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PROCEDURE

REVISION

CORE OPERATING LIMITS REPORT

5

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APPLICABLE MANUAL: CORE OPERATING LIMITS REPORT

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NEW YORK POWER AUTHORITY
JAMES A. FITZPATRICK NUCLEAR POWER PLANT
REPORT

CORE OPERATING LIMITS REPORT
REVISION 5

REVIEWED BY: PLANT OPERATIONS REVIEW COMMITTEE

MEETING NO. 96-120

DATE 17 Nov 96

APPROVED BY:

Vanouzel by dir
REACTOR ANALYST SUPERVISOR

DATE 11/18/96

APPROVED BY:

McGee
PLANT MANAGER

DATE 11/21/96

1.0 PURPOSE

This report provides the cycle-specific operating limits for Cycle 13 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

Stability Option ID Exclusion Region

2.0 APPLICABILITY

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

3.0 REFERENCES

- 3.1 JAFNPP Administrative Procedure 12.05, Control of Core Operating Limits Report.
- 3.2 JAFNPP License Appendix A, Operating Technical Specifications.
- 3.3 FitzPatrick Cycle 13 Core Reload Safety Evaluation, JAF-SE-96-052.
- 3.4 JAFNPP SAFER/GESTR-LOCA Loss of Coolant Analysis, NEDE-31317P Rev.2, April 1993.
- 3.5 GE Report, Supplemental Reload Licensing Report for James A. FitzPatrick Reload 12 Cycle13, J11-02914SRL Rev.0, August 1996.
- 3.6 GE Report, Lattice Dependent MAPLHGR Report for James A. FitzPatrick Reload 12 Cycle13, J11-02914MAP Rev.0, August 1996.
- 3.7 Cycle 13 Core Reload, M1-95-077.
- 3.8 RAP-7.3.17 Rev.5, Core Monitoring Software and Databasae Changes.

- 3.9 PLANT OPERATION UP TO 100% POWER WITH ONE STEAM LINE ISOLATED, JAF-SE-96-035.
- 3.10 FitzPatrick Cycle 12 Core Reload Safety Evaluation, JAF-SE-94-127.
- 3.11 General Electric Standard Application for Reload Fuel, NEDE-24011-P-A-13

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 77.0×10^6 lb/hr.

5.0 RESPONSIBILITIES

- 5.1 See AP-12.05 (Reference 3.1).
- 5.2 It is the responsibility of the Shift Manager to assure that the reactor is operated within the limits described herein.
- 5.3 It is the responsibility of the Reactor Analyst Supervisor to assure that the limits described herein are properly installed in the 3D-Monicores databank used for thermal limit surveillance (Reference 3.8)

6.0 SPECIAL INSTRUCTIONS/REQUIREMENTS

Not applicable.

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 surveillance i, and

τ_i = average scram time to notch position 38 of all rods measured in surveillance test i.

- 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:

- μ = mean of the distribution for the average scram insertion time to the pickup of notch position 38 = 0.706 sec.
- σ = 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 7.1.2.1 is met, the Operating Limit MCPR shall not be less than that specified in Table 8.1, or Table 8.1.A if operating above 75% of rated thermal power with three steam lines in service.

- 7.1.4 When the requirement 7.1.2.1 is not met (i.e. $\tau_B < \tau_{AVE}$) then the Operating Limit MCPR values (as a function of τ) are given in Figures 8.1.1 and 8.1.2, or Figure 8.1.A.1 and 8.1.A.2 if operating above 75% of rated thermal power with three steam lines in service.

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

and

τ_{AVE} = the average scram time to notch position 38 as defined in 7.1.2.2.

τ_B = the adjusted analysis mean scram time as defined in 7.1.2.3

τ_A = the scram time to notch position 38 as defined in Technical Specification 3.3.C.1.

Note: Should the operating limit MCPR obtained from these figures be less than the operating limit MCPR found in 7.1.3 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_f 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 hand 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 shown in Figures 8.3.a through g.

- 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.

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

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

where:

S = setting in percent of rated thermal power;

W = recirculation flow in percent of rated;

 ΔW = 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:

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

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

where:

FRP = fraction of rated thermal power;

MFLPD = Maximum fraction of limiting power density, see Definition 4.3.

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.

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

- 7.4.2.2 The APRM rod block trip setting shall be:

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

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

where:

S = rod block setting in percent of rated thermal power;

W = recirculation flow in percent of rated;

ΔW = 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:

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

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

where:

FRP = fraction of rated thermal power;

MFLPD = maximum fraction of limiting power density, see Definition 4.3.

7.5 RBM Flow Biased Rod Block Setting

- 7.5.1 Technical Specification Reference: 3.2.C

- 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 MCPR Operating Limit from Table 8.1 (note that for Cycle 13 the RBM intercept value does not effect the MCPR Operating Limit for K values $\leq 44\%$);

ΔW = difference between two loop and single loop effective drive flow at the same core flow.

7.6 Stability Option ID Exclusion Region

- 7.6.1 Technical Specification Reference 3.5.J

- 7.6.2 The reactor shall not be intentionally operated within the exclusion region given in Figure 8.4.

8.0 FIGURES AND TABLES

Table 8.1	MCPR Operating Limit for Incremental Cycle Core Average Exposure
Table 8.1.A	MCPR Operating Limit for Incremental Cycle Core Average Exposure for Operation above 75% of Rated Thermal Power with Three Steam Lines in Service
Table 8.2	Maximum LHGR
Figure 8.1.1	MCPR Operating Limit Versus τ for GE11
Figure 8.1.2	MCPR Operating Limit Versus τ for GE12
Figure 8.1.A.1	MCPR Operating Limit Versus τ for Operation above 75% of Rated Thermal Power with Three Steam Lines in Service for GE11
Figure 8.1.A.2	MCPR Operating Limit Versus τ for Operation above 75% of Rated Thermal Power with Three Steam Lines in Service for GE12
Figure 8.2	K_f Factor
Figure 8.3.a	MAPLHGR Versus Planar Average Exposure: GE10-P8HXB322-11GZ-70M-150-T
Figure 8.3.b	MAPLHGR Versus Planar Average Exposure: GE10-P8HXB324-12GZ-70M-150T
Figure 8.3.c	MAPLHGR Versus Planar Average Exposure: GE11-P9HUB356-15GZ-100M-146T and ATRIUM-10A
Figure 8.3.d	MAPLHGR Versus Planar Average Exposure: GE11-P9HUB359-16GZ1-100M-146-T
Figure 8.3.e	MAPLHGR Versus Planar Average Exposure: GE11-P9HUB380-12GZ5-100M-146-T
Figure 8.3.f	MAPLHGR Versus Planar Average Exposure: GE12-P10DSB417-15GZ-100T-150-T
Figure 8.3.g	MAPLHGR Versus Planar Average Exposure: GE12-P10DSB412-17GZ-100T-150-T
Figure 8.4	Stability Option ID Exclusion Region
Figure 8.5.a	CYCLE 13 LOADING PATTERN, UPPER LEFT QUADRANT, BUNDLE DESIGN
Figure 8.5.b	CYCLE 13 LOADING PATTERN, UPPER RIGHT QUADRANT, BUNDLE DESIGN

Figure 8.5.c CYCLE 13 LOADING PATTERN, LOWER RIGHT
QUADRANT, BUNDLE DESIGN

Figure 8.5.d CYCLE 13 LOADING PATTERN, LOWER LEFT
QUADRANT, BUNDLE DESIGN

9.0 EXHIBITS

Not Applicable.

