RXE-95-002, Rev. 1

CPSES UNIT 1 CYCLE 5

CORE OPERATING LIMITS REPORT

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DISCLAIMER

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1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for CPSES UNIT 1 CYCLE 5 has been prepared to satisfy the requirements of Technical Specification 6.9.1.6.

The Technical Specifications affected by this report are listed below:

3/4.1.1.1	Shutdown Margin - T_{avg} Greater Than 200°F	Rev. 1
3/4.1.1.2	Shutdown Margin - T_{avg} Less Than or Equal to 200°F	Rev. 1
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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 the NRC-approved methodologies specified in Technical Specification 6.9.1.6b, Items 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 19. These limits have been determined such that all applicable limits of the safety analysis are met. Rev. 1

2.1 Moderator Temperature Coefficient (Specification 3/4.1.1.3)

2.1.1 The Moderator Temperature Coefficient (MTC) limits are:

The BOL/ARO/HZP-MTC shall be less positive than +5 pcm/°F.

The EOL/ARO/RTP-MTC shall be less negative than - 40 pcm/°F.

2.1.2 The MTC surveillance limit is:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to -31 pcm/°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

2.2 Shutdown Rod Insertion Limit (Specification 3/4.1.3.5)

2.2.1 The shutdown rods shall be fully withdrawn. Fully withdrawn shall be the condition where shutdown rods are at a position within the interval of 222 and 231 steps withdrawn, inclusive.

2.3. Control Rod Insertion Limits (Specification 3/4.1.3.6)

2.3.1 The control banks shall be limited in physical insertion as shown in Figure 1.

2.4 Axial Flux Difference (Specification 3/4.2.1)

2.4.1 The AXIAL FLUX DIFFERENCE (AFD) target band is +3%, -12%.

2.4.2 The AFD Acceptable Operation Limits are provided in Figure 2.

2.5 Heat Flux Hot Channel Factor (Specification 3/4.2.2)

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

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

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

2.5.1 $F_Q^{RTP} = 2.42$

2.5.2 K(Z) is provided in Figure 3.

2.5.3 Maximum elevation dependent W(Z) values are given in Figure 4. Figures 5, 6, and 7 give burnup dependent values for W(Z). Figures 5, 6, and 7 can be used in place of Figure 4 to interpolate or extrapolate (via a three point fit) the W(Z) at a particular burnup.

2.5.4 A constant 2% decrease in F_Q margin allowance shall be used to increase $F_Q^C(z)$ for compliance with the 4.2.2.2.f Surveillance Requirement for all cycle burnups.

