McGuire Nuclear Station COLR

QA CONDITION 1

Duke Power Company
McGuire Unit 2 Cycle 6
Core Operating Limits Report
Revision 0
February 1990

Prepared by: Jim Randle

Checked by: David E. Batz

Approved by: Richard M. Clark

McGuire 2 Cycle 6 Core Operating Limits Report

REVISION LOG

Revision	Effective Date	Effective Pages
Original Issue	March 7, 1990	Pages 1 - 15

McGuire 2 Cycle 6 Core Operating Limits Report

1.0 Core Operating Limits Report

This Core Operating Limits Report (COLR) for McGuire Unit 2 Cycle 6 has been prepared in accordance with the requirements of Technical Specification 6.9.1.9.

The technical specifications affected by this report are listed below:

3/4.1.1.3	Moderator Temperature Coefficient
3/4.1.3.5	Shutdown Rod Insertion Limit
3/4.1.3.6	Control Rod Insertion Limit
3/4.2.1	Axial Flux Difference
3/4.2.2	Heat Flux Hot Channel Factor
3/4.2.3	Reactor Coolant System Flow Rate and Nuclear Enthalpy Rise Hot Channel Factor

McGuire 2 Cycle 6 Core Operating Limits Report

2.0 Operating Limits

The cycle-specific parameter limits for the specifications listed in section 1.0 are presented in the following subsections. These limits have been developed using NRC-approved methodologies specified in Technical Specification 6.9.1.9

2.1 Moderator Temperature Coefficient (Specification 3/4.1.1.3)

2.1.1 The Moderator Temperature Coefficient (MTC) Limits are:

The MTC shall be less positive than the limits shown in Figure 1. (The BOL/ARO/HZP-MTC shall be less positive than 0.7×10^{-4} $\Delta K/K/°F$).

The EOL/ARO/RTP-MTC shall be less negative than -4.1×10^{-4} $\Delta K/K/°F$.

2.1.2 The MTC Surveillance Limit is:

The 300 PPM/ARO/RTP-MTC should be less negative than or equal to -3.2×10^{-4} $\Delta K/K/°F$.

Where: BOL Stands For Beginning Of Cycle Life
ARO Stands For All Rods Out
HZP Stands For Hot Zero THERMAL POWER
EOL Stands For End Of Cycle Life
RTP Stands For RATED THERMAL POWER

