(CYCLE 11)

APPROVED: [signature] FOR SSW 22 NOV 96
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Operations Review Committee Date

APPROVED: [signature] for JAS 12/2/96
Plant Department Manager Date

APPROVED: [signature] 12/4/96
Station Director Date

TABLE OF CONTENTS

RECORD OF REVISIONS

Revision	Effective Date	Description
8A	Effective date based on issuance of license amendment by NRC	Applicable for use during Cycle 8 Operation
9A	Effective date based on issuance of license amendment by NRC for ARTS and SAFER/GESTR	Applicable for use during Cycle 9 operation
10A	Effective date based on initial startup of Cycle 10	Applicable for use during Cycle 10 Operation
11A	Effective date based on initial startup of Cycle 11	Applicable for use during Cycle 11 Operation
11B	Effective upon final approval	Applicable for use during Cycle 11 Operation
11C	Effective upon final approval	Applicable for use during Cycle 11 Operation
11D	Effective upon final approval	Applicable for use during Cycle 11 Operation

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

This report provides the cycle-specific limits for operation of the Pilgrim Nuclear Power Station (PNPS) during Cycle 11. In this report, Cycle 11 will frequently be referred to as the present cycle.

Although this report is not part of the PNPS Technical Specifications, the Technical Specifications refer to this report for the applicable values of the following fuel-related parameters:

	Reference Technical Specification
APRM Flux Scram Trip Setting (Run Mode)	Table 3.1.1
APRM Rod Block Trip Setting (Run Mode)	Table 3.2.C-2
Rod Block Monitor Trip Setting	Table 3.2.C-2
Average Planar Linear Heat Generation Rate	3.11.A
Linear Heat Generation Rate (LHGR)	3.11.B
Minimum Critical Power Ratio (MCPR)	3.11.C
Power/Flow Relationship	3.11.D
Reactor Vessel Core Design	5.2

If any of the core operating limits in this report are exceeded, actions will be taken as defined in the referenced Technical Specification.

The core operating limits in this report have been established for the present cycle using the NRC-approved methodology provided in the documents listed both in Section 5.0, References, and in Technical Specification 6.9.A.4. These limits are established such that the applicable limits of the plant safety analysis are met.

2.0 INSTRUMENTATION TRIP SETTINGS:

2.1 APRM Flux Scram Trip Setting (Run Mode)

Reference Technical Specifications: Table 3.1.1, 3.1.B.1

When the mode switch is in the run position, the average power range monitor (APRM) flux scram trip setting (S_s) shall be:

$$S_s \leq 0.66\ W + 69\%$$

with a clamp at 120% of rated core thermal power and

S_s = APRM flux scram trip setting in percent of rated thermal power (1998 MW_t).

W = Percent of drive flow required to produce a rated core flow of 69 Mlb/hr.

The APRM flux scram trip setting is valid only for operation using two recirculation loops. Operation with one recirculation loop out of service is restricted by License Condition 3.E.

In accordance with Technical Specification Table 3.1.1, Note 15, for no combination of loop recirculation flow rate and core thermal power shall the APRM flux scram trip setting be allowed to exceed 120% of rated thermal power.

2.2 APRM Rod Block Trip Setting (Run Mode)

Reference Technical Specifications: Table 3.2.C-2, 3.1.B.1

When the mode switch is in the run position, the average power range monitor (APRM) rod block trip setting (S_{RB}) shall be:

$$S_{RB} \leq 0.66\ W + 62\%$$

with a clamp at 115% of rated core thermal power and

S_{RB} = APRM rod block trip setting in percent of rated thermal power (1998 MW_t).

W = Percent of drive flow required to produce a rated core flow of 69 Mlb/hr.

2.2 APRM Rod Block Trip Setting (Run Mode) (Continued)

The APRM rod block trip setting is valid only for operation using two recirculation loops. Operation with one recirculation loop out of service is restricted by License Condition 3.E.

2.3 Rod Block Monitor Trip Setting

Reference Technical Specification: Table 3.2.C-2

Allowable values for the power-dependent Rod Block Monitor trip setpoints shall be:

Reactor Power, P (% of Rated)	Trip Setpoint (% of Reference Level)
$P \leq 25.9$	Not applicable (All RBM Trips Bypassed)
$25.9 < P \leq 62.0$	120
$62.0 < P \leq 82.0$	115
$82.0 < P$	110

The allowable value for the RBM downscale trip setpoint shall be ≥ 94.0% of the reference level. The RBM downscale trip is bypassed for reactor power ≤ 25.9% of rated.

3.0 CORE OPERATING LIMITS

3.1 Average Planar Linear Heat Generation Rate (APLHGR)

Reference Technical Specification: 3.11.A

During power operation, APLHGR for each fuel type as a function of axial location and average planar exposure shall not exceed the applicable limiting value. The applicable limiting value for each fuel type is the smaller of the flow- and power-dependent APLHGR limits, $MAPLHGR_F$ and $MAPLHGR_P$. The flow-dependent APLHGR limit, $MAPLHGR_F$, is the product of the MAPLHGR flow factor, $MAPFAC_F$, shown in Figure 3.1-5 and the MAPLHGR for rated power and flow conditions. The power-dependent APLHGR limit, $MAPLHGR_P$, is the product of the MAPLHGR power factor, $MAPFAC_P$, shown in Figure 3.1-6 and the MAPLHGR for rated power and flow conditions. The MAPLHGR for rated power and flow conditions for each fuel type as a function of axial location and average planar exposure are based on the approved methodology referenced in Section 5.0 and programmed in the plant process computer. The MAPLHGR for rated power and flow conditions for the limiting lattice in each fuel type (excluding natural uranium) are presented in Figures 3.1-1 through 3.1-4.

The core loading pattern for each type of fuel in the reactor vessel is shown for the present cycle in Figure 4.0-1.

3.2 Linear Heat Generation Rage (LHGR)

Reference Technical Specification: 3.11.B

During reactor power operation, the LHGR of any rod in any fuel assembly at any axial location shall not exceed the limits presented in Table 3.2-1.

