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CPSES UNIT 1 CYCLE 6

CORE OPERATING LIMITS REPORT

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1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for CPSES UNIT 1 CYCLE 6 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
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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.

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 <u>Shutdown Rod Insertion Limit</u> (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2.2.1 The shutdown rods shall be fully withdrawn. Fully withdrawn shall be the condition where shutdown rods are at a position within the interval of 222 and 231 steps withdrawn, inclusive.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. <u>Control Rod Insertion Limits</u> (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 <u>Axial Flux Difference</u> (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 $F_Q^{RTP} = 2.40$

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 $PF_{\Delta H} = 0.3$

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)

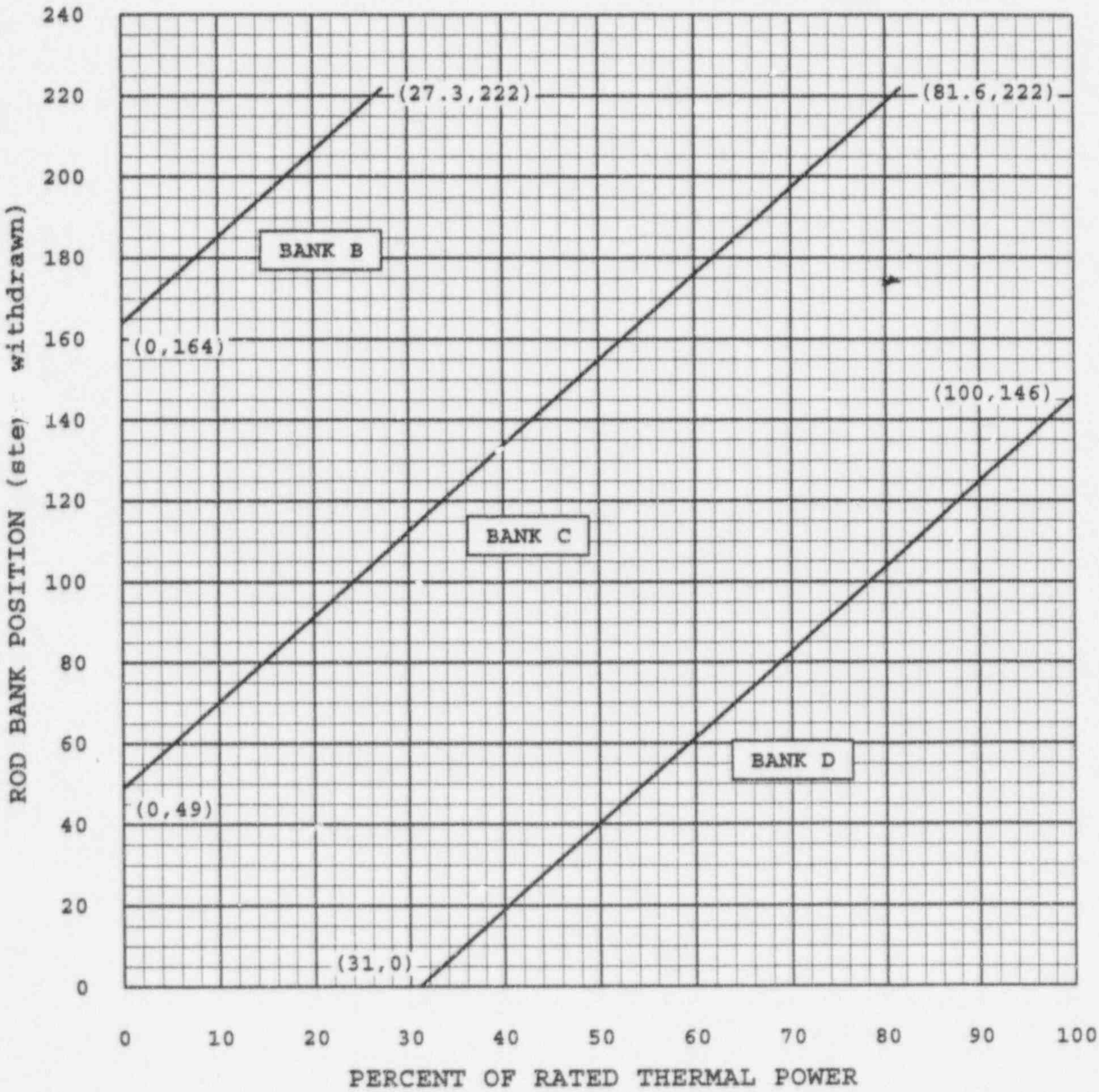
The SHUTDOWN MARGIN shall be greater than or equal to 1.3% $\Delta k/k$ in MODES 1, 2, 3, and 4.