McGuire 2 Cycle 6 Core Operating Limits Report

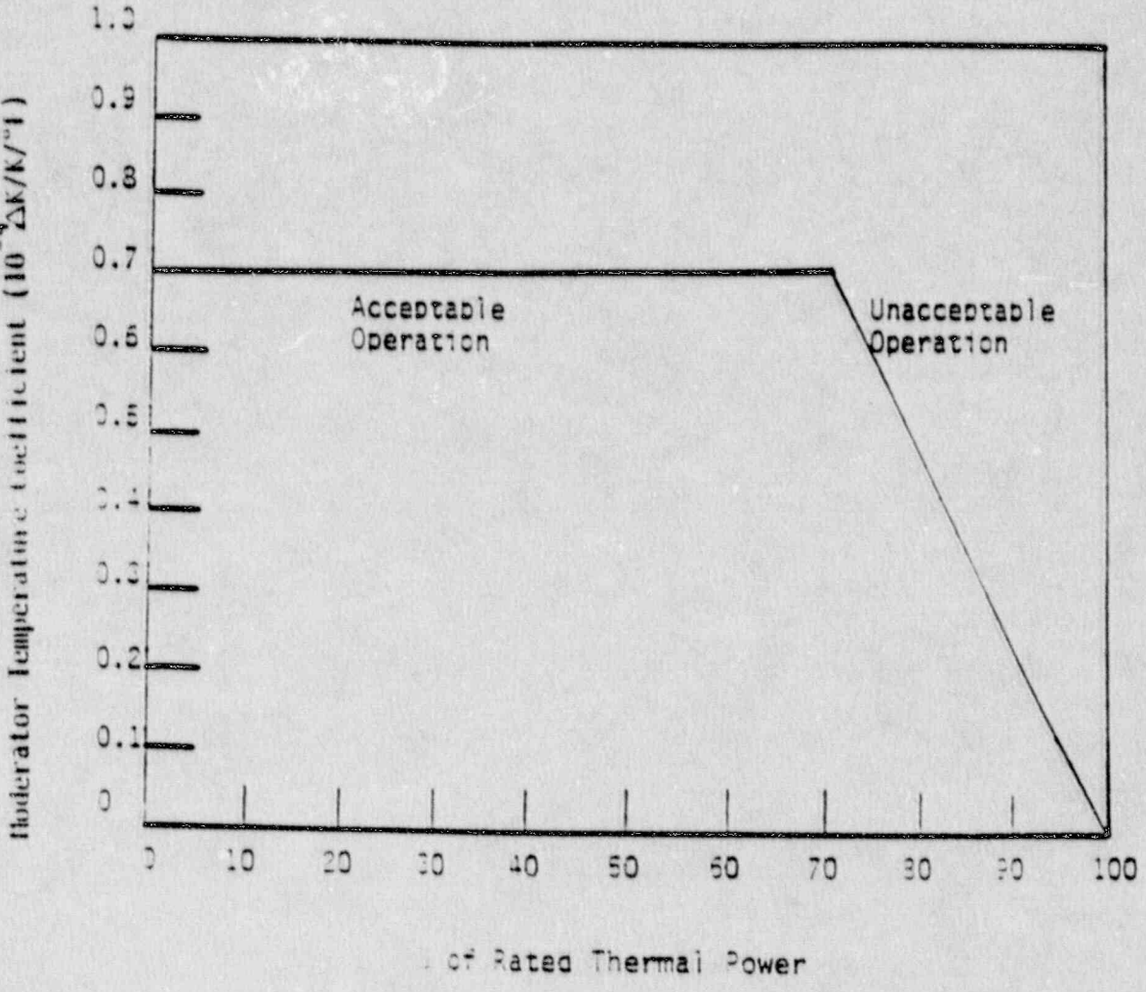


FIGURE 1
MODERATOR TEMPERATURE COEFFICIENT VS. POWER LEVEL

McGuire 2 Cycle 6 Core Operating Limits Report

2.2 Shutdown Rod Insertion Limit (Specification 3/4.1.3.5)

2.2.1 The shutdown rods shall be withdrawn to at least 228 steps.

2.3 Control Rod Insertion Limits (Specification 3/4.1.3.6)

2.3.1 The control rod banks shall be limited in physical insertion as shown in Figure 2.

2.4 Axial Flux Difference (Specification 3/4.2.1)

2.4.1 The AXIAL FLUX DIFFERENCE (AFD) Limits are provided in Figure 3.