TABLE 8.1
MCPR Operating Limit for Incremental Cycle
Core Average Exposure

Cycle 13 Exposure Range	GE11 and GE10	GE12
BOC to 8.5 GWD/ST	1.32	1.34
>8.5 GWD/ST to 10.7 GWD/ST	1.32	1.39
>10.7 GWD/ST to EOC	1.33	1.40

Technical Specification Reference: 3.1.B

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

See Reference 3.3 for MCPR requirement for ATRIUM-10A assemblies, required margin is provided by non-limiting core location.

Note: When entering a new Exposure Range, check the current value of τ to assure adjustment per Section 7.1.4

TABLE 8.1.A
MCPR Operating Limit for Incremental Cycle Core Average Exposure
for Operation above 75% of Rated Thermal Power with Three Steam
Lines in Service

Cycle 13 Exposure Range	GE11 and GE10	GE12
BOC to 8.5 GWD/ST	1.32	1.36
>8.5 GWD/ST to 10.7 GWD/ST	1.32	1.41
>10.7 GWD/ST to EOC	1.35	1.42

Technical Specification Reference: 3.1.B

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

See Reference 3.3 for MCPR requirement for ATRIUM-10A assemblies, required margin is provided by non-limiting core location.

Note: When entering a new Exposure Range, check the current value of τ to assure adjustment per Section 7.1.4

TABLE 8.2
Maximum LHGR

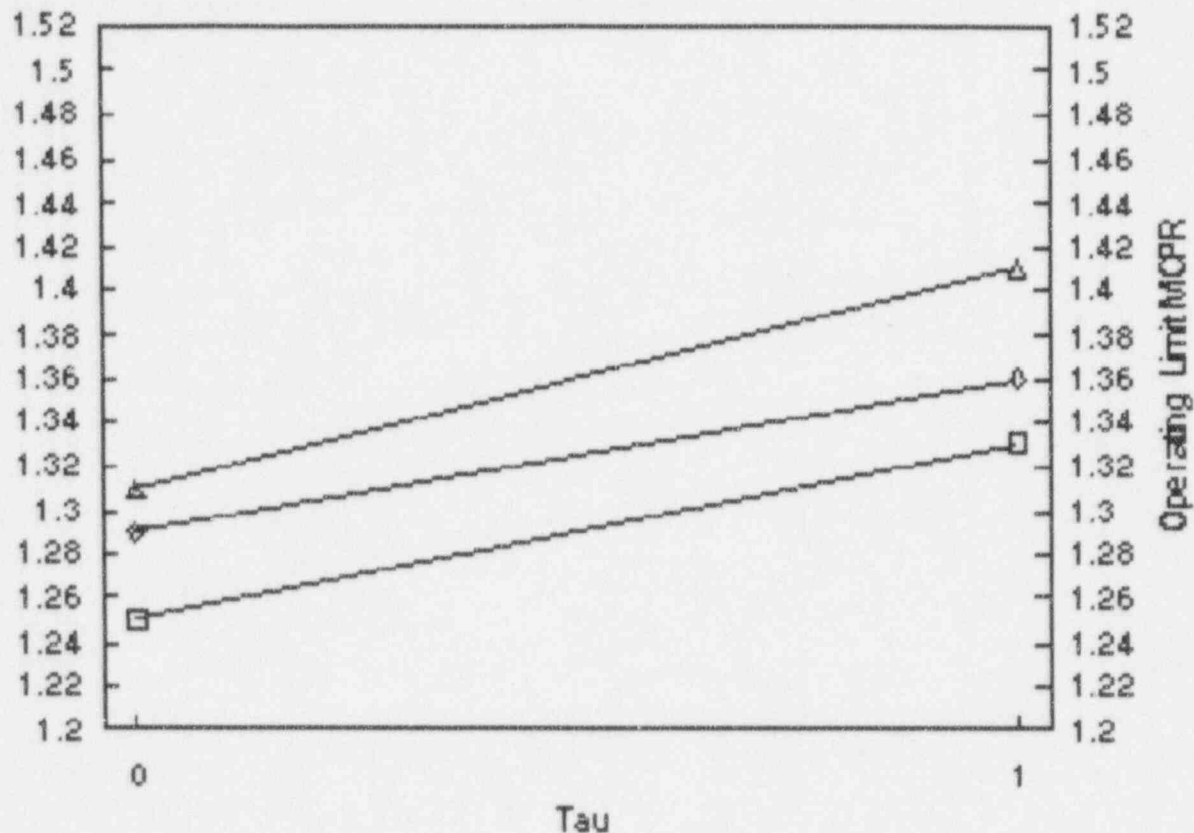
Fuel Type	Fuel Bundle Design	Maximum LHGR (kw/ft)
GE10-P8HXB322 11GZ-70M-150-T	GE10, also known as GE8x8NB-3	14.4
GE10-P8HXB324 12GZ-70M-150-T	GE10, also known as GE8x8NB-3	14.4
GE11-P9HUB356 15GZ-100M-146-T	GE11	14.4
GE11-P9HUB359 16GZ1-100M-146-T	GE11	14.4
GE11-P9HUB380 12GZ5-100M-146-T	GE11	14.4
GE12-P10DSB417 15GZ-100T-150-T	GE12	11.8
GE12-P10DSB412 17GZ-100T-150-T	GE12	11.8

Technical Specification Reference: 3.5.I

Design features of the fuel assemblies in the Cycle 13 core are provided in Reference 3.7

LHGR for ATRIUM-10A assemblies is controlled by the MAPLHGR limit given in Figure 8.3.c see Reference 3.10

FIGURE 8.1.1
MCPR Operating Limit Versus τ (TAU)
for GE11 and GE10



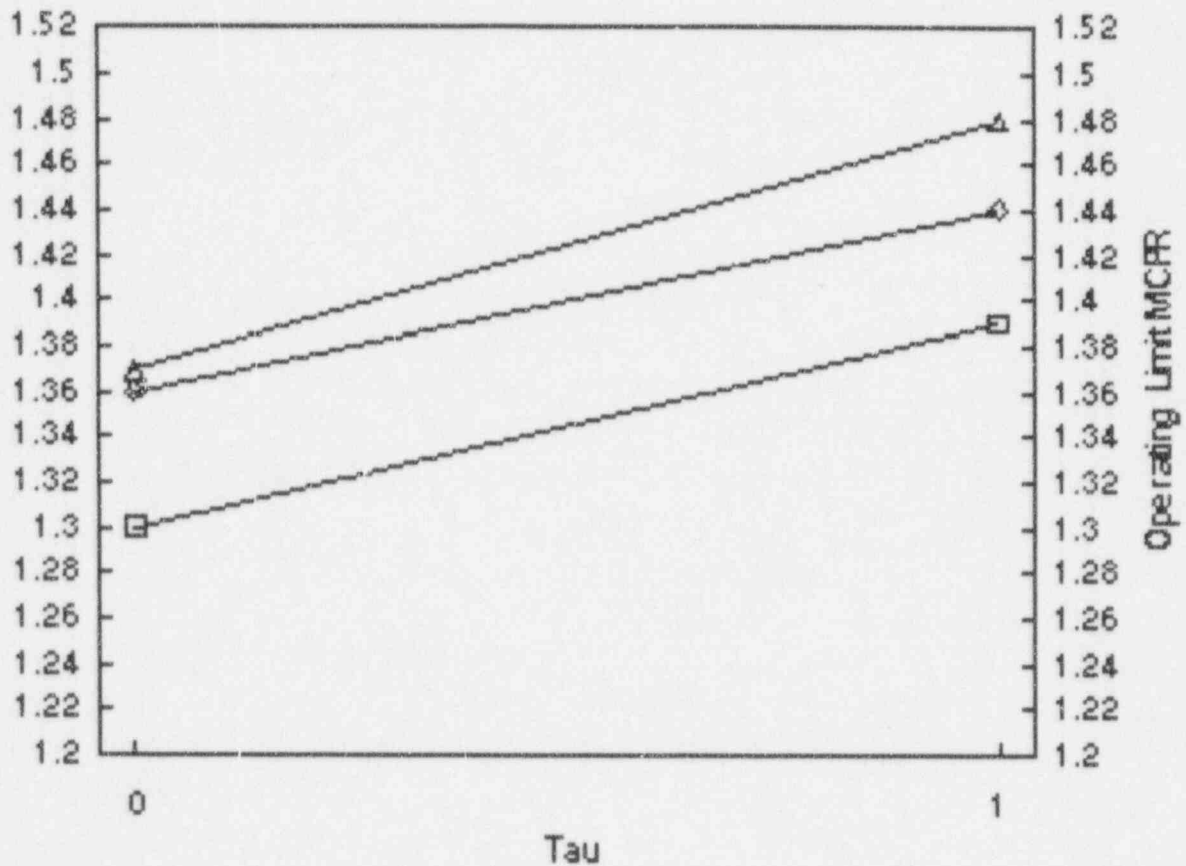
□ BOC to 8.5 GW/DST ♦ 8.5 to 10.7 GW/DST ▲ 10.7 GW/DST to EOC