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% $\Delta k/k$ 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

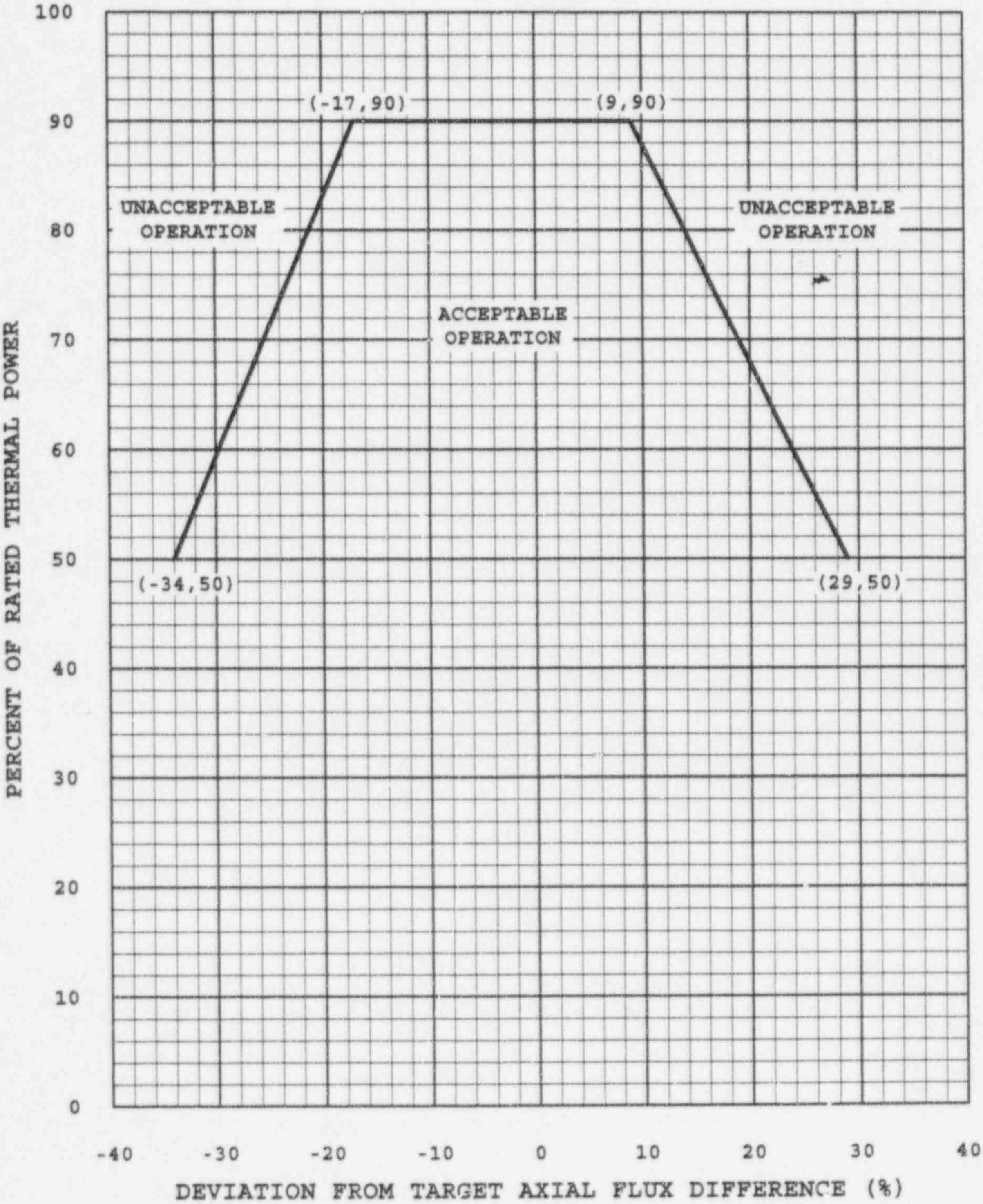
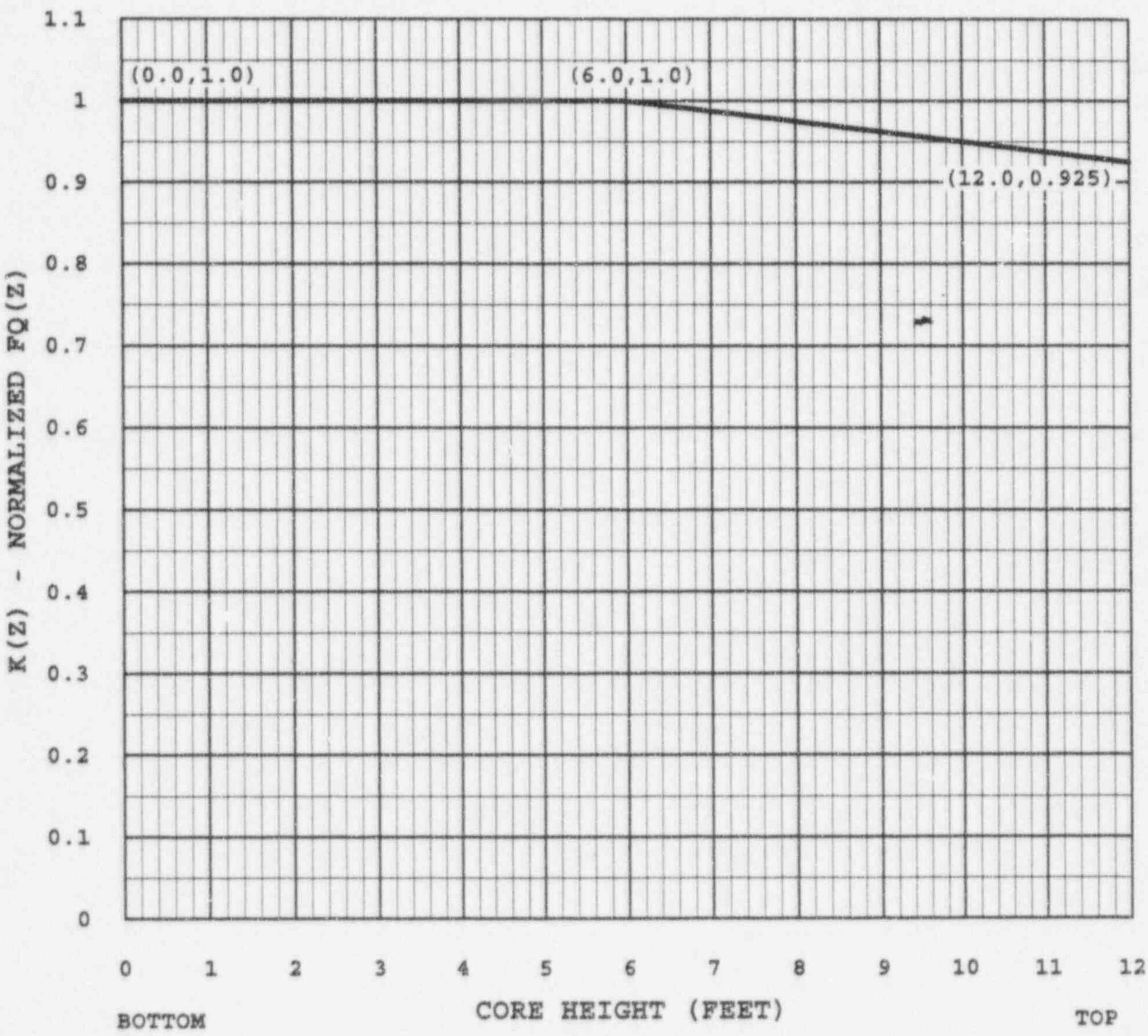