2.4.2 The target band during base load operation is not applicable for McGuire 2 Cycle 6.

2.4.3 The minimum allowable power level for Base Load Operation (APL^{ND}) is not applicable for McGuire 2 Cycle 6.

McGuire 2 Cycle 6 Core Operating Limits Report

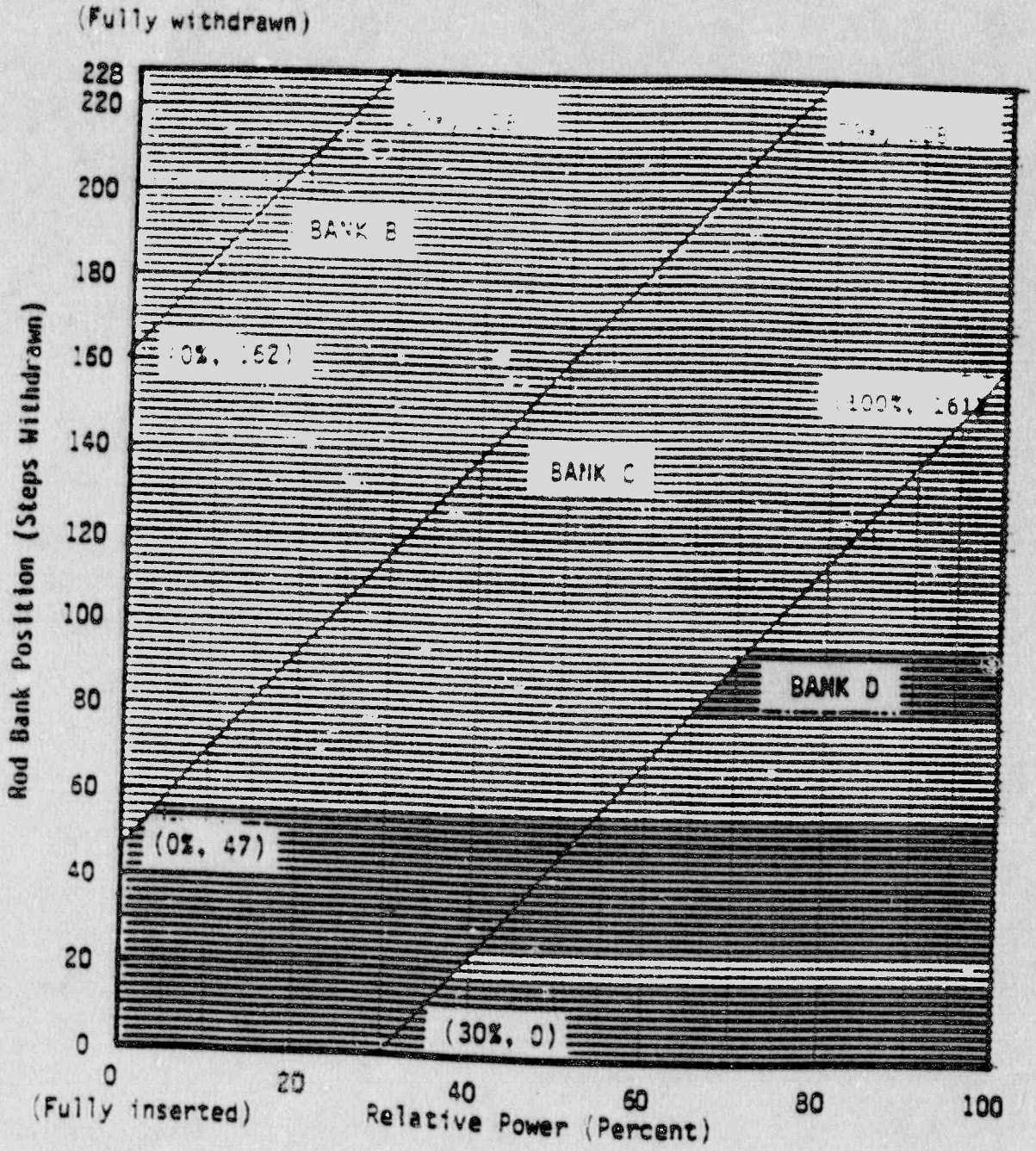


FIGURE 2
Control Rod Bank Insertion Limits
vs. Percent RATED THERMAL POWER

McGuire 2 Cycle 6 Core Operating Limits Report

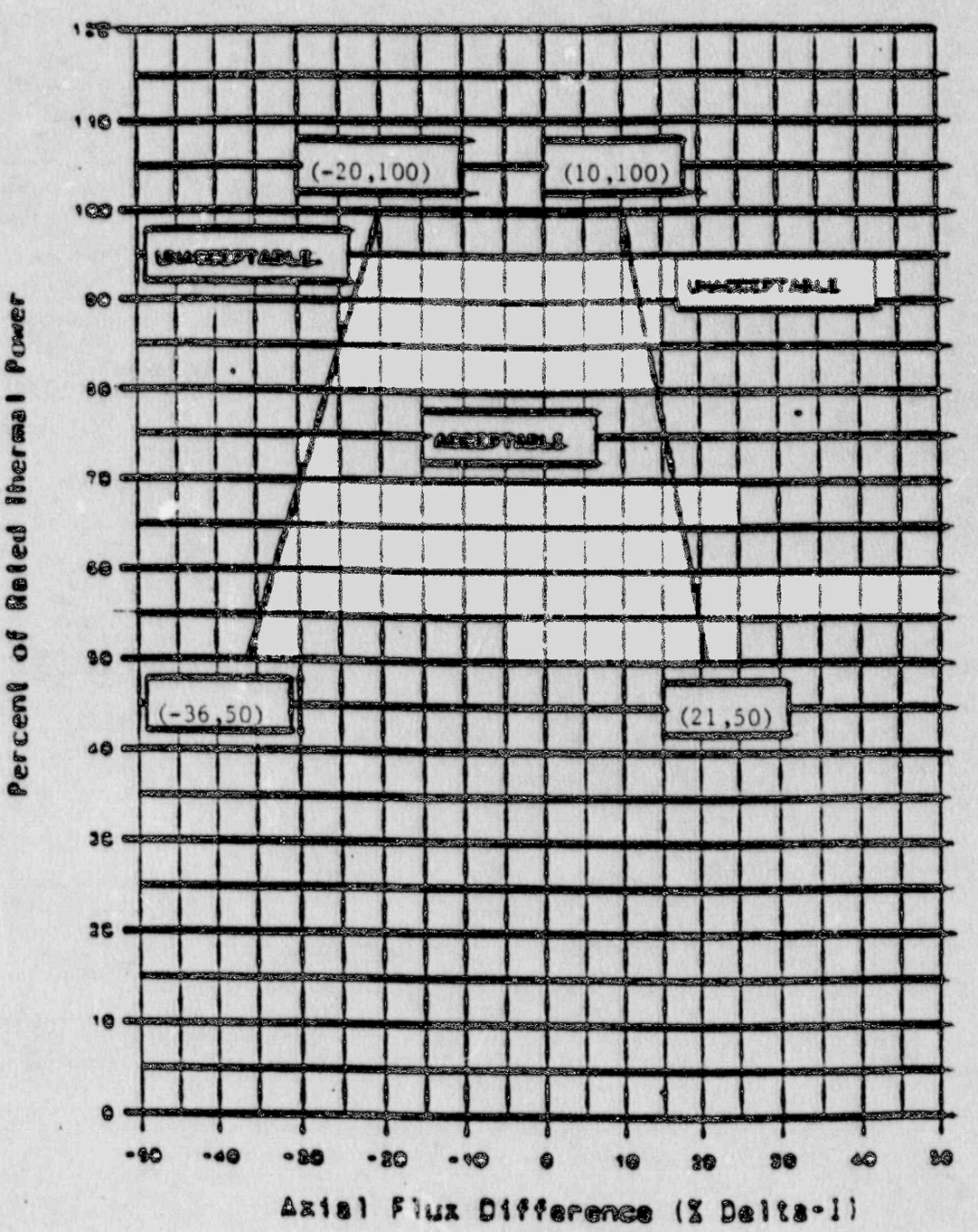


FIGURE 3

Axial Flux Difference Limits As A
Function Of RATED THERMAL POWER

McGuire 2 Cycle 6 Core Operating Limits Report

