 hrs	24 hrs	24 hrs
	MPC-32/32F				
	MPC-68/68F/68FF/68M				
	MPC-68M	Appendix B, Figures 2.4-1 through 2.4-4			
Alloy X	MPC-24/24E/24EF	Appendix B, Section 2.4	8 hrs	16 hrs	16 hrs
	MPC-32/32F				
	MPC-68/68F/68FF/68M				
Alloy X	MPC-68M	Appendix B, Figures 2.4-1 through 2.4-4	4 hrs	12 hrs	12 hrs
Alloy X Except Duplex ¹	MPC-24	Appendix A, Table 3-3 (Regionalized)	8 hrs	64 hrs	24 hrs
	MPC-24E/EF				
	MPC-32/32F	Appendix A, Table 3-4 (Uniform)			
	MPC-68/68F/68FF/68M				
Alloy X	MPC-24	Appendix A, Table 3-3 (Regionalized)	8 hrs	24 hrs	24 hrs
	MPC-24E/EF				
	MPC-32/32F	Appendix A, Table 3-4 (Uniform)			
	MPC-68/68F/68FF/68M				
Alloy X	MPC-24/24E/24EF	0.75 kW	24 hrs	64 hrs	30 days
	MPC-32/32F	0.5 kW			
	MPC-68/68F/68FF/68M	0.264 kW			

Note

1) If any component of the MPC is made of duplex, these completion times are not applicable.

2) For patterns developed in accordance with Table 3-1a, Note 9, alternative completion times shall be calculated in accordance with Topical Report HI-2200343-A Revision 2

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APPENDIX B

APPROVED CONTENTS AND DESIGN FEATURES

FOR THE HI-STORM 100 CASK SYSTEM

2.4.2 Regionalized Fuel Loading Decay Heat Limits for ZR-Clad Fuel for VENTILATED OVERPACK

The maximum allowable decay heat per fuel storage location for intact or undamaged fuel assemblies in regionalized loading is determined using the following equations:

$$Q(X) = 2 \times Q_0 / (1 + X^y)$$

$$y = 0.23 / X^{0.1}$$

$$q_2 = Q(X) / (n_1 \times X + n_2)$$

$$q_1 = q_2 \times X$$

Where:

Q_0 = Maximum uniform storage MPC decay heat (34 kW)

X = Inner region to outer region assembly decay heat ratio
($0.5 \leq X \leq 3$)

n_1 = Number of storage locations in inner region from Table 2.4-2.

n_2 = Number of storage locations in outer region from Table 2.4-2.

Allowable heat loads for Damaged Fuel and Fuel Debris in regionalized loading are shown in Table 2.4-5.

Optional loading patterns for MPC-68M are shown in Figures 2.4-1 through 2.4-4.

Alternatively to the heat load patterns in Sections 2.4.1 and 2.4.2, per cell allowable heat loads may be determined per Topical Report HI-2200343-A Revision 2.

2.4.3 Burnup Limits as a Function of Cooling Time for ZR-Clad Fuel for VENTILATED OVERPACK

The maximum allowable ZR-clad fuel assembly average burnup varies with the minimum required fuel assembly cooling time. Tables 2.4-3 and 2.4-4 provide for each MPC the allowable maximum burnup based on the assembly's particular cooling time. **These same limits apply for heat load patterns developed in accordance with the topical report, HI-2200343-A, Revision 2.**

- 2.4.3.1 Linear interpolation of burnups between cooling times is permitted. For example, the allowable burnup for a cooling time of 4.5 years may be interpolated between those burnups calculated for 4 year and 5 years.
- 2.4.3.2 Calculated burnup limits shall be rounded down to the nearest integer.
- 2.4.3.3 Calculated burnup limits greater than 68,200 MWD/MTU for PWR fuel and 65,000 MWD/MTU for BWR must be reduced to be equal to these values.

2.4.4 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.

2.4.5 Fuel Loading Decay Heat Limits for UNVENTILATED OVERPACK

Tables 2.4-6a and 2.4-6b provide the maximum allowable decay heat per fuel storage location for MPC-68M in an UNVENTILATED OVERPACK.

A minor deviation from the prescribed loading pattern in an MPC's permissible contents to allow one slightly thermally-discrepant fuel assembly per quadrant to be loaded as long as the peak cladding temperature for the MPC remains below the ISG-11 Rev 3 requirements is permitted for essential dry storage campaigns to support decommissioning.

2.4.6 Burnup and Cooling Time Qualifications for the MPC-68M for UNVENTILATED OVERPACK

The burnup and cooling time for every fuel loaded into the MPC-68M must satisfy the following equation:

$$Ct = A \cdot Bu^3 + B \cdot Bu^2 + C \cdot Bu + D$$

where,

Ct = Minimum cooling time (years),

Bu = Assembly-average burnup (MWd/mtU),

A, B, C, D= Polynomial coefficients listed in Table 2.4-9