RXE-94-004, Rev. 1

CPSES UNIT 2 CYCLE 2

CORE OPERATING LIMITS REPORT

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1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for CPSES UNIT 2 CYCLE 2 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	
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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 1, 2, 3, 4, 5, 6, 7, 8, 16, 18, 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2.2.1 The shutdown rods shall be fully withdrawn. Fully withdrawn shall be the condition where shutdown rods are at a position within the interval of 222 and 231 steps withdrawn, inclusive.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 $F_Q^{RTP} = 2.32$

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 Table 1 shows F_Q margin decreases that are greater than 2% per 31 Effective Full Power Days (EFPD). These values shall be used instead of a constant 2% to increase $F_Q^C(z)$ per Surveillance Requirement 4.2.2.2.f. A constant factor of 2% shall be used at all cycle burnups that are outside the range of Table 1.

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

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

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% 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)

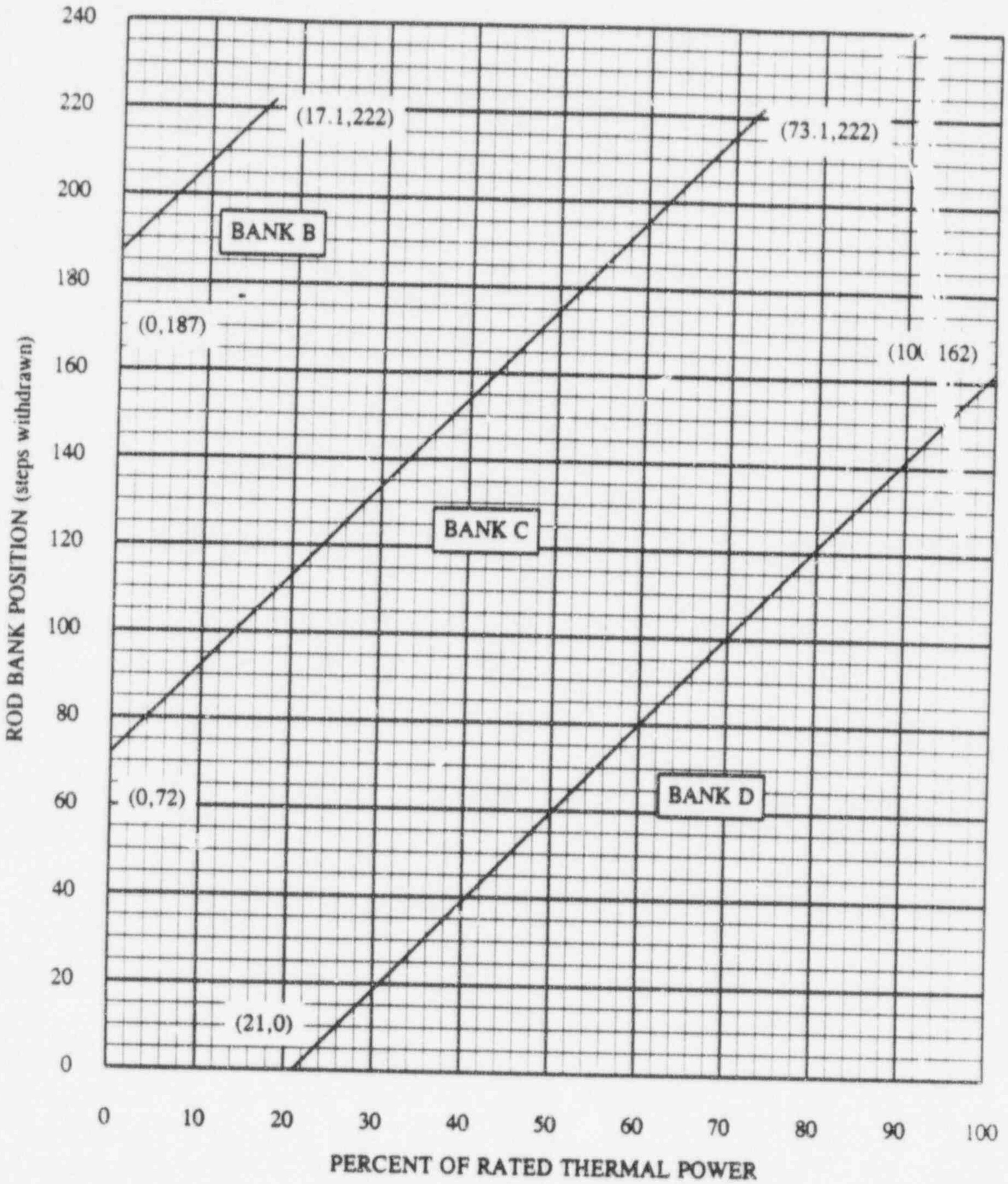
The SHUTDOWN MARGIN shall be greater than or equal to 1.3% Δk/k in MODE 5.

