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SOUTHERN COMPANY
Energy to Serve Your World℠

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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Edwin I. Hatch Nuclear Plant
Unit 1 Cycle 21Core Operating Limits Report (COLR), Revision 1

Ladies and Gentlemen:

In accordance with Technical Specification 5.6.5, Southern Nuclear Operating Company hereby submits the Edwin I. Hatch Nuclear Plant Unit 1 Cycle 21 Core Operating Limits Report, Revision 1.

This letter contains no NRC commitments. If you have any questions, please advise.

Sincerely,

H. L. Sumner, Jr.

HLS/IL/daj

Enclosures: Unit 1 Cycle 21 Core Operating Limits Report, Revision 1

cc: Southern Nuclear Operating Company
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SOUTHERN NUCLEAR OPERATING COMPANY
EDWIN I. HATCH NUCLEAR PLANT

Unit 1 Cycle 21
CORE OPERATING LIMITS REPORT

Revision 1

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

Edwin I. Hatch Nuclear Plant
Unit 1 Cycle 21
Core Operating Limits Report

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1.0 INTRODUCTION

The Core Operating Limits Report (COLR) for Plant Hatch Unit 1 Cycle 21 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 (Reference 1). Results from the reload analyses for the fuel in Unit 1 Cycle 21 are documented in References 2, 3, and 4. Results from the most recent cycle independent analyses are documented in Reference 5. Revised APLHGR limits for GE13 fuel are documented in References 6 and 7.

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.

c. Maximum allowable scram setpoints for the Period Based Detection Algorithm (PBDA) in the Oscillation Power Range Monitor (OPRM) system.

From a fuel thermal limits perspective, the following limitations are placed on Unit 1 operation with equipment out of service.

Equipment / Condition	Limitation
EOC-RPT Out of Service AND Turbine Bypass Valves Inoperable Simultaneously	Not analyzed
Single-Loop Operation (SLO)	• ≤ 2000 MWt • ≤ 56% Core Flow

Also included in this report are the maximum allowable scram setpoints 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 2-8, 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.

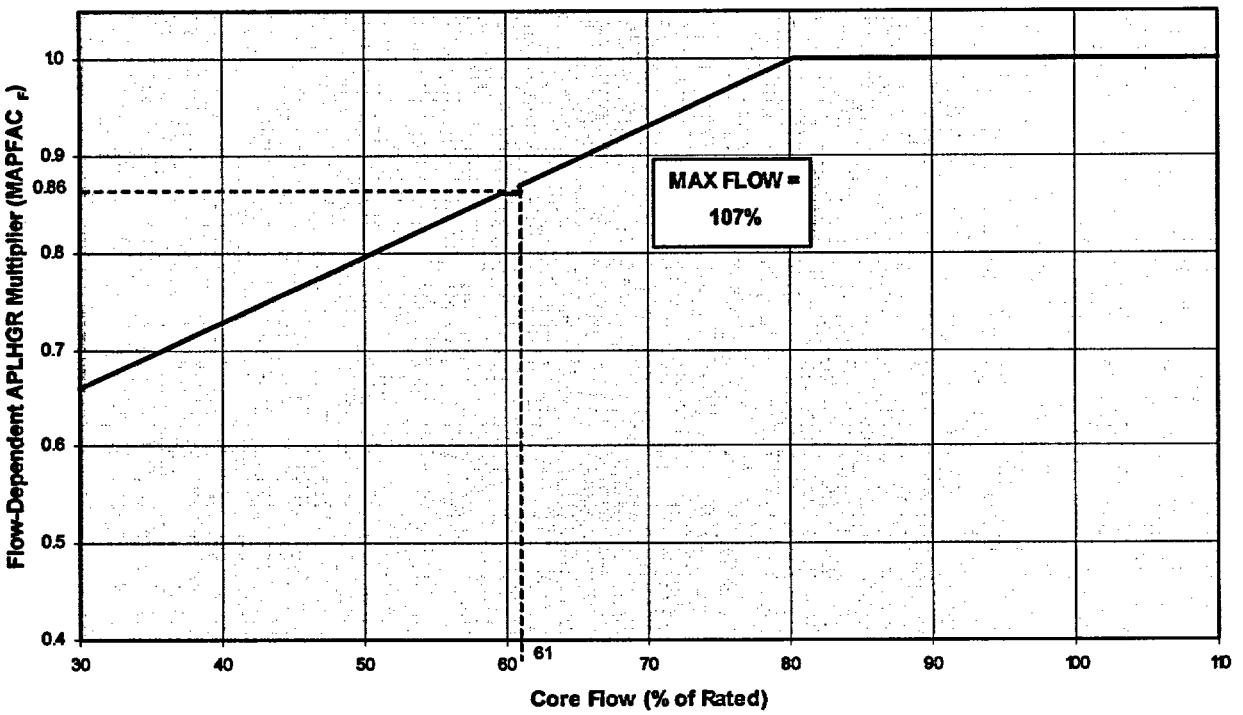
Since every assembly in the core contains more than one enriched lattice, GESTAR-II (Reference 1) requires that the appropriate APLHGR limit from Figures 2-3 through Figures 2-8 be applied to every axial location in the fuel assembly, when APLHGR values are hand-calculated. The limits shown in those figures are the values for the most limiting enriched lattice in each fuel bundle as a function of average planar exposure.

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	Bypass Valves	Pressure Regulator	$MAPFAC_P$ Curve
BOC to EEOC	Operable	Operable	Figure 2-2A
BOC to EEOC	Inoperable	Operable	Figure 2-2B
BOC to EEOC	Operable or Inoperable	Inoperable	Figure 2-2C



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

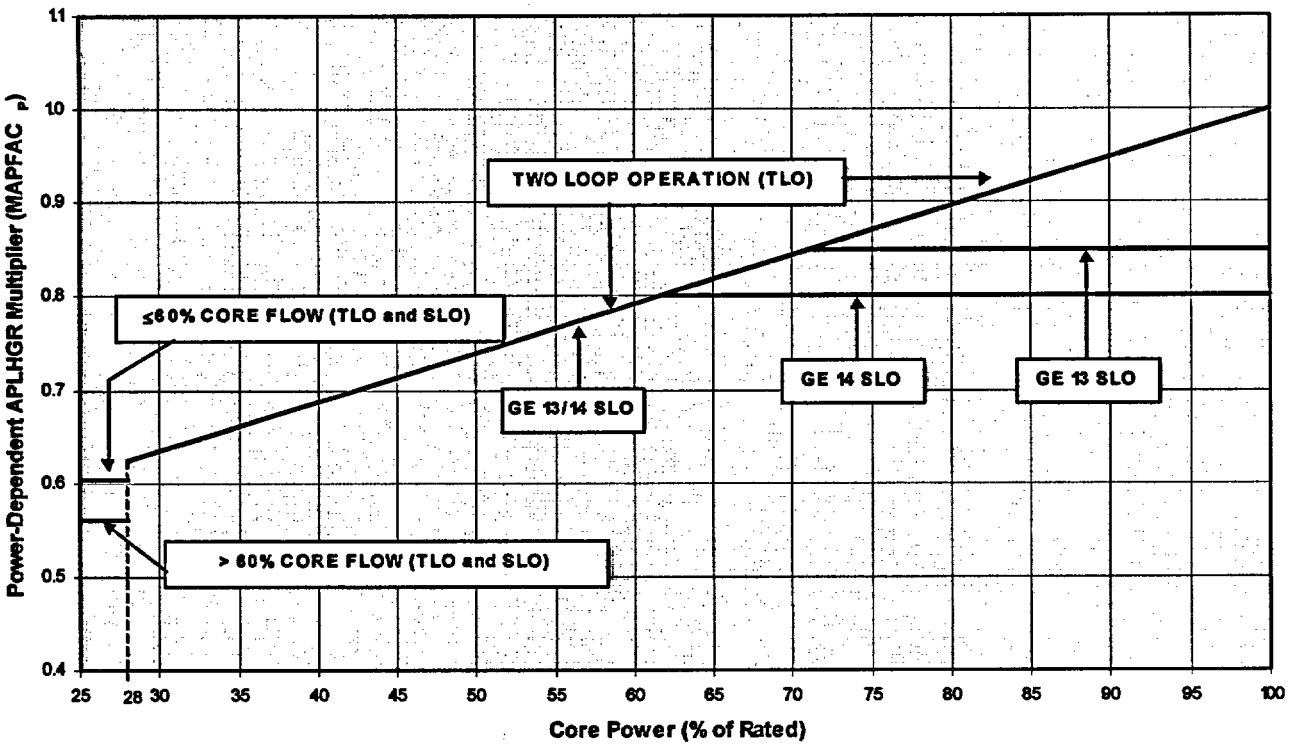
Maximum Core Flow (% of Rated)	A	B
107.0	0.4574	0.006758

