CORE OPERATING LIMITS REPORT FOR

PEACH BOTTOM ATOMIC POWER STATION UNIT 2

RELOAD 12, CYCLE 13

REVISION 1

Prepared By: _____ Date: 10-5-98

A. D. Giancatarino
Engineer

Reviewed By: _____ Date: 10-12-98

J. J. Tusar
Engineer

Approved By: _____ Date: 10/12/98

J. M. Carmody
Manager
Nuclear Design Branch

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INTRODUCTION AND SUMMARY

This report provides the following cycle-specific parameter limits for Peach Bottom Atomic Power Station Unit 2 Cycle 13 (Reload 12):

- Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)
- ARTS MAPLHGR thermal limit multipliers
- Single Loop Operation (SLO) MAPLHGR multipliers
- Minimum Critical Power Ratio (MCPR)
- ARTS MCPR thermal limit adjustments and multipliers
- Single Loop Operation (SLO) MCPR adjustment
- Rod Block Monitor (RBM) Analytical Limits, Allowable Values and MCPR Limits
- Linear Heat Generation Rate (LHGR)
- Turbine Bypass Valve Parameters

These values have been determined using NRC-approved methodology and are established such that all applicable limits of the plant safety analysis are met.

This report provides the means for calculating the Operating Limit MCPR and MAPLHGR thermal limits for the following conditions:

- All points in the operating region of the power/flow map including Maximum Extended Load Line Limit (MELLL) down to 81% of rated core flow during full power (3458 MWt) operation
- Increased Core Flow (ICF), up to 110% of rated core flow
- End-of-Cycle Power Coastdown to a minimum power level of 40%
- Feedwater Heaters Out of Service (FWHOOS) to 55° F temperature reduction
- Final Feedwater Temperature Reduction (FWTR) between End-of-Rated (EOR) and End-of-Cycle (EOC) to 90° F temperature reduction

The Allowable Values, documented in Reference 17, for feedwater temperature as a function of thermal power for both FWHOOS and FWTR are specified in the appropriate Peach Bottom procedures.

Note that the term "EOR" refers to the cycle exposure at which operation at "rated conditions" is no longer possible (i.e., the cycle exposure at which cycle extension begins) based on the EOR point as documented in the current revision of the Cycle Management Report.

Preparation of this report was performed in accordance with PECO Energy Fuel and Services Division Procedure FM-300, "Reload Core Licensing". This report is submitted in accordance with Technical Specification 5.6.5 of Reference (1) and contains all thermal limit parameters related to the implementation of the ARTS Improvement Program and Maximum Extended Load Line Limit Analyses (ARTS/MELLLA) for Peach Bottom Unit 2 Cycle 13.

MAPLHGR LIMITS

The bounding MAPLHGR limits (kW/ft) for each fuel type are provided in Figures 1 through 5. The bounding MAPLHGR limits are the lowest kW/ft limits of the fuel lattices (excluding natural uranium) which comprise a given fuel type as a function of average planar exposure. The MAPLHGR figures are used when hand calculations are required as specified in Reference (4). All MAPLHGR values for each fuel type as a function of axial location and average planar exposure shall be less than or equal to the applicable MAPLHGR limits for the respective fuel and lattice types to be in compliance with Technical Specification 3.2.1. These MAPLHGR limits are specified in References (2), (3), (15) and (16) and the process computer databank. The ARTS-based MAPLHGR power-dependent multipliers (MAPFAC(P)) are provided in Figures 6 and 7. Figure 6 is valid for seven or more (of nine) Turbine Bypass Valves (TBVs) In-Service and Recirculation Pump Trip (RPT) In-Service with a maximum temperature reduction of 90° F for FWTR operation. Figure 7 is valid for three or more (of nine) TBVs Out-of-Service (OOS) or RPTOOS with a maximum FWTR of 90° F. The flow-dependent multipliers (MAPFAC(F)) are provided in Figures 8 and 9 as a function of the number of recirculation loops in operation only. The SLO MAPLHGR multiplier (0.87) is applied through MAPFAC(F) as shown in Figure 9. MAPFAC(F) is clamped at 0.87 starting at 54.55% of rated core flow to ensure peak clad temperatures are maintained within the limits of the cycle-specific LOCA analysis for single recirculation loop operation. The power- and flow-dependent MAPLHGR multipliers were obtained from References (5), (11), (17) and (18).

MCPR LIMITS

The Operating Limit MCPR (OLMCPR) for use in Technical Specification 3.2.2 for each fuel type is provided in Table 1. These values are determined by the cycle-specific fuel reload analyses in Reference (2). The OLMCPR is increased by 0.02 when operating in SLO (due to the safety limit increase). The Safety Limit MCPRs are documented in Section 2.1.1.2 of Reference (1).

Control rod scram time verification is required as per Technical Specification 3.1.4, "Control Rod Scram Times". Tau, a measure of scram time performance to notch position 36 throughout the cycle, is determined based on the cumulative scram time test results. The calculation of Tau shall be performed in accordance with site procedures. Linear interpolation shall be used to calculate the OLMCPR value if Tau is between 0.0 (Tau Option B) and 1.0 (Tau Option A).

Separate MCPR values are presented herein (Table 1) for the following domains:

- TBVs In-Service (seven or more in-service) and RPT In-Service, maximum FWTR of 90 °F
- TBVs Out-of-Service (three or more out-of-service) and RPT In-Service, maximum FWTR of 90 °F
- TBVs In-Service (seven or more in-service) and RPT Out-of-Service, maximum FWTR of 90 °F

The OLMCPR values are documented in References (2) for the GE11 and GE13 fuel designs.

The ARTS-based power-dependent MCPR limits, OLMCPR(P), for use in Technical Specification 3.2.2 are provided in Figure 10. Figure 10 is valid for all operating conditions. The flow-dependent MCPR limits, OLMCPR(F), are provided in Figure 11. Figure 11 is valid for all operating conditions. The OLMCPR(P) values below the turbine scram bypass power are documented in Reference (17). OLMCPR(P, F) curves were obtained from References (5), (11), (17) and (18).

OVERALL GOVERNING MCPR AND MAPLHGR LIMITS

ARTS provides for power- and flow-dependent thermal limit adjustments and multipliers which allow for a more reliable administration of the MCPR and MAPLHGR thermal limits. At any given power/flow (P/F) state,

all four limits are to be determined: MAPFAC(P), MAPFAC(F), OLMCPR(P), and OLMCPR(F) from Figures 6 through 11, inclusive. The most limiting MCPR and the most limiting MAPLHGR [maximum of OLMCPR(P) and OLMCPR(F) and minimum of MAPLHGR(P) and MAPLHGR(F)] for a given (P,F) condition will be the governing limits. The OLMCPR for each fuel type is determined by the cycle-specific fuel reload analyses in Reference (2). Rated MAPLHGR values are a composite of results obtained from bundle-specific thermal-mechanical and emergency core cooling system analyses. Supporting documentation for the ARTS-based limits is provided in References (5), (10), (11), (14), (17), and (18).

ROD BLOCK MONITOR SETPOINTS

The RBM power-biased Analytical Limits, Allowable Values and MCPR Limits for use in Technical Specification 3.3.2.1 are provided in Table 2 per Reference (5) with supporting documentation in References (2), (11), (12) and (13).

LINEAR HEAT GENERATION RATES

The beginning of life (maximum) LHGR values for each fuel type for use in Technical Specification 3.2.3 are provided in Table 3. The LHGR values as a function of fuel exposure are provided in Reference (3). The bases for the LHGR values are documented in Reference (4).

