RXE-96-001, Rev. 0

CPSES UNIT 2 CYCLE 3

CORE OPERATING LIMITS REPORT

March 1996

Daniel E. Brozak

Reviewed: Stephen M. Maier Date: 3/27/96

Stephen M. Maier
Reactor Physics Supervisor

Reviewed: Whee G. Choe Date: 3/27/96

Whee G. Choe
Safety Analysis Manager

Approved: Mickey R Killgore Date: 3/28/96

Mickey R. Killgore
Nuclear Analysis and
Fuel Manager

DISCLAIMER

The information contained in this report was prepared for the specific requirement of Texas Utilities Electric Company (TUEC), and may not be appropriate for use in situations other than those for which it was specifically prepared. TUEC PROVIDES NO WARRANTY HEREUNDER, EXPRESS OR IMPLIED, OR STATUTORY, OF ANY KIND OR NATURE WHATSOEVER, REGARDING THIS REPORT OR ITS USE, INCLUDING BUT NOT LIMITED TO ANY WARRANTIES ON MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

By making this report available, TUEC does not authorize its use by others, and any such use is forbidden except with the prior written approval of TUEC. Any such written approval shall itself be deemed to incorporate the disclaimers of liability and disclaimers of warranties provided herein. In no event shall TUEC have any liability for any incidental or consequential damages of any type in connection with the use, authorized or unauthorized, of this report or of the information in it.

TABLE OF CONTENTS

LIST OF FIGURES

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for CPSES UNIT 2 CYCLE 3 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
3/4.1.1.2	Shutdown Margin - T_{avg} Less Than or Equal to 200°F
3/4.1.1.3	Moderator Temperature Coefficient
3/4.1.2.2	Flow Paths - Operating
3/4.1.2.4	Charging Pumps - Operating
3/4.1.2.6	Borated Water Sources - Operating
3/4.1.3.5	Shutdown Rod Insertion Limit
3/4.1.3.6	Control Rod Insertion Limits
3/4.2.1	Axial Flux Difference
3/4.2.2	Heat Flux Hot Channel Factor
3/4.2.3	Nuclear Enthalpy Rise Hot Channel Factor

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 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)

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

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

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)