FIGURE 3

K(Z) - NORMALIZED FQ(Z) AS A FUNCTION OF CORE HEIGHT

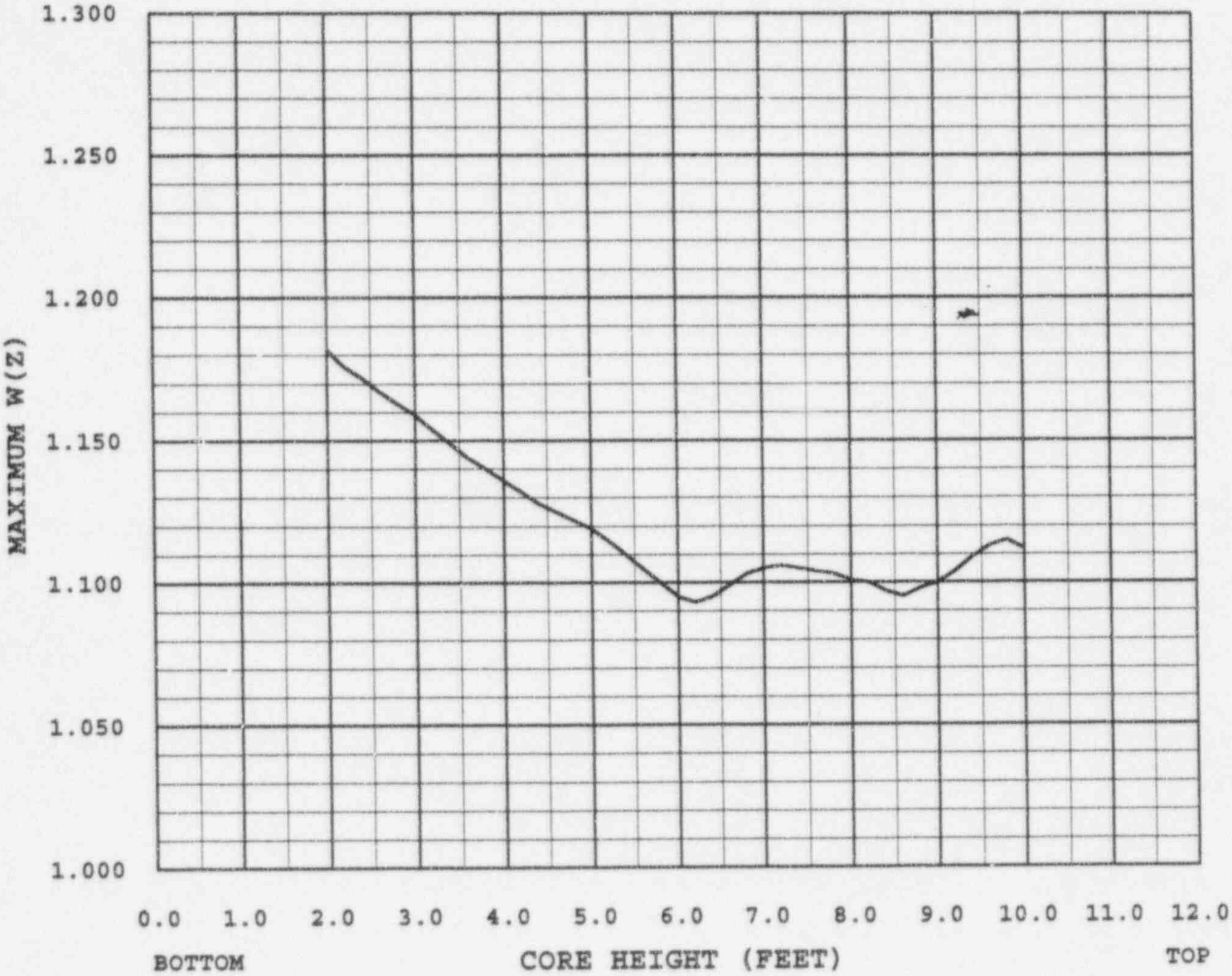


Axial Node	K(Z)	Axial Node	K(Z)	Axial Node	K(Z)	Axial Node	K(Z)
1 - 31	1.0000	39	0.9800	47	0.9600	55	0.9400
32	0.9975	40	0.9775	48	0.9575	56	0.9375
33	0.9950	41	0.9750	49	0.9550	57	0.9350
34	0.9925	42	0.9725	50	0.9525	58	0.9325
35	0.9900	43	0.9700	51	0.9500	59	0.9300
36	0.9875	44	0.9675	52	0.9475	60	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)