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



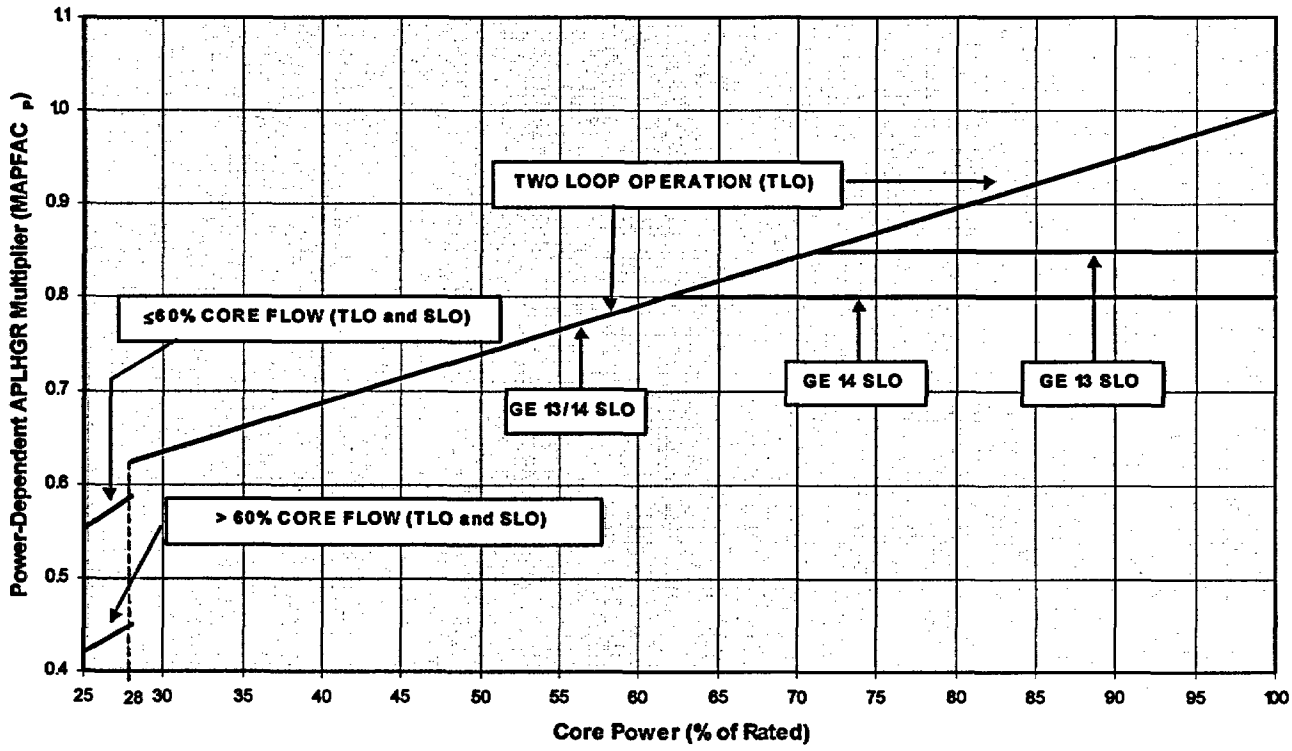
$MAPFAC_P = A - B\,(P_O - P)$

Operating Conditions				Values of Variables		
P	F	Fuel Type	SLO/TLO	A	B	P_0
25 ≤ P < 28	F ≤ 60	GE13/14	SLO/TLO	0.603	0	28
25 ≤ P < 28	F > 60	GE13/14	SLO/TLO	0.560	0	28
28 ≤ P < 61.72	All	GE13/14	SLO/TLO	1.00	0.005224	100
61.72 ≤ P < 71.28	All	GE13	SLO/TLO	1.00	0.005224	100
61.72 ≤ P < 71.28	All	GE14	TLO	1.00	0.005224	100
71.28 ≤ P	All	GE13/14	TLO	1.00	0.005224	100
71.28 ≤ P	All	GE13	SLO	0.85	0.000	100
61.72 ≤ P	All	GE14	SLO	0.80	0.000	100

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

FIGURE 2-2A

Power-Dependent APLHGR Multiplier ($MAPFAC_P$) versus Core Power
(Bypass Valves Operable and Pressure Regulator Operable)



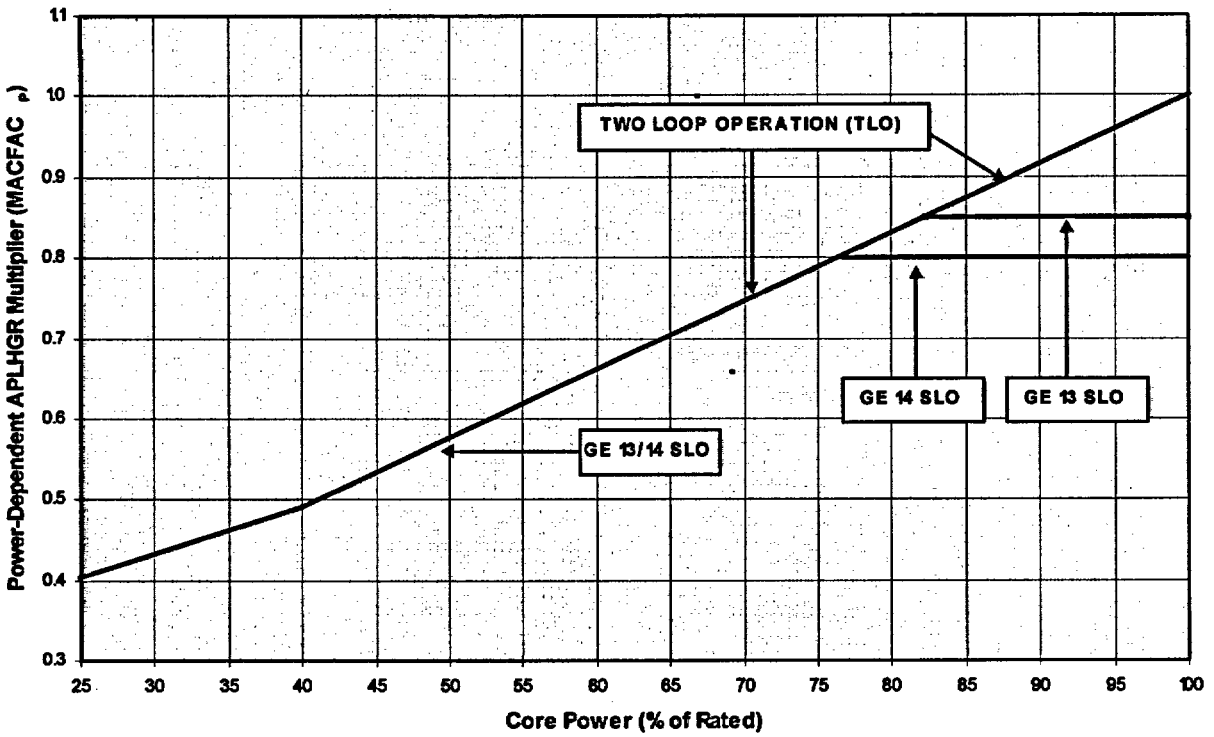
$MAPFAC_P = A - B\,(P_O - P)$

Operating Conditions				Values of Variables		
P	F	Fuel Type	SLO/TLO	A	B	P_0
25 ≤ P < 28	F ≤ 60	GE13/14	SLO/TLO	0.588	0.01167	28
25 ≤ P < 28	F > 60	GE13/14	SLO/TLO	0.450	0.00967	28
28 ≤ P < 61.72	All	GE13/14	SLO/TLO	1.00	0.005224	100
61.72 ≤ P < 71.28	All	GE13	SLO/TLO	1.00	0.005224	100
61.72 ≤ P < 71.28	All	GE14	TLO	1.00	0.005224	100
71.28 ≤ P	All	GE13/14	TLO	1.00	0.005224	100
71.28 ≤ P	All	GE13	SLO	0.85	0.000	100
61.72 ≤ P	All	GE14	SLO	0.80	0.000	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
(Bypass Valves Inoperable and Pressure Regulator Operable)



