COOPER NUCLEAR STATION

CORE OPERATING LIMITS REPORT

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1.0 INTRODUCTION

This report provides the cycle-specific limits for operation of the Cooper Nuclear Station through Cycle 17. It includes the limits for the Rod Block Monitor Upscale Set Point, Average Planar Linear Heat Generation Rate (APLHGR), Linear Heat Generation Rate (LHGR), and Minimum Critical Power Ratio (MCPR). If any of these limits are exceeded, the action will be taken as defined in the Technical Specifications.

These core operating limit values have been determined using the NRC-approved methodologies given in References 1 and 4, and are established such that all applicable limits of the plant safety analysis are met.

2.0 CORE OPERATING LIMITS

Cooper Nuclear Station shall be operated within the bounds of the below limits. The applicable Technical Specifications are referenced in each subsection.

2.1 Rod Block Monitor Upscale Set Point

Technical Specification Table 3.2.C states that the Rod Block Monitor (RBM) upscale (Power Referenced) trip level setting is determined from the following:

Lowest Rated MCPR Limit:	Low Trip Set Point (LTSP) (LPSP ≤ P < IPSP)	Intermediate Trip Set Point (ITSP) (IPSP ≤ P < HPSP)	High Trip Set Point (HTSP) (HPSP ≤ P)
≥ 1.20	≤ 117.0/125	≤ 111.2/125	≤ 107.4/125
≥ 1.25	≤ 120.0/125	≤ 115.2/125	≤ 110.2/125
≥ 1.30	≤ 123.0/125	≤ 118.0/125	≤ 113.2/125

LPSP, IPSP, and HPSP are the Low Power Set Point, Intermediate Power Set Point, and High Power Set Point respectively, as listed on Technical Specification Table 3.2.C.

The lowest rated MCPR limit to be used with this table for Cycle 17 is ≥ 1.20. The trip level settings associated with this MCPR limit have been generically calculated and verified to bound the Rod Withdrawal Error Analysis for Cycle 17 operation.

Technical Specifications Reference: 3.2.C.

2.2 Average Planar Linear Heat Generation Limits

The limiting APLHGR value for the most limiting lattice (excluding natural uranium) for each fuel bundle as a function of Planar Average Exposure and core power and flow is calculated by taking the value from Figures 1, 2, 3, or 4, and multiplying it by the smaller of the MAPLHGR Flow Factor, $MAPFAC_F$ from Figure 5, or the Power-Dependent MAPLHGR Factor, $MAPFAC_P$ from Figure 6. APLHGR values

were determined with the SAFE/REFLOOD LOCA methodology and are given in References 3 through 6, while the $MAPFAC_F$ and $MAPFAC_P$ were determined in Reference 8.

The fuel bundles referred to in Figures 1, 2, 3, and 4 consists of multiple combinations of enriched uranium and gadolinia filled lattices with each having its own calculated maximum APLHGR (MAPLHGR) value. Hence, these fuel bundles have multiple MAPLHGR limiting values at a given planar exposure. The MAPLHGR values for these lattices, along with the axial location of each lattice in the bundle, are considered proprietary information by General Electric and are given in References 5 and 6 as a function of planar average exposure.

The MAPLHGR limits referred to above are for two recirculation loop operations. For single loop operation, the limiting APLHGR value is obtained as explained by the note at the bottom of Figures 1 through 4 per Reference 6.

Technical Specification Reference: 3.11.A

2.3 Linear Heat Generation Rate Limit

The limiting power density and maximum allowable Linear Heat Generation Rate (LHGR) referred to in the Technical Specification Sections 1.0.A.4 and 3.11.B are the design LHGR; this design LHGR value is given in Table 1.

2.4 Minimum Critical Power Ratio Limits

The operating limit MCPR (OLMCPR) values are a function of core thermal power, core flow, fuel bundle, scram time (τ), and fuel exposure. The scram time (τ) is determined from CNS Procedure 10.9, Control Rod Scram Time Evaluation; the OLMCPR values are provided as follows:

2.4.1 For core thermal power $\geq$ 25 percent and $<$ 30 percent of rated power, the OLMCPR is equal to the power dependent MCPR ($MCPR_P$) from Figure 7.

2.4.2 For core thermal power $\geq$ 30 percent of rated power, the OLMCPR is the greater of either:

2.4.2.1 The applicable flow dependent MCPR ($MCPR_F$) determined from Figure 8, or

2.4.2.2 The appropriate scram time (τ) dependent MCPR at rated power from Figures 9 and 10, multiplied by the applicable power dependent MCPR multiplier (K_P) from Figure 7.

Technical Specification Reference: 3.11.C

3.0 REFERENCES

1. NEDE-24011-P-A-10, February 1991, General Electric Standard Application for Reactor Fuel. (The approved revision at the time the reload analyses were performed.)

2. Supplemental Reload Licensing Submittal for Cooper Nuclear Station Reload 16, Cycle 17, 24A5187, Revision June 1996.

3. Letter No. 262-95-182 from Ala Alzaben of General Electric to Gautam Sen of NPPD, for Cooper Nuclear Station Reload 16, Cycle 17, Lattice Dependent MAPLHGR, dated September 15, 1995.

4. NEDO-24045, August 1977, Loss-of-Coolant Accident Analysis Report for Cooper Nuclear Power Station.

5. NEDE-24045P Supplement 1, December 1989, Loss-of-Coolant Accident Analysis Report for Cooper Nuclear Station.

6 NEDE-24045P Supplement 2, Loss-of-Coolant Accident Analysis Report for Cooper Nuclear Power Station Reload 15, Cycle 16, March 1993.