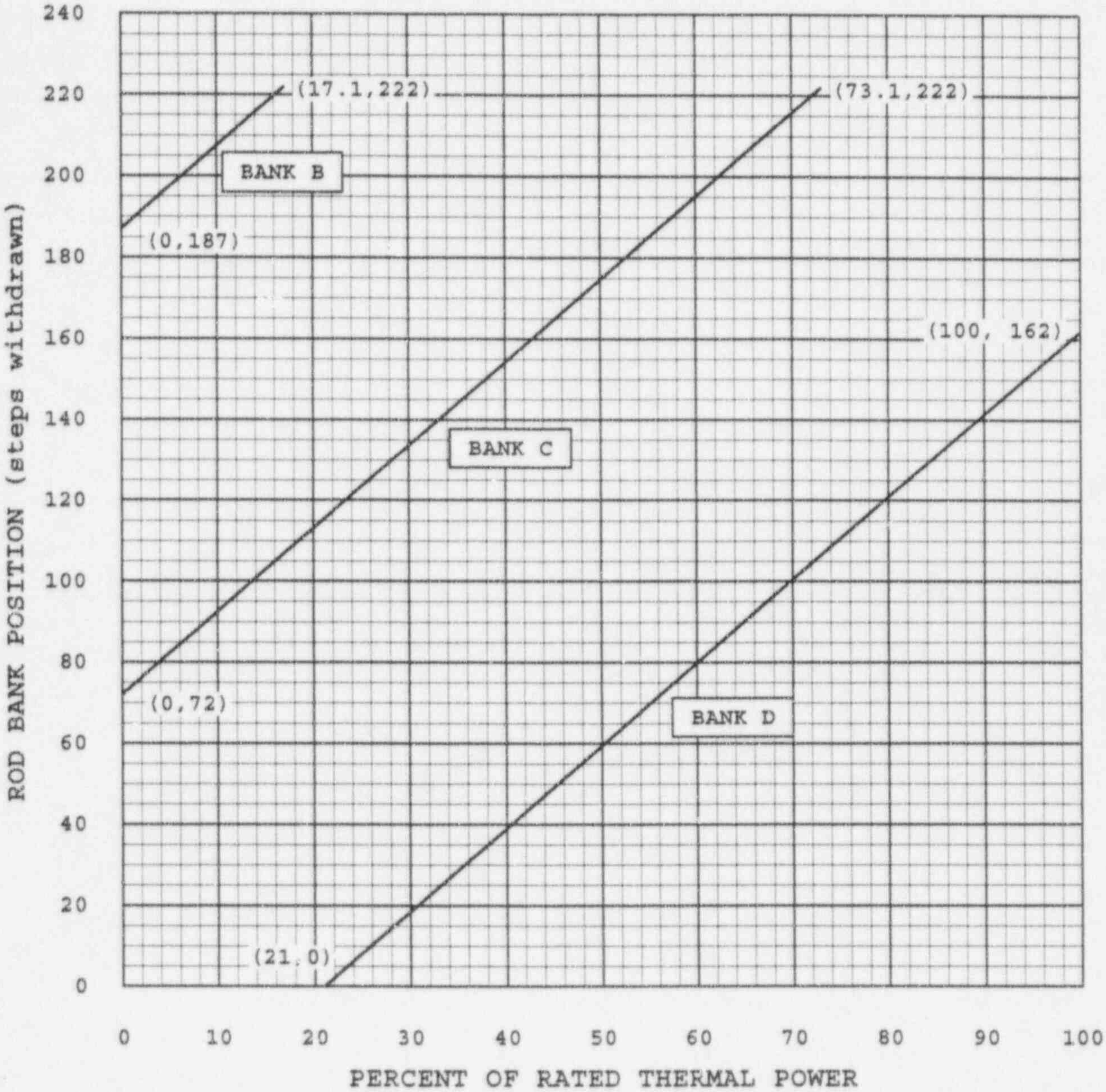
The SHUTDOWN MARGIN shall be greater than or equal to 1.3% Δk/k in MODES 1, 2, 3, and 4.

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% 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

