Enclosure 1

Unit 1

Cycle 17 Core Operating Limits Report (COLR)

Revision 3

SOUTHERN NUCLEAR OPERATING COMPANY
EDWIN I. HATCH NUCLEAR PLANT

Unit 1 Cycle 17
CORE OPERATING LIMITS REPORT

Revision 3

Southern Nuclear Operating Company
Post Office Box 1295
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Edwin I. Hatch Nuclear Plant
Unit 1 Cycle 17
Core Operating Limits Report

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1.0 INTRODUCTION

The Core Operating Limits Report (COLR) for Plant Hatch Unit 1 Cycle 17 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 1 Cycle 17 are documented in References 3 through 8.

The following core operating limits are included in this report:

a. Control Rod Block Instrumentation -- Technical Specification 3.3.2.1

b. Average Planar Linear Heat Generation Rate (APLHGR) -- Technical Specification 3.2.1

c. Minimum Critical Power Ratio (MCPR) -- Technical Specifications 3.2.2 and 3.3.2.1

d. APRM Flow Biased Simulated Thermal Power - High -- Technical Specifications Surveillance Requirement 3.3.1.1.14

2.0 ROD BLOCK MONITOR (Technical Specification 3.3.2.1)

Both Rod Block Monitor (RBM) channels shall be operable as specified in Technical Specification 3.3.2.1 and when:

a. Thermal Power is ≥ 29% and < 90% of Rated Thermal Power, and MCPR is < 1.70;

or

b. Thermal Power is ≥ 90% of Rated Thermal Power, and MCPR is < 1.40.

3.0 APLHGR LIMITS (Technical Specification 3.2.1)

The APLHGR limit for each fuel type is given by the applicable rated-power, rated-flow APLHGR limit taken from Figures 3-3 through 3-9, multiplied by the smaller of either:

a. The flow-dependent multiplier, $MAPFAC_F$, from Figure 3-1,

or

b. The power-dependent multiplier, $MAPFAC_P$, from Figure 3-2A or Figure 3-2B, as determined by Table 3-1.

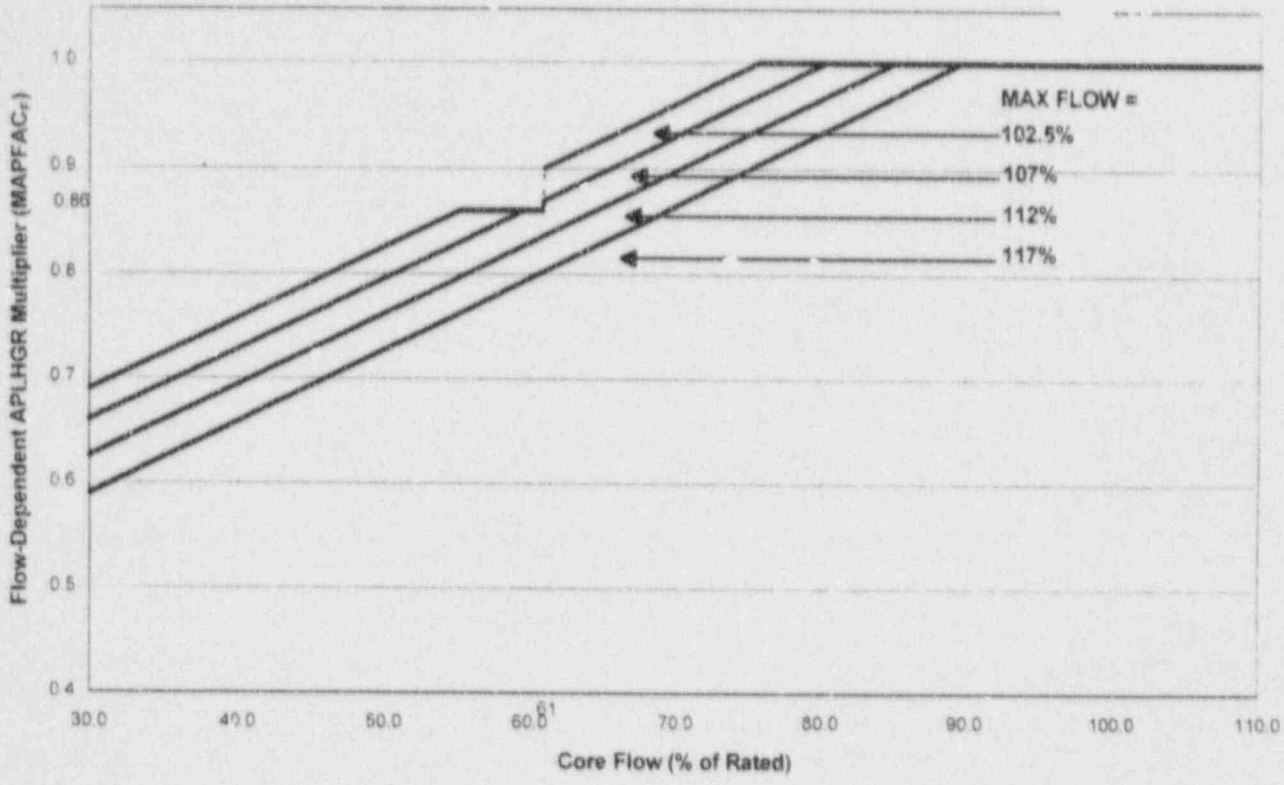
For the fuel types whose APLHGR limits are shown in Figures 3-3 through 3-9, the APLHGR limit shall be applied to each axial location in the fuel assembly.

As required by GESTAR-II (Reference 1), if the APLHGR values are hand-calculated, all of the lattices in a multi-lattice fuel bundle (i.e., GE9B-P8DWB330-10GZ-80M-150-T, GE9B-P8DWB331-10GZ-80M-150-T, GE13-P9HTB327-12GZ-100M-146-T-LUA-RECON, GE9B-P8DWB346-10GZ-80U-150-T, GE12-P10HSB331-6G5.0/4G4.0-100T-150-T, and GE9B-P8DWB331-10GZ-80M-150-T-MAPL) must have APLHGR values less than or equal to the APLHGR limits shown in Figures 3-3, 3-5, 3-6, 3-7, 3-8, and 3-9 respectively. When APLHGR values are determined by the process computer, the lattice-dependent APLHGR limits are used. Under these conditions, some axial locations may have APLHGR values exceeding the values shown in the figures.

Table 3-1

APLHGR Operating Flexibility Options

Number of Operable Turbine Pressure Regulators	Use
One	Figure 3-2A
Two	Figure 3-2B



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

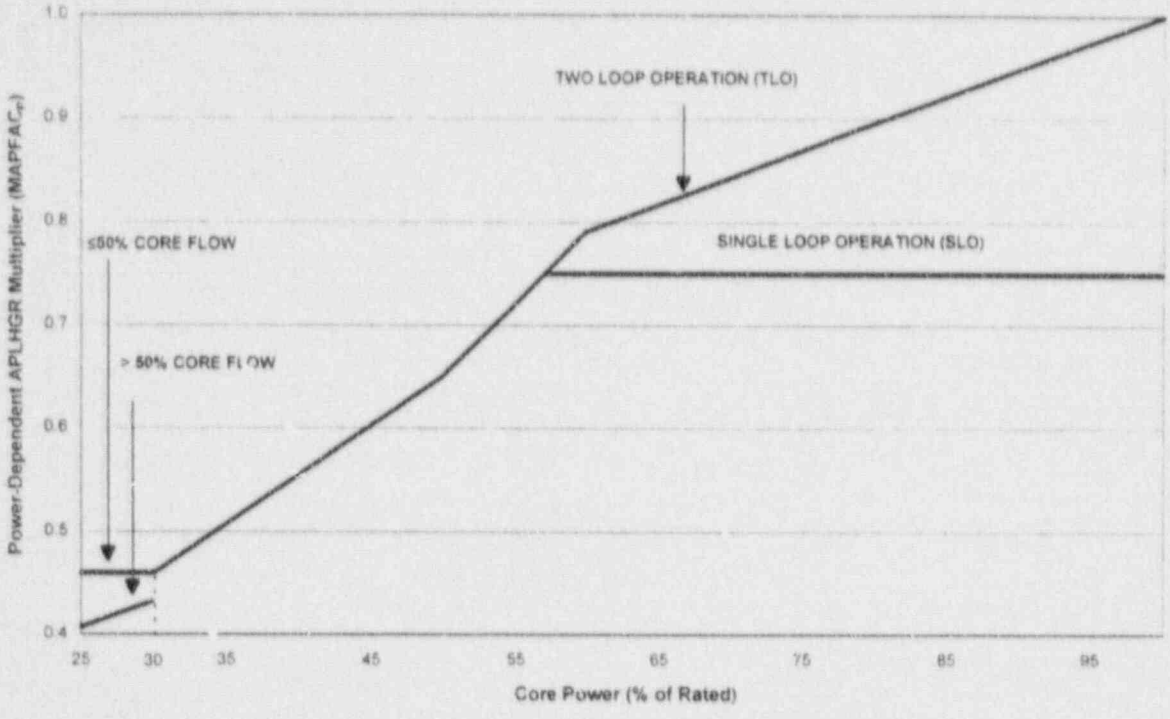
Maximum Core Flow (% of Rated)	A	B
102.5	0.4861	0.6784
107.0	0.4574	0.6758
112.0	0.4214	0.6807
117.0	0.3828	0.6886