7. Letter (with attachment), R. H. Buckholz (GE) to P. S. Check (NRC) dated September 5, 1980, Response to NRC Request for Information on ODYN Computer Model.

8 NEDC-31892P, Revision 1, May 1991, Extended Load Line Limit and ARTS Improvement Program Analysis for Cooper Nuclear Station Cycle 14.

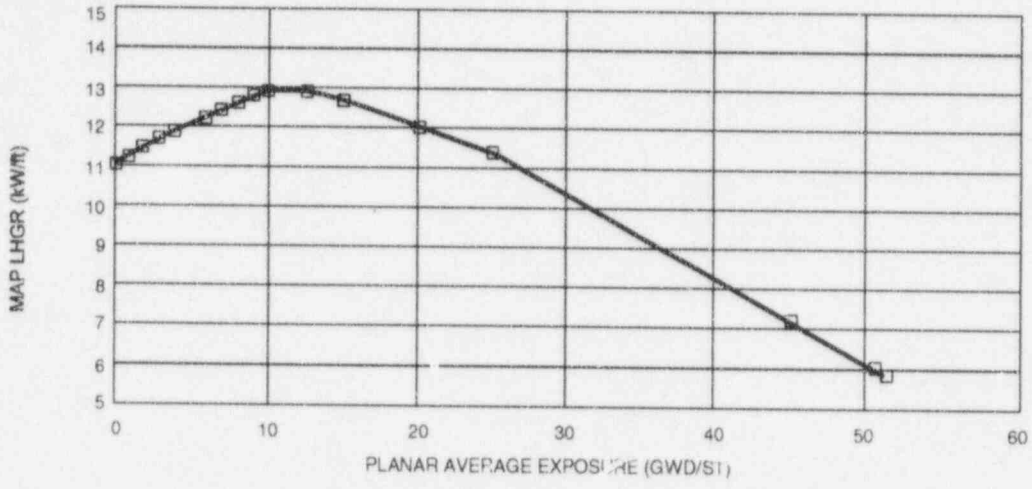
9 Cooper Reload 16/Cycle 17 Revised OPL-7, dated June 8, 1996.

Table 1

LHGR Limit	
Fuel Type	LHGR Limit (kW/Ft)
GE 8x8 NB (3.02%, 3.20%, and 3.48%)	14.4

Figure 1

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) versus Exposure with LPCI Modification and Bypass Holes Plugged, 3.02% GE 8x8 NB Fuel



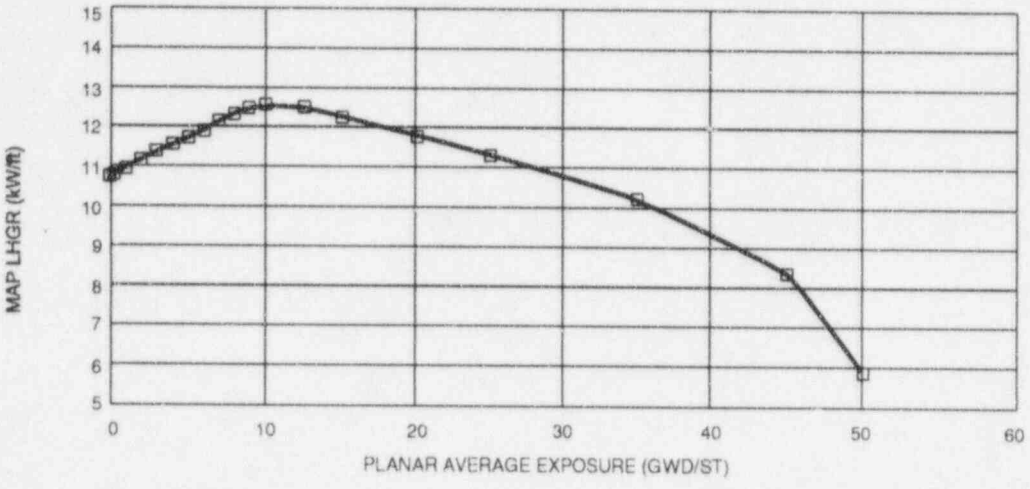
DATA COORDINATES (Reference 5)

Planar Avg. GWD/ST	kW/Ft
0.2	11.07
1.0	11.26
2.0	11.49
3.0	11.73
4.0	11.90
6.0	12.23
7.0	12.41
8.0	12.61
9.0	12.80
10.0	12.93
12.5	12.93
15.0	12.69
20.0	12.02
25.0	11.35
45.0	7.12
50.6	5.92
51.3	5.80

Note: When in single loop operation, a MAPLHGR factor of 0.75 is substituted for the LOCA analysis factors of 1.0 and 0.86 contained in the flow dependent MAPLHGR factor curves in Figure 5.