Table 3.2-1

LHGR Operating Limits

Fuel Type	LHGR Operating Limit (KW/ft)
BP8DRB300	13.4
BP8DQB323	14.4
BP8HXB355	14.4
BP9HUB378	14.4

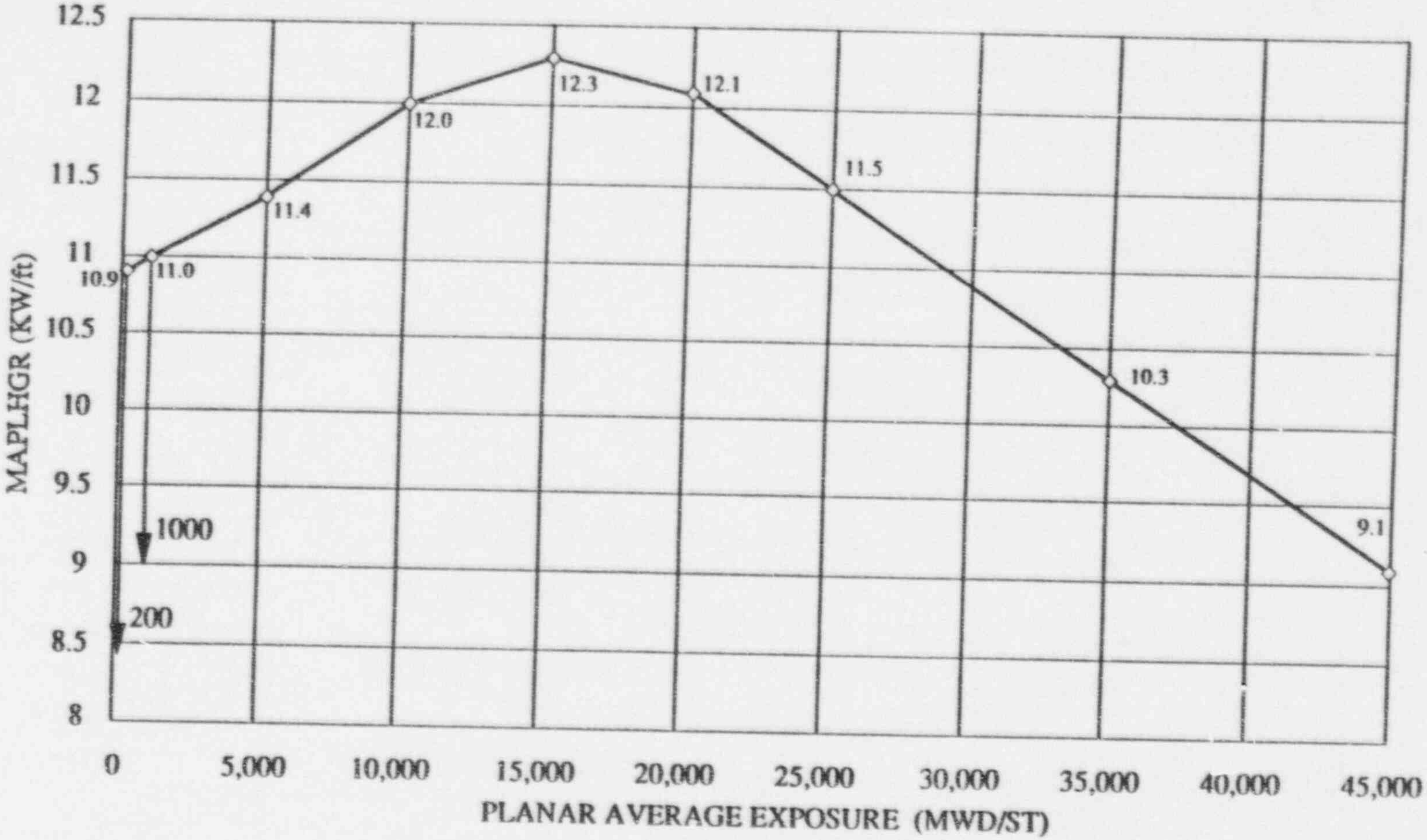


FIGURE 3.1-1

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) for Fuel Type BP8DRB300