F = Percent of Rated Core Flow

MAPMULT = 1.0 for F > 61
0.86 for F ≤ 61

FIGURE 3-1

Flow-Dependent APLHGR Multiplier ($MAPFAC_F$) versus Core Flow



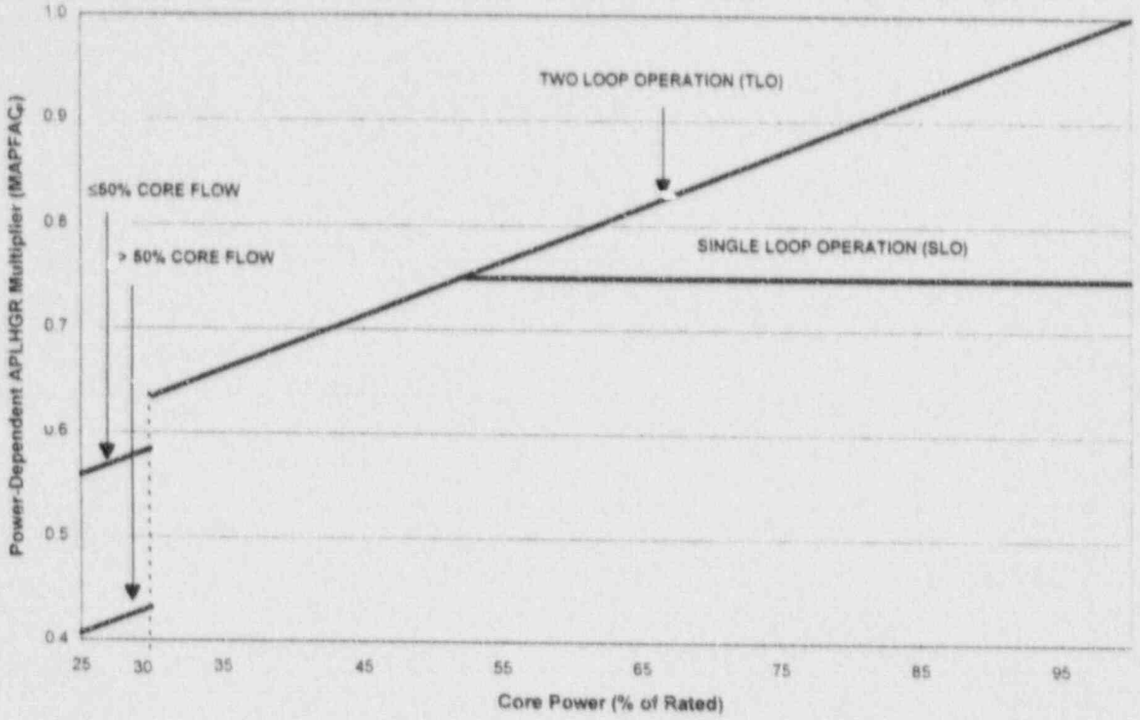
$$MAPFAC_P = A - B (P_0 - P)$$

Operating Conditions			Values of Variables		
P	F	SLO / TLO	A	B	P_0
$25 \le P < 30$	$F \le 50$	SLO / TLO	0.460	0.0000	30
$25 \le P < 30$	$F > 50$	SLO / TLO	0.433	0.0052	30
$30 \le P < 50$	All	SLO / TLO	0.650	0.0095	50
$50 \le P < 57.09$	All	SLO / TLO	0.791	0.0141	60
$57.09 \le P < 60$	All	TLO	0.791	0.0141	60
$60 \le P < 70$	All	TLO	0.843	0.0052	70
$70 \le P < 80$	All	TLO	0.896	0.0053	80
$P \ge 80$	All	TLO	1.000	0.0052	100
$P \ge 57.09$	All	SLO	0.750	0.0000	-

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

FIGURE 3-2A

Power-Dependent APLHGR Multiplier ($MAPFAC_P$) versus Core Power
(One Turbine Pressure Regulator Operable)



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

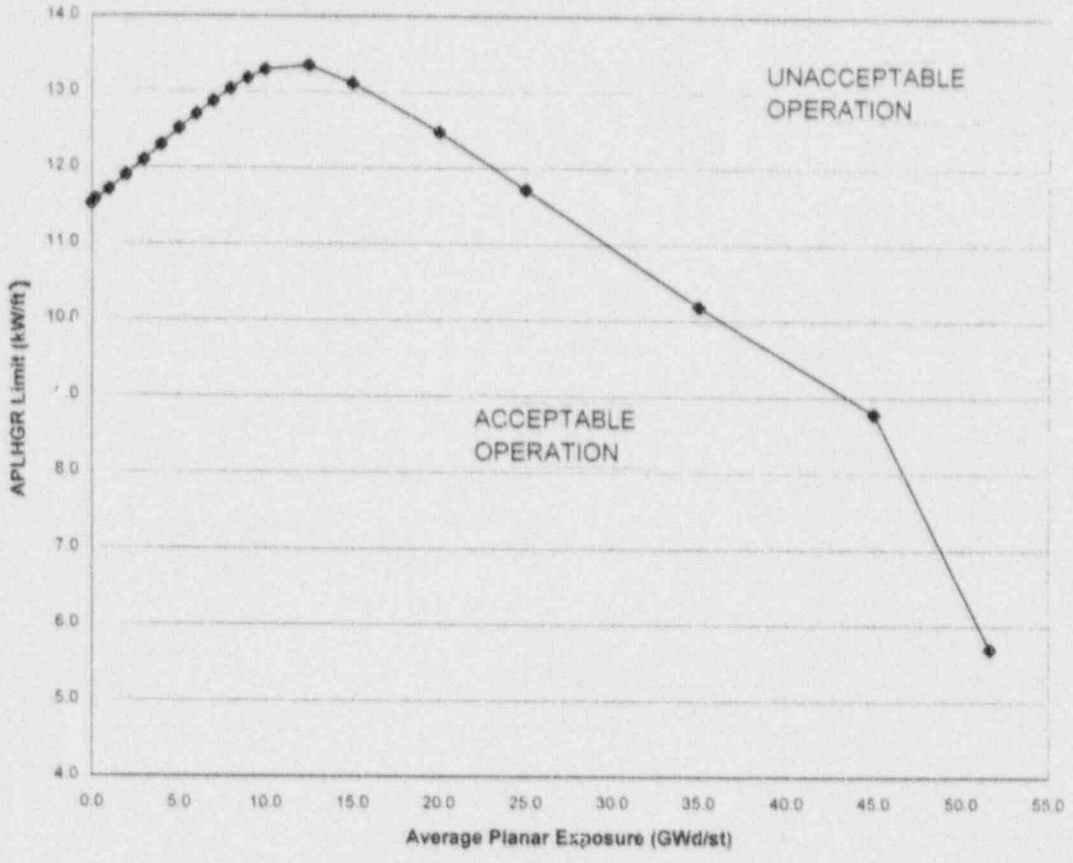
Operating Conditions			Values of Variables		
P	F	SLO / TLO	A	B	P_0
$25 \le P < 30$	$F \le 50$	SLO / TLO	0.585	0.005224	30
$25 \le P < 30$	$F > 50$	SLO / TLO	0.433	0.005224	30
$30 \le P < 52$	All	SLO / TLO	1.00	0.005224	100
$P \ge 52$	All	TLO	1.00	0.005224	100
$P \ge 52$	All	SLO	0.75	0.00	-

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

FIGURE 3-2B

Power-Dependent APLHGR Multiplier ($MAPFAC_P$) versus Core Power
(Two Turbine Pressure Regulators Operable)

Average Planar Exposure	APLHGR Limit
0.00	11.52
0.20	11.58
1.00	11.71
2.00	11.90
3.00	12.10
4.00	12.30
5.00	12.52
6.00	12.71
7.00	12.88
8.00	13.05
9.00	13.19
10.00	13.30
12.50	13.36
15.00	13.12
20.00	12.48
25.00	11.72
35.00	10.19
45.00	8.79
51.64	5.70



NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 3-3

APLHGR Limit versus Average Planar Exposure
(Fuel Type: GE9B-P8DWB330-10GZ-80M-150-T)