Figure 2

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) versus Exposure with LPCI Modification and Bypass Holes Plugged, 3.20% GE 8x8 NB Fuel



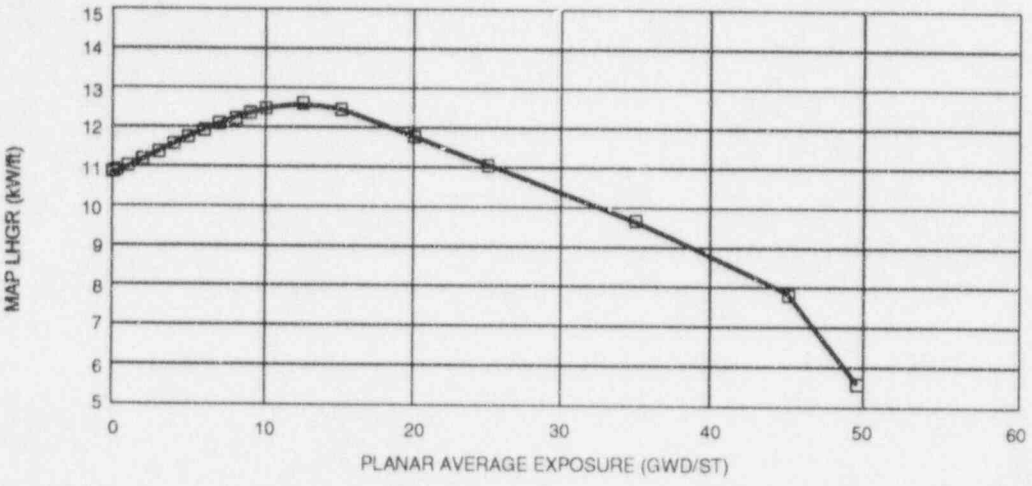
DATA COORDINATES (Reference 5)

Planar Avg. GWD/ST	kW/Ft
0.0	10.80
0.2	10.85
1.0	11.01
2.0	11.23
3.0	11.47
4.0	11.63
5.0	11.80
6.0	11.99
7.0	12.23
8.0	12.38
9.0	12.52
10.0	12.64
12.5	12.57
15.0	12.32
20.0	11.83
25.0	11.34
35.0	10.25
45.0	8.44
50.0	5.90

Note: When in single loop operation, a MAPLHGR factor of 0.75 is substituted for the LOCA analysis factors of 1.0 and 0.86 contained in the flow dependent MAPLHGR factor curves in Figure 5.

Figure 3

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) versus Exposure with LPCI Modification and Bypass Holes Plugged, 3.48% w/11GZ GE 8x8 NB Fuel



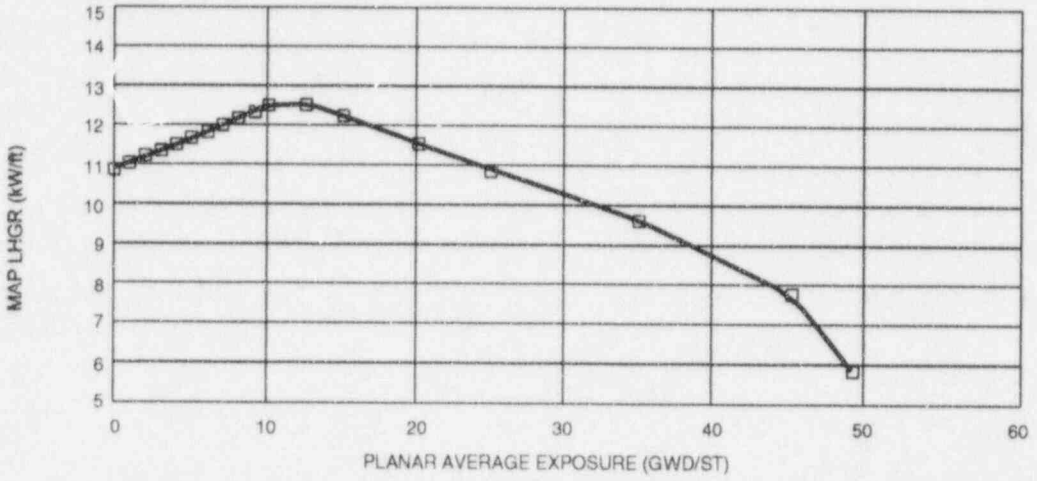
DATA COORDINATES (Reference 6)

Planar Avg. GWD/ST	kW/Ft
0.0	10.85
0.2	10.90
1.0	11.01
2.0	11.17
3.0	11.36
4.0	11.56
5.0	11.76
6.0	11.91
7.0	12.07
8.0	12.23
9.0	12.38
10.0	12.48
12.5	12.61
15.0	12.47
20.0	11.79
25.0	11.05
35.0	9.69
45.0	7.86
49.6	5.62

Note: When in single loop operation, a MAPLHGR factor of 0.75 is substituted for the LOCA analysis factors of 1.0 and 0.86 contained in the flow dependent MAPLHGR factor curves in Figure 5.

Figure 4

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) versus Exposure with LPCI Modification and Bypass Holes Plugged, 3.48% w/12GZ GE 8x8 NB Fuel



DATA COORDINATES (Reference 6)