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

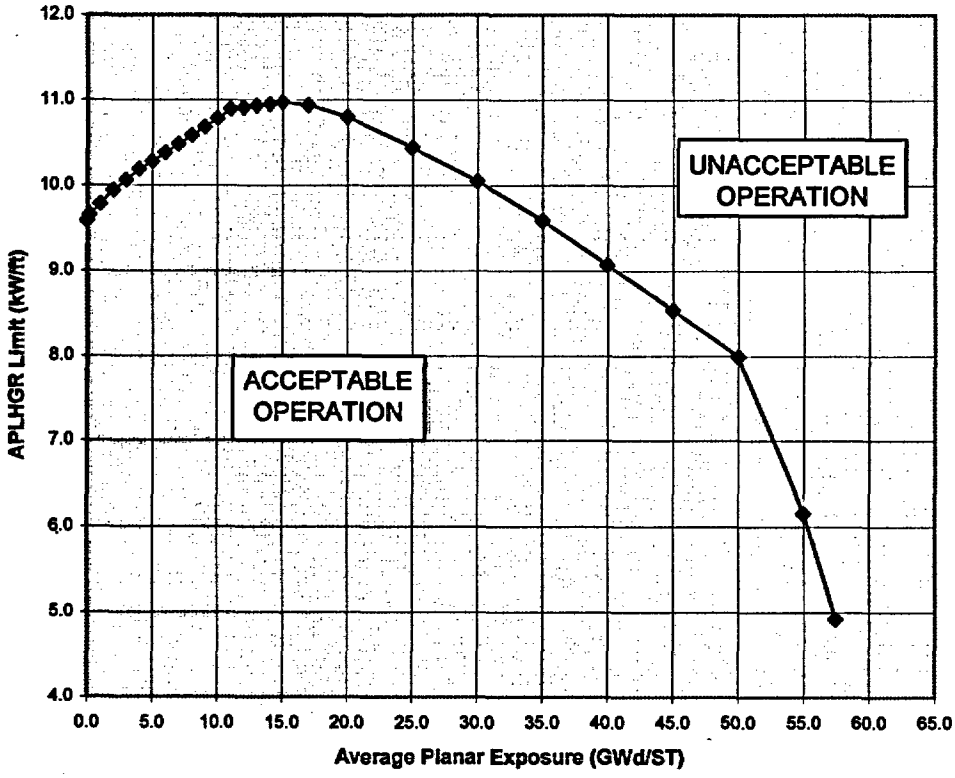
Operating Conditions				Values of Variables		
P	F	Fuel Type	SLO/TLO	A	B	P_0
$25 \le P < 40$	All	GE13/14	SLO/TLO	0.49	0.00580	40
$40 \le P < 100$	All	GE13/14	SLO/TLO	1.00	0.0085	100

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

FIGURE 2-2C

Power-Dependent APLHGR Multiplier ($MAPFAC_P$) versus Core Power
(Pressure Regulator Inoperable)

Average Planar Exposure	APLHGR Limit
0.00	9.59
0.20	9.66
1.00	9.78
2.00	9.94
3.00	10.06
4.00	10.19
5.00	10.28
6.00	10.38
7.00	10.48
8.00	10.58
9.00	10.68
10.00	10.78
11.00	10.89
12.00	10.91
13.00	10.93
14.00	10.95
15.00	10.97
17.00	10.94
20.00	10.80
25.00	10.44
30.00	10.05
35.00	9.59
40.00	9.07
45.00	8.54
50.00	7.99
55.00	6.16
57.45	4.92

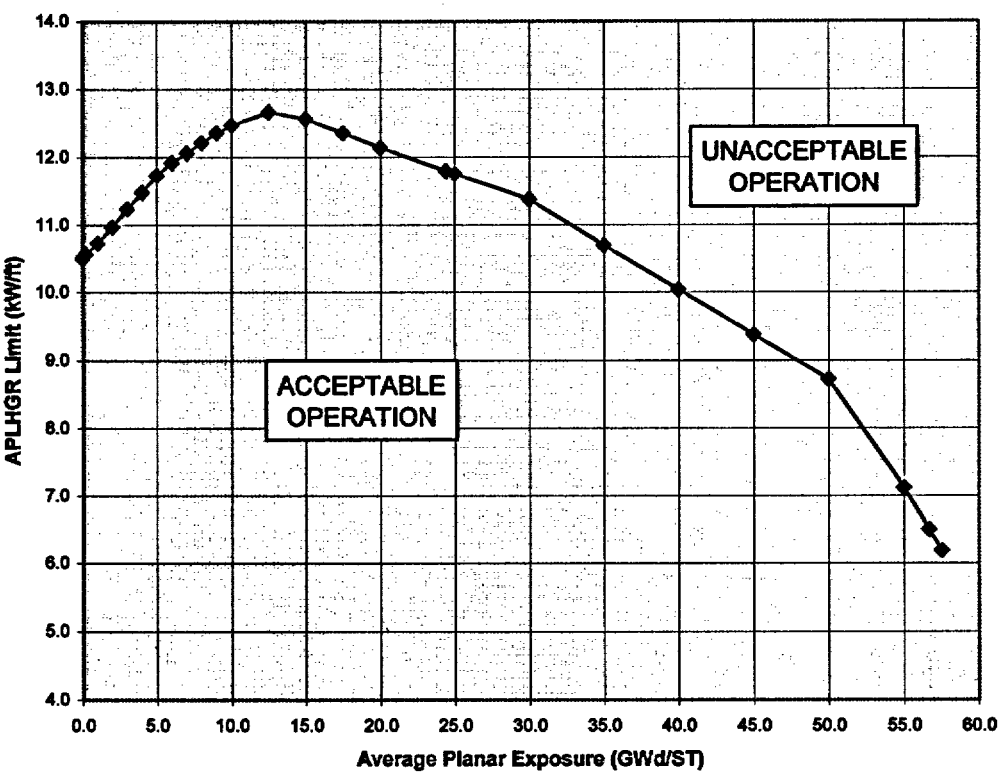


NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 2-3

APLHGR Limit versus Average Planar Exposure
(Bundle Type: GE14-P10DNAB399-16GZ-100T-150-T-2517)

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	12.47
12.50	12.67
15.00	12.57
17.50	12.36
20.00	12.14
24.40	11.80
25.00	11.76
30.00	11.38
35.00	10.70
40.00	10.04
45.00	9.38
50.00	8.72
55.00	7.12
56.70	6.50
57.53	6.19

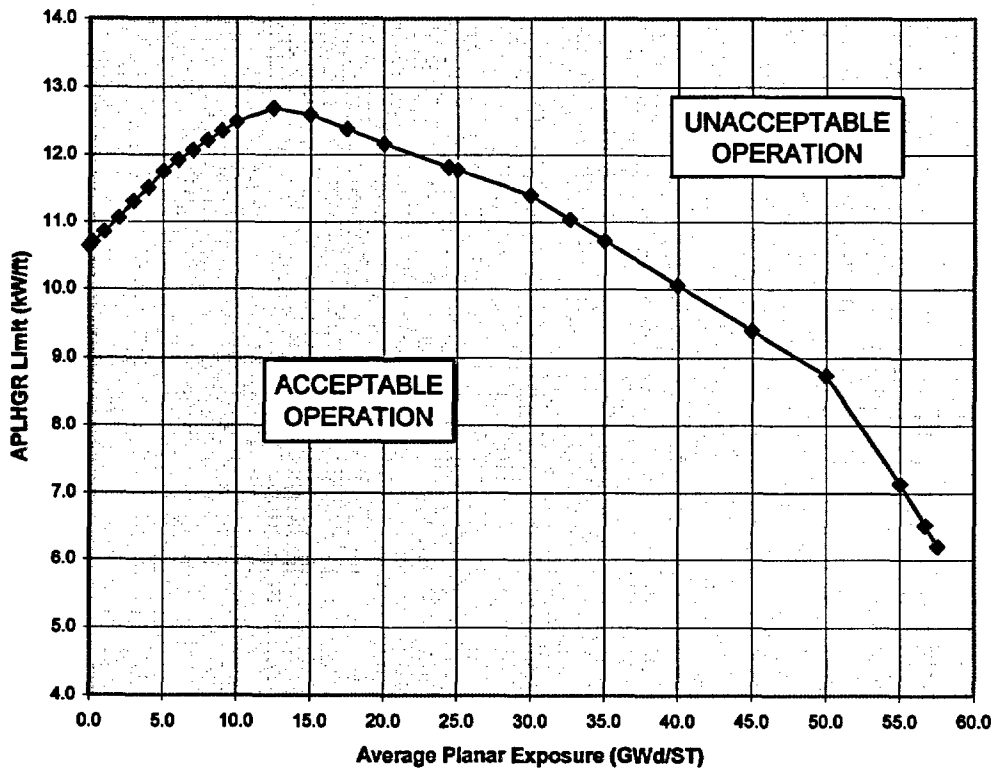


NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 2-4

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

Average Planar Exposure	APLHGR Limit
0.00	10.64
0.20	10.70
1.00	10.85
2.00	11.06
3.00	11.30
4.00	11.51
5.00	11.75
6.00	11.92
7.00	12.06
8.00	12.21
9.00	12.35
10.00	12.49
12.50	12.69
15.00	12.59
17.50	12.38
20.00	12.16
24.40	11.82
25.00	11.78
30.00	11.40
32.66	11.04
35.00	10.72
40.00	10.06
45.00	9.40
50.00	8.74
55.00	7.14
56.70	6.52
57.54	6.21