Average Planar Exposure	APLHGR Limit
0.00	11.8
0.20	11.9
1.00	12.0
2.00	12.2
3.00	12.3
4.00	12.5
5.00	12.7
6.00	12.9
7.00	13.1
8.00	13.2
9.00	13.3
10.00	13.4
12.50	13.5
15.00	13.2
20.00	12.5
25.00	11.8
35.00	10.5
45.00	9.0
51.87	5.8

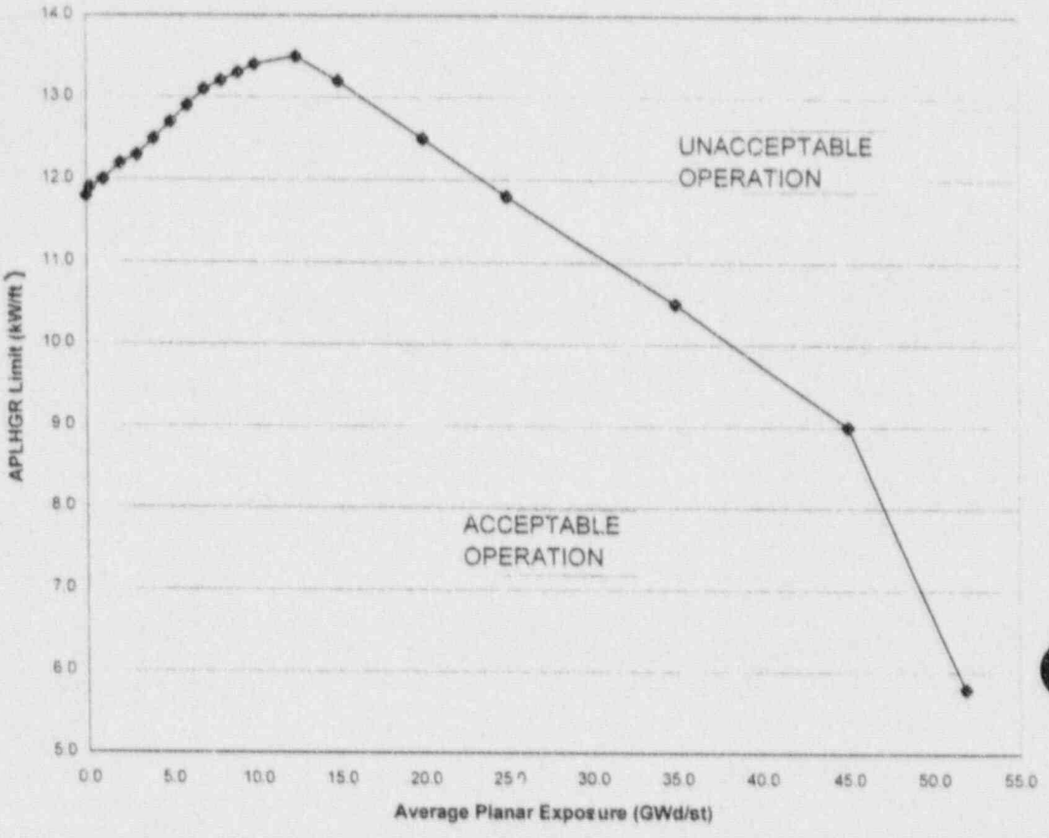
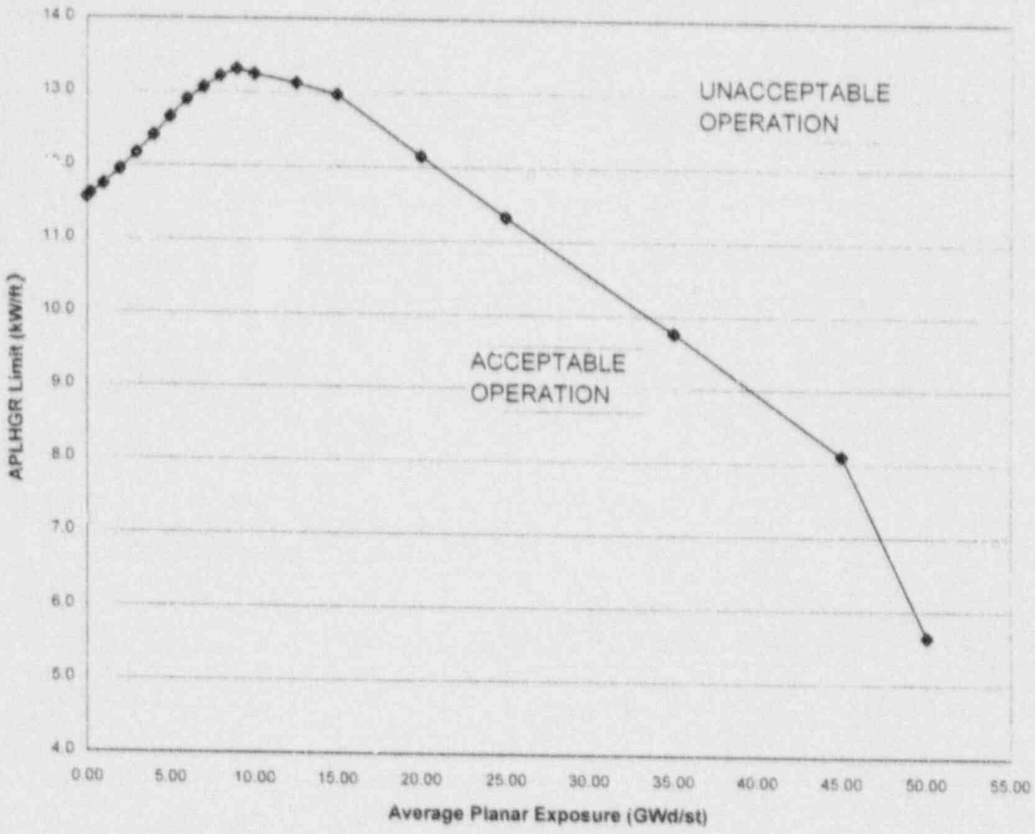


FIGURE 3-4

APLHGR Limit versus Average Planar Exposure
(Fuel Type: GE9B-P8DWB314-8G4.0-80M-150-T)

Average Planar Exposure	APLHGR Limit
0.00	11.57
0.20	11.62
1.00	11.75
2.00	11.95
3.00	12.17
4.00	12.41
5.00	12.66
6.00	12.90
7.00	13.07
8.00	13.22
9.00	13.32
10.00	13.25
12.50	13.13
15.00	12.98
20.00	12.15
25.00	11.33
35.00	9.77
45.00	8.11
50.06	5.65

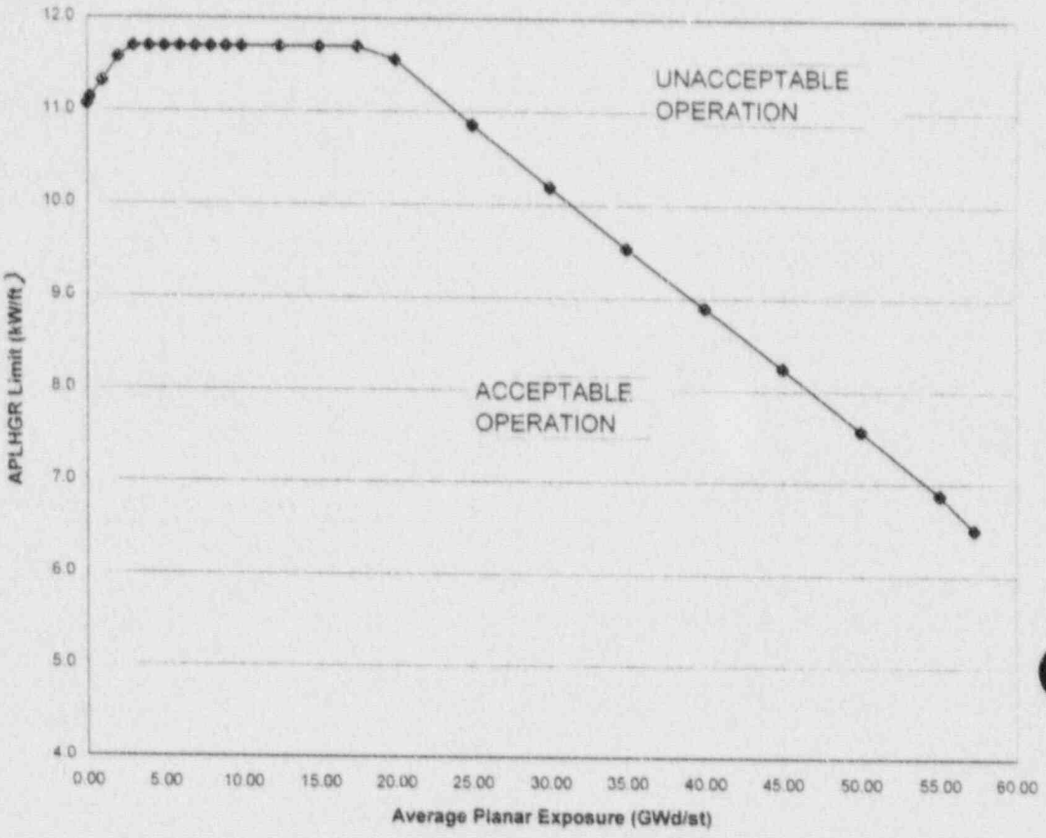


NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 3-5

APLHGR Limit versus Average Planar Exposure
(Fuel Type: GE9B-P8DWB331-10GZ-80M-150-T)