TABLE 1 F_Q MARGIN DECREASES IN EXCESS OF 2% PER 31 EFPD

Cycle Burnup (MWD/MTU)	Maximum Decrease in F_Q Margin (Percent)
2560	2.00
2720	2.23
2881	2.52
3042	2.70
3202	2.55
3363	2.37
3524	2.18
3684	2.04
3730	2.00

Note: All cycle burnups outside the range of the table shall use a constant 2% decrease in F_Q margin for compliance with the 4.2.2.2.f Surveillance Requirements. Linear interpolation is acceptable to determine the F_Q margin decrease for cycle burnups which fall between the specified burnups.

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

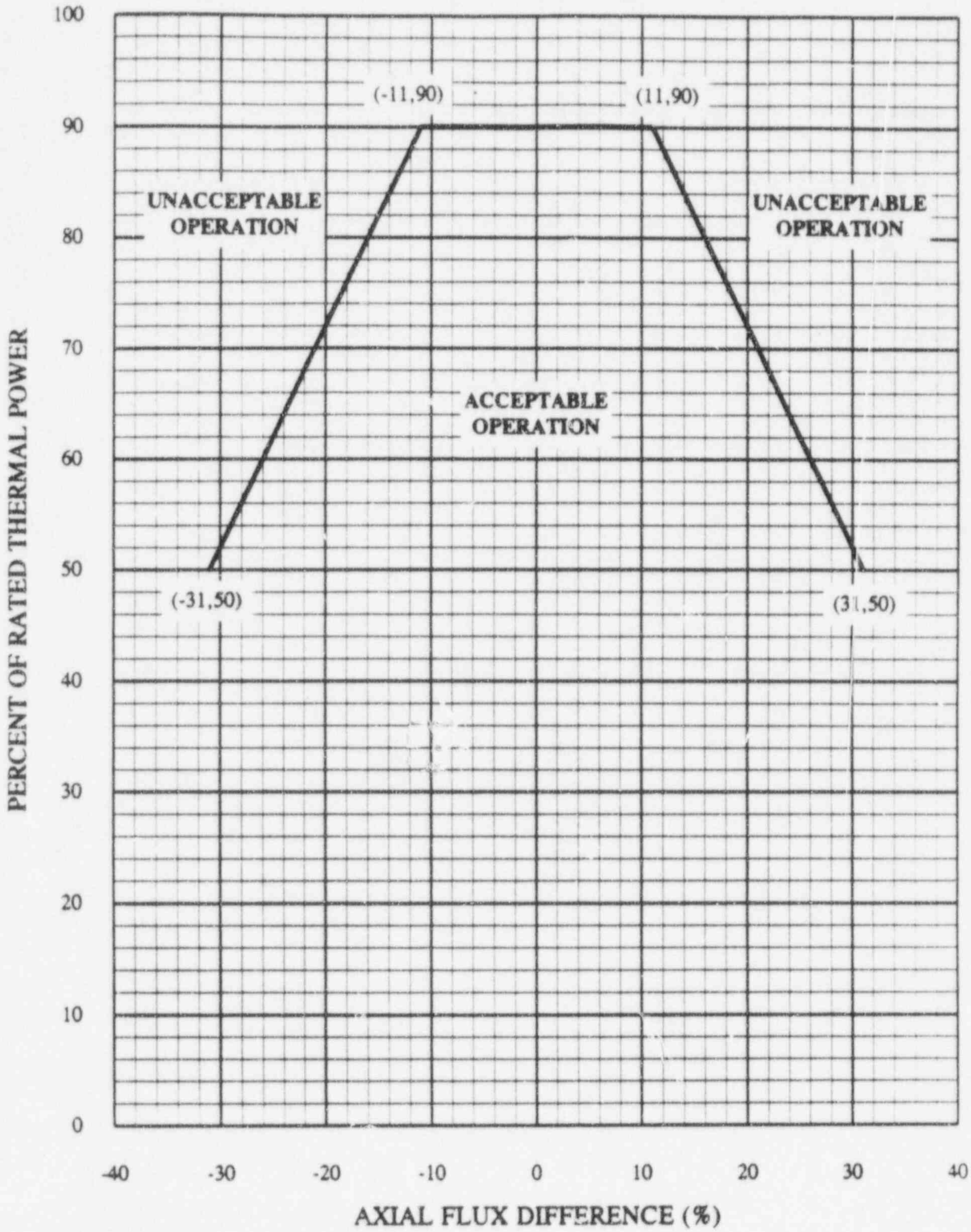
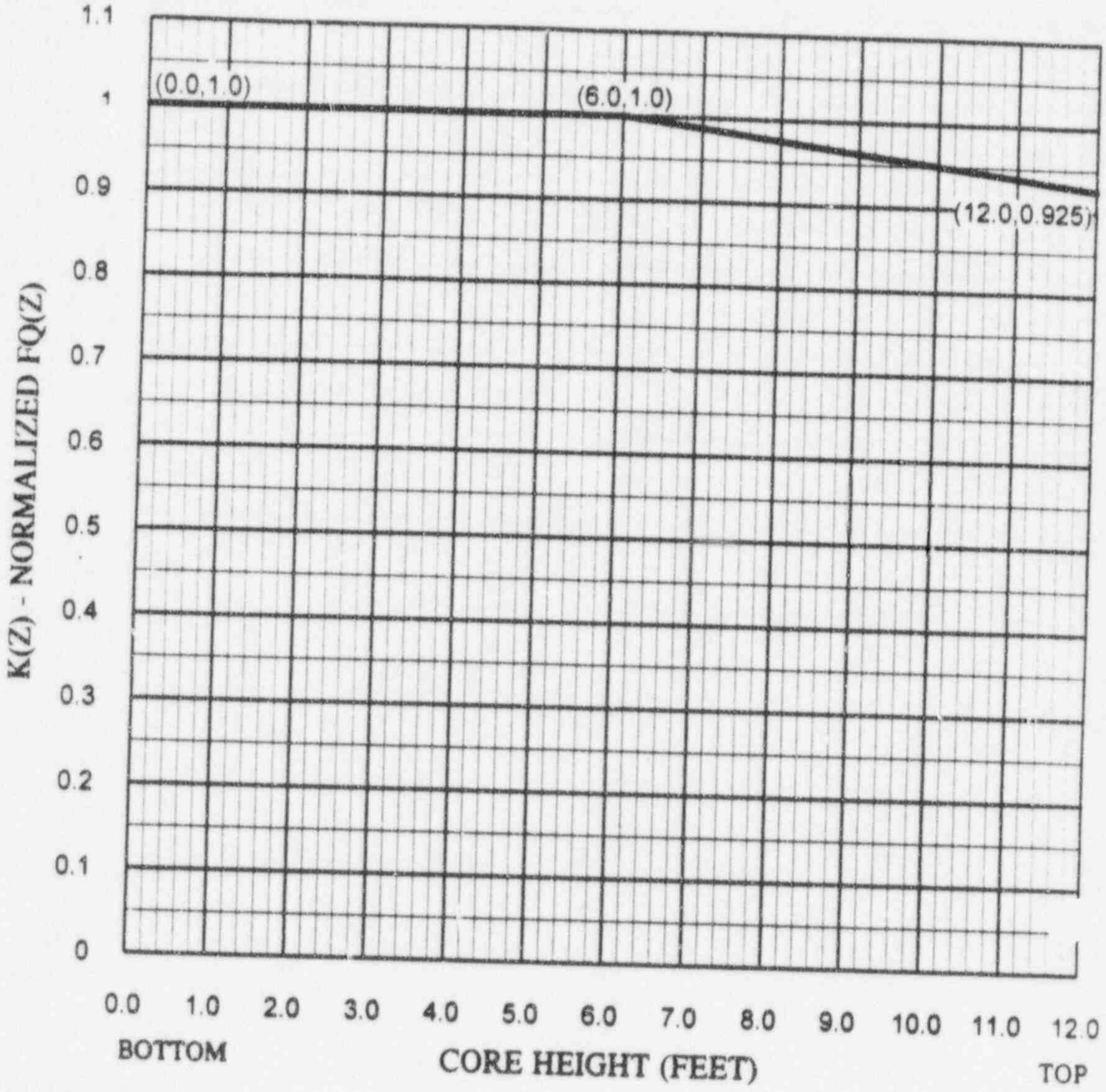


