H. L Sumner, Jr.
Vice President
Hatch Project

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

Tel 205.992.7279

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U. S. Nuclear Regulatory Commission
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Washington, D. C. 20555-0001

Edwin I. Hatch Nuclear Plant Unit 1
Unit 1 Cycle 22 Core Operating Limits Report (COLR)

Ladies and Gentlemen:

In accordance with Technical Specification 5.6.5, Southern Nuclear Operating Company (SNC) hereby submits the Edwin I. Hatch Nuclear Plant Unit 1 Cycle 22 Core Operating Limits Report (COLR), Version 1.

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

Sincerely,

H. L. Sumner, Jr.

HLS/IL/daj

Enclosure: Unit 1 Cycle 22 Core Operating Limits Report, Version 1

cc: Southern Nuclear Operating Company
Mr. J. B. Beasley, Jr., Executive Vice President
Mr. G. R. Frederick, General Manager – Plant Hatch
RTYPE: CHA02.004

U. S. Nuclear Regulatory Commission
Mr. L. A. Reyes, Regional Administrator
Mr. C. Gratton, NRR Project Manager – Hatch
Mr. D. S. Simpkins, Senior Resident Inspector – Hatch

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SOUTHERN NUCLEAR OPERATING COMPANY
EDWIN I. HATCH NUCLEAR PLANT

Unit 1 Cycle 22
CORE OPERATING LIMITS REPORT

Version 1

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

Edwin I. Hatch Nuclear Plant
Unit 1 Cycle 22 Core Operating Limits Report

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1.0 INTRODUCTION

The Core Operating Limits Report (COLR) for Plant Hatch Unit 1 Cycle 22 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, 2, 3, and 4). Results from the reload analyses for the fuel in Unit 1 Cycle 22 are documented in References 3, 4, 5 and 6.

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. Linear Heat Generation Rate (LHGR) – Technical Specification 3.2.3

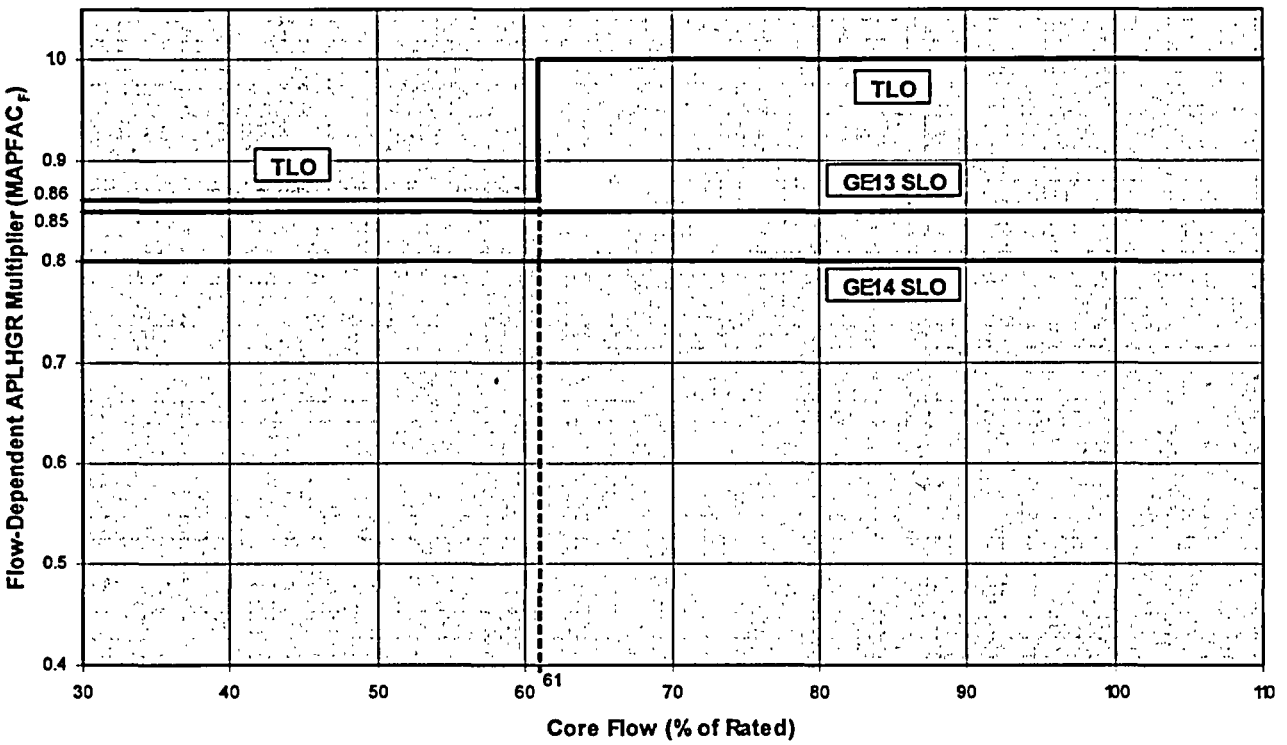
From a fuel thermal limits perspective, the following limitations are placed on Unit 1 operation with equipment out of service.

Equipment / Condition	Limitation
EOC-RPT Out of Service AND Turbine Bypass Valves Inoperable Simultaneously	Not analyzed
Single-Loop Operation (SLO)	• Core thermal power ≤ 2000 MWth • Core Flow ≤ 56% of Rated
Pressure Regulator Inoperable	Option B Scram Speeds Must be Met (in place)

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 six inch axial segment of each fuel assembly in the core is the applicable APLHGR limit taken from Figure 2-2 or 2-3, multiplied by the flow-dependent multiplier, $MAPFAC_F$, from Figure 2-1.



Operating Conditions			MAPFAC$_F$
Flow	SLO / TLO	Fuel Type	
30 ≤ F ≤ 61	TLO	All	0.86
61 < F	TLO	All	1.00
30 ≤ F	SLO	GE13	0.85
30 ≤ F	SLO	GE14	0.80

F = Percent of Rated Core Flow

FIGURE 2-1

Flow-Dependent APLHGR Multiplier (MAPFAC$_F$) versus Core Flow

Average Planar Exposure	APLHGR Limit
0.00	13.42
24.40	13.42
32.66	12.70
56.70	9.00
63.50	6.40