STEAM BYPASS SYSTEM OPERABILITY

The operability requirements for the steam bypass system are governed by Technical Specification 3.7.6. If the requirements cannot be met, the appropriate power dependent limits for Turbine Bypass Valves Out-of-Service (TBVOOS) must be used (Table 1 with Figure 7). The minimum number of bypass valves to maintain system operability is seven as per References (8) and (9) and Table 4. Table 4 also includes other Turbine Bypass Valve parameters.

EOC RECIRCULATION PUMP TRIP (EOC-RPT) OPERABILITY

If the EOC-RPT is inoperable, then the OLMCPR (Table 1) and MAPFAC(P) limits (Figure 7) for EOC Recirculation Pump Trip Out-of-Service (RPTOOS), must be used.

The measured EOC-RPT response time as defined in Section 1.1 of the Technical Specifications shall be :

≤ 0.145 seconds for TCV Fast Closure Trip (i.e. Generator Load Rejection)

≤ 0.155 seconds for TSV Fast Closure Trip (i.e. Turbine Trip)

A total RPT response time of 0.175 seconds is assumed in the safety analysis for both trips and is defined as the time from the turbine valves (TCV or TSV) start to close until complete arc suppression of the EOC-RPT circuit breakers. Reference (19) provides the basis for the RPT response time.

CONCURRENT TBVOOS AND RPTOOS

Cycle 13 is not licensed for TBVOOS and RPTOOS to occur concurrently. Therefore, concurrent TBVOOS and RPTOOS is an unanalyzed condition.

REFERENCES

1) "Technical Specifications for Peach Bottom Atomic Power Station Unit 2", Docket No. 50-277, Appendix A to License No. DPR-44

2) "Supplemental Reload Licensing Report for Peach Bottom Atomic Power Station Unit 2, Reload 12, Cycle 13", GE Nuclear Energy Document No. J11-03306SRLR, Rev. 0, August 1998

3) "Lattice Dependent MAPLHGR Report for Peach Bottom Atomic Power Station Unit 2 Reload 12 Cycle 13", J11-03306MAPL, Revision 0, August, 1998

4) "General Electric Standard Application for Reactor Fuel", NEDE-24011-P-A-13, August 1996; and NEDE-24011-P-A-13-US, August 1996

5) "Maximum Extended Load Line Limit and ARTS Improvement Program Analyses for Peach Bottom Atomic Power Station Unit 2 and 3", NEDC-32162P, Revision 2, March 1995

6) "Level 8 Analytical Limit Increase Engineering Report for Peach Bottom 2 and 3", NEDC-32231P, August 1993

7) Letter, G. V. Kumar to H. J. Ryan, "Justification for Reduction of Rod Block Monitor System Downscale Trip Setpoint For Peach Bottom Atomic Power Station", May 23, 1994

8) "Letter from R. M. Butrovich to H. J. Diamond, "Peach Bottom-2 Cycle 12 Turbine Bypass Valve Capacity Variation from Design Basis", January 9, 1995

9) Letter from G. V. Kumar to G. C. Storey, "PBAPS Evaluation of Turbine Bypass Surveillance Requirements", January 19, 1995

10) Letter, G. V. Kumar to A. M. Olson, "PECO Rerate Project, ARTS Thermal Limits", June 27, 1995

11) Peach Bottom Atomic Power Station Unit 2 Cycle 13 ARTS Thermal Limits Analyses, GE Nuclear Energy, Rev. 0, August 1998

12) PECO Energy Calc. PM-0875, "GE NSSS Setpoints Required to Support Power Rerate"

13) Letter from M. G. Wiwel to A. S. Hegedus and R. C. Stott, "Rod Block Monitor Downscale Settings for ITS", March 14, 1995

14) "Peach Bottom Atomic Power Station Unit 2 Cycle 12 ARTS Thermal Limits Analyses", NEDC-32706P, Revision 0, April 1997

15) "Lattice Dependent MAPLHGR Report for Peach Bottom Atomic Power Station Unit 2 Reload 10 Cycle 11", 24A5154AA, Revision 0, September, 1994

16) "Lattice Dependent MAPLHGR Report for Peach Bottom Atomic Power Station Unit 2 Reload 11 Cycle 12", 24A5366AA, Revision 0, September, 1996

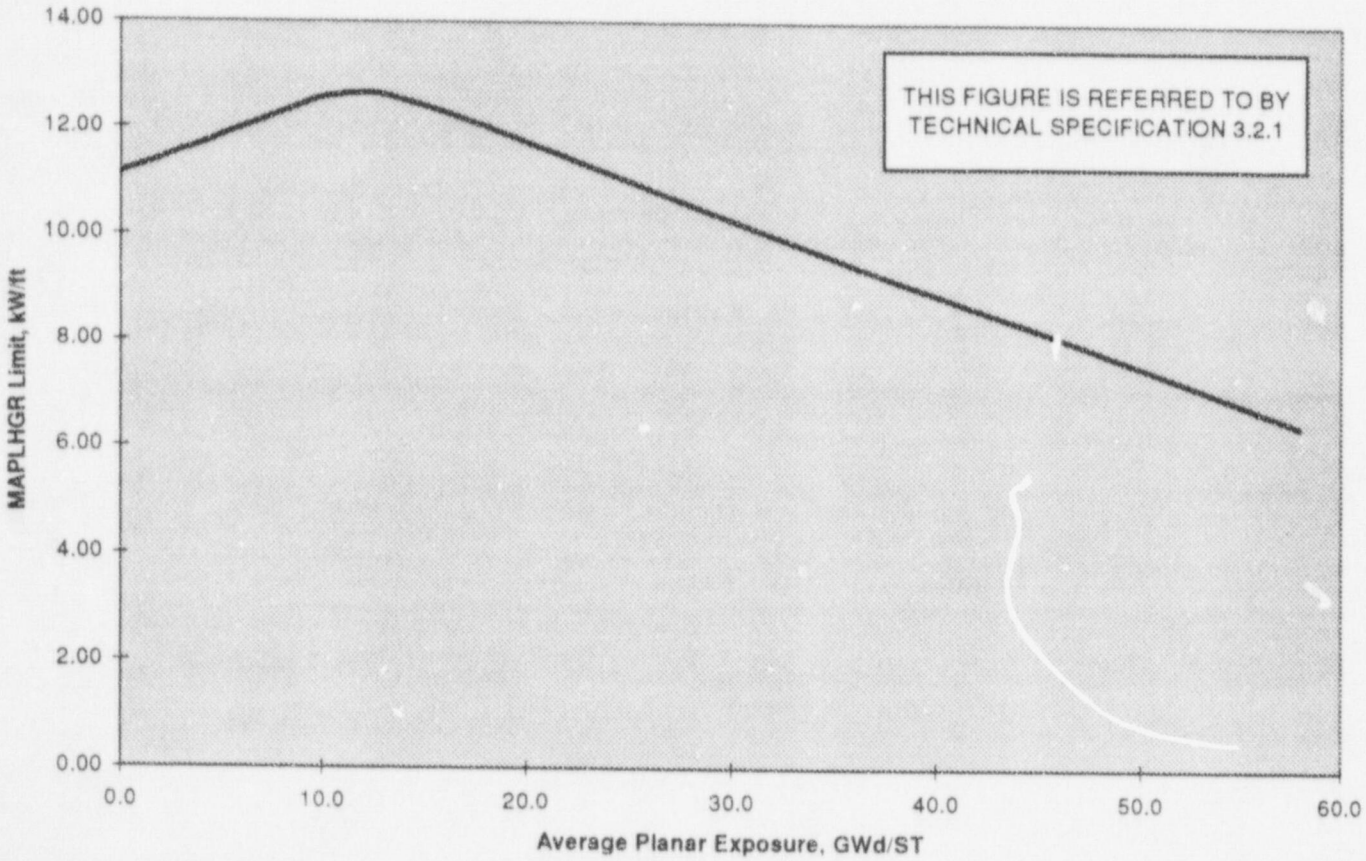
17) "Peach Bottom Atomic Power Station Evaluation for Extended Final Feedwater Temperature Reduction of 90° F", NEDC-32707P, Supplement 1, May 20, 1998