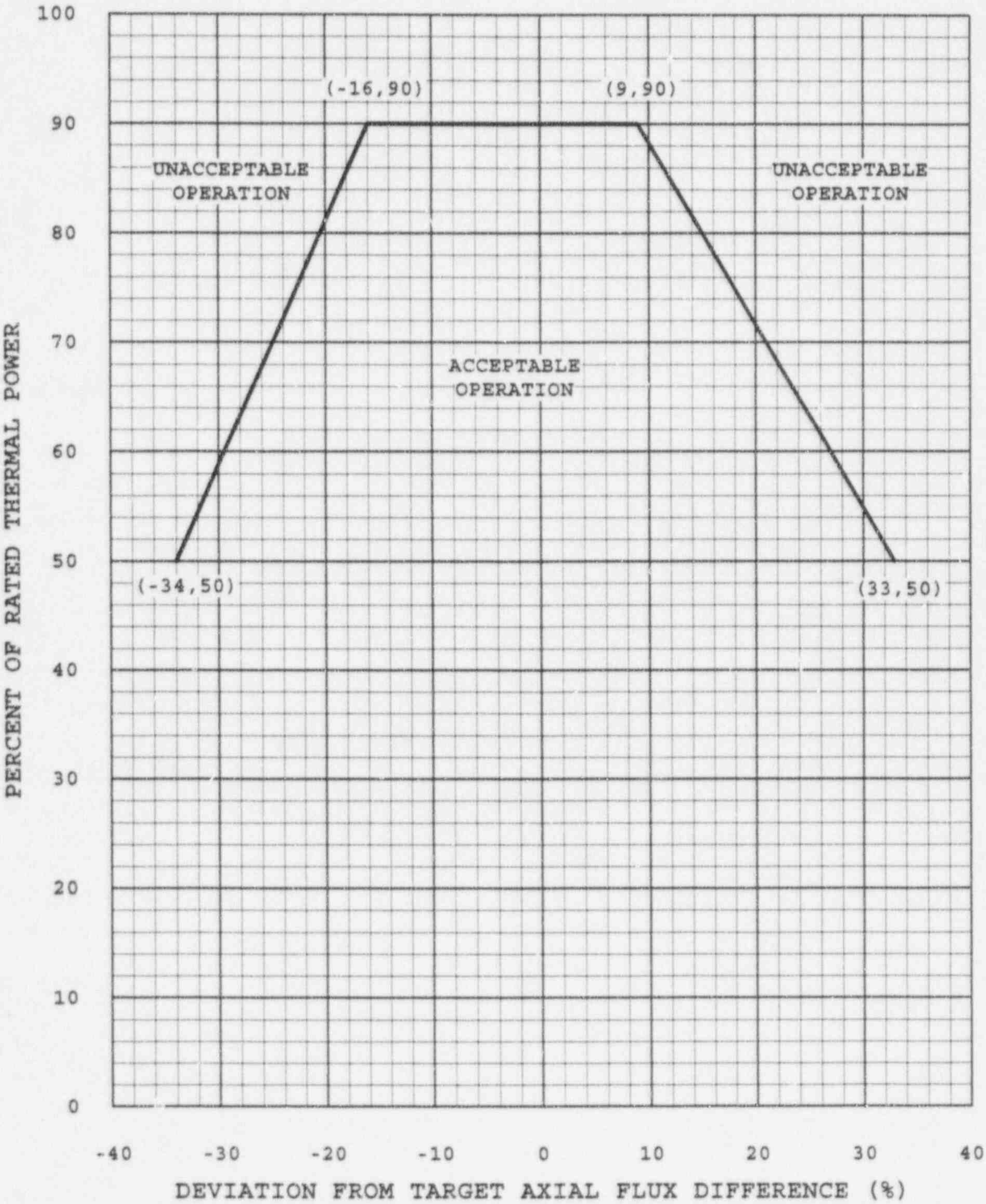