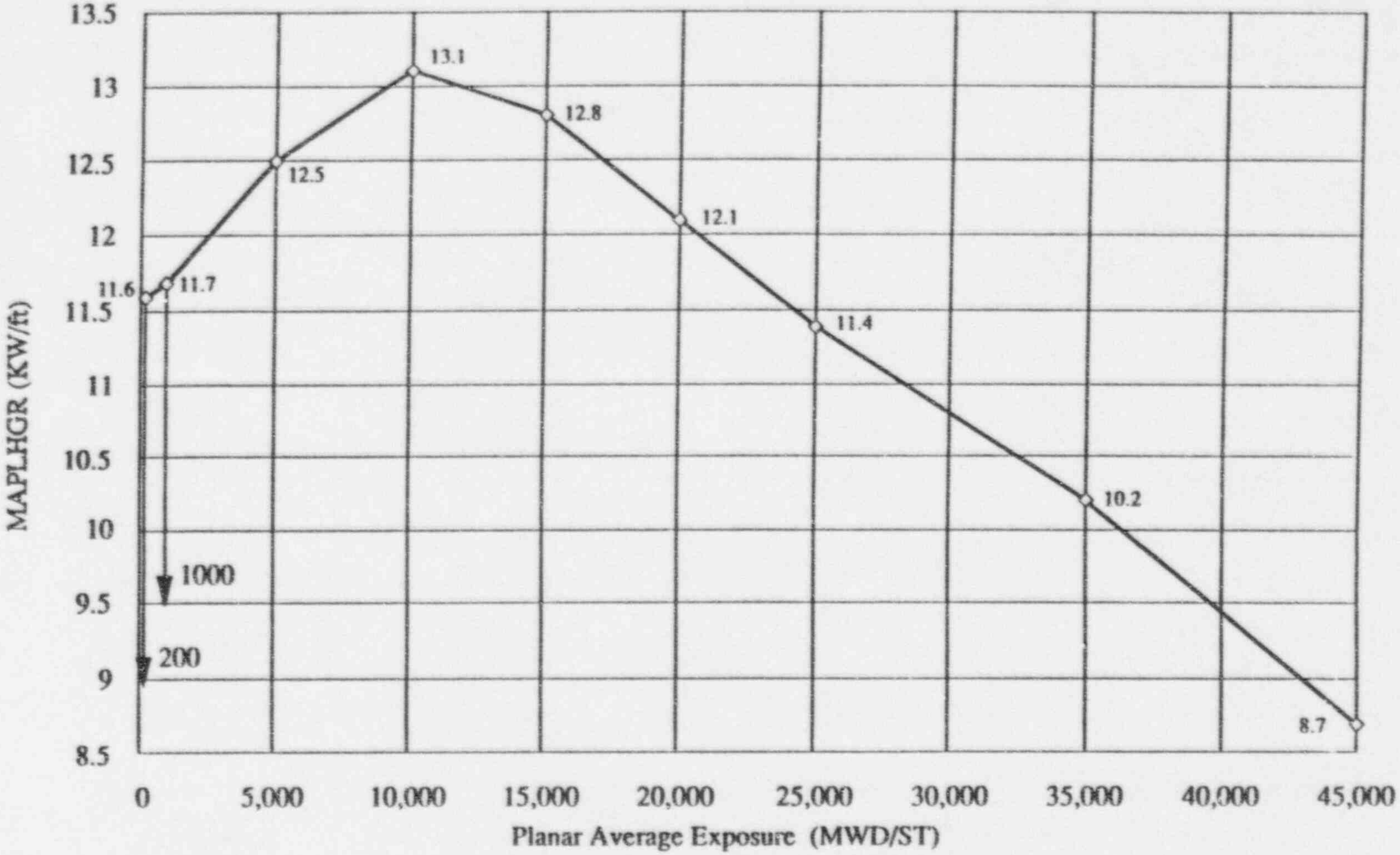


FIGURE 3.1-2

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) for Fuel Type BP8DQB323

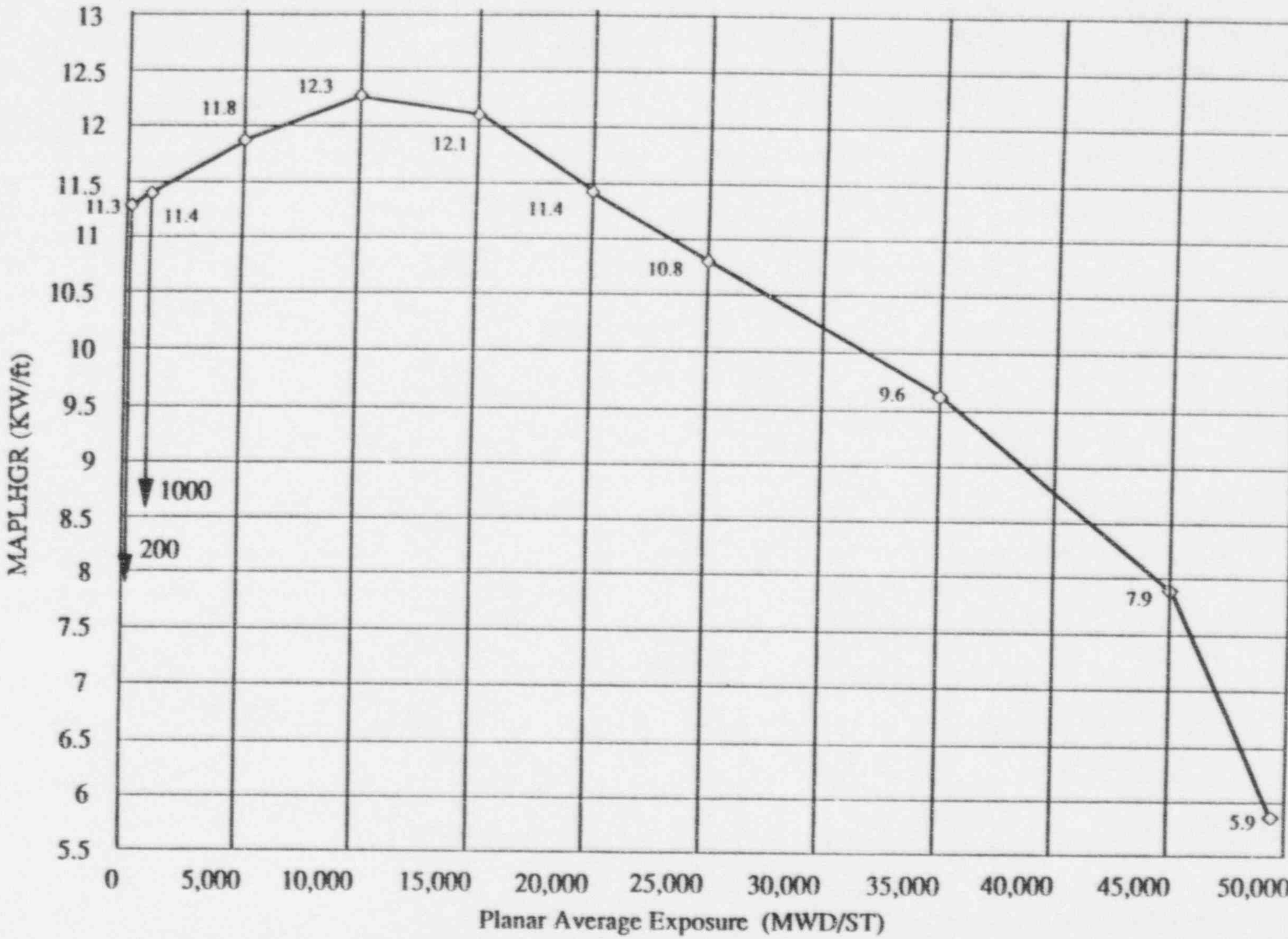


FIGURE 3.1-3: Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) for Fuel Type BP8HXB355