Technical Specification Reference: 3.1.B

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

Note: Should the operating limit MCPR obtained from this figure 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.

FIGURE 8.1.2

MCPR Operating Limit Versus τ (TAU)
for GE12

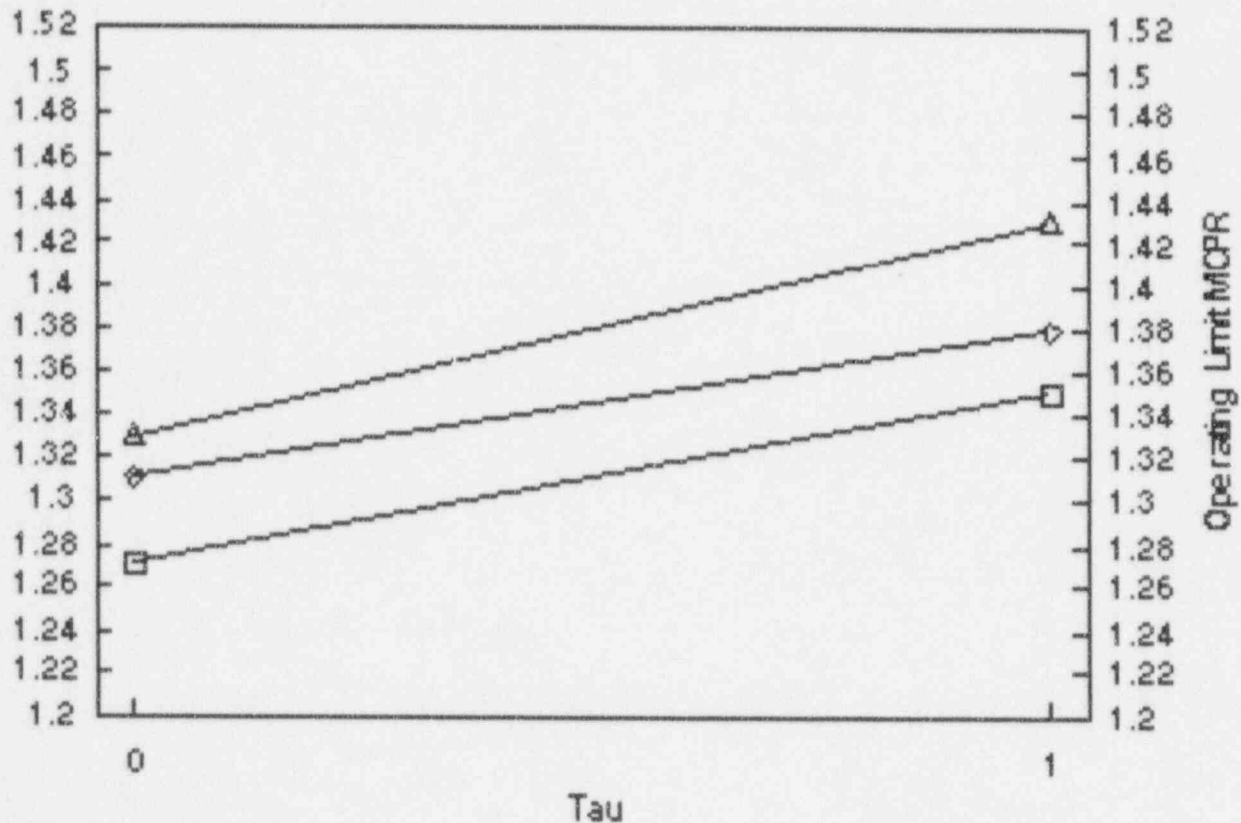
□ BOC to 8.5 GW/DST ♦ 8.5 to 10.7 GW/DST ▲ 10.7 GW/DST to EOC

Technical Specification Reference: 3.1.B

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

Note: Should the operating limit MCPR obtained from this figure 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.

FIGURE 8.1.A.1
 MCPR Operating Limit Versus τ (TAU)
 For Operation above 75% of Rated Thermal
 Power with Three Steam Lines in Service
 For GE11 and GE10



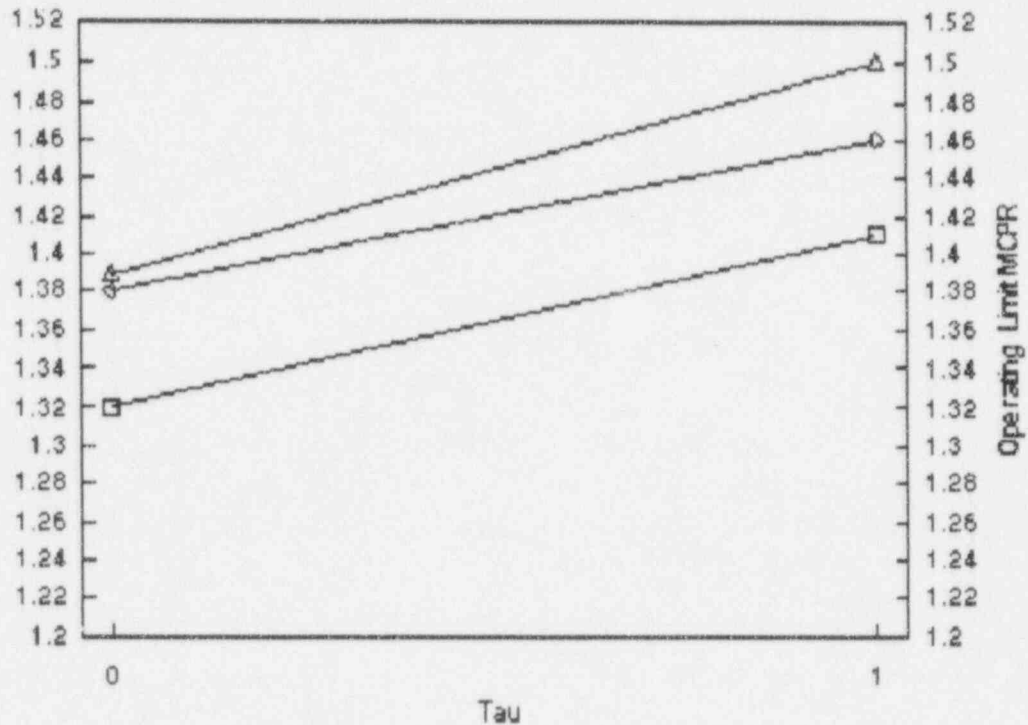
□ 10.7 GW/DIST to EOC ♦ 8.5 to 10.7 GW/DIST ▲ 10.7 GW/DIST to EOC

Technical Specification Reference: 3.1.B

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

Note: Should the operating limit MCPR obtained from this figure 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.