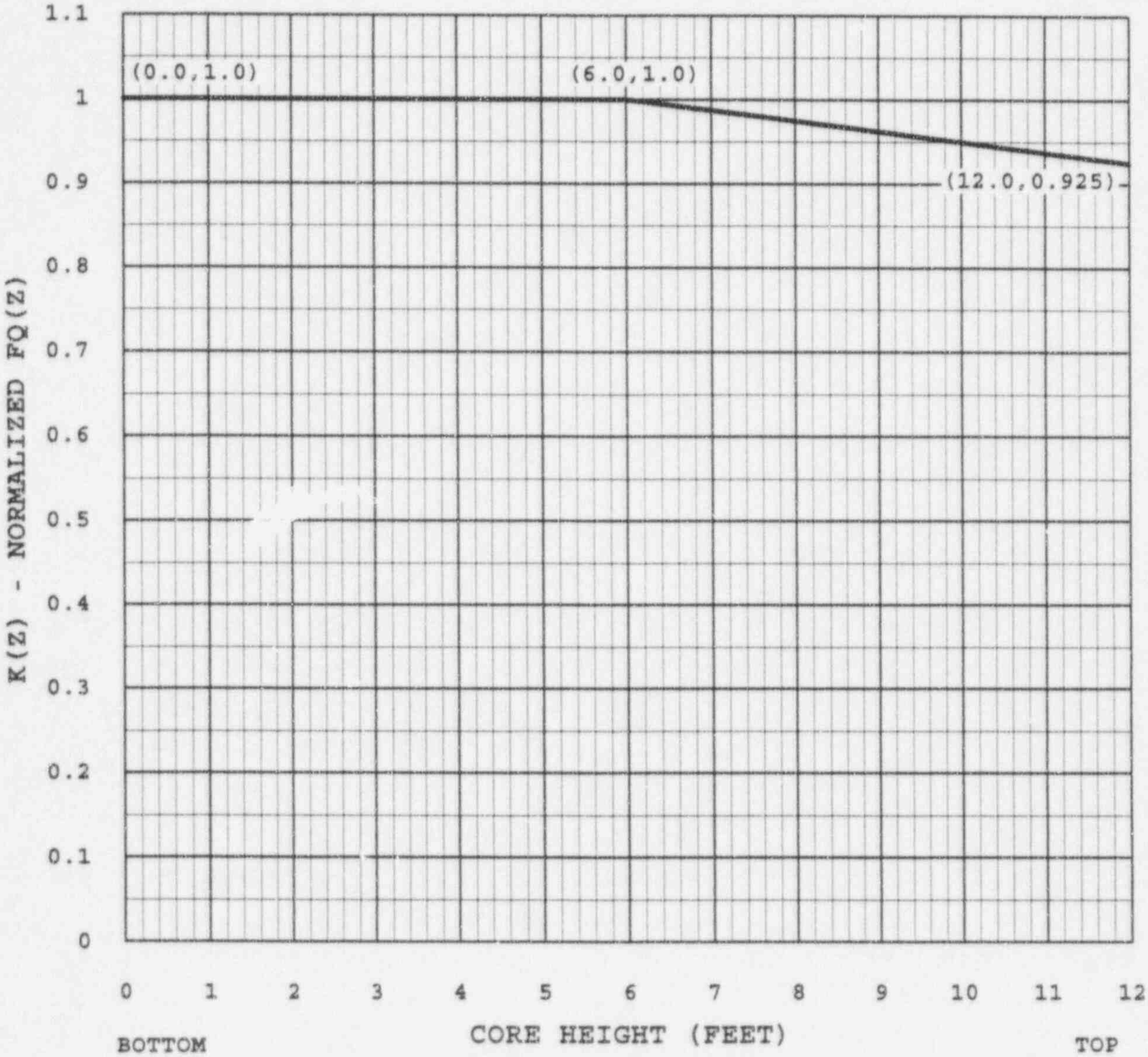