18) "ARTS Flow-Dependent Limits with TBVOOS for Peach Bottom Atomic Power Station and Limerick Generating Station", NEDC-32847P, June 1998

19) PECO Calculation PE-0173 , "Determination of Total Time Required to Initiate the trip Signal to the EOC-RPT Circuit Breaker"

FIGURE 1

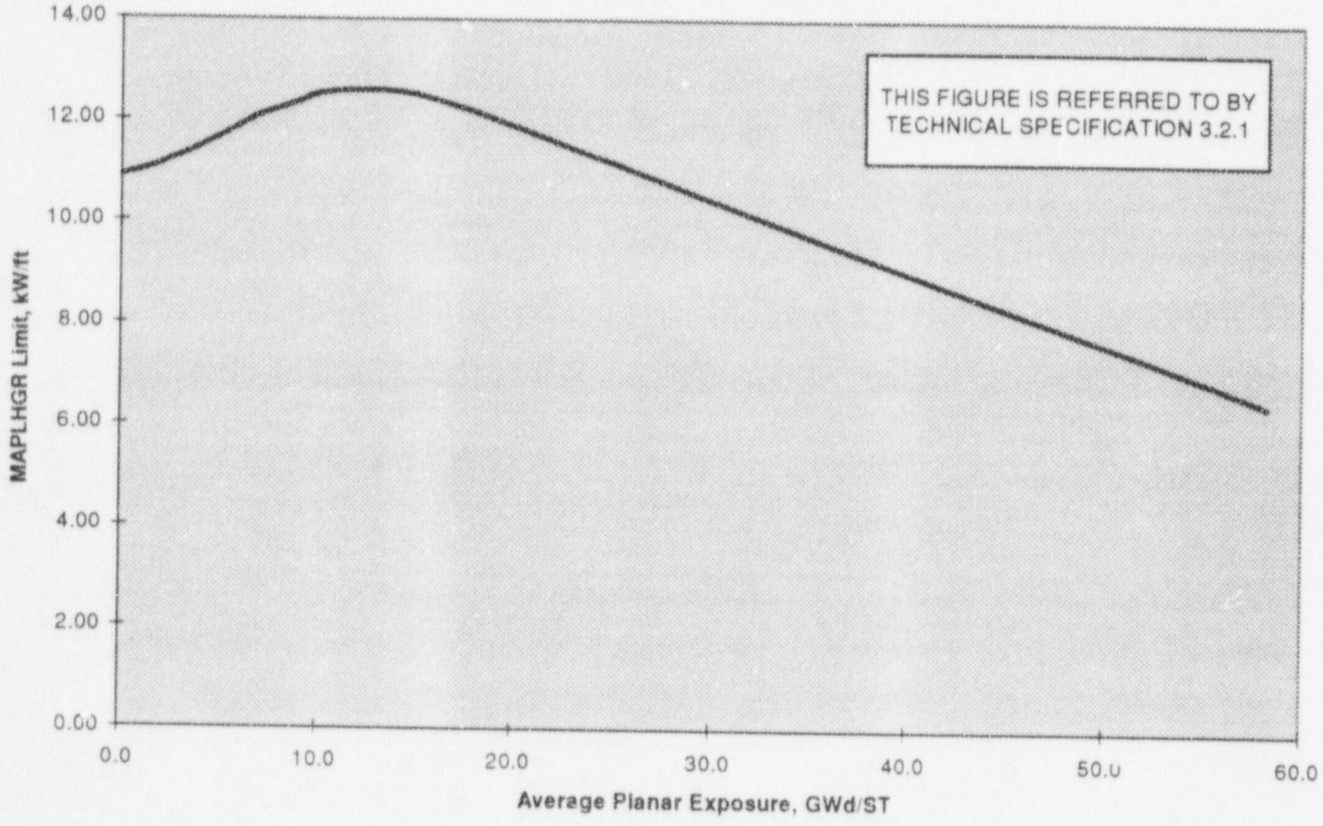
MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FUEL TYPE P9HUB387-12GZ3 (GE11)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	11.13	7.0	12.15	25.0	11.01
0.2	11.18	8.0	12.30	30.0	10.29
1.0	11.28	9.0	12.44	35.0	9.59
2.0	11.42	10.0	12.58	40.0	8.90
3.0	11.56	12.5	12.66	45.0	8.22
4.0	11.70	15.0	12.42	50.0	7.54
5.0	11.86	17.5	12.10	55.0	6.85
6.0	12.01	20.0	11.74	57.85	6.45

FIGURE 2

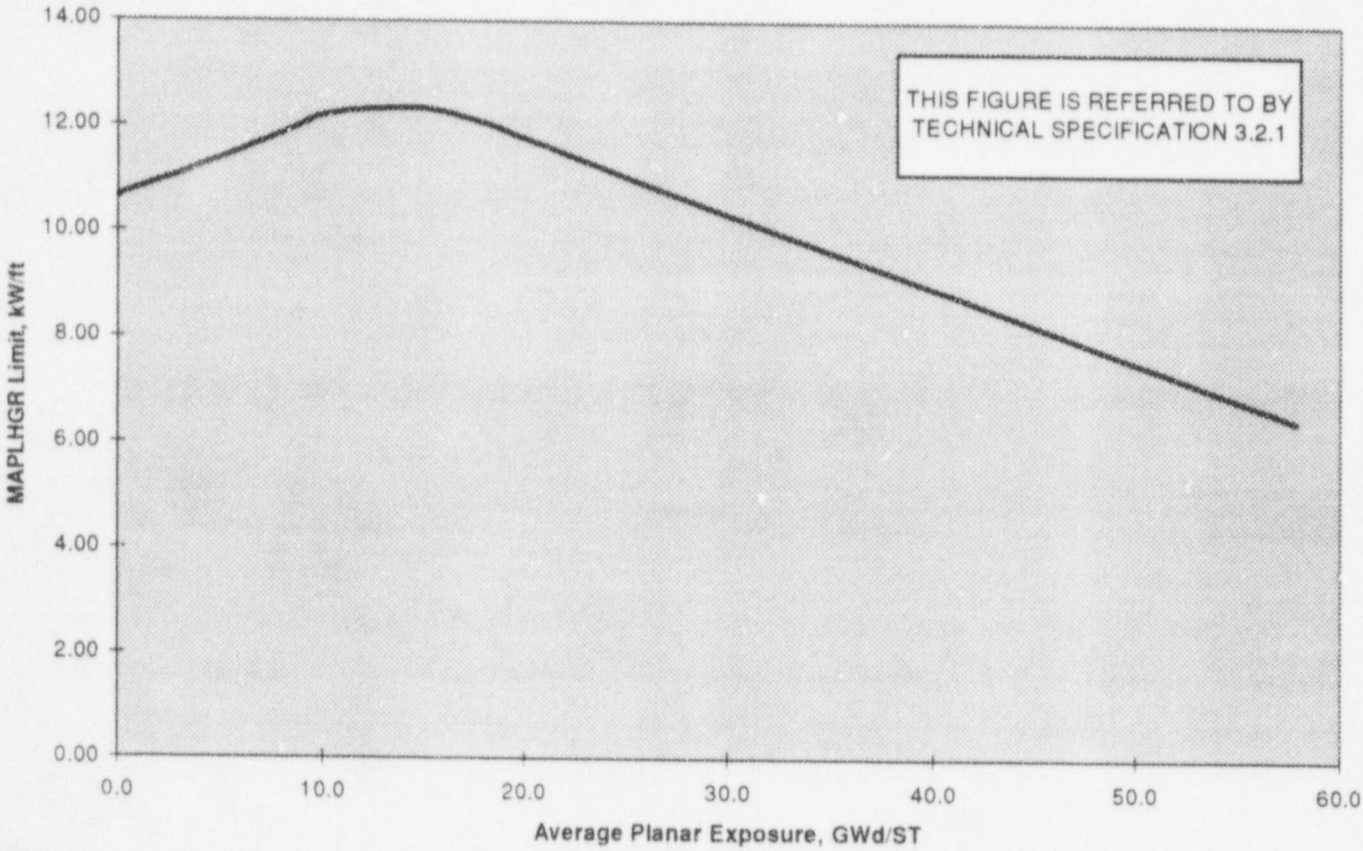
MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FUEL TYPE P9DTB397-13GZ (GE13)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	10.89	7.0	12.10	25.0	11.17
0.2	10.91	8.0	12.23	30.0	10.44
1.0	10.99	9.0	12.37	35.0	9.73
2.0	11.12	10.0	12.52	40.0	9.03
3.0	11.29	12.5	12.61	45.0	8.34
4.0	11.47	15.0	12.51	50.0	7.65
5.0	11.67	17.5	12.24	55.0	6.95
6.0	11.89	20.0	11.90	58.22	6.49