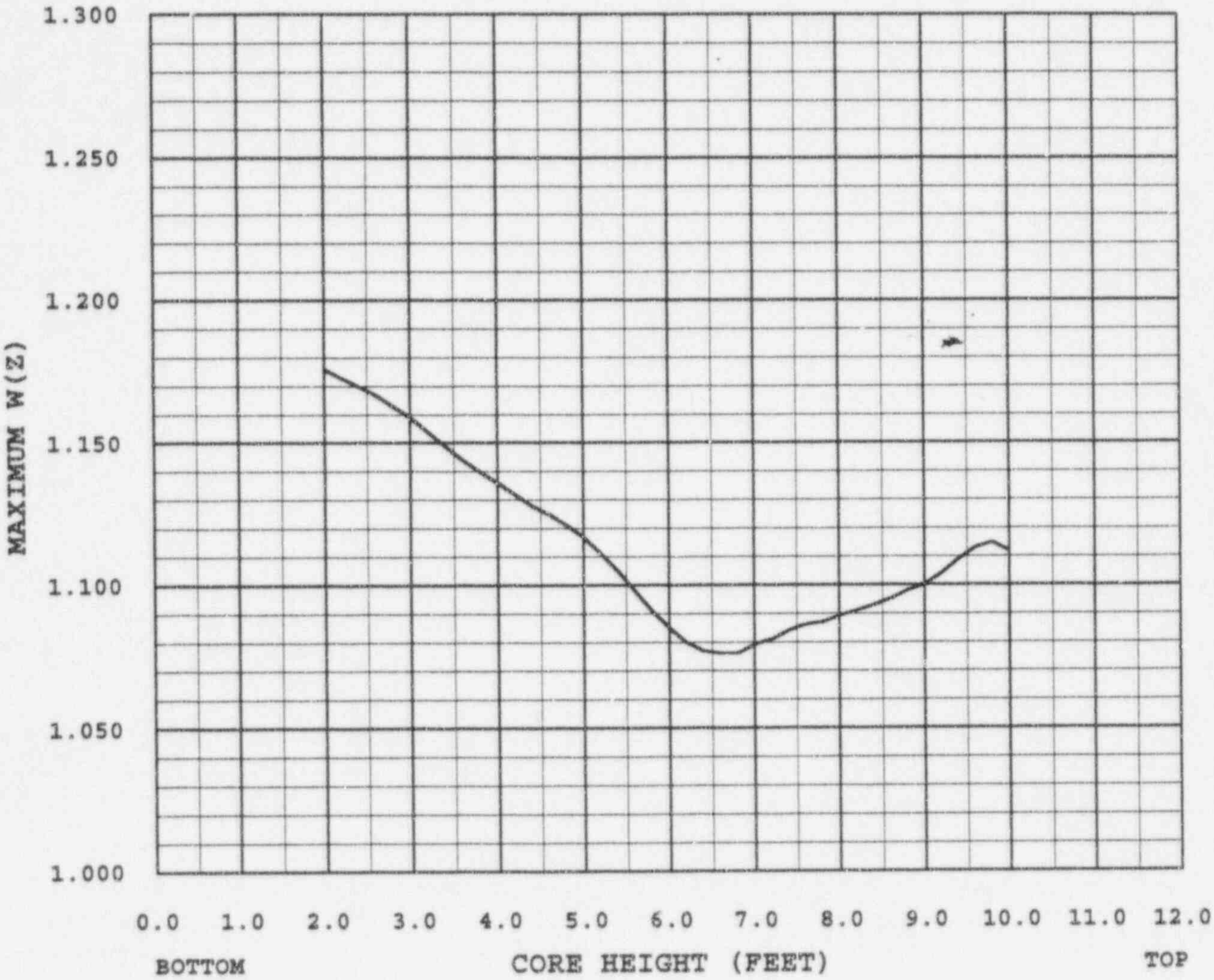


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.136	32	1.093	43	1.097
11	1.182	22	1.132	33	1.095	44	1.095
12	1.176	23	1.128	34	1.099	45	1.098
13	1.172	24	1.125	35	1.103	46	1.100
14	1.167	25	1.122	36	1.105	47	1.104
15	1.163	26	1.119	37	1.106	48	1.109
16	1.159	27	1.115	38	1.105	49	1.113
17	1.154	28	1.110	39	1.104	50	1.115
18	1.149	29	1.105	40	1.103	51	1.112
19	1.144	30	1.100	41	1.101	52 - 61	---
20	1.140	31	1.095	42	1.100		

