

3.1 SFSC INTEGRITY

3.1.1 Multi-Purpose Canister (MPC)

LCO 3.1.1 The MPC shall be dry and helium filled.

Table 3-1 provides decay heat and burnup limits for forced helium dehydration (FHD) and vacuum drying. FHD is not subject to time limits. Vacuum drying of MPCs may be subject to time limits, from the end of bulk water removal until the start of helium backfill, as shown in Table 3-1.

APPLICABILITY: During TRANSPORT OPERATIONS and STORAGE OPERATIONS.

ACTIONS

NOTES

Separate Condition entry is allowed for each MPC.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. MPC cavity vacuum drying pressure or demohsturizer exit gas temperature limit not met.	A.1 Perform an engineering evaluation to determine the quantity of moisture left in the MPC.	7 days
	<p style="text-align: center;"><u>AND</u></p> A.2 Develop and initiate corrective actions necessary to return the MPC to compliance with Table 3-1.	30 days

SR 3.1.2	<p>Verify all OVERPACK inlets and outlets are free of blockage from solid debris or floodwater.</p> <p><u>OR</u></p> <p>For OVERPACKS with installed temperature monitoring equipment, verify that the difference between the average OVERPACK air outlet temperature and ISFSI ambient temperature is <math>\leq 155^{\circ}\text{F}</math> for OVERPACKS containing PWR MPCs, <math>\leq 137^{\circ}\text{F}</math> for OVERPACKS containing BWR MPCs (except MPC-68M) and <math>\leq 164^{\circ}\text{F}</math> for OVERPACKS containing MPC-68M.</p>	<p>Table 3-5</p> <p>Table 3-5</p>
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Table 3-1  
MPC Cavity Drying Limits for all MPC Types

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 <sup>Note 5</sup> or FHD <sup>Note 6</sup>
	$\leq 36.9$ (MPC-68M) <sup>Note 6</sup>	VDS or FHD
	$\leq 42.8$ (MPC-68M) <sup>Note 7</sup>	VDS or FHD
All Assemblies $\leq$ 45,000	$\leq 36.9$ (MPC-24/24E/24EF, MPC-32/32F, MPC-68/68F/68FF) <sup>Note 6</sup>	VDS <sup>Note 8</sup> or FHD
One or more assemblies $>$ 45,000	$\leq 29$ (MPC-68M)	VDS <sup>Note 4</sup>
One or more assemblies $>$ 45,000	$\leq 36.9$ (MPC-24/24E/24EF/MPC-32/32F/MPC-68/68F/68FF) <sup>Note 6</sup>	VDS <sup>Note 8</sup> or FHD
	$\leq 36.9$ (MPC-68M) <sup>Note 6</sup>	VDS <sup>Note 8</sup> or FHD
	$\leq 42.8$ (MPC-68M) <sup>Note 7</sup>	VDS <sup>Note 8</sup> 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 demister shall be  $\leq 21^\circ\text{F}$  for  $\geq 30$  minutes or the gas dew point exiting the MPC shall be  $\leq 22.9^\circ\text{F}$  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 Figure 2.4-1.

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.

Table 3-2  
MPC Helium Backfill Limits<sup>1</sup>

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

<sup>1</sup> Helium used for backfill of MPC shall have a purity of  $\geq 99.995\%$ . Pressure range is at a reference temperature of 70°F

**MPC-68M**

- |   |   |
|---|---|
| i. Cask Heat Load $\leq$ 28.19 kW -<br>uniformly distributed per Table 3-4<br>or<br>regionalized loading per Table 3-3          | 0.1218 +/-10% g-moles/l<br><u>OR</u><br>$\geq$ 29.3 psig and $\leq$ 48.5 psig |
| ii. Cask Heat Load $>$ 28.19 kW -<br>uniformly distributed<br>or<br>greater than regionalized heat load<br>limits per Table 3-3 | $\geq$ 45.5 psig and $\leq$ 48.5 psig   |
| iii. Cask Heat Load $\leq$ 42.8 kW<br>Regionalized Loading Pattern shown in<br>Appendix B, Figure 2.4-1                         | $\geq$ 43.5 psig and $\leq$ 46.5 psig   |

MPC Heat Load Limits  
Table 3-3

Table 3-5: Completion Time for Actions to Restore SFSC Heat Removal System Operable

MPC Material	MPC Type	Decay Heat Limits per Storage Location	Condition B Completion Time	Condition C Completion Time	Surveillance Frequency
Alloy X Except Duplex <sup>1</sup>	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, Figure 2.4-1			
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, Figure 2.4-1	4 hrs	12 hrs	12 hrs
Alloy X Except Duplex <sup>1</sup>	MPC-24	Appendix A, Table 3-3 (Regionalized)	8 hrs	64 hrs	24 hrs
	MPC-24E/EF	OR			
	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	OR			
	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.

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## 2.0 Approved Contents

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### 2.1 Fuel Specifications and Loading Conditions (cont'd)

#### 2.1.3 Regionalized Fuel Loading

Users may choose to store fuel using regionalized loading in lieu of uniform loading to allow higher heat emitting fuel assemblies to be stored than would otherwise be able to be stored using uniform loading. Figures 2.1-1 through 2.1-4 define the regions for the MPC-24, MPC-24E, MPC-24EF, MPC-32, MPC-32F, MPC-68, MPC-68FF, and MPC-68M models, respectively<sup>1</sup>. Fuel assembly decay heat limits for regionalized loading are specified in Section 2.4.2. Fuel assemblies used in regionalized loading 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.

### 2.3 Not Used

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<sup>1</sup> These figures are only intended to distinguish the fuel loading regions. Other details of the basket design are illustrative and may not reflect the actual basket design details. The design drawings should be consulted for basket design details.

## 2.4.2 Regionalized Fuel Loading Decay Heat Limits for ZR-Clad Fuel

The maximum allowable decay heat per fuel storage location for **intact 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.

An optional regionalized loading pattern for MPC-68M is shown in Figure 2.4-1.

Table 2.4-2  
Fuel Storage Regions per MPC

MPC Model	Number of Storage Locations in Inner Region (Region 1)	Number of Storage Locations in Outer Region (Region 2)
MPC-24 and MPC-24E/EF	12	12
MPC- 32/32F	12	20
MPC-68/68FF/68M <sup>Note 1</sup>	32	36

Note 1: For an optional regionalized loading pattern for MPC-68M, see Figure 2.4-1

Table 2.4-5

Allowable Heat Load for Damaged Fuel Assemblies and Fuel Debris under Regionalized Loading

MPC Model	Maximum Per Cell Allowable Heat Load for Damaged Fuel Assemblies and Fuel Debris <sup>Note 1</sup>
MPC-24E/24EF	$0.75 \cdot q_2$
MPC- 32/32F	$0.65 \cdot q_2$
MPC-68/68FF/68M <sup>Note 2</sup>	$0.75 \cdot q_2$

Note 1:  $q_2$  is the maximum permissible heat load in Region 2 for intact fuel assemblies.

Note 2: An optional regionalized loading pattern for MPC-68M including Damaged Fuel and Fuel Debris is shown in Figure 2.4-1

### 2.4.3 Burnup Limits as a Function of Cooling Time

The maximum allowable fuel assembly average burnup varies with the following parameters:

- Minimum fuel assembly cooling time
- Maximum fuel assembly decay heat
- Minimum fuel assembly average enrichment

The maximum allowable ZR-clad fuel assembly average burnup for a given MINIMUM ENRICHMENT is calculated as described below for minimum cooling times between 2 and 40 years using the maximum permissible decay heat determined in Section 2.4.1 or 2.4.2. Different fuel assembly average burnup limits may be calculated for different minimum enrichments (by individual fuel assembly) for use in choosing the fuel assemblies to be loaded into a given MPC.