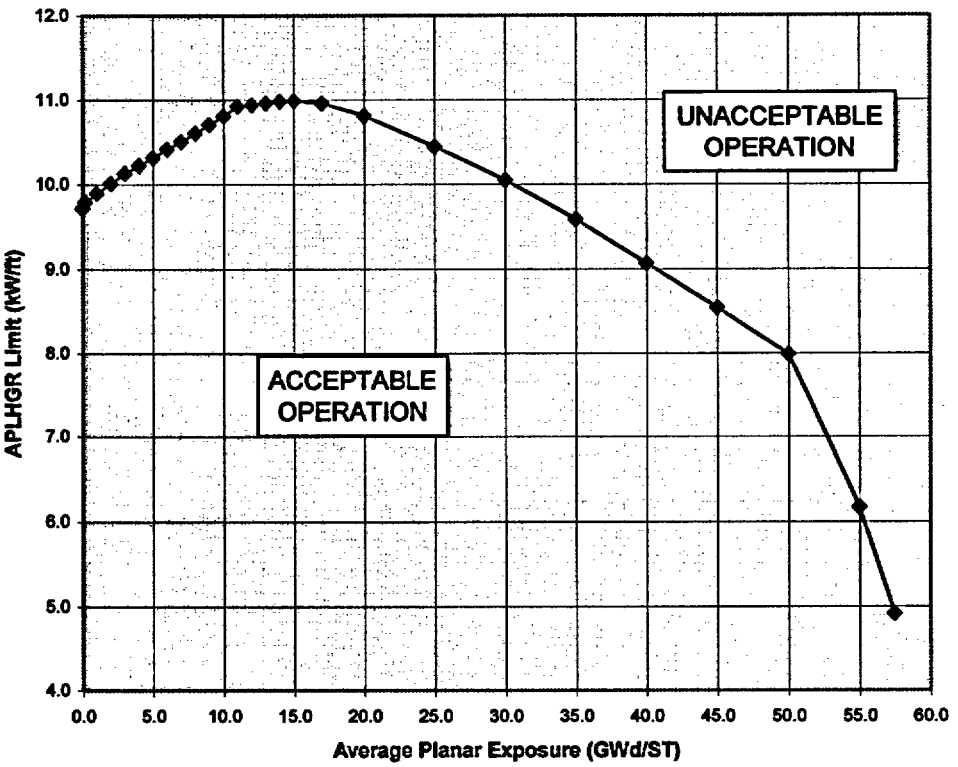


NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 2-5

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

Average Planar Exposure	APLHGR Limit
0.00	9.72
0.20	9.79
1.00	9.89
2.00	10.01
3.00	10.13
4.00	10.22
5.00	10.31
6.00	10.41
7.00	10.50
8.00	10.60
9.00	10.70
10.00	10.80
11.00	10.92
12.00	10.94
13.00	10.96
14.00	10.98
15.00	10.99
17.00	10.96
20.00	10.81
25.00	10.44
30.00	10.05
35.00	9.59
40.00	9.07
45.00	8.54
50.00	7.99
55.00	6.17
57.47	4.92

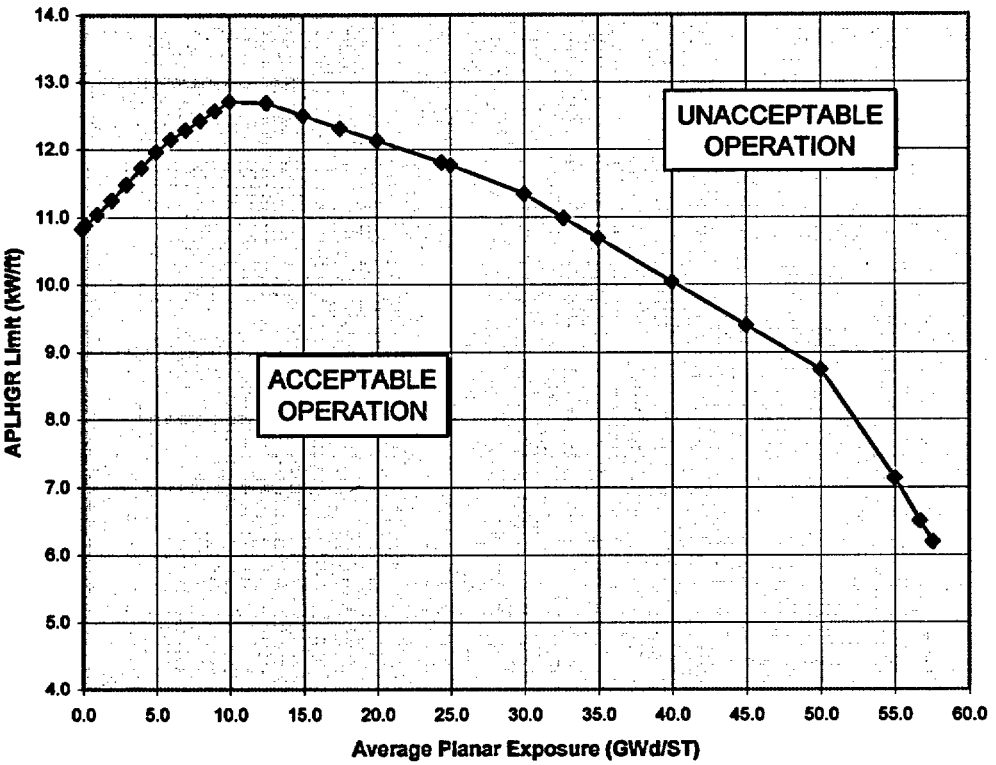


NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 2-6

APLHGR Limit versus Average Planar Exposure
(Bundle Type: GE14-P10DNAB398-15GZ-100T-150-T-2518)

Average Planar Exposure	APLHGR Limit
0.00	10.83
0.20	10.89
1.00	11.04
2.00	11.25
3.00	11.48
4.00	11.73
5.00	11.96
6.00	12.14
7.00	12.28
8.00	12.42
9.00	12.57
10.00	12.71
12.50	12.69
15.00	12.50
17.50	12.31
20.00	12.13
24.40	11.81
25.00	11.77
30.00	11.34
32.66	10.99
35.00	10.69
40.00	10.04
45.00	9.40
50.00	8.74
55.00	7.14
56.70	6.51
57.54	6.20

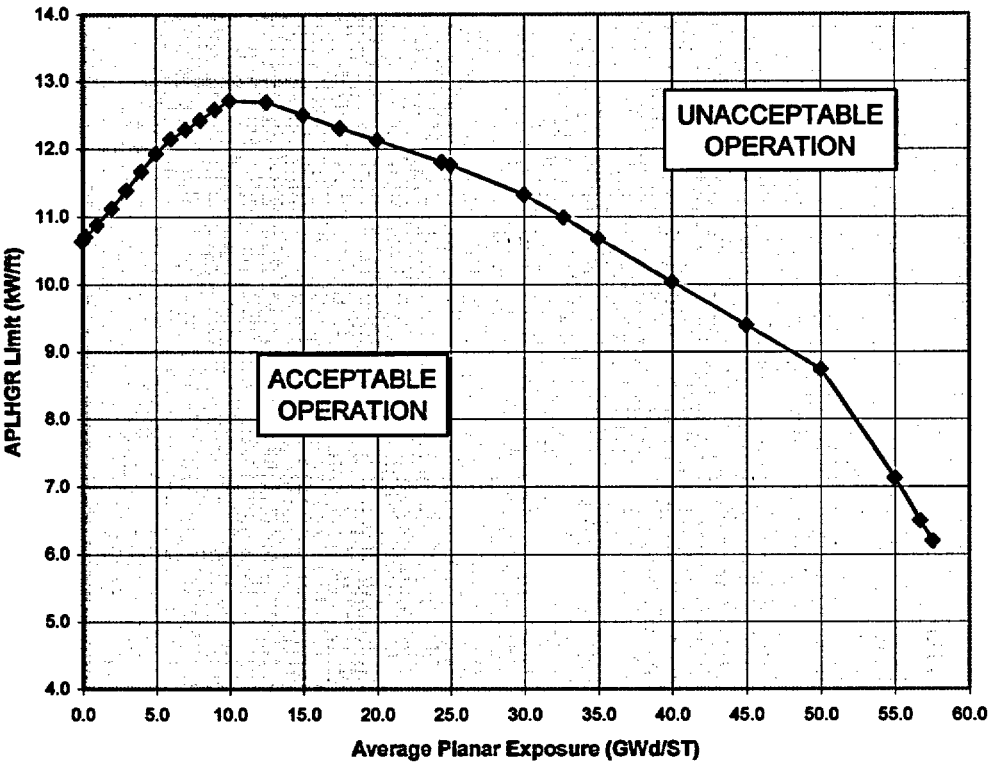


NOTE: THIS IS THE APLHGR LIMIT FOR THE MOST LIMITING LATTICE AS A FUNCTION OF AVERAGE PLANAR EXPOSURE.