FIGURE 3

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

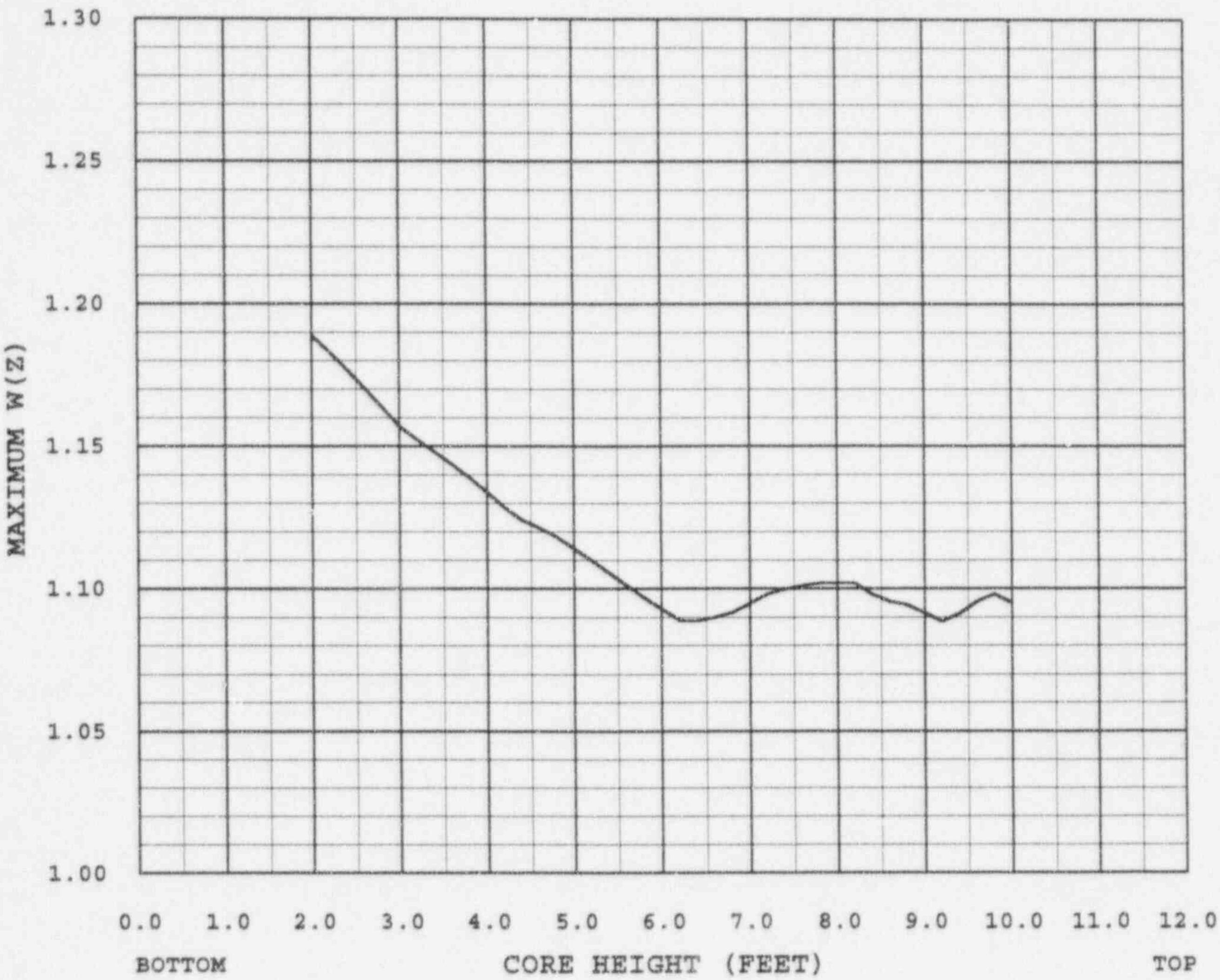


Axial Node	K(Z)	Axial Node	K(Z)	Axial Node	K(Z)	Axial Node	K(Z)
1 - 31	1.0000	39	0.9800	47	0.9600	55	0.9400
32	0.9975	40	0.9775	48	0.9575	56	0.9375
33	0.9950	41	0.9750	49	0.9550	57	0.9350
34	0.9925	42	0.9725	50	0.9525	58	0.9325
35	0.9900	43	0.9700	51	0.9500	59	0.9300
36	0.9875	44	0.9675	52	0.9475	60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