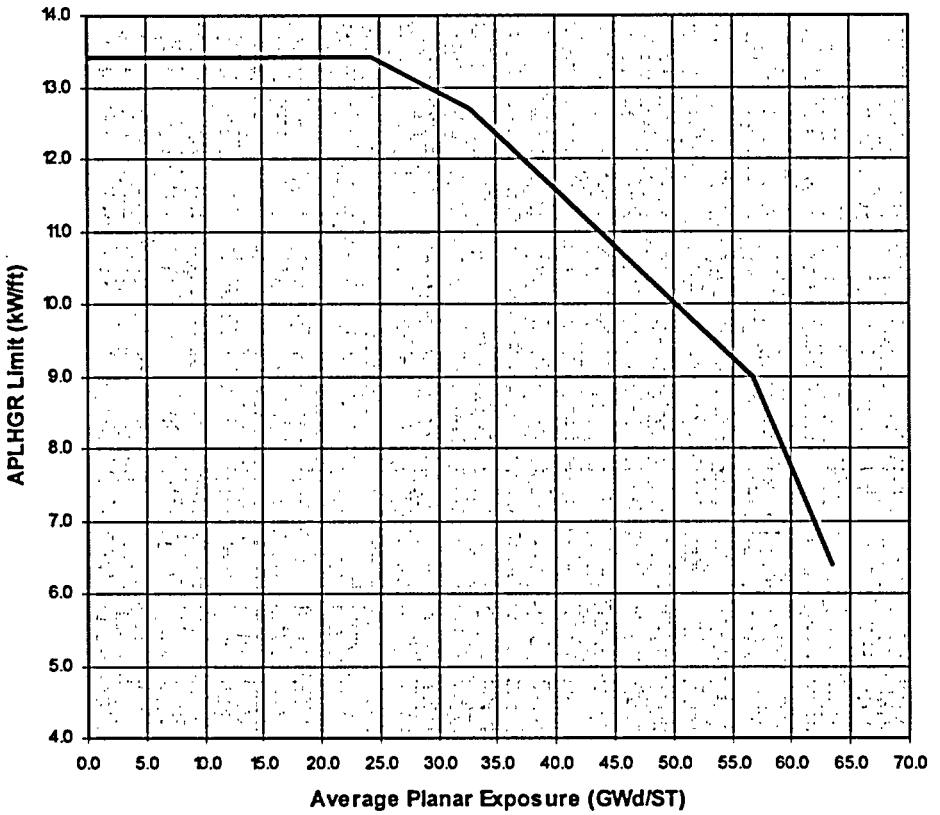


FIGURE 2-2

APLHGR Limit versus Average Planar Exposure
(Fuel Type: GE13)

Average Planar Exposure	APLHGR Limit
0.00	12.82
14.51	12.82
19.13	12.82
57.61	8.00
63.50	5.00

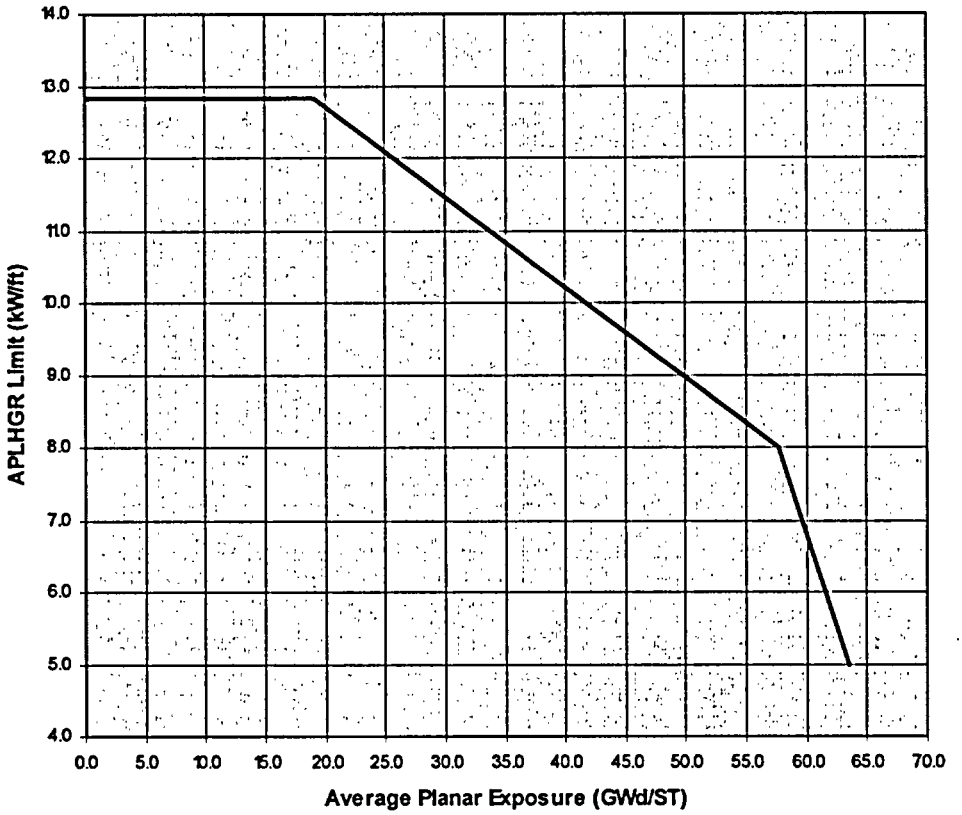


FIGURE 2-3

APLHGR Limit versus Average Planar Exposure
(Fuel Type: GE14)

3.0 MCPR OPERATING LIMITS (Technical Specification 3.2.2)

The MCPR operating limit (OLMCPR) is a function of core power, core flow, average scram time, number of operating recirculation loops, EOC-RPT system status, operability of the turbine bypass valves, and whether both pressure regulators are operable.

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

a. For 24% ≤ power < 28%, the power-dependent MCPR limit, $MCPR_P$, as determined by Table 3-1.

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 OLMCPR, as determined by Table 3-1.

With only one recirculation pump in operation (SLO), the OLMCPR 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 and 3-4B, Option A scram time OLMCPRs 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 rated-power, rated-flow OLMCPR corresponds to τ. If τ has not been determined, Option A limits are to be used.

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.

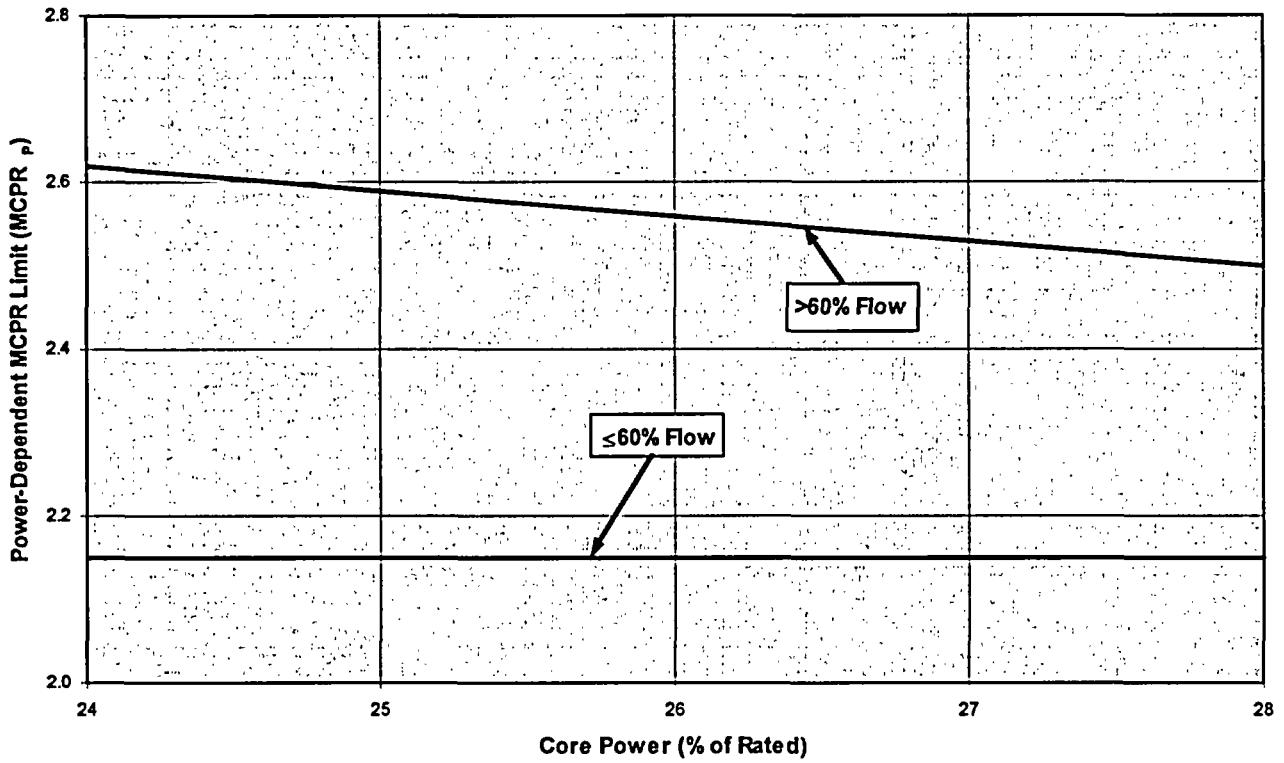
N_1 = total number of active rods measured in Technical Specifications Surveillance Requirement 3.1.4.1.