FIGURE 3

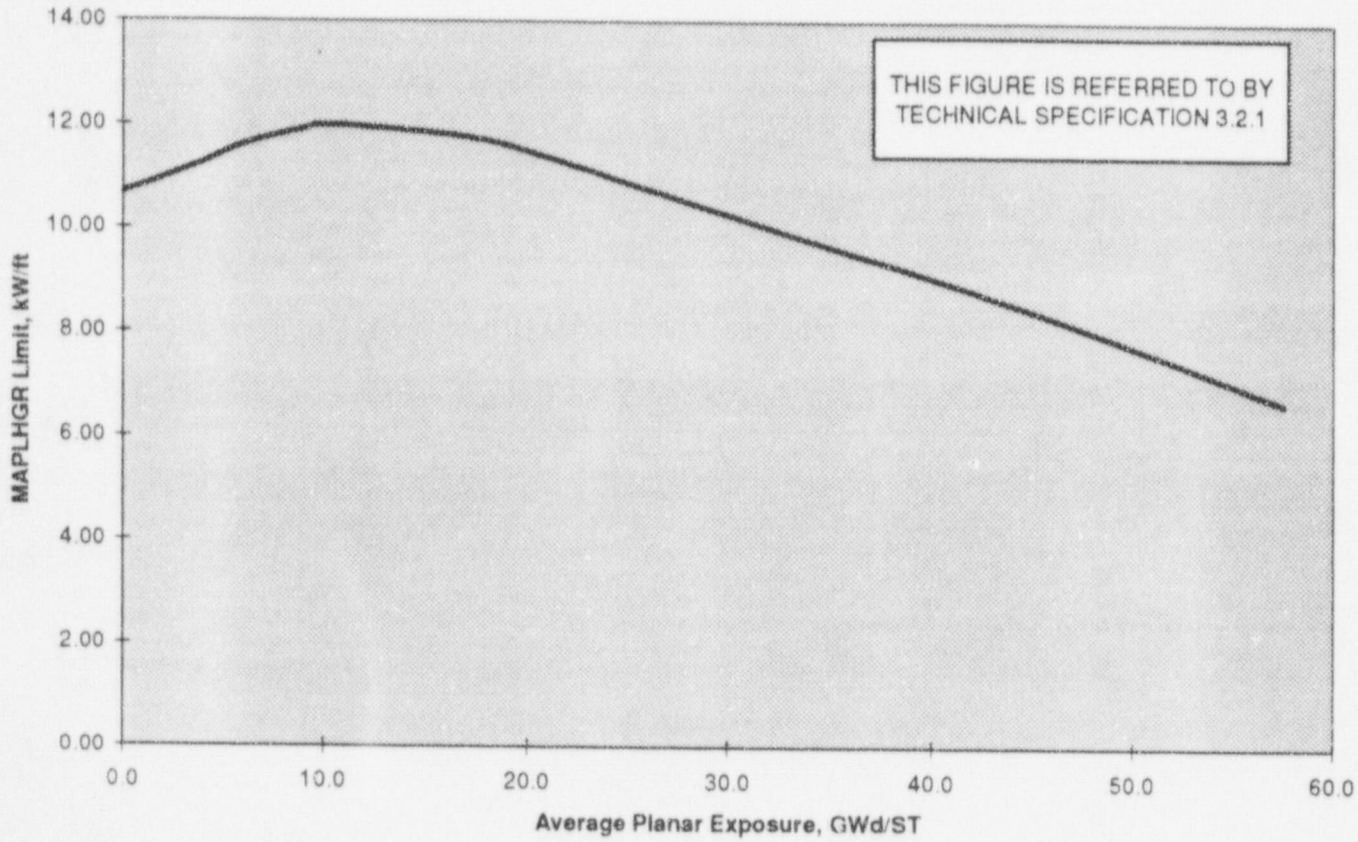
MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FUEL TYPE P9DTB392-15GZ (GE13)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	10.64	7.0	11.69	25.0	11.06
0.2	10.69	8.0	11.86	30.0	10.34
1.0	10.80	9.0	12.03	35.0	9.64
2.0	10.93	10.0	12.21	40.0	8.94
3.0	11.07	12.5	12.33	45.0	8.26
4.0	11.22	15.0	12.33	50.0	7.57
5.0	11.37	17.5	12.11	55.0	6.88
6.0	11.53	20.0	11.78	57.88	6.48