FIGURE 8.1.A.2
 MCPR Operating Limit Versus τ (TAU)
 For Operation above 75% of Rated Thermal
 Power with Three Steam Lines in Service
 For GE12

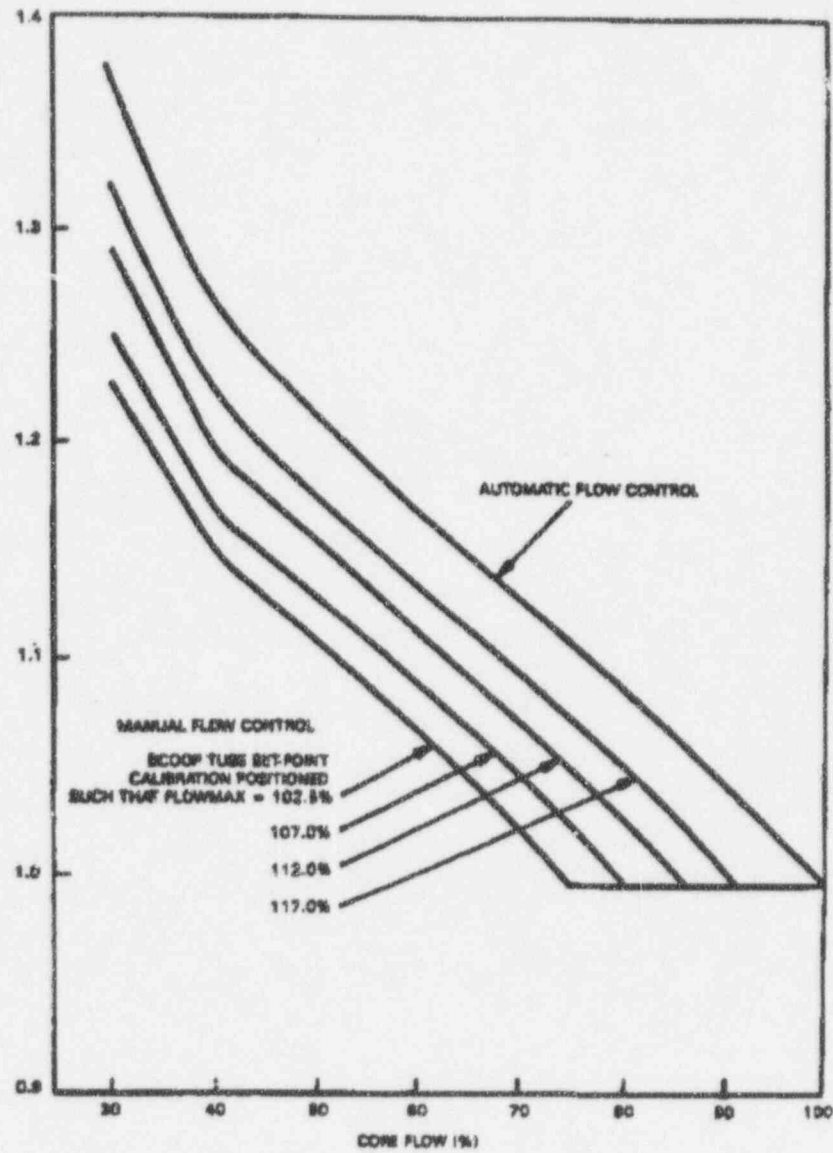


□ BOC to 8.5 GW/DST ○ 8.5 to 10.7 GW/DST △ 10.7 GW/DST to EOC

Technical Specification Reference: 3.1.B

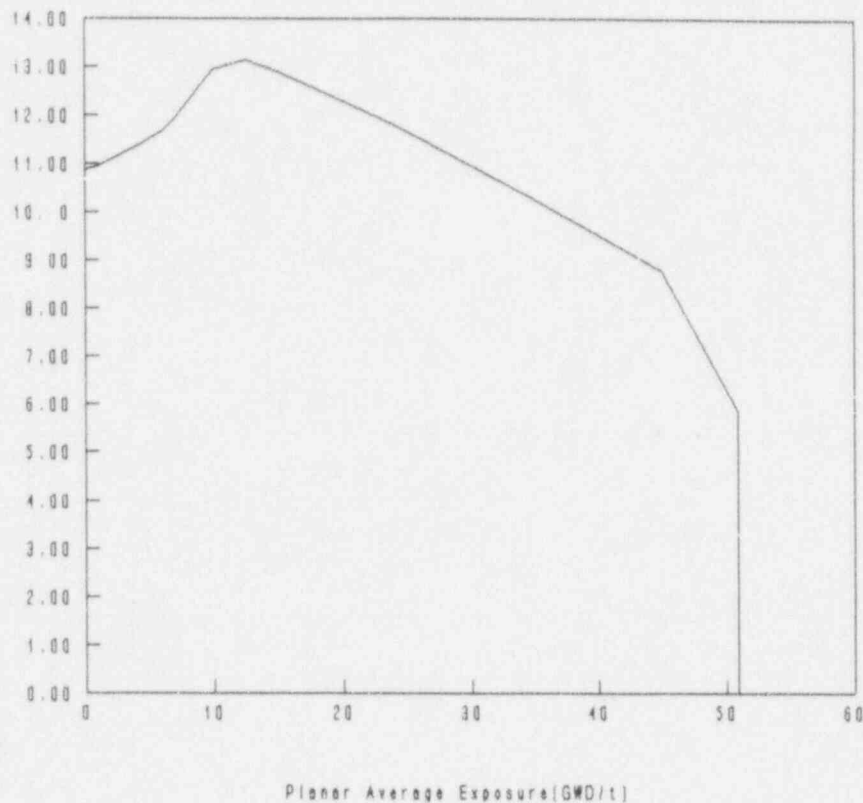
For single loop operation, these limits shall be increased by 0.01.

Note: Should the operating limit MCPR obtained from this figure 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.