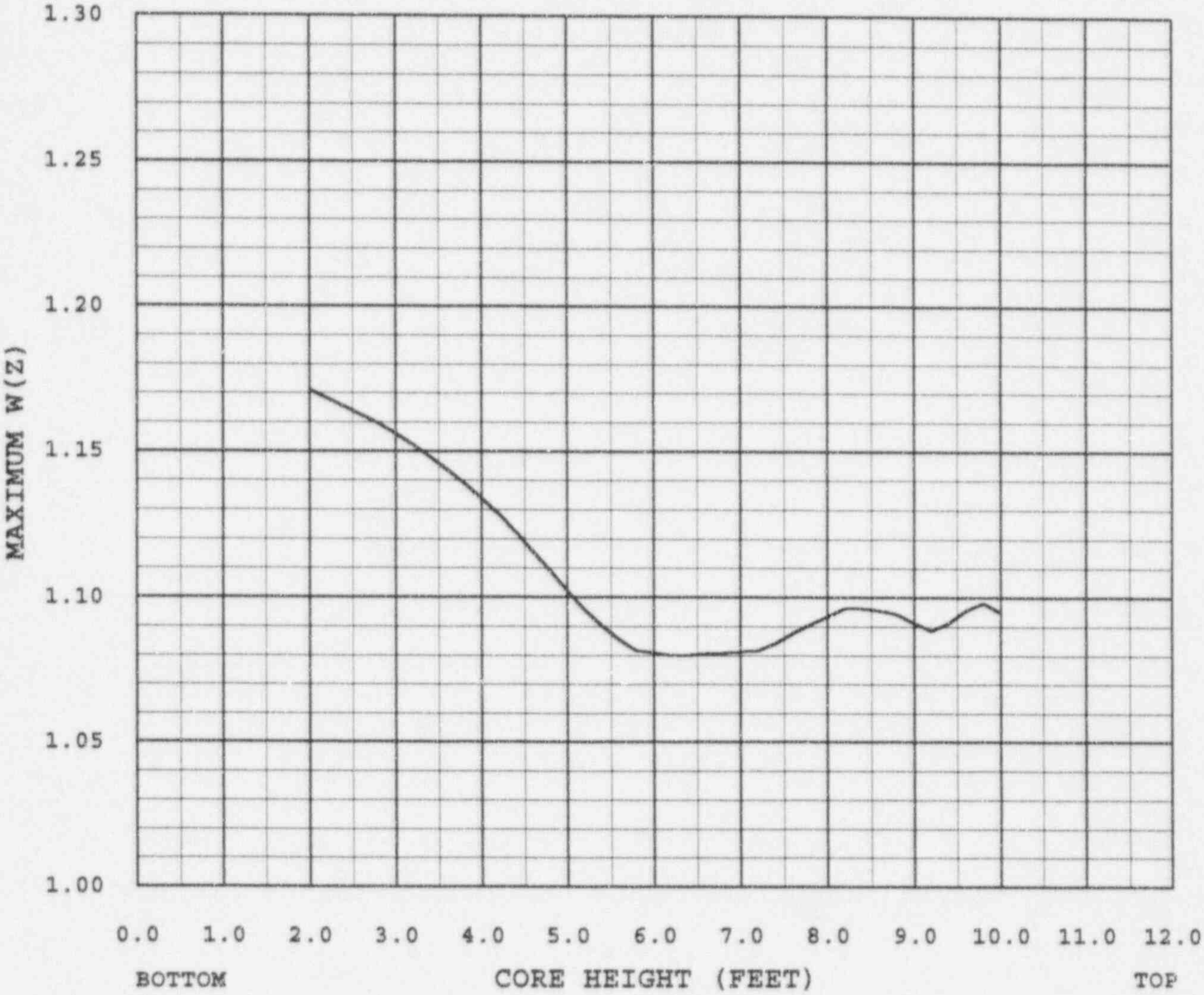


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.134	32	1.089	43	1.098
11	1.189	22	1.128	33	1.089	44	1.095
12	1.183	23	1.124	34	1.090	45	1.094
13	1.177	24	1.121	35	1.092	46	1.091
14	1.170	25	1.118	36	1.095	47	1.088
15	1.164	26	1.114	37	1.098	48	1.091
16	1.157	27	1.110	38	1.100	49	1.096
17	1.152	28	1.106	39	1.101	50	1.098
18	1.148	29	1.101	40	1.102	51	1.095
19	1.144	30	1.097	41	1.102	52 - 61	---
20	1.139	31	1.093	42	1.102		