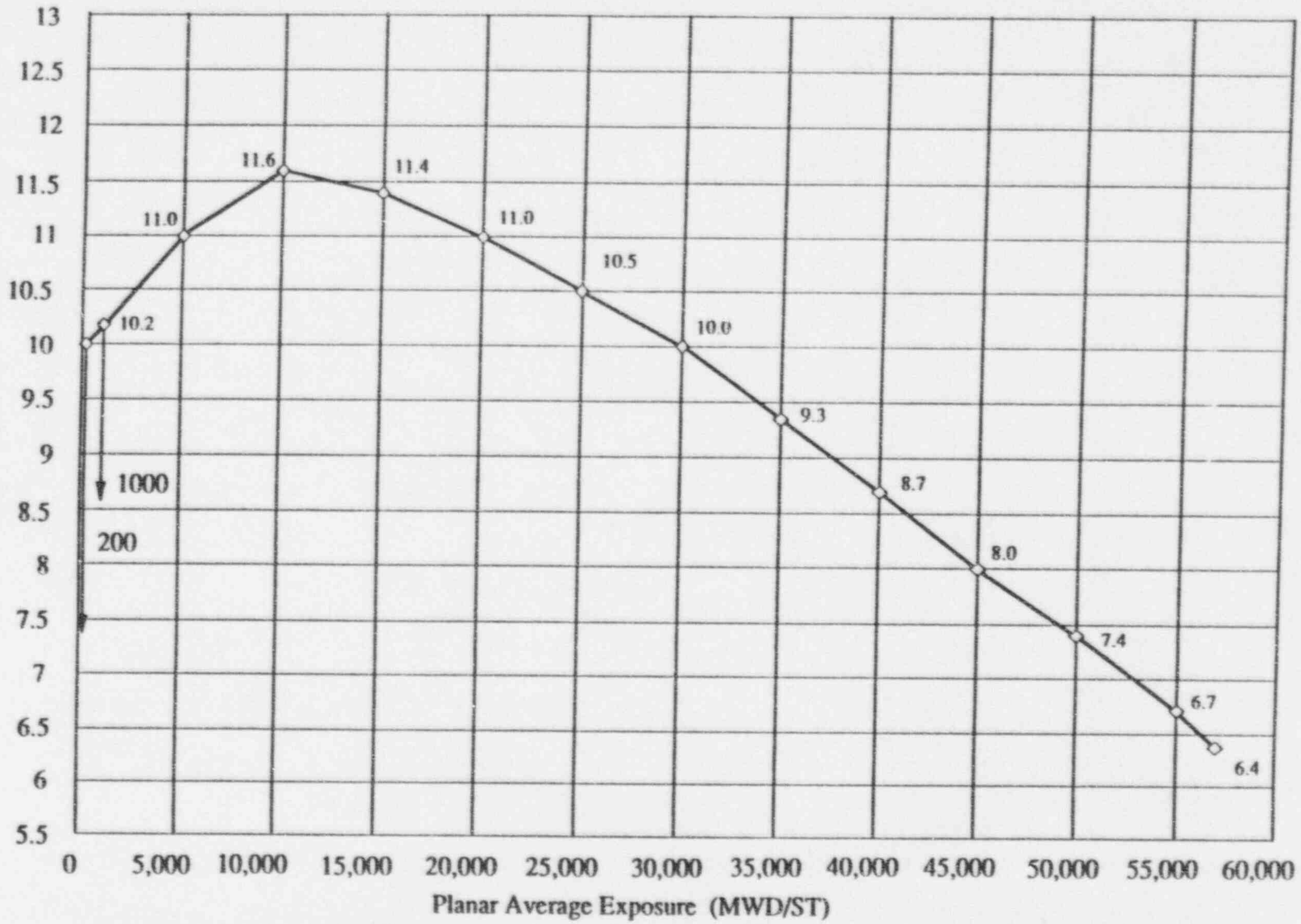


FIGURE 3.1-4: Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) for Fuel Type BP9HUB378

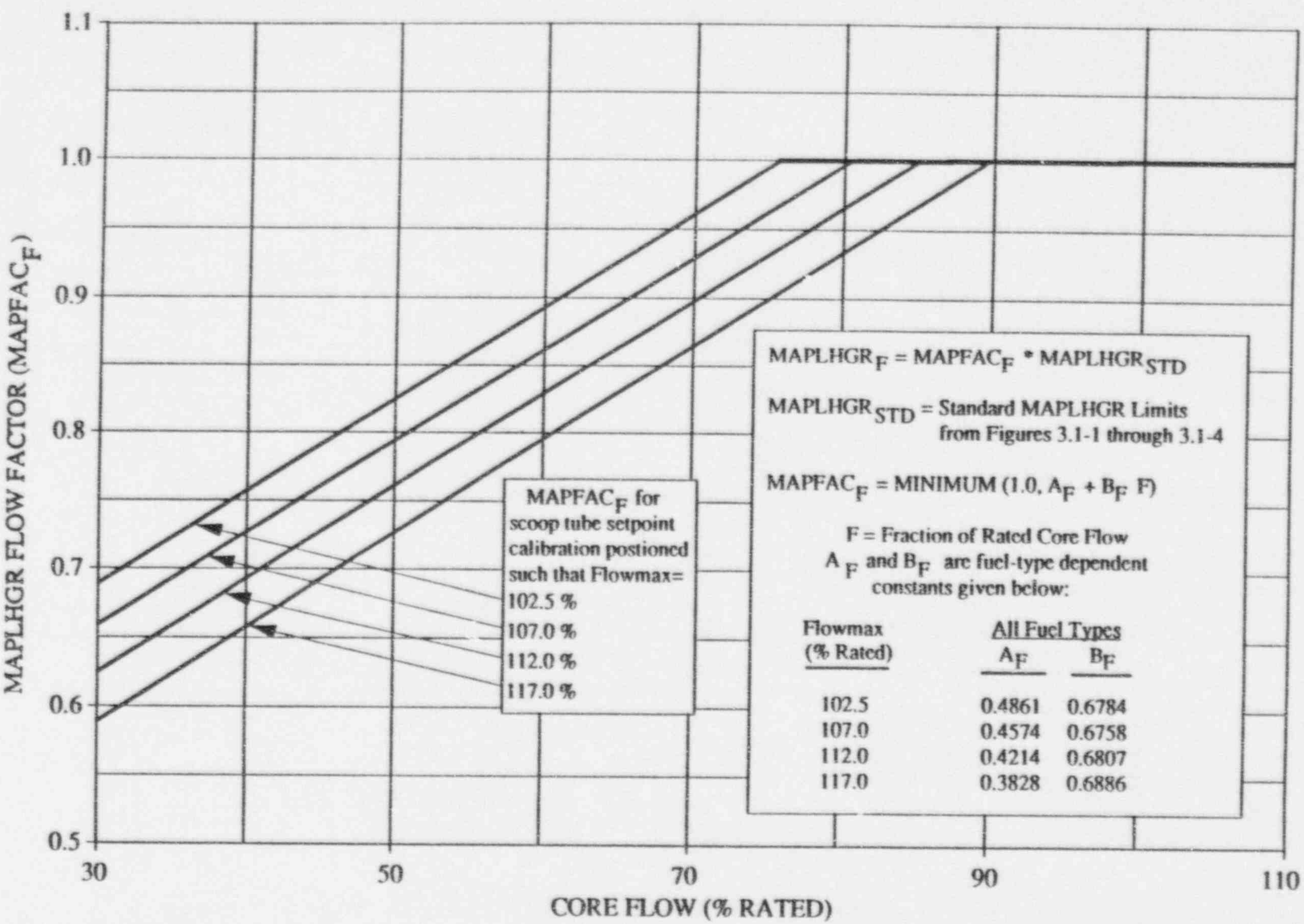


FIGURE 3.1-5

Flow Dependent MAPLHGR Factor (MAPFAC$_F$)