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

FIGURE 5

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

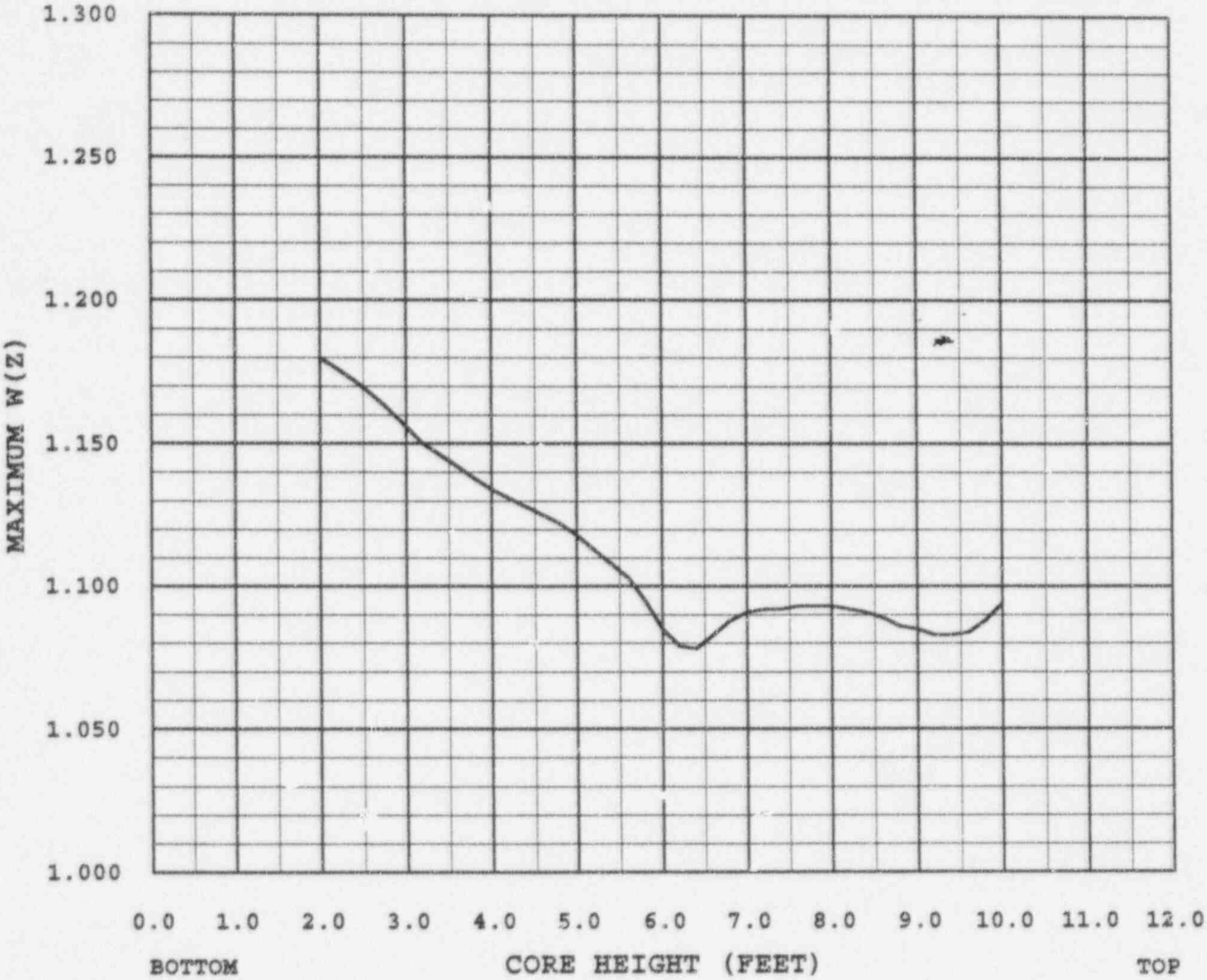


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.136	32	1.080	43	1.093
11	1.176	22	1.132	33	1.077	44	1.095
12	1.173	23	1.128	34	1.076	45	1.098
13	1.170	24	1.125	35	1.076	46	1.100
14	1.167	25	1.121	36	1.079	47	1.104
15	1.163	26	1.117	37	1.081	48	1.109
16	1.159	27	1.111	38	1.084	49	1.113
17	1.154	28	1.105	39	1.086	50	1.115
18	1.149	29	1.098	40	1.087	51	1.112
19	1.144	30	1.091	41	1.089	52 - 61	---
20	1.140	31	1.085	42	1.091		

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

FIGURE 6

W(Z) AS A FUNCTION OF CORE HEIGHT
(10000 MWD/MTU)