FIGURE 2-7

APLHGR Limit versus Average Planar Exposure
(Bundle Type: GE13-P9DTB378-6G5.0/6G4.0-100T-146-T-2411)

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	12.69
15.00	12.50
17.50	12.31
20.00	12.13
24.40	11.81
25.00	11.77
30.00	11.33
32.66	10.99
35.00	10.68
40.00	10.04
45.00	9.40
50.00	8.74
55.00	7.13
56.70	6.50
57.53	6.20



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

FIGURE 2-8

ALPHGR Limit versus Average Planar Exposure
(Bundle Type: GE13-P9DTB378-6G5.0/6G4.0/1G2.0-100T-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, operability of the turbine bypass valve system, and whether both pressure regulators are operable.

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

a. For 25% ≤ power < 28%, the power-dependent MCPR limit, $MCPR_P$, as determined by Table 3-1A or 3-1B.

b. For power ≥ 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, and the rated-power, rated-flow MCPR limit as determined by Table 3-1A or 3-1B.

With only one recirculation pump in operation (SLO), the OLMCPR for each fuel type is the TLO OLMCPR plus 0.02.

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 3-4E, Option A scram time MCPR limits correspond to τ = 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 τ = 0.0. For scram times between Option A and Option B, the MCPR limit for each fuel corresponds to τ. If τ has not been determined, Option A limits are to be used. Refer to Table 3-1A or 3-1B 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).

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

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

N_i = number of active control rods measured in the *ith* surveillance test.

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

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

TABLE 3-1A

MCPR Operating Flexibility Options
for Cycle Exposures BOC to EOC-2100

EOC-RPT System	Turbine Bypass Valve System	Pressure Regulator System	$MCPR_P$ Curve	Kp Curve	Rated-Power, Rated-Flow MCPR Limits
Operable	Operable	Operable	Figure 3-1A	Figure 3-3A	Figure 3-4A
Operable	Operable	Inoperable	Figure 3-1A	Figure 3-3B	Figure 3-4A
Inoperable	Operable	Operable	Figure 3-1A	Figure 3-3A	Figure 3-4B
Inoperable	Operable	Inoperable	Figure 3-1A	Figure 3-3B	Figure 3-4B
Operable	Inoperable	Operable	Figure 3-1B	Figure 3-3A	Figure 3-4C
Operable	Inoperable	Inoperable	Figure 3-1B	Figure 3-3B	Figure 3-4C

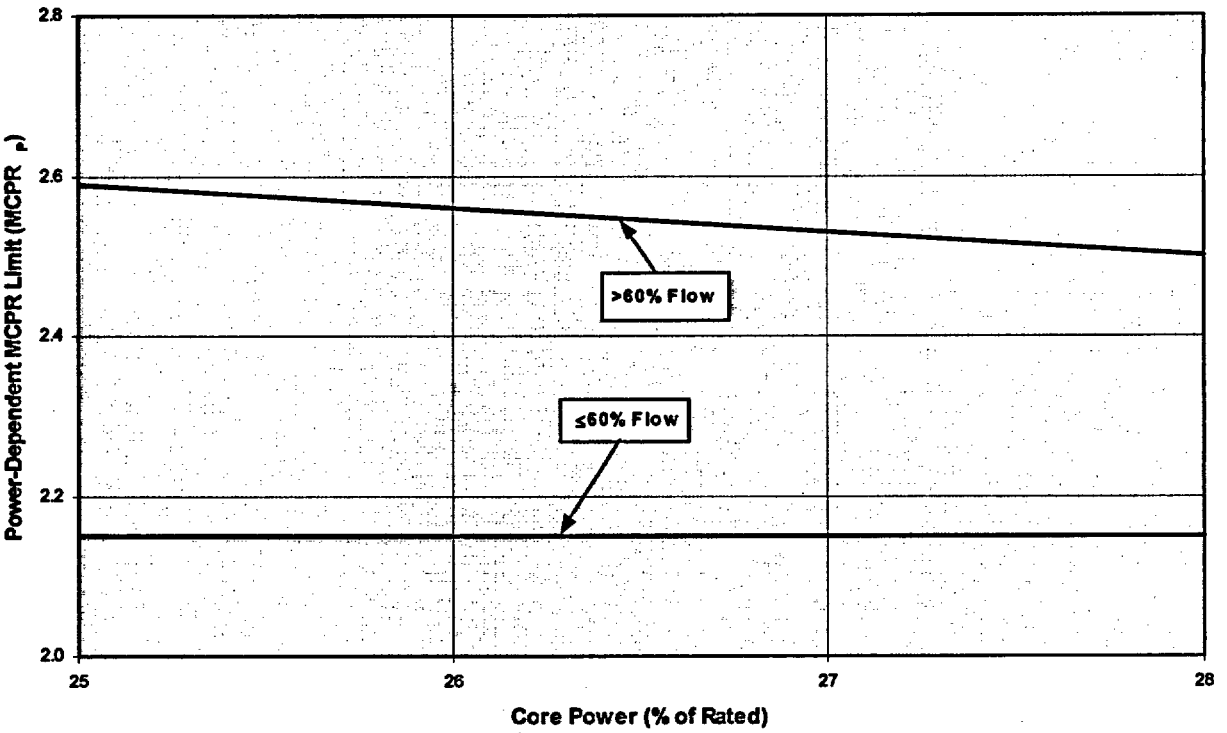
BOC = Beginning of Cycle
EOC = End of Cycle
EEOC = Extended End of Cycle

TABLE 3-1B

MCPR Operating Flexibility Options
for Cycle Exposures EOC-2100 to EEOC

EOC-RPT System	Turbine Bypass Valve System	Pressure Regulator System	$MCPR_P$ Curve	Kp Curve	Rated-Power, Rated-Flow MCPR Limits
Operable	Operable	Operable	Figure 3-1A	Figure 3-3A	Figure 3-4D
Operable	Operable	Inoperable	Figure 3-1A	Figure 3-3B	Figure 3-4D
Inoperable	Operable	Operable	Figure 3-1A	Figure 3-3A	Figure 3-4E
Inoperable	Operable	Inoperable	Figure 3-1A	Figure 3-3B	Figure 3-4E
Operable	Inoperable	Operable	Figure 3-1B	Figure 3-3A	Figure 3-4C
Operable	Inoperable	Inoperable	Figure 3-1B	Figure 3-3B	Figure 3-4C

BOC = Beginning of Cycle
EOC = End of Cycle
EEOC = Extended End of Cycle



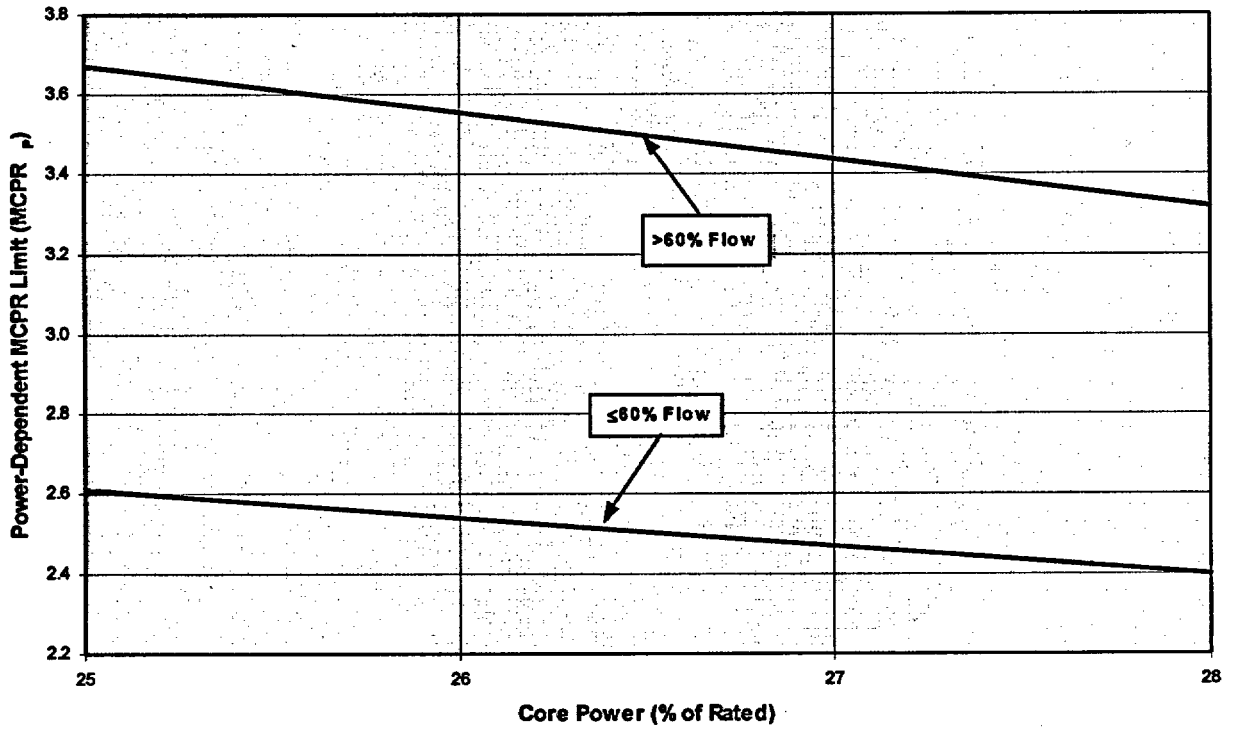
$MCPR_P = A + B (28-P)$

F	A	B
≤ 60%	2.15	0
> 60%	2.5	0.03

P = Percent of Rated Core Thermal 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 Valves Operable)