2.4.3.1 Choose a fuel assembly minimum enrichment,  $E_{235}$ .

2.4.3.2 Calculate the maximum allowable fuel assembly average burnup for a minimum cooling time between 2 and 40 years using the equation below.

$$Bu = (A \times q) + (B \times q^2) + (C \times q^3) + [D \times (E_{235})^2] + (E \times q \times E_{235}) + (F \times q^2 \times E_{235}) + G$$

Where:

Bu = Maximum allowable average burnup per fuel assembly (MWD/MTU)

q = Maximum allowable decay heat per fuel storage location determined in Section 2.4.1 or 2.4.2 (kW)

$E_{235}$  = Minimum fuel assembly average enrichment (wt. %  $^{235}\text{U}$ ) (e.g., for 4.05 wt.%, use 4.05)

A through G = Coefficients from Tables 2.4-3 and 2.4-4 for the applicable fuel assembly array/class and minimum cooling time

2.4.3.3 Calculated burnup limits shall be rounded down to the nearest integer.

2.4.3.4 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.

2.4.3.5 Linear interpolation of calculated burnups between cooling times for a given fuel assembly maximum decay heat and minimum enrichment 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.

2.4.3.6 Each ZR-clad fuel assembly to be stored must have a MINIMUM ENRICHMENT greater than or equal to the value used in Step 2.4.3.2.

- 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.

Table 2.4-3 (Page 1 of 8)  
PWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 14x14A						
	A	B	C	D	E	F	G
2.0	8716.89	1454.67	-91.96	-168.45	2047.50	-209.91	-738.51
2.25	10917.50	1441.49	-112.76	-162.14	2274.96	-266.46	-788.45
2.5	13452.90	1258.44	-119.69	-154.08	2491.83	-329.35	-760.18
2.75	16326.90	847.56	-100.72	-146.46	2680.07	-390.55	-727.50
3.0	19310.30	276.56	-59.30	-139.52	2851.81	-452.00	-614.85
4.0	33007.90	-4711.82	663.64	-117.16	3291.32	-622.31	-338.63
5.0	46306.70	-12448.80	2292.51	-113.20	3504.56	-662.41	-73.12
6.0	57461.80	-20693.50	4405.17	-121.14	3633.52	-614.82	1.66
7.0	66450.10	-28314.10	6635.00	-129.61	3706.00	-510.84	-113.74
8.0	73652.70	-34919.90	8759.36	-136.91	3752.43	-391.36	-311.56
9.0	79378.80	-40316.60	10606.30	-141.55	3784.66	-280.29	-485.97
10.0	84125.10	-44860.80	12239.70	-143.00	3777.62	-152.58	-635.70
11.0	88066.60	-48540.60	13594.30	-142.74	3758.54	-33.78	-726.86
12.0	91416.80	-51619.90	14789.00	-141.31	3742.31	64.80	-833.14
13.0	94657.90	-54579.30	15916.70	-137.14	3652.04	215.05	-967.41
14.0	97332.40	-56854.80	16823.50	-133.83	3610.21	315.79	-959.48
15.0	99866.10	-58816.70	17560.80	-128.68	3529.41	430.14	-991.32
16.0	102093.00	-60412.40	18171.30	-124.64	3469.67	535.07	-1078.73
17.0	104419.00	-62150.90	18846.80	-118.62	3363.97	674.13	-1092.27
18.0	106439.00	-63357.20	19259.50	-114.31	3300.43	769.38	-1137.26
19.0	108613.00	-64655.80	19660.70	-107.71	3182.61	904.63	-1084.05
20.0	110475.00	-65506.20	19883.50	-103.32	3125.81	988.08	-1062.86
22.0	114223.00	-66854.40	19969.00	-91.34	2899.19	1260.81	-1076.58
24.0	117822.00	-67556.70	19641.80	-79.56	2684.32	1499.23	-1011.23
26.0	121396.00	-67752.70	18783.80	-68.61	2465.91	1753.65	-940.82
28.0	125040.00	-67445.30	17353.90	-55.51	2184.99	2059.27	-883.36
30.0	128075.00	-65562.60	14994.70	-45.58	2003.10	2244.12	-819.25
35.0	136419.00	-58633.40	6027.48	-15.81	1354.94	2757.84	-687.83
40.0	144776.00	-48670.50	-4898.54	5.02	1019.97	2652.57	-507.64

Table 2.4-3 (Page 2 of 8)  
PWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 14x14B						
	A	B	C	D	E	F	G
2.0	7962.04	1332.84	-83.96	-165.28	1836.65	-176.15	-859.65
2.25	10055.50	1296.32	-100.51	-156.80	2012.11	-217.67	-907.11
2.5	12332.50	1153.20	-110.56	-149.42	2185.46	-264.52	-845.06
2.75	15072.80	715.71	-82.42	-140.68	2336.22	-310.64	-833.26
3.0	18034.30	64.77	-24.88	-130.87	2450.80	-348.00	-857.34
4.0	30007.50	-4046.37	538.96	-110.22	2792.92	-469.98	-371.81
5.0	41033.00	-9824.17	1644.13	-108.10	2979.87	-509.22	122.91
6.0	50398.10	-16082.00	3115.79	-113.75	3084.72	-485.25	117.44
7.0	57782.60	-21657.00	4602.39	-121.19	3161.16	-433.49	-112.57
8.0	63670.20	-26431.00	6006.16	-127.70	3227.81	-382.20	-74.84
9.0	68390.50	-30359.70	7246.09	-131.82	3277.23	-336.08	-200.60
10.0	72284.50	-33630.50	8335.68	-132.71	3293.15	-279.98	-291.73
11.0	75584.30	-36387.10	9298.07	-132.38	3295.07	-227.50	-340.65
12.0	78425.20	-38681.30	10125.90	-130.36	3283.13	-176.12	-462.22
13.0	80928.60	-40624.70	10848.10	-127.28	3259.89	-127.73	-563.09
14.0	83136.90	-42279.70	11500.20	-124.50	3249.69	-97.40	-565.79
15.0	85398.00	-44023.70	12192.30	-119.64	3186.24	-30.11	-665.54
16.0	87257.50	-45137.70	12617.40	-113.94	3127.01	22.40	-678.95
17.0	89196.20	-46520.30	13209.90	-110.27	3091.45	63.17	-713.69
18.0	90991.80	-47570.50	13623.80	-104.55	3008.16	136.69	-772.63
19.0	92591.90	-48339.00	13957.70	-99.63	2967.34	161.34	-697.42
20.0	94285.30	-49165.00	14265.20	-93.25	2875.59	235.94	-721.92
22.0	97593.80	-50692.00	14904.40	-82.77	2745.24	324.79	-695.61
24.0	100677.00	-51565.30	15201.30	-71.53	2596.73	409.91	-701.93
26.0	103715.00	-52185.40	15380.80	-60.88	2445.30	499.31	-581.96
28.0	106669.00	-52197.30	15136.20	-49.42	2276.34	582.57	-547.22
30.0	109832.00	-52431.30	15114.20	-38.14	2103.73	641.34	-544.99
35.0	116933.00	-49435.10	12742.20	-10.82	1691.80	667.30	-388.35
40.0	123932.00	-43775.70	9268.80	15.25	1356.03	327.73	-339.10

Table 2.4-3 (Page 3 of 8)  
PWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 14x14C						
	A	B	C	D	E	F	G
2.0	7910.49	1566.52	-112.06	-173.92	1975.67	-202.57	-1582.61
2.25	10090.40	1516.08	-132.53	-164.22	2144.71	-245.91	-1586.24
2.5	12672.30	1230.85	-127.98	-154.40	2293.68	-288.88	-1526.05
2.75	15404.70	785.48	-103.88	-146.02	2435.58	-333.58	-1526.92
3.0	18263.20	174.52	-57.73	-138.13	2539.97	-369.83	-1372.54
4.0	30052.40	-3931.93	484.14	-116.91	2815.30	-467.36	-710.84
5.0	40995.00	-9796.91	1583.72	-113.09	2900.21	-451.56	-204.87
6.0	49804.50	-15620.10	2905.31	-119.64	2970.21	-399.85	-228.44
7.0	56671.50	-20724.30	4228.04	-129.87	3058.54	-347.83	-244.26
8.0	62114.70	-24957.40	5410.68	-135.49	3080.42	-267.82	-216.83
9.0	66532.70	-28492.00	6458.64	-138.92	3102.21	-196.64	-343.21
10.0	70257.00	-31538.30	7424.54	-139.96	3109.64	-131.37	-466.58
11.0	73240.40	-33856.10	8182.60	-139.49	3113.36	-77.52	-528.62
12.0	75830.10	-35829.20	8857.54	-137.30	3097.43	-23.81	-597.83
13.0	78304.00	-37697.30	9499.38	-132.64	3034.49	60.52	-690.28
14.0	80401.00	-39162.40	10022.20	-129.04	3004.11	112.39	-819.41
15.0	82413.50	-40565.20	10547.80	-125.00	2972.01	159.60	-815.35
16.0	84138.60	-41575.10	10920.50	-121.03	2935.91	206.01	-844.59
17.0	85994.20	-42654.40	11295.20	-113.82	2848.12	279.72	-924.47
18.0	87721.10	-43657.50	11664.00	-108.56	2775.07	353.35	-960.97
19.0	89122.20	-44109.80	11806.40	-103.94	2740.54	384.66	-864.21
20.0	90678.60	-44723.70	11996.00	-97.44	2648.86	459.77	-907.84
22.0	93894.70	-46071.00	12444.30	-85.57	2487.47	593.03	-912.09
24.0	96742.60	-46597.20	12482.60	-75.19	2358.14	688.79	-833.76
26.0	99697.50	-47055.90	12472.30	-63.23	2185.39	810.10	-803.84
28.0	102343.00	-46639.70	11970.90	-52.13	2038.03	893.63	-704.66
30.0	105173.00	-46148.00	11326.10	-41.21	1856.73	1002.71	-620.51
35.0	111963.00	-42828.60	8640.91	-13.96	1473.64	1063.44	-455.86
40.0	118574.00	-36526.50	4330.66	12.00	1111.29	892.32	-351.40