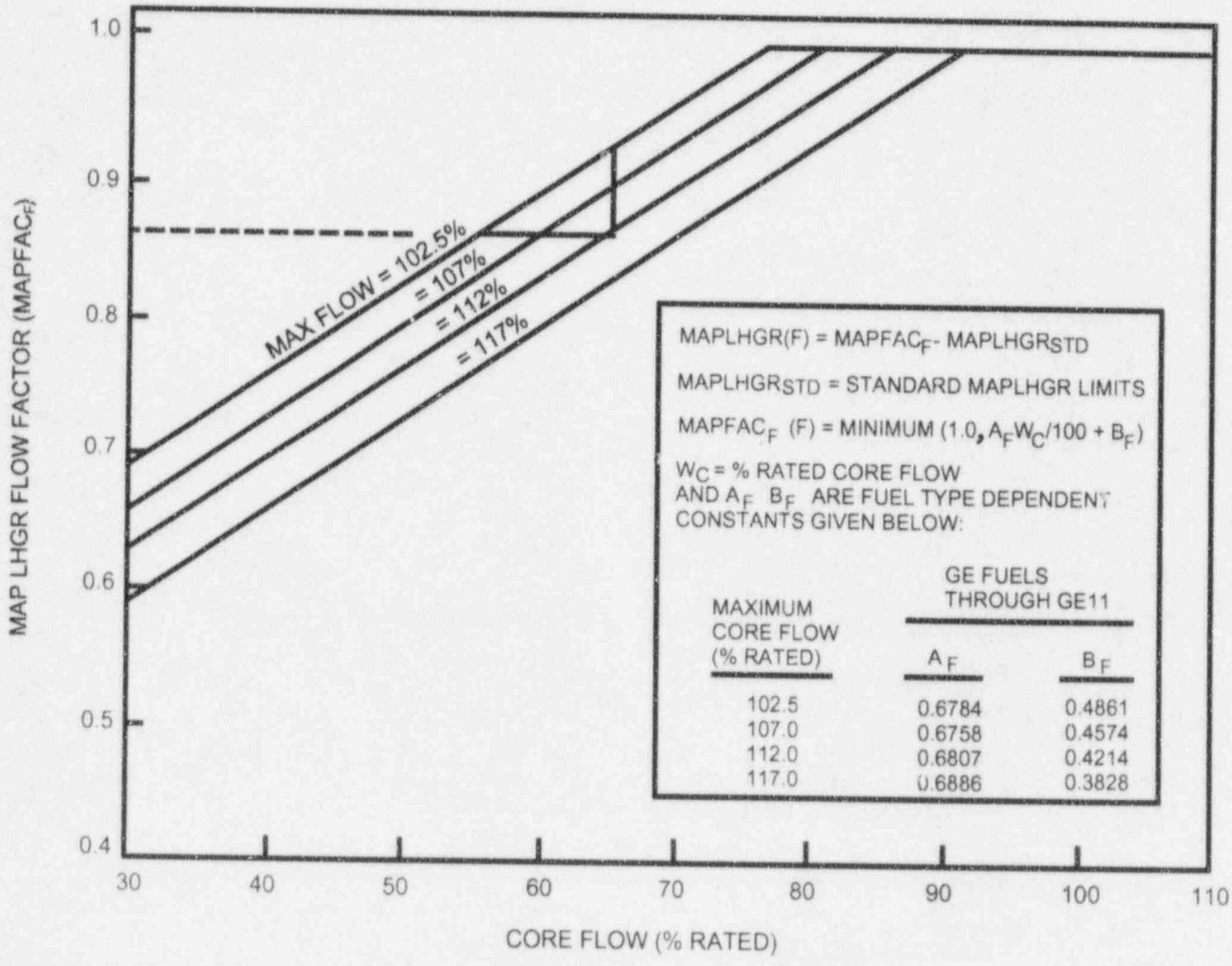
Planar Avg. GWD/ST	kW/Ft
0.0	10.89
0.2	10.94
1.0	11.05
2.0	11.19
3.0	11.34
4.0	11.49
5.0	11.64
6.0	11.80
7.0	11.97
8.0	12.14
9.0	12.31
10.0	12.49
12.5	12.52
15.0	12.23
20.0	11.53
25.0	10.86
35.0	9.60
45.0	7.75
49.0	5.83

Note: When in single loop operation, a MAPLHGR factor of 0.75 is substituted for the LOCA analysis factors of 1.0 and 0.86 contained in the flow dependent MAPLHGR factor curves in Figure 5.

Figure 5

Flow Dependent MAPLHGR Factor
($MAPFAC_F$)

(Reference 8, Section 5.4.4, Figure 5-9)



MAXIMUM CORE FLOW (% RATED)	GE FUELS THROUGH GE11	
	A_F	B_F
102.5	0.6784	0.4861
107.0	0.6758	0.4574
112.0	0.6807	0.4214
117.0	0.6886	0.3828

Figure 6

Power Dependent MAPLHGR Factor
($MAPFAC_p$)

Reference 8, Section 5.4.2, Figure 5-7)