FIGURE 8.2
 K_f Factor K_f 

Technical Specification Reference: 3.1.B

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



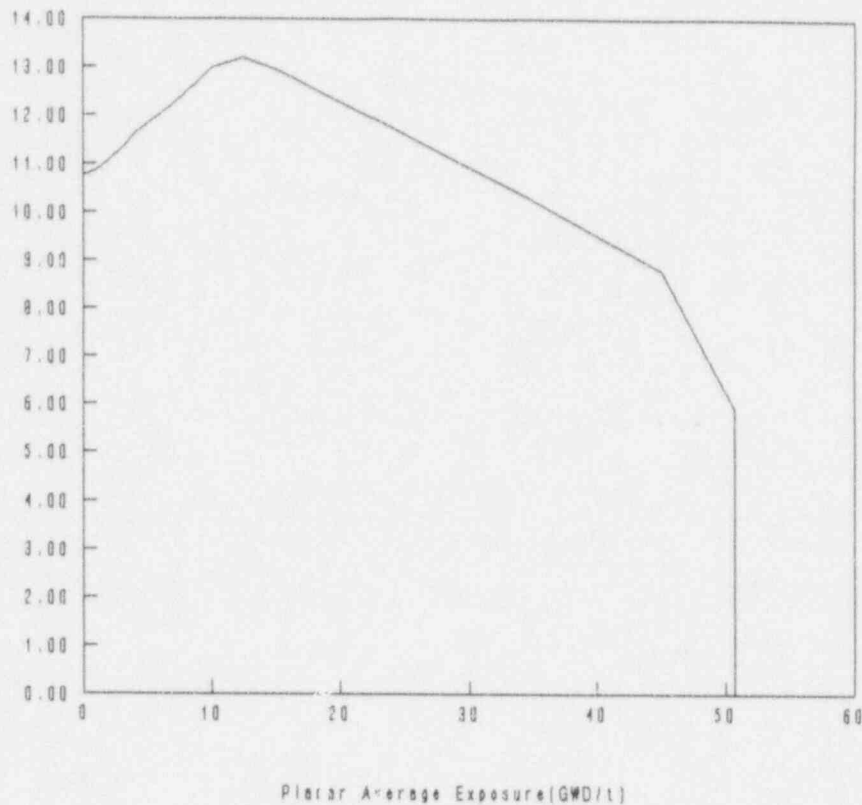
This curve represents the limiting exposure dependent MAPLHGR values per Reference 3.11.

Technical Specification Reference: 3.5.H

Reference: NEDC-31317P

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

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



This curve represents the limiting exposure dependent MAPLHGR values per Reference 3.11.

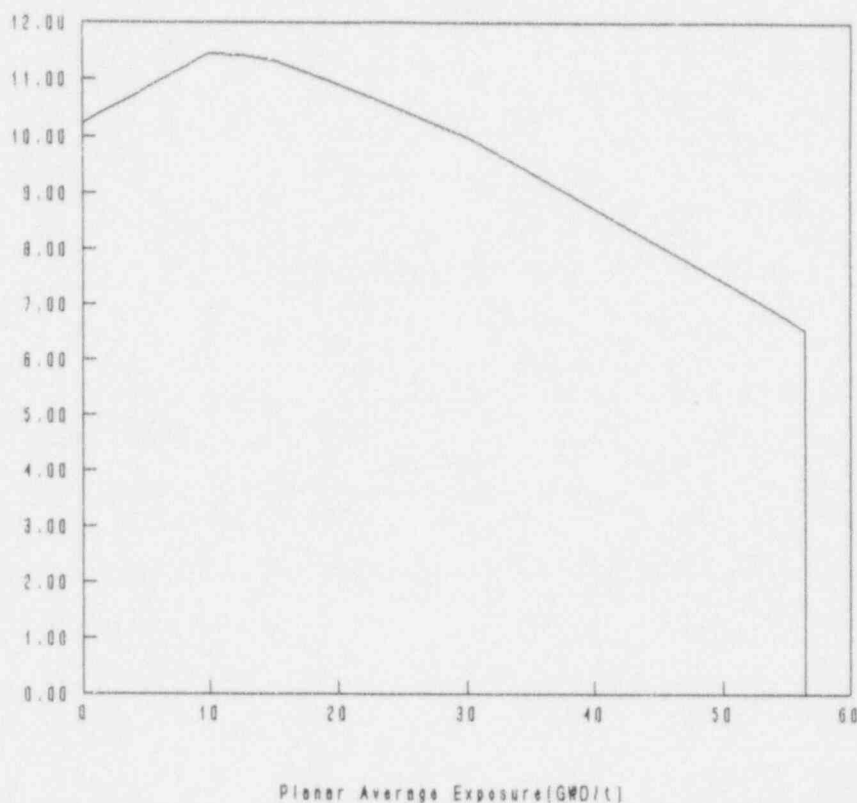
Technical Specification Reference: 3.5.H

Reference: NEDC-31317P

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

FIGURE 8.3.c

MAPLHGR Versus Planar Average Exposure:
GE11-P9HUB356-15GZ-100M-146-T and ATRIUM-10A*

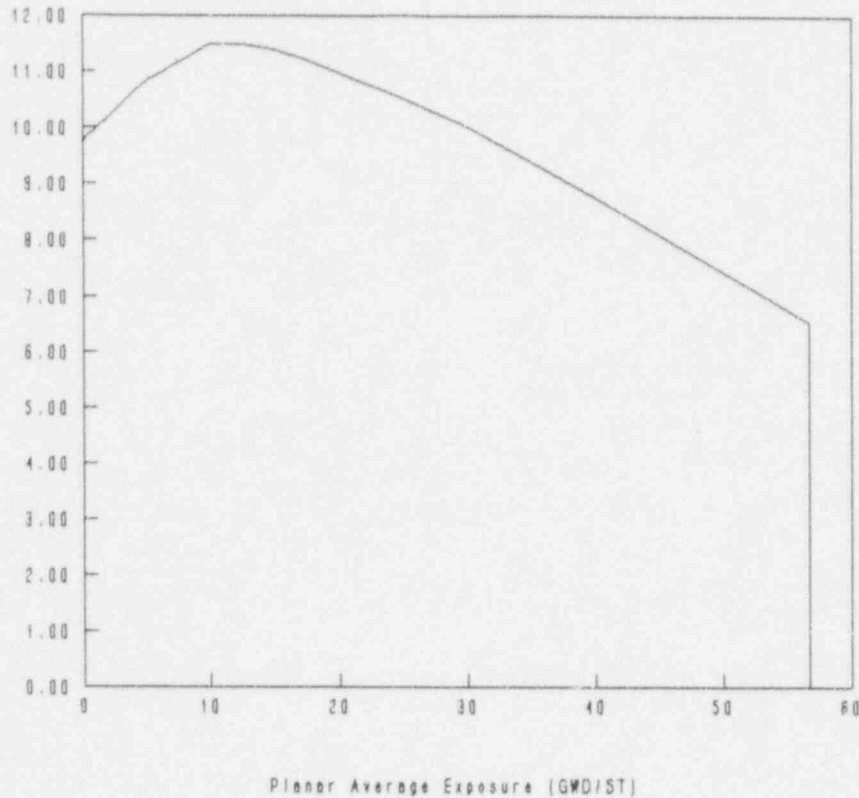


*The ATRIUM-10A bundles will be monitored as a GE11-P9HUB356-15GZ-100M-146-T bundle. Operation to the limiting MAPLHGR for the GE11 bundle assures this bundle will remain within LHGR limits, see Reference 3.10.

This curve represents the limiting exposure dependent MAPLHGR values per Reference 3.11.

