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**U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555**

**Edwin I. Hatch Nuclear Plant - Unit 2
Unit 2 Cycle 16 Core Operating Limits Report (COLR)**

Ladies and Gentlemen:

In accordance with Technical Specification 5.6.5, Southern Nuclear Operating Company hereby submits the Edwin I. Hatch Nuclear Plant Unit 2 Cycle 16 Core Operating Limits Report, Revision 0.

Should you have any questions in this regard, please contact this office.

Respectfully submitted,

A handwritten signature in cursive script that reads "Lewis Sumner".

H. L. Sumner, Jr.

IFL/eb

Enclosure: Unit 2 Cycle 16 Core Operating Limits Report, Revision 0

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**SOUTHERN NUCLEAR OPERATING COMPANY
EDWIN I. HATCH NUCLEAR PLANT**

**Unit 2 Cycle 16
CORE OPERATING LIMITS REPORT**

Revision 0

Southern Nuclear Operating Company
Post Office Box 1295
Birmingham, Alabama 35201

Edwin I. Hatch Nuclear Plant
Unit 2 Cycle 16
Core Operating Limits Report

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1.0 INTRODUCTION

The Core Operating Limits Report (COLR) for Plant Hatch Unit 2 Cycle 16 is prepared in accordance with the requirements of Technical Specification 5.6.5. The core operating limits presented herein were developed using NRC-approved methods (References 1 and 2). Results from the fuel vendor's reload analyses for the fuel in Unit 2 Cycle 16 are documented in References 2, 3, and 4.

The following core operating limits are included in this report:

- a. Average Planar Linear Heat Generation Rate (APLHGR) -- Technical Specification 3.2.1
- b. Minimum Critical Power Ratio (MCPR) -- Technical Specification 3.2.2

From a fuel thermal limits perspective, Unit 2 can be operated with only one of the following systems out of service at a time:

- End-of-cycle recirculation pump trip (EOC-RPT)
- Turbine bypass valves
- High pressure feedwater heaters

Also included in this report is the maximum allowable scram setpoint for the Period Based Detection Algorithm (PBDA) in the Oscillation Power Range Monitor (OPRM).

2.0 APLHGR LIMITS (Technical Specification 3.2.1)

The APLHGR limit for each fuel assembly is the applicable rated-power, rated-flow APLHGR limit taken from Figures 2-3 through 2-7, multiplied by the smaller of either:

- a. The flow-dependent multiplier, $MAPFAC_F$, from Figure 2-1,

or

- b. The power-dependent multiplier, $MAPFAC_P$, as determined by Table 2-1.

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Since every assembly in the core contains more than one enriched lattice, GESTAR-II (Reference 1) requires that the appropriate APLHGR limit from Figures 2-3 through 2-7 be applied to every axial location in the fuel assembly, when APLHGR values are hand-calculated.

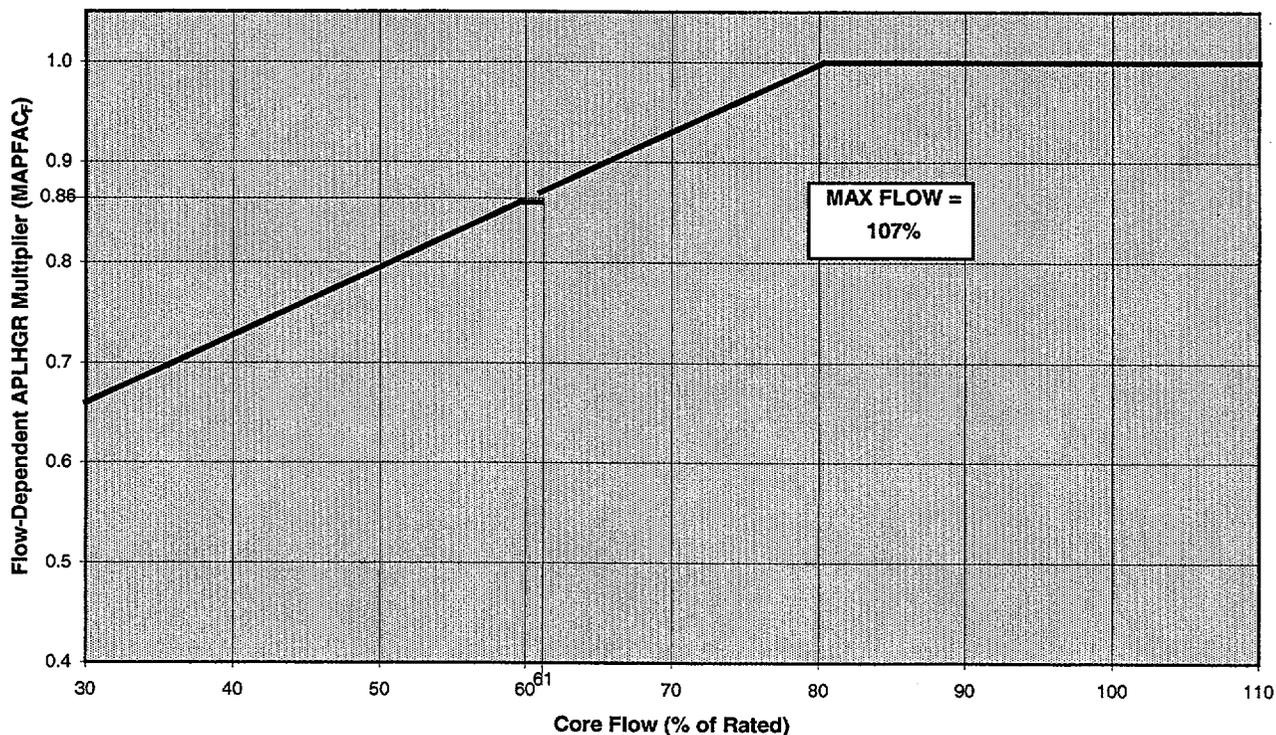
When APLHGR values are determined by the process computer, the lattice type-dependent APLHGR limits are used. Under these conditions, some axial locations may have APLHGR values exceeding the values shown in the figures.

TABLE 2-1

APLHGR Operating Flexibility Options

Cycle Average Exposure	High Pressure Feedwater Heaters	MAPFAC _p
BOC to EEOC	In Service	Figure 2-2A
BOC to EEOC	Out of Service	Figure 2-2B