FIGURE 4

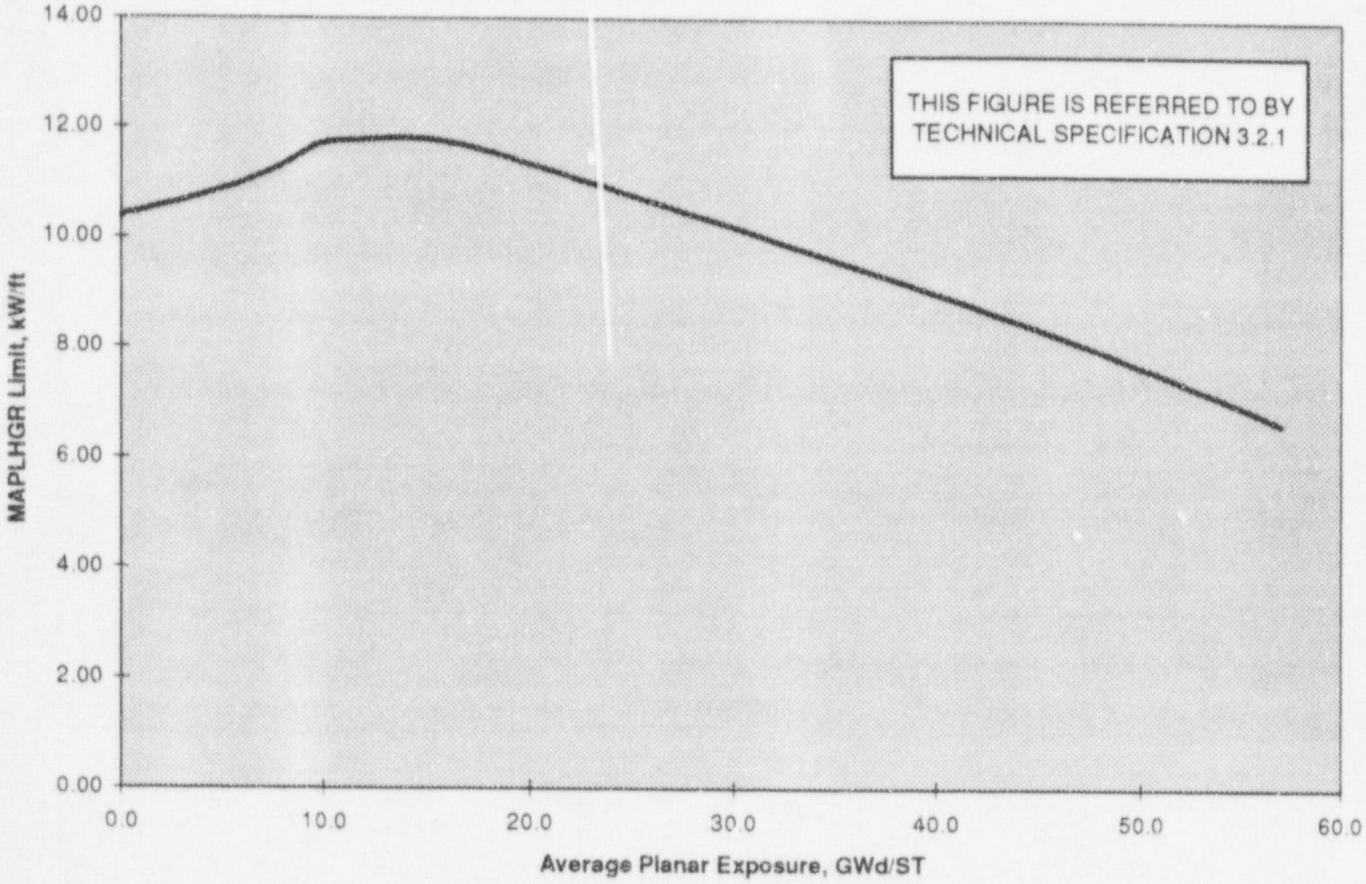
MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FUEL TYPE P9DTB406-12GZ (GE13)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	10.67	7.0	11.72	25.0	10.89
0.2	10.72	8.0	11.83	30.0	10.28
1.0	10.82	9.0	11.92	35.0	9.67
2.0	10.96	10.0	12.01	40.0	9.06
3.0	11.11	12.5	11.95	45.0	8.42
4.0	11.27	15.0	11.86	50.0	7.75
5.0	11.43	17.5	11.74	55.0	7.05
6.0	11.60	20.0	11.50	57.58	6.67

FIGURE 5

MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FUEL TYPE P9DTB409-13GZ (GE13)



Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)	Avg Plan Exposure (GWd/ST)	MAPLHGR (kW/ft)
0.0	10.38	7.0	11.16	25.0	10.78
0.2	10.42	8.0	11.34	30.0	10.21
1.0	10.48	9.0	11.54	35.0	9.62
2.0	10.57	10.0	11.73	40.0	9.01
3.0	10.67	12.5	11.80	45.0	8.37
4.0	10.77	15.0	11.80	50.0	7.69
5.0	10.88	17.5	11.63	55.0	6.96
6.0	11.00	20.0	11.35	56.99	6.67