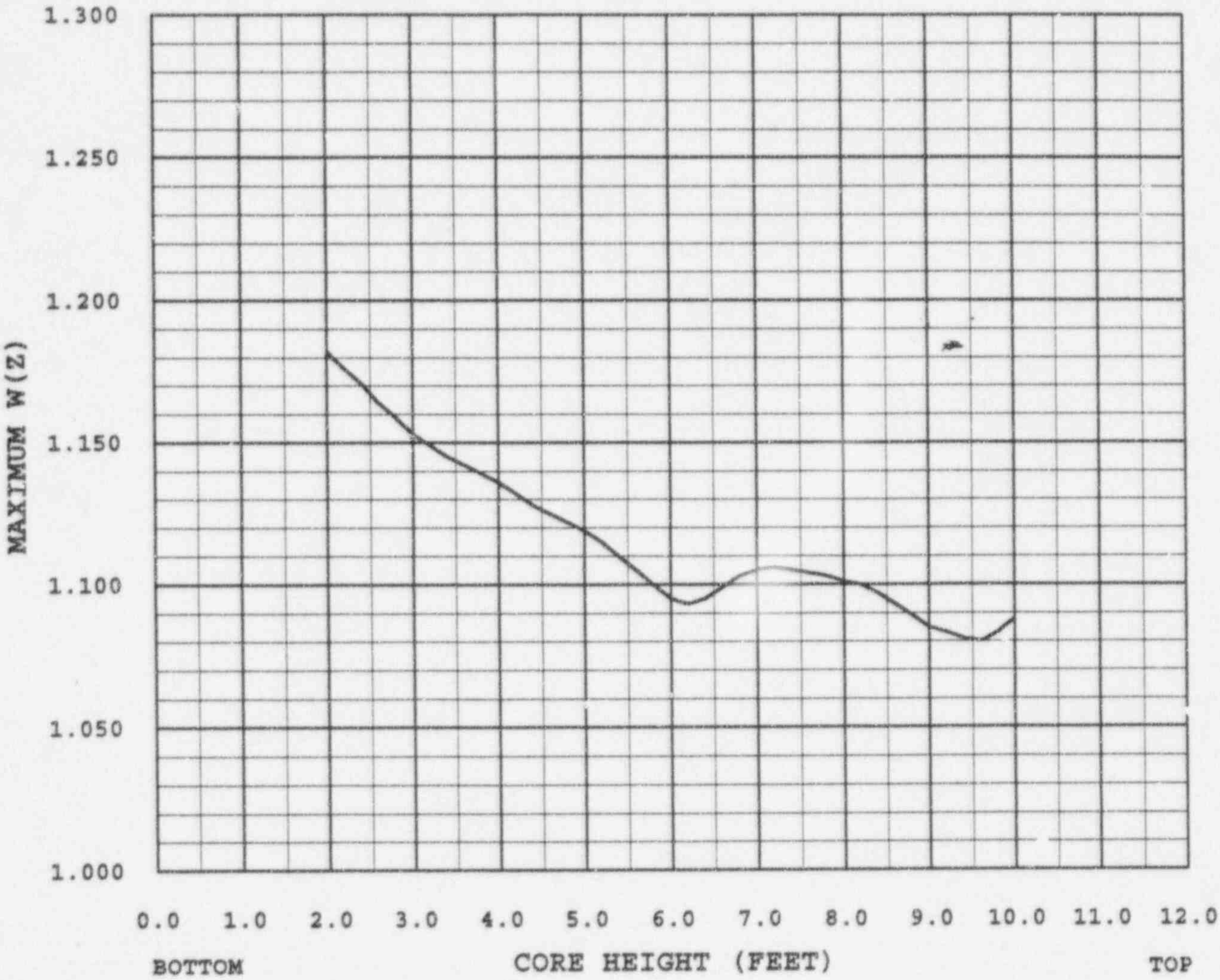


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.134	32	1.079	43	1.091
11	1.180	22	1.131	33	1.078	44	1.089
12	1.176	23	1.128	34	1.083	45	1.086
13	1.172	24	1.125	35	1.088	46	1.085
14	1.167	25	1.122	36	1.091	47	1.083
15	1.162	26	1.118	37	1.092	48	1.083
16	1.156	27	1.113	38	1.092	49	1.084
17	1.150	28	1.108	39	1.093	50	1.088
18	1.146	29	1.103	40	1.093	51	1.094
19	1.142	30	1.095	41	1.093	52 - 61	---
20	1.138	31	1.085	42	1.092		

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

FIGURE 7

W(Z) AS A FUNCTION OF CORE HEIGHT
(19000 MWD/MTU)



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.136	32	1.093	43	1.097
11	1.182	22	1.132	33	1.095	44	1.093
12	1.176	23	1.128	34	1.099	45	1.089
13	1.171	24	1.125	35	1.103	46	1.085
14	1.164	25	1.122	36	1.105	47	1.083
15	1.159	26	1.119	37	1.106	48	1.081
16	1.153	27	1.115	38	1.105	49	1.080
17	1.149	28	1.110	39	1.104	50	1.083
18	1.145	29	1.105	40	1.103	51	1.088
19	1.142	30	1.100	41	1.101	52 - 61	---
20	1.139	31	1.095	42	1.100		

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