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

FIGURE 5

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

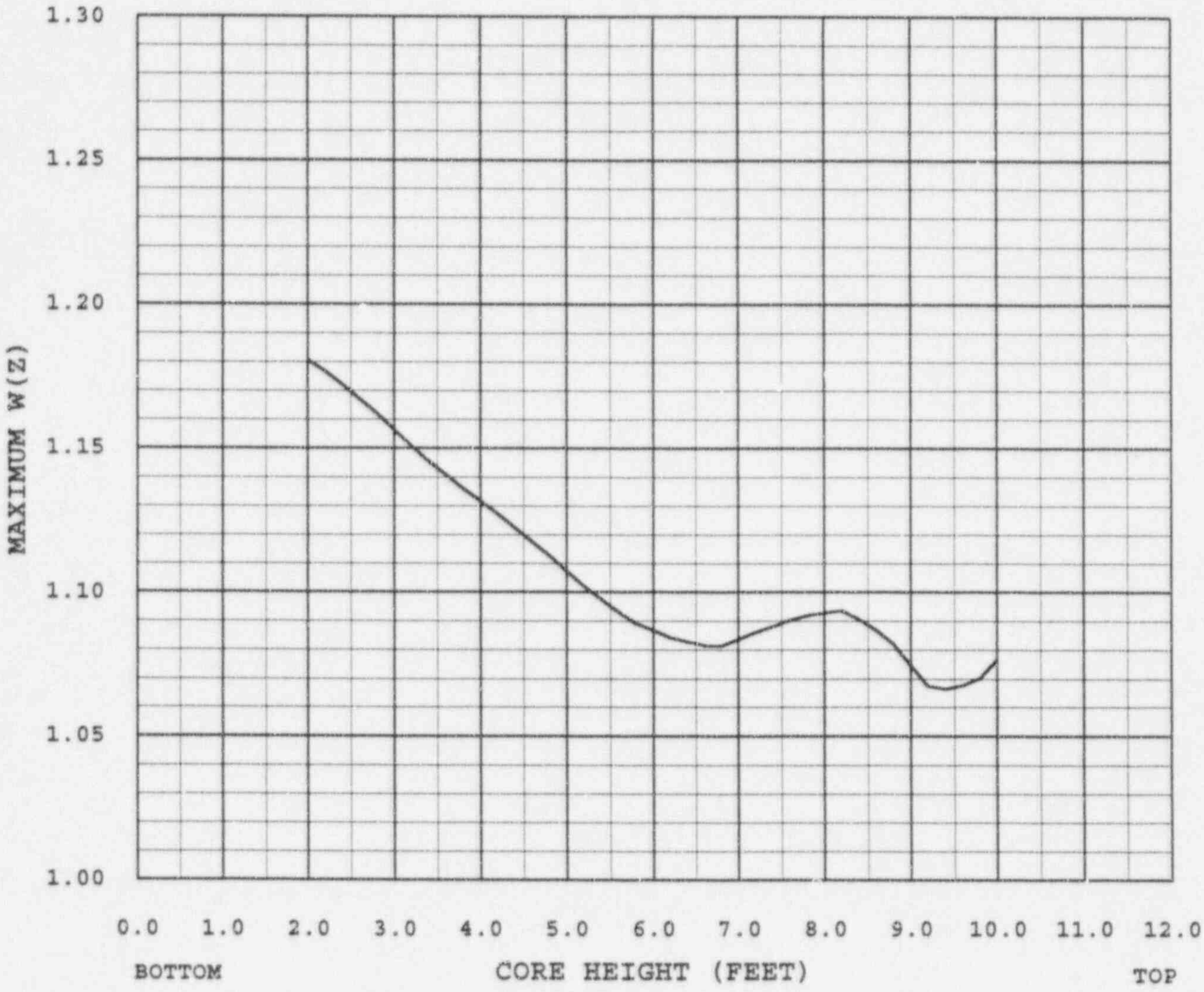


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.134	32	1.080	43	1.096
11	1.171	22	1.128	33	1.080	44	1.095
12	1.168	23	1.122	34	1.080	45	1.094
13	1.165	24	1.116	35	1.081	46	1.091
14	1.163	25	1.109	36	1.081	47	1.088
15	1.160	26	1.102	37	1.082	48	1.091
16	1.156	27	1.096	38	1.084	49	1.096
17	1.152	28	1.090	39	1.087	50	1.098
18	1.148	29	1.085	40	1.090	51	1.095
19	1.144	30	1.082	41	1.093	52 - 61	---
20	1.139	31	1.081	42	1.096		