BOC = Beginning of Cycle
EEOC = Extended End of Cycle



$MAPFAC_F = \text{Minimum} [1.0, (A + B * F), MAPMULT]$

Maximum Core Flow (% of Rated)	A	B
107.0	0.4574	0.006758

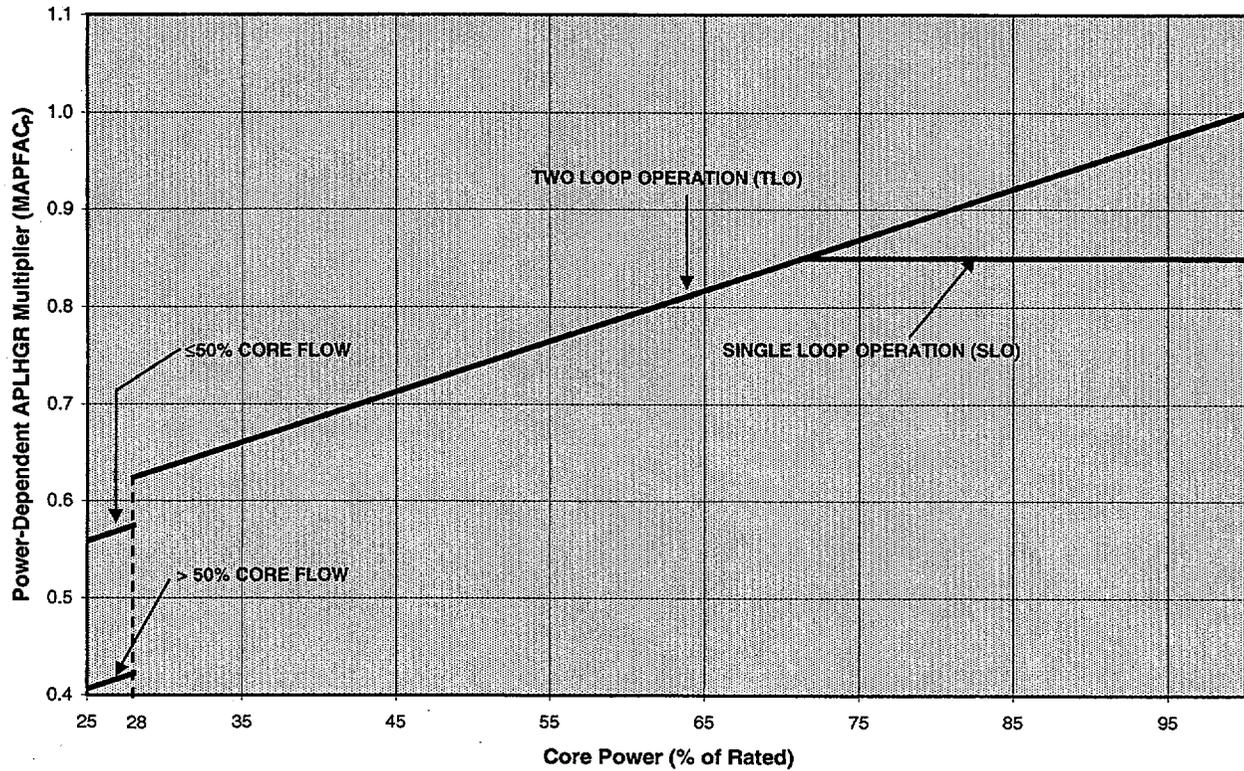
MAPMULT = 1.0 for F > 61.0
 0.86 for F ≤ 61.0

F = Percent of Rated Core Flow

FIGURE 2-1

Flow-Dependent APLHGR Multiplier (MAPFAC_F) versus Core Flow

Plant Hatch Unit 2 Cycle 16
 Core Operating Limits Report



$$MAPFAC_P = A - B (P_0 - P)$$

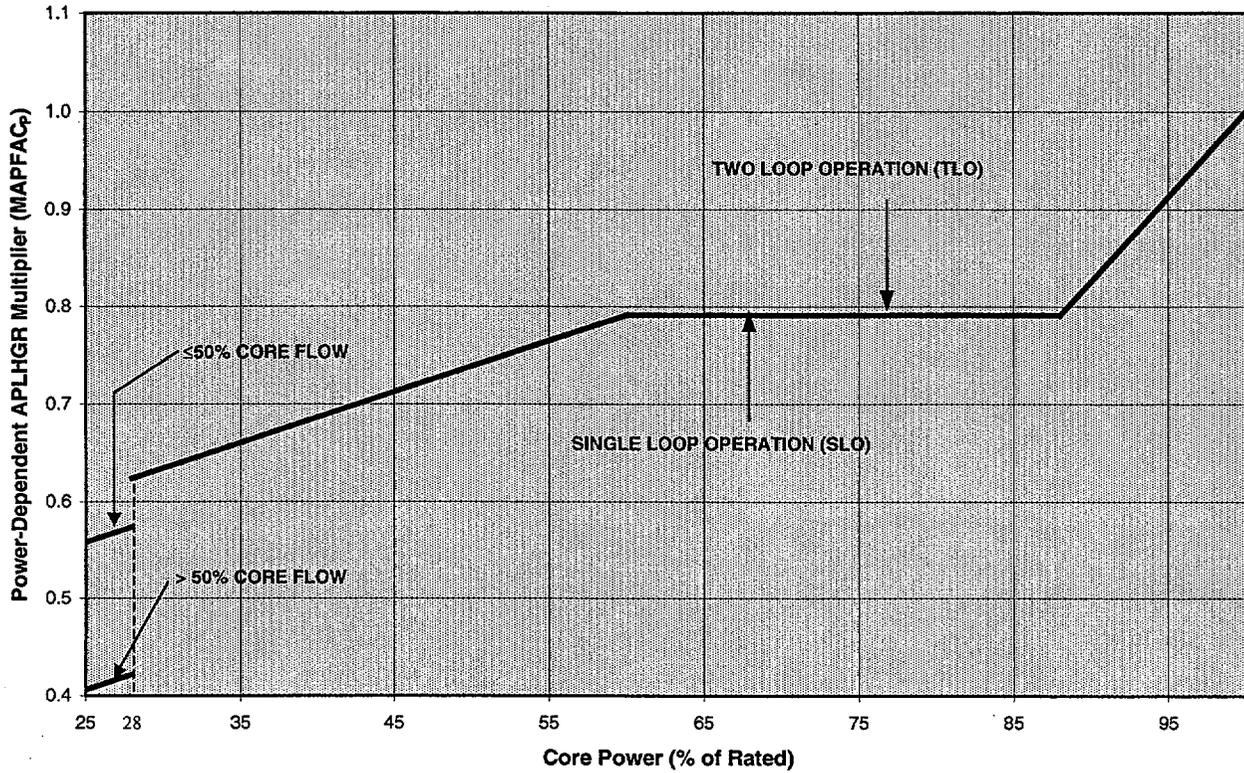
Operating Conditions			Values of Variables		
P	F	SLO / TLO	A	B	P ₀
25 ≤ P < 28	F ≤ 50	SLO / TLO	0.574	0.005224	28
25 ≤ P < 28	F > 50	SLO / TLO	0.422	0.005224	28
28 ≤ P < 71.29	All	SLO / TLO	1.000	0.005224	100
71.29 ≤ P < 100	All	TLO	1.000	0.005224	100
P ≥ 71.29	All	SLO	0.85	0.000	-

P = Percent of Rated Core Power
 F = Percent of Rated Core Flow

FIGURE 2-2A

Power-Dependent APLHGR Multiplier (MAPFAC_P) versus Core Power
 (High Pressure Feedwater Heaters In Service)

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$$MAPFAC_P = A - B (P_0 - P)$$

Operating Conditions			Values of Variables		
P	F	SLO / TLO	A	B	P ₀
25 ≤ P < 28	F ≤ 50	SLO / TLO	0.574	0.005224	28
25 ≤ P < 28	F > 50	SLO / TLO	0.422	0.005224	28
28 ≤ P < 60	All	SLO / TLO	1.000	0.005224	100
60 ≤ P < 88	All	SLO / TLO	0.791	0.000	-
88 ≤ P < 100	All	TLO	1.000	0.01744	100

P = Percent of Rated Core Power
 F = Percent of Rated Core Flow

FIGURE 2-2B

Power-Dependent APLHGR Multiplier (MAPFAC_p) versus Core Power
 (High Pressure Feedwater Heaters Out of Service)