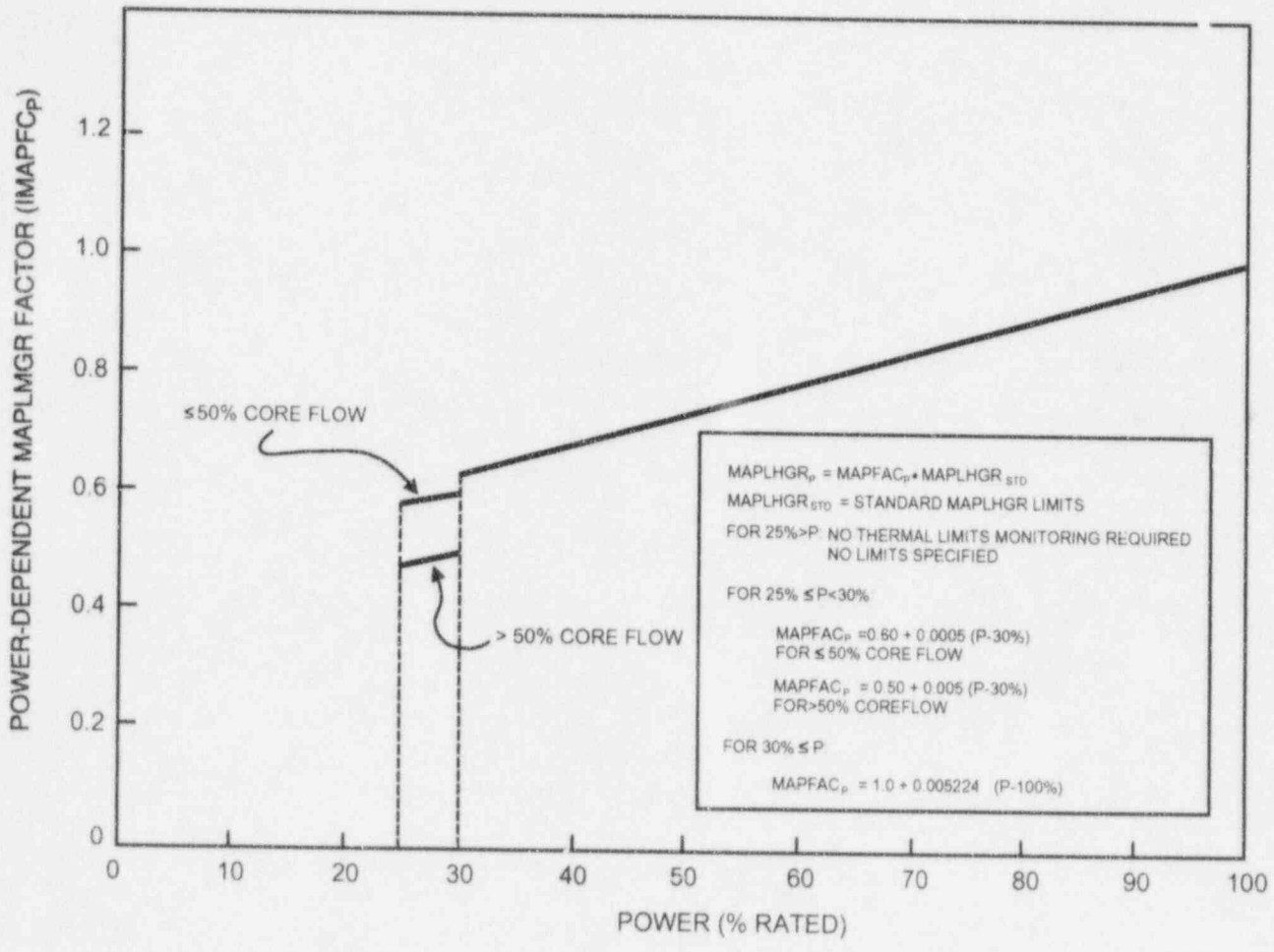


Figure 7

Power Dependent MCPR Limits
($MCPR_p$ and K_p)

(Reference 9)

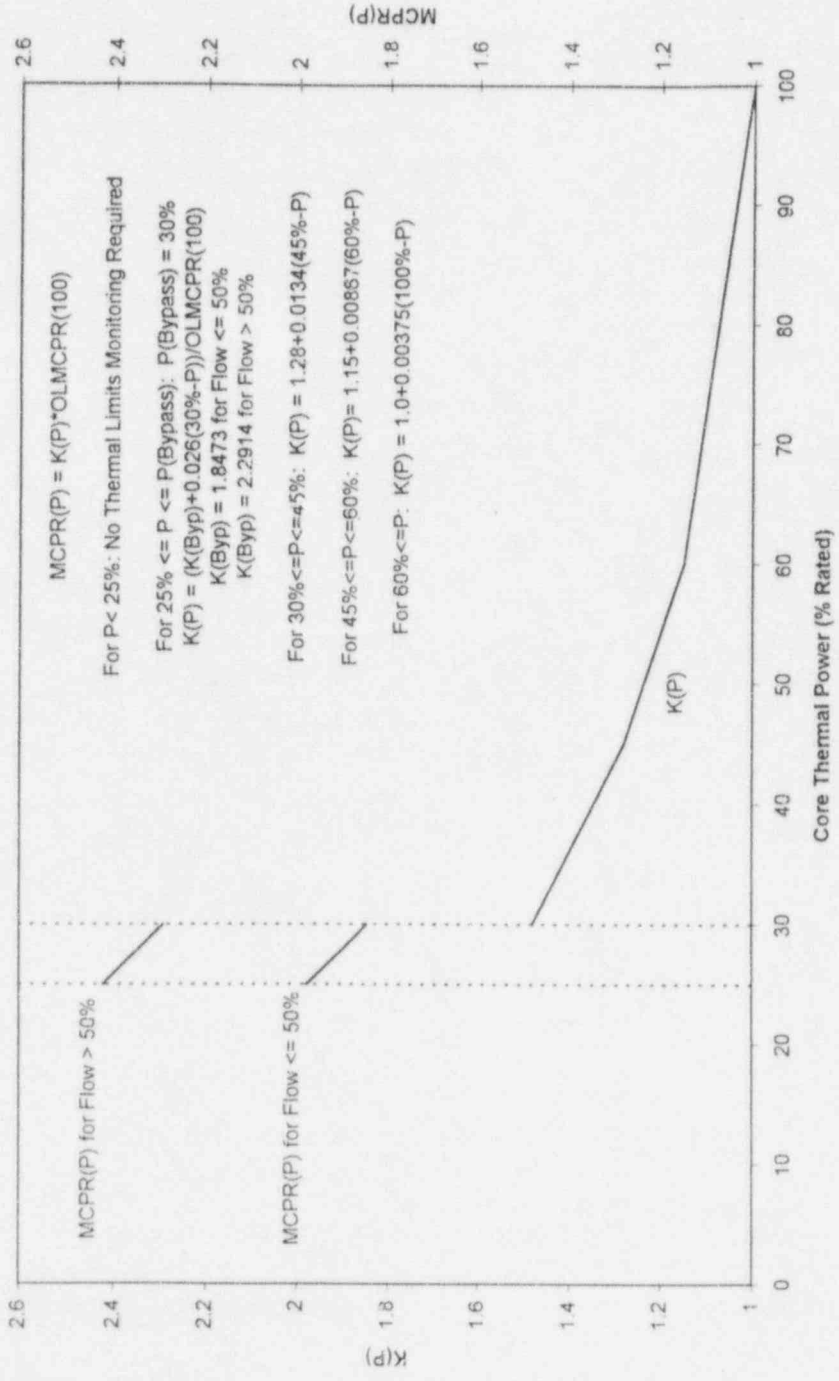


Figure 8

Flow Dependent MCPR Limits
($MCPR_F$)