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

FIGURE 6

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

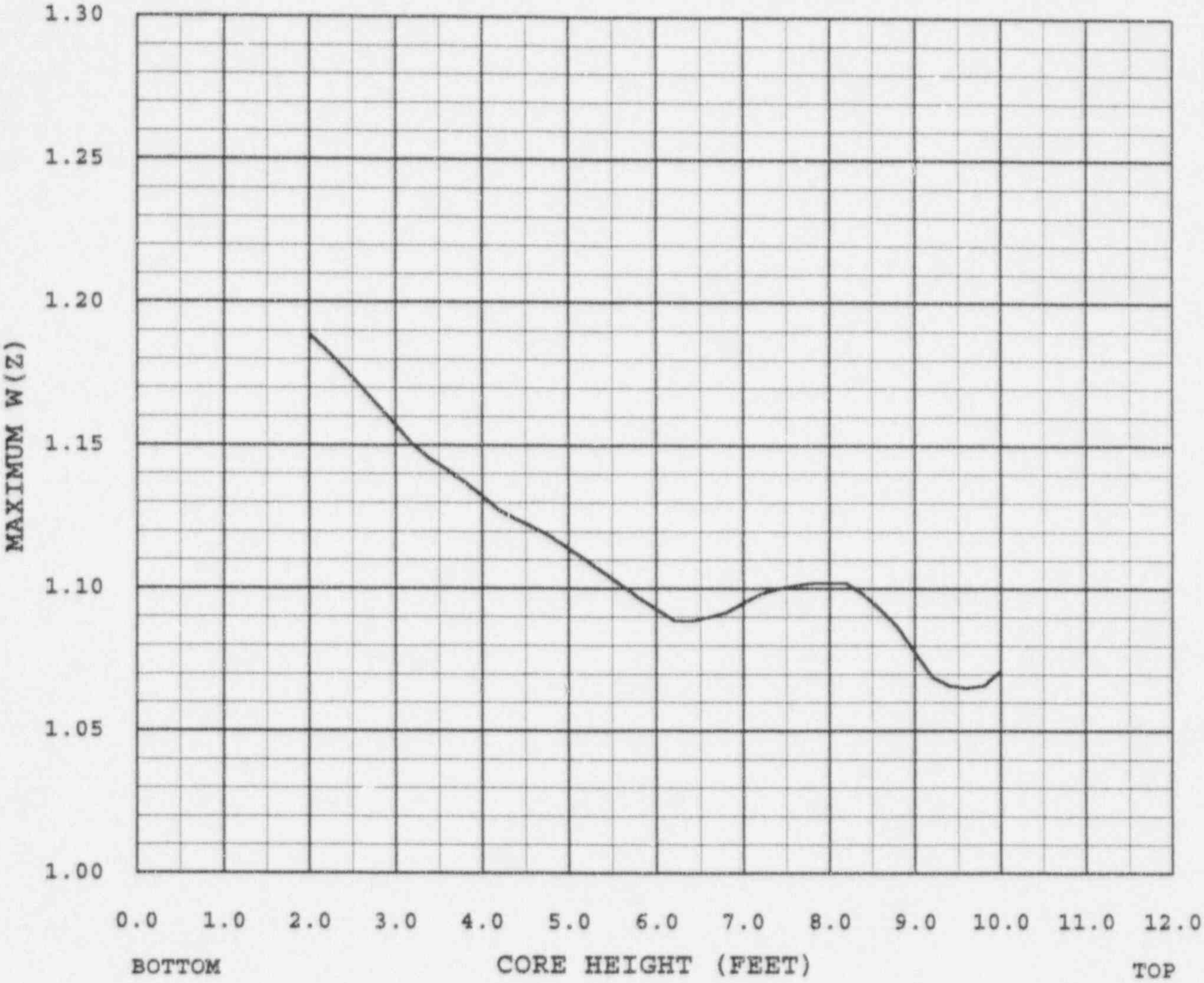


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.132	32	1.084	43	1.091
11	1.181	22	1.127	33	1.083	44	1.087
12	1.177	23	1.123	34	1.082	45	1.082
13	1.172	24	1.118	35	1.081	46	1.075
14	1.167	25	1.113	36	1.084	47	1.067
15	1.162	26	1.107	37	1.086	48	1.066
16	1.156	27	1.102	38	1.088	49	1.068
17	1.151	28	1.098	39	1.090	50	1.070
18	1.146	29	1.093	40	1.092	51	1.077
19	1.141	30	1.089	41	1.093	52 - 61	---
20	1.136	31	1.087	42	1.094		

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

FIGURE 7

W(Z) AS A FUNCTION OF CORE HEIGHT
(20000 MWD/MTU)



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	[illegible]	32	1.089	43	1.098
11	1.189	22	1.127	33	1.089	44	1.093
12	1.183	23	1.124	34	1.090	45	1.087
13	1.177	24	1.121	35	1.092	46	1.078
14	1.170	25	1.118	36	1.095	47	1.069
15	1.164	26	1.114	37	1.098	48	1.066
16	1.157	27	1.110	38	1.100	49	1.065
17	1.150	28	1.106	39	1.101	50	1.066
18	1.145	29	1.101	40	1.102	51	1.071
19	1.141	30	1.097	41	1.102	52 - 61	---
20	1.137	31	1.093	42	1.102		

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