TABLE 3-1

MCPR Operating Flexibility Options

Cycle Average Exposure	EOC-RPT	Turbine Bypass Valves	$MCPR_P$ Curve	Pressure Regulator	Kp Curve	Rated-Power, Rated-Flow OLMCPRs
BOC to EOR-1800	In Service or Out of Service	Operable	Figure 3-1A	Operable	Figure 3-3A	Figure 3-4A
				Inoperable	Figure 3-3B	
	In Service	Inoperable	Figure 3-1B	Operable	Figure 3-3A	
				Inoperable	Figure 3-3B	
EOR-1800 to EEOC	In Service or Out of Service	Operable	Figure 3-1A	Operable	Figure 3-3A	Figure 3-4B
				Inoperable	Figure 3-3B	
	In Service	Inoperable	Figure 3-1B	Operable	Figure 3-3A	
				Inoperable	Figure 3-3B	

BOC = Beginning of Cycle
EOR = End of rated conditions (100% power, 100% flow, ARO, with nominal feedwater temp.)
EEOC = Extended End of Cycle (beyond EOR, 100% power, 105% flow, with reduced feedwater temp.)



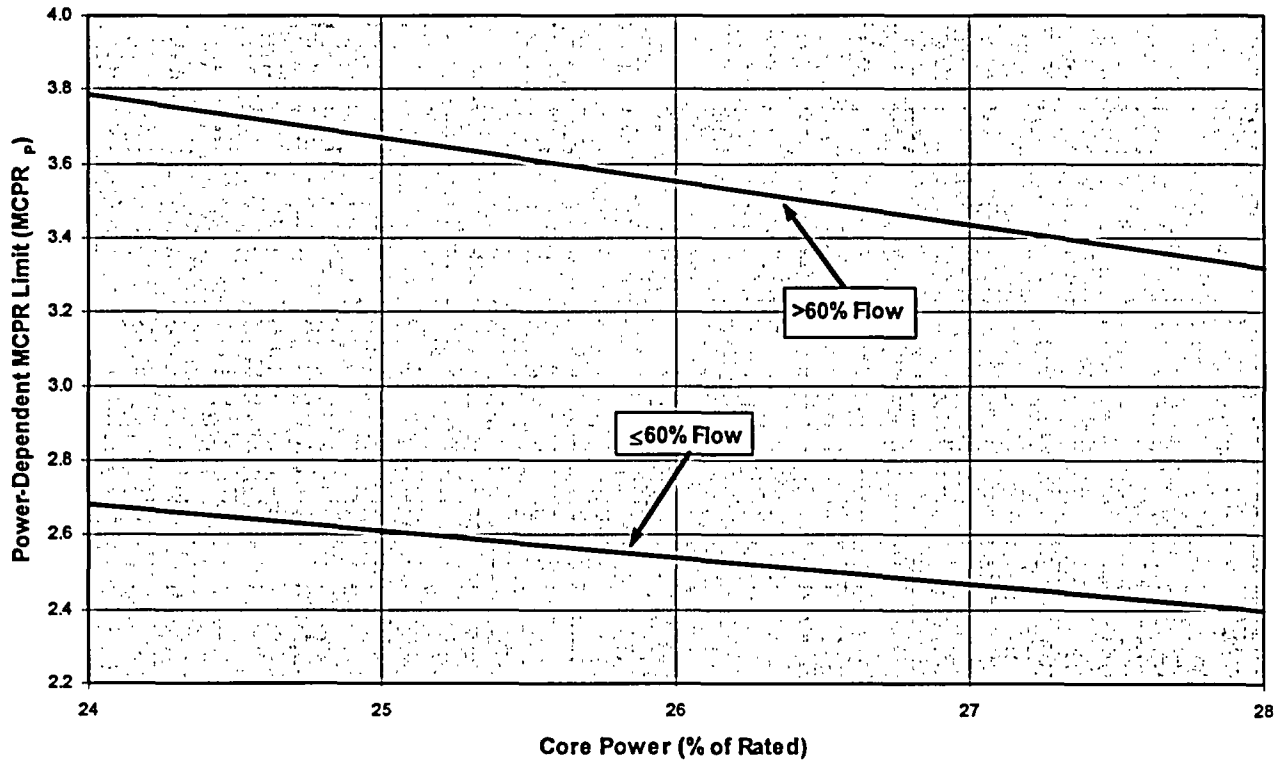
$MCPR_P = A + B (28 - P)$

F	A	B
F ≤ 60	2.15	0.00
F > 60	2.50	0.03

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 24% to 28% of Rated Core Power
(Turbine Bypass Valves Operable)



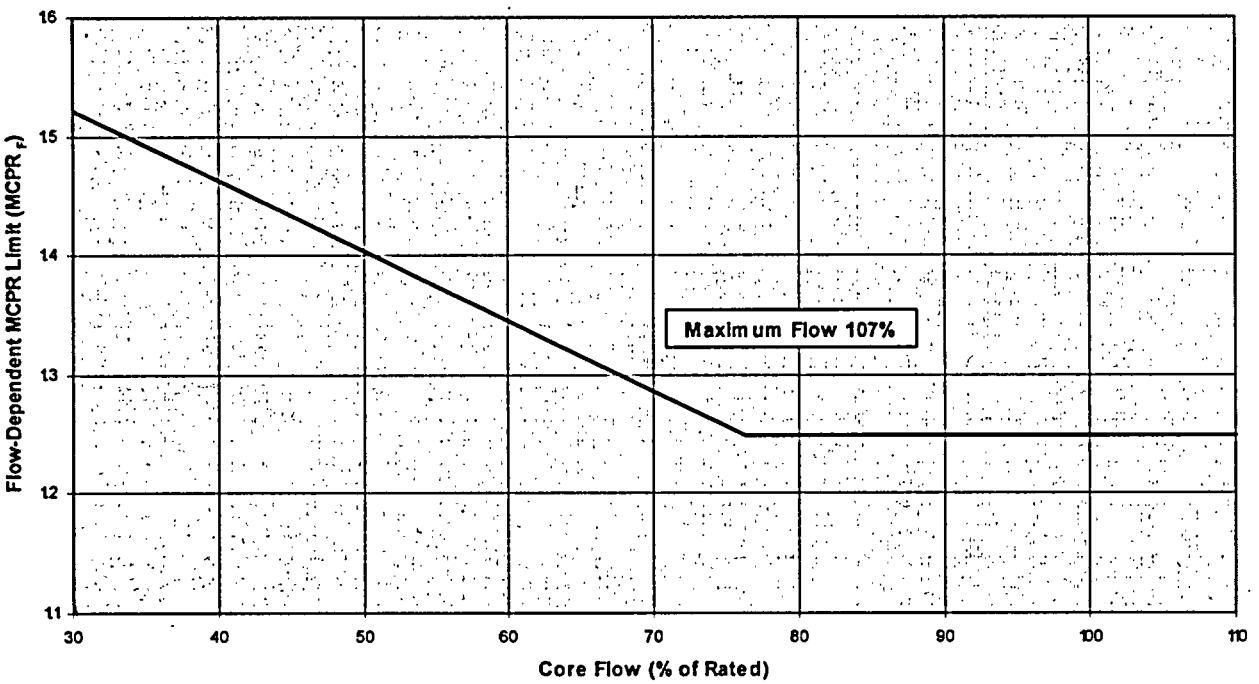
$MCPR_P = A + B (28 - P)$

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

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 24% to 28% of Rated Core Power
(Turbine Bypass Valves Inoperable)