2.6 Nuclear Enthalpy Rise Hot Channel Factor
(Specification 3/4.2.3)

$$F^{N}_{\Delta H} \leq F^{RTP}_{\Delta H} [1 + PF_{\Delta H} (1-P)]$$

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

2.6.1 $F^{RTP}_{\Delta H} = 1.55$

2.6.2 $PF_{\Delta H} = 0.2$

2.7 Shutdown Margin

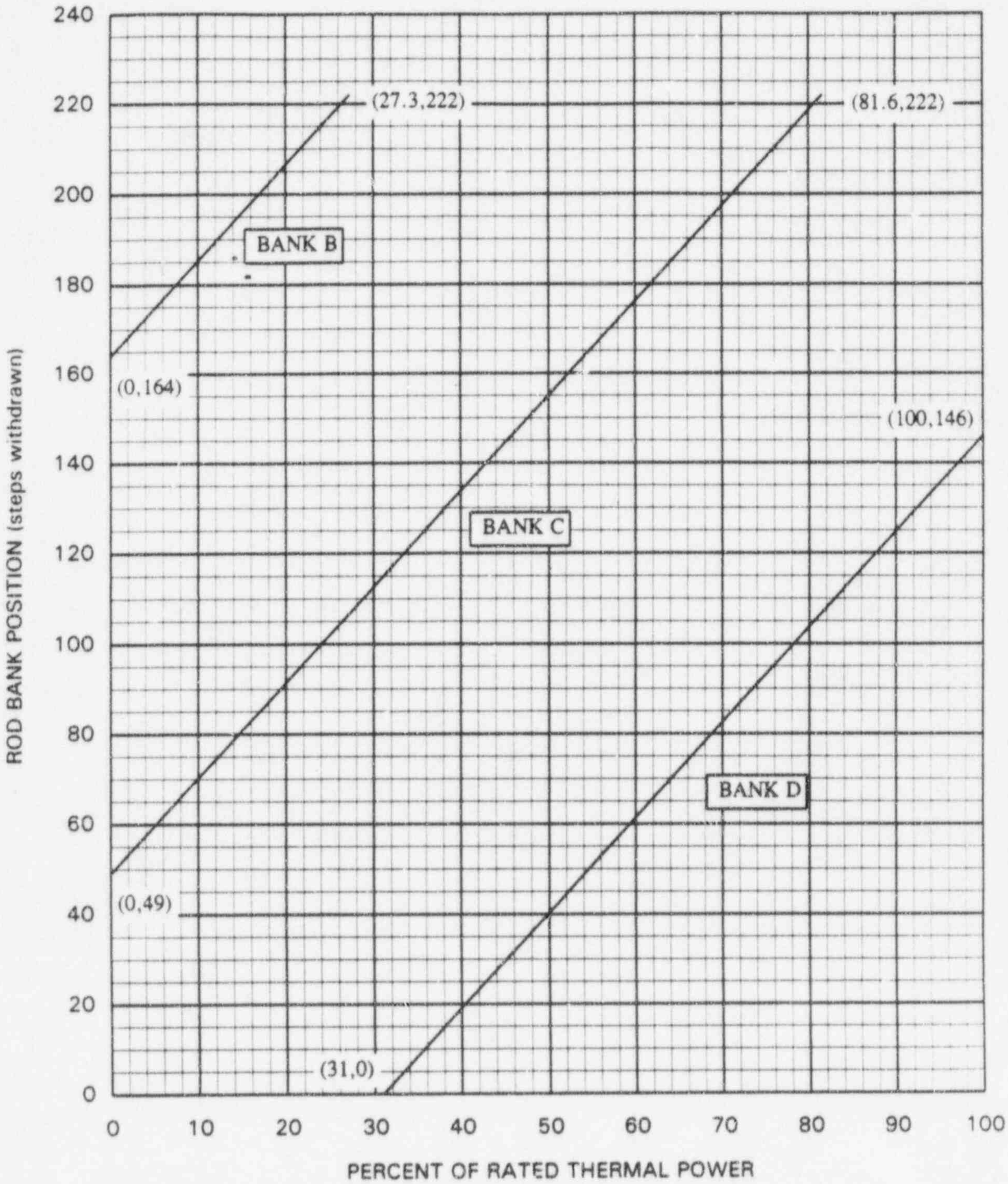
2.7.1 Shutdown Margin - T_{avg} Greater Than 200°F
(Specifications 3/4.1.1.1, 3/4.1.2.2, 3/4.1.2.4, and 3/4.1.2.6)

The SHUTDOWN MARGIN shall be greater than or equal to 1.6% Δk/k in MODES 1, 2, 3, and 4. Rev. 1

2.7.2 Shutdown Margin - T_{avg} Less Than or Equal to 200°F
(Specification 3/4.1.1.2)

The SHUTDOWN MARGIN shall be greater than or equal to 1.3% Δk/k in MODE 5.

FIGURE 1   ROD BANK INSERTION LIMITS VERSUS THERMAL POWER



NOTES:

1. Fully withdrawn shall be the condition where control rods are at a position within the interval of 222 and 231 steps withdrawn, inclusive.
2. Control Bank A shall be fully withdrawn.

