

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

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REVIEWED BY: Plant Operations Review Committee

Meeting No. 92-086 Date 07/22/92

APPROVED BY: *Scott Bush* Date 7/27/92  
Reactor Analyst Supervisor

APPROVED BY: *Paul Haley* Date 8/26/92  
Resident Manager

Page No.	1	2	3	4	5	6	7	8
Rev. No.	1	1	1	1	1	1	1	1
Page No.	9	10	11	12	13	14	15	16
Rev. No.	1	1	1	1	1	1	1	1
Page No.	17	18	19	20	21	22	23	24
Rev. No.	1	1	1	1	1	1	1	1
Page No.	25	26	27	28	29	30	31	32
Rev. No.	1	1	1	1	1	1	1	1
Page No.	33							
Rev. No.	1							

Rev. No. 1

Page 1 of 33

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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

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1.0 PURPOSE

This report provides the cycle-specific operating limits for Cycle 11 of the James A. FitzPatrick Nuclear Power Plant. The following limits are addressed:

Operating Limit Minimum Critical Power Ratio (MCPR)

Flow Dependent MCPR Limits

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)

Linear Heat Generation Rate (LHGR)

Flow-Biased Average Power Range Monitor (APRM) and Rod Block Monitor (RBM) Settings

2.0 APPLICABILITY

The plant must be operated within the limits specified in this report. If any of these limits are violated, the corrective actions specified in the Technical Specifications must be taken.

3.0 REFERENCES

- 3.1 JAFNPP Administrative Procedure 7.2, Control of Core Operating Limits Report.
- 3.2 JAFNPP License Appendix A, Operating Technical Specifications.
- 3.3 FitzPatrick Cycle 11 Reload Safety Evaluation. JAF-SE-92-125
- 3.4 GE11 Lead Test Assembly Report.
- 3.5 JAFNPP SAFER/GESTR-LOCA Loss of Coolant Analysis, NEDE-31317P, including Errata and Addenda Sheets 1, 2 and 3.
- 3.6 Supplemental Reload Licensing Submittal for JAFNPP Reload 10 Cycle 11, GE Report 23A7114 June 1992. Includes a Supplement 1 containing MAPLHGR DATA.
- 3.7 Cycle 11 Reload Core. F1-91-252.

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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

---

4.0 DEFINITIONS

- 4.1 Minimum critical power ratio (MCPR) Minimum value of the ratio of that power in a fuel assembly which is calculated to cause some point in that fuel assembly to experience boiling transition to the actual assembly operating power as calculated by application of the GEXL correlation (Reference NEDE-10958).
- 4.2 Fraction of Limiting Power Density - The ratio of the linear heat generation rate (LHGR) existing at a given location to the design LHGR. The design LHGR is given in Table 8.2.
- 4.3 Maximum Fraction of Limiting Power Density - The Maximum Fraction of Limiting Power Density (MFLPD) is the highest value existing in the core of the Fraction of Limiting Power Density (FLPD).
- 4.4 Rated Recirculation Flow - that drive flow which produces a core flow of  $77.0 \times 10^6$  lb/hr.

5.0 RESPONSIBILITIES

- 5.1 See AP-7.2 (Reference 3.1).
- 5.2 It is the responsibility of the Shift Supervisor to assure that the reactor is operated within the limits described herein.

6.0 SPECIAL INSTRUCTIONS/REQUIREMENTS

Not applicable.

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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

---

7.0 PROCEDURE

7.1 Operating Limit MCPR

During power operation, The Operating Limit MCPR shall be equal to or greater than the limits given below.

7.1.1 Technical Specification Reference: 3.1.B

7.1.2 The Operating Limit MCPR shall be determined based on the following requirement:

7.1.2.1 The average scram time to notch position 38 shall be:

$$\tau_{AVE} \leq \tau_B$$

7.1.2.2 The average scram time to notch position 38 is determined as follows:

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

where:

$n$  = number of surveillance tests performed to date in the cycle,

$N_i$  = number of active rods measured in the  $i$ th surveillance, and

$\tau_i$  = average scram time to notch position 38 of all rods measured in the  $i$ th surveillance test.

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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

---

7.1.2.3 The adjusted analysis mean scram time is calculated as follows:

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

where:

- $\mu$  = mean of the distribution for the average scram insertion time to the pickup of notch position 38 = 0.706 sec.
- $\sigma$  = standard deviation of the distribution for average scram insertion time to the pickup of notch position 38 = 0.016 sec.
- $N_1$  = the total number of active rods measured in Technical Specification 4.3.C.1.

The number of rods to be scram tested and the test intervals are given in Technical Specification 4.3.C.

7.1.3 When requirement of 7.1.2 is met, the Operating Limit MCPR shall not be less than that specified in Tables 8.1 a through d.

7.1.4 When the requirement 7.1.2 is not met (i.e.  $\tau_B < \tau_{AVE}$ ) then the Operating Limit MCPR values (as a function of  $\tau$ ) are given in Figures 8.1.a through d.

where  $\tau = (\tau_{AVE} - \tau_B) / (\tau_A - \tau_B)$

and

- $\tau_{AVE}$  = the average scram time to notch position 38 as defined in 7.1.2.2.
- $\tau_B$  = the adjusted analysis mean scram time as defined in 7.1.2.3
- $\tau_A$  = the scram time to notch position 38 as defined in Technical Specification 3.3.C.1.

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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

---

Note: Should the operating limit MCPR obtained from these figures be less than the operating limit MCPR found in 7.1.3 for the applicable RBM trip level setting then 7.1.3 shall apply.

- 7.1.5 During single-loop operation, the Operating Limit MCPR shall be increased by 0.01.
- 7.1.6 During reactor power operation with core flow less than 100 percent of rated, the Operating Limit MCPR shall be multiplied by the appropriate  $K_r$  specified in Figure 8.2.
- 7.2 Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)
  - 7.2.1 Technical Specification Reference: 3.5.H
  - 7.2.2 During power operation, the APLHGR for each fuel type as a function of axial location and average planar exposure shall be within limits based on applicable APLHGR limit values which have been approved for the respective fuel and lattice types.
  - 7.2.3 When and calculations are required, the APLHGR for each type of fuel as a function of average planar exposure shall not exceed the limiting value for the most limiting lattice (excluding natural uranium) shown in Figures 8.3.a through h.
  - 7.2.4 During single loop operation, the APLHGR for each fuel type shall not exceed the values given in 7.2.2 or 7.2.3 above multiplied by 0.84.
- 7.3 Linear Heat Generation Rate (LHGR)
  - 7.3.1 Technical Specification Reference: 3.5.I.
  - 7.3.2 The LHGR of any rod in any fuel assembly at any axial location shall not exceed the maximum allowable LHGR specified in Table 8.2.

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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

---

7.4 APRM Trip Settings

7.4.1 APRM Flow Referenced Flux Scram Trip Setting (Run Mode)

7.4.1.1 Technical Specification References: 2.1.A.1.c, Table 3.1-1, 3.1.A

7.4.1.2 When the Mode Switch is in the RUN position, the APRM flow referenced flux scram trip setting shall be

$$S \leq 0.66W + 54\% \text{ for two loop operation;}$$

$$S \leq 0.66W + 54\% - 0.66 \Delta W \text{ for single loop operation;}$$

where:

S = setting in percent of rated thermal power (2436 MWt);

W = recirculation flow in percent of rated;

$\Delta W$  = difference between two loop and single-loop effective drive flow at the same core flow.

7.4.1.3 In the event of operation with a maximum fraction of limiting power density (MFLPD) greater than the fraction of rated power (FRP), the setting shall be modified as follows:

$$S \leq (0.66W + 54\%)(FRP/MFLPD) \text{ for two loop operation;}$$

$$S \leq (0.66W + 54\% - 0.66 \Delta W)(FRP/MFLPD) \text{ for single-loop operation;}$$

where:

FRP = fraction of rated thermal power (2436 MWt);

MFLPD = Maximum fraction of limiting power density, where the limiting power density is as specified in Table 8.2.