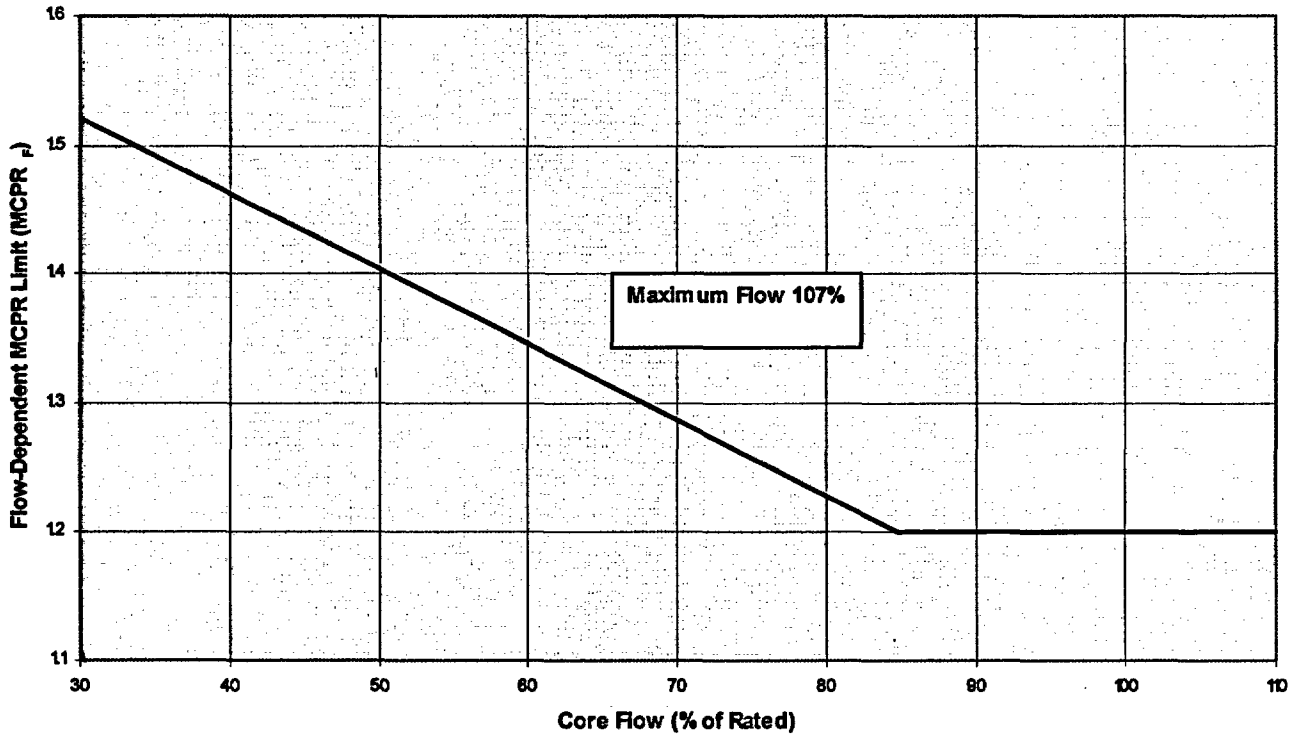
$MCPR_P = A + B (28-P)$

F	A	B
≤ 60%	2.40	0.070
> 60%	3.32	0.1167

P = Percent of Rated Core Thermal 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 Valves Inoperable)



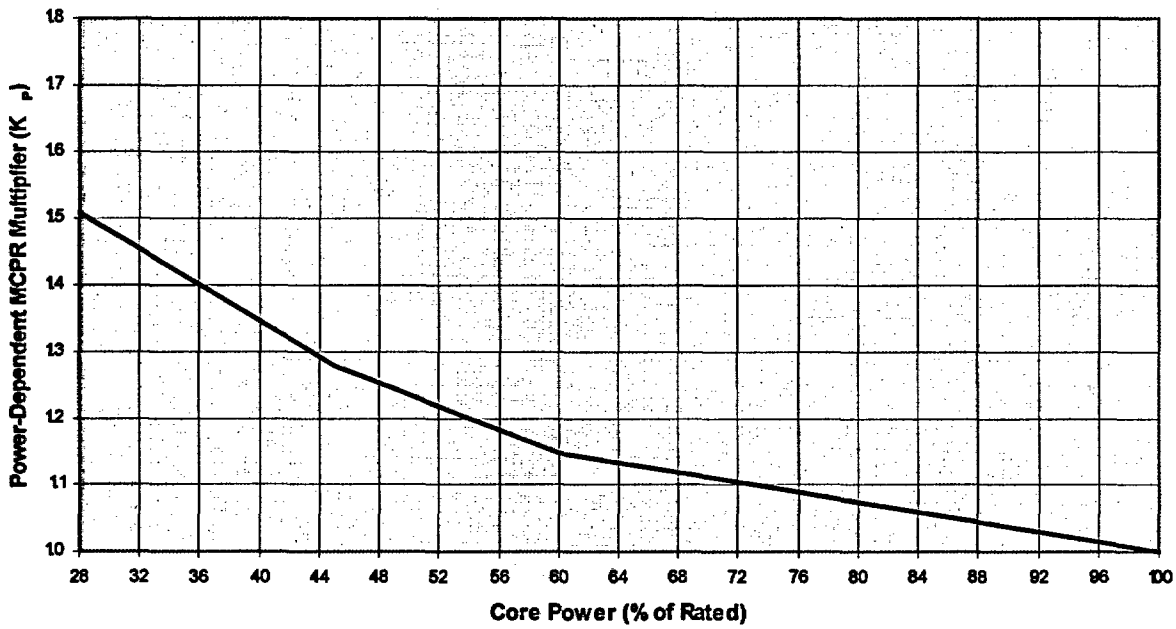
$MCPR_F$ = Maximum [1.20, (A * F + B)]

Maximum Core Flow (% of Rated)	A	B
107.0	-0.00586	1.697

F = Percent of Rated Core Flow

FIGURE 3-2

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



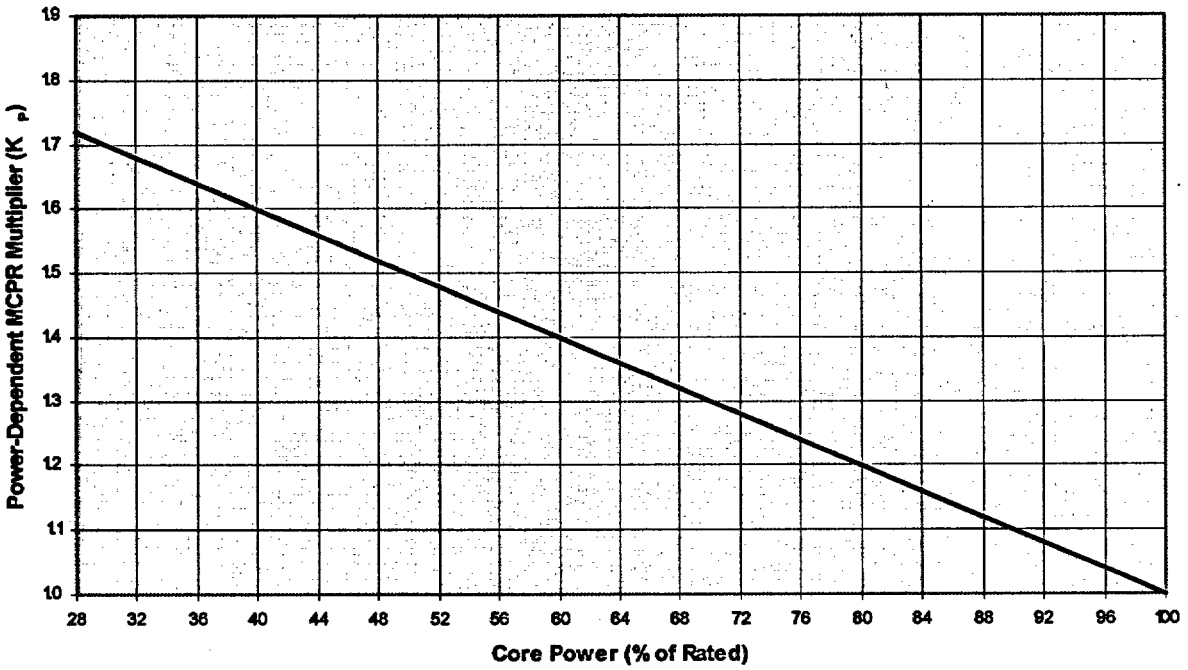
$K_P = A + B^*(P_O-P)$

P	A	B	P_O
$28 \le P < 45$	1.28	0.01340	45
$45 \le P < 60$	1.15	0.00867	60
$60 \le P$	1.00	0.00375	100