FIGURE 6

POWER-DEPENDENT MAPLHGR MULTIPLIER, MAPFAC(P)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.1

VALID FOR 7 OR MORE TBVs IN-SERVICE, RPT IN-SERVICE AND MAX 90° F FWTR

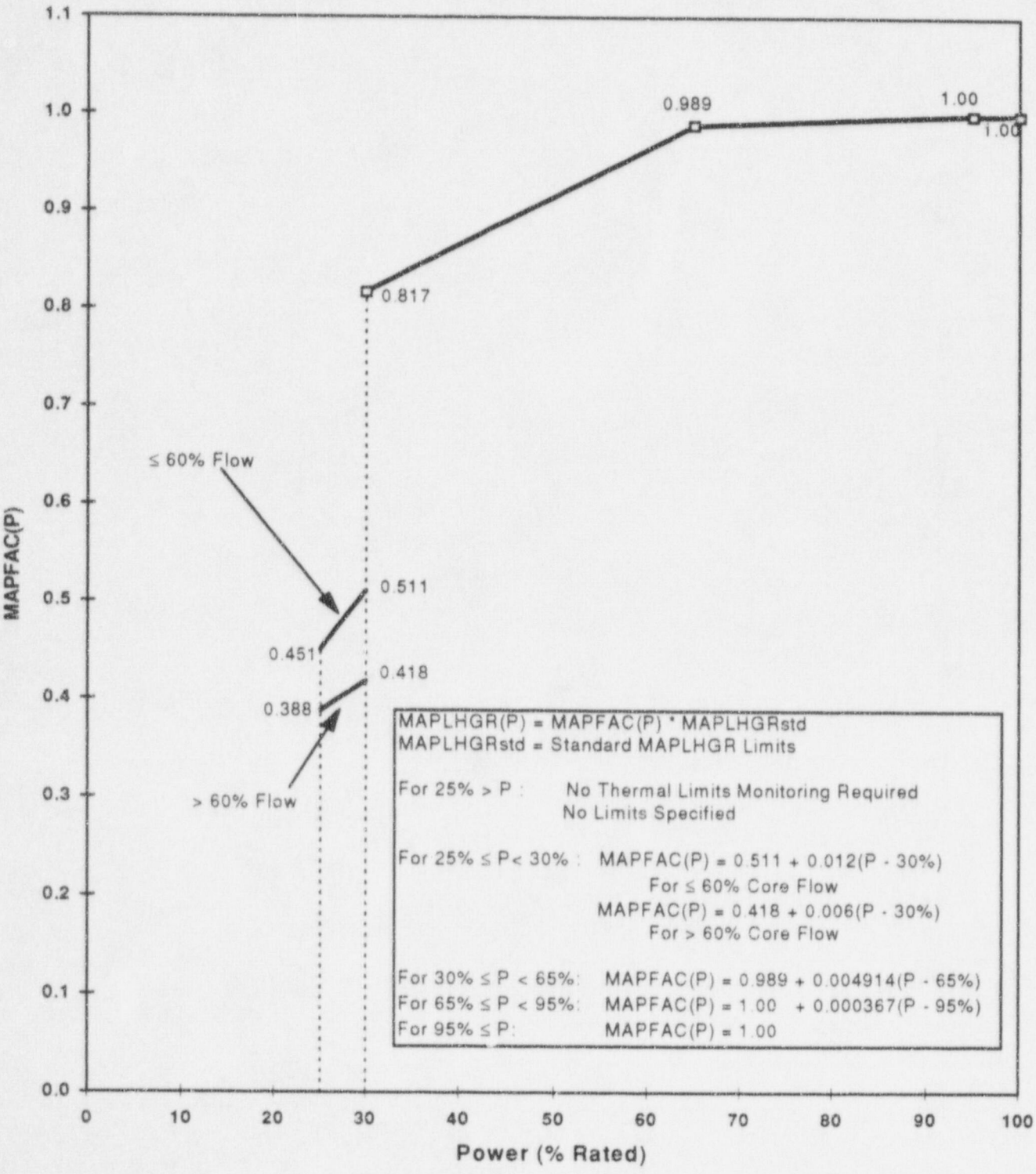


FIGURE 7

POWER-DEPENDENT MAPLHGR MULTIPLIER, MAPFAC(P)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.1

VALID FOR 3 OR MORE TBVOOS OR F[illegible]OOS AND MAX 90°F FWTR

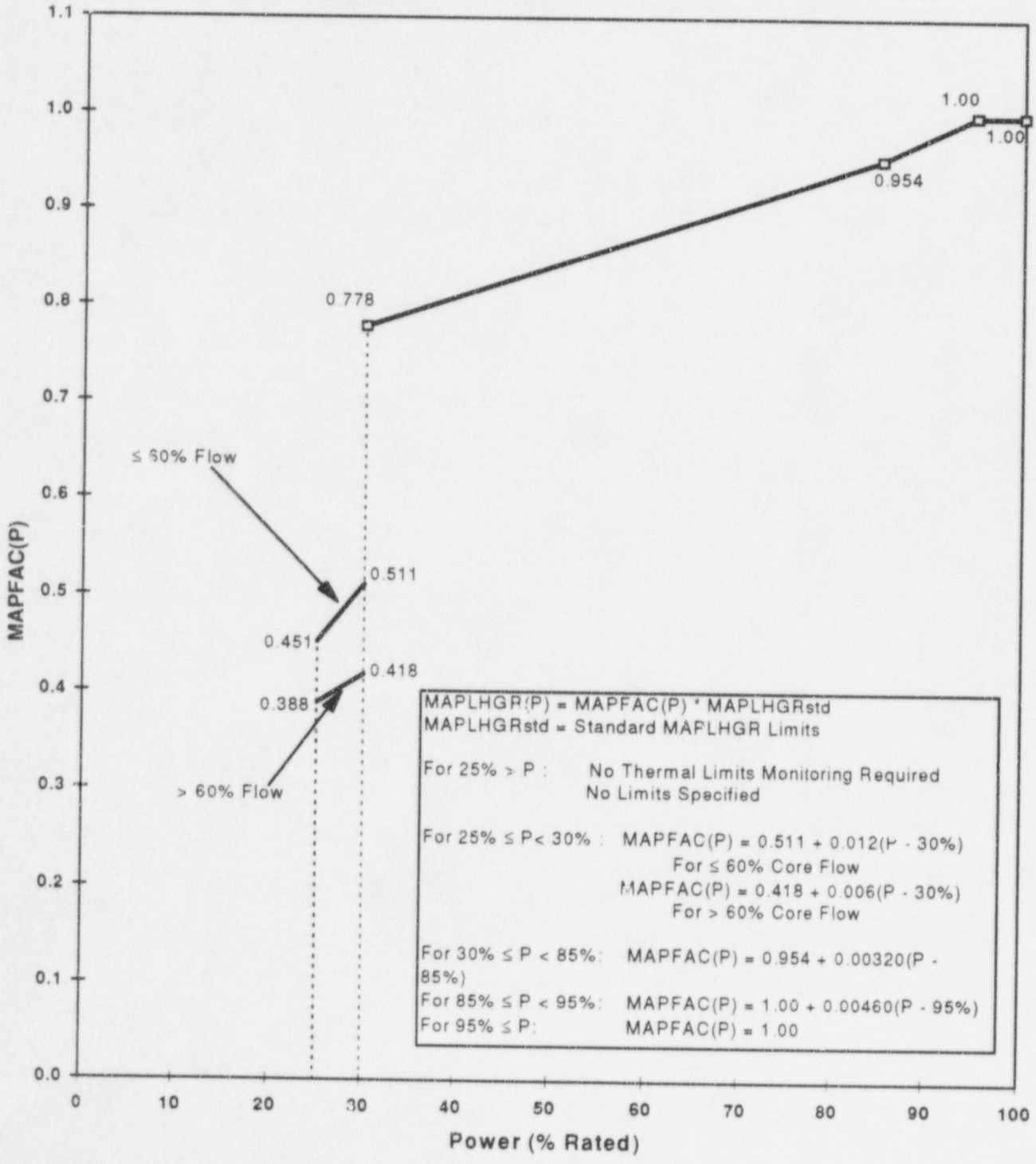


FIGURE 8

FLOW-DEPENDENT MAPLHGR MULTIPLIER, MAPFAC(F)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.1

VALID FOR 2 LOOP RECIRC FLOW

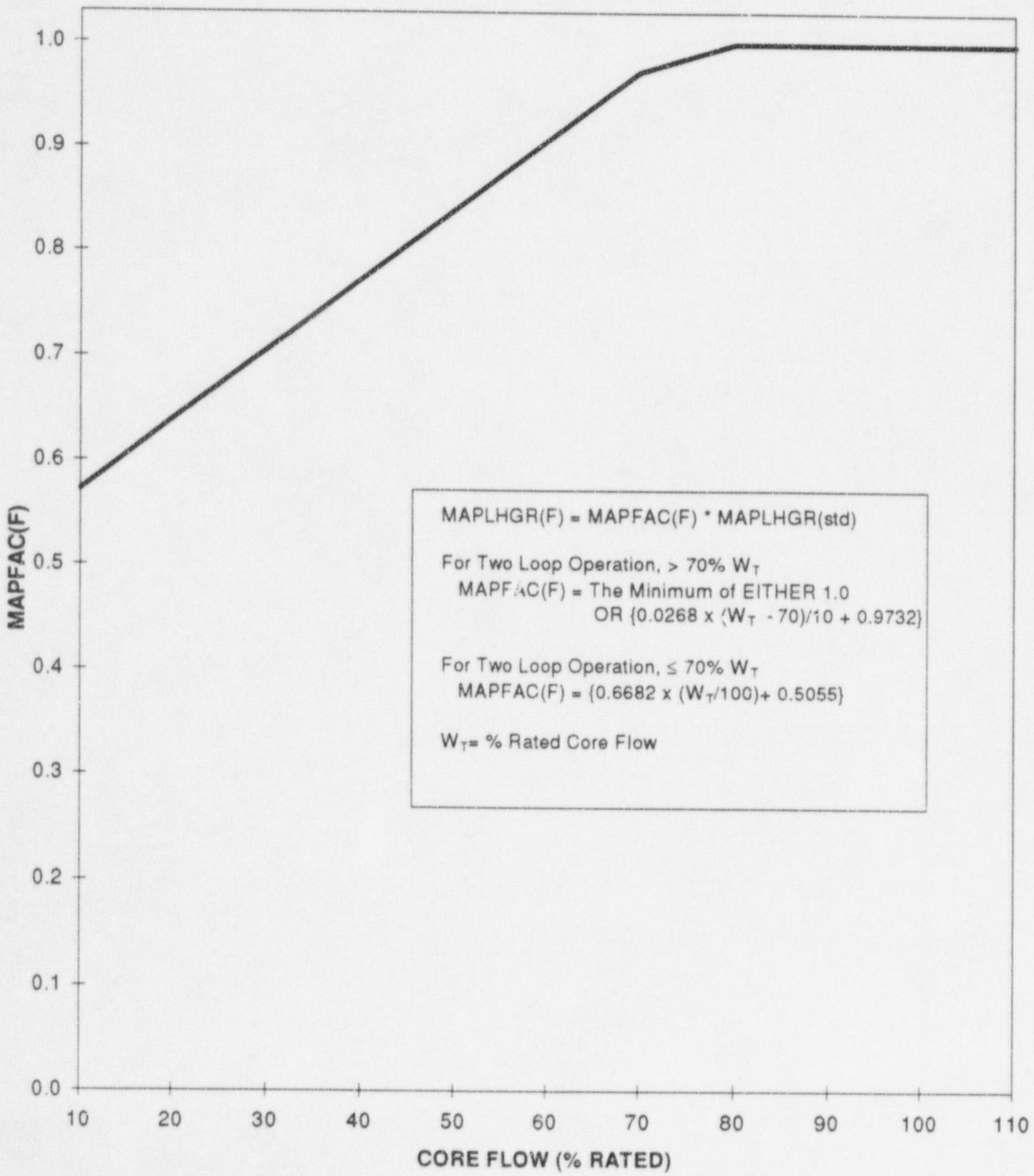


FIGURE 9

FLOW-DEPENDENT MAPLHGR MULTIPLIER, MAPFAC(F)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.1 AND 3.4.1

VALID FOR SINGLE LOOP RECIRC FLOW