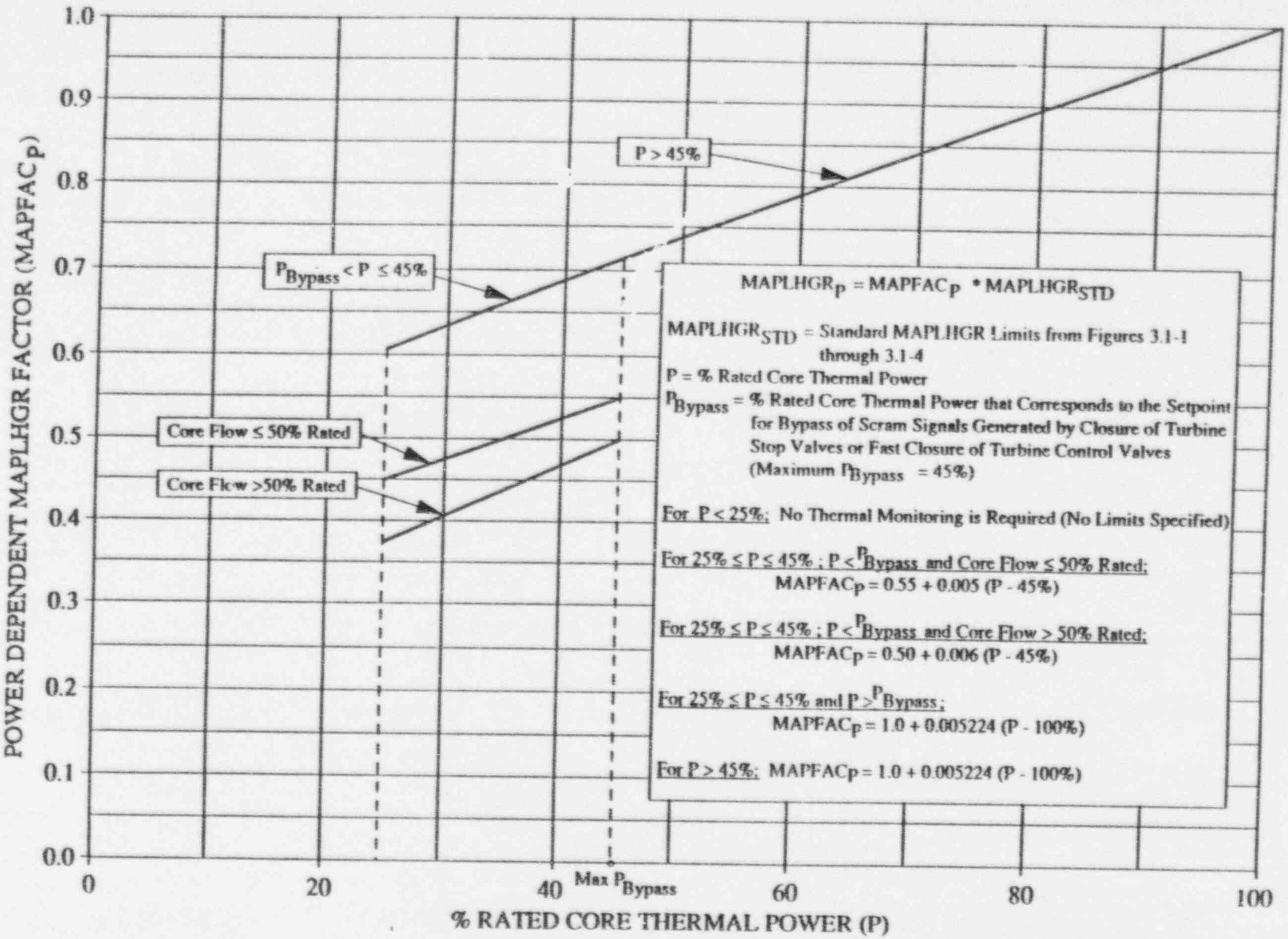


FIGURE 3.1-6
Power Dependent MAPLHGR Factor ($MAPFAC_P$)

3.3 Minimum Critical Power Ratio (MCPR)

Reference Technical Specification: 3.11.C

During power operation, the MCPR shall be greater than or equal to the operating limit MCPR. The operating limit MCPR is the greater of the flow- and power-dependent MCPR operating limits, $MCPR_F$ and $MCPR_P$. The flow-dependent MCPR operating limit, $MCPR_F$, is provided in Figure 3.3-1. For core thermal powers less than or equal to P_{Bypass}, the power-dependent MCPR operating limit, $MCPR_P$, is provided in Figure 3.3-2. Above P_{Bypass}, $MCPR_P$ is the product of the rated power and flow MCPR operating limit presented in Tables 3.3-1, 3.3-2 and 3.3-3, and the K_P factor presented in Figure 3.3-2. Figure 3.3-2 also specifies the maximum value for P_{Bypass}. The rated power and flow MCPR operating limits presented in Tables 3.3-1 and 3.3-2 are functions of τ for the indicated MOC and EOC cycle exposures. The rated power and flow MCPR operating limits presented in Table 3.3-3 are functions of τ for EOC exposures and a final feedwater temperature reduction of up to 75°F.

The value of τ in Tables 3.3-1 and 3.3-2 shall be equal to 1.0, unless it is calculated from the results of the surveillance testing of Technical Specification 4.3.C, as follows:

$$\tau = \frac{\tau_{ave} - \tau_B}{1.252 - \tau_B}$$

Where:

τ_{ave} = Average scram time to drop out of Notch 34

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

τ_B = Adjusted analysis mean scram time

$$= \mu + 1.65\sigma \sqrt{\frac{N_1}{\sum_{i=1}^{n} N_i}}$$

3.3 Minimum Critical Power Ratio (MCPR) (Continued)

n	=	Number of surveillance tests performed to date in the present cycle
N_1	=	Total number of active control rods
N_i	=	Number of active control rods measured in the i^{th} surveillance test
τ_i	=	Average scram time to drop out of Notch 34 position of all rods measured in the i^{th} surveillance test
μ	=	Mean of the distribution for average scram insertion time to drop out of Notch 34
	=	0.937 sec
σ	=	Standard deviation of the distribution for average scram insertion time to dropout of Notch 34
	=	0.021 sec