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

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



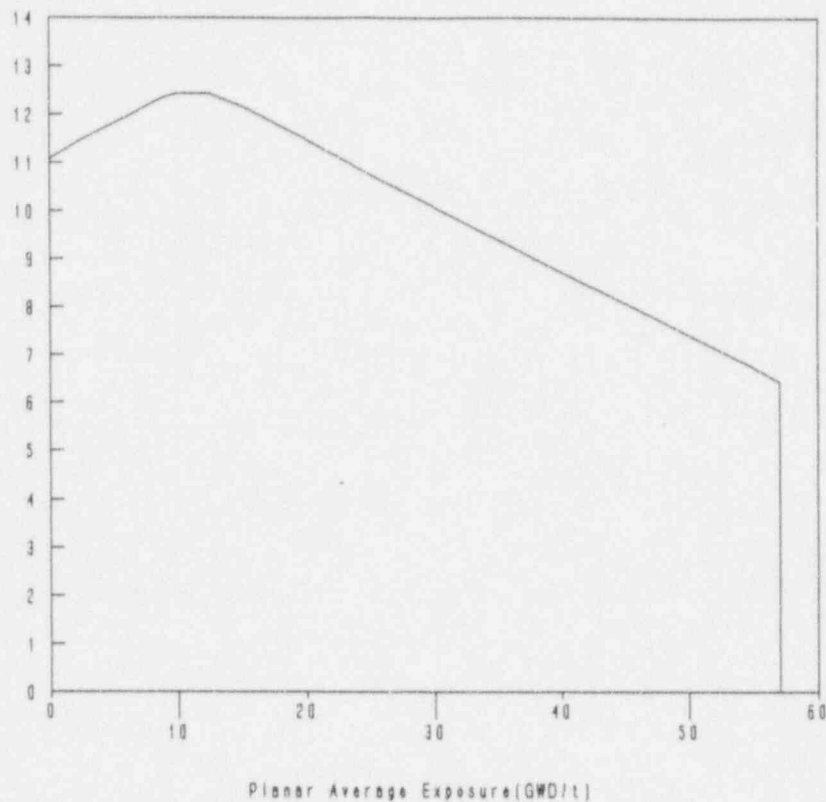
This curve represents the limiting exposure dependent MAPLHGR values per Reference 3.11.

Technical Specification Reference: 3.5.H

Reference: 23A7114 Rev 1

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

FIGURE 8.3.e
MAPLHGR Versus Planar Average Exposure:
GE11-P9HUB380-12GZ5-100M-146-T



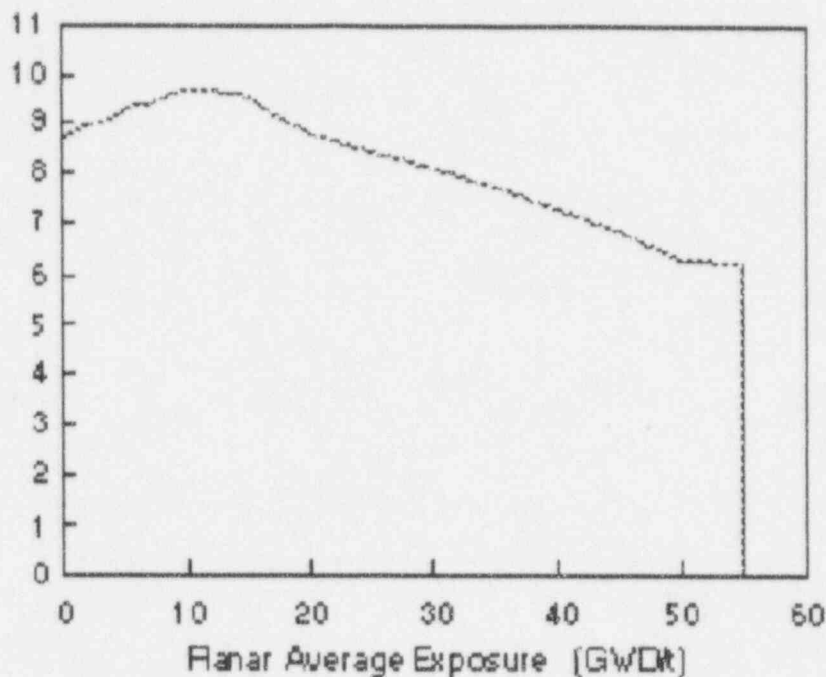
This curve represents the limiting exposure dependent MAPLHGR values per Reference 3.11.

Technical Specification Reference: 3.5.H

Reference: 24A5167 Rev 0

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

FIGURE 8.3.f
MAPLHGR Versus Planar Average Exposure:
GE12-P10DSB417-15GZ-100T-150-T



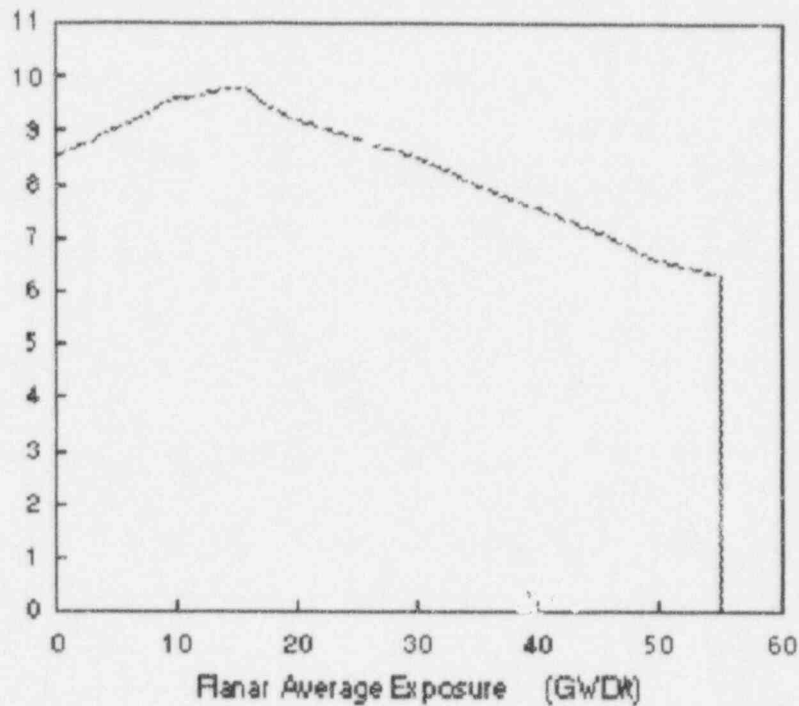
This curve represents the limiting exposure dependent MAPLHGR values per Reference 3.11.

Technical Specification Reference: 3.5.H

Reference: NEDC-31317P

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

FIGURE 8.3.g
MAPLHGR Versus Planar Average Exposure:
GE12-P10DSB412-17GZ-100T-150-T



This curve represents the limiting exposure dependent MAPLHGR values per Reference 3.11.

