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2.5 Burnup and Cooling Time Qualification Requirements

2.5.1 Burnup and cooling time limits for fuel assemblies authorized for loading into the MPC-32ML are provided in Table 2.5-1. Burnup and cooling time limits for fuel assemblies authorized for loading according to only the alternative loading patterns shown in Figures 2.30-1 through 2.3-9 (MPC-37) and Figures 2.3-10 through 2.3-13 (MPC-89) are provided in Table 2.5-2. Burnup and cooling time combinations in Table 2.5-2 also apply for 10x10J fuel loaded according to heat load regions shown in Tables 2.3-2A, 2.3-2B and 2.3-4.

The burnup and cooling time for every fuel loaded into the MPC-32 ML must satisfy the following equation:

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

where,

Ct = Minimum cooling time (years)

Bu = Assembly-average burnup (MWd/mtU)

A,B,C,D =Polynomial coefficients listed in ~~the above~~ Tables 2.5-1 and 2.5-2

Minimum cooling time must also meet limits specified in Table 2.1-1. If the calculated Ct is less than the cooling time limit in Table 2.1-1, the minimum cooling time in Table 2.1-1 is used.

2.5.2 Burnup and cooling time limits for fuel assemblies authorized for loading into the MPC-37P and MPC-44 are provided in Table 2.5-3.

The burnup and cooling time for every fuel assembly loaded into the MPC-37P and MPC-44 must satisfy the following equation:

$$Ct = A \bullet Bu^4 + B \bullet Bu^3 + C \bullet Bu^2 + D \bullet Bu + E$$

where,

Ct = Minimum cooling time (years),

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

A, B, C, D, E = Polynomial coefficients listed in Table 2.5-3.

2.5.3 Alternative burnup and cooling time limits for fuel assemblies authorized for loading into the MPC-37P and MPC-37 are provided in Table 2.5-4 and Table 2.5-5.

2.5.4 Burnup and cooling time limits for Assembly Class 10x10J loaded according to Tables 2.3-2A, 2.3-2B and 2.3-4 are provided in Table 2.5-6.

TABLE 2.5-1
BURNUP AND COOLING TIME FUEL QUALIFICATION REQUIREMENTS
FOR MPC-32ML

A	B	C	D
6.7667E-14	-36736E-09	8.1319E-05	2.7951E+00

TABLE 2.5-2
BURNUP AND COOLING TIME FUEL QUALIFICATION REQUIREMENTS
FOR MPC-37 AND MPC-89

Cell Decay Heat Load Limit (kW)	Polynomial Coefficients			
	A	B	C	D (Note 1)
MPC-37				
≤ 0.85	1.68353E-13	-9.65193E-09	2.69692E-04	2.95915E-01
0.85 < decay heat ≤ 3.5	1.19409E-14	-1.53990E-09	9.56825E-05	-3.98326E-01
MPC-89 <u>(Note 2)</u>				
≤ 0.32	1.65723E-13	-9.28339E-09	2.57533E-04	3.25897E-01
0.32 < decay heat ≤ 0.5	3.97779E-14	-2.80193E-09	1.36784E-04	3.04895E-01
0.5 < decay heat ≤ 0.75	1.44353E-14	-1.21525E-09	8.14851E-05	3.31914E-01
0.75 < decay heat ≤ 1.1	-7.45921E-15	1.09091E-09	-1.14219E-05	9.76224E-01
1.1 < decay heat ≤ 1.45	3.10800E-15	-7.92541E-11	1.56566E-05	6.47040E-01
1.45 < decay heat ≤ 1.6	-8.08081E-15	1.23810E-09	-3.48196E-05	1.11818E+00

NOTES:

1. _____
4. For BLEU fuel, coefficient D is increased by 1.
2. _____ For calculation of the minimum cooling time for 10x10J fuel that is loaded in accordance with Table 2.3-2A, 2.3-2B and 2.3-4 or Figures 2.3-10 through 2.3-13, the assembly-average burnup must be increased by 10,000 MWd/mtU and 5,000 MWd/mtU, respectively.
4. _____

TABLE 2.5-4
ALTERNATIVE BURNUP AND COOLING TIME FUEL QUALIFICATION REQUIREMENTS
FOR THE MPC-37P

Cell Location (see Figure 2.1-4)	Maximum Burnup, MWd/mtU	Minimum Cooling Time, Years
2-2, 2-4 through 2-9, 2-11	55000	1.6
	60000	3.5
2-1, 2-3, 2-10, 2-12	55000	1.8
	60000	3.5
3-4, 3-5, 3-12, 3-13	55000	2
	60000	6
3-2, 3-6 through 3-11, 3-15	45000	3.5
	50000	5
	55000	6
	60000	10
3-1, 3-3, 3-14, 3-16	50000	11
1-2, 1-4, 1-5, 1-6, 1-8	15000	3.5
	50000	5
	55000	10
	60000	13

Note: Cell Locations 1-1, 1-3, 1-7 and 1-9 need to remain empty

TABLE 2.5-5
ALTERNATIVE BURNUP AND COOLING TIME FUEL QUALIFICATION REQUIREMENTS
FOR THE MPC-37

Cell Location (see Figure 2.1-1)	Maximum Burnup, MWd/mtU	Minimum Cooling Time, Years
1-1 through 1-9	50000	5
	55000	6
	60000	10
2-1 through 2-12	55000	5
	60000	6
3-1 through 3-16	50000	3.5
	55000	5
	60000	6

TABLE 2.5-6
BURNUP AND COOLING TIME FUEL QUALIFICATION REQUIREMENTS FOR
ASSEMBLY CLASS 10X10J LOADED ACCORDING TO TABLE 2.3-2A

Region	Maximum Burnup, MWd/mtU	Minimum Cooling Time, Years
2	5000	1.2
	10000	1.4
	20000	2.0
	30000	2.4
	40000	3.0
	50000	3.5
	60000	5.0
	70000	6.0
1,3	5000	1.8
	10000	2.2
	20000	2.8
	30000	3.5
	40000	5.0
	50000	7.0
	60000	9.0
	70000	13.0