FIGURE 2 AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER

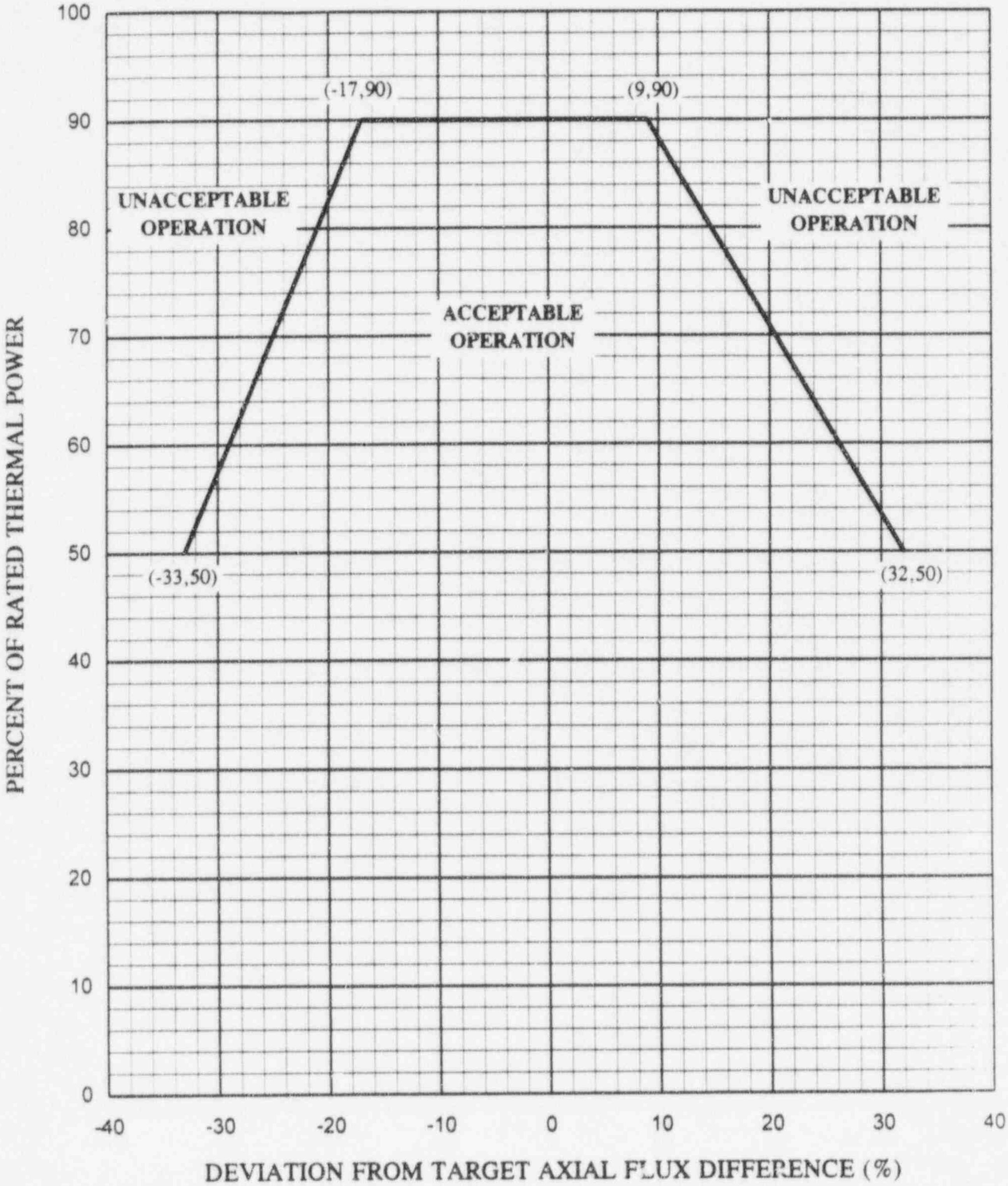
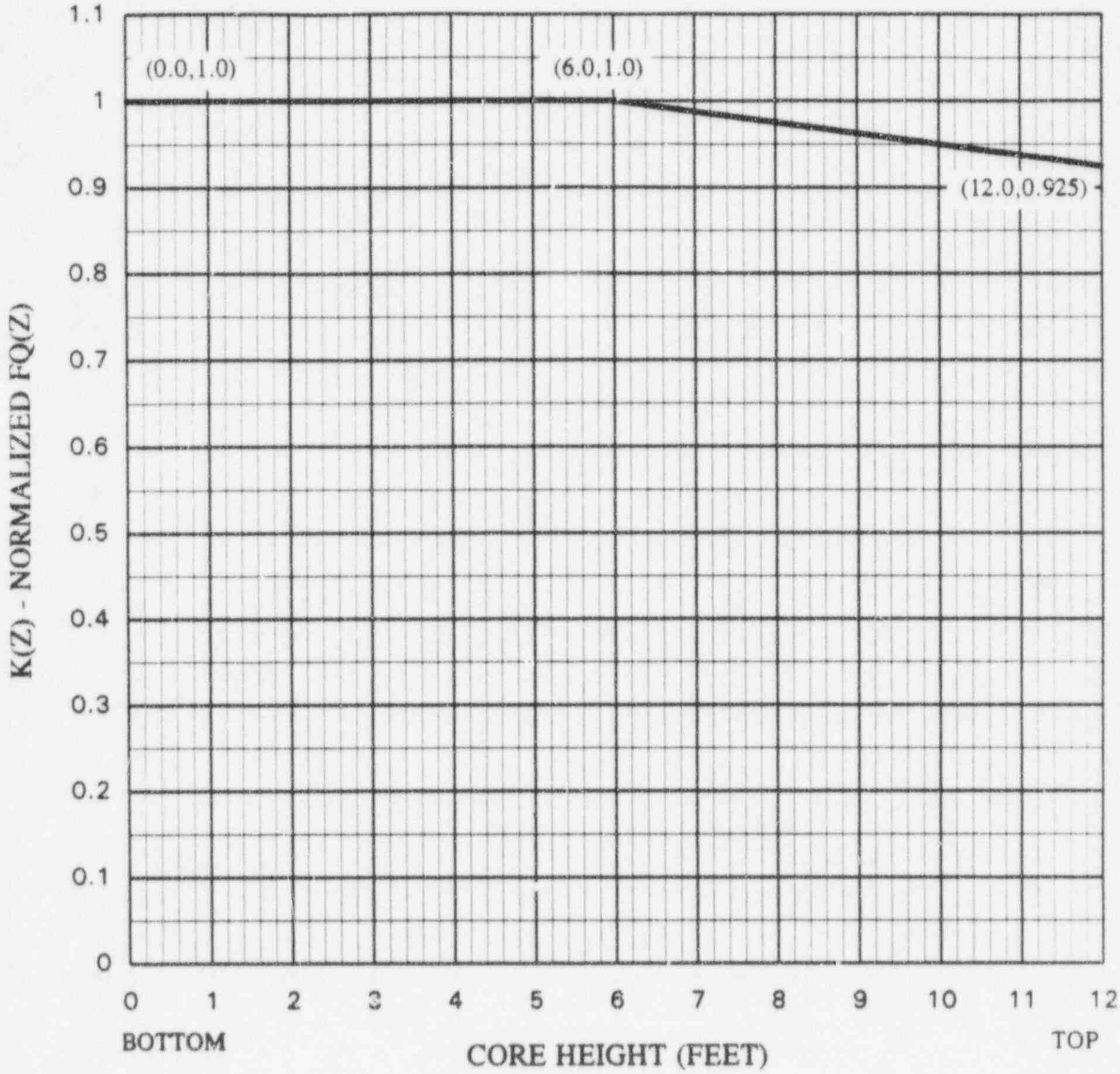