Average Planar Exposure	APLHGR Limit
0.00	11.07
0.20	11.14
1.00	11.32
2.00	11.58
3.00	11.70
4.00	11.70
5.00	11.70
6.00	11.70
7.00	11.70
8.00	11.70
9.00	11.70
10.00	11.70
12.50	11.70
15.00	11.70
17.50	11.70
20.00	11.56
25.00	10.86
30.00	10.19
35.00	9.54
40.00	8.90
45.00	8.25
50.00	7.57
55.00	6.88
57.27	6.51

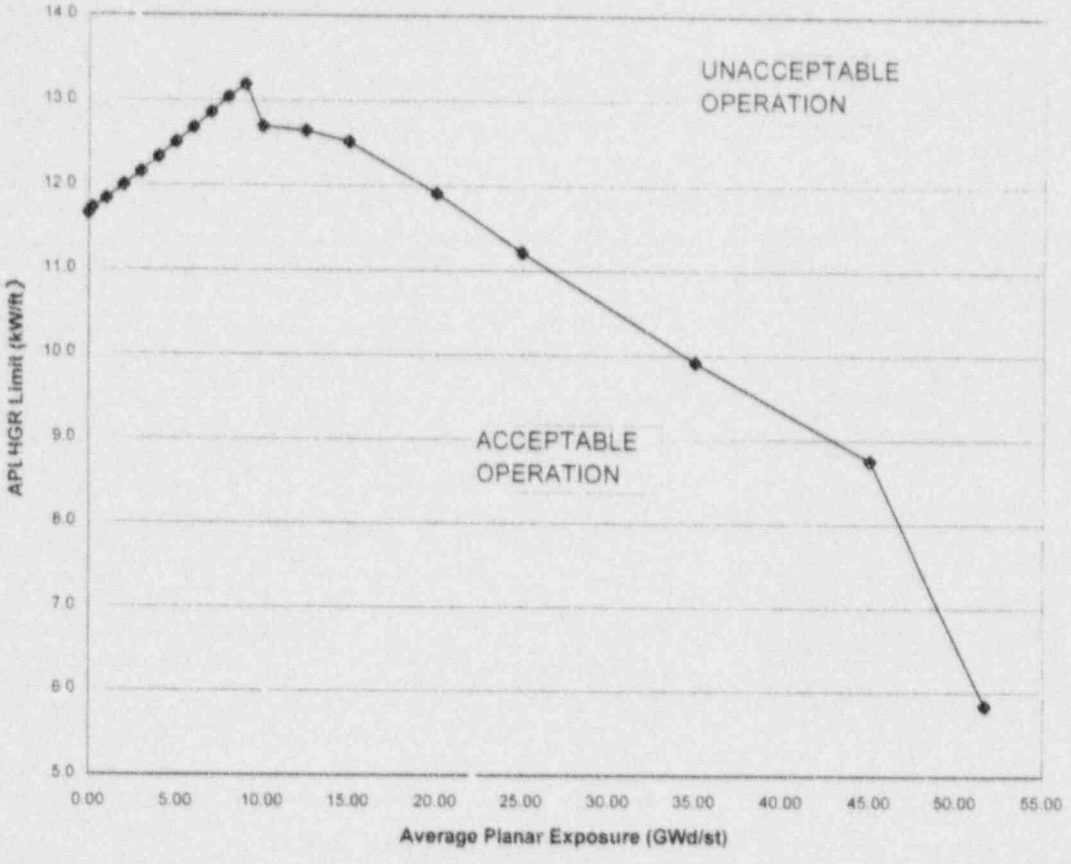


NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 3-6

APLHGR Limit versus Average Planar Exposure
(Fuel Type: GE13-P9HTB327-12GZ-100M-146-T-LUA-RECON)

Average Planar Exposure	APLHGR Limit
0.00	11.67
0.20	11.73
1.00	11.84
2.00	12.00
3.00	12.16
4.00	12.34
5.00	12.51
6.00	12.68
7.00	12.86
8.00	13.04
9.00	13.19
10.00	12.70
12.50	12.65
15.00	12.52
20.00	11.91
25.00	11.22
35.00	9.92
45.00	8.76
51.71	5.84

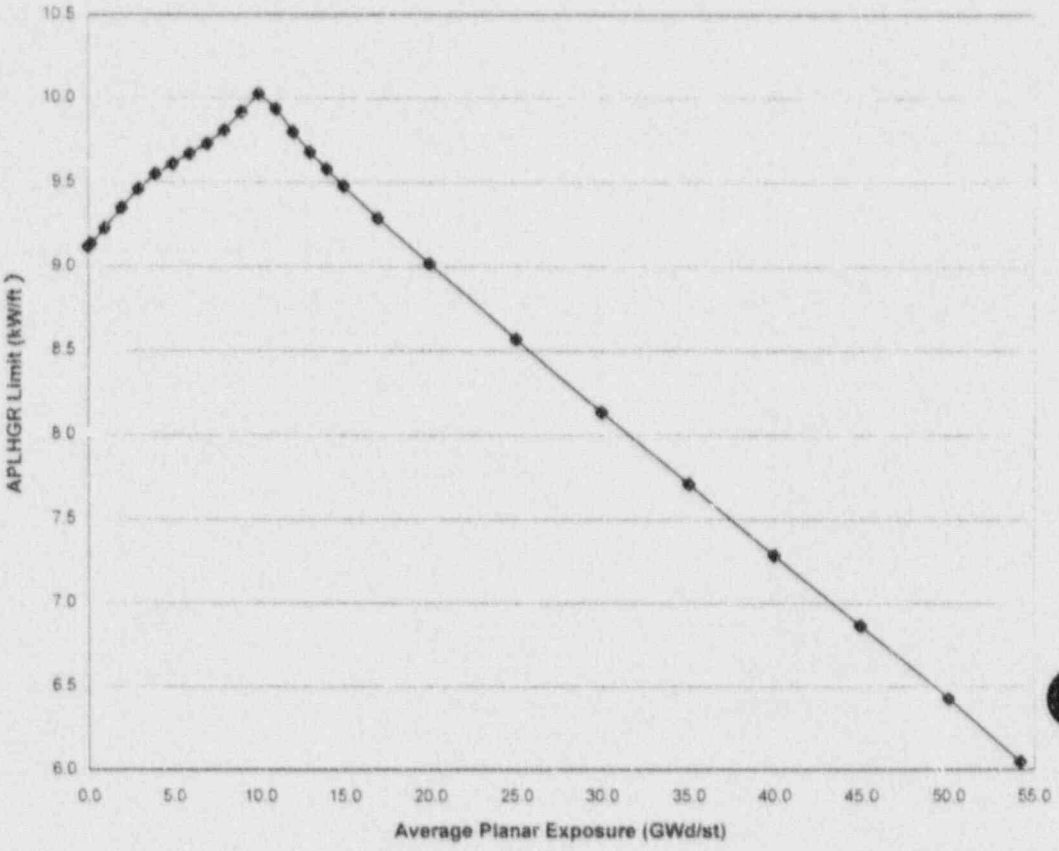


NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 3-7

APLHGR Limit versus Average Planar Exposure
(Fuel Type: GE9B-P8DWB346-10GZ-80U-150-T)

Average Planar Exposure	APLHGR Limit
0.00	9.12
0.20	9.14
1.00	9.23
2.00	9.35
3.00	9.46
4.00	9.55
5.00	9.61
6.00	9.67
7.00	9.73
8.00	9.81
9.00	9.92
10.00	10.03
11.00	9.94
12.00	9.80
13.00	9.68
14.00	9.58
15.00	9.48
17.00	9.29
20.00	9.02
25.00	8.57
30.00	8.14
35.00	7.71
40.00	7.29
45.00	6.87
50.00	6.43
54.21	6.05