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Average Planar Exposure	APLHGR Limit
0.00	10.51
0.20	10.57
1.00	10.73
2.00	10.97
3.00	11.24
4.00	11.48
5.00	11.73
6.00	11.92
7.00	12.06
8.00	12.21
9.00	12.36
10.00	12.49
12.50	12.60
15.00	12.42
17.50	12.05
20.00	11.69
25.00	10.97
30.00	10.27
35.00	9.60
40.00	8.93
45.00	8.28
50.00	7.62
55.00	6.94
57.53	6.59

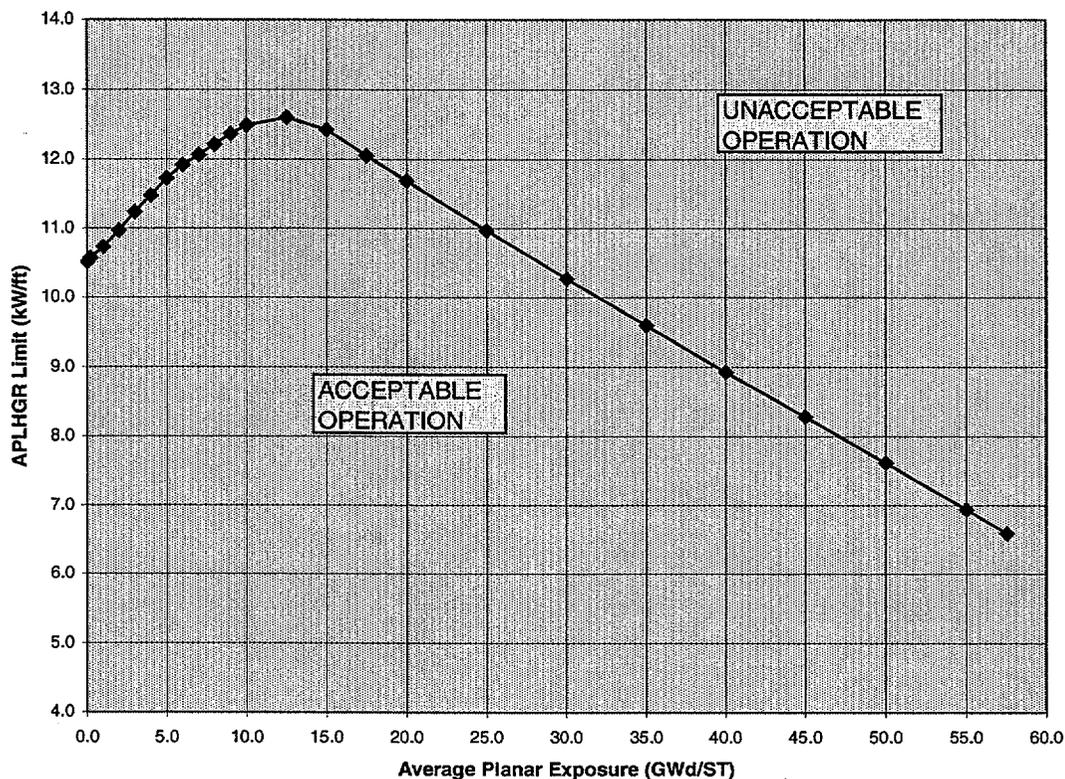


FIGURE 2-3

APLHGR Limit versus Average Planar Exposure
 (Fuel Type: GE13-P9HTB378-6G5.0/6G4.0/1G2.0-100T-146-T)

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Average Planar Exposure	APLHGR Limit
0.00	11.08
0.20	11.12
1.00	11.21
2.00	11.33
3.00	11.45
4.00	11.57
5.00	11.69
6.00	11.81
7.00	11.92
8.00	12.04
9.00	12.16
10.00	12.30
12.50	12.48
15.00	12.22
17.50	11.87
20.00	11.48
25.00	10.71
30.00	9.98
35.00	9.29
40.00	8.63
45.00	8.00
50.00	7.38
55.00	6.70
56.53	6.49

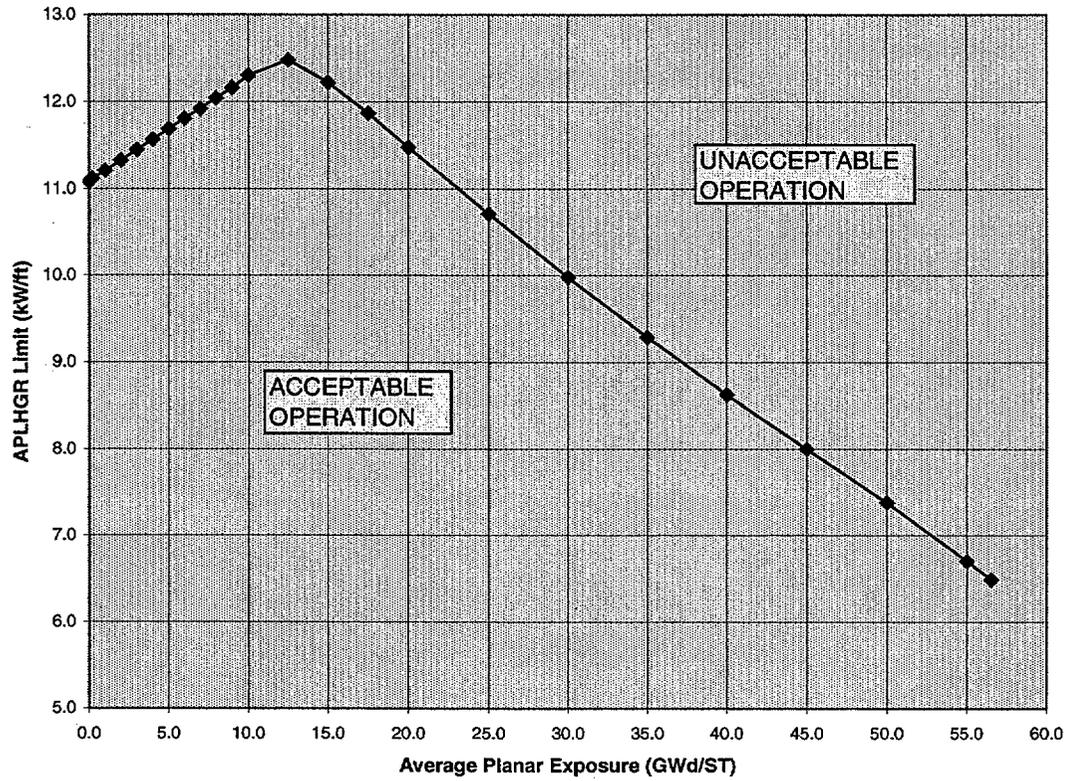


FIGURE 2-4

APLHGR Limit versus Average Planar Exposure
 (Fuel Type: GE13-P9HTB355-12GZ-100T-146-T)

Plant Hatch Unit 2 Cycle 16
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Average Planar Exposure	APLHGR Limit
0.00	10.64
0.20	10.71
1.00	10.88
2.00	11.12
3.00	11.39
4.00	11.67
5.00	11.93
6.00	12.14
7.00	12.28
8.00	12.42
9.00	12.58
10.00	12.71
12.50	12.60
15.00	12.25
17.50	11.90
20.00	11.56
25.00	10.88
30.00	10.21
35.00	9.56
40.00	8.92
45.00	8.27
50.00	7.62
55.00	6.93
57.53	6.58