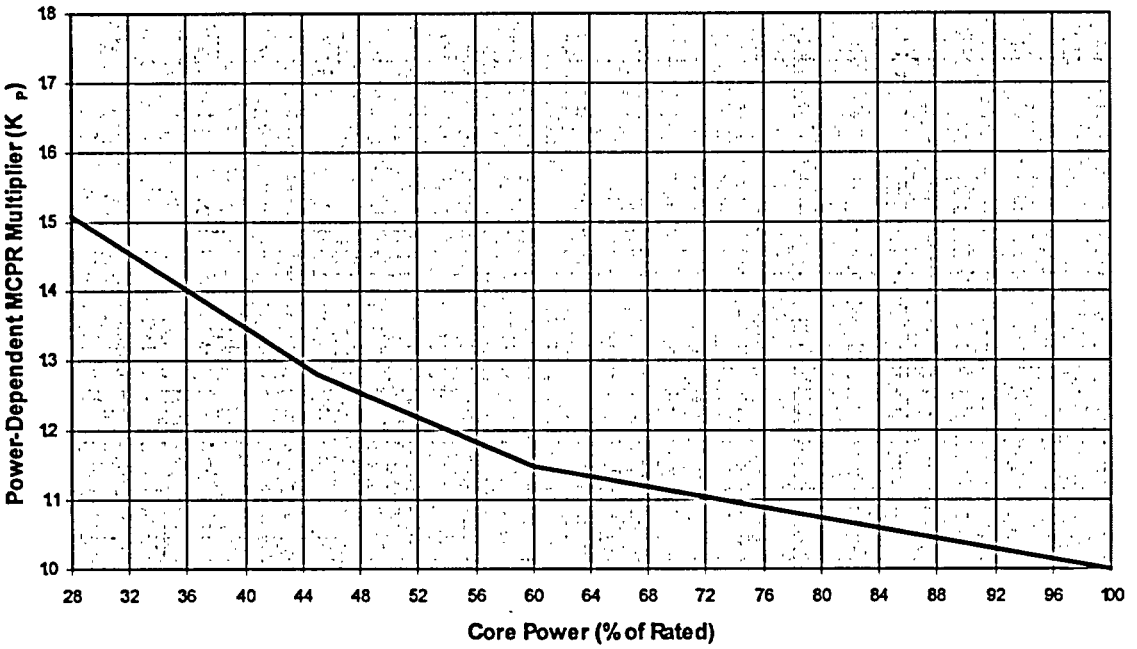
$MCPR_F$ = Maximum [1.25, (A*F + B)]

Operating Conditions	Values of Variables	
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



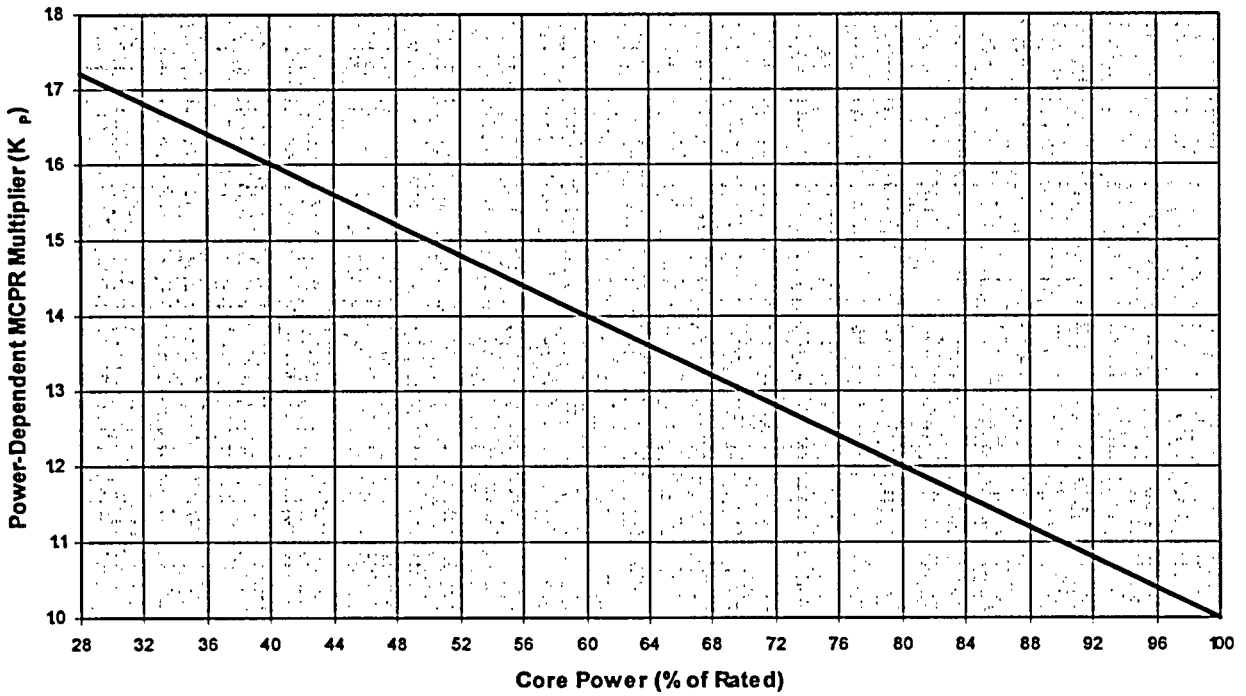
$K_P = A + B (P_0 - P)$

P	A	B	P_0
$28 \leq P < 45$	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 3-3A