Table 2.4-3 (Page 4 of 8)  
PWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 15x15A/B/C						
	A	B	C	D	E	F	G
2.0	6771.99	897.63	-45.95	-155.96	1478.91	-112.57	-571.21
2.25	8543.84	862.70	-53.16	-148.35	1638.47	-142.90	-603.00
2.5	10454.10	757.88	-56.51	-143.91	1802.08	-178.39	-613.38
2.75	12589.40	536.75	-50.58	-136.31	1939.28	-212.48	-598.75
3.0	15043.50	106.18	-18.51	-127.37	2049.65	-242.76	-584.58
4.0	25256.40	-2809.40	320.40	-108.47	2382.23	-339.78	-246.30
5.0	34995.70	-7157.77	1037.70	-104.27	2547.85	-373.57	64.26
6.0	43079.90	-11755.40	1968.81	-110.42	2669.55	-367.08	207.73
7.0	49495.50	-15880.10	2915.99	-117.70	2745.06	-335.00	79.17
8.0	54674.20	-19541.50	3863.26	-124.97	2823.26	-307.52	-139.52
9.0	58746.90	-22465.30	4666.71	-128.88	2870.36	-274.05	-284.74
10.0	62159.00	-24900.00	5358.04	-129.81	2882.28	-231.65	-307.41
11.0	64980.00	-26916.40	5974.92	-128.99	2890.02	-197.70	-320.91
12.0	67449.80	-28657.30	6533.20	-126.96	2889.14	-168.72	-358.64
13.0	69587.80	-30096.10	7005.49	-125.03	2881.70	-138.49	-417.57
14.0	71617.00	-31412.90	7443.05	-120.37	2839.04	-95.47	-497.72
15.0	73320.90	-32442.90	7811.27	-117.59	2836.73	-78.55	-582.44
16.0	75078.70	-33504.10	8184.69	-111.70	2773.08	-28.70	-569.58
17.0	76605.90	-34256.30	8446.38	-106.43	2722.31	10.58	-648.37
18.0	78201.90	-35135.30	8779.71	-102.00	2687.99	34.04	-637.10
19.0	79683.00	-35825.50	9024.65	-96.68	2626.60	78.21	-644.17
20.0	81040.00	-36264.40	9175.96	-90.42	2571.71	105.53	-621.79
22.0	83842.80	-37347.80	9582.93	-79.77	2452.81	179.87	-678.83
24.0	86457.20	-37934.30	9779.99	-69.09	2348.63	223.29	-555.43
26.0	89143.70	-38488.40	9965.70	-58.22	2222.80	276.21	-541.65
28.0	91552.10	-38289.80	9775.89	-47.03	2083.59	328.54	-483.47
30.0	93976.80	-37775.30	9380.97	-35.17	1933.91	367.06	-412.13
35.0	99743.70	-35109.80	7937.17	-10.10	1701.23	242.55	-292.95
40.0	105747.00	-30710.40	5734.70	16.14	1409.70	-19.63	-330.25

Table 2.4-3 (Page 5 of 8)  
PWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 15x15D/E/F/H/I						
	A	B	C	D	E	F	G
2.0	6290.79	883.39	-49.29	-150.42	1348.67	-93.23	-194.84
2.25	7850.16	906.09	-62.37	-145.85	1507.07	-121.33	-234.20
2.5	9917.64	729.63	-57.61	-138.51	1649.34	-150.19	-389.61
2.75	12039.70	498.88	-50.28	-132.19	1776.46	-179.02	-384.86
3.0	14308.20	140.88	-27.37	-126.11	1896.47	-208.80	-424.35
4.0	24246.40	-2585.64	274.38	-105.96	2197.31	-292.15	-98.88
5.0	33660.00	-6672.88	931.23	-104.57	2380.99	-330.06	323.27
6.0	41534.90	-11039.20	1790.84	-111.20	2485.37	-318.04	436.06
7.0	47737.40	-14940.00	2668.46	-119.75	2572.84	-293.94	394.87
8.0	52510.40	-18097.60	3446.19	-126.75	2647.38	-274.16	310.51
9.0	56484.50	-20845.30	4162.00	-129.08	2662.71	-225.75	158.84
10.0	59692.00	-23093.90	4799.05	-130.53	2692.07	-199.57	18.86
11.0	62307.70	-24865.90	5320.34	-130.34	2710.88	-176.52	-96.66
12.0	64497.20	-26247.00	5725.38	-127.89	2691.98	-137.42	-152.99
13.0	66473.70	-27479.90	6111.71	-124.64	2678.39	-110.34	-220.62
14.0	68322.50	-28605.10	6471.87	-120.12	2648.26	-78.83	-317.16
15.0	69880.10	-29416.90	6732.96	-115.83	2620.06	-52.26	-351.02
16.0	71504.30	-30337.40	7046.36	-110.89	2583.27	-22.60	-386.91
17.0	72938.30	-31008.00	7269.02	-105.81	2541.55	5.22	-421.21
18.0	74306.50	-31601.90	7471.26	-100.67	2498.95	31.67	-421.69
19.0	75649.10	-32149.50	7661.36	-95.47	2449.77	61.38	-439.23
20.0	76868.40	-32525.30	7793.09	-90.99	2421.09	73.14	-450.75
22.0	79592.40	-33604.00	8197.86	-78.90	2293.07	142.14	-486.11
24.0	81996.10	-34015.70	8295.91	-67.98	2173.93	196.55	-435.49
26.0	84232.50	-34067.60	8271.85	-57.61	2083.11	215.81	-374.64
28.0	86620.60	-34049.50	8171.94	-45.82	1954.61	249.73	-400.41
30.0	88983.60	-33826.80	8026.95	-34.27	1835.41	255.33	-353.18
35.0	94579.10	-31817.80	7120.43	-8.81	1596.94	131.34	-263.56
40.0	100058.00	-27653.80	5318.64	17.12	1355.45	-187.62	-273.88