2.5 Heat Flux Hot Channel Factor - $F_Q(Z)$ (Specification 3/4.2.2)

$$F_Q(Z) \leq \frac{F_Q^{RTP}}{P} * K(Z) \qquad \text{for } P > 0.5$$

$$F_Q(Z) \leq \frac{F_Q^{RTP}}{0.5} * K(Z) \qquad \text{for } P \leq 0.5$$

where $P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$

2.5.1 $F_Q^{RTP} = 2.32$

2.5.2 K(Z) is provided in Figure 4.

2.5.3 W(Z) values are provided in Figures 5 through 7.

2.5.4 Base load W(z)'s are not applicable for McGuire 1 Cycle 7.

McGuire 2 Cycle 6 Core Operating Limits Report

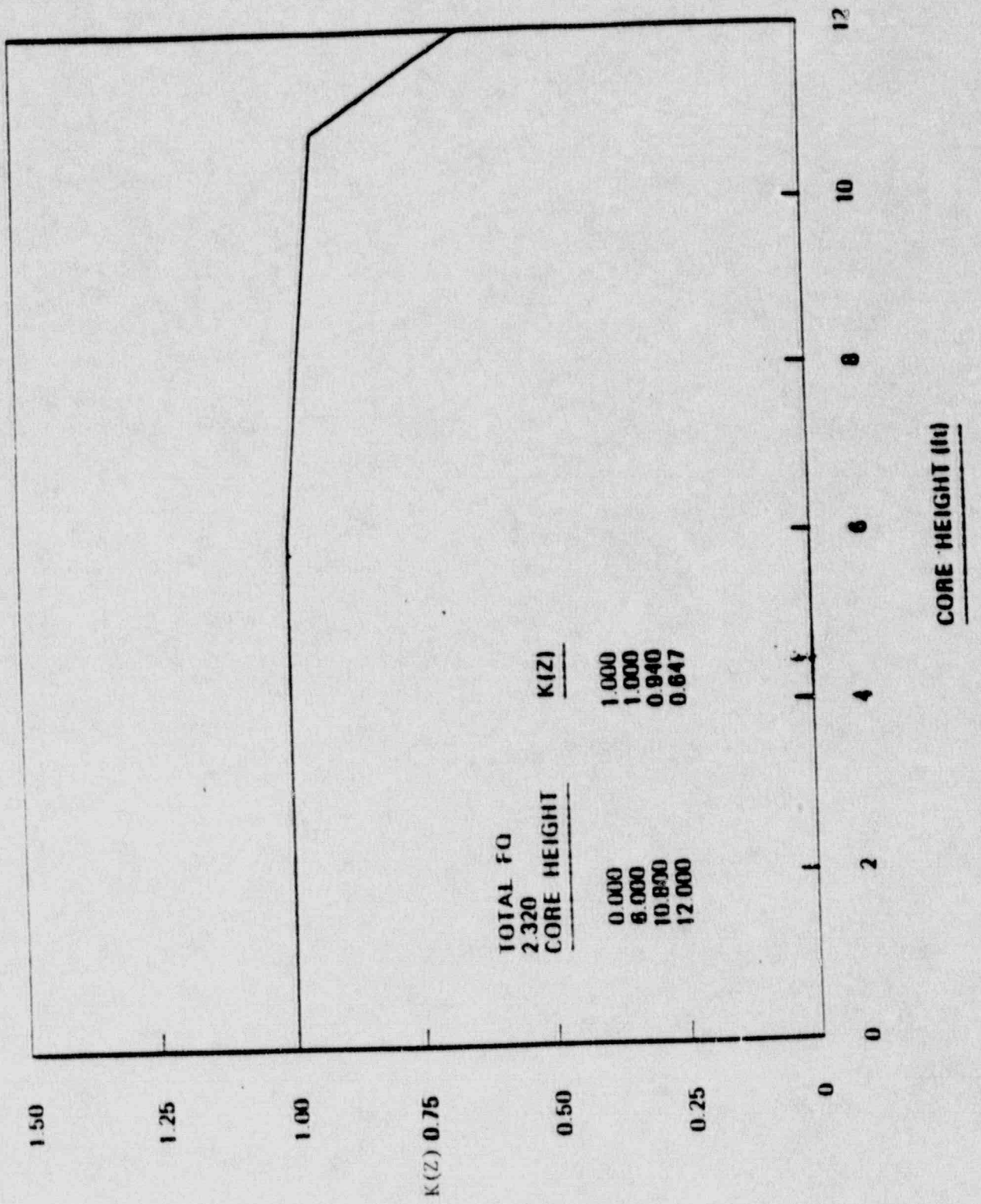
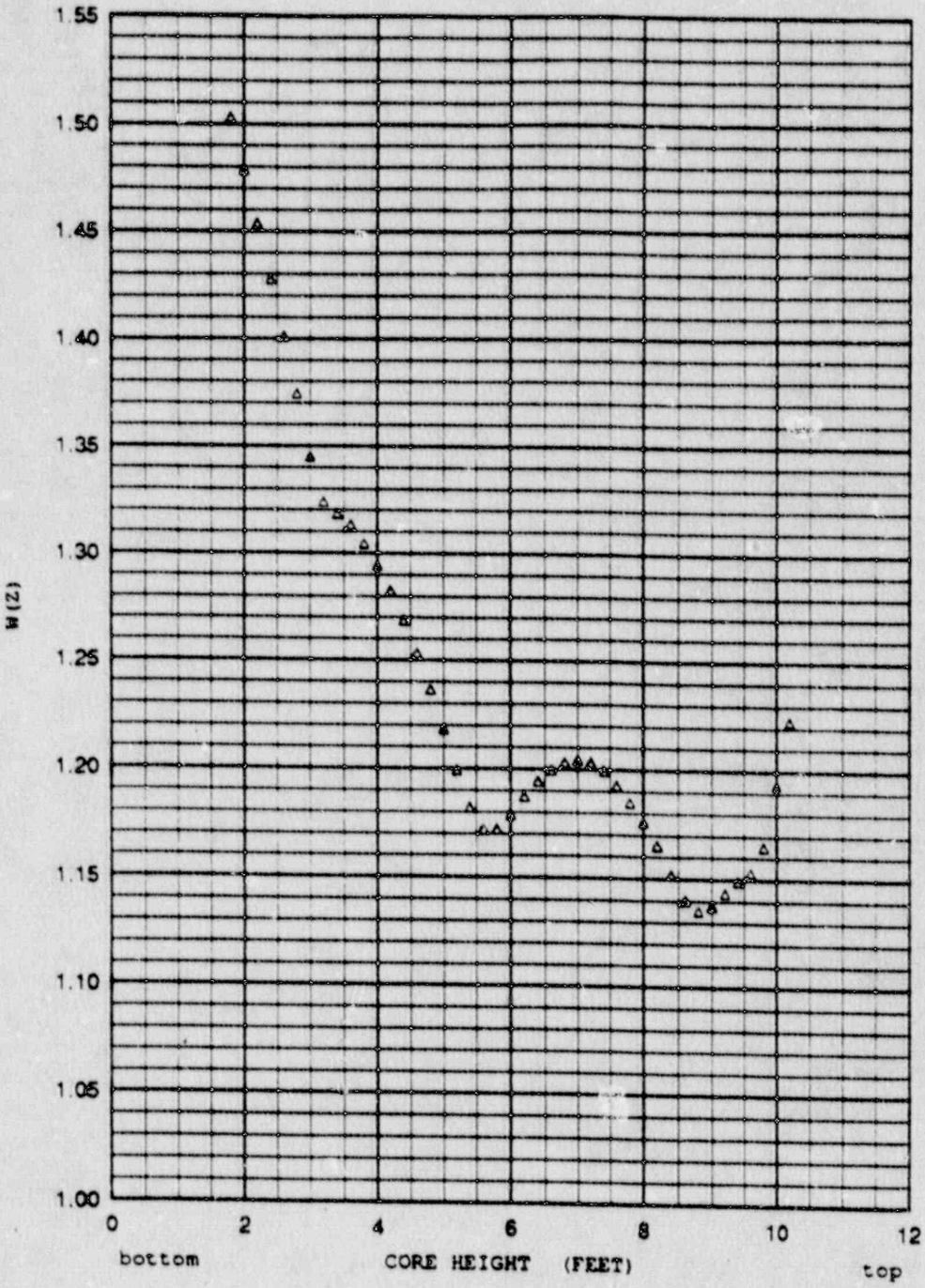