P = Percent of Rated Core Power

FIGURE 3-3A

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



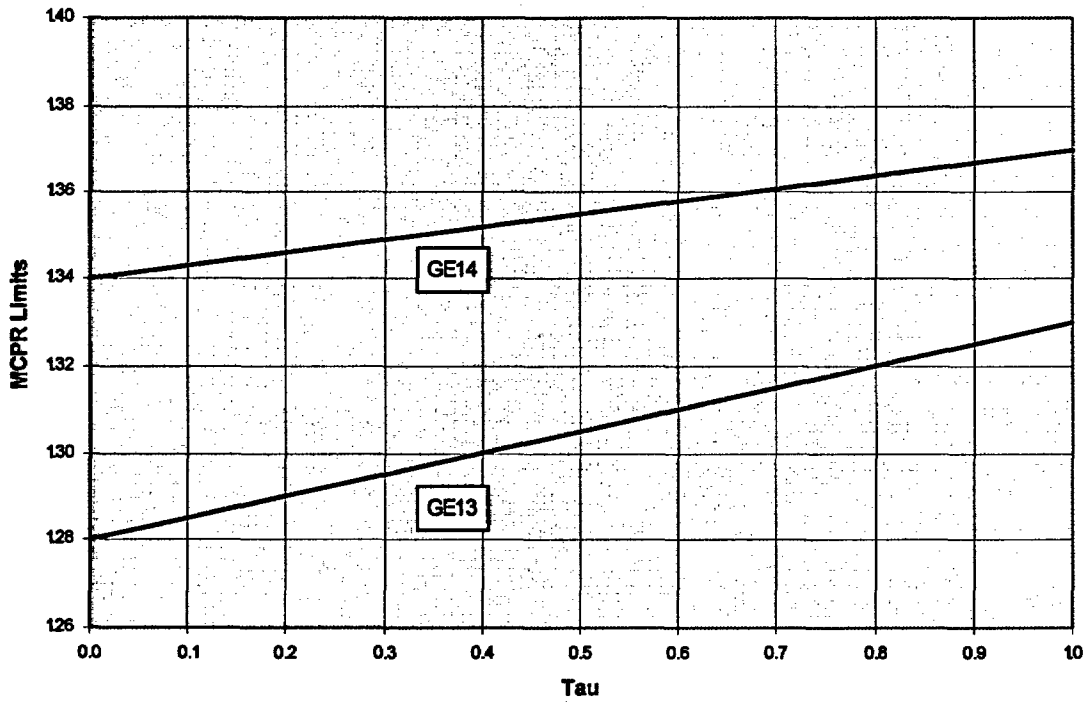
$K_P = A + B*(P_O-P)$

P	A	B	P_O
$28 \le P < 100$	1.00	0.010	100

P = Percent of Rated Core Power

FIGURE 3-3B

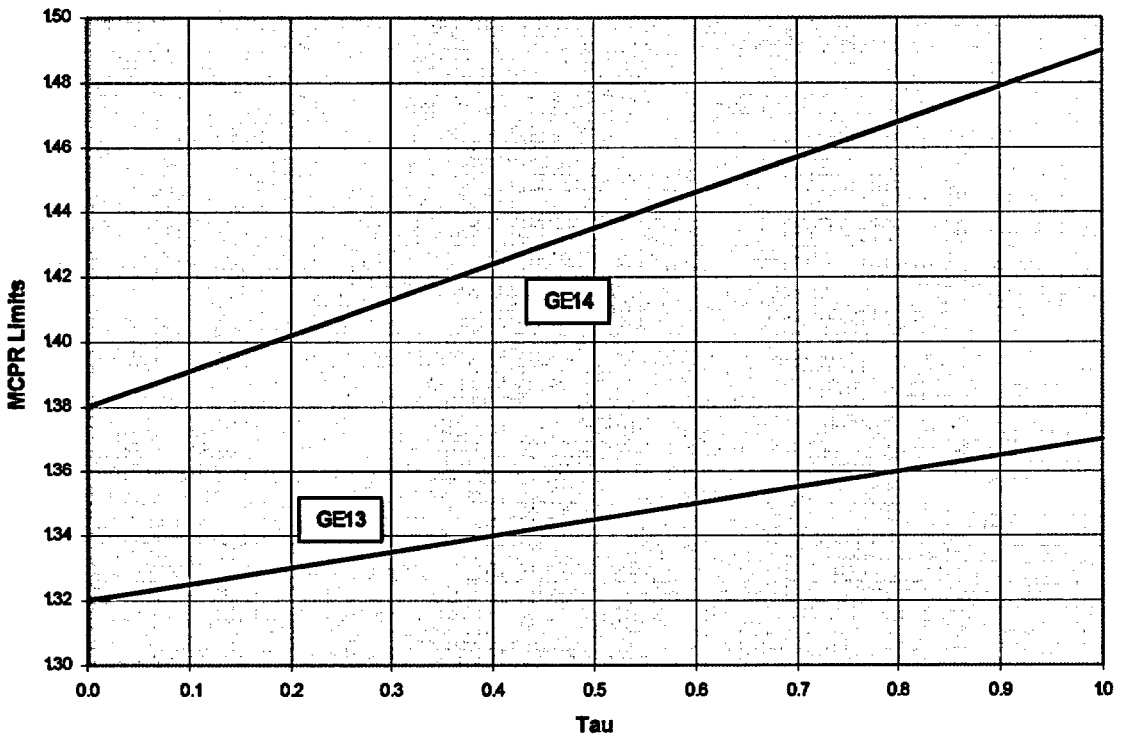
Power-Dependent MCPR Multiplier (K_P) versus Core Power
(Pressure Regulator Inoperable)



Tau	GE14	GE13
1.0	1.37	1.33
0.0	1.34	1.28

FIGURE 3-4A

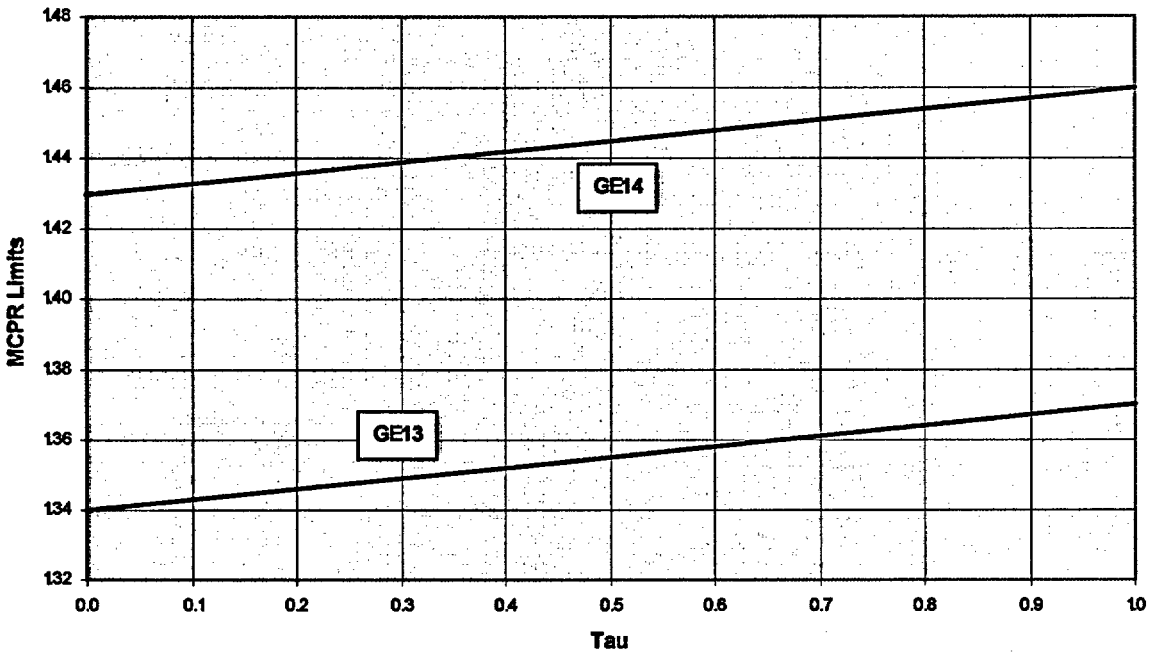
MCPR Limits versus Average Scram Time
(BOC to EOC-2100 with EOC-RPT System Operable and Bypass Valves Operable)