Table 3.3-1

MOC MCPR Operating Limits

The MCPR operating limits (OLMCPR) for operation from the Beginning of Cycle (BOC) to the End of Cycle (EOC) - 5250 MWD/ST as a function of τ and core flow are:

	OLMCPR (τ)	
τ	Core Flow ≤102% Rated	102% Rated < Core Flow ≤107.5% Rated
τ ≤ 1.0	1.40	1.45

Table 3.3-2

EOC MCPR Operating Limits

The MCPR operating limits (OLMCPR) as a function of τ for operation from the End of Cycle (EOC) - 5250 MWD/ST to the EOC with core flow ≤107.5% of rated are:

τ	OLMCPR (τ)
τ ≤ 0.0	1.39
0.0 < τ ≤ 0.1	1.40
0.1 < τ ≤ 0.2	1.40
0.2 < τ ≤ 0.3	1.41
0.3 < τ ≤ 0.4	1.41
0.4 < τ ≤ 0.5	1.42
0.5 < τ ≤ 0.6	1.43
0.6 < τ ≤ 0.7	1.43
0.7 < τ ≤ 0.8	1.44
0.8 < τ ≤ 0.9	1.44
0.9 < τ ≤ 1.0	1.45

Table 3.3-3

EOC MCPR Operating Limits with Feedwater Temperature Reduction

The MCPR operating limits (OLMCPR) as a function of τ for operation from the End of Cycle (EOC) - 5250 MWD/ST to the EOC with core flow ≤107.5% of rated and a feedwater temperature reduction of up to 75°F are:

τ	OLMCPR (τ)
$\tau \leq 0.0$	1.41
$0.0 < \tau \leq 0.1$	1.42
$0.1 < \tau \leq 0.2$	1.42
$0.2 < \tau \leq 0.3$	1.43
$0.3 < \tau \leq 0.4$	1.43
$0.4 < \tau \leq 0.5$	1.44
$0.5 < \tau \leq 0.6$	1.45
$0.6 < \tau \leq 0.7$	1.45
$0.7 < \tau \leq 0.8$	1.46
$0.8 < \tau \leq 0.9$	1.46
$0.9 < \tau \leq 1.0$	1.47

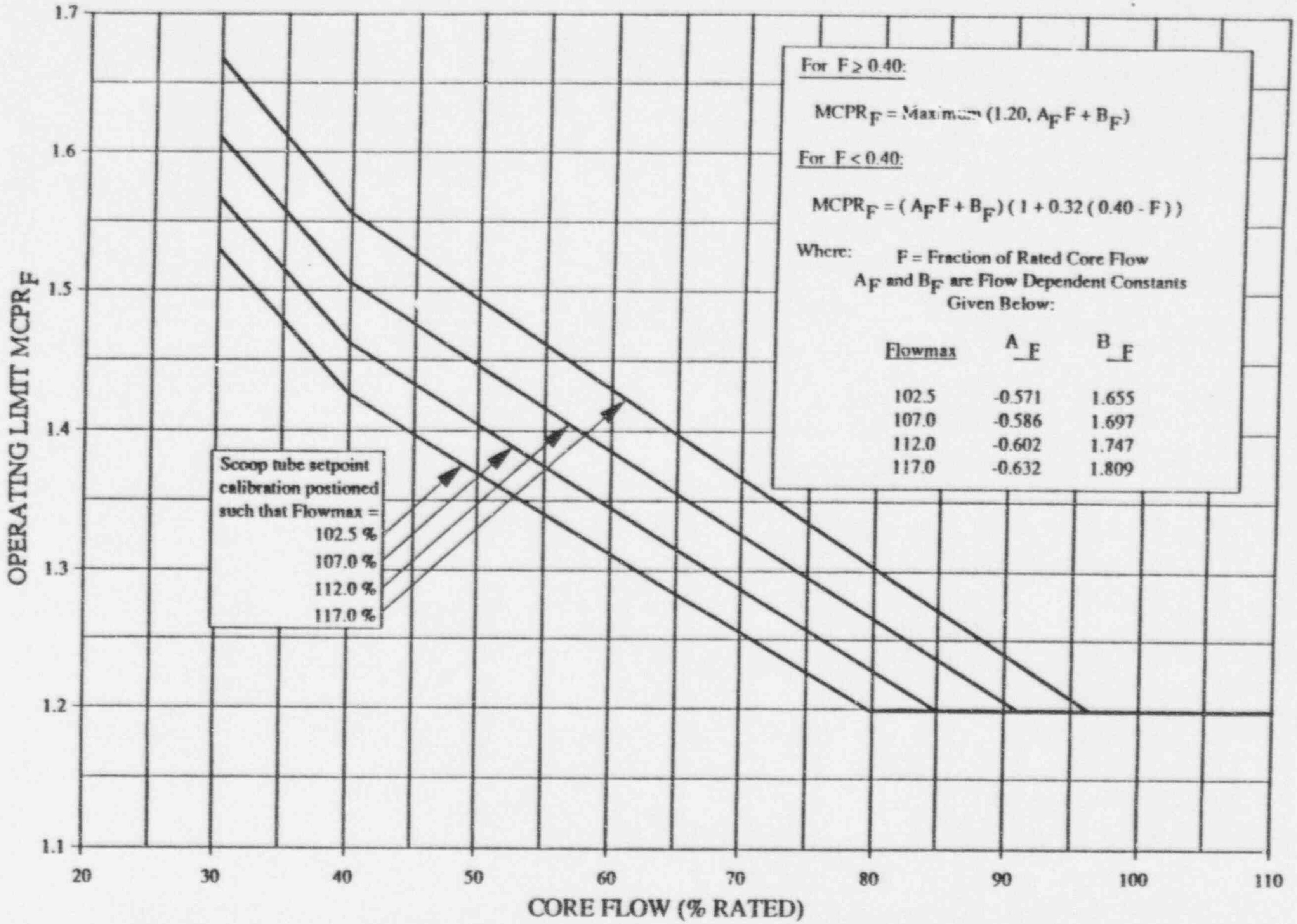


FIGURE 3.3-1
Flow Dependent MCPR Limits ($MCPR_F$)