(Reference 9)

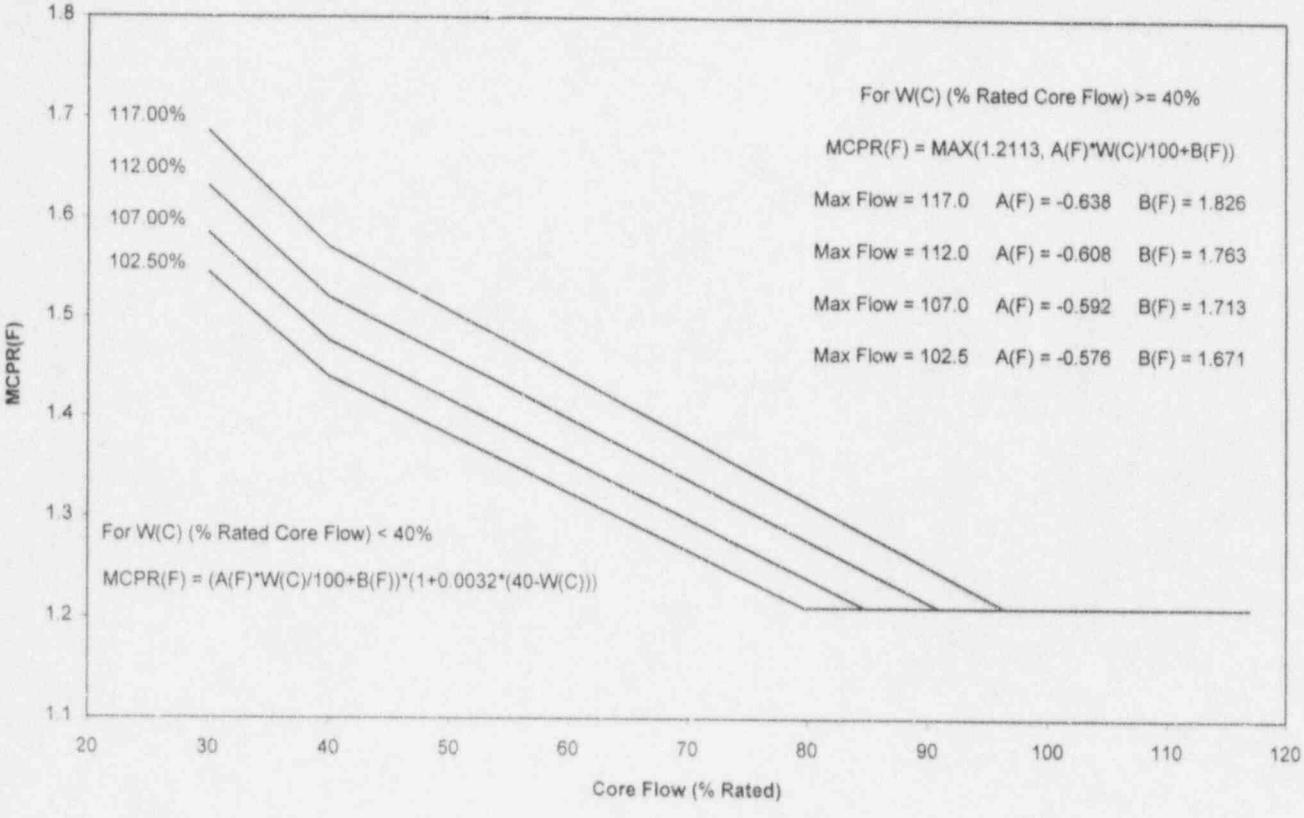
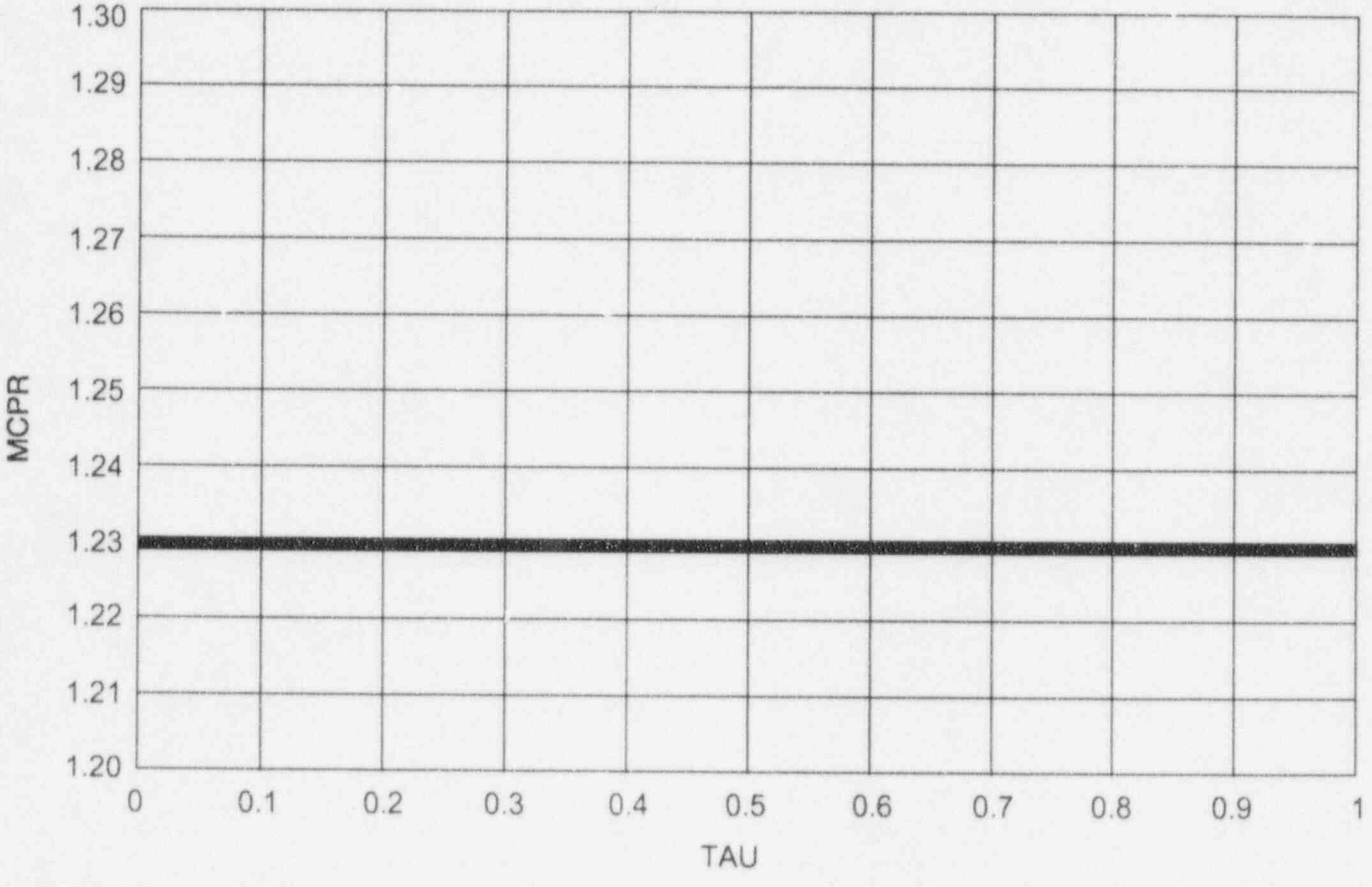