The ratio of FRP to MFLPD shall be set equal to 1.0 unless the actual operating value is less than the design value of 1.0, in which case the actual operating value will be used.



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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

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7.4.2 APRM Flow Biased Rod Block Setting

7.4.2.1 Technical Specification References:  
2.1.A.1.d, Table 3.2-3, 3.2.C.1

7.4.2.2 The APRM rod block trip setting shall be:

$$S \leq 0.66W + 42\% \text{ for two loop operation;}$$

$$S \leq 0.66W + 42\% - 0.66 \Delta W \text{ for single loop operation;}$$

where:

S = rod block setting in percent of rated thermal power (2436 Mwt);

W = recirculation flow in percent of rated;

$\Delta W$  = difference between two loop and single loop effective drive flow at the same core flow.

7.4.2.3 In the event of operation with a maximum fraction of limiting power density (MFLPD) greater than the fraction of rated power (FRP), the setting shall be modified as follows:

$$S \leq (0.66W + 42\%)(FRP/MFLPD) \text{ for two loop operation;}$$

$$S \leq (0.66W + 42\% - 0.66\Delta W)(FRP/MFLPD) \text{ for single loop operation;}$$

where:

FRP = fraction of rated thermal power (2436 Mwt);

MFLPD = maximum fraction of limiting power density as specified in Table 8.2.



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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

---

7.5 RBM Flow Biased Rod Block Setting

7.5.1 Technical Specification Reference: 3.2.C.1

7.5.2 The RBM flow biased rod block trip setting shall be:

$S \leq 0.66W + K$  for two loop operation;

$S \leq 0.66W + K - 0.66\Delta W$  for single loop operation;

where:

S = rod block setting in percent of initial;

W = loop flow in percent of rated

K = intercept values of 39%, 40%, 41%, 42%, 43%, and 44% can be used with the appropriate MCPD Operating Limit from Table 8.1.a through d;

$\Delta W$  = difference between two loop and single loop effective drive flow.

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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

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8.0 FIGURES AND TABLES

Table 8.1.a MCPR Operating Limit for Incremental Cycle Core Average Exposure:  
GE8x8EB

Table 8.1.b MCPR Operating Limit for Incremental Cycle Core Average Exposure:  
GE8x8NB-3

Table 8.1.c MCPR Operating Limit for Incremental Cycle Core Average Exposure:  
GE11LTA

Table 8.1.d MCPR Operating Limit for Incremental Cycle Core Average Exposure:  
GE11

Table 8.2 Maximum LHGR

Figure 8.1.a MCPR Operating Limit Versus  $\tau$ : GE8x8EB

Figure 8.1.b MCPR Operating Limit Versus  $\tau$ : GE8x8NB-3

Figure 8.1.c MCPR Operating Limit Versus  $\tau$ : GE11LTA

Figure 8.1.d MCPR Operating Limit Versus  $\tau$ : GE11

Figure 8.2  $K_t$  Factor

Figure 8.3.a MAPLHGR Versus Planar Average Exposure: BD319A

Figure 8.3.b MAPLHGR Versus Planar Average Exposure: BD336A

Figure 8.3.c MAPLHGR Versus Planar Average Exposure: BD339A

Figure 8.3.d MAPLHGR Versus Planar Average Exposure: GE10-P8HXB322-11GZ-  
70M-150-T

Figure 8.3.e MAPLHGR Versus Planar Average Exposure: GE10-P8HXB324-12GZ-  
70M-150T

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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

---

Figure 8.3.f MAPLHGR Versus Planar Average Exposure: 89LTA

Figure 8.3.g MAPLHGR Versus Planar Average Exposure: GE11-P9HUB356-15GZ-100M-146T

Figure 8.3.h MAPLHGR Versus Planar Average Exposure: GE11-P9HUB359-16GZ1-100M-146-T

Figure 8.4.a CYCLE 11 LOADING PATTERN, UPPER LEFT QUADRANT, BUNDLE DESIGN

Figure 8.4.b CYCLE 11 LOADING PATTERN, UPPER RIGHT QUADRANT, BUNDLE DESIGN

Figure 8.4.c CYCLE 11 LOADING PATTERN, LOWER RIGHT QUADRANT, BUNDLE DESIGN

Figure 8.4.d CYCLE 11 LOADING PATTERN, LOWER LEFT QUADRANT, BUNDLE DESIGN

9.0 EXHIBITS

Not Applicable.

NEW YORK POWER AUTHORITY  
 JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
 CORE OPERATING LIMITS REPORT

TABLE 8.1.a

MCPR Operating Limit for Incremental Cycle  
 Core Average Exposure  
 for GE8x8EB

At RBM Hi-Trip Level Setting	BOC to 9000 GWD/t	9000 GWD/t to 10250 GWD/t	10250 GWD/t to EOC
$S = 0.66W + 39\%$	1.26	1.26	1.27
$S = 0.66W + 40\%$	1.26	1.26	1.27
$S = 0.66W + 41\%$	1.27	1.27	1.27
$S = 0.66W + 42\%$	1.29	1.29	1.29
$S = 0.66W + 43\%$	1.31	1.31	1.31
$S = 0.66W + 44\%$	1.31	1.31	1.31

Technical Specification Reference: 3.1.B

For single loop operation, these limits shall be increased by 0.01.

NEW YORK POWER AUTHORITY  
 JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
 CORE OPERATING LIMITS REPORT

TABLE 8.1.b

MCPR Operating Limit for Incremental Cycle  
 Core Average Exposure: GE8x8NB-3

At RBM Hi-Trip Level Setting	BOC to 9000 GWD/t	9000 GWD/t to 10250 GWD/t	10250 GWD/t to EOC
$S = 0.66W + 39\%$	1.31	1.31	1.31
$S = 0.66W + 40\%$	1.31	1.31	1.31
$S = 0.66W + 41\%$	1.31	1.31	1.31
$S = 0.66W + 42\%$	1.31	1.31	1.31
$S = 0.66W + 43\%$	1.31	1.31	1.31
$S = 0.66W + 44\%$	1.32	1.32	1.32

Technical Specification Reference: 3.i.B

For single loop operation, these limits shall be increased by 0.01.

NEW YORK POWER AUTHORITY  
 JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
 CORE OPERATING LIMITS REPORT

TABLE 8.1.c

MCPR Operating Limit for Incremental Cycle  
 Core Average Exposure: GE11LTA

At RBM Hi-Trip Level Setting	BOC to 9000 GWD/t	9000 GWD/t to 10250 GWD/t	10250 GWD/t to EOC
$S = 0.66W + 39\%$	1.30	1.30	1.34
$S = 0.66W + 40\%$	1.30	1.30	1.34
$S = 0.66W + 41\%$	1.30	1.30	1.34
$S = 0.66W + 42\%$	1.30	1.30	1.34
$S = 0.66W + 43\%$	1.30	1.30	1.34
$S = 0.66W + 44\%$	1.30	1.30	1.34

Technical Specification Reference: 3.1.B

For single loop operation, these limits shall be increased by 0.01.

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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

---

TABLE 8.1.d

MCPR Operating Limit for Incremental Cycle  
Core Average Exposure: GE11

At RBM Hi-Trip Level Setting	BOC to 9000 GWD/t	9000 GWD/t 10250 GWD/t	10250 GWD/t to EOC
$S = 0.66W + 39\%$	1.33	1.35	1.38
$S = 0.66W + 40\%$	1.33	1.35	1.38
$S = 0.66W + 41\%$	1.33	1.35	1.38
$S = 0.66W + 42\%$	1.33	1.35	1.38
$S = 0.66W + 43\%$	1.33	1.35	1.38
$S = 0.66W + 44\%$	1.33	1.35	1.38

Technical Specification Reference: 3.1.B

For single loop operation, these limits shall be increased by 0.01.