Tau	GE14	GE13
1.0	1.49	1.37
0.0	1.38	1.32

FIGURE 3-4B

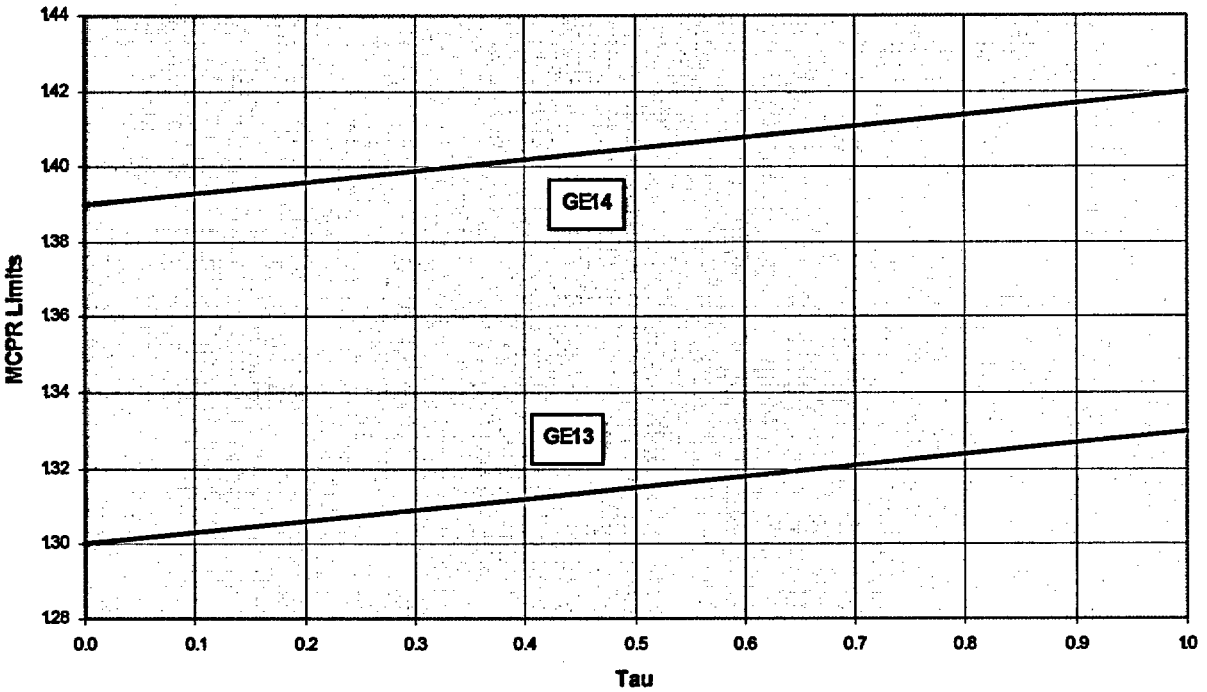
MCPR Limits versus Average Scram Time
(BOC to EOC-2100 with EOC-RPT System Inoperable and Bypass Valves Operable)



Tau	GE14	GE13
1.0	1.46	1.37
0.0	1.43	1.34

FIGURE 3-4C

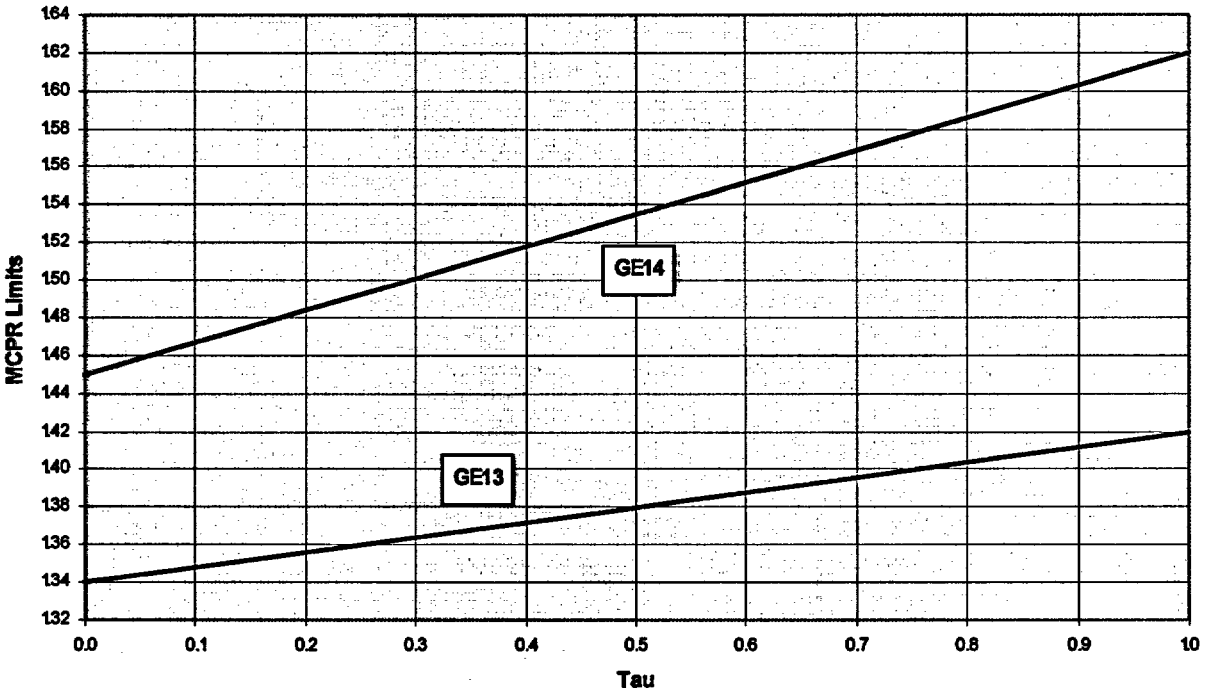
MCPR Limits versus Average Scram Time
(BOC to EEOC with EOC-RPT System Operable and Bypass Valves Inoperable)



Tau	GE14	GE13
1.0	1.42	1.33
0.0	1.39	1.30

FIGURE 3-4D

MCPR Limits versus Average Scram Time
(EOC-2100 to EEOC with EOC-RPT System Operable and Bypass Valves Operable)



Tau	GE14	GE13
1.0	1.62	1.42
0.0	1.45	1.34

FIGURE 3-4E

MCPR Limits versus Average Scram Time
(EOC-2100 to EEOC with EOC-RPT System Inoperable and Bypass Valves Operable)

4.0 PBDA AMPLITUDE SETPOINT

The amplitude trip setpoint in the Period Based Detection Algorithm in the OPRM system shall not exceed the values reported in the Table below. This applies to instruments 1C51K615 A, B, C, and D. These are the nominal trip setpoint values, not the allowable values. Projected Figure of Merit (FOM) value(s) throughout the cycle will be supplied by the Hatch Core Analysis Group. The values in this table are based on GE13 fuel, since it has lower OLMCPRs than the GE14 fuel.

FOM >	FOM ≤	1.28 ≤ OLMCPR < 1.30	1.30 ≤ OLMCPR < 1.34	OLMCPR ≥ 1.34
0.0	92.1	1.11	1.12	1.13
92.1	96.9	1.10	1.10	1.11
96.9	102.4	1.08	1.09	1.10
102.4	108.0	1.07	1.08	1.09

5.0 REFERENCES

1. GE/GNF Report "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A-14, June 2000, and the US Supplement, NEDE-24011-P-A-14-US, June 2000.

2. GNF Report 0000-0002-7058-SRLR, Revision 0, "Supplemental Reload Licensing Report for Edwin I. Hatch Nuclear Power Plant Unit 1, Reload 20 Cycle 21," March 2002.

3. SNC Letter CAH-NF-2370, "Hatch-1 Cycle 21 Pressure Regulator Out-of-Service ARTS Limits," E. B. Gibson to K. S. Folk, April 8, 2002.

4. SNC Letter CAH-NF-2371, "GE14 Low Power ARTS Below P_{BYP} With Bypass Valves Inoperable," W. R. Mertz to K. S. Folk, April 8, 2002.

5. GE Report GE-NE-0000-0001-3737-01P, "GE14 Fuel Design Cycle-Independent Analyses for Hatch Units 1 and 2, March 2002.

6. GNF Letter VRU-03-005, V. Ruiz-Ugalde to E. B. Gibson, "Hatch 1 and 2 Improved MPLHGR Limits", June 26, 2003.

7. GNF Letter EWG-S-03-011, E. W. Gibbs to E. B. Gibson, "Hatch-1 Bundle 2255 Improved MAPLHGRs", July 17, 2003.