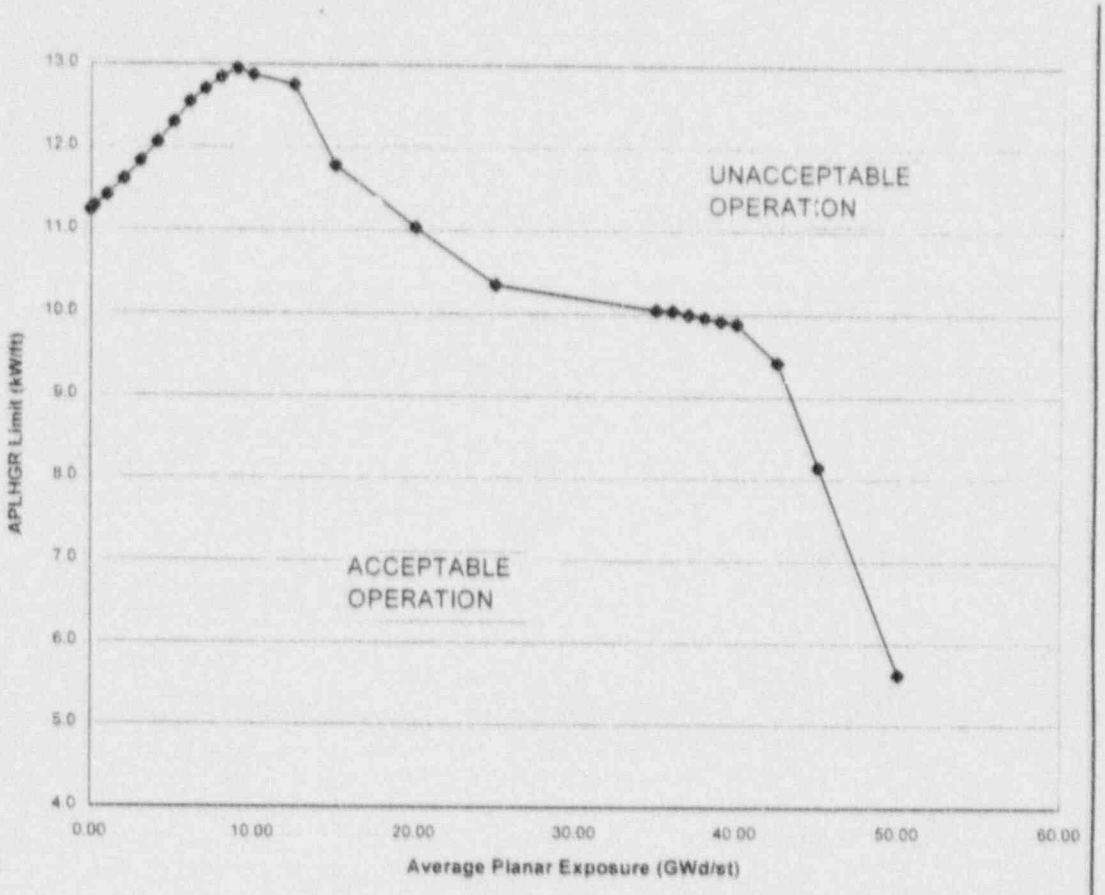


NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 3-8

APLHGR Limit versus Average Planar Exposure
(Fuel Type: GE12-P10HSB331-6G5.0/4G4.0-100T-150-T)

Avgerage Planar Exposure	APLHGR Limit
0.00	11.24
0.20	11.29
1.00	11.42
2.00	11.61
3.00	11.83
4.00	12.06
5.00	12.30
6.00	12.55
7.00	12.71
8.00	12.85
9.00	12.95
10.00	12.88
12.50	12.76
15.00	11.79
20.00	11.04
25.00	10.35
35.00	10.05
36.00	10.04
37.00	10.00
38.00	9.96
39.00	9.92
40.00	9.89
42.50	9.42
45.00	8.15
50.06	5.63



NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 3-9

APLHGR Limit versus Average Planar Exposure
(Fuel Type:GE9B-P8DWB331-10GZ-80M-150-T-MAPL)

4.0 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 end-of-cycle recirculation pump trip (EOC-RPT) system, operability of the turbine bypass valves, and number of operating turbine pressure regulators.

With both recirculation pumps in operation (TLO), the OLMCPR for each fuel type with various combinations of equipment operability, scram times, core power and core flow is determined as follows:

a. For 25% ≤ power < 30%, the power-dependent MCPR limit is given in Figure 4-1.

b. For power ≥ 30%, the OLMCPR is the greater of either:

1) The product of the appropriate value from Figure 4-2A or Figure 4-2B and the appropriate value from Figures 4-4A through 4-4D, as determined by Table 4-1,

or

2) The flow-dependent MCPR limit determined from the applicable maximum core flow limit line of Figure 4-3.

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

Operation with intermittent feedwater temperature reduction is included in the MCPR limits presented in Figures 4-4A through 4-4D.

In Figures 4-4A through 4-4D, 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 4-1 to determine the applicable set of fuel-type dependent curves.

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

$$\tau_B = \mu + 1.65 * \sigma * \left[\frac{N_1}{\sum_{i=1}^{n} N_i} \right]^{1/2}$$

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

σ = 0.018 sec (standard deviation of μ).

$$\tau_{ave} = \frac{\sum_{i=1}^{n} Ni\tau}{\sum_{i=1}^{n} Ni}$$

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.

τ_i = average scram time to notch 36 of all rods in the i*th* surveillance test.

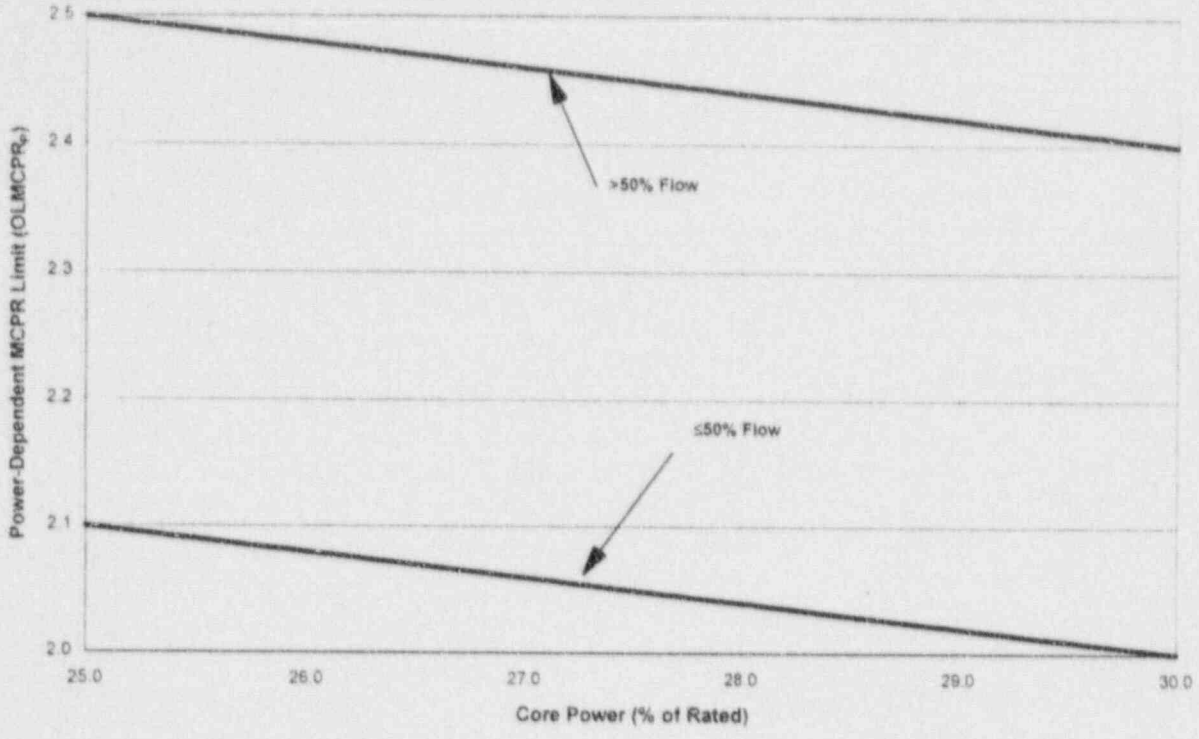
N_1 = total number of active rods measured in Technical Specifications Surveillance Requirement 3.1.4.1.