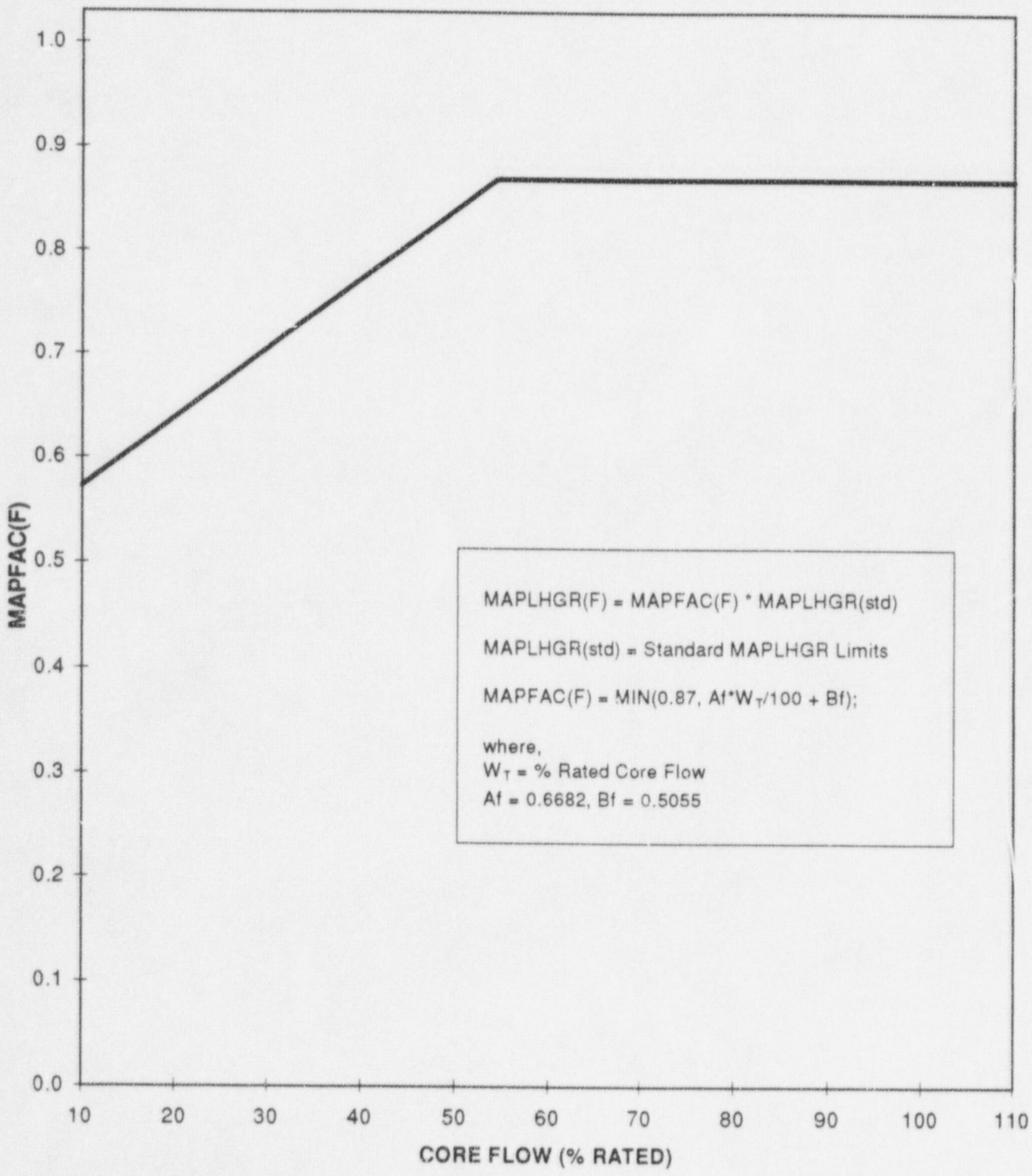


TABLE 1

OPERATING LIMIT MINIMUM CRITICAL POWER RATIO (OLMCPR)

Applicable to all fuel types

Use in conjunction with Figures 10 and 11

Add 0.02 to the OLMCPR when in Single Loop Operation

These Tables are referred to by Technical Specification 3.2.2, 3.4.1 and 3.7.6

	TBV In Service and RPT In Service		TBV out of Service (3 or more TBVOOS)		RPT Out of Service	
	OPT. B ($\tau=0$)	OPT. A ($\tau=1$)	OPT. B ($\tau=0$)	OPT. A ($\tau=1$)	OPT. B ($\tau=0$)	OPT. A ($\tau=1$)
BOC to EOR - 2000 MWd/ST	1.30	1.35	1.38	1.41	1.38	1.46
EOR - 2000 MWd/ST to EOC	1.33	1.36	1.38	1.41	1.38	1.46

NOTES:

1) When Tau does not equal 0 or 1, use linear interpolation.

FIGURE 10

POWER-DEPENDENT MCPR LIMIT, OLMCPR(P)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.2