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



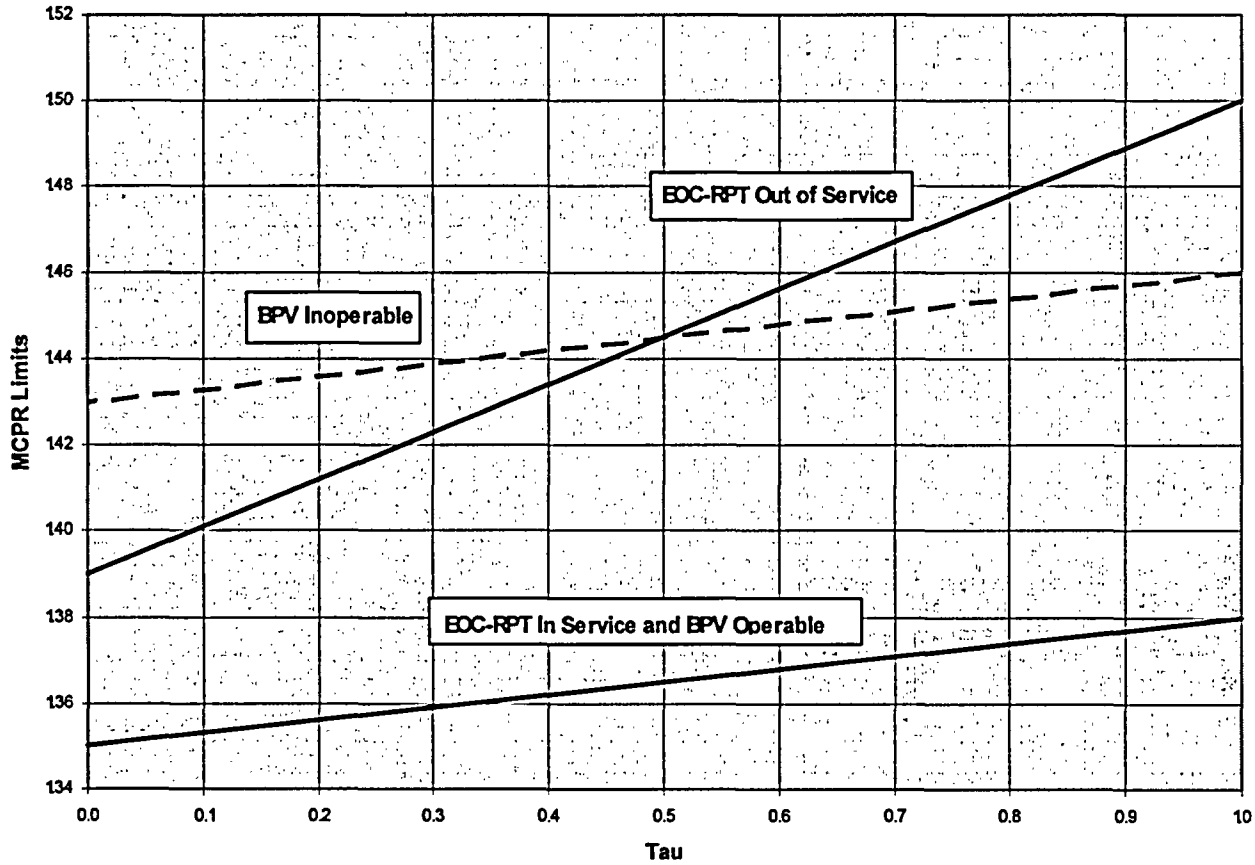
$K_P = A + B (P_0 - P)$

P	A	B	P_0
$28 \leq P \leq 100$	1.00	0.01000	100

P = Percent of Rated Core Power

FIGURE 3-3B

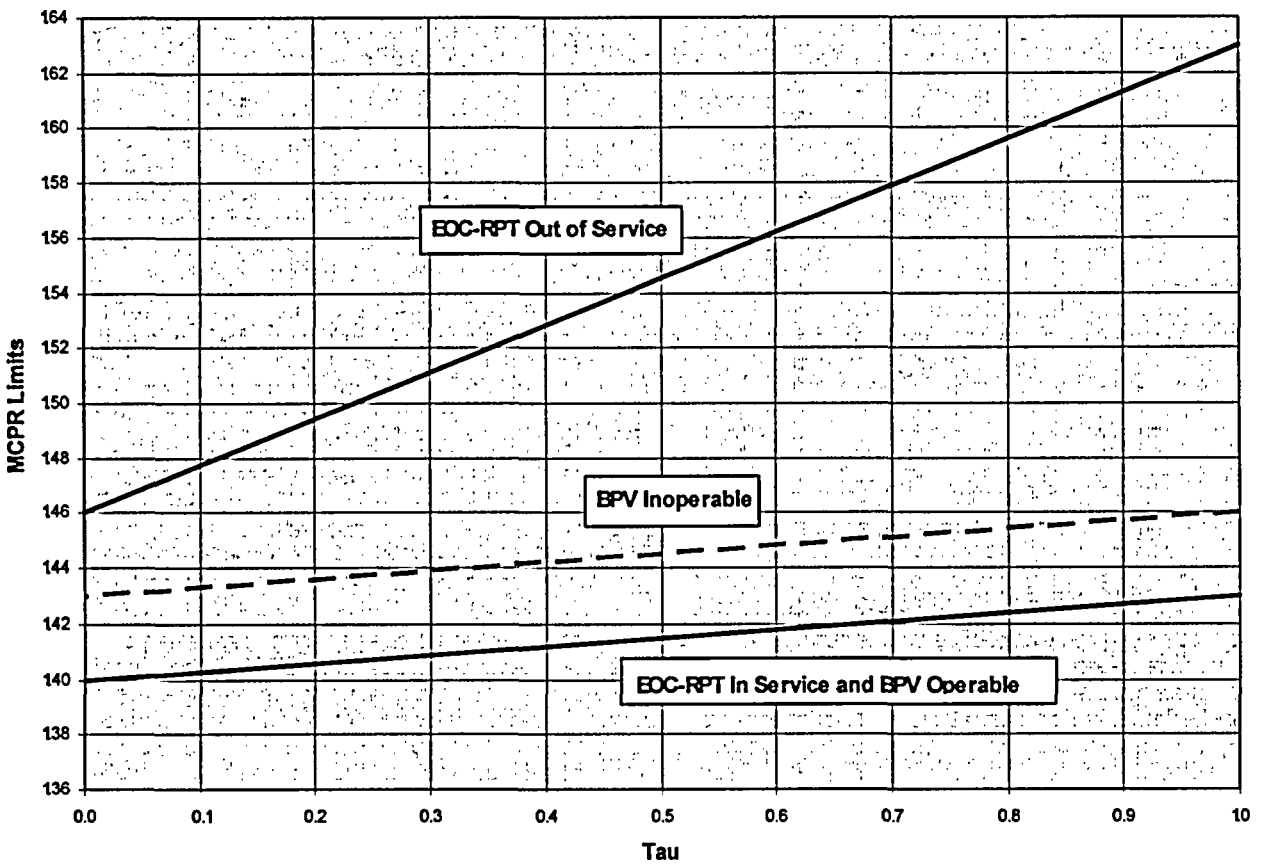
Power-Dependent MCPR Multiplier (K_P) versus Core Power
(Pressure Regulator Inoperable)



Operating Conditions		OLMCPR	
EOC-RPT	Bypass Valves	Tau = 0.0	Tau = 1.0
In Service	Operable	1.35	1.38
Out of Service	Operable	1.39	1.50
In Service	Inoperable	1.43	1.46

FIGURE 3-4A

MCPR Limits versus Average Scram Time
(BOC to EOR-1800 MWd/st)



Operating Conditions		OLMCPR	
EOC-RPT	Bypass Valves	Tau = 0.0	Tau = 1.0
In Service	Operable	1.40	1.43
Out of Service	Operable	1.46	1.63
In Service	Inoperable	1.43	1.46

FIGURE 3-4B

MCPR Limits versus Average Scram Time
(EOR-1800 MWd/st to EEOC)

4.0 LHGR LIMITS (Technical Specification 3.2.3)

The LHGR limit for each six inch axial segment of each fuel rod in the core is the applicable rated-power, rated-flow LHGR limit taken from Figure 4-3 or 4-4, multiplied by the smaller of either:

a. The flow-dependent multiplier, $LHGRFAC_F$, from Figure 4-1,

or

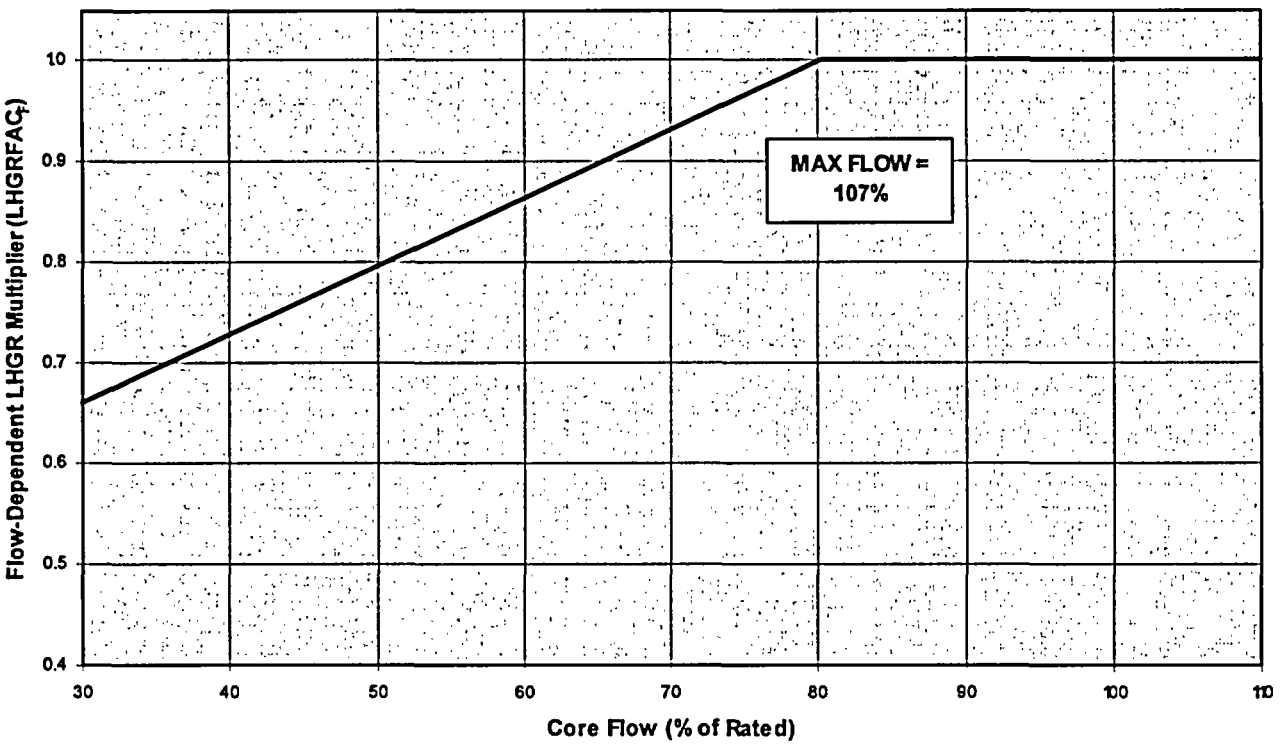
b. The power-dependent multiplier, $LHGRFAC_P$, as determined by Table 4-1.

Figures 4-3 and 4-4 show the LHGR limits for both UO_2 rods (which contain no gadolinium) and the most limiting gadolinium-bearing rods for GE13 and GE14 fuel types, respectively. Other gadolinium-bearing rods may have proprietary LHGR limits which lie between these two curves. Compliance with the proprietary limits will be monitored by the plant's process computer, in which case some gadolinium-bearing rods may operate at power levels above the more restrictive limits shown on these curves.

Table 4-1

LHGR Operating Flexibility Options

Bypass Valves	Pressure Regulator	$LHGRFAC_P$ Curve
Operable	Operable	Figure 4-2A
Inoperable	Operable	Figure 4-2B
Operable or Inoperable	Inoperable	Figure 4-2C



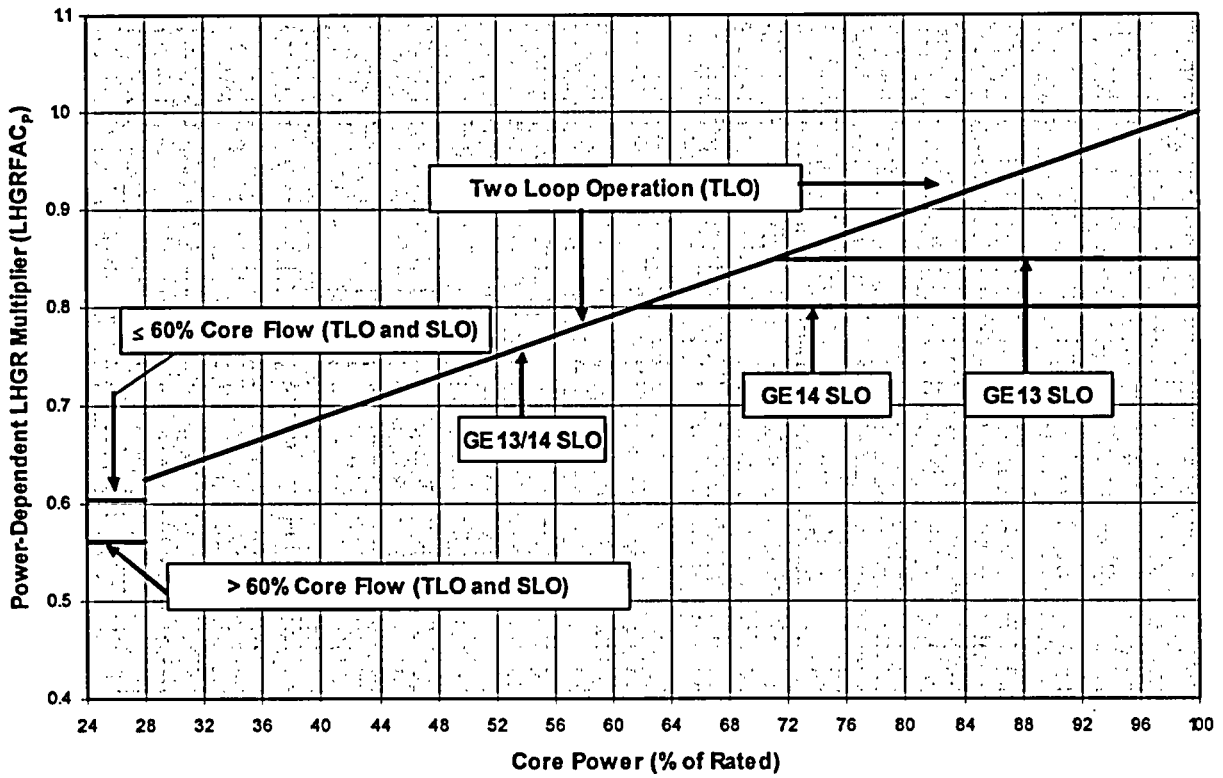
LHGRFAC$_F$ = Minimum [1.0, (A+B*F)]