FIGURE 4

K(Z) - Normalized $F_Q(Z)$ as a Function of Core Height

McGuire 2 Cycle 6 Core Operating Limits Report



	HEIGHT (FEET)	BOL W(Z)
*	0.00	1.0000
*	0.20	1.0000
*	0.40	1.0000
*	0.60	1.0000
*	0.80	1.0000
*	1.00	1.0000
*	1.20	1.0000
*	1.40	1.0000
*	1.60	1.0000
	1.80	1.5053
	2.00	1.4788
	2.20	1.4537
	2.40	1.4277
	2.60	1.4013
	2.80	1.3745
	3.00	1.3452
	3.20	1.3240
	3.40	1.3185
	3.60	1.3133
	3.80	1.3045
	4.00	1.2945
	4.20	1.2826
	4.40	1.2688
	4.60	1.2534
	4.80	1.2365
	5.00	1.2183
	5.20	1.1994
	5.40	1.1822
	5.60	1.1718
	5.80	1.1721
	6.00	1.1788
	6.20	1.1873
	6.40	1.1944
	6.60	1.1998
	6.80	1.2032
	7.00	1.2045
	7.20	1.2034
	7.40	1.1996
	7.60	1.1928
	7.80	1.1850
	8.00	1.1761
	8.20	1.1652
	8.40	1.1521
	8.60	1.1406
	8.80	1.1356
	9.00	1.1379
	9.20	1.1440
	9.40	1.1494
	9.60	1.1532
	9.80	1.1652
	10.00	1.1940
	10.20	1.2231
*	10.40	1.0000
*	10.60	1.0000
*	10.80	1.0000
*	11.00	1.0000
*	11.20	1.0000
*	11.40	1.0000
*	11.60	1.0000
*	11.80	1.0000
*	12.00	1.0000