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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

---

TABLE 8.2

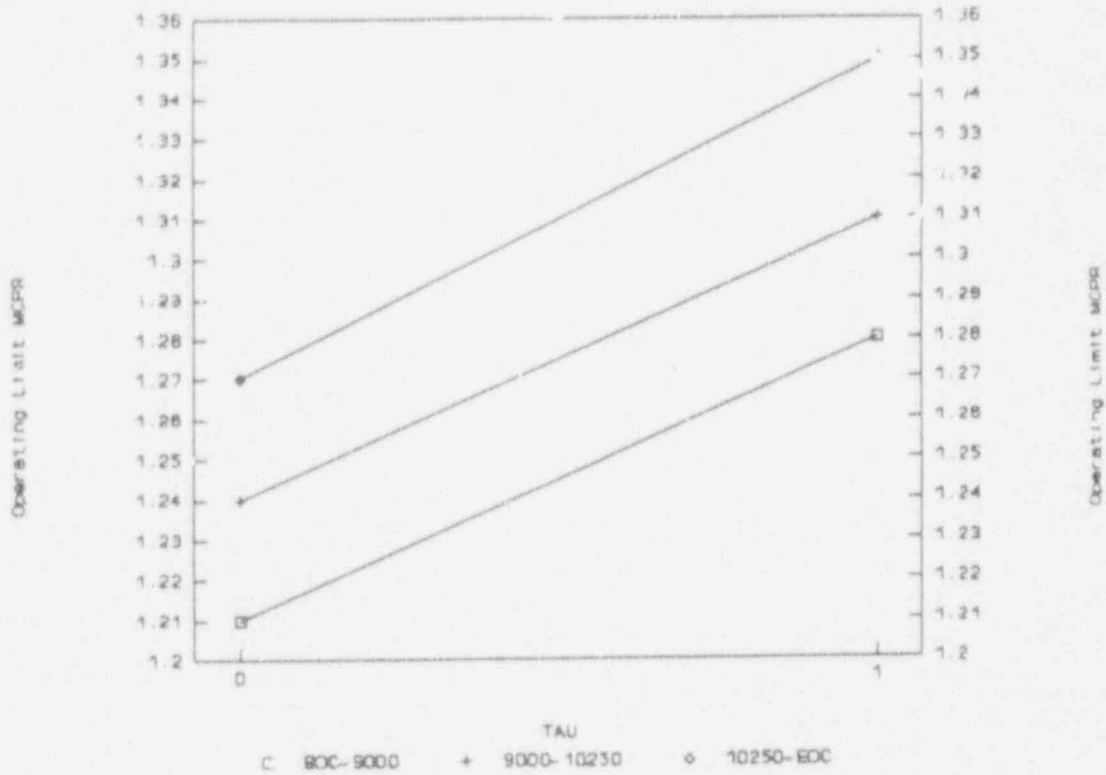
Maximum LHGR

Fuel Type	Fuel Bundle Design	Maximum LHGR (kw/ft)
BD319A	GE8x8EB	14.4
BD336A	GE8x8EB	14.4
BD339A	GE8x8EB	14.4
GE10-P8HXB322 11GZ-70M-150-T	GE8x8NB-3	14.4
GE10-P8HXB324 12GZ-70M-150-T	GE8x8NB-3	14.4
89LTA	GE11LTA	14.4
GE11-PSZUB356 15GZ-100M-146-T	GE11	14.4
GE11-P9HUB359 16GZ1-100M-146-T	GE11	14.4

Technical Specification Reference: 3.5.1

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.1.a  
MCPR Operating Limit Versus  $\tau$  (TAU): GE8x8EB

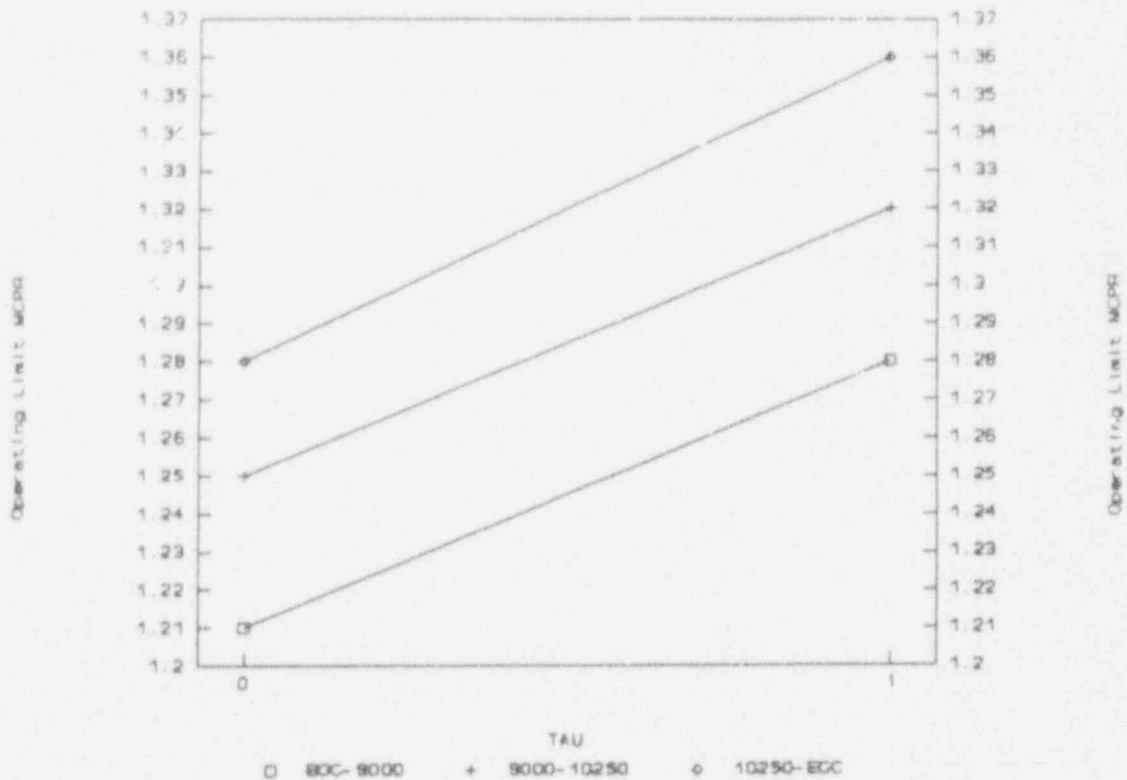


Technical Specification Reference 3.1.B

For single loop operation, these limits shall be increased by 0.01.

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.1.b  
MCPR Operating Limit Versus  $\tau$  (TAU): GE8x8NB-3