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

F = Percent of Rated Core Flow

FIGURE 4-1

Flow-Dependent LHGR Multiplier (LHGRFAC$_F$) versus Core Flow



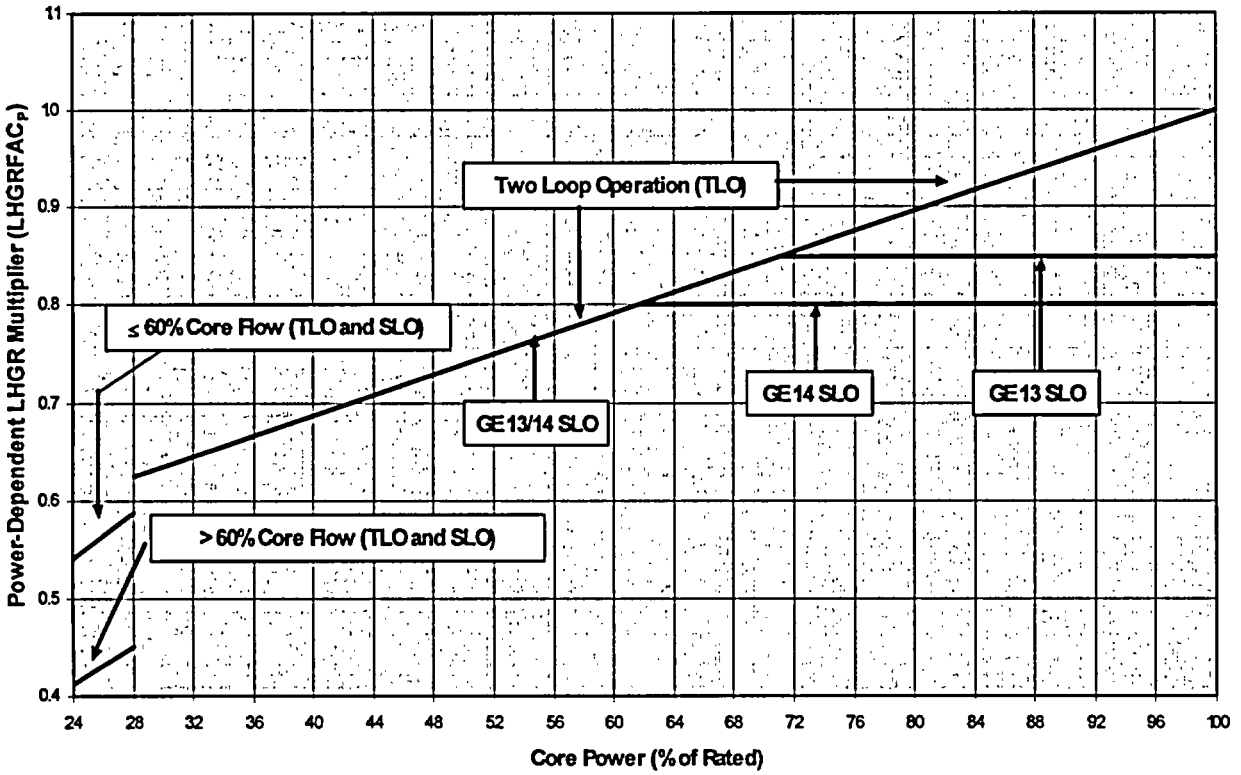
$LHGRFAC_P = A - B\ (P_0 - P)$

Operating Conditions				Values of Variables		
P	F	SLO/TLO	Fuel Type	A	B	P_0
$24 \le P < 28$	$F \le 60$	SLO / TLO	All	0.603	0.000	28
$24 \le P < 28$	$F > 60$	SLO / TLO	All	0.560	0.00	28
$28 \le P < 61.72$	All	SLO / TLO	All	1.00	0.005224	100
$61.72 \le P < 71.28$	All	SLO / TLO	GE13	1.00	0.005224	100
$61.72 \le P < 71.28$	All	TLO	GE14	1.00	0.005224	100
$P \ge 71.28$	All	TLO	All	1.00	0.005224	100
$P \ge 71.28$	All	SLO	GE13	0.85	0.00	100
$P \ge 61.72$	All	SLO	GE14	0.80	0.00	100

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

FIGURE 4-2A

Power-Dependent LHGR Multiplier ($LHGRFAC_P$) versus Core Power
(Turbine Bypass Valves Operable and Pressure Regulator Operable)



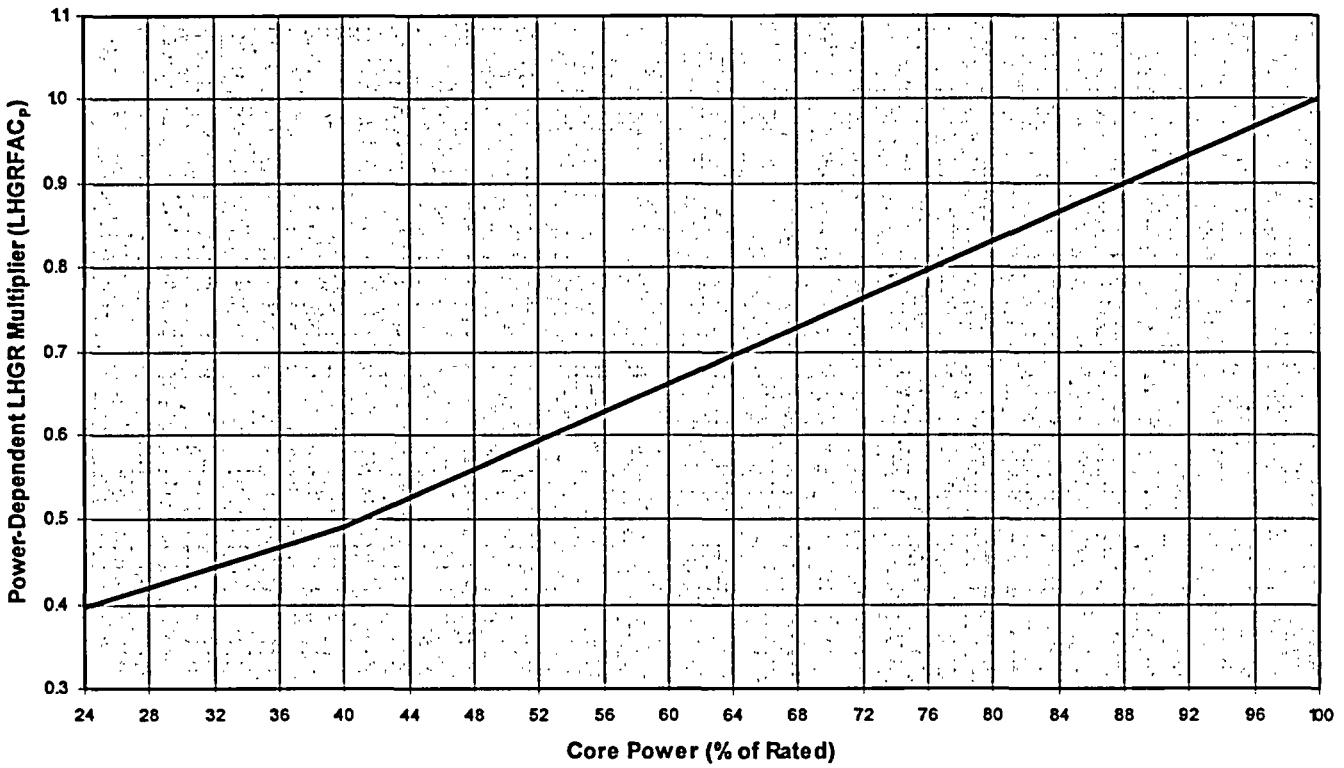
$LHGRFAC_P = A - B (P_0 - P)$

Operating Conditions				Values of Variables		
P	F	SLO/ TLO	Fuel Type	A	B	P_0
24 ≤ P < 28	F ≤ 60	SLO / TLO	All	0.588	0.01167	28
24 ≤ P < 28	F > 60	SLO / TLO	All	0.450	0.00967	28
28 ≤ P < 61.72	All	SLO / TLO	All	1.00	0.005224	100
61.72 ≤ P < 71.28	All	SLO / TLO	GE13	1.00	0.005224	100
61.72≤ P < 71.28	All	TLO	GE14	1.00	0.005224	100
P ≥ 71.28	All	TLO	All	1.00	0.005224	100
P ≥ 71.28	All	SLO	GE13	0.85	0.000	100
P ≥ 61.72	All	SLO	GE14	0.80	0.000	100

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

FIGURE 4-2B

Power-Dependent LHGR Multiplier ($LHGRFAC_P$) versus Core Power
(Turbine Bypass Valves Inoperable and Pressure Regulator Operable)



$$LHGRFAC_P = A - B\,(P_0 - P)$$

Operating Conditions			Values of Variables		
P	F	Fuel Type	A	B	P_0
$24 \le P < 40$	All	All	0.49	0.0058	40
$40 \le P \le 100$	All	All	1.00	0.0085	100

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

FIGURE 4-2C

Power-Dependent LHGR Multiplier (LHGRFAC$_P$) versus Core Power
(Pressure Regulator Inoperable)

UO2 Rods	
Peak Pellet Exposure	LHGR
0.00	14.40
13.24	14.40
32.66	12.70
56.70	9.00
63.50	6.40