VALID FOR ALL CONDITIONS

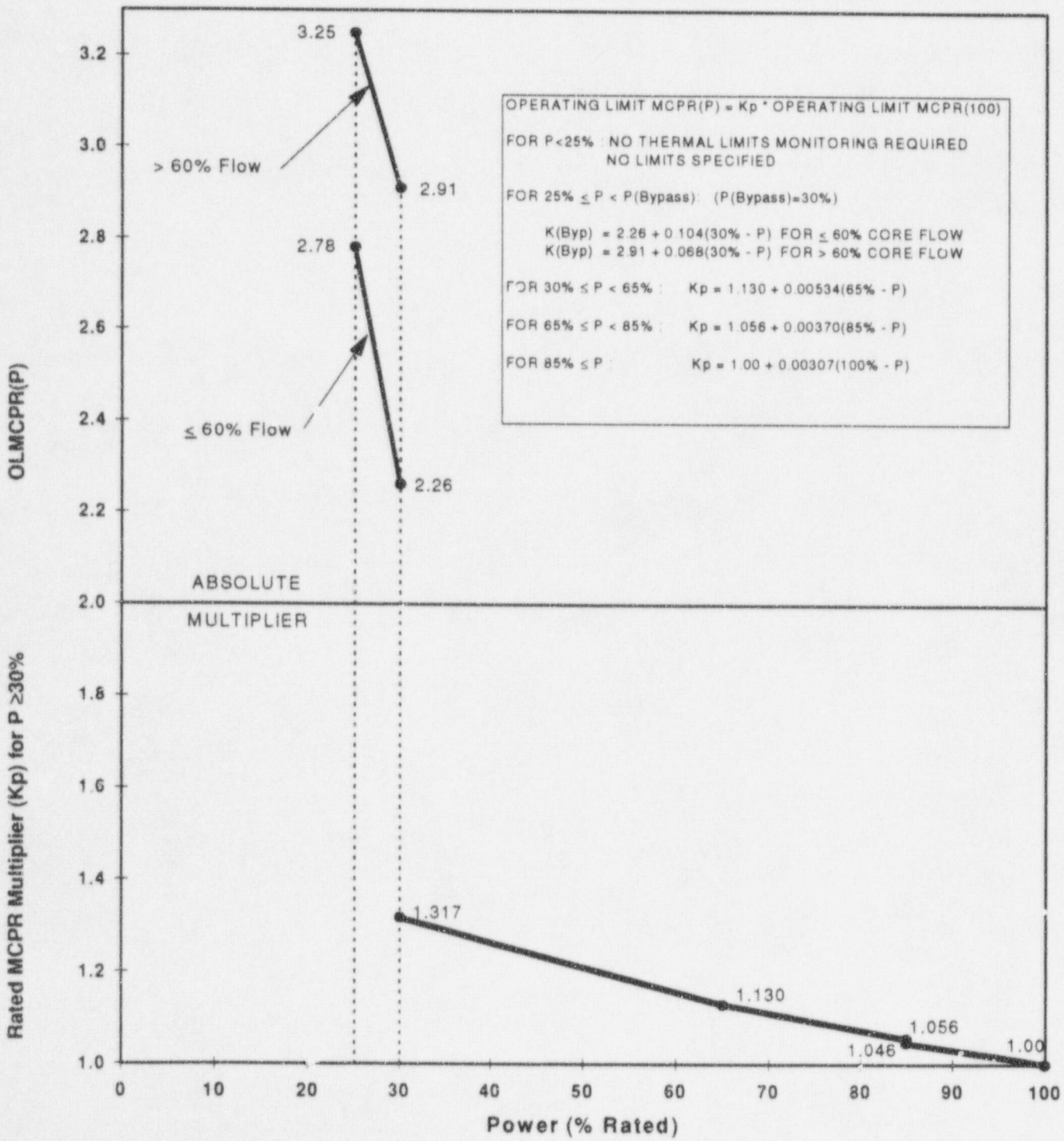


FIGURE 11

FLOW-DEPENDENT MCPR LIMITS, OLMCPR(F)
THIS FIGURE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.2.2 AND 3.4.1

VALID FOR ALL CONDITIONS

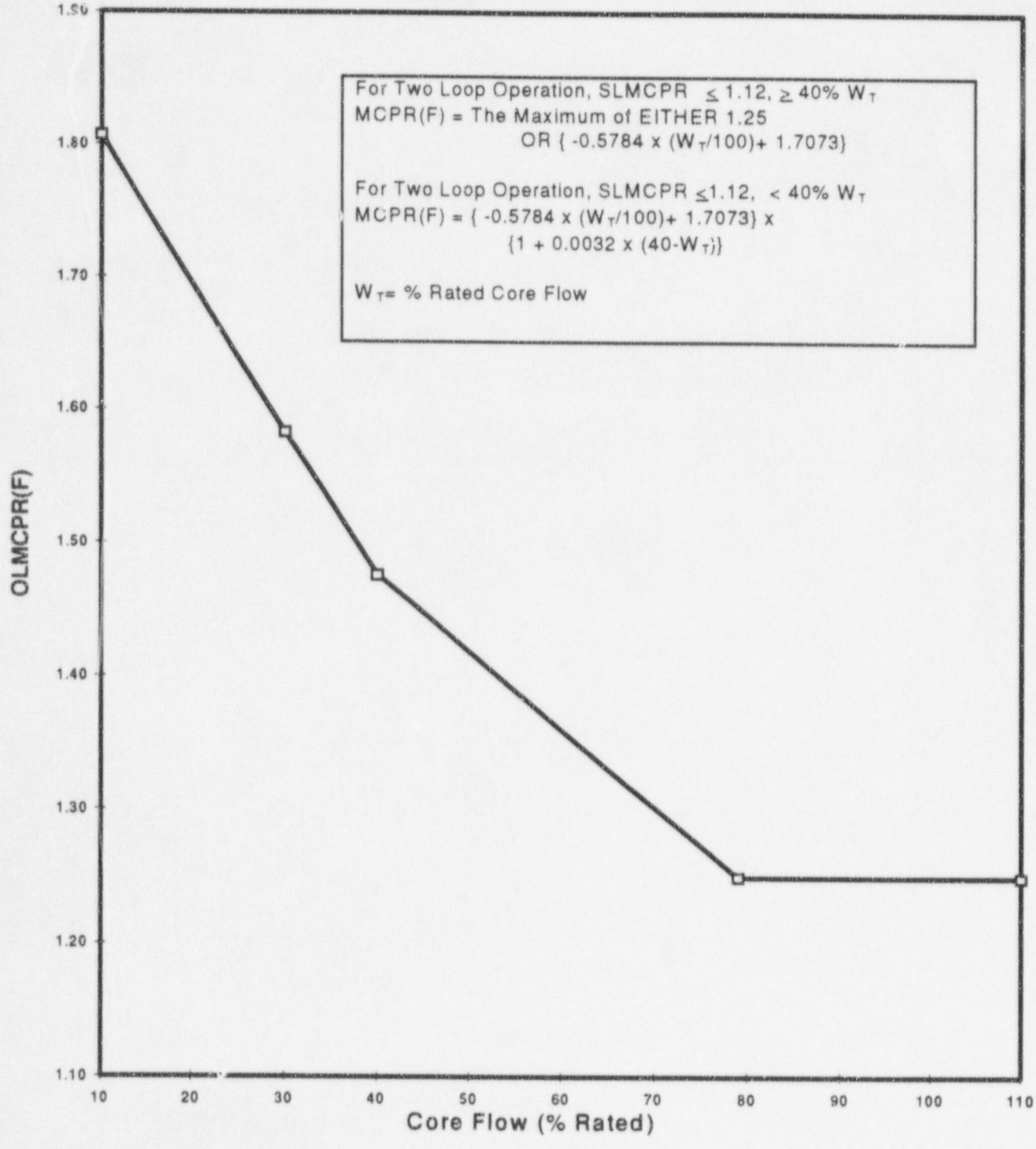


TABLE 2

ROD BLOCK MONITOR ANALYTICAL LIMITS, ALLOWABLE VALUES, AND MCPR LIMITS THIS TABLE IS REFERRED TO BY TECHNICAL SPECIFICATION 3.3.2.1

Applicability: **BOC to EOC**

FUNCTION	ANALYTICAL LIMIT(1)	ALLOWABLE VALUE(1)	MCPR LIMIT
Low Power Range - Upscale	≤ 120.0%	≤ 118.4%	< 1.70 (2)
Intermediate Power Range - Upscale	≤ 115.2%	≤ 113.6%	< 1.70 (2)
High Power Range - Upscale	≤ 110.2%	≤ 108.6%	< 1.70 (2) < 1.40 (3)
Inop	N/A	N/A	< 1.70 (2) < 1.40 (3)
Downscale	≥ 1.0%	≥ 2.5%	< 1.70 (2) < 1.40 (3)
Bypass Time Delay(4)	----	----	----

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(1) These Trip Level Settings (with RBM filter) are based on a cycle-specific rated RWE MCPR limit of 1.30 and are consistent with an RBM filter time constant between 0.1 and 0.55 seconds.

(2) This is the MCPR limit (given THERMAL POWER ≥ 28.3% and < 90% RTP) below which the RBM is required to be OPERABLE (see COLR references 2 and 5 and TS Table 3.3.2.1-1).

(3) This is the MCPR limit (given THERMAL POWER ≥ 90% RTP) below which the RBM is required to be OPERABLE (see COLR references 2 and 5 and TS Table 3.3.2.1-1).

(4) This time delay option is currently not in use at Peach Bottom Unit 2 (see COLR reference 5).

TABLE 3

DESIGN LINEAR HEAT GENERATION RATE (LHGR) LIMITS[1]

FUEL TYPE	LHGR LIMIT
GE11	14.4 kW/ft
GE13	14.4 kW/ft

[1] The LHGR limits provided above are the beginning of life (maximum) values. The LHGR limits as a function of fuel exposure are provided in Reference (3).

TABLE 4

TURBINE BYPASS VALVE PARAMETERS

TURBINE BYPASS SYSTEM RESPONSE TIMES

Maximum delay time before start of bypass valve opening following generation of the turbine bypass valve flow signal	0.10 sec
Maximum time after generation of a turbine bypass valve flow signal for bypass valve position to reach 80% of full flow (includes the above delay time)	0.30 sec.
Minimum required number of bypass valves to maintain system operability	7