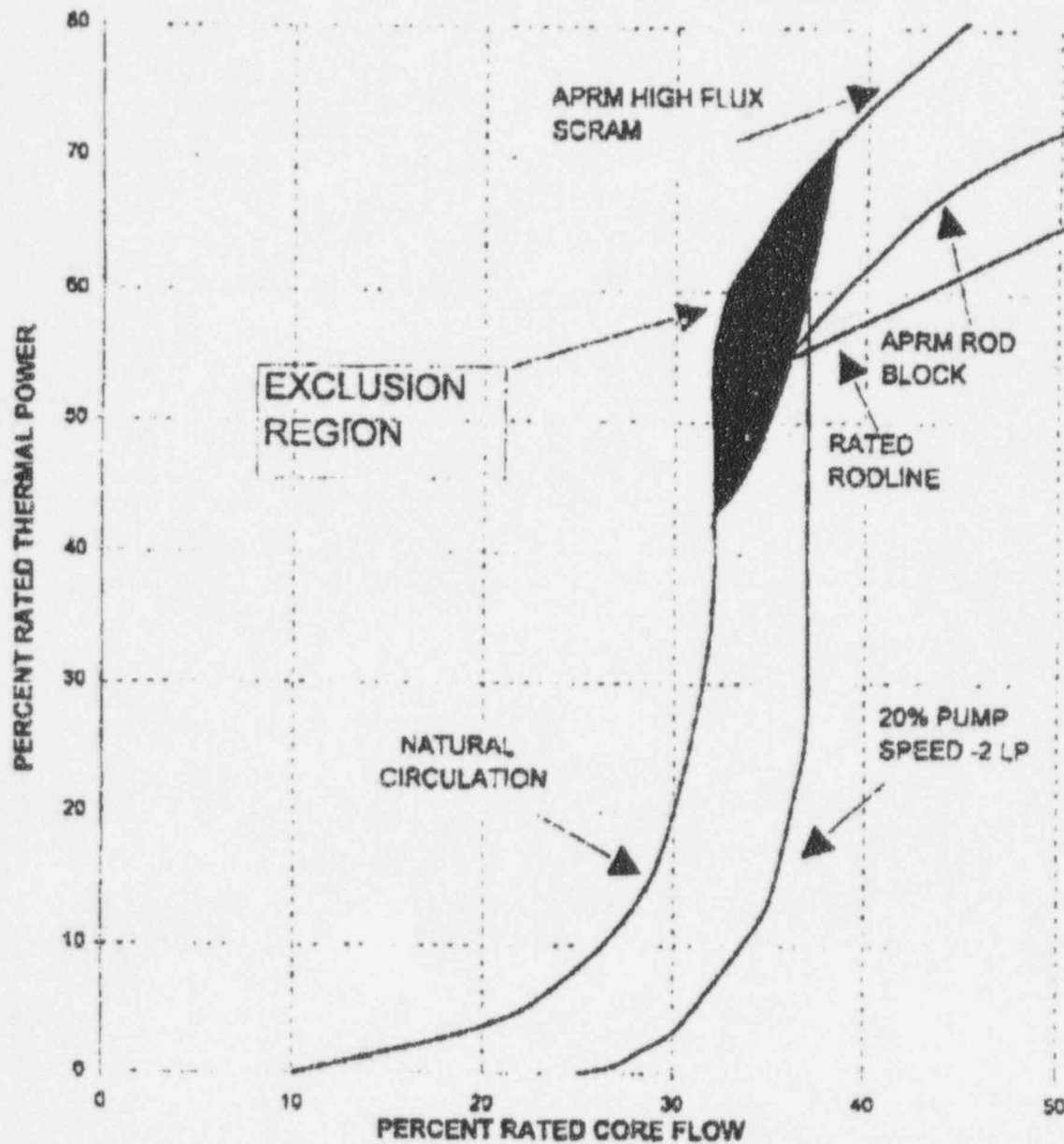
Technical Specification Reference: 3.5.H

Reference: NEDC-31317P

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

Figure 8.4

Stability Option ID Exclusion Region



Technical Specification Reference 3.5.J
Reference J11-02914SRL Rev.0

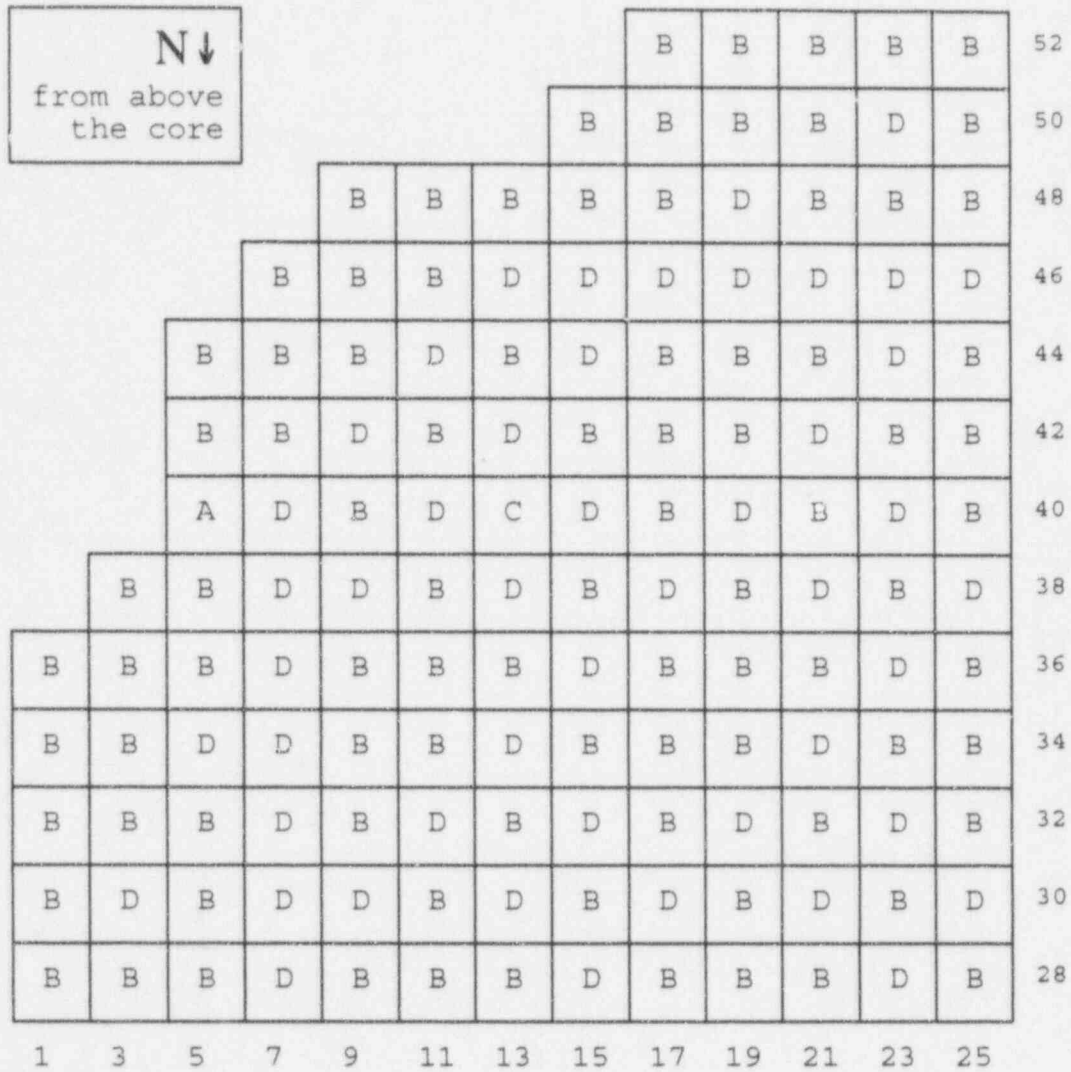
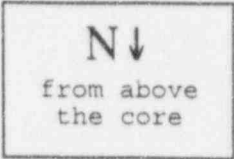