Figure 9

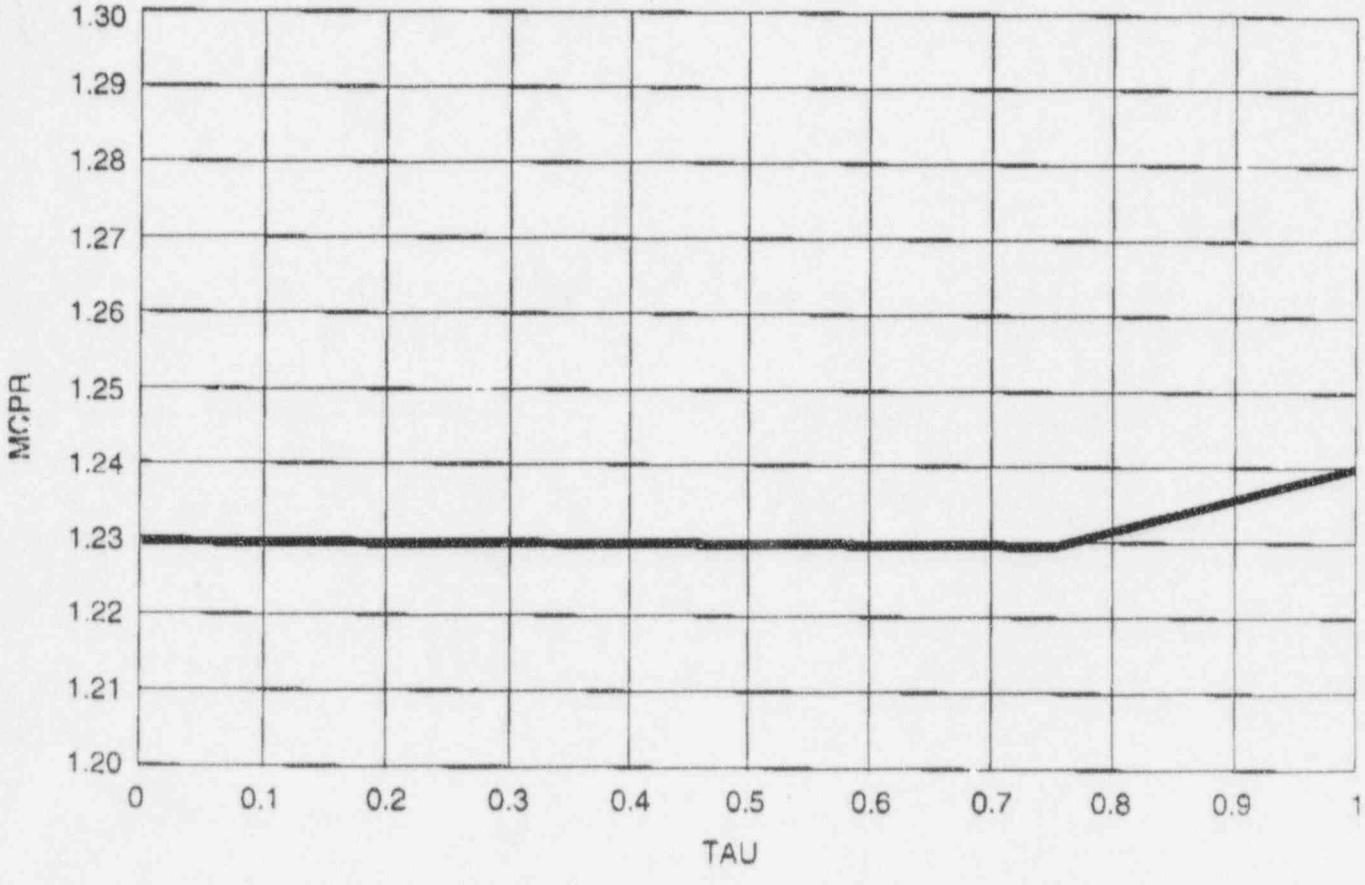
Minimum Critical Power Ratio (MCPR) versus Tau (based on tested measured scram time as defined in Reference 7), GE 8x8 NB Fuel