Limiting Gd Rods	
Peak Pellet Exposure	LHGR
0.00	13.21
10.88	13.21
29.92	11.65
53.50	8.26
60.18	5.87

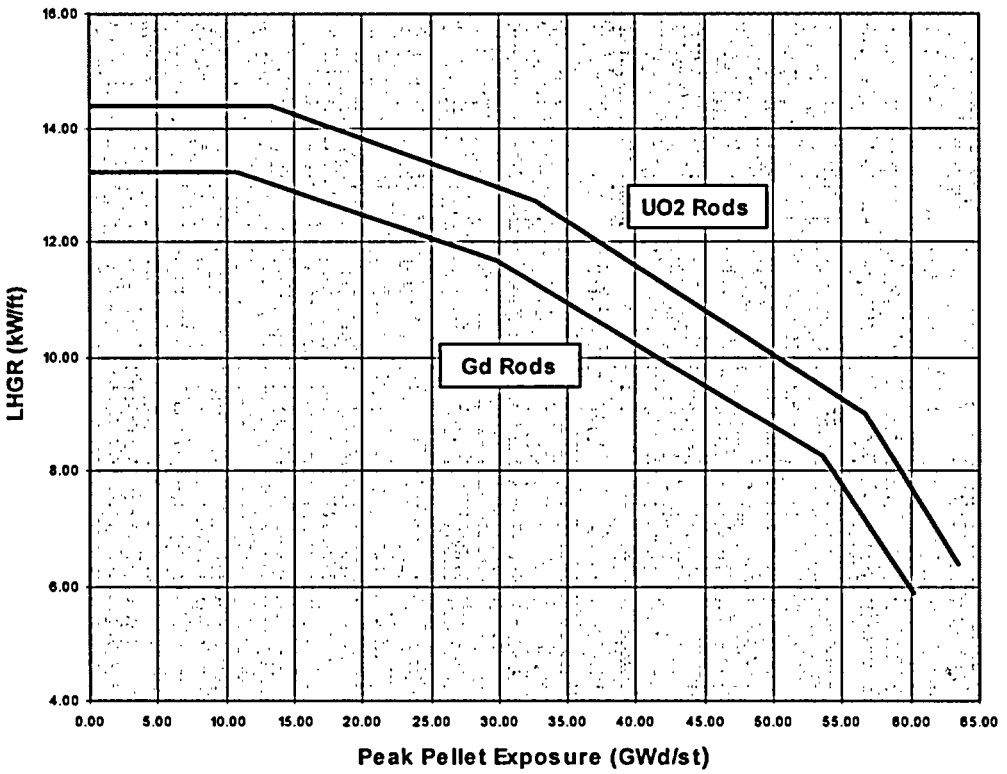


FIGURE 4-3

LHGR versus Peak Pellet Exposure
(Fuel Type: GE13)

UO2 Rods	
Peak Pellet Exposure	LHGR
0.00	13.40
14.51	13.40
57.61	8.00
63.50	5.00

Limiting Gd Rods	
Peak Pellet Exposure	LHGR
0.00	12.00
12.17	12.00
54.59	7.16
60.39	4.48

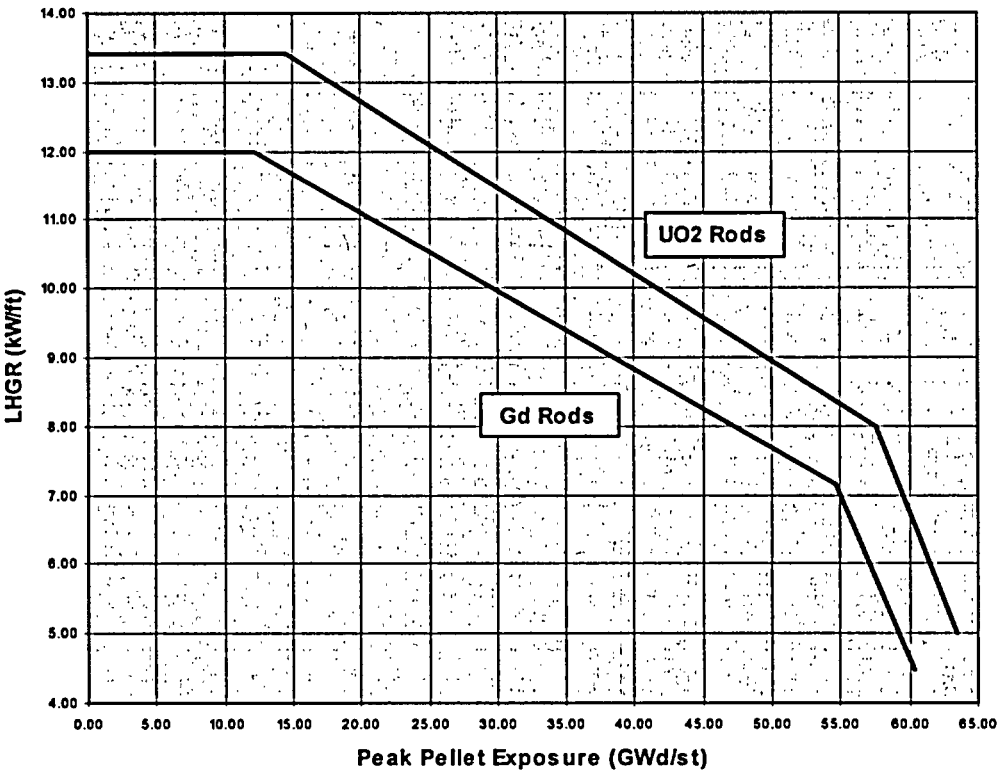


FIGURE 4-4

LHGR versus Peak Pellet Exposure
(Fuel Type: GE14)

5.0 PBDA AMPLITUDE SETPOINTS

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. Projected Figure of Merit (FOM) value(s) throughout the cycle will be supplied by the Hatch Core Analysis Group.

OLMCPR	0.0 ≤ FOM ≤92.1	92.1 < FOM ≤96.9	96.9 < FOM ≤ 102.4	102.4 < FOM ≤ 108.0
1.35	1.15	1.13	1.11	1.10
1.36	1.15	1.13	1.11	1.10
1.37	1.15	1.14	1.11	1.11
1.38	1.15	1.14	1.12	1.11
1.39	1.15	1.14	1.12	1.11
1.40	1.15	1.14	1.12	1.11
1.41	1.15	1.15	1.12	1.11
1.42	1.15	1.15	1.13	1.12
1.43	1.15	1.15	1.13	1.12
1.44	1.15	1.15	1.13	1.12
1.45	1.15	1.15	1.13	1.12

6.0 REFERENCES

1. "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 Letter "Plant Hatch Technical Specification Modification to include LHGR," M. E. Harding (GNF) to E. B. Gibson, January 22, 2004.

3. Global Nuclear Fuel document 0000-0018-9797-SRLR, "Supplemental Reload Licensing Report for Edwin I. Hatch Nuclear Power Plant Unit 1, Reload 21 Cycle 22," Revision 0, March 2004.

4. SNC Memo CAH-NF-2464, "H1C22 Pressure Regulator Failure Downscale (PRFDS) Analysis," W. R. Mertz to K. S. Folk, March 1, 2004.

5. SNC Memo CAH-NF-2465, "TPO Low Power ARTS Multipliers," W. R. Mertz to K. S. Folk, March 1, 2004.

6. Global Nuclear Fuel document 0000-0018-9797-FBIR, "Fuel Bundle Information Report for Edwin I. Hatch Nuclear Power Plant Unit 1, Reload 21 Cycle 22," Revision 0, March 2004.