FIGURE 8.5.a
 CYCLE 13 LOADING PATTERN, UPPER LEFT QUADRANT, BUNDLE DESIGN

A = GE8x8NB-3
 B = GE11
 C = ATRIUM - 10A
 D = GE12



A = GE8x8NB-3
B = GE11
C = ATRIUM - 10A
D = GE12

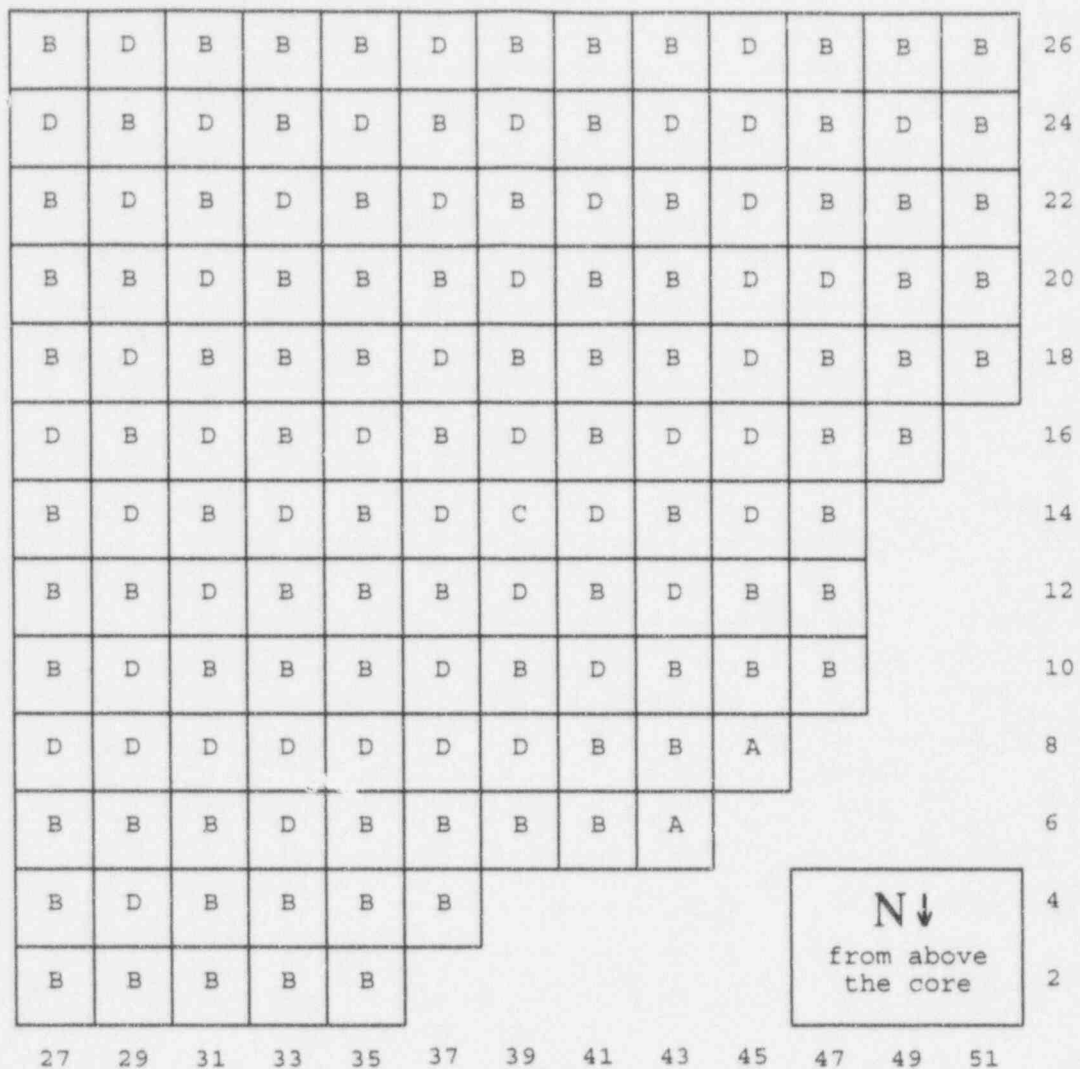


FIGURE 8.5.c
CYCLE 13 LOADING PATTERN, LOWER RIGHT QUADRANT, BUNDLE DESIGN

A = GE8x8NB-3
B = GE11
C = ATRIUM - 10A
D = GE12

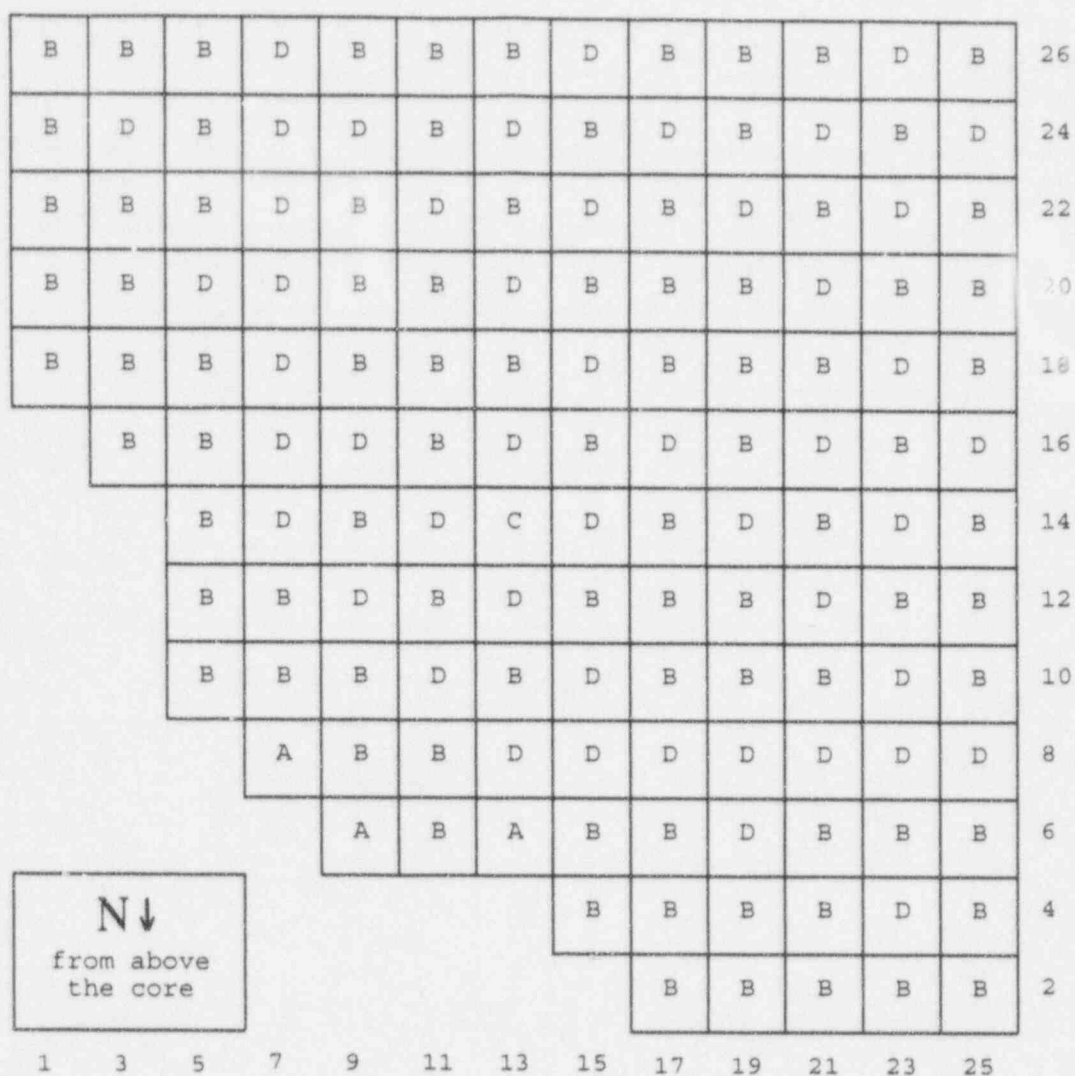


FIGURE 8.5.d
CYCLE 13 LOADING PATTERN, LOWER LEFT QUADRANT, BUNDLE DESIGN

A = GE8x8NB-3
B = GE11
C = ATRIUM - 10A
D = GE12