Exposure Range: BOC17 to EHFP17 - 2205 MWd/MT

Figure 10

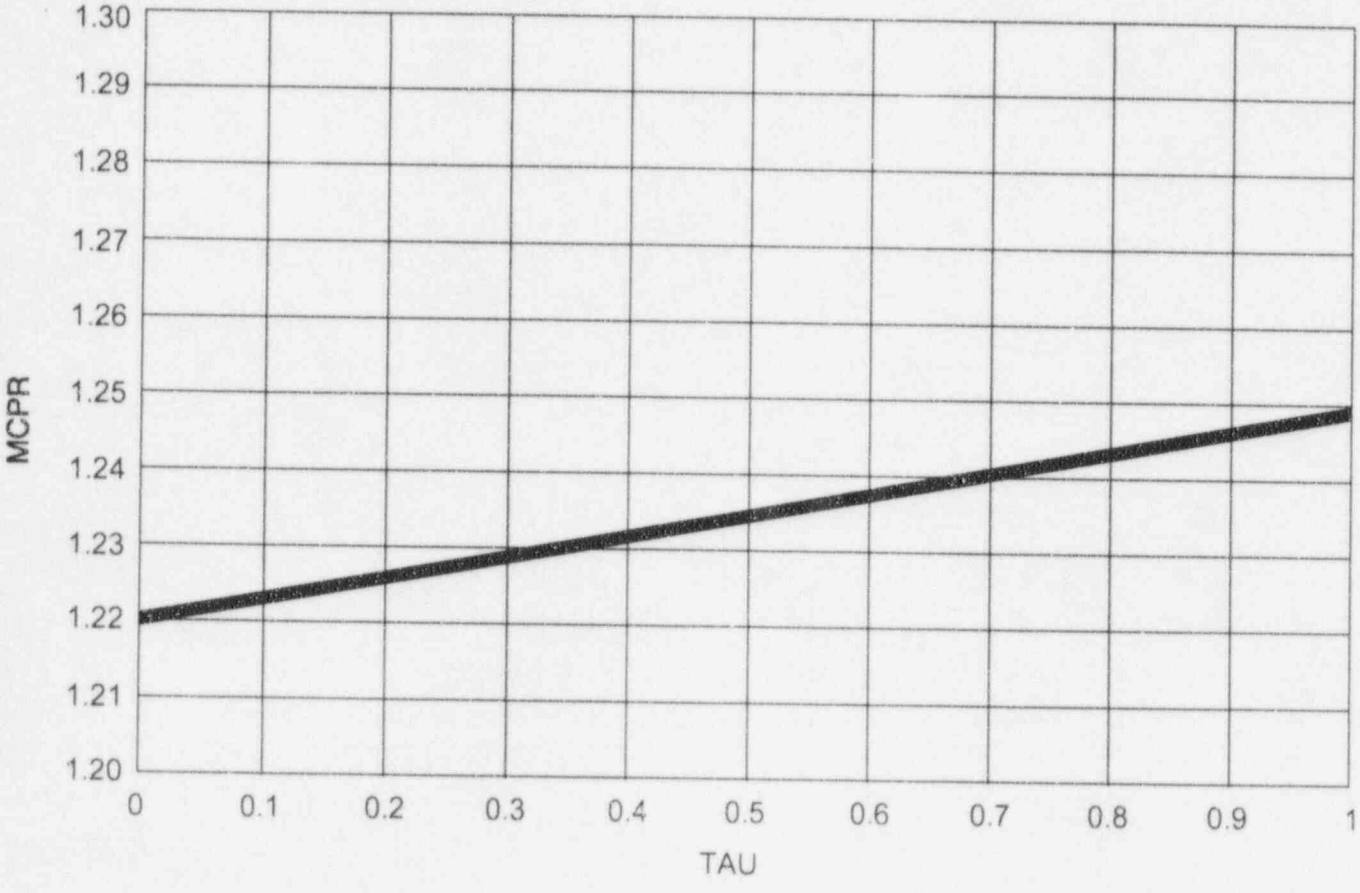
Minimum Critical Power Ratio (MCPR) versus Tau (based on tested measured scram time as defined in Reference 7), GE 8x8 NB Fuel



Exposure Range: EHFP17 - 2205 MWd/MT to EOC17

Figure 11

Minimum Critical Power Ratio (MCPR) versus Tau with One Turbine Bypass Valve Unavailable (based on tested measured scram time as defined in Reference 7), GE 8x8 NB Fuel



Exposure Range: BOC17 to EOC17