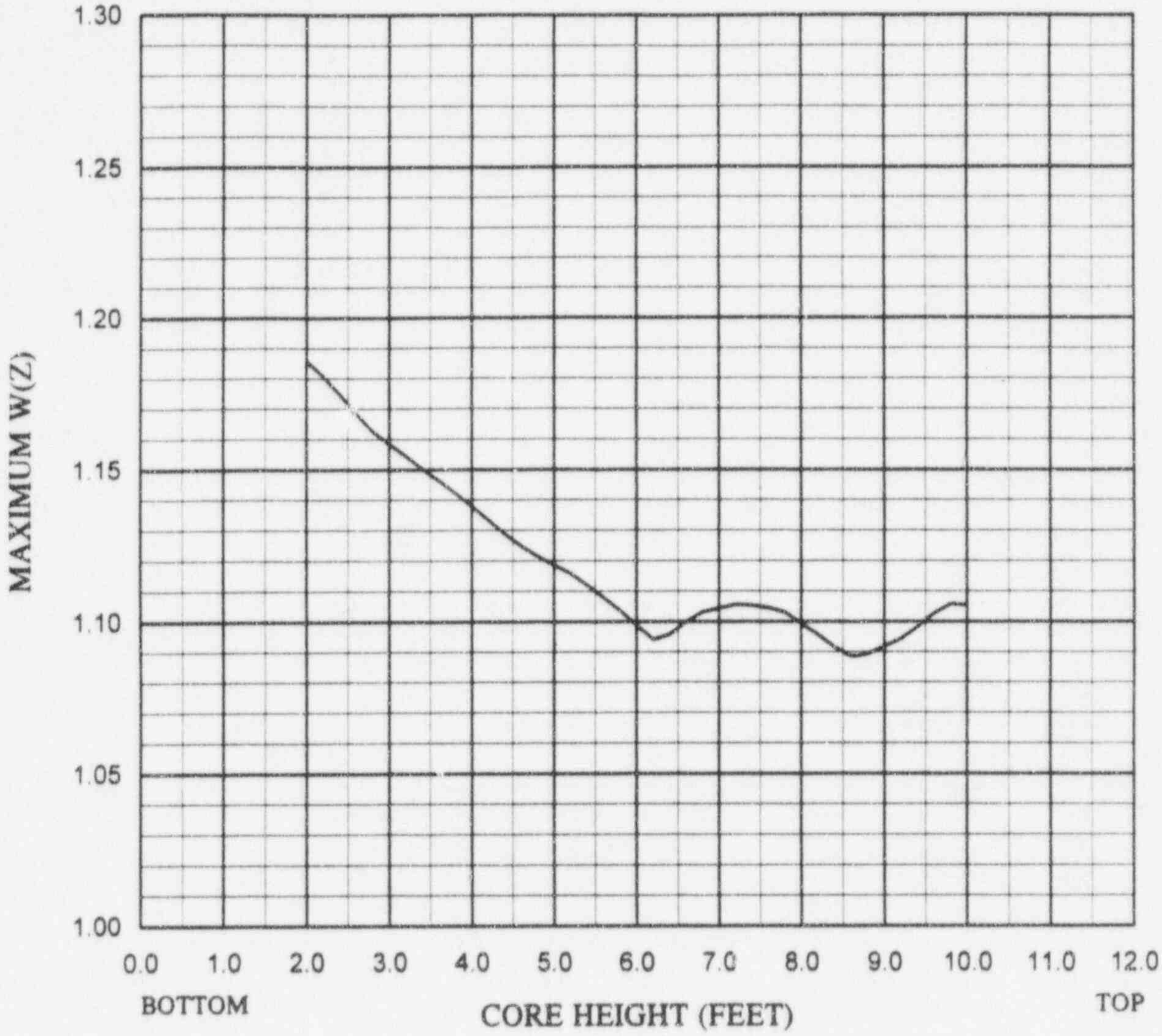
FIGURE 3 K(Z) - NORMALIZED $F_Q(Z)$ AS A FUNCTION OF CORE HEIGHT



Axial Node	K(Z)	Axial Node	K(Z)	Axial Node	K(Z)	Axial Node	K(Z)
1 - 31	1.0000	39	0.9800	47	0.9600	55	0.9400
32	0.9975	40	0.9775	48	0.9575	56	0.9375
33	0.9950	41	0.9750	49	0.9550	57	0.9350
34	0.9925	42	0.9725	50	0.9525	58	0.9325
35	0.9900	43	0.9700	51	0.9500	59	0.9300
36	0.9875	44	0.9675	52	0.9475	60	0.9275
37	0.9850	45	0.9650	53	0.9450	61	0.9250
38	0.9825	46	0.9625	54	0.9425		