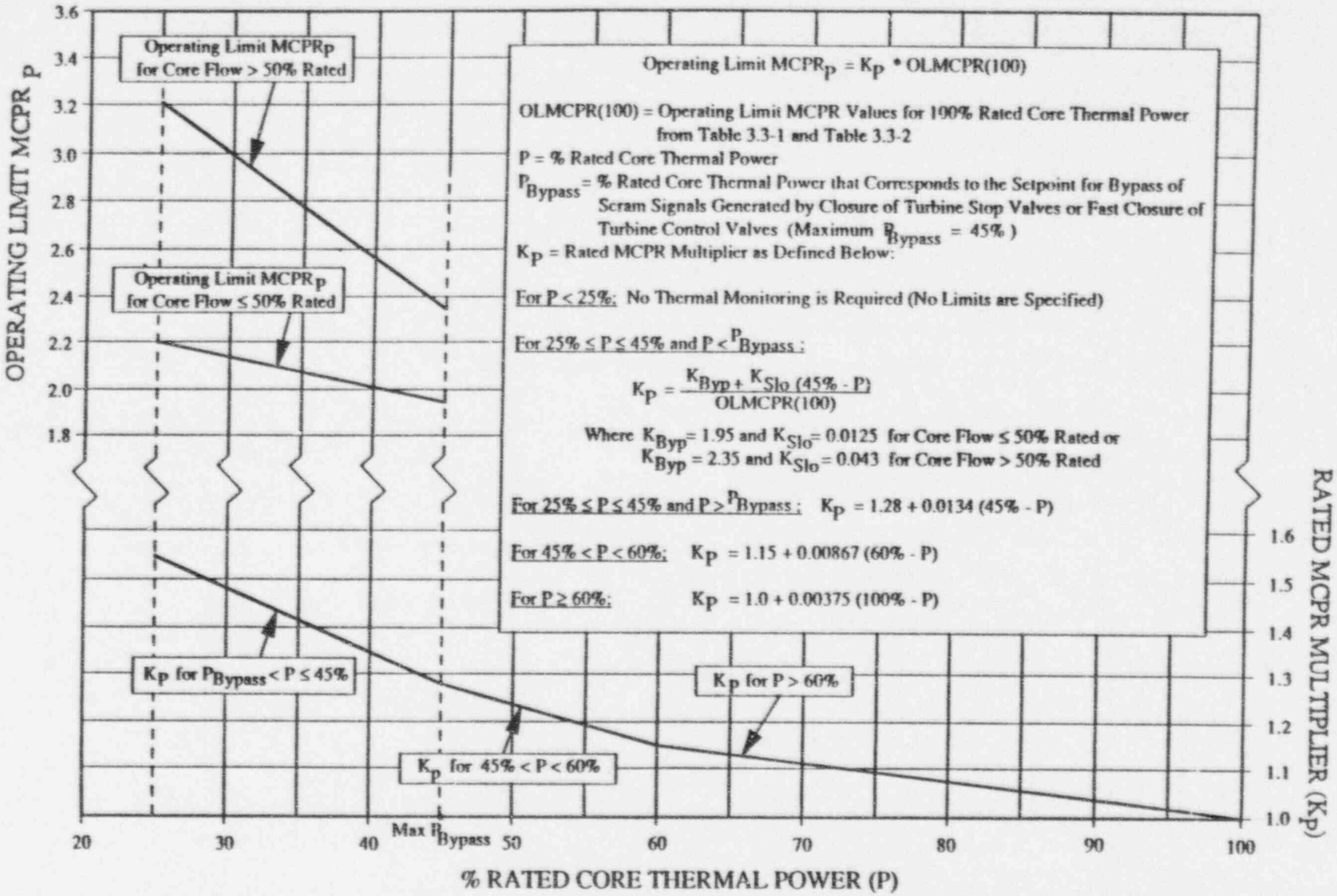


FIGURE 3.3-2
Power Dependent MCPR Limits ($MCPR_P$)

3.4 Power/Flow Relationship During Power Operation

Reference Technical Specification: 3.11.D

The power/flow relationship shall not exceed the limiting values shown on the Power/Flow Operating Map in Figure 3.4-1.

4.0 REACTOR VESSEL CORE DESIGN

Reference Technical Specification: 5.2

The reactor vessel core for the present cycle consists of 580 fuel assemblies of the types listed below. The core loading pattern for each type of fuel is shown for the present cycle in Figure 4.0-1.

Fuel Type	Cycle Loaded	Number
Irradiated		
BP8DRB300	8	136
BP8DQB323	9	168
BP8HXB355	10	140
New		
BP9HUB378	11	136
Total		580

The reactor vessel core contains 145 cruciform-shaped control rods. The control materials used are either boron carbide powder (B_4C) compacted to approximately 70% of the theoretical density or a combination of boron carbide powder and solid hafnium.

5.0 REFERENCES

5.1 NEDE-24011-P-A-10 and NEDE-24011-P-A-10-US, "General Electric Standard Application for Reactor Fuel", February and March, 1991.

5.2 NEDC-31852-P, "Pilgrim Nuclear Power Station SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis", September 1990.