Table 2.4-3 (Page 6 of 8)  
PWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 16x16A						
	A	B	C	D	E	F	G
2.0	7213.94	1062.48	-60.18	-163.16	1632.73	-137.39	-660.90
2.25	9068.86	1052.65	-73.90	-157.12	1812.61	-174.53	-682.57
2.5	11282.40	881.74	-74.10	-149.28	1970.43	-212.23	-710.99
2.75	13602.30	625.18	-68.06	-143.44	2124.68	-253.65	-734.52
3.0	16226.30	143.97	-32.51	-136.73	2255.52	-291.73	-699.79
4.0	27528.60	-3346.42	393.54	-115.66	2587.71	-397.43	-273.55
5.0	38357.70	-8605.59	1312.06	-110.58	2719.25	-409.35	60.77
6.0	47353.00	-14184.20	2511.45	-117.96	2810.98	-373.58	26.38
7.0	54492.70	-19227.40	3751.22	-126.74	2889.14	-321.58	-84.61
8.0	60159.30	-23487.00	4884.62	-133.44	2918.29	-242.53	-126.66
9.0	64663.30	-26994.20	5900.01	-137.02	2946.64	-181.25	-285.69
10.0	68346.00	-29851.40	6755.60	-138.49	2958.18	-120.30	-384.11
11.0	71361.10	-32184.10	7502.54	-138.40	2964.72	-68.91	-497.04
12.0	74014.20	-34136.30	8127.59	-135.73	2938.32	-7.78	-627.98
13.0	76326.40	-35820.10	8697.58	-132.72	2908.57	49.64	-715.32
14.0	78450.30	-37288.70	9197.21	-128.85	2871.70	104.32	-771.96
15.0	80439.10	-38636.00	9667.15	-124.14	2815.86	168.64	-851.14
16.0	82142.00	-39610.20	10013.20	-120.20	2790.66	203.72	-859.48
17.0	83886.70	-40590.10	10336.30	-114.04	2714.78	270.50	-870.62
18.0	85580.90	-41545.60	10677.80	-108.53	2648.66	332.69	-921.15
19.0	87028.10	-42030.60	10787.80	-102.57	2576.39	390.15	-880.17
20.0	88490.60	-42584.60	10956.70	-97.67	2529.96	430.91	-912.08
22.0	91586.50	-43770.60	11272.60	-85.21	2343.82	579.90	-878.01
24.0	94293.80	-44158.40	11248.70	-74.44	2224.40	656.22	-824.58
26.0	97086.50	-44420.30	11078.90	-62.82	2045.62	784.53	-737.98
28.0	99965.10	-44515.00	10777.60	-51.29	1871.32	897.77	-719.30
30.0	102352.00	-43418.60	9831.79	-40.46	1725.50	957.49	-626.62
35.0	109039.00	-40353.50	7075.81	-12.07	1286.03	1106.60	-531.72
40.0	115345.00	-34020.20	2448.15	13.49	928.92	963.44	-395.64

Table 2.4-3 (Page 7 of 8)  
PWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 17x17A, 16x16B/C						
	A	B	C	D	E	F	G
2.0	7482.84	749.18	-32.06	-153.69	1490.54	-111.64	-301.94
2.25	9138.06	783.14	-45.73	-148.43	1678.27	-147.42	-271.38
2.5	11115.90	682.88	-49.46	-143.38	1855.10	-184.65	-248.90
2.75	13492.40	392.81	-34.32	-137.63	2018.42	-224.60	-364.95
3.0	15985.10	3.54	-9.05	-128.84	2149.50	-260.42	-263.00
4.0	27326.30	-3316.13	388.73	-110.89	2545.62	-376.10	-60.44
5.0	38630.20	-8729.17	1335.65	-109.86	2754.84	-407.49	244.70
6.0	48364.20	-14788.30	2652.90	-117.55	2878.88	-375.72	252.15
7.0	56144.10	-20415.70	4068.96	-128.12	2970.68	-312.43	-145.42
8.0	62319.20	-25122.10	5332.37	-133.94	2986.20	-212.65	-192.32
9.0	67097.40	-28916.30	6441.26	-139.07	3028.70	-142.12	-304.90
10.0	71141.80	-32210.80	7461.17	-140.60	3037.68	-63.75	-484.40
11.0	74293.50	-34623.40	8214.63	-140.16	3026.35	11.71	-567.89
12.0	77101.60	-36783.10	8922.19	-138.37	3008.48	83.17	-677.97
13.0	79705.10	-38760.90	9576.13	-134.21	2949.33	173.71	-820.83
14.0	81840.20	-40208.40	10063.30	-130.61	2915.99	236.79	-867.80
15.0	83845.30	-41560.10	10535.80	-126.12	2867.51	306.60	-940.08
16.0	85751.10	-42671.70	10876.60	-120.77	2799.15	386.28	-990.12
17.0	87613.20	-43744.30	11214.60	-114.75	2722.88	466.15	-1028.96
18.0	89198.60	-44487.50	11451.40	-110.00	2673.61	522.32	-974.28
19.0	90843.80	-45204.50	11637.70	-103.89	2591.93	602.99	-1048.14
20.0	92361.20	-45701.20	11710.50	-98.45	2507.40	689.65	-1034.50
22.0	95455.20	-46715.70	11886.10	-86.86	2353.10	835.28	-1006.44
24.0	98319.40	-46988.20	11622.80	-74.63	2169.86	995.06	-941.81
26.0	101240.00	-47039.80	11136.00	-62.32	1971.79	1168.97	-907.73
28.0	103863.00	-46243.10	10186.30	-51.51	1822.28	1270.39	-758.20
30.0	106638.00	-45299.90	9011.04	-39.38	1598.42	1447.93	-698.69
35.0	113059.00	-40056.10	4113.55	-12.17	1169.02	1660.44	-557.52
40.0	119131.00	-30799.70	-3521.78	14.35	791.94	1564.09	-401.82

Table 2.4-3 (Page 8 of 8)  
PWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 17x17B/C						
	A	B	C	D	E	F	G
2.0	6766.33	744.89	-33.96	-154.11	1387.05	-99.30	-455.94
2.25	8406.78	735.84	-42.13	-148.76	1546.40	-127.76	-412.22
2.5	10326.00	618.40	-42.67	-140.84	1696.17	-158.83	-428.21
2.75	12425.70	400.95	-35.11	-134.79	1833.92	-190.65	-448.69
3.0	14787.40	16.36	-8.09	-128.41	1953.16	-221.24	-426.08
4.0	25076.00	-2855.35	319.19	-107.73	2268.19	-307.82	-118.54
5.0	34842.80	-7144.52	1015.11	-107.42	2457.65	-342.14	294.08
6.0	43259.40	-11920.40	1970.81	-113.08	2547.52	-316.78	82.08
7.0	49884.40	-16230.60	2962.56	-122.92	2650.94	-291.11	127.95
8.0	55105.20	-19804.80	3845.74	-128.64	2682.52	-232.47	-61.87
9.0	59268.90	-22820.00	4674.45	-133.56	2742.72	-203.91	-265.03
10.0	62653.20	-25227.80	5347.65	-134.19	2744.28	-150.34	-229.28
11.0	65528.50	-27328.80	5990.85	-134.07	2759.67	-117.12	-349.73
12.0	67925.00	-28930.10	6470.25	-131.66	2738.04	-69.75	-467.93
13.0	70014.00	-30295.30	6903.21	-128.41	2714.49	-27.74	-580.42
14.0	71939.40	-31542.90	7318.09	-124.70	2688.09	8.93	-630.83
15.0	73678.50	-32578.30	7669.57	-120.41	2659.19	41.04	-637.54
16.0	75313.80	-33488.20	7973.96	-115.46	2610.74	86.53	-708.01
17.0	76870.20	-34276.40	8238.11	-110.15	2563.22	123.29	-739.52
18.0	78338.30	-34971.50	8477.60	-104.26	2505.00	166.49	-731.14
19.0	79849.90	-35703.80	8726.57	-99.14	2447.13	211.29	-756.38
20.0	81109.20	-36047.10	8827.48	-93.99	2404.21	235.46	-751.74
22.0	83793.40	-36898.90	9088.73	-82.74	2281.57	313.80	-704.73
24.0	86424.70	-37453.70	9205.18	-70.11	2134.35	393.96	-654.44
26.0	88971.30	-37671.00	9134.01	-58.64	1983.82	478.46	-659.93
28.0	91497.60	-37723.60	9032.79	-47.61	1861.20	520.75	-564.47
30.0	93706.20	-36961.70	8512.11	-37.17	1743.83	543.52	-523.93
35.0	99798.50	-34670.70	6911.55	-9.53	1376.43	593.61	-406.67
40.0	105384.00	-29185.20	3708.34	16.92	1086.25	354.06	-343.59