Core Height (ft) = (Node - 1) * 0.2

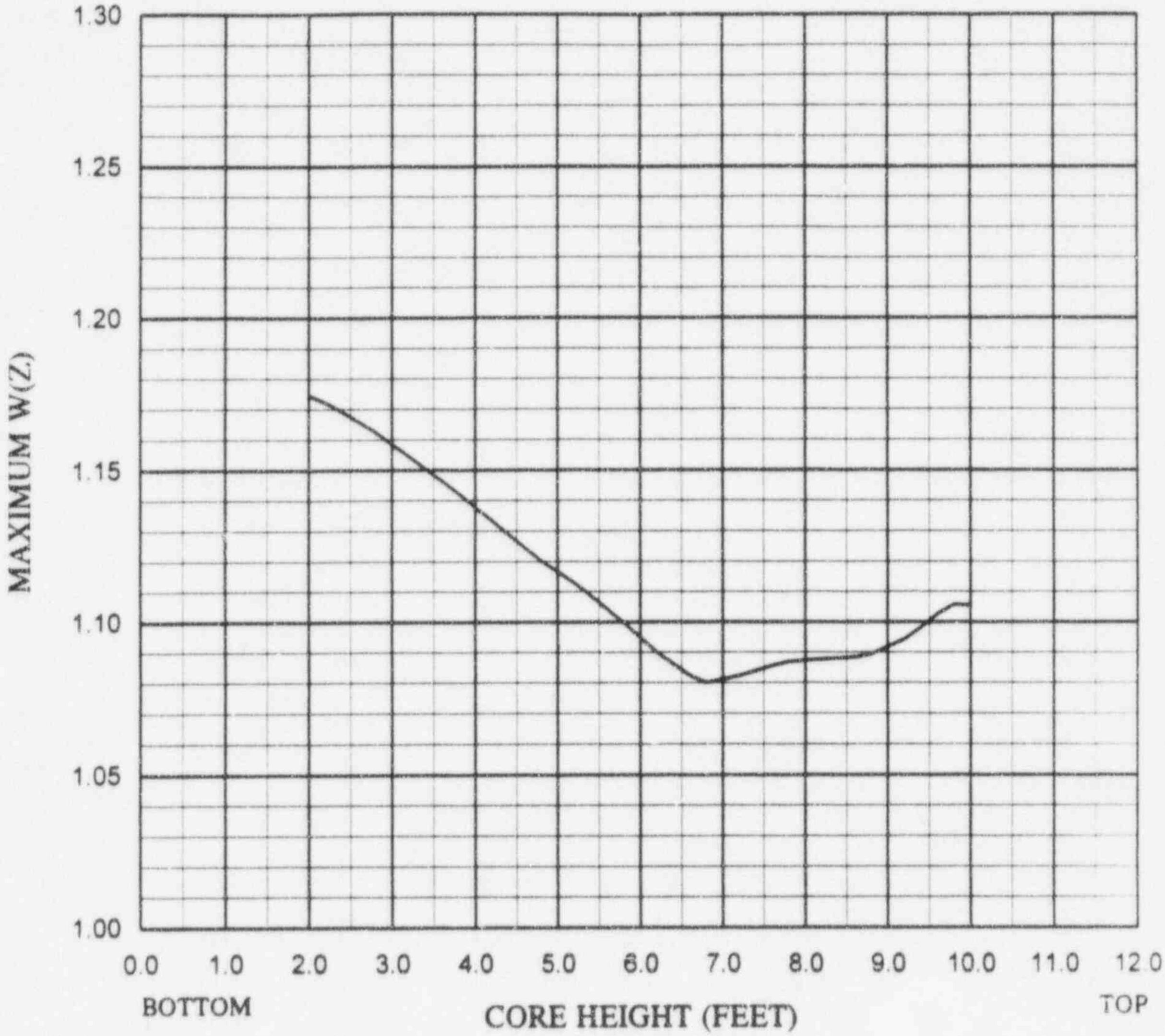
FIGURE 4 W(Z) AS A FUNCTION OF CORE HEIGHT
MAXIMUM



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	—	21	1.138	32	1.094	43	1.092
11	1.186	22	1.133	33	1.096	44	1.088
12	1.181	23	1.129	34	1.100	45	1.089
13	1.175	24	1.125	35	1.103	46	1.092
14	1.168	25	1.121	36	1.104	47	1.094
15	1.163	26	1.119	37	1.106	48	1.098
16	1.158	27	1.116	38	1.105	49	1.103
17	1.154	28	1.112	39	1.105	50	1.106
18	1.150	29	1.108	40	1.103	51	1.105
19	1.146	30	1.104	41	1.099	52 - 61	---
20	1.142	31	1.099	42	1.096		