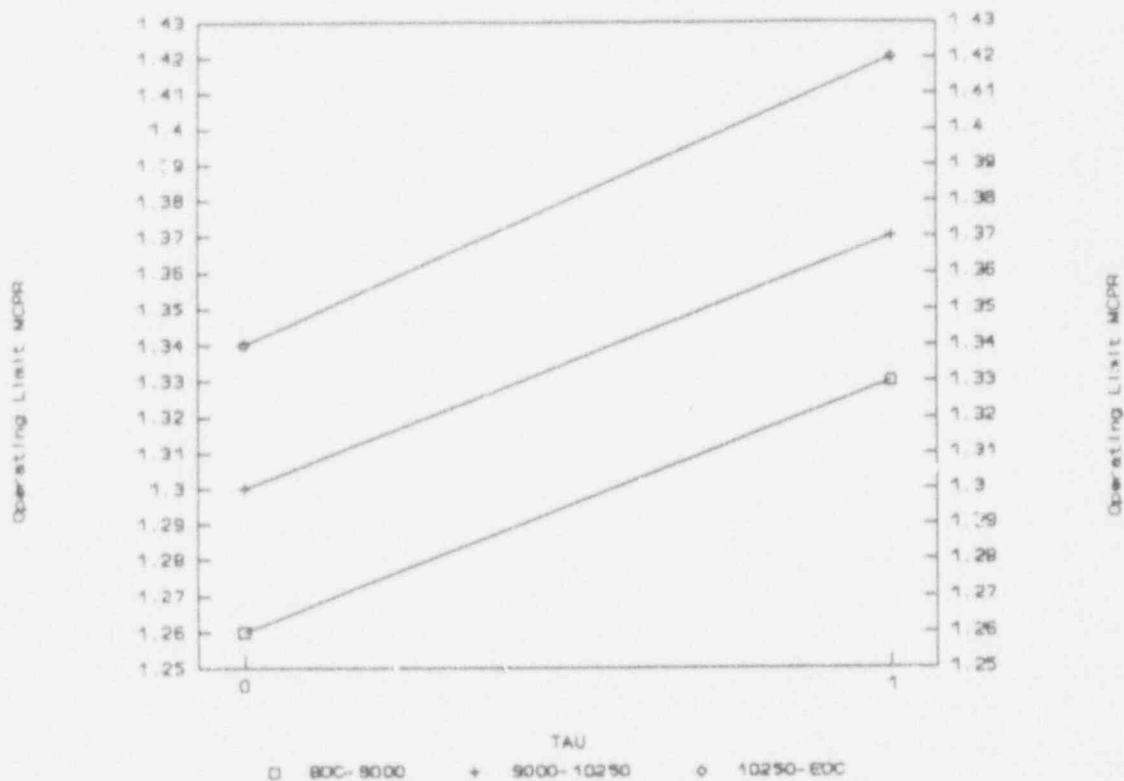


Technical Specification Reference: 3.1.B

For single loop operation, these limits shall be increased by 0.01.

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.1.c  
MCPR Operating Limit Versus  $\tau$  (TAU): GE11LTA

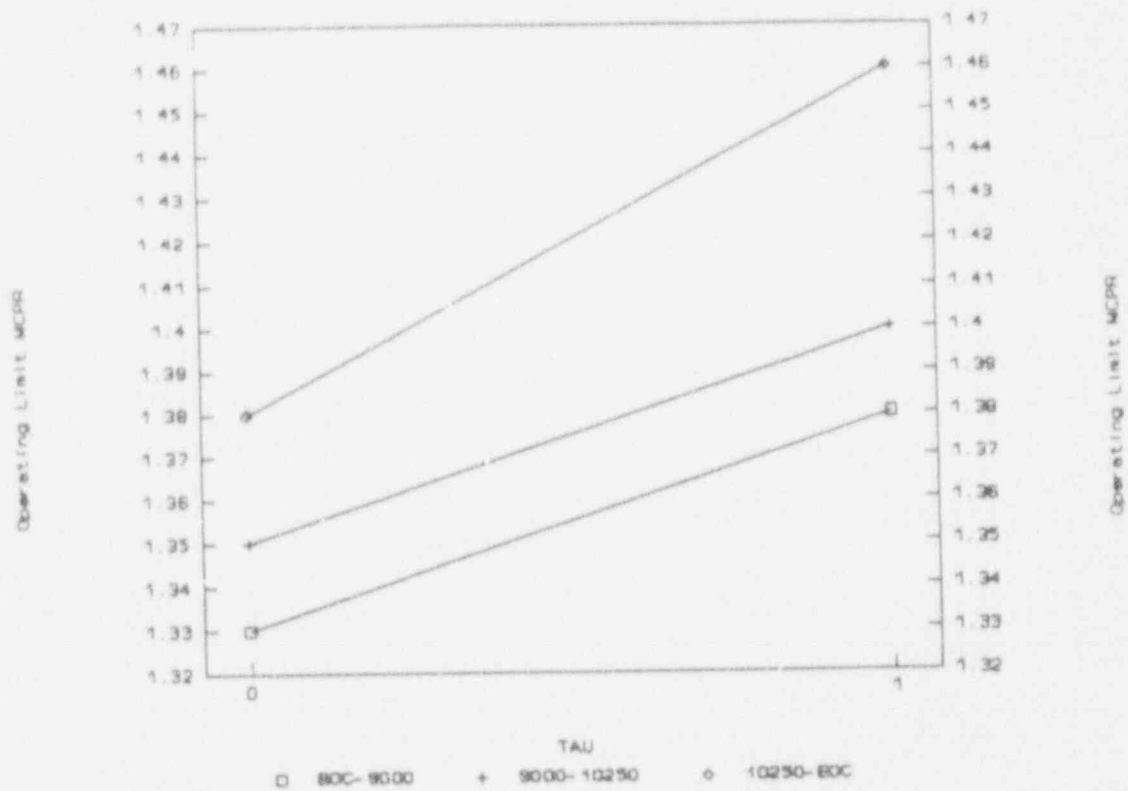


Technical Specification Reference: 3.1.B

For single loop operation, these limits shall be increased by 0.01.

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.1.d  
MCPR Operating Limit Versus  $\tau$  (TAU): GE11

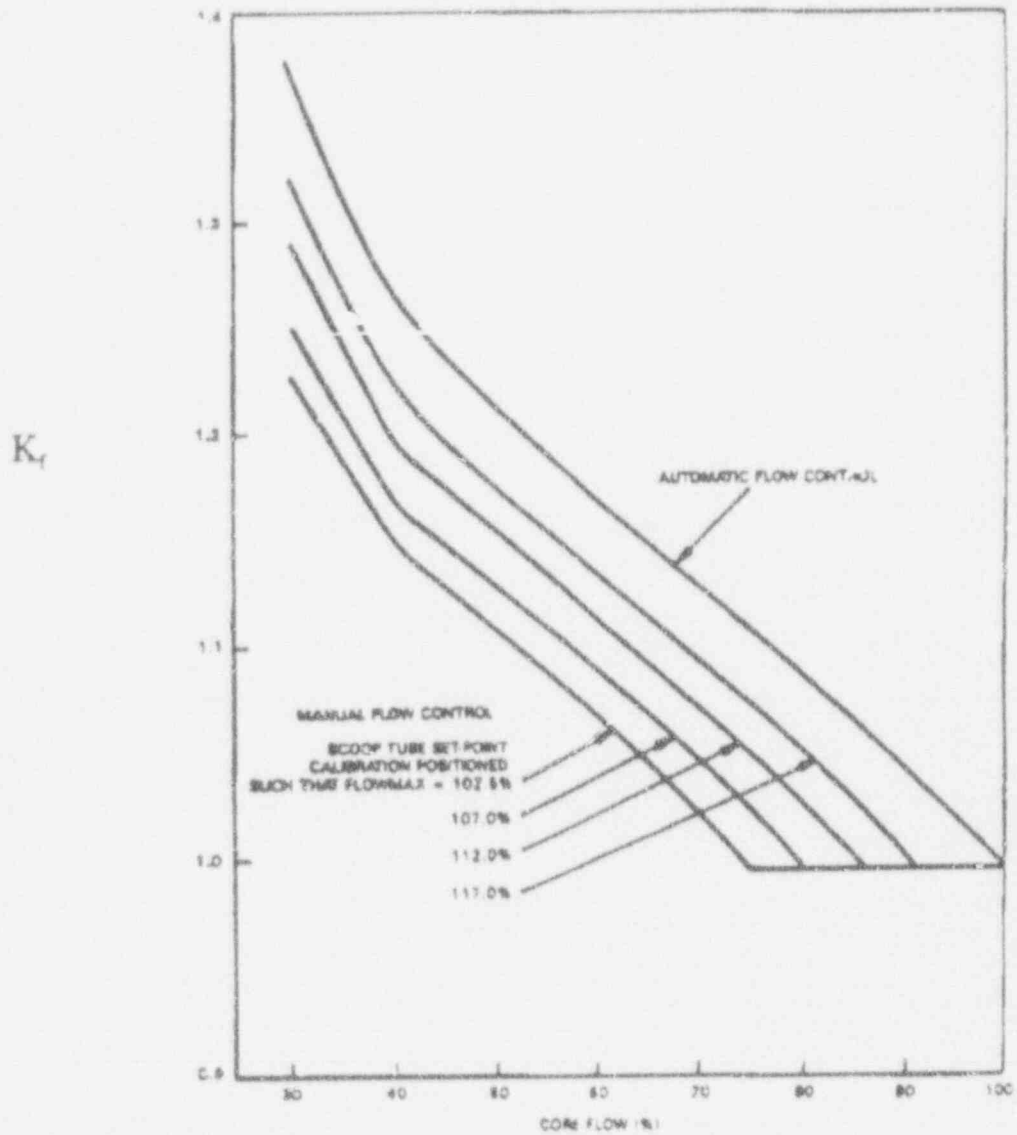


Technical Specification Reference: 3.1.B

For single loop operation, these limits shall be increased by 0.01.