5.3 NEDC-31312-P, "ARTS Improvement Program Analysis for Pilgrim Nuclear Power Station", September 4, 1987.

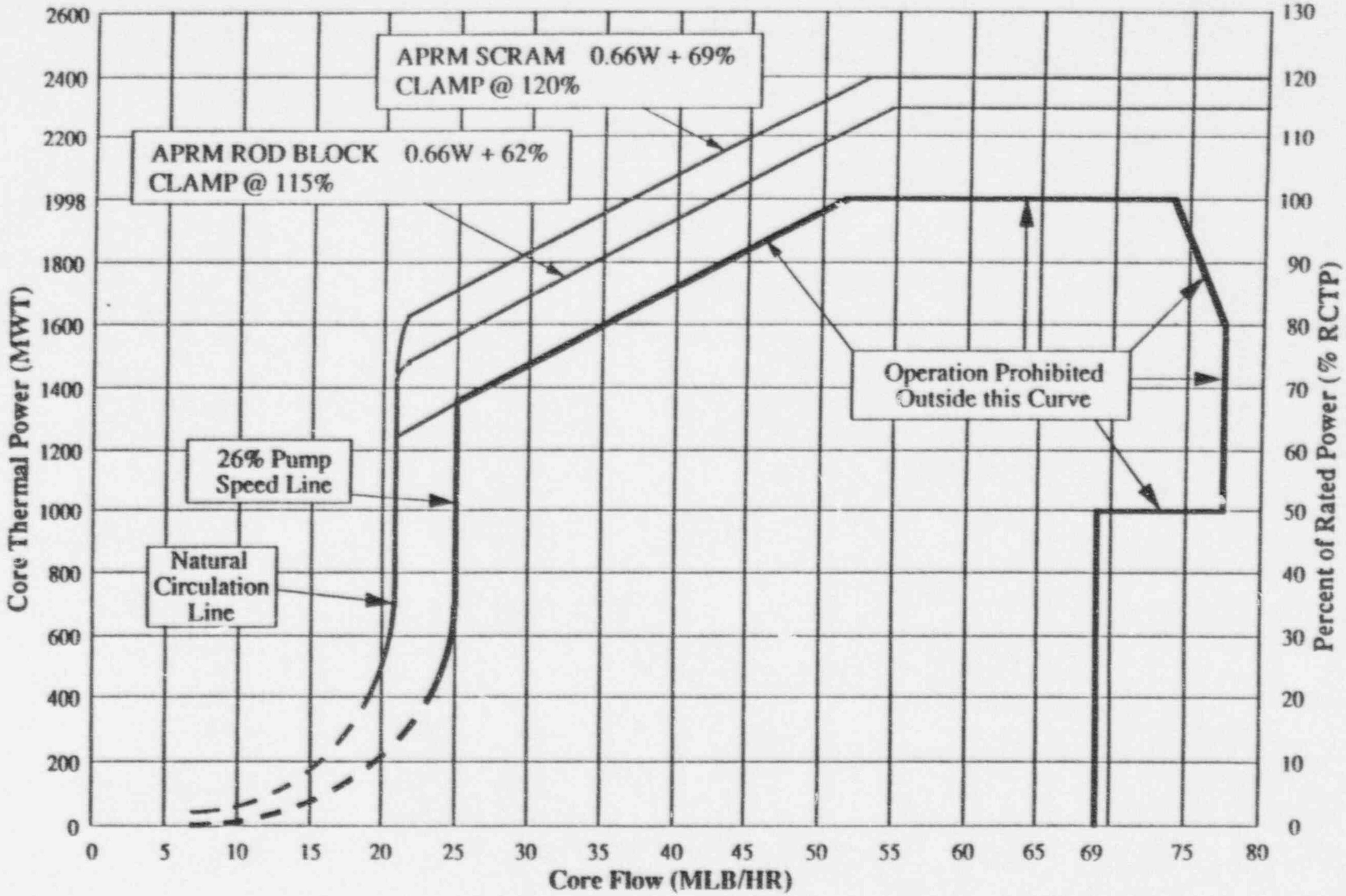
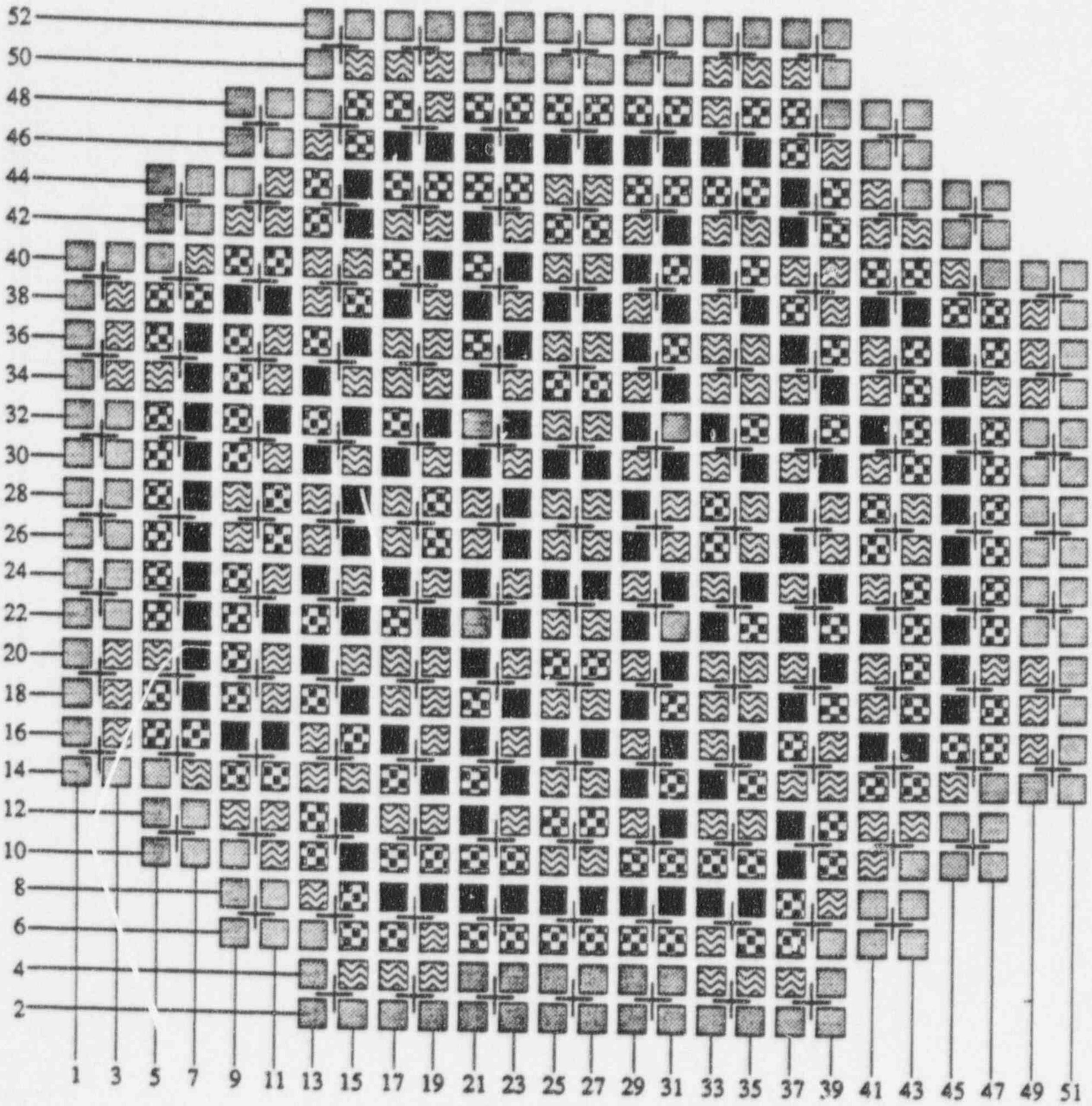


FIGURE 3.4-1
Power/ Flow Operating Map



Fuel Types (Cycle Loaded)	
BP8DRB300 (Cycle 8)	BP8HXB355 (Cycle 10)
BP8DQB323 (Cycle 9)	BP9HUB378 (Cycle 11)

FIGURE 4.0-1

Reactor Vessel Core Loading Pattern