Core Height (ft) = (Node - 1) * 0.2

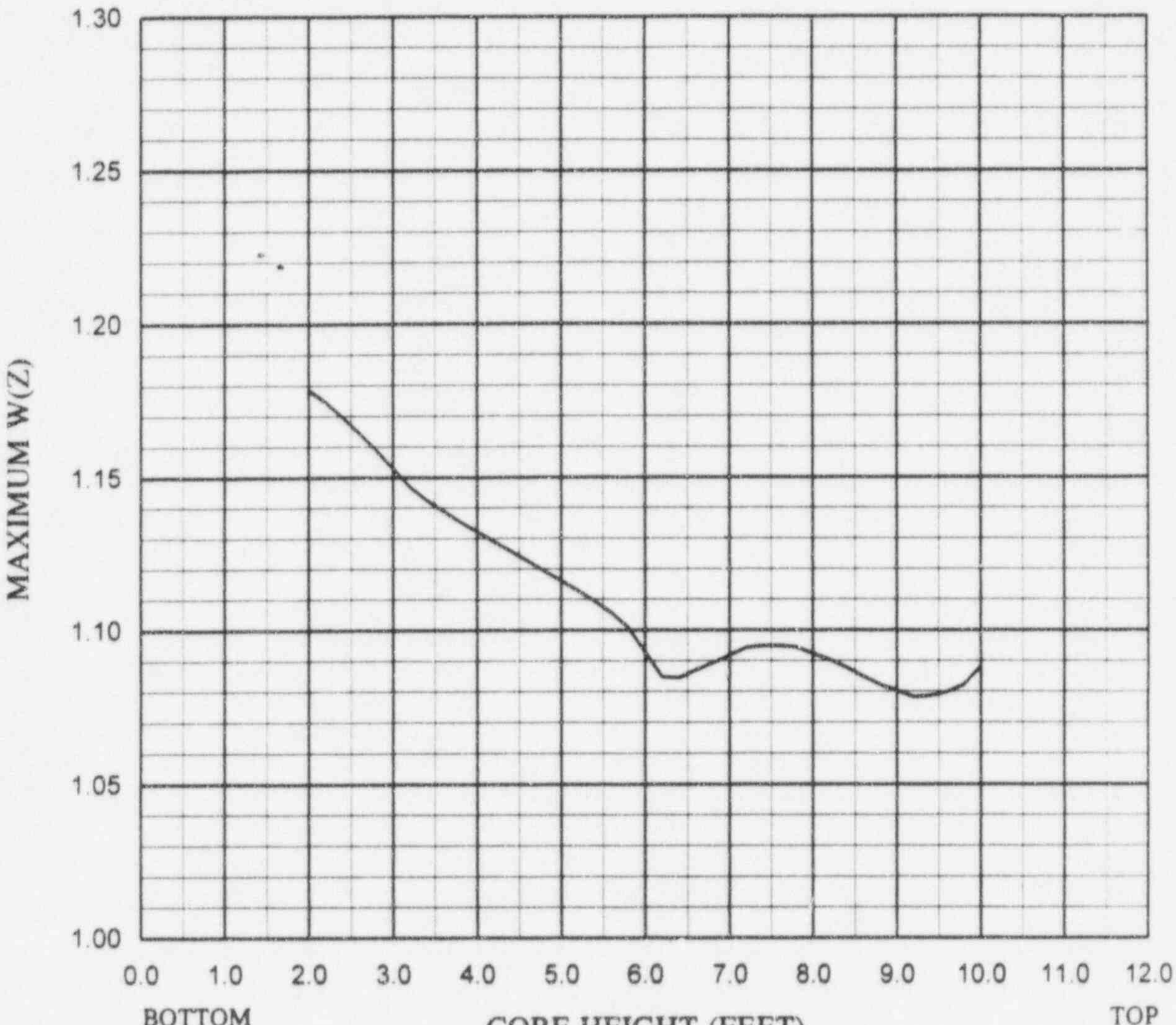
FIGURE 5 W(Z) AS A FUNCTION OF CORE HEIGHT
150 MWD/MTU



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.138	32	1.090	43	1.088
11	1.175	22	1.133	33	1.086	44	1.088
12	1.172	23	1.129	34	1.082	45	1.089
13	1.169	24	1.124	35	1.080	46	1.092
14	1.166	25	1.120	36	1.081	47	1.094
15	1.163	26	1.117	37	1.082	48	1.098
16	1.158	27	1.113	38	1.084	49	1.103
17	1.154	28	1.109	39	1.086	50	1.106
18	1.150	29	1.104	40	1.087	51	1.105
19	1.146	30	1.100	41	1.087	52 - 61	---
20	1.142	31	1.095	42	1.088		