Table 2.4-4 (Page 1 of 10)  
BWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 7x7B, 10x10F						
	A	B	C	D	E	F	G
2.0	15761.10	10171.40	-1983.74	-180.41	4533.44	-1035.69	-1020.71
2.25	20683.90	10100.50	-2362.96	-171.37	4924.21	-1259.16	-1149.28
2.5	25710.50	9847.51	-2788.08	-162.18	5329.88	-1548.05	-1048.31
2.75	31858.60	7767.18	-2661.83	-154.93	5675.76	-1804.31	-992.87
3.0	38703.40	4333.22	-2101.88	-144.94	5898.42	-1990.59	-1030.87
4.0	65948.40	-16991.70	3924.57	-118.43	6390.16	-2406.62	-614.30
5.0	90881.20	-47264.90	16771.40	-112.75	6498.93	-2241.12	-192.49
6.0	111776.00	-79261.50	33399.20	-115.32	6416.04	-1620.07	-84.57
7.0	127348.00	-107023.00	50534.70	-139.25	6848.43	-1458.29	-14.89
8.0	140072.00	-130028.00	65223.10	-144.93	6836.24	-857.79	-99.75
9.0	150749.00	-150213.00	79005.50	-147.77	6773.51	-231.87	-331.15
10.0	158943.00	-167178.00	92612.70	-164.66	7287.36	-461.83	-382.12
11.0	165714.00	-179168.00	101557.00	-164.07	7241.92	-45.10	-521.50
12.0	171975.00	-190727.00	110548.00	-161.09	7166.19	380.43	-589.16
13.0	177624.00	-200947.00	118921.00	-158.82	7131.17	664.17	-667.75
14.0	182802.00	-210117.00	126526.00	-154.60	7016.50	1083.45	-747.88
15.0	186884.00	-214518.00	128584.00	-147.82	6809.36	1591.41	-783.35
16.0	191316.00	-221293.00	134071.00	-142.04	6646.92	2019.29	-841.16
17.0	195369.00	-231600.00	147624.00	-158.43	7404.40	946.55	-820.02
18.0	199404.00	-236224.00	150408.00	-148.69	7053.70	1655.35	-883.27
19.0	203726.00	-243272.00	157476.00	-143.31	6936.71	1903.09	-895.71
20.0	206861.00	-245479.00	159023.00	-137.13	6829.41	2091.47	-903.40
22.0	213325.00	-250875.00	163825.00	-127.55	6623.17	2500.20	-800.98
24.0	220063.00	-255065.00	166460.00	-114.40	6330.37	2896.83	-803.85
26.0	226903.00	-262541.00	177379.00	-115.77	6627.51	2189.72	-651.65
28.0	234964.00	-270961.00	187677.00	-102.37	6255.46	2595.08	-735.34
30.0	241796.00	-272482.00	188002.00	-88.80	5779.54	3315.93	-731.24
35.0	257457.00	-265751.00	183333.00	-71.68	5676.93	1648.24	-511.23
40.0	282525.00	-292276.00	240288.00	-43.47	4948.25	152.96	-833.96

Table 2.4-4 (Page 2 of 10)  
BWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 8x8B						
	A	B	C	D	E	F	G
2.0	15913.80	11664.70	-2480.99	-179.56	4694.73	-1100.00	-1003.87
2.25	20652.00	12023.80	-3025.66	-174.12	5204.92	-1412.29	-979.17
2.5	26986.10	10399.30	-3032.60	-163.94	5594.88	-1694.85	-1213.71
2.75	33074.30	8670.65	-3129.69	-156.84	5959.94	-1975.74	-1054.90
3.0	39987.50	5388.94	-2722.03	-146.15	6189.85	-2184.18	-1039.58
4.0	68821.60	-18071.10	4016.97	-119.21	6655.64	-2578.72	-677.77
5.0	95032.70	-50959.00	18228.50	-113.67	6737.08	-2341.46	-253.74
6.0	117864.00	-88879.60	39468.80	-128.75	6937.68	-1918.61	-203.01
7.0	133919.00	-117151.00	56431.30	-139.69	6960.80	-1212.83	-123.38
8.0	147621.00	-142952.00	73246.80	-143.67	6879.18	-441.73	-342.11
9.0	158036.00	-165478.00	90946.70	-167.32	7480.35	-551.45	-378.22
10.0	166796.00	-181378.00	101771.00	-165.98	7346.03	114.50	-504.04
11.0	174312.00	-195869.00	112810.00	-165.26	7291.07	642.48	-648.03
12.0	180736.00	-207916.00	122412.00	-163.34	7243.01	1055.04	-742.81
13.0	187002.00	-219945.00	132127.00	-159.70	7084.08	1641.84	-903.88
14.0	192382.00	-229413.00	139613.00	-156.32	7001.62	2085.84	-972.60
15.0	196087.00	-233618.00	142299.00	-151.48	6860.06	2570.55	-883.73
16.0	202268.00	-249608.00	159974.00	-162.80	7359.57	1999.93	-1048.13
17.0	206376.00	-256109.00	166401.00	-159.20	7309.03	2257.68	-1062.93
18.0	209117.00	-255071.00	162389.00	-151.82	7125.28	2596.49	-891.61
19.0	213124.00	-261295.00	168674.00	-146.82	7004.96	2966.11	-951.40
20.0	217047.00	-267281.00	175609.00	-141.96	6943.62	3118.99	-1012.59
22.0	223569.00	-268761.00	171389.00	-127.42	6436.52	4175.11	-877.23
24.0	233533.00	-291046.00	200512.00	-131.73	6830.33	3613.57	-988.74
26.0	238557.00	-284966.00	188216.00	-118.63	6424.02	4316.86	-862.50
28.0	245385.00	-285588.00	185055.00	-105.51	6116.61	4651.69	-844.39
30.0	254559.00	-295608.00	196106.00	-100.36	6027.39	4465.31	-886.90
35.0	272231.00	-295589.00	203313.00	-71.05	5259.94	4464.18	-744.47
40.0	290782.00	-286198.00	204311.00	-50.38	4868.38	2364.75	-614.59

Table 2.4-4 (Page 3 of 10)  
BWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 8x8C/D/E						
	A	B	C	D	E	F	G
2.0	16663.00	10889.80	-2211.52	-182.17	4831.25	-1175.27	-1260.49
2.25	21598.90	10980.20	-2691.18	-176.65	5300.72	-1453.46	-1219.04
2.5	27348.40	10071.30	-2967.33	-165.41	5680.31	-1735.86	-1252.79
2.75	33467.10	8232.39	-2999.52	-158.56	6061.56	-2033.93	-1086.98
3.0	40382.30	4849.42	-2525.53	-148.53	6314.10	-2257.89	-1075.95
4.0	68954.10	-18263.30	4048.93	-123.13	6850.62	-2734.70	-652.59
5.0	96324.30	-53730.10	19778.60	-114.90	6841.59	-2381.30	-353.71
6.0	118229.00	-89906.60	39997.30	-134.45	7190.60	-2120.86	-143.41
7.0	134948.00	-119919.00	58227.10	-143.18	7200.03	-1397.69	-170.37
8.0	149092.00	-147517.00	76590.50	-149.16	7110.00	-528.97	-313.19
9.0	159771.00	-170139.00	93968.00	-170.19	7649.69	-595.38	-403.04
10.0	168715.00	-187828.00	107088.00	-172.19	7651.82	-46.57	-555.81
11.0	176169.00	-201821.00	117349.00	-170.83	7550.84	552.84	-651.76
12.0	182662.00	-214445.00	127628.00	-169.36	7519.56	997.32	-756.73
13.0	189114.00	-227085.00	137699.00	-166.11	7388.07	1583.27	-844.97
14.0	195273.00	-239345.00	148361.00	-160.79	7228.22	2124.28	-1017.11
15.0	199939.00	-249862.00	159949.00	-174.10	7782.47	1566.35	-1026.32
16.0	204899.00	-258274.00	166856.00	-167.77	7534.06	2227.05	-1070.51
17.0	209356.00	-265290.00	173458.00	-161.96	7463.49	2386.89	-1040.14
18.0	213546.00	-272476.00	180667.00	-158.41	7387.49	2763.66	-1098.37
19.0	217506.00	-277100.00	183949.00	-150.21	7155.18	3240.82	-1107.07
20.0	219837.00	-275266.00	179705.00	-145.05	7009.96	3638.55	-1007.16
22.0	228092.00	-285272.00	186688.00	-133.55	6672.08	4473.64	-1122.87
24.0	237213.00	-304032.00	211958.00	-136.95	7000.92	4086.48	-1049.61
26.0	242060.00	-297359.00	199620.00	-125.83	6734.22	4465.79	-972.10
28.0	249432.00	-299622.00	196900.00	-111.26	6222.03	5440.43	-914.71
30.0	263307.00	-334844.00	247655.00	-111.83	6452.32	4775.31	-1191.53
35.0	273393.00	-291765.00	178985.00	-83.84	5736.80	4650.87	-621.35
40.0	293153.00	-283353.00	175255.00	-57.06	4937.79	3684.27	-559.25