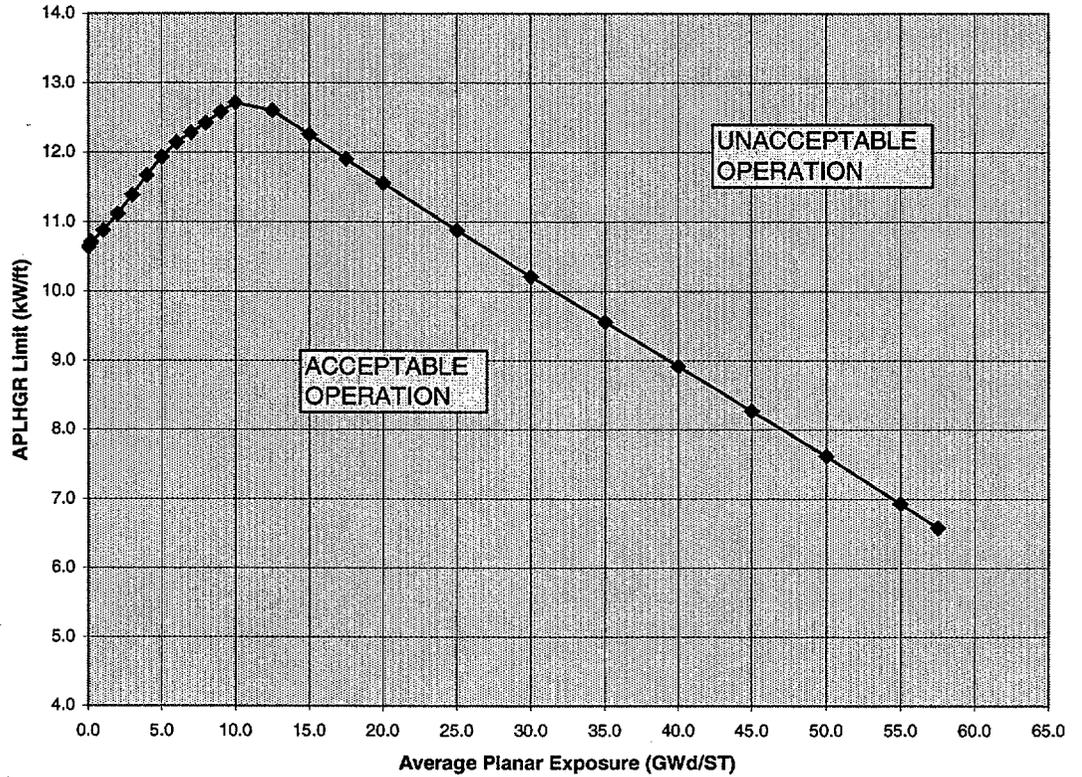


FIGURE 2-5

APLHGR Limit versus Average Planar Exposure
 (Fuel Type: GE13-P9DTB378-6G5.0/6G4.0/1G2.0-100T-146-T)

Plant Hatch Unit 2 Cycle 16
 Core Operating Limits Report

Average Planar Exposure	APLHGR Limit
0.00	9.02
0.20	9.02
1.00	9.07
2.00	9.14
3.00	9.22
4.00	9.32
5.00	9.42
6.00	9.53
7.00	9.61
8.00	9.67
9.00	9.75
10.00	9.84
11.00	9.95
12.00	10.04
13.00	10.13
14.00	10.21
15.00	10.28
17.00	10.41
20.00	10.52
25.00	10.21
30.00	9.57
35.00	8.96
40.00	8.38
45.00	7.80
50.00	7.22
55.00	6.64
56.27	6.45

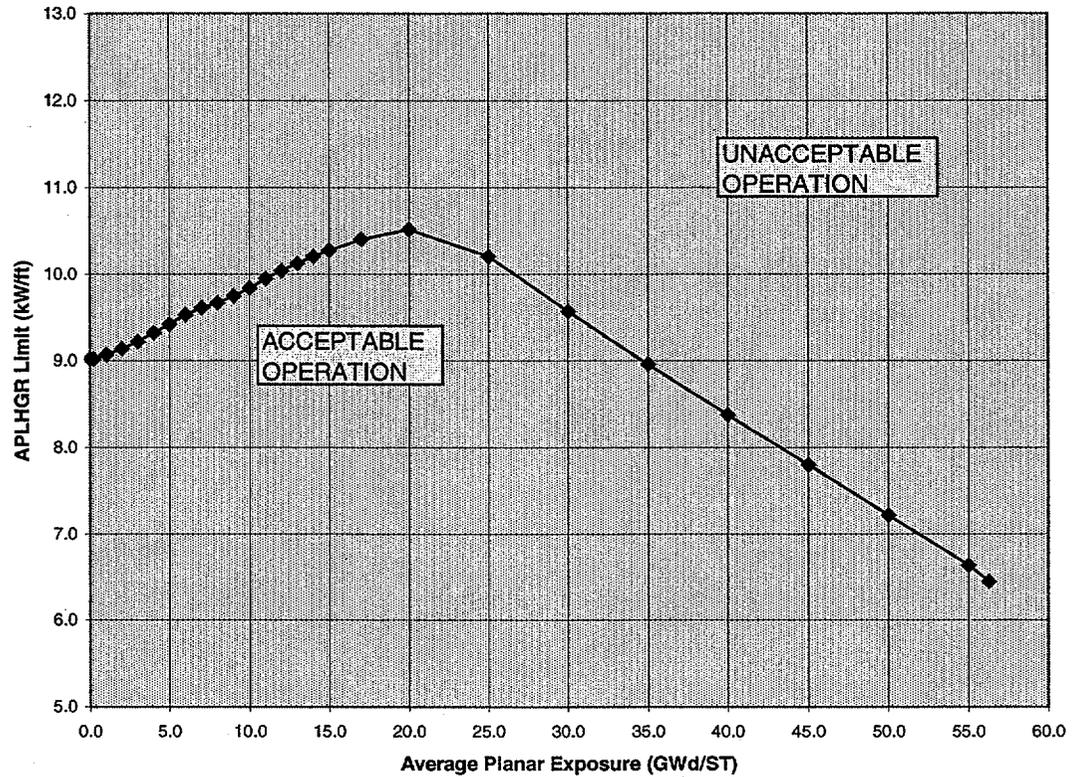


FIGURE 2-6

APLHGR Limit versus Average Planar Exposure
 (Fuel Type: GE14-P10HNAB348-6G6.0/5G5.0-100T-148-T-LUA)

Plant Hatch Unit 2 Cycle 16
 Core Operating Limits Report

Average Planar Exposure	APLHGR Limit
0.00	11.21
0.20	11.25
1.00	11.31
2.00	11.41
3.00	11.50
4.00	11.60
5.00	11.69
6.00	11.79
7.00	11.89
8.00	12.02
9.00	12.18
10.00	12.35
12.50	12.49
15.00	12.21
17.50	11.87
20.00	11.49
25.00	10.72
30.00	9.99
35.00	9.29
40.00	8.64
45.00	8.01
50.00	7.39
55.00	6.71
56.60	6.48