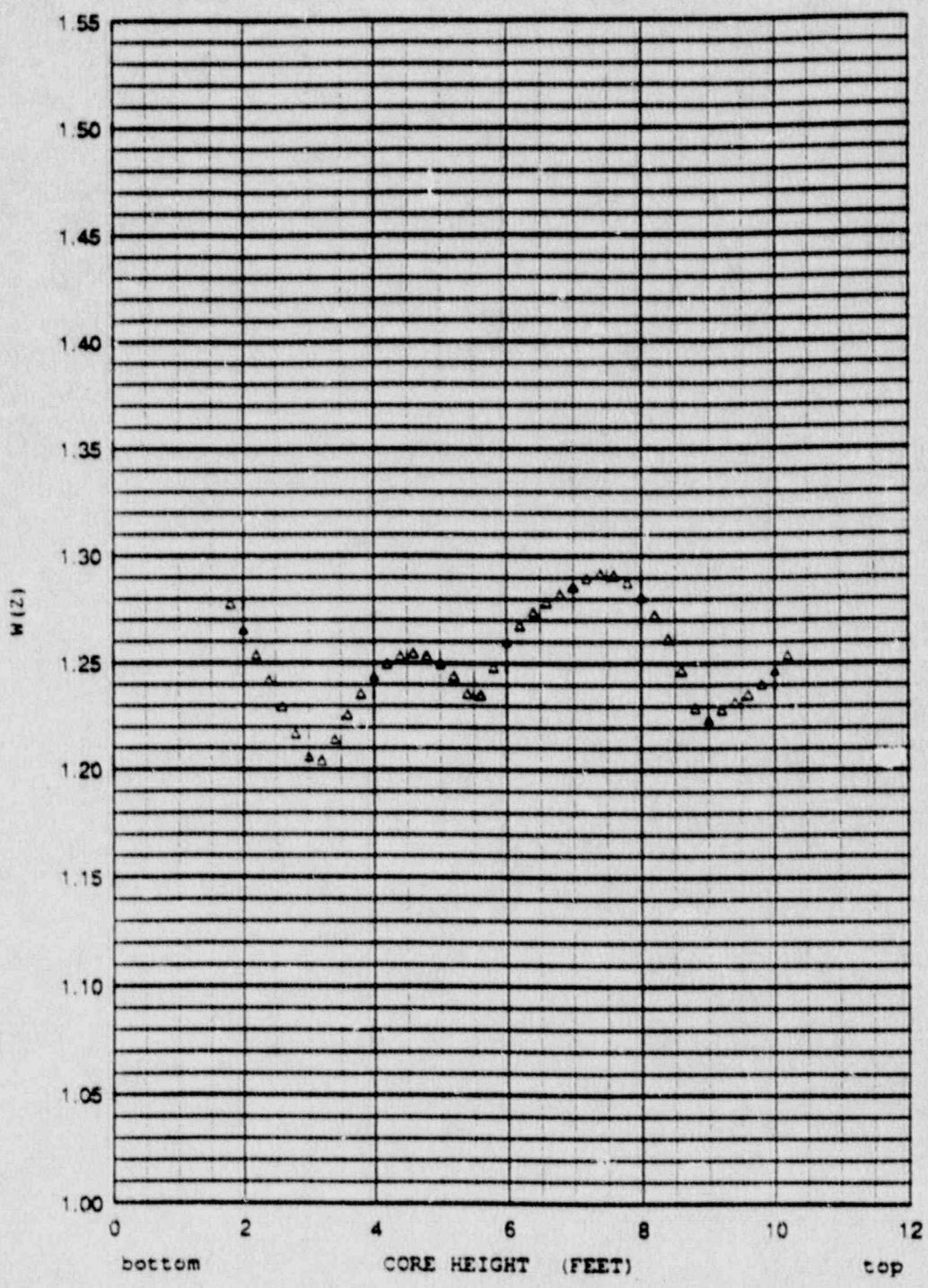
FIGURE 5

MCGUIRE UNIT 2 CYCLE 6

RAOC W(Z) AT 150 MWD/MTU

TOP AND BOTTOM 15% EXCLUDED AS PER TECH SPEC 4.2.2.2.G

McGuire 2 Cycle 6 Core Operating Limits Report



	HEIGHT (FEET)	MOL W(Z)
*	0.00	1.0000
*	0.20	1.0000
*	0.40	1.0000
*	0.60	1.0000
*	0.80	1.0000
*	1.00	1.0000
*	1.20	1.0000
*	1.40	1.0000
*	1.60	1.0000
	1.80	1.2779
	2.00	1.2659
	2.20	1.2540
	2.40	1.2422
	2.60	1.2297
	2.80	1.2168
	3.00	1.2062
	3.20	1.2043
	3.40	1.2142
	3.60	1.2259
	3.80	1.2358
	4.00	1.2439
	4.20	1.2498
	4.40	1.2534
	4.60	1.2546
	4.80	1.2533
	5.00	1.2498
	5.20	1.2440
	5.40	1.2360
	5.60	1.2352
	5.80	1.2483
	6.00	1.2604
	6.20	1.2679
	6.40	1.2739
	6.60	1.2787
	6.80	1.2825
	7.00	1.2861
	7.20	1.2897
	7.40	1.2919
	7.60	1.2912
	7.80	1.2878
	8.00	1.2815
	8.20	1.2725
	8.40	1.2616
	8.60	1.2469
	8.80	1.2292
	9.00	1.2238
	9.20	1.2284
	9.40	1.2320
	9.60	1.2355
	9.80	1.2404
	10.00	1.2469
	10.20	1.2537
*	10.40	1.0000
*	10.60	1.0000
*	10.80	1.0000
*	11.00	1.0000
*	11.20	1.0000
*	11.40	1.0000
*	11.60	1.0000
*	11.80	1.0000
*	12.00	1.0000