Table 2.4-4 (Page 4 of 10)  
BWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 9x9A						
	A	B	C	D	E	F	G
2.0	16564.30	12063.20	-2586.67	-184.87	4976.49	-1228.06	-894.91
2.25	22071.80	11834.70	-3015.91	-174.88	5443.22	-1518.94	-1014.33
2.5	27866.60	10993.50	-3286.54	-168.71	5965.88	-1909.06	-1027.88
2.75	34375.10	9004.62	-3367.62	-158.97	6305.05	-2182.06	-933.24
3.0	41566.50	5392.11	-2800.23	-149.79	6613.45	-2462.36	-904.38
4.0	72006.50	-20264.40	4921.01	-123.85	7211.86	-3004.62	-603.22
5.0	100197.00	-57315.80	21669.60	-118.72	7356.33	-2796.24	-243.52
6.0	124367.00	-99348.10	46264.80	-136.71	7648.05	-2394.38	-67.58
7.0	143009.00	-134740.00	68824.10	-143.35	7544.90	-1403.30	-173.80
8.0	157479.00	-165996.00	92255.30	-168.05	8114.30	-1315.88	-266.71
9.0	169636.00	-191379.00	110928.00	-172.50	8069.55	-500.37	-450.57
10.0	179282.00	-211202.00	125969.00	-172.12	7976.57	283.36	-617.13
11.0	187512.00	-228637.00	140325.00	-172.16	7928.03	894.69	-760.39
12.0	195321.00	-245580.00	154682.00	-170.38	7824.20	1596.02	-863.97
13.0	202110.00	-263050.00	173293.00	-187.18	8470.09	1003.55	-953.17
14.0	208171.00	-274758.00	183332.00	-179.75	8249.83	1717.21	-1103.07
15.0	213590.00	-284590.00	191650.00	-175.64	8098.33	2289.04	-1165.13
16.0	218091.00	-292503.00	199557.00	-171.84	8035.82	2659.38	-1119.03
17.0	223491.00	-302449.00	208733.00	-164.92	7833.36	3192.21	-1255.80
18.0	226523.00	-304524.00	209895.00	-162.71	7829.04	3410.57	-1091.33
19.0	231702.00	-312496.00	215730.00	-153.73	7552.13	4052.91	-1189.12
20.0	236531.00	-324776.00	232293.00	-164.72	8073.05	3368.73	-1233.57
22.0	244888.00	-335452.00	241932.00	-150.44	7566.26	4642.58	-1160.69
24.0	252171.00	-340795.00	244542.00	-141.18	7321.23	5355.16	-1142.40
26.0	259438.00	-343494.00	244340.00	-129.66	7094.56	5645.82	-1119.92
28.0	268823.00	-359239.00	266068.00	-130.16	7204.93	5605.85	-1064.30
30.0	277221.00	-363922.00	268930.00	-116.96	6799.84	6219.78	-1037.79
35.0	294285.00	-351643.00	245914.00	-99.35	6404.25	5923.44	-713.23
40.0	324174.00	-389397.00	319233.00	-77.68	5933.52	3992.56	-1188.62

Table 2.4-4 (Page 5 of 10)  
BWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 9x9B						
	A	B	C	D	E	F	G
2.0	17186.80	11657.20	-2441.58	-183.45	5049.98	-1246.51	-1156.40
2.25	21800.20	12295.50	-3074.77	-180.94	5660.86	-1631.58	-1064.82
2.5	28010.00	11198.70	-3349.88	-169.84	6074.18	-1943.73	-1220.46
2.75	34607.80	9092.75	-3327.98	-161.55	6476.70	-2279.47	-1090.70
3.0	41425.40	6300.12	-3202.59	-151.95	6782.84	-2566.85	-1000.46
4.0	71942.80	-18734.90	3920.65	-125.38	7367.52	-3119.27	-631.75
5.0	101151.00	-57291.00	21182.10	-118.05	7377.24	-2721.50	-361.88
6.0	125823.00	-99944.80	45636.60	-136.47	7588.00	-2124.69	-262.67
7.0	144638.00	-135378.00	67687.60	-143.88	7447.72	-995.76	-340.94
8.0	159872.00	-168383.00	91921.20	-168.66	7933.70	-673.04	-395.74
9.0	172305.00	-194121.00	110332.00	-172.16	7831.09	301.31	-634.37
10.0	181683.00	-213140.00	124418.00	-173.36	7740.03	1165.16	-753.12
11.0	190922.00	-232977.00	140095.00	-171.28	7581.53	2053.29	-1027.00
12.0	198213.00	-248066.00	152236.00	-170.70	7492.96	2781.03	-1087.99
13.0	205947.00	-268590.00	173240.00	-187.42	8096.44	2390.78	-1199.48
14.0	211867.00	-280583.00	184192.00	-183.14	8023.23	2903.27	-1325.04
15.0	217071.00	-289407.00	190649.00	-177.77	7760.30	3819.17	-1355.68
16.0	221340.00	-294404.00	193178.00	-173.59	7653.54	4235.81	-1282.26
17.0	227205.00	-306489.00	204027.00	-164.96	7309.81	5290.73	-1440.44
18.0	231085.00	-310612.00	206608.00	-160.03	7176.88	5715.32	-1383.11
19.0	236345.00	-320398.00	215697.00	-153.84	7020.00	6284.82	-1522.44
20.0	240125.00	-328538.00	227545.00	-170.25	7836.24	5008.11	-1382.77
22.0	245672.00	-325279.00	216287.00	-158.18	7517.98	5919.63	-1187.15
24.0	256479.00	-345503.00	236771.00	-144.07	6970.57	7508.12	-1317.75
26.0	260950.00	-331434.00	205388.00	-130.57	6497.58	8638.70	-1076.78
28.0	269984.00	-343628.00	218366.00	-134.58	6861.68	8165.52	-1062.58
30.0	278259.00	-348285.00	221391.00	-123.31	6538.19	8720.28	-1076.88
35.0	297697.00	-344053.00	202586.00	-105.06	6094.38	9194.58	-852.15
40.0	331243.00	-401432.00	313358.00	-81.82	5561.33	7636.50	-1470.42

Table 2.4-4 (Page 6 of 10)  
BWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 9x9C/D						
	A	B	C	D	E	F	G
2.0	16691.80	11823.60	-2447.14	-185.99	5008.36	-1243.90	-1059.30
2.25	21740.60	12301.10	-3136.66	-173.22	5422.51	-1511.79	-1061.56
2.5	27709.70	11300.00	-3398.46	-167.10	5898.90	-1850.17	-1171.40
2.75	33988.10	9774.59	-3696.16	-158.15	6268.38	-2155.04	-974.14
3.0	41117.20	6515.41	-3381.03	-148.32	6548.78	-2413.74	-948.98
4.0	71428.60	-18297.80	3576.44	-123.51	7125.21	-2923.50	-632.21
5.0	100397.00	-56458.80	20611.70	-115.75	7125.58	-2528.06	-313.97
6.0	124283.00	-97234.10	43750.10	-135.36	7393.89	-2038.45	-178.07
7.0	142677.00	-131502.00	64937.90	-142.42	7276.64	-994.67	-255.89
8.0	158111.00	-164750.00	89150.00	-165.13	7682.79	-614.18	-382.56
9.0	169539.00	-187815.00	105688.00	-170.16	7701.54	95.21	-536.66
10.0	179168.00	-207560.00	120407.00	-172.05	7615.14	907.40	-757.15
11.0	187428.00	-224318.00	133228.00	-170.11	7472.64	1710.47	-885.30
12.0	195546.00	-241540.00	147050.00	-166.19	7281.30	2560.85	-1135.94
13.0	202256.00	-258699.00	164971.00	-182.40	7906.42	2044.37	-1182.19
14.0	207838.00	-268927.00	173192.00	-178.93	7770.91	2703.98	-1224.09
15.0	213979.00	-281611.00	184781.00	-172.75	7552.21	3409.13	-1276.86
16.0	217809.00	-285839.00	187221.00	-168.56	7458.11	3805.42	-1317.69
17.0	223749.00	-297214.00	196642.00	-160.86	7141.47	4676.19	-1362.21
18.0	226075.00	-295937.00	193130.00	-157.66	7127.19	4895.03	-1291.13
19.0	230997.00	-304670.00	201281.00	-150.53	6907.85	5558.32	-1353.07
20.0	238022.00	-324930.00	227066.00	-158.32	7284.25	5103.45	-1464.16
22.0	243676.00	-322706.00	217208.00	-147.77	6978.74	5979.30	-1239.05
24.0	251683.00	-332524.00	227486.00	-137.48	6744.91	6651.45	-1261.39
26.0	256408.00	-321812.00	204514.00	-125.79	6394.39	7373.18	-1135.32
28.0	264537.00	-330729.00	215269.00	-131.03	6864.20	6415.84	-1014.55
30.0	273958.00	-341208.00	225146.00	-115.29	6196.43	7947.39	-1073.39
35.0	292385.00	-333153.00	204415.00	-98.00	5956.86	7222.98	-860.79
40.0	329247.00	-419504.00	371883.00	-71.42	4943.73	7633.01	-1618.27