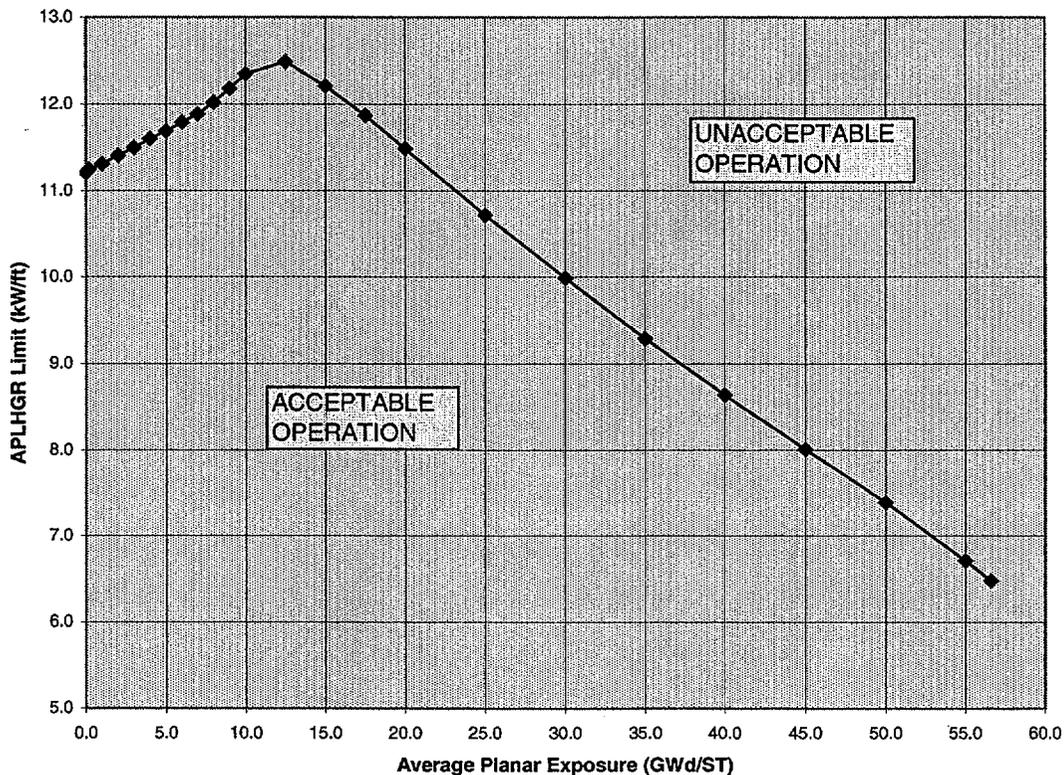


FIGURE 2-7

APLHGR Limit versus Average Planar Exposure
 (Fuel Type: GE13-P9HTB355-4G5.0/6G4.0-100T-146-T)

3.0 MCPR OPERATING LIMITS (Technical Specification 3.2.2)

The MCPR operating limit (OLMCPR) for each fuel type is a function of core power, core flow, average scram time, number of operating recirculation loops, operability of the EOC-RPT system, and operability of the turbine bypass valve system.

With both recirculation pumps in operation (TLO), the OLMCPR for each fuel type is determined as follows:

- a. For $25\% \leq \text{power} < 28\%$, the power-dependent MCPR limit, MCPR_P , as determined by Table 3-1.
- b. For $\text{power} \geq 28\%$, the OLMCPR is the greater of either:
 - 1) The flow-dependent MCPR limit, MCPR_F , from Figure 3-2,

or
 - 2) The product of the power-dependent multiplier, K_P , from Figure 3-3 and the rated-power, rated-flow MCPR limit as determined by Table 3-1.

With only one recirculation pump in operation (SLO), the OLMCPR for each fuel type is the TLO OLMCPR plus 0.01.

These limits apply to all modes of operation with intermittent feedwater temperature reduction, as well as operation with normal feedwater temperatures.

In Figures 3-4A through 3-4C, Option A scram time MCPR limits correspond to $\tau = 1.0$, where τ is determined from scram time measurements performed in accordance with Technical Specifications Surveillance Requirements 3.1.4.1 and 3.1.4.2. Option B values correspond to $\tau = 0.0$. For scram times between Option A and Option B, the MCPR limit for each fuel type corresponds to τ . If τ has not been determined, Option A limits are to be used. Refer to Table 3-1 to determine the applicable set of fuel-type dependent curves.

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The average scram time of the control rods, τ , is defined as:

$$\tau = 0, \text{ or } \frac{\tau_{ave} - \tau_B}{\tau_A - \tau_B}, \text{ whichever is greater.}$$

where: $\tau_A = 1.08$ sec (Technical Specification 3.1.4, Table 3.1.4-1, scram time limit to notch 36).

$$\tau_B = \mu + 1.65 * \sigma * \left[\frac{N_I}{\sum_{i=1}^n N_i} \right]^{1/2}$$

where: $\mu = 0.822$ sec (mean scram time used in the transient analysis).

$\sigma = 0.018$ sec (standard deviation of μ).

$$\tau_{ave} = \frac{\sum_{i=1}^n N_i \tau_i}{\sum_{i=1}^n N_i}$$

where: $n =$ number of surveillance tests performed to date in the cycle.

$N_i =$ number of active control rods measured in the i th surveillance test.

$\tau_i =$ average scram time to notch 36 of all rods in the i th surveillance test.

$N_I =$ total number of active rods measured in Technical Specifications Surveillance Requirement 3.1.4.1.