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.2  
K<sub>r</sub> Factor

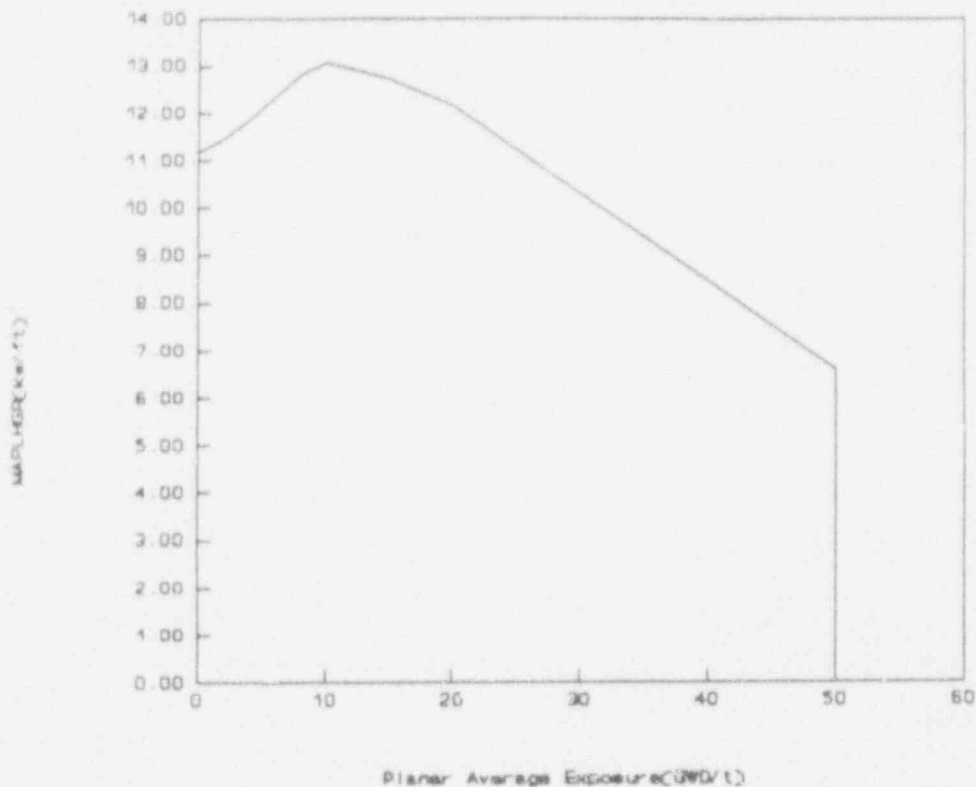


Technical Specification Reference: 3.1.B

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.3.a

MAPLHGR Versus Planar Average Exposure: BD319A



This curve represents the limiting exposure dependent MAPLHGR values.

Technical Specification Reference: 3.5.H

Reference: NEDC-31317P

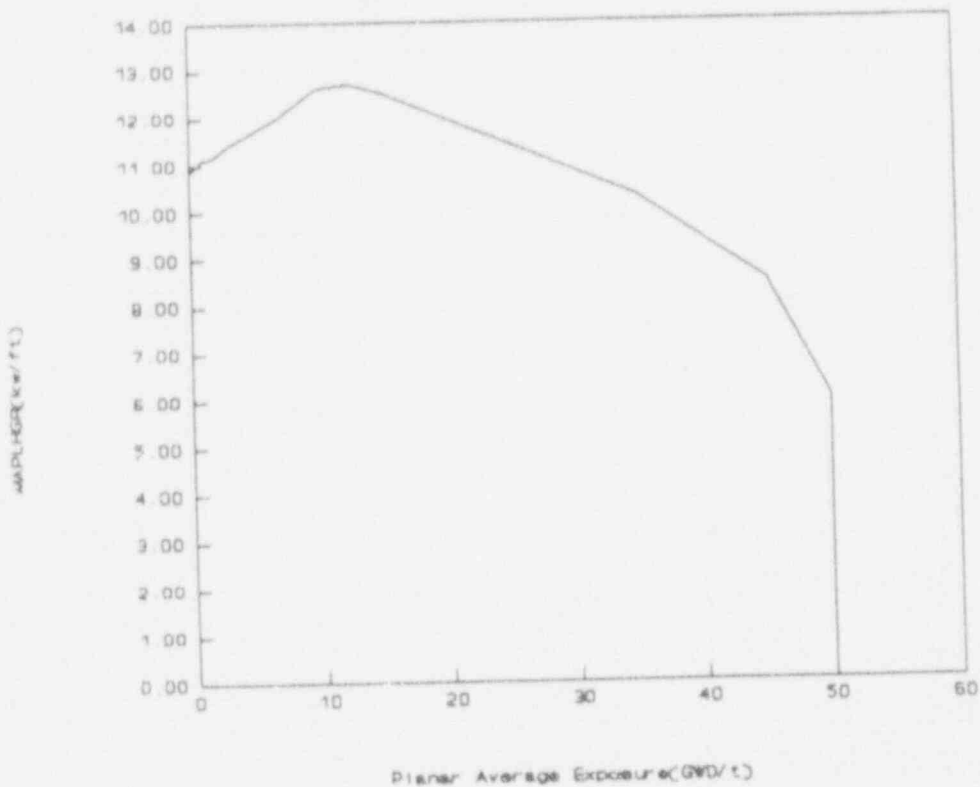
For single loop operation, these MAPLHGR values shall be multiplied by 0.84.



NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.3.b

MAPLHGR Versus Planar Average Exposure: BD336A



This curve represents the limiting exposure dependent MAPLHGR values.

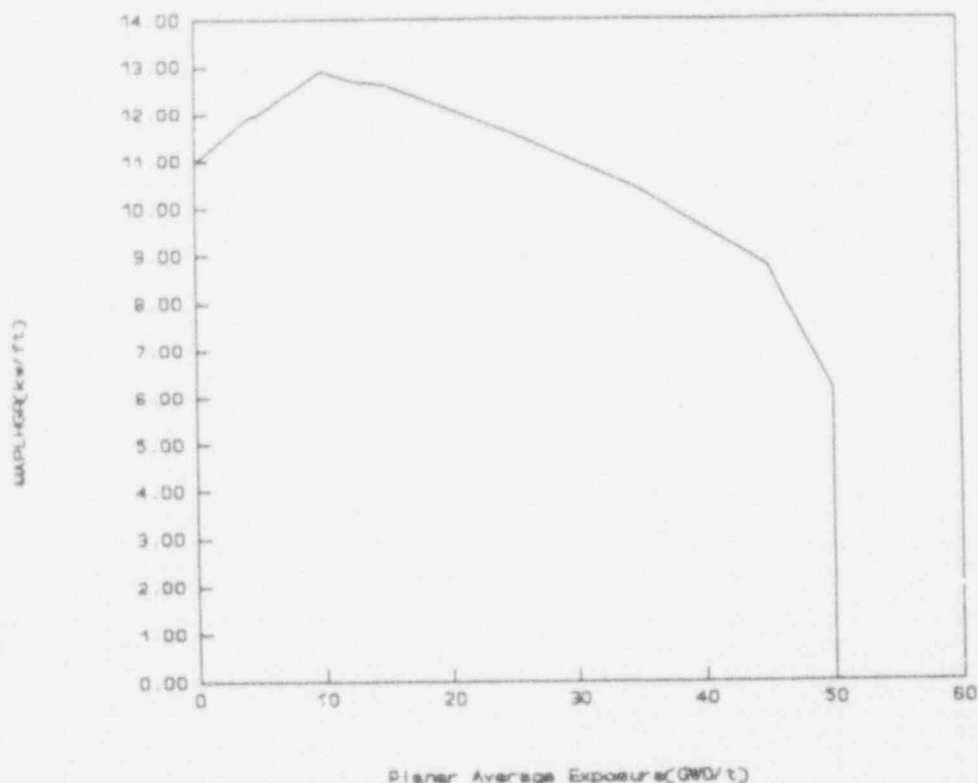
Technical Specification Reference: 3.5.H

Reference: NEDC-31317P

For single loop operating these MAPLHGR values shall be multiplied by 0.84.