Table 2.4-4 (Page 7 of 10)  
BWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 9x9E/F						
	A	B	C	D	E	F	G
2.0	16854.60	11084.70	-2322.04	-181.73	4769.99	-1147.12	-810.29
2.25	21630.80	11546.20	-2940.96	-172.49	5228.13	-1436.00	-839.61
2.5	27849.90	10029.20	-2985.66	-164.15	5650.51	-1736.59	-1040.92
2.75	34540.60	7548.11	-2786.62	-154.38	5990.92	-2013.50	-935.15
3.0	41307.10	4337.80	-2362.16	-146.82	6295.85	-2275.82	-884.96
4.0	70768.40	-20480.20	5197.61	-121.39	6876.47	-2797.83	-537.40
5.0	98180.80	-56583.30	21720.10	-115.24	7004.63	-2612.66	-168.15
6.0	120573.00	-94683.40	43765.30	-134.45	7390.91	-2400.88	20.85
7.0	138493.00	-128353.00	65326.00	-141.23	7368.45	-1657.87	2.12
8.0	151304.00	-154813.00	84923.70	-165.48	7997.42	-1799.73	-3.75
9.0	162835.00	-178601.00	102770.00	-169.20	8012.87	-1222.27	-178.21
10.0	173089.00	-200396.00	119704.00	-169.43	7906.04	-489.94	-481.35
11.0	180227.00	-213998.00	130552.00	-169.48	7924.61	-143.28	-537.04
12.0	188058.00	-230819.00	144797.00	-165.45	7782.15	482.35	-705.69
13.0	193490.00	-240795.00	153382.00	-163.80	7756.04	834.76	-753.66
14.0	199338.00	-255751.00	170303.00	-178.59	8424.78	16.81	-795.55
15.0	204471.00	-264530.00	177215.00	-172.61	8186.47	708.91	-873.25
16.0	209807.00	-275635.00	189071.00	-167.97	8087.71	1042.99	-936.73
17.0	214452.00	-282609.00	194830.00	-159.86	7819.12	1616.41	-906.17
18.0	217197.00	-283928.00	195786.00	-157.56	7869.81	1568.69	-890.15
19.0	221266.00	-288837.00	199363.00	-149.64	7592.40	2213.50	-965.82
20.0	225737.00	-295774.00	205279.00	-143.23	7337.40	2875.11	-876.23
22.0	234598.00	-314227.00	231133.00	-148.51	7825.76	2021.35	-879.15
24.0	242046.00	-320606.00	235951.00	-134.75	7367.58	2926.98	-913.50
26.0	247960.00	-318479.00	229552.00	-123.51	7133.33	3171.11	-783.22
28.0	261521.00	-352854.00	278305.00	-120.41	7120.21	3024.72	-1121.44
30.0	264913.00	-340198.00	263913.00	-111.92	6968.28	2888.33	-788.23
35.0	288082.00	-360268.00	293412.00	-86.40	6220.44	2894.70	-961.02
40.0	298948.00	-303570.00	215523.00	-55.72	5417.82	785.23	-415.39

Table 2.4-4 (Page 8 of 10)  
BWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 9x9G						
	A	B	C	D	E	F	G
2.0	18157.70	12664.10	-2736.69	-182.35	5344.31	-1383.11	-916.79
2.25	23646.70	12752.10	-3248.16	-178.95	5971.94	-1793.73	-925.78
2.5	29660.10	12309.80	-3821.64	-169.21	6473.09	-2183.65	-879.92
2.75	36525.80	10358.80	-3962.11	-162.46	6968.29	-2613.38	-863.49
3.0	44006.40	7030.85	-3698.49	-153.38	7336.54	-2971.63	-809.92
4.0	77288.30	-21207.50	4543.15	-125.70	8058.78	-3705.78	-537.87
5.0	110686.00	-69960.20	29062.30	-130.54	8442.77	-3626.36	-336.85
6.0	137786.00	-118830.00	58088.00	-136.52	8339.36	-2532.48	-201.40
7.0	160795.00	-169293.00	94340.50	-161.16	8672.27	-1671.25	-379.07
8.0	177763.00	-207034.00	122389.00	-170.18	8619.96	-400.24	-562.99
9.0	193108.00	-243101.00	150849.00	-171.94	8368.05	1156.18	-881.11
10.0	205042.00	-275555.00	181997.00	-195.35	9071.69	1098.87	-1083.51
11.0	215280.00	-300568.00	204362.00	-194.55	8934.09	2200.13	-1266.10
12.0	223585.00	-319189.00	220301.00	-191.69	8775.21	3201.84	-1325.62
13.0	230947.00	-335777.00	234994.00	-189.96	8659.97	4110.52	-1472.39
14.0	239135.00	-355478.00	253619.00	-183.93	8406.36	5194.67	-1726.13
15.0	245572.00	-374776.00	278406.00	-203.34	9278.36	4194.86	-1666.34
16.0	251881.00	-387322.00	288544.00	-193.80	8836.24	5557.89	-1689.56
17.0	257861.00	-401610.00	304798.00	-189.68	8737.81	6220.47	-1840.71
18.0	262232.00	-408488.00	311370.00	-185.11	8602.16	6925.67	-1728.75
19.0	265329.00	-406025.00	301388.00	-178.52	8347.70	7730.36	-1689.95
20.0	271234.00	-419055.00	315509.00	-171.72	8067.36	8751.47	-1705.40
22.0	283895.00	-451199.00	356261.00	-175.40	8389.72	8926.87	-1890.66
24.0	288388.00	-437401.00	323902.00	-164.80	8075.31	9968.86	-1575.02
26.0	299757.00	-459004.00	349014.00	-154.15	7793.16	11086.10	-1690.60
28.0	312233.00	-487890.00	389532.00	-156.41	8001.62	11248.70	-1695.28
30.0	317451.00	-470929.00	352843.00	-144.12	7616.90	12129.50	-1519.49
35.0	340908.00	-472938.00	320383.00	-126.33	6958.19	14189.40	-1265.87
40.0	355826.00	-406707.00	181832.00	-109.88	6567.54	13350.90	-690.33