Table 4-1

MCPR Operating Flexibility Options

With	Use
One Turbine Pressure Regulator Operable	Figure 4-2A
Two Turbine Pressure Regulators Operable	Figure 4-2B

With		Use
EOC-RPT	Turbine Bypass Valves	
Operable	Operable	Figure 4-4A
Inoperable	Operable	Figure 4-4B
Operable	Inoperable	Figure 4-4C
Inoperable	Inoperable	Figure 4-4D



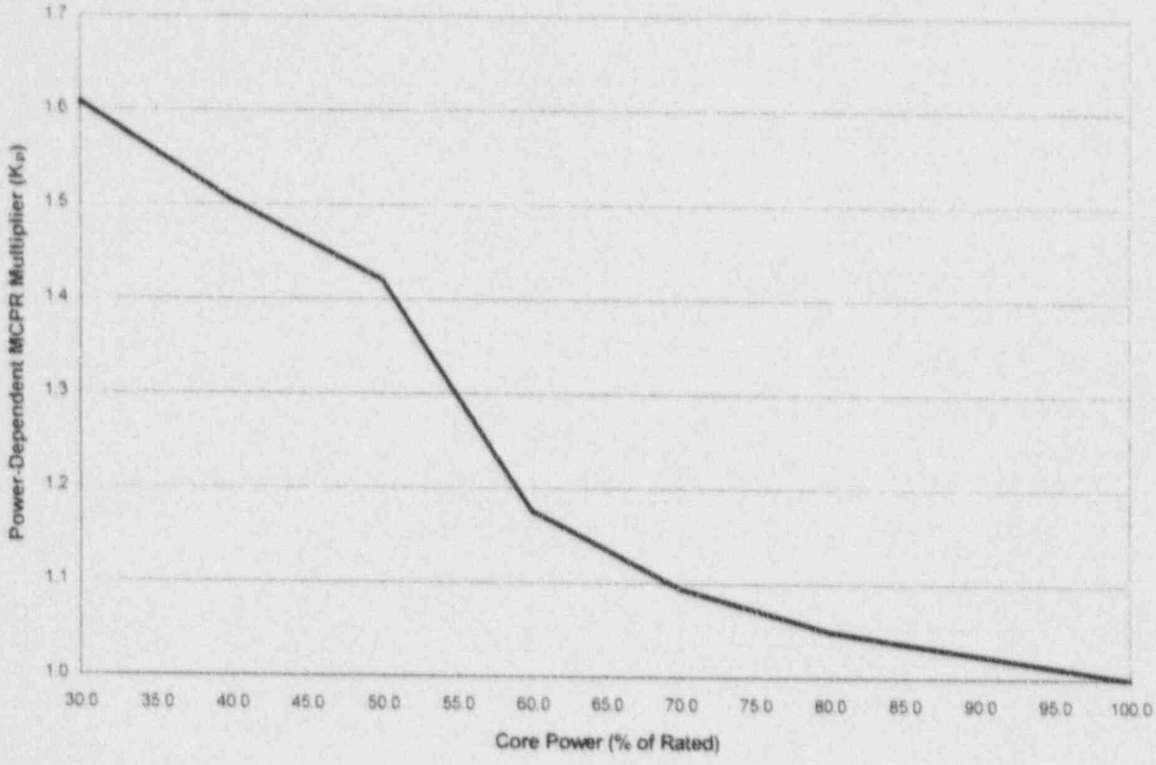
OLMCPR = A + B (30 - P)

F	A	B
F ≤ 50	2.00	0.02
F > 50	2.40	0.02

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

FIGURE 4-1

Power-Dependent MCPR Limit ($MCPR_P$) versus Core Power from 25% to 30 % of Rated Core Power



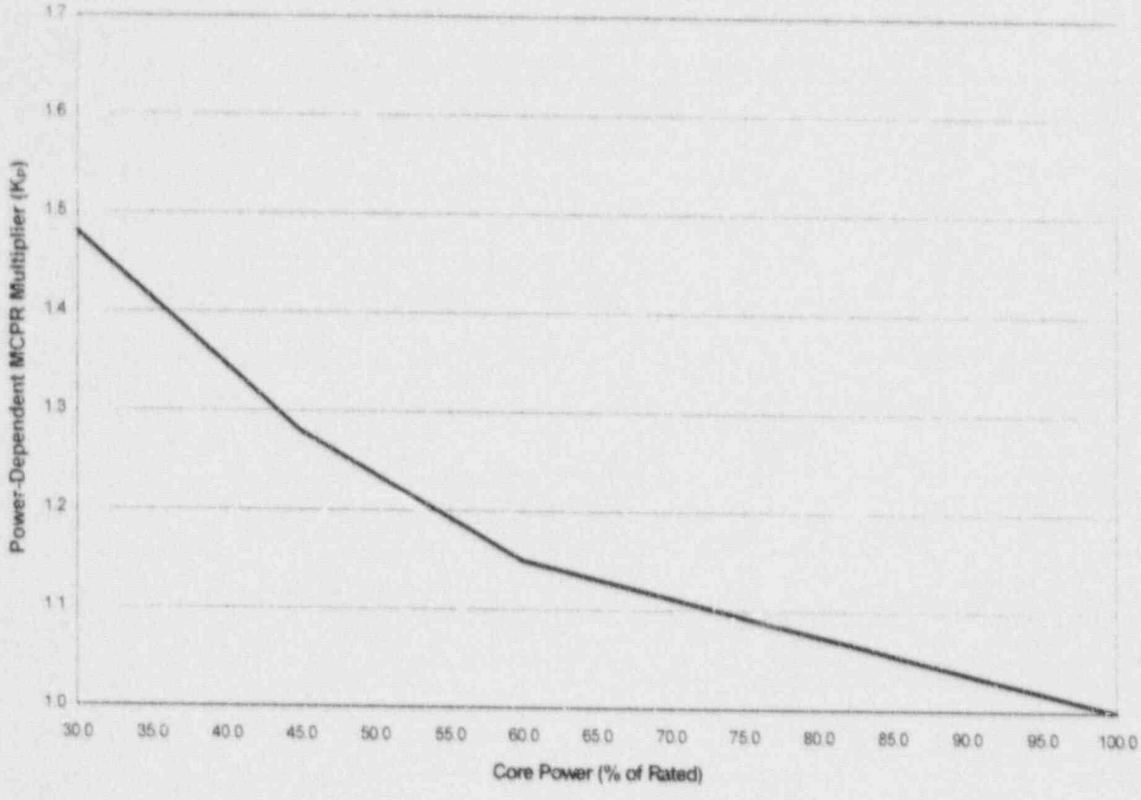
$$K_P = A + B\,(P_0 - P)$$

P	A	B	P_0
$30 \le P < 40$	1.50525	0.010311	40
$40 \le P < 50$	1.42103	0.008422	50
$50 \le P < 60$	1.17649	0.024454	60
$60 \le P < 70$	1.09478	0.008171	70
$70 \le P < 80$	1.04959	0.004519	80
$80 \le P$	1.00000	0.00248	100

P = Percent of Rated Core Power

FIGURE 4-2A

Power-Dependent MCPR Multiplier (K_P) versus Core Power
(One Turbine Pressure Regulator Operable)