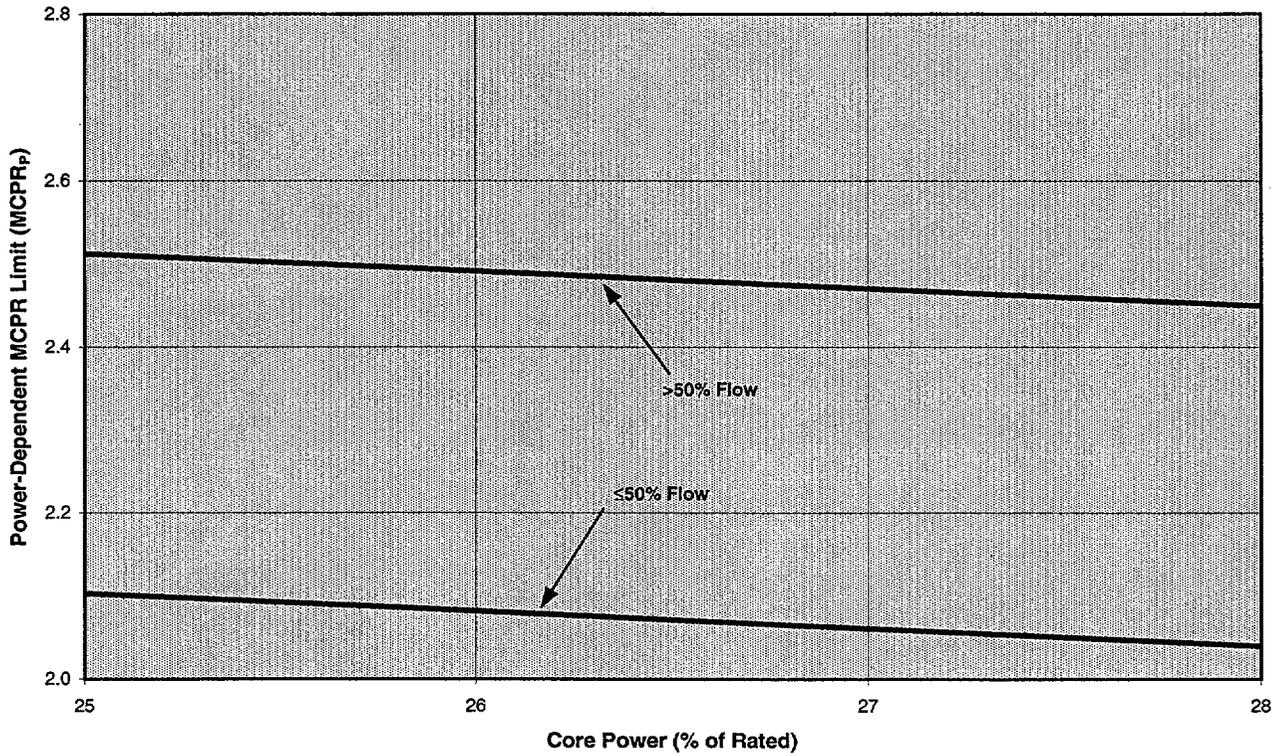
TABLE 3-1

M CPR Operating Flexibility Options

Cycle Average Exposure	EOC-RPT System	Turbine Bypass Valve System	M CPR _p Curve	Rated-Power, Rated-Flow M CPR Limits
BOC to EEOC	Operable	Operable	Figure 3-1A	Figure 3-4A
BOC to EEOC	Inoperable	Operable	Figure 3-1A	Figure 3-4B
BOC to EEOC	Operable	Inoperable	Figure 3-1B	Figure 3-4C

BOC = Beginning of Cycle
 EEOC = Extended End of Cycle

Plant Hatch Unit 2 Cycle 16
 Core Operating Limits Report



$$MCPR_p = A + B (28 - P)$$

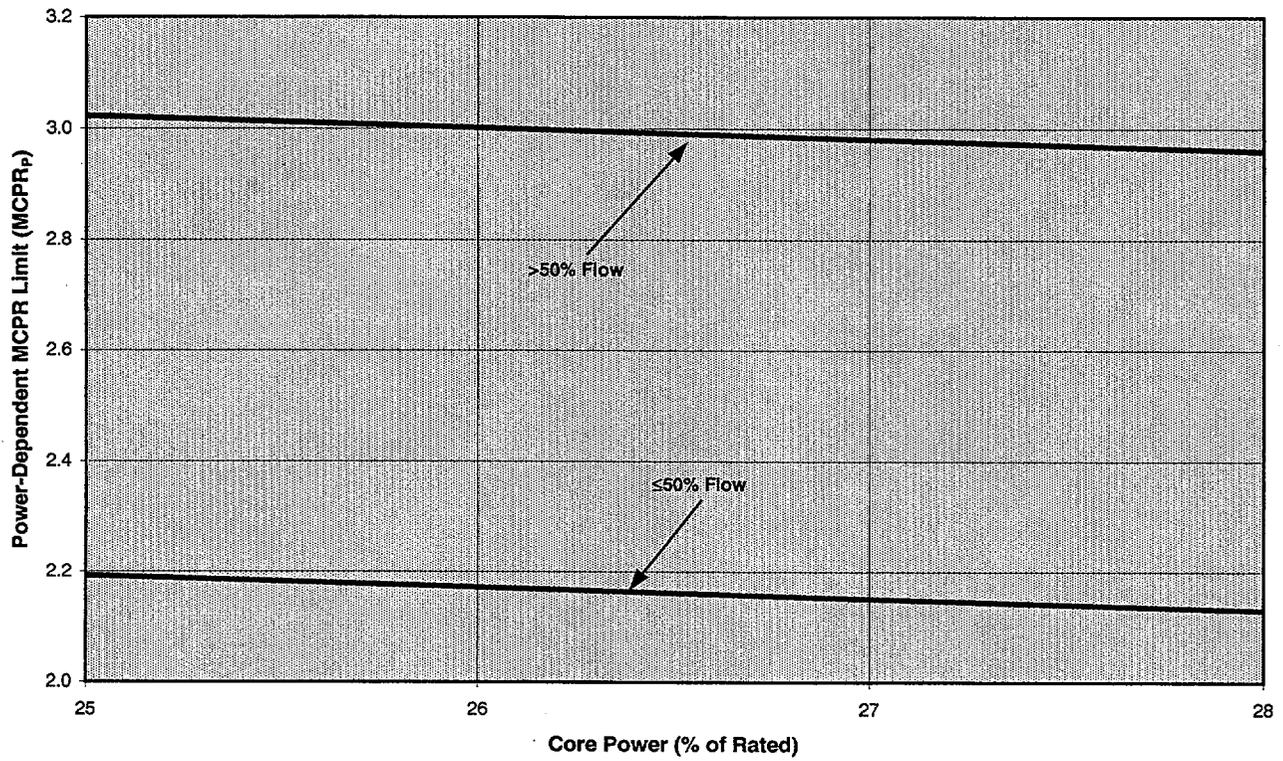
F	A	B
F ≤ 50	2.04	0.021
F > 50	2.45	0.021

P = Percent of Rated Core Power
 F = Percent of Rated Core Flow

FIGURE 3-1A

**Power-Dependent MCPR Limit (MCPR_p) versus Core Power
 from 25% to 28% of Rated Core Power
 (Bypass Valve System Operable)**

Plant Hatch Unit 2 Cycle 16
 Core Operating Limits Report



$$MCPR_p = A + B (28 - P)$$

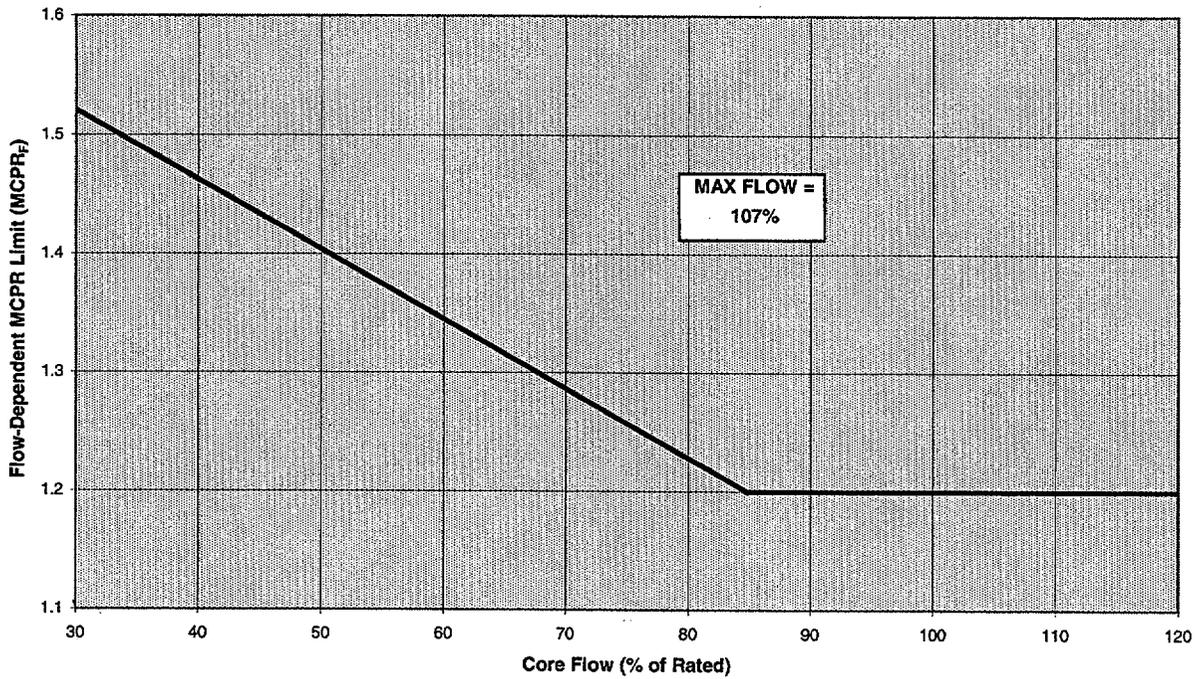
F	A	B
F ≤ 50	2.13	0.021
F > 50	2.96	0.021