Core Height (ft) = (Node - 1) * 0.2

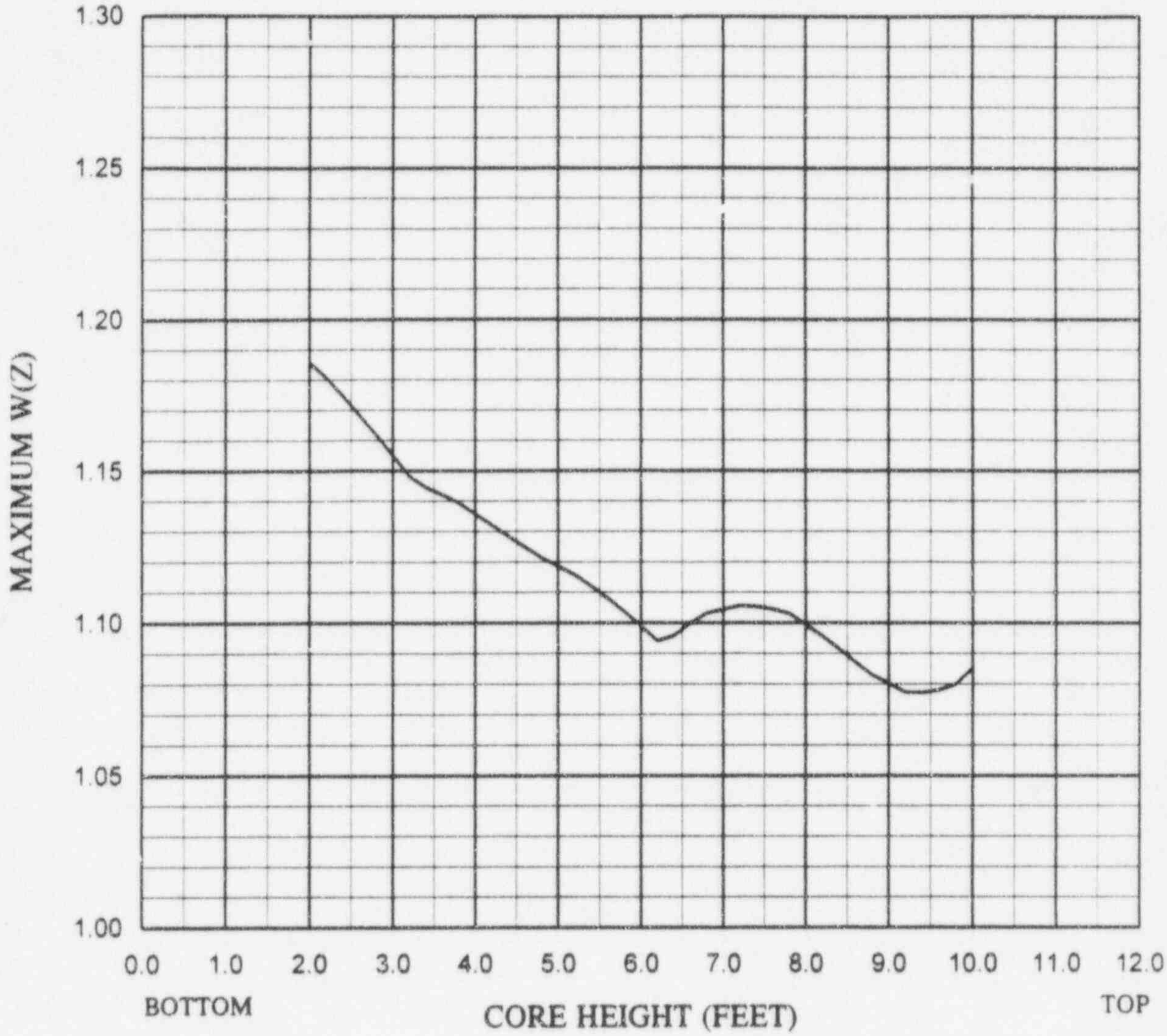
FIGURE 6 W(Z) AS A FUNCTION OF CORE HEIGHT
10,000 MWD/MTU



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.132	32	1.085	43	1.088
11	1.179	22	1.129	33	1.085	44	1.085
12	1.175	23	1.126	34	1.087	45	1.082
13	1.170	24	1.123	35	1.089	46	1.080
14	1.164	25	1.119	36	1.092	47	1.078
15	1.159	26	1.116	37	1.094	48	1.079
16	1.153	27	1.113	38	1.095	49	1.080
17	1.147	28	1.109	39	1.095	50	1.082
18	1.143	29	1.106	40	1.094	51	1.088
19	1.139	30	1.101	41	1.092	52 - 61	---
20	1.135	31	1.093	42	1.090		

Core Height (ft) = (Node - 1) * 0.2

FIG'RE 7 W(Z) AS A FUNCTION OF CORE HEIGHT
18,000 MWD/MTU



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.136	32	1.094	43	1.092
11	1.186	22	1.132	33	1.096	44	1.087
12	1.181	23	1.128	34	1.100	45	1.083
13	1.175	24	1.125	35	1.103	46	1.080
14	1.168	25	1.121	36	1.104	47	1.077
15	1.162	26	1.119	37	1.106	48	1.077
16	1.155	27	1.116	38	1.105	49	1.078
17	1.148	28	1.112	39	1.105	50	1.080
18	1.145	29	1.108	40	1.103	51	1.085
19	1.142	30	1.104	41	1.099	52 - 61	---
20	1.139	31	1.099	42	1.096		

Core Height (ft) = (Node - 1) * 0.2