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.3.c  
MAPLHGR Versus Planar Average Exposure: BD339A



This curve represents the limiting exposure dependent MAPLHGR values.

Technical Specification Reference: 3.5.H

Reference: NEDC-31317P

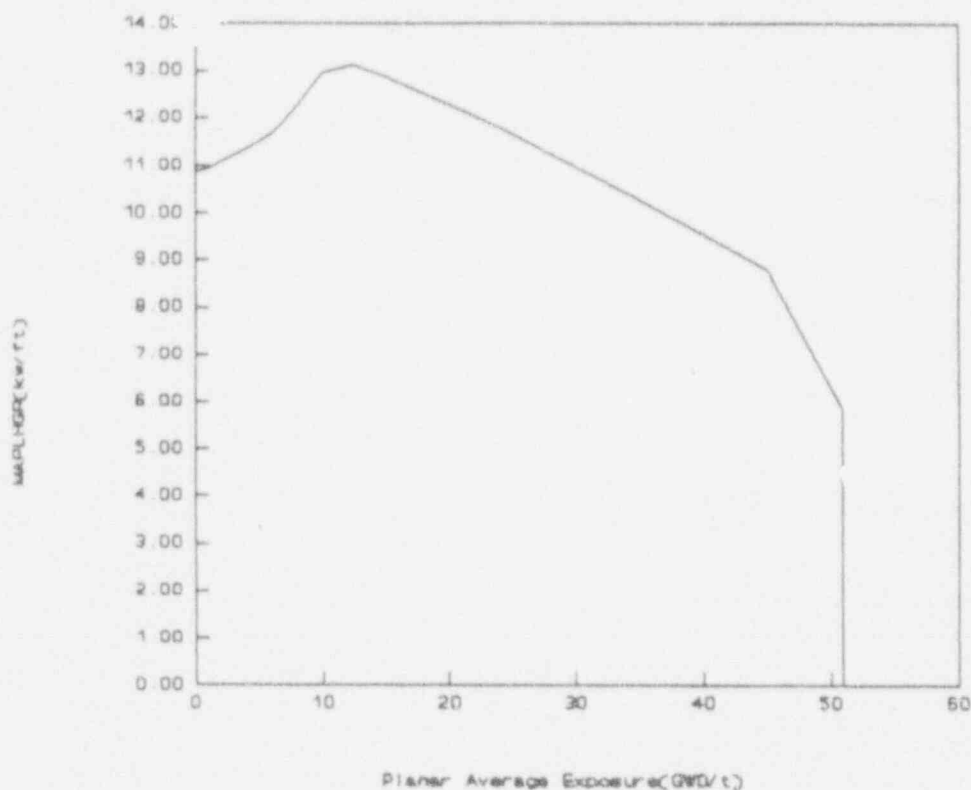
For single loop operating these MAPLHGR values shall be multiplied by 0.84.

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NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

---

FIGURE 8.3.d  
MAPLHGR Versus Planar Average Exposure:  
GE10-P8HXB322-11GZ-70M-150-T



This curve represents the limiting exposure dependent MAPLHGR values.

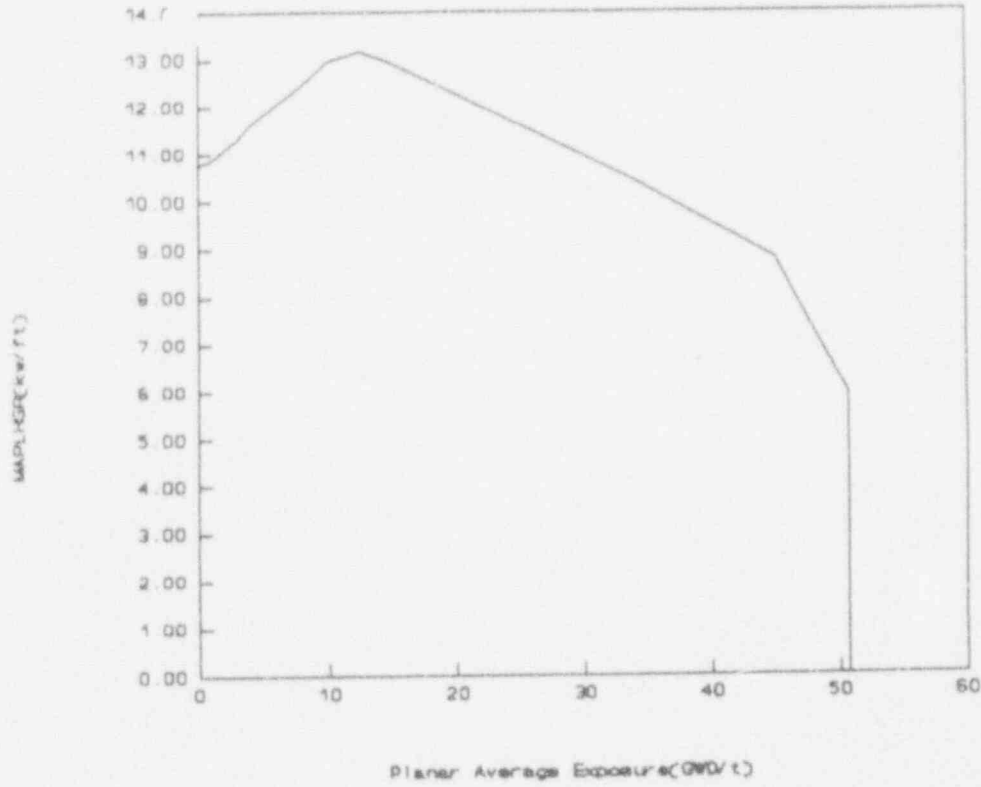
Technical Specification Reference: 3.5.H

Reference: NEDC-31317P

For single loop operating these MPLHGR values shall be multiplied by 0.84.

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.3.e  
MAPLHGR Versus Planar Average Exposure:  
GE16-P8HXB324-12GZ-70M-150T



This curve represents the limiting exposure dependent MAPLHGR values.