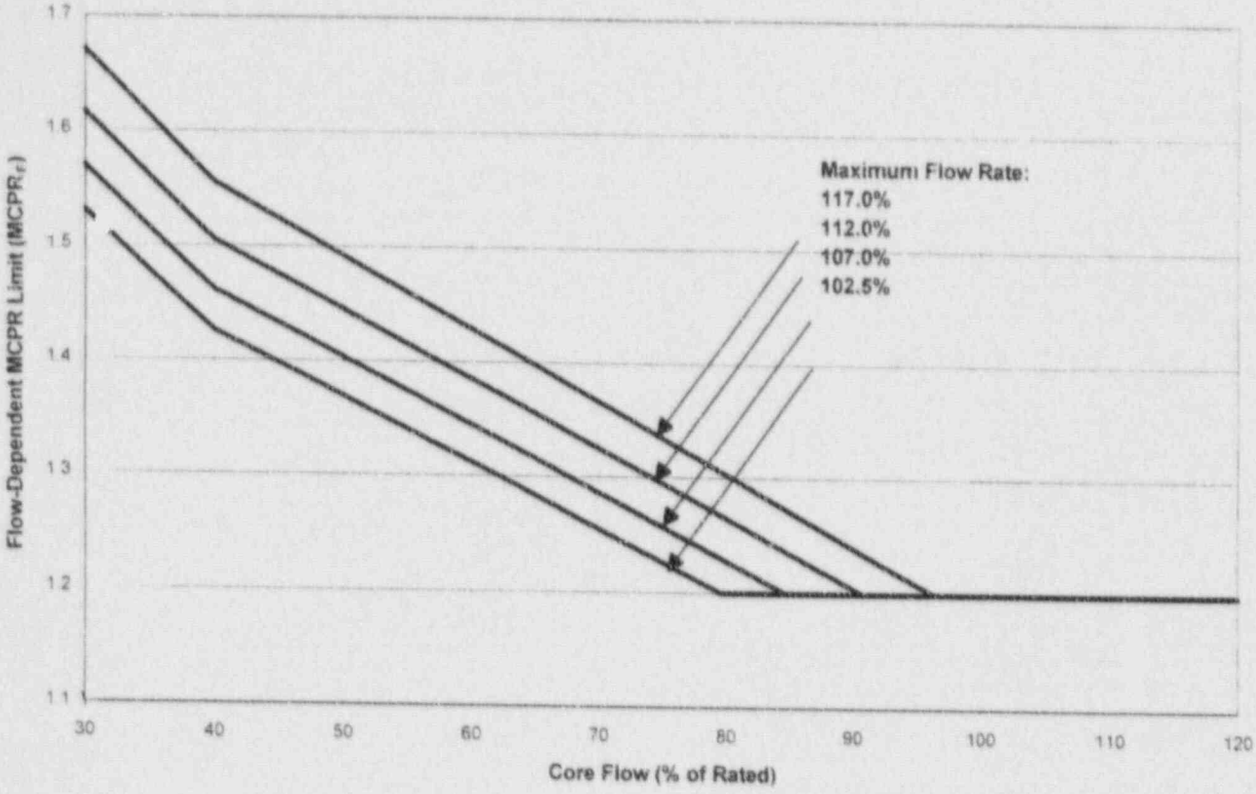
$K_P = A + B (P_0 - P)$

P	A	B	P_0
$30 \leq P < 45$	1.28	0.01340	45
$45 \leq P < 60$	1.15	0.00867	60
$60 \leq P$	1.00	0.00375	100

P = Percent of Rated Core Power

FIGURE 4-2B

Power-Dependent MCPR Multiplier (K_P) versus Core Power
(Two Turbine Pressure Regulators Operable)



$$MCPR_F = \text{Maximum } [1.2, (A*F + B)C]$$

Operating Conditions	Values of Variables	
Maximum Core Flow (% of Rated)	A	B
117.0	-0.00632	1.809
112.0	-0.00602	1.747
107.0	-0.00586	1.697
102.5	-0.00571	1.655

F	C
F < 40	1 + 0.0032 * (40 - F)
F ≥ 40	1.000

F = Percent of Rated Core Flow

FIGURE 4-3

Flow-Dependent MCPR Limit ($MCPR_F$) versus Core Flow

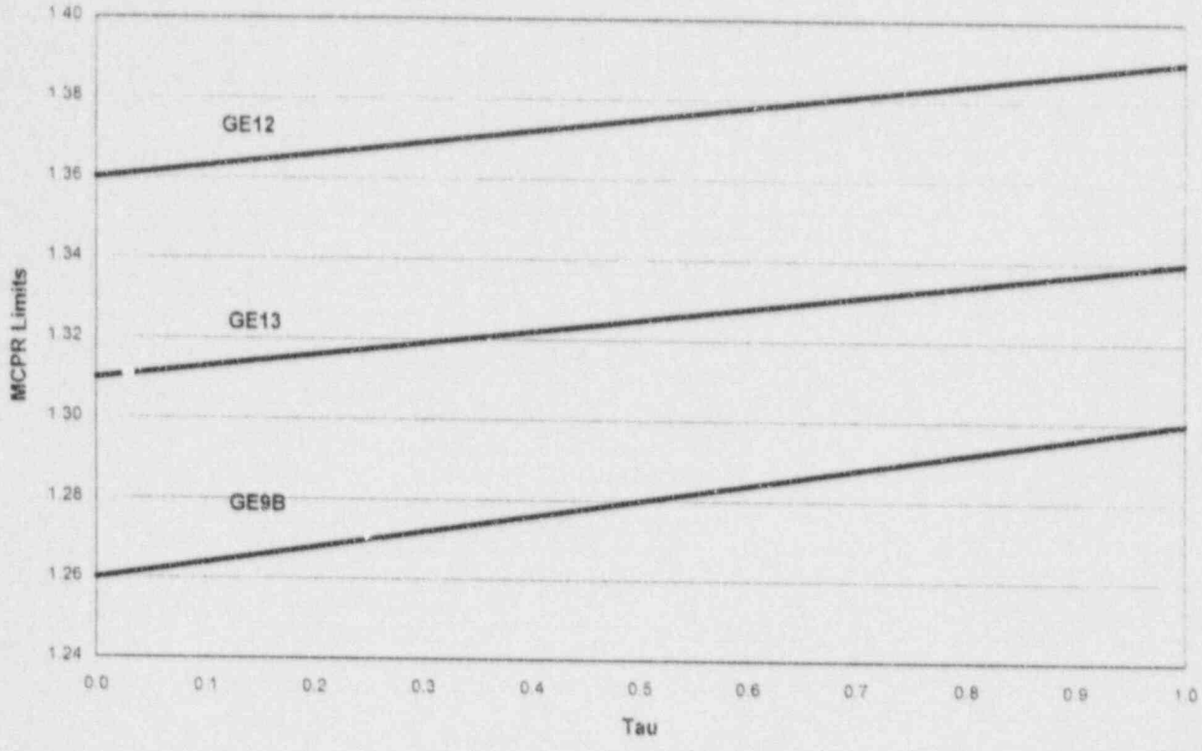


FIGURE 4-4A

MCPR Limits versus Average Scram Time
(EOC-RPT System Operable and Turbine Bypass Valves Operable)

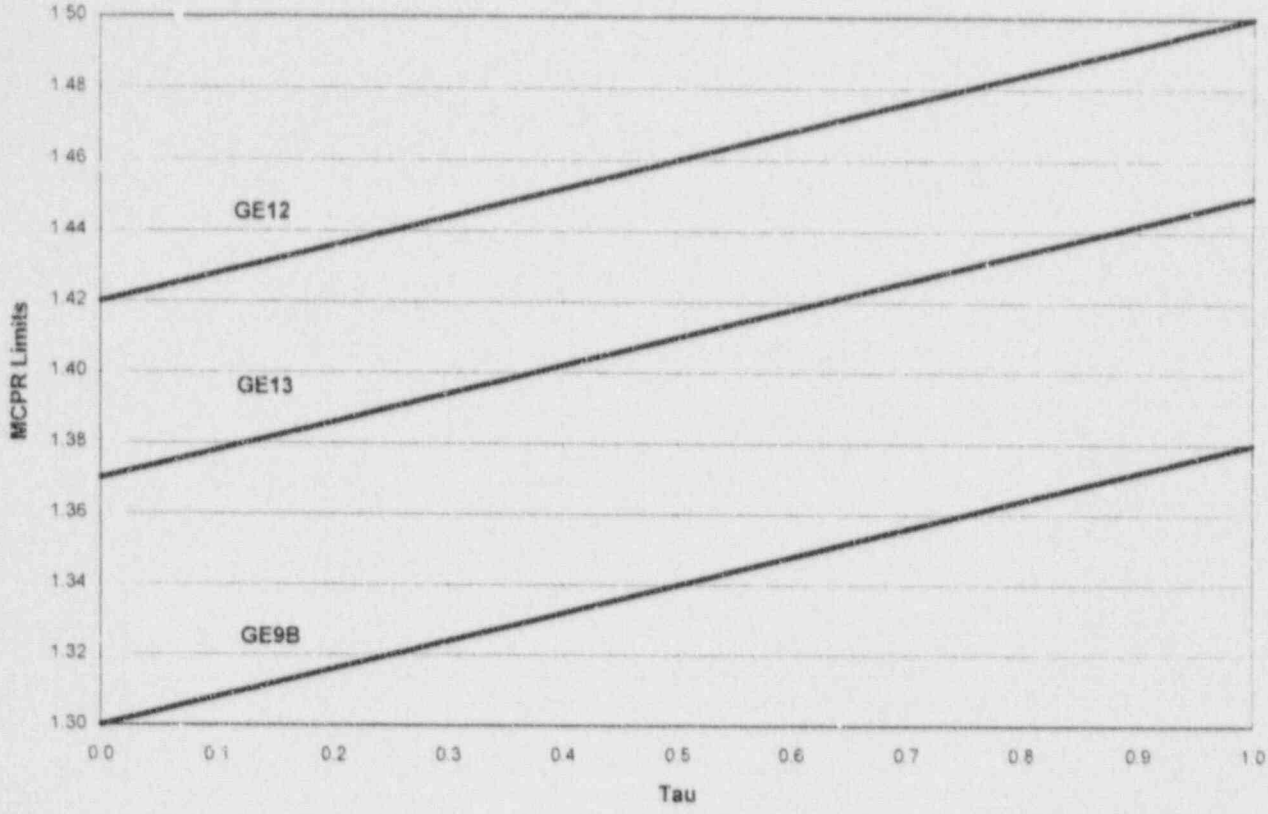


FIGURE 4-4B

MCPR Limits versus Average Scram Time
(EOC-RPT System Inoperable and Turbine Bypass Valves Operable)