Table 2.4-4 (Page 9 of 10)  
BWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 10x10A/B/G						
	A	B	C	D	E	F	G
2.0	16284.00	11316.60	-2373.42	-183.95	4757.49	-1129.72	-908.53
2.25	21494.10	11161.90	-2738.06	-174.87	5233.98	-1435.08	-1029.88
2.5	27378.90	10122.70	-3001.13	-163.37	5590.72	-1687.18	-1133.76
2.75	33997.50	7667.21	-2796.85	-154.59	5934.47	-1960.21	-1063.93
3.0	40669.30	4604.85	-2427.68	-146.64	6233.46	-2224.40	-1023.08
4.0	69456.60	-19048.60	4510.80	-121.07	6769.53	-2693.26	-595.32
5.0	96363.50	-53810.50	20060.80	-115.15	6852.01	-2455.28	-235.29
6.0	118075.00	-89649.00	40101.30	-135.03	7207.34	-2199.03	-31.82
7.0	135465.00	-121448.00	59891.00	-141.81	7176.22	-1464.52	-84.35
8.0	149172.00	-147759.00	77477.10	-146.29	7123.94	-720.75	-270.69
9.0	160098.00	-171854.00	96698.30	-168.49	7716.07	-861.33	-341.94
10.0	168703.00	-188210.00	108590.00	-170.65	7707.01	-369.98	-413.26
11.0	176895.00	-205123.00	122221.00	-167.56	7590.63	267.07	-597.28
12.0	183500.00	-217775.00	132403.00	-165.29	7503.92	748.16	-696.44
13.0	189527.00	-229054.00	141757.00	-162.77	7481.92	1050.96	-848.98
14.0	195892.00	-241671.00	152138.00	-155.37	7192.81	1854.09	-983.23
15.0	199561.00	-249322.00	161820.00	-172.75	7962.69	824.80	-863.19
16.0	204447.00	-258563.00	171271.00	-167.33	7839.02	1163.01	-928.77
17.0	209187.00	-266807.00	178586.00	-160.49	7588.94	1870.46	-983.28
18.0	212908.00	-270532.00	180865.00	-155.48	7487.99	2077.63	-955.84
19.0	216478.00	-274912.00	185127.00	-150.92	7417.63	2302.50	-949.30
20.0	219761.00	-276790.00	185299.00	-144.53	7207.71	2794.21	-860.04
22.0	230330.00	-297894.00	208958.00	-142.95	7317.84	2710.62	-1141.54
24.0	235204.00	-296597.00	207242.00	-136.96	7299.78	2658.68	-881.02
26.0	243035.00	-302622.00	210474.00	-120.72	6753.85	3686.66	-891.14
28.0	250446.00	-307503.00	216130.00	-107.51	6366.92	4185.55	-863.84
30.0	265199.00	-348982.00	280458.00	-107.22	6539.80	3562.03	-1192.36
35.0	273468.00	-298369.00	203934.00	-79.97	5875.23	3082.40	-627.85
40.0	292898.00	-285148.00	187876.00	-50.41	4835.07	2436.15	-509.94

Table 2.4-4 (Page 10 of 10)  
BWR Fuel Assembly Cooling Time-Dependent Coefficients  
(ZR-Clad Fuel)

Cooling Time (years)	Array/ Class 10x10C						
	A	B	C	D	E	F	G
2.0	17325.30	11490.30	-2423.96	-183.30	5030.60	-1243.75	-1042.41
2.25	22130.00	11951.30	-2993.28	-179.73	5638.45	-1641.98	-1049.38
2.5	28141.40	10893.00	-3249.42	-171.97	6092.80	-1970.42	-1042.25
2.75	35001.90	8485.77	-3132.08	-161.49	6464.02	-2288.54	-1064.03
3.0	41817.40	5588.18	-2935.15	-152.37	6778.27	-2580.33	-960.42
4.0	72503.80	-20126.90	4676.40	-126.12	7389.26	-3161.51	-598.75
5.0	101686.00	-58844.80	22172.30	-118.88	7430.83	-2824.08	-314.90
6.0	125964.00	-100714.00	46115.40	-137.38	7670.65	-2280.40	-139.13
7.0	145279.00	-138063.00	69971.00	-145.81	7593.29	-1239.47	-240.17
8.0	160736.00	-171770.00	94922.90	-169.48	8074.18	-936.98	-413.14
9.0	173109.00	-198050.00	114195.00	-173.24	7952.04	107.22	-587.69
10.0	183348.00	-219689.00	130706.00	-174.38	7886.25	887.26	-747.19
11.0	192349.00	-239413.00	146643.00	-173.03	7738.68	1801.89	-960.79
12.0	198722.00	-251849.00	156661.00	-174.40	7779.41	2247.21	-1024.32
13.0	206317.00	-271870.00	177242.00	-191.21	8405.58	1825.60	-1138.70
14.0	212647.00	-284224.00	187282.00	-183.63	8103.28	2759.09	-1219.61
15.0	218920.00	-297923.00	200391.00	-179.50	7978.82	3335.37	-1313.57
16.0	223379.00	-304963.00	206476.00	-175.76	7922.23	3689.54	-1328.16
17.0	228676.00	-314595.00	214380.00	-168.29	7569.76	4728.35	-1384.57
18.0	233175.00	-321606.00	220636.00	-164.63	7582.84	4872.65	-1394.73
19.0	238334.00	-334048.00	236292.00	-170.69	7886.97	4618.40	-1403.78
20.0	242429.00	-340497.00	242818.00	-172.36	8094.92	4434.37	-1437.97
22.0	251428.00	-353397.00	253878.00	-156.59	7500.41	6060.21	-1412.04
24.0	257957.00	-354461.00	249954.00	-147.71	7305.10	6634.39	-1346.94
26.0	272010.00	-391459.00	299301.00	-145.25	7227.25	7258.81	-1619.05
28.0	273995.00	-368436.00	261102.00	-136.90	7071.78	7562.48	-1159.20
30.0	279666.00	-356857.00	232864.00	-125.34	6696.43	8273.08	-973.58
35.0	297242.00	-340805.00	191056.00	-108.66	6404.77	8127.91	-777.55
40.0	330405.00	-398218.00	299749.00	-84.01	5531.03	7980.06	-1232.79

				1 0.5*	2 0.5*				
		3 0.5*	4 0.5	5 1.2	6 1.2	7 0.5	8 0.5*		
	9 0.5*	10 0.5	11 1.2	12 0.4	13 0.4	14 1.2	15 0.5	16 0.5*	
	17 0.5	18 1.2	19 0.4	20 0.4	21 0.4	22 0.4	23 1.2	24 0.5	
25 0.5*	26 1.2	27 0.4	28 0.4	29 0.4	30 0.4	31 0.4	32 0.4	33 1.2	34 0.5*
35 0.5*	36 1.2	37 0.4	38 0.4	39 0.4	40 0.4	41 0.4	42 0.4	43 1.2	44 0.5*
	45 0.5	46 1.2	47 0.4	48 0.4	49 0.4	50 0.4	51 1.2	52 0.5	
	53 0.5*	54 0.5	55 1.2	56 0.4	57 0.4	58 1.2	59 0.5	60 0.5*	
		61 0.5*	62 0.5	63 1.2	64 1.2	65 0.5	66 0.5*		
				67 0.5*	68 0.5*				

  

Cell ID
Heat Load (kW)

\* When DAMAGED FUEL or FUEL DEBRIS is stored in this location (in a DFC), the allowable heat load of the cell is limited to 0.35 kW

**Figure 2.4-1**  
**Per Cell Allowable Heat Loads (kW) - MPC-68M**



<b>Table 3-1 (page 2 of 9)</b> <b>LIST OF ASME CODE ALTERNATIVES FOR HI-STORM 100 CASK SYSTEM</b>			
<b>Component</b>	<b>Reference ASME Code Section/Article</b>	<b>Code Requirement</b>	<b>Alternative, Justification &amp; Compensatory Measures</b>
MPC basket supports and lift lugs	NB-1130	<p>NB-1132.2(d) requires that the first connecting weld of a nonpressure-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.</p> <p>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.</p>	The MPC basket supports (nonpressure-retaining structural attachments) and lift lugs (nonstructural attachments (relative to the function of lifting a loaded MPC) 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 basket supports and associated attachment welds are designed to satisfy the stress limits of Subsection NG and the lift lugs and associated attachment welds are designed to satisfy the stress limits of Subsection NF, as a minimum. These attachments and their welds are shown by analysis to meet the respective stress limits for their service conditions. Likewise, non-structural items, such as shield plugs, spacers, etc. if used, can be attached to pressure-retaining parts in the same manner.
MPC	NB-2000	Requires materials to be supplied by ASME-approved material supplier.	Materials will be supplied by Holtec-approved suppliers with Certified Material Test Reports (CMTRs) in accordance with NB-2000 requirements.
MPC	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. UNS S31803 duplex stainless steel alloy is evaluated in the HI-STORM 100 FSAR and meets the required design criteria for use in the HI-STORM 100 system per ASME Code Case N-635-1.