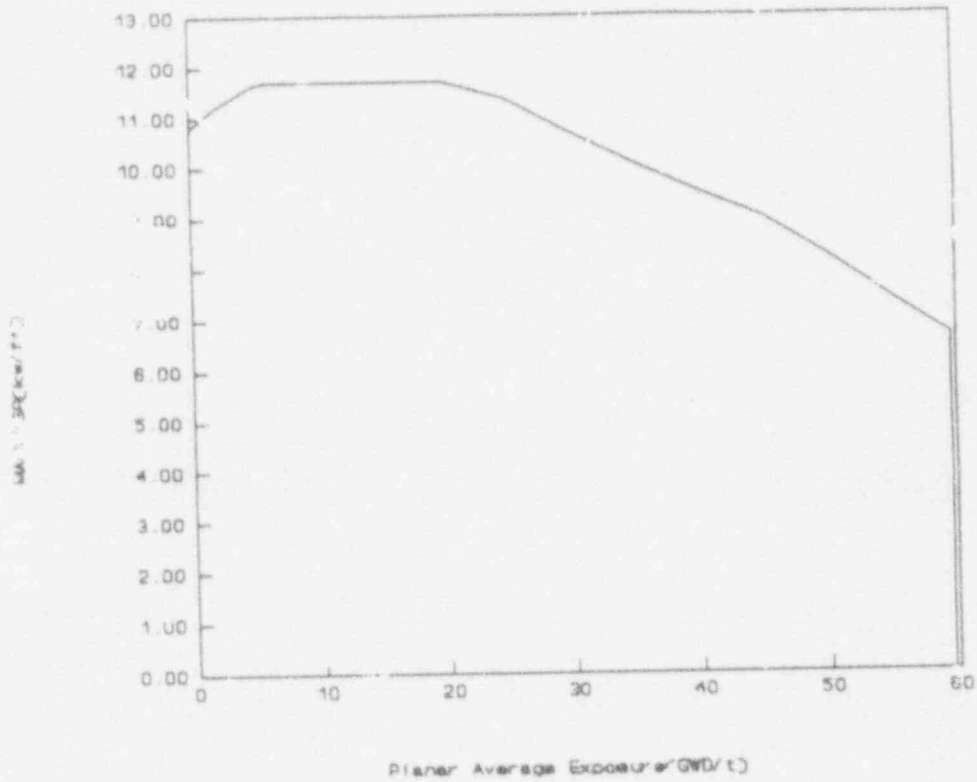
Technical Specification Reference: 3.5.H

Reference: NEDC-31317P

For single loop operating these MAPLHGR values shall be multiplied by 0.84.

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.3.f  
MAPLHGR Versus Planar Average Exposure: 89LTA



This curve represents the limiting exposure dependent MAPLHGR values.

Technical Specification Reference: 3.5.H

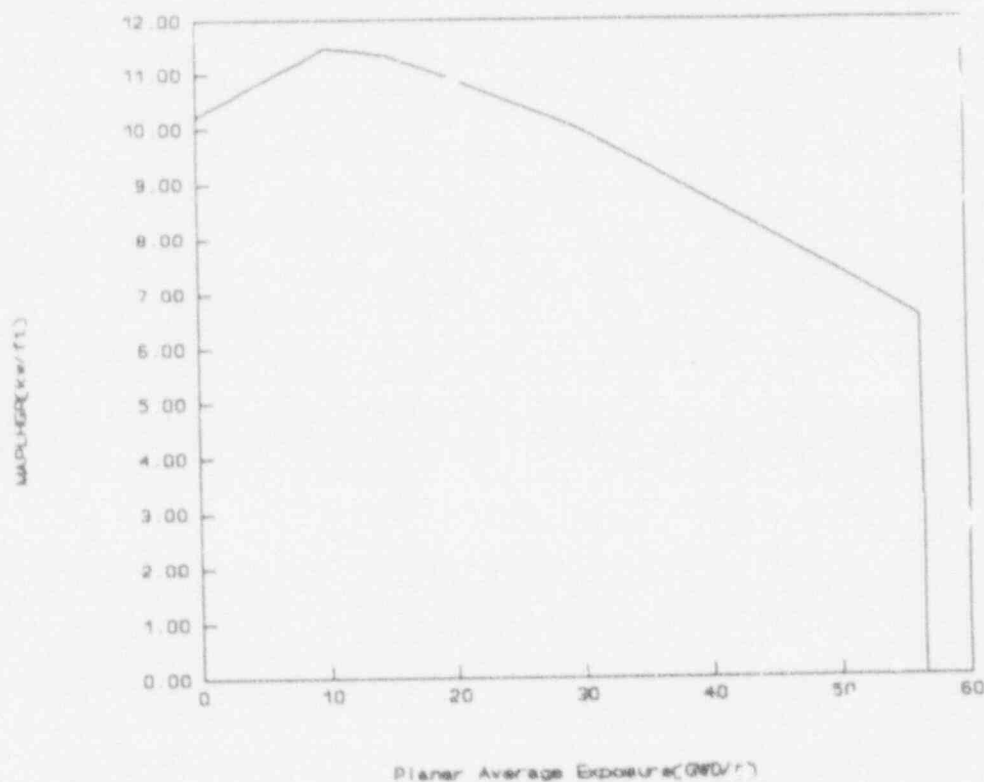
Reference: NEDC-31317P

For single loop operating these MAPLHGR values shall be multiplied by 0.84.

NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.3.g

MAPLHGR Versus Planar Average Exposure: GE11-P9HUB356-15GZ-100M-146-T



This curve represents the limiting exposure dependent MAPLHGR values.

Technical Specification Reference: 3.5.H

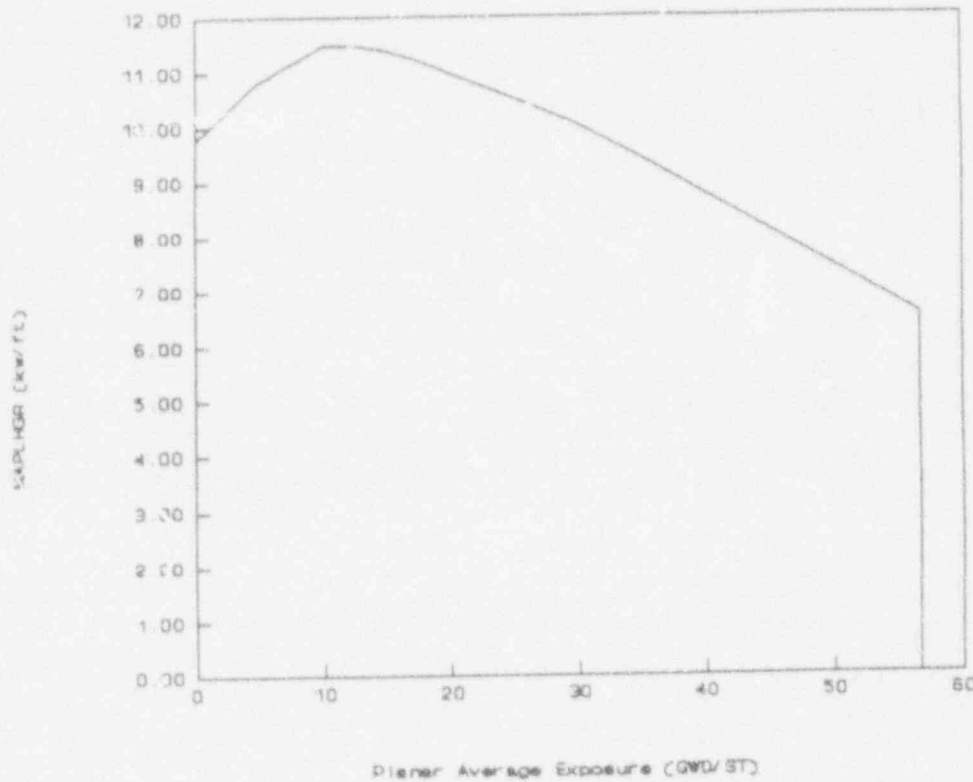
Reference: A23A7114 Rev 1

For single loop operating these MAPLHGR values shall be multiplied by 0.84.



NEW YORK POWER AUTHORITY  
JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
CORE OPERATING LIMITS REPORT

FIGURE 8.3.h  
MAPLHGR Versus Planar Average Exposure GE11-P9HUB359-16GZ1-100M-146-T



This curve represents the limiting exposure dependent MAPLHGR values.

Technical Specification Reference: 3.5.H

Reference: 23A7114 Rev 1

For single loop operating these MAPLHGR values shall be multiplied by 0.84.