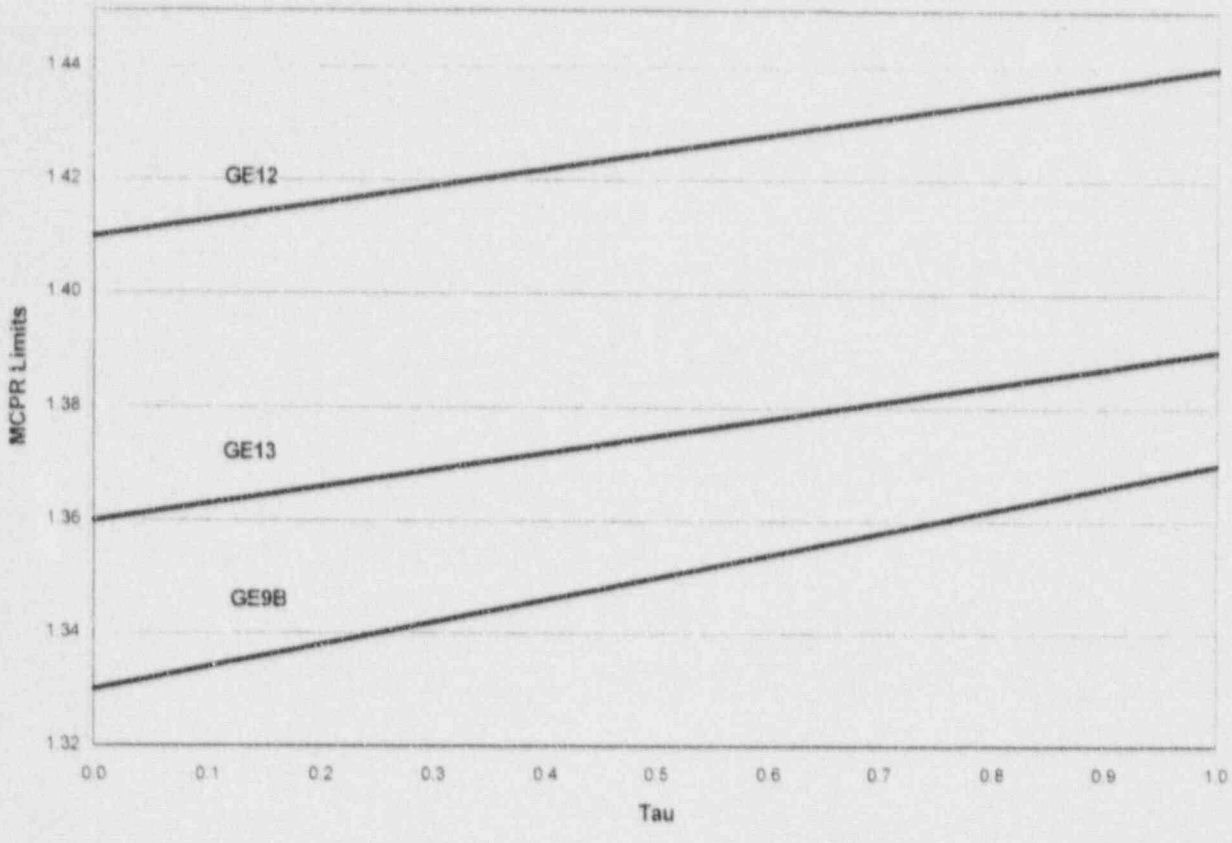


FIGURE 4-4C

MCPR Limits versus Average Scram Time
(EOC-RPT System Operable and Turbine Bypass Valves Inoperable)

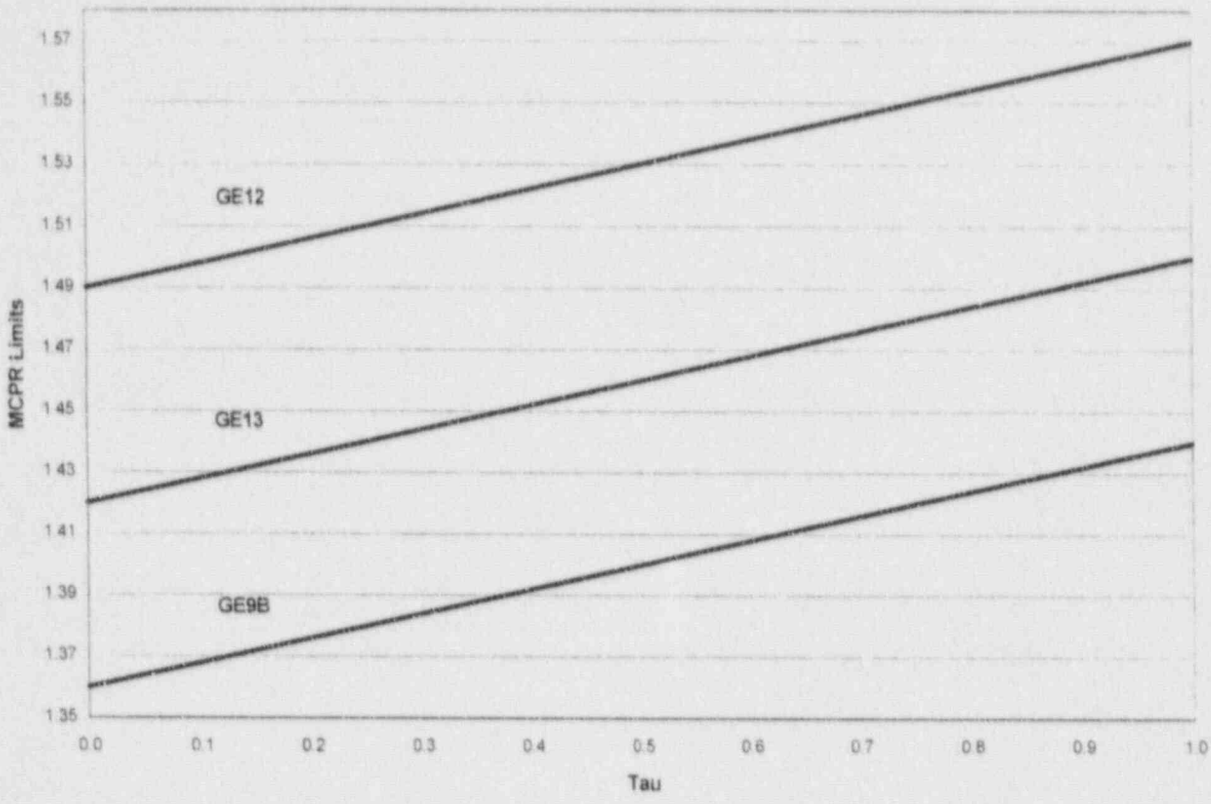


FIGURE 4-4D

MCPR Limits versus Average Scram Time
(EOC-RPT System Inoperable and Turbine Bypass Valves Inoperable)

5.0 APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH Time Constant (Surveillance Requirement 3.3.1.1.14)

The allowable value for the APRM Flow Biased Simulated Thermal Power - High time constant is ≤ 7.0 seconds.

6.0 REFERENCES

1. "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-13-US, August 1996.

2. Letter, L. P. Crocker (NRC) to W. G. Hairston (GPC), "Issuance of Amendment No. 168 to Facility Operating License DPR-57 and Amendment No. 106 to Facility Operating License NPF-5 - Edwin I. Hatch Nuclear Plant Units 1 and 2 (TAC Nos. 73614 and 73615)," December 29, 1989.

3. "Supplemental Reload Licensing Report for Edwin I. Hatch Nuclear Plant Unit 1, Reload 16, Cycle 17," General Electric Document 24A5353, Revision 0, March 1996.

4. "Edwin I. Hatch Nuclear Plant Units 1 and 2 SAFER/GESTR - LOCA Loss-of-Coolant Accident Analysis," NEDC-31376-P, December 1986.

5. Letter REK:96-146, "Feedwater Controller Failure Transients for Hatch 1 Cycle 17," R. E. Kingston (GE) to K. S. Folk (SNC), April 25, 1996.

6. Letter LDN97093, "Hatch 1 Cycle 17 ARTS Limits for PROOS," L. D. Noble (GE) to K. S. Folk (SNC), August 8, 1997.

7. Letter LDN97094, "Hatch 1 Cycle 17 Updated MCPR Operating Limits, MAPLHGRs, and Process Computer Update," L. D. Noble (GE) to K. S. Folk (SNC), August 18, 1997.

8. Letter LDN97106, "New MAPLHGR Limits for Bundle 2190," L. D. Noble (GE) to R. G. Cocherell (SNC), September 9, 1997.