P = Percent of Rated Core Power
 F = Percent of Rated Core Flow

FIGURE 3-1B

**Power-Dependent MCPR Limit (MCPR_p) versus Core Power
 from 25% to 28% of Rated Core Power
 (Bypass Valve System Inoperable)**

Plant Hatch Unit 2 Cycle 16
 Core Operating Limits Report



$MCPR_F = \text{Maximum} [1.20, (A * F + B)]$

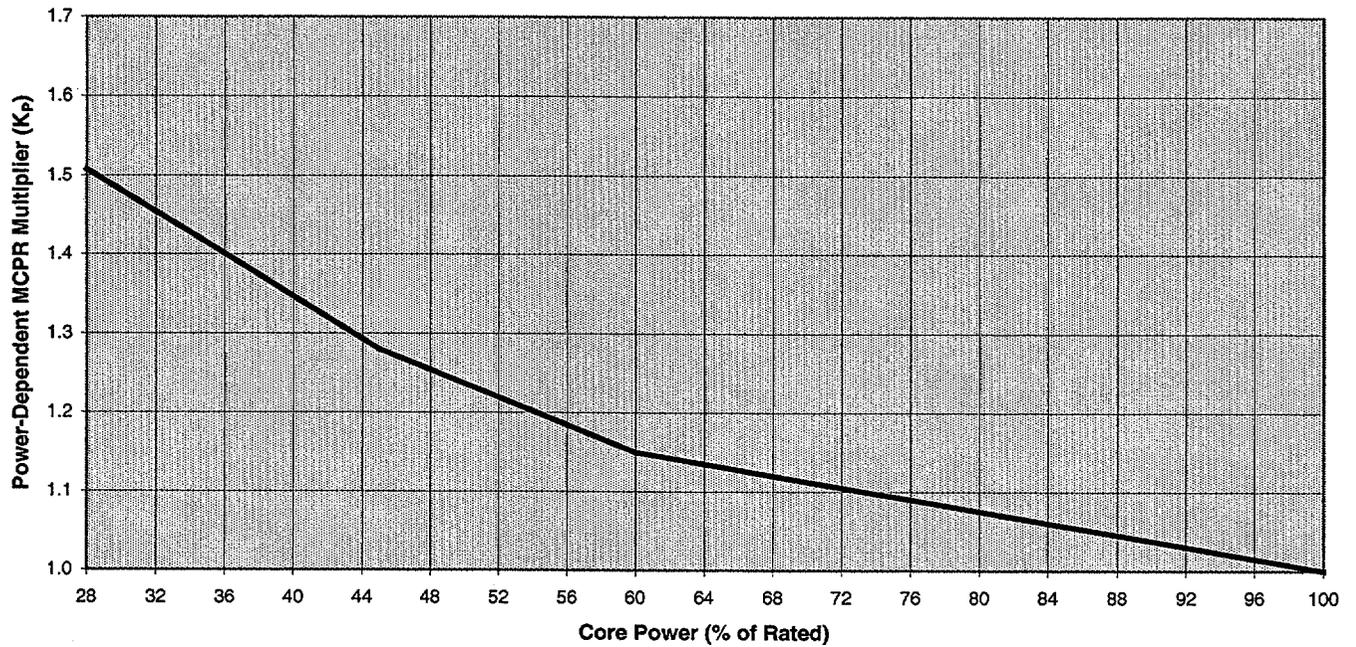
Operating Conditions	Values of Variables	
	A	B
Maximum Core Flow (% of Rated)		
107.0	-0.00586	1.697

F = Percent of Rated Core Flow

FIGURE 3-2

Flow-Dependent MCPR Limit (MCPR_F) versus Core Flow

Plant Hatch Unit 2 Cycle 16
 Core Operating Limits Report



$$K_P = A + B (P_0 - P)$$

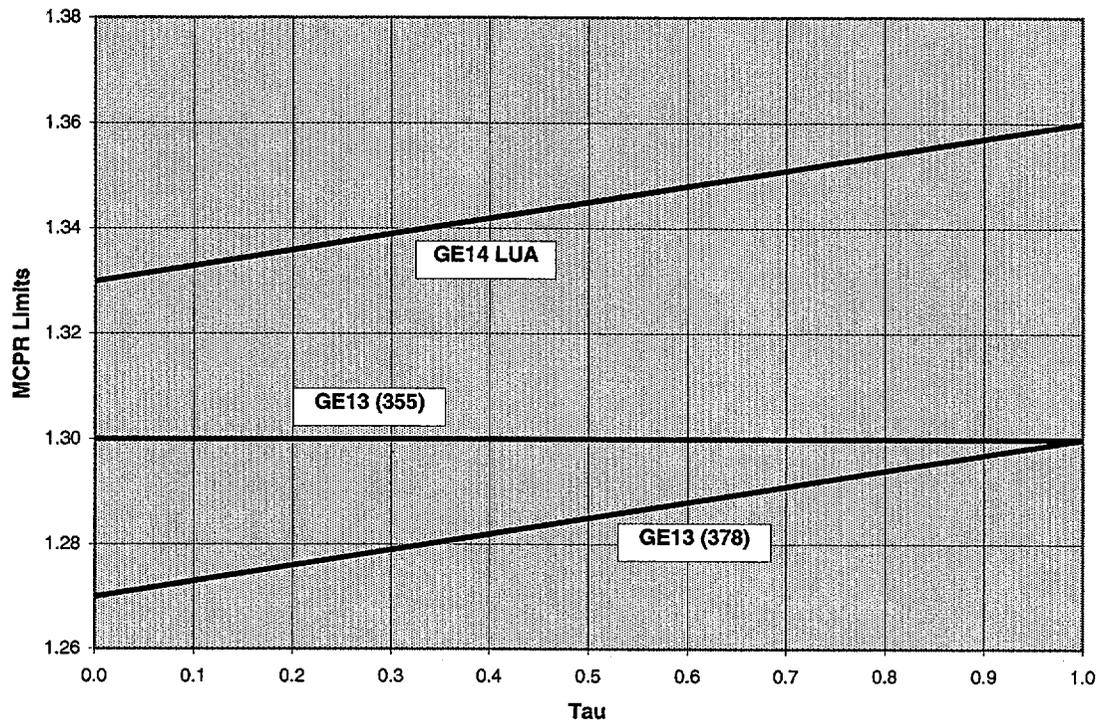
P	A	B	P ₀
28 ≤ P < 45	1.28	0.01340	45
45 ≤ P < 60	1.15	0.00867	60
60 ≤ P	1.00	0.00375	100