NEW YORK POWER AUTHORITY  
 JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
 CORE OPERATING LIMITS REPORT

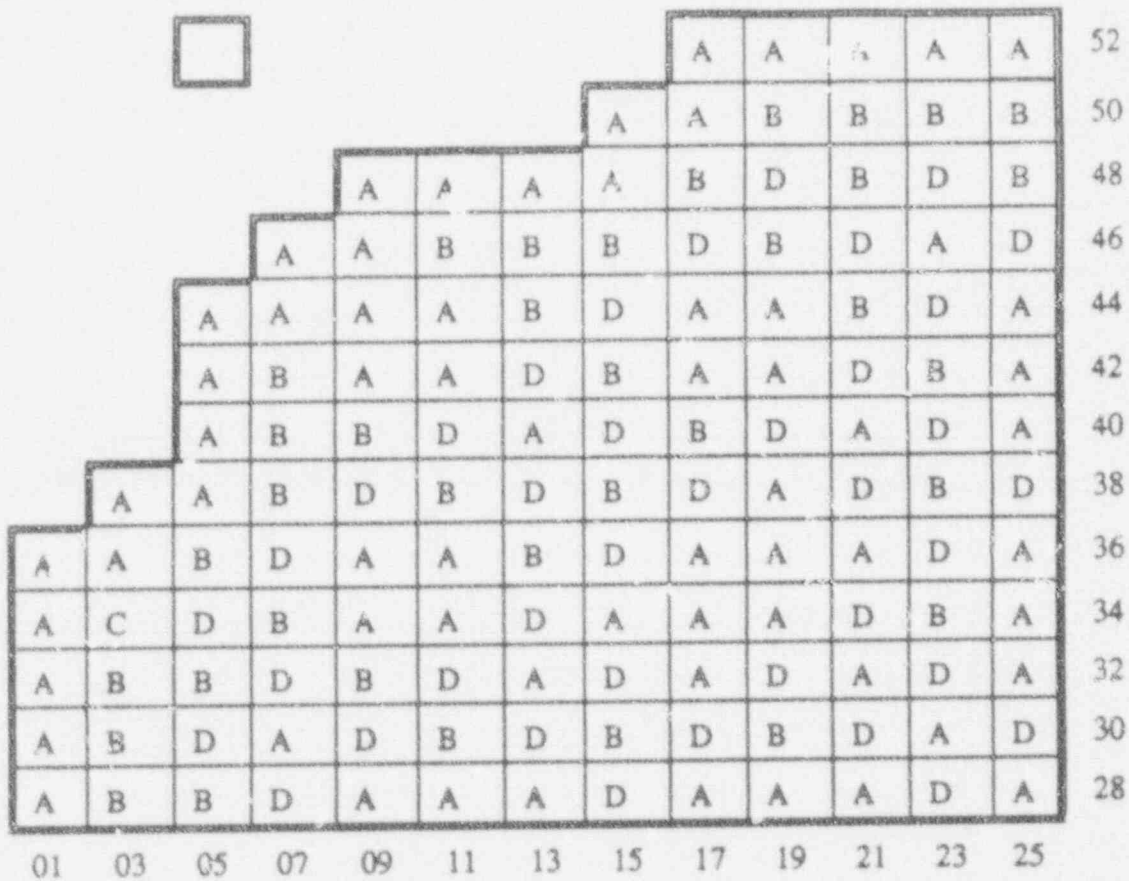


FIGURE 8.4.a  
 CYCLE 11 LOADING PATTERN, UPPER LEFT QUADRANT, BUNDLE DESIGN

- A = GE8x8EB, Bundle Types BD319A, BD336A, BD339A
- B = GE8x8NB-3, Bundle Types P8HXB322, P8HXB324
- C = GE11LTA, Bundle Type 89LTA
- D = GE11, Bundle Type P9HUB356, P9HUB359

NEW YORK POWER AUTHORITY  
 JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
 CORE OPERATING LIMITS REPORT

52	A	A	A	A	A								
50	B	B	B	B	A	A							
48	B	D	B	D	B	A	A	A	A				
46	D	A	D	E	D	B	B	B	A	A			
44	A	D	B	A	A	D	B	A	A	A	A		
42	A	B	D	A	A	B	D	A	A	B	A		
40	A	D	A	D	B	D	A	D	B	B	A		
38	D	B	D	A	D	B	D	B	D	B	A	A	
36	A	D	A	A	A	D	B	A	A	D	B	A	A
34	A	B	D	A	A	A	D	A	A	B	D	C	A
32	A	D	A	D	A	D	A	D	B	D	B	B	A
30	D	A	D	B	D	B	D	B	D	A	D	B	A
28	A	D	A	A	A	D	A	A	A	D	B	B	A
	27	29	31	33	35	37	39	41	43	45	47	49	51

FIGURE 8.4 b  
 CYCLE 11 LOADING PATTERN, UPPER RIGHT QUADRANT, BUNDLE DESIGN

- A = GE8x8EB, Bundle Types BD319A, BD336A, BD339A
- B = GE8x8NB-3, Bundle Types P8HXB322, P8HXB324
- C = GE11LTA, Bundle Type 89LTA
- D = GE11, Bundle Types P8HUB356, P9HUB359

NEW YORK POWER AUTHORITY  
 JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
 CORE OPERATING LIMITS REPORT

	27	29	31	33	35	37	39	41	43	45	47	49	51
26	A	D	A	A	A	D	A	A	A	D	B	B	A
24	D	A	D	B	D	B	D	B	D	A	D	B	A
22	A	D	A	D	A	D	A	D	B	D	B	B	A
20	A	B	D	A	A	A	D	△	A	B	D	C	A
18	A	D	A	A	A	D	B	A	A	D	B	A	A
16	D	B	D	A	D	B	D	B	D	B	A	A	
14	A	D	A	D	B	D	A	D	B	B	A		
12	A	B	D	A	A	B	D	A	A	B	A		
10	A	D	B	A	A	D	B	A	A	A	A		
08	D	A	D	B	D	B	B	B	A	A			
06	B	D	B	D	B	A	A	A	A				
04	B	B	B	B	A	A							
02	A	A	A	A	A								

FIGURE 8.4.c  
 CYCLE 11 LOADING PATTERN, LOWER RIGHT QUADRANT, BUNDLE DESIGN

- A = GE8x8EB, Bundle Types RD319A, SD336A, BD339A
- B = GE3x8NB-3, Bundle Types P8HDCB322, P8HXB324
- △ = GE11LTA, Bundle Type 89LTA
- D = GE11, Bundle Type P9HUB356, P9HUB359

NEW YORK POWER AUTHORITY  
 JAMES A. FITZPATRICK NUCLEAR POWER PLANT  
 CORE OPERATING LIMITS REPORT

	01	03	05	07	09	11	13	15	17	19	21	23	25	
	A	B	B	D	A	A	A	D	A	A	A	D	A	26
	A	B	D	A	D	B	D	B	D	B	D	A	D	24
	A	B	B	D	B	D	A	D	A	D	A	D	A	22
	A	C	D	B	A	A	D	A	A	A	D	B	A	20
	A	A	B	D	A	A	B	D	A	A	A	D	A	18
		A	A	B	D	B	D	B	D	A	D	B	D	16
			A	B	B	D	A	D	B	D	A	D	A	14
			A	B	A	A	D	B	A	A	D	B	A	12
			A	A	A	A	B	D	A	A	B	D	A	10
				A	A	B	B	B	D	B	D	A	D	08
					A	A	A	A	B	D	B	D	B	06
								A	A	B	B	B	B	04
									A	A	A	A	A	02

FIGURE 8.4.d  
 CYCLE 11 LOADING PATTERN, LOWER LEFT QUADRANT, BUNDLE DESIGN

A = GE3x8EB, Bundle Types BD319A, BD336A, BD339A  
 B = GE2x8NB-3, Bundle Types P8HXB322, P8HXB324  
 C = GE11LTA, Bundle Type 89LTA  
 D = GE11, Bundle Type P9HUB356, P9HUB359