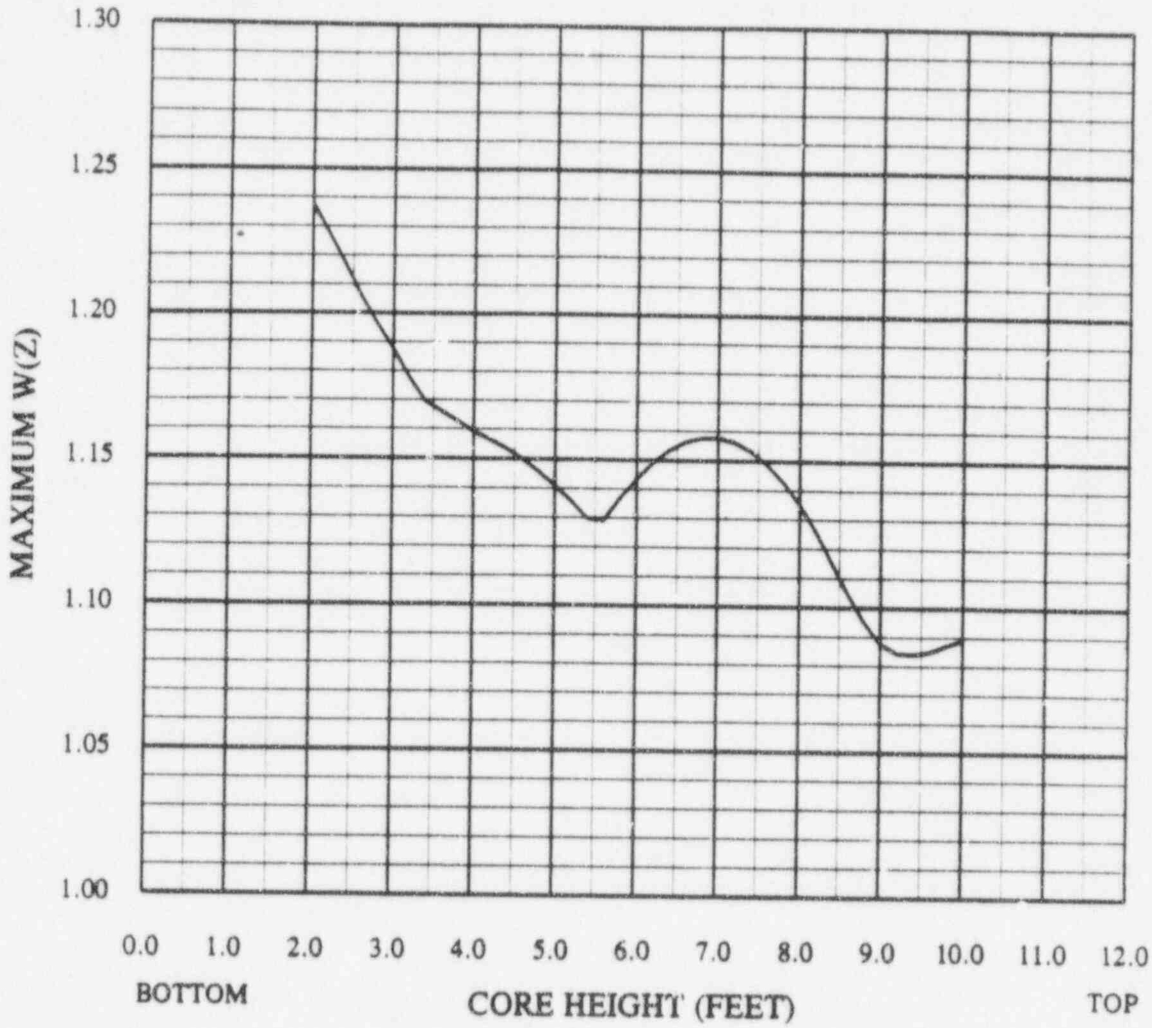
FIGURE 3 K(Z) - NORMALIZED $F_Q(Z)$ AS A FUNCTION OF CORE HEIGHT



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

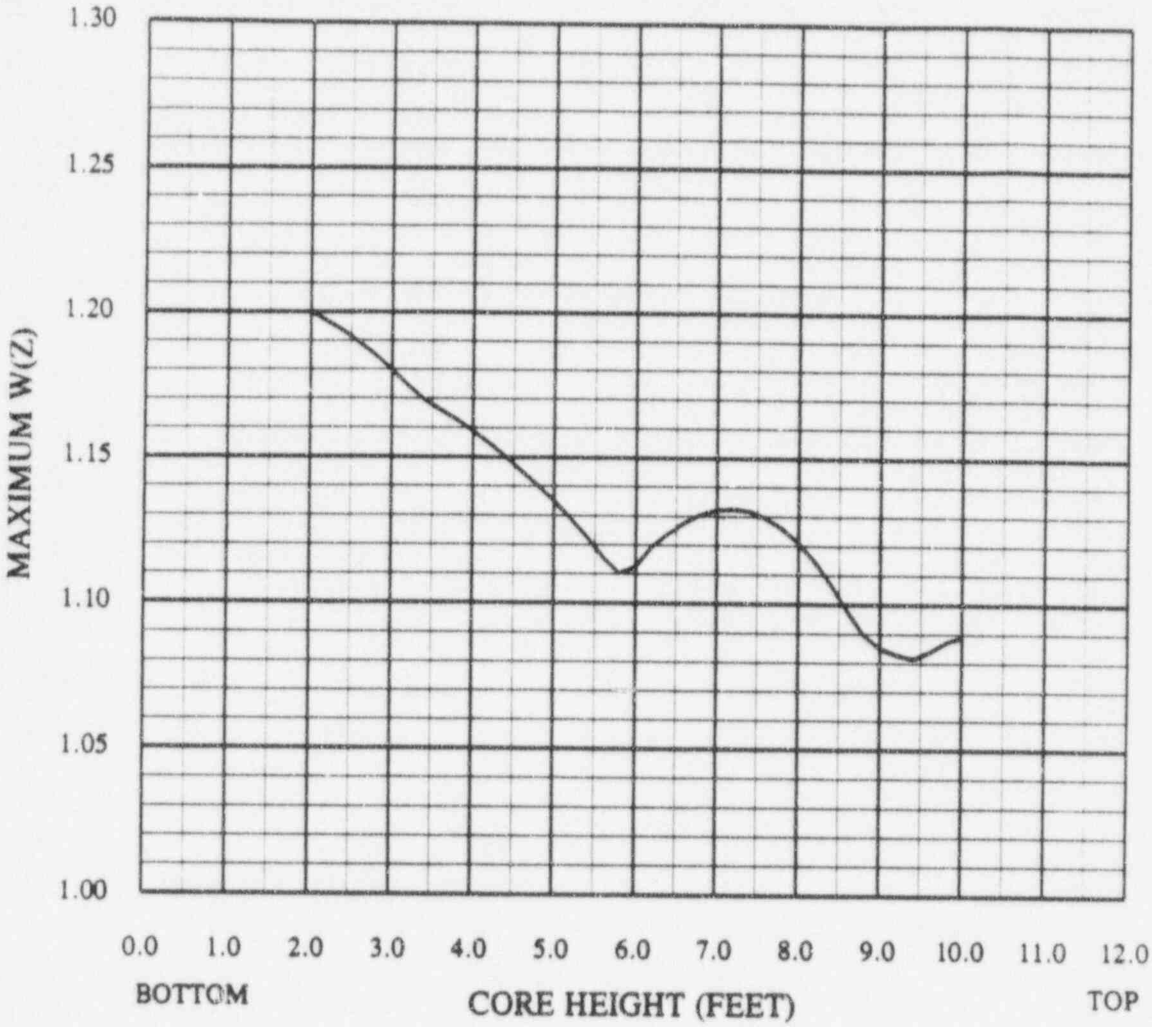
FIGURE 4 W(Z) AS A FUNCTION OF CORE HEIGHT
MAXIMUM



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.1592	32	1.1491	43	1.1154
11	1.2375	22	1.1564	33	1.1533	44	1.1047
12	1.2277	23	1.1533	34	1.1562	45	1.0950
13	1.2171	24	1.1497	35	1.1577	46	1.0876
14	1.2058	25	1.1456	36	1.1577	47	1.0843
15	1.1960	26	1.1409	37	1.1563	48	1.0840
16	1.1876	27	1.1357	38	1.1532	49	1.0850
17	1.1779	28	1.1298	39	1.1487	50	1.0871
18	1.1696	29	1.1290	40	1.1427	51	1.0892
19	1.1661	30	1.1368	41	1.1352	52 - 61	---
20	1.1627	31	1.1435	42	1.1260		