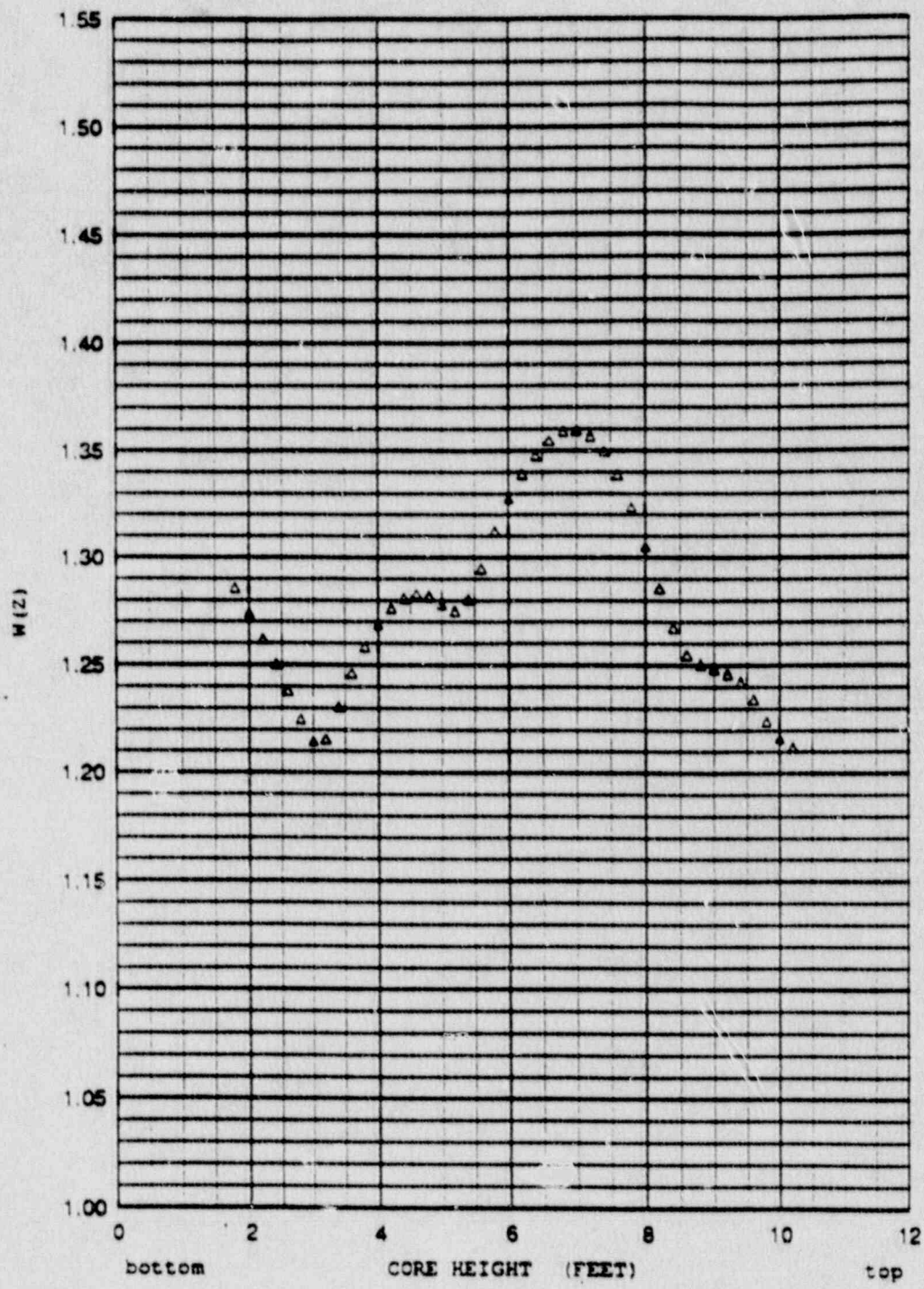
FIGURE 6

MCGUIRE UNIT 2 CYCLE 6

RAOC W(Z) AT 8000 MWD/MTU

TOP AND BOTTOM 15% EXCLUDED AS PER TECH SPEC 4.2.2.2.G

McGuire 2 Cycle 6 Core Operating Limits Report



	HEIGHT (FEET)	EOL W(Z)
*	0.00	1.0000
*	0.20	1.0000
*	0.40	1.0000
*	0.60	1.0000
*	0.80	1.0000
*	1.00	1.0000
*	1.20	1.0000
*	1.40	1.0000
*	1.60	1.0000
	1.80	1.2858
	2.00	1.2739
	2.20	1.2621
	2.40	1.2505
	2.60	1.2381
	2.80	1.2250
	3.00	1.2149
	3.20	1.2158
	3.40	1.2308
	3.60	1.2464
	3.80	1.2586
	4.00	1.2688
	4.20	1.2764
	4.40	1.2812
	4.60	1.2830
	4.80	1.2820
	5.00	1.2784
	5.20	1.2750
	5.40	1.2805
	5.60	1.2948
	5.80	1.3125
	6.00	1.3270
	6.20	1.3390
	6.40	1.3478
	6.60	1.3547
	6.80	1.3590
	7.00	1.3597
	7.20	1.3565
	7.40	1.3497
	7.60	1.3388
	7.80	1.3237
	8.00	1.3053
	8.20	1.2856
	8.40	1.2675
	8.60	1.2549
	8.80	1.2504
	9.00	1.2484
	9.20	1.2460
	9.40	1.2423
	9.60	1.2343
	9.80	1.2242
	10.00	1.2165
	10.20	1.2121
*	10.40	1.0000
*	10.60	1.0000
*	10.80	1.0000
*	11.00	1.0000
*	11.20	1.0000
*	11.40	1.0000
*	11.60	1.0000
*	11.80	1.0000
*	12.00	1.0000