P = Percent of Rated Core Power

FIGURE 3-3

Power-Dependent MCPR Multiplier (K_P) versus Core Power

Plant Hatch Unit 2 Cycle 16
 Core Operating Limits Report

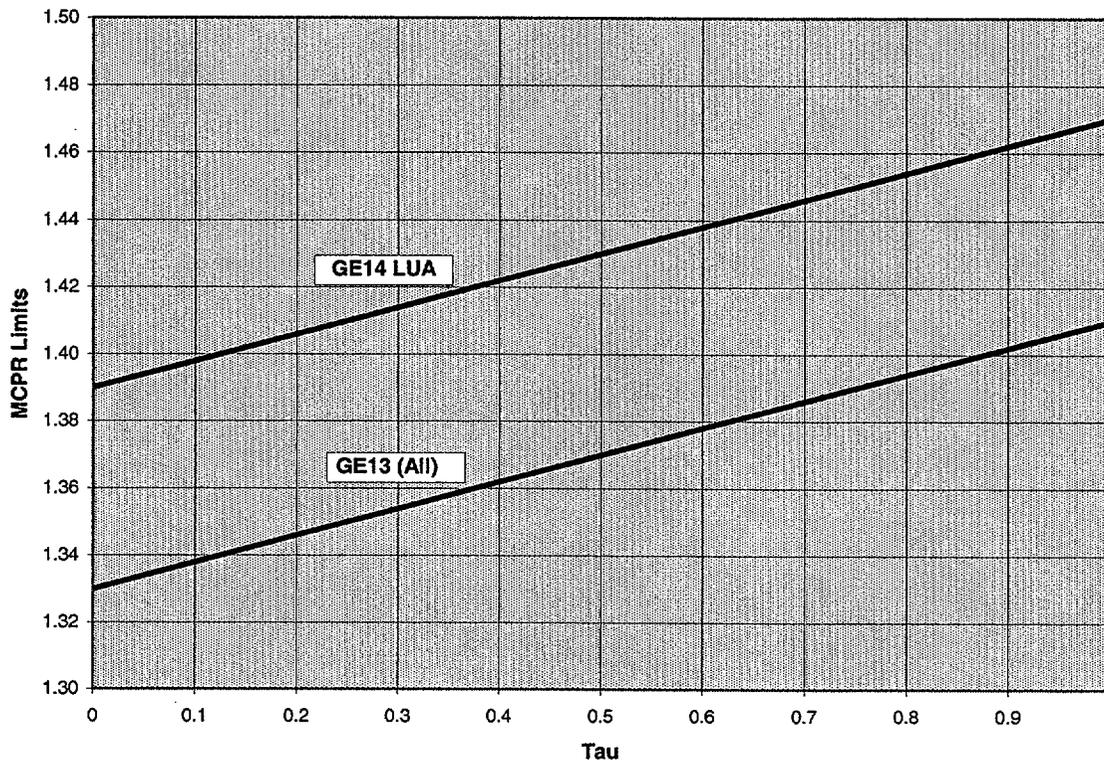


Tau	GE14 LUAs	GE13 355	GE13 378
1.0	1.36	1.30	1.30
0.0	1.33	1.30	1.27

FIGURE 3-4A

MCPR Limits versus Average Scram Time
*(BOC to EEOC with EOC-RPT System Operable
 and Bypass Valves Operable)*

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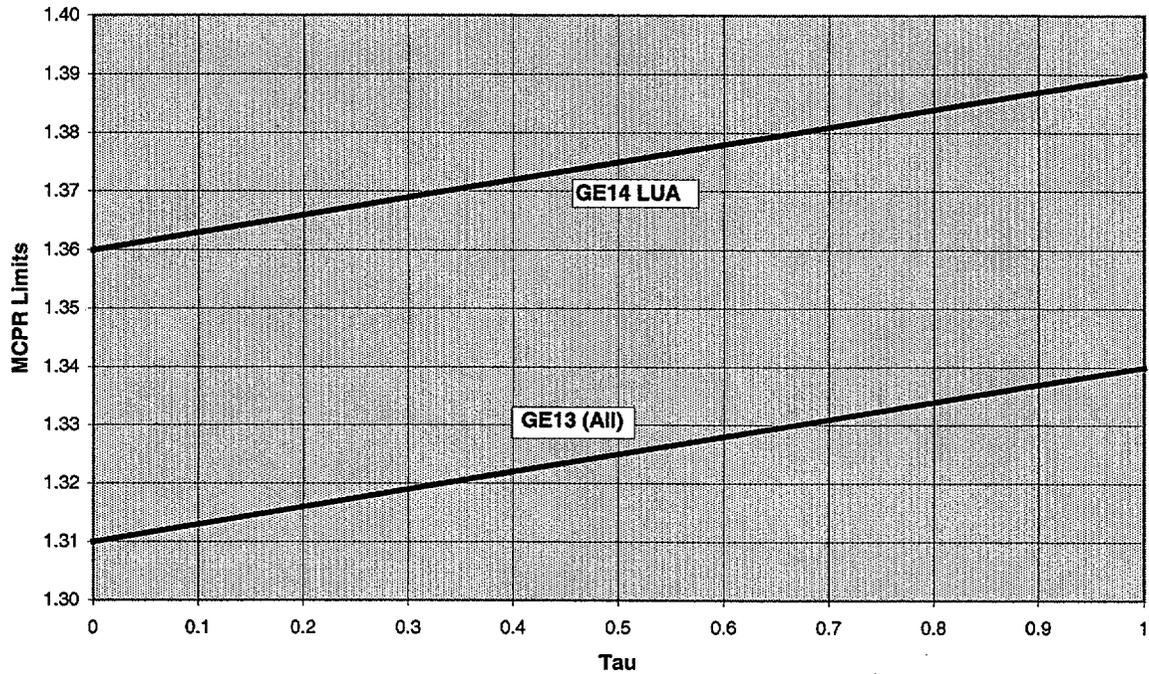


Tau	GE14 LUAs	GE13 All
1.0	1.47	1.41
0.0	1.39	1.33

FIGURE 3-4B

**MCPR Limits versus Average Scram Time
 (BOC to EEOC with EOC-RPT System Inoperable
 and Bypass Valves Operable)**

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Tau	GE14 LUAs	GE13 All
1.0	1.39	1.34
0.0	1.36	1.31

FIGURE 3-4C

MCPR Limits versus Average Scram Time
*(BOC to EEOC with EOC-RPT System Operable
 and Bypass Valves Inoperable)*

4.0 PBDA AMPLITUDE SETPOINT

The amplitude trip setpoint in the Period Based Detection Algorithm in the OPRM system shall not exceed 1.11. This applies to instruments 2C51K615 A, B, C, and D. This is the nominal trip setpoint value, not the allowable value.

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5.0 REFERENCES

1. "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-13, August 1996, as amended, and the US Supplement, NEDE-24011-P-A-13-US, August 1996, as amended.
2. "Supplemental Reload Licensing Report for Edwin I. Hatch Nuclear Power Plant Unit 2, Reload 15 Cycle 16," Global Nuclear Fuel document J11-03620SRLR, Revision 0, March 2000.
3. "Hatch Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis," NEDC-32720P, March 1997.
4. Letter TGO:00-027, "Transmittal of Hatch-2 Cycle 16 Miscellaneous ARTS Curves," T. G. Orr (GNF) to K. S. Folk (SNC), March 17, 2000.