FIGURE 7

MCGUIRE UNIT 2 CYCLE 6

RAOC W(Z) AT 13300 MWD/MTU

TOP AND BOTTOM 15% EXCLUDED AS PER TECH SPEC 4.2.2.2.G

McGuire 2 Cycle 6 Core Operating Limits Report

2.6 RCS Flow Rate and Nuclear Enthalpy Rise Hot Channel Factor - $F^{N}_{\Delta H}$ (Specification 3/4.2.3)

$$R = \frac{F^{N}_{\Delta H}}{F^{RTP}_{\Delta H} * (1 + MF_{\Delta H} * (1-P))}$$

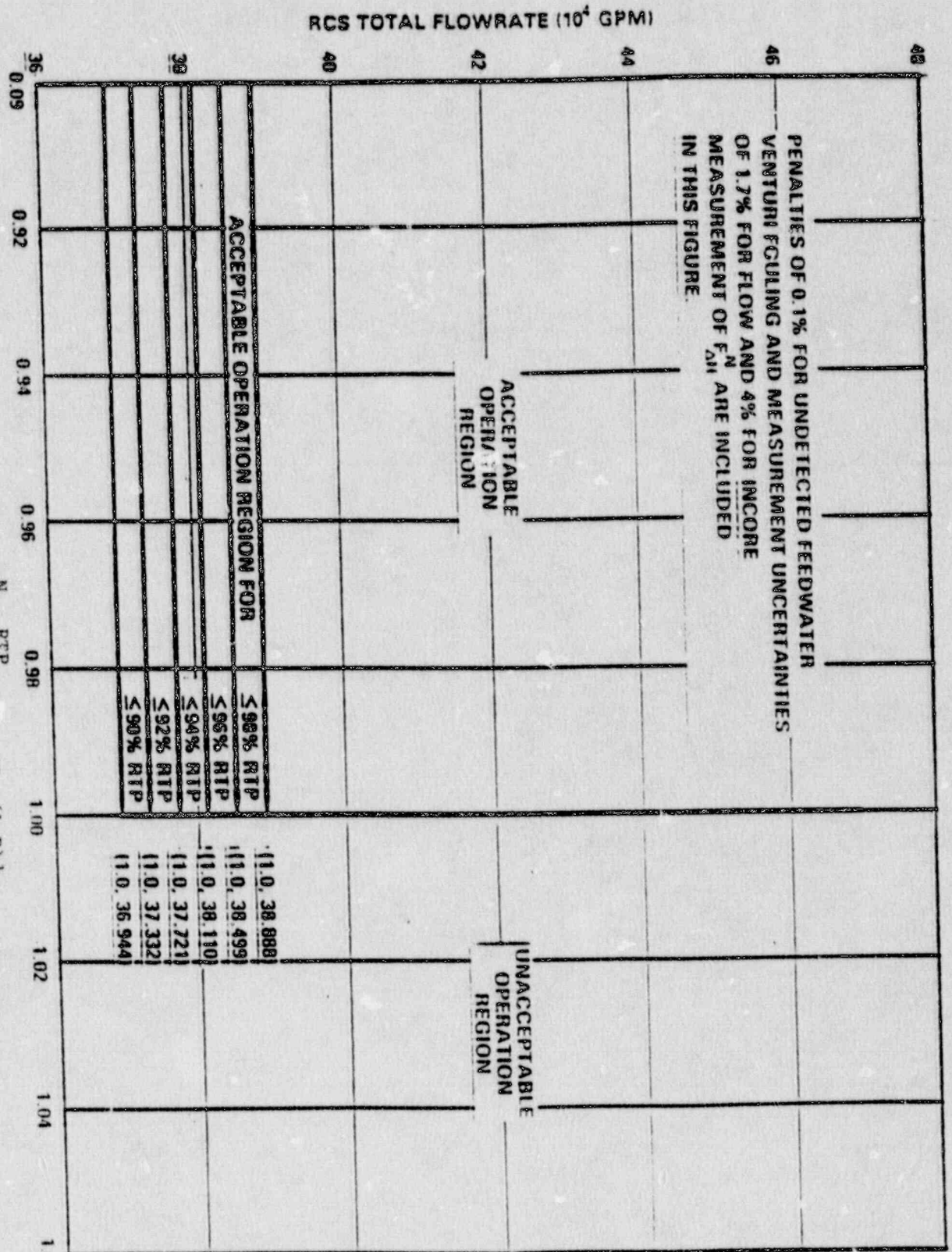
where: $P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$

2.6.1 $F^{RTP}_{\Delta H} = 1.49$

2.6.2 $MF_{\Delta H} = 0.3$

2.6.3 The Acceptable Operation Region from the combination of Reactor Coolant System total flow and R is provided in Figure 8.

McGuire 2 Cycle 6 Core Operating Limits Report



$R = F^N_{\Delta H} / F^{RTP}_{\Delta H} [1.0 + MF_{\Delta H}(1-P)]$

FIGURE 8

RCS FLOW RATE VERSES P - FOUR LOOPS IN OPERATION