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

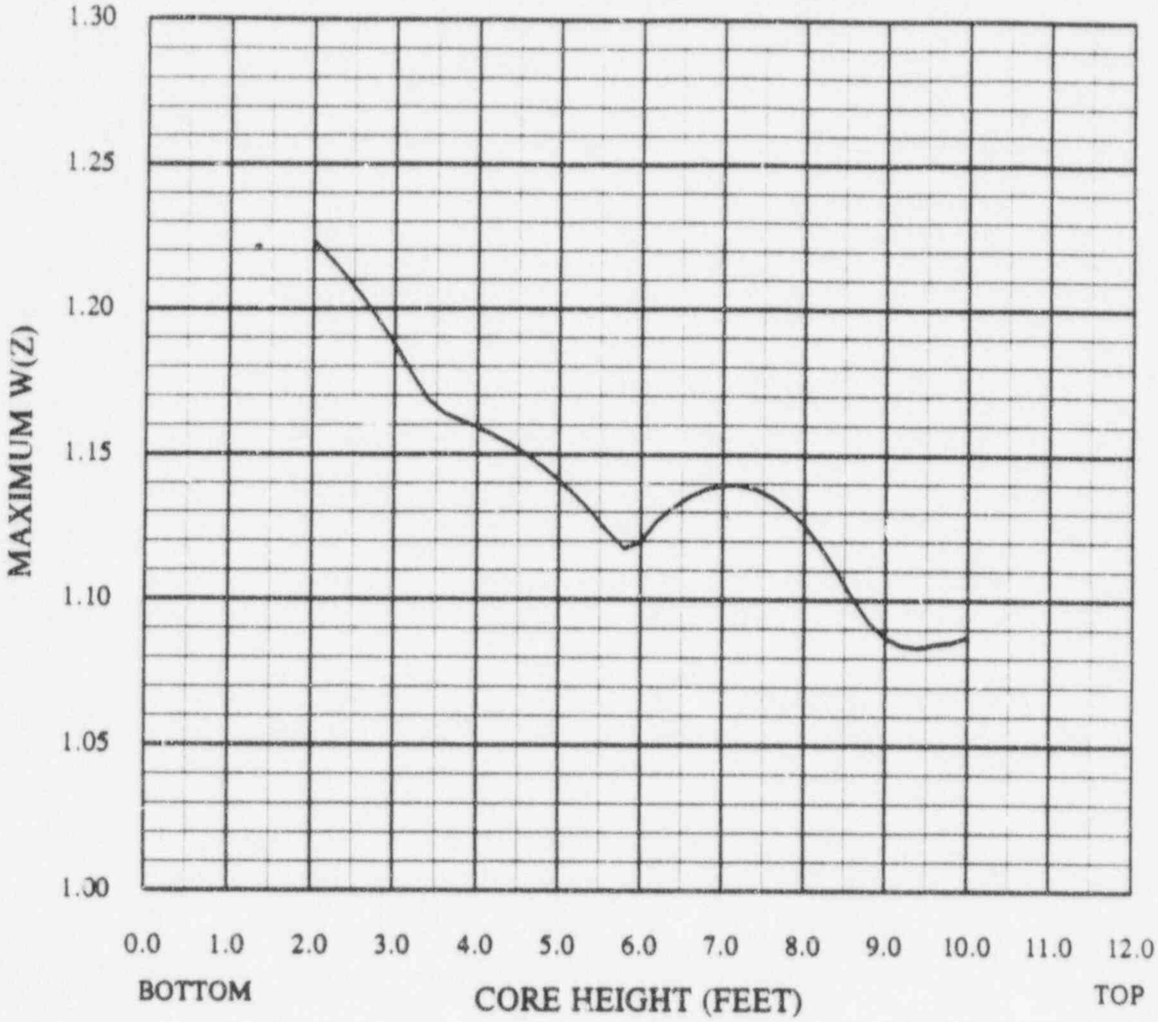
FIGURE 5 W(Z) AS A FUNCTION OF CORE HEIGHT
150 MWD/MTU



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.1589	32	1.1195	43	1.1067
11	1.2001	22	1.1547	33	1.1240	44	1.0977
12	1.1967	23	1.1501	34	1.1278	45	1.0895
13	1.1933	24	1.1450	35	1.1306	46	1.0850
14	1.1892	25	1.1401	36	1.1321	47	1.0829
15	1.1847	26	1.1349	37	1.1325	48	1.0814
16	1.1797	27	1.1291	38	1.1317	49	1.0839
17	1.1744	28	1.1228	39	1.1295	50	1.0871
18	1.1696	29	1.1158	40	1.1260	51	1.0892
19	1.1661	30	1.1102	41	1.1210	52 - 61	---
20	1.1627	31	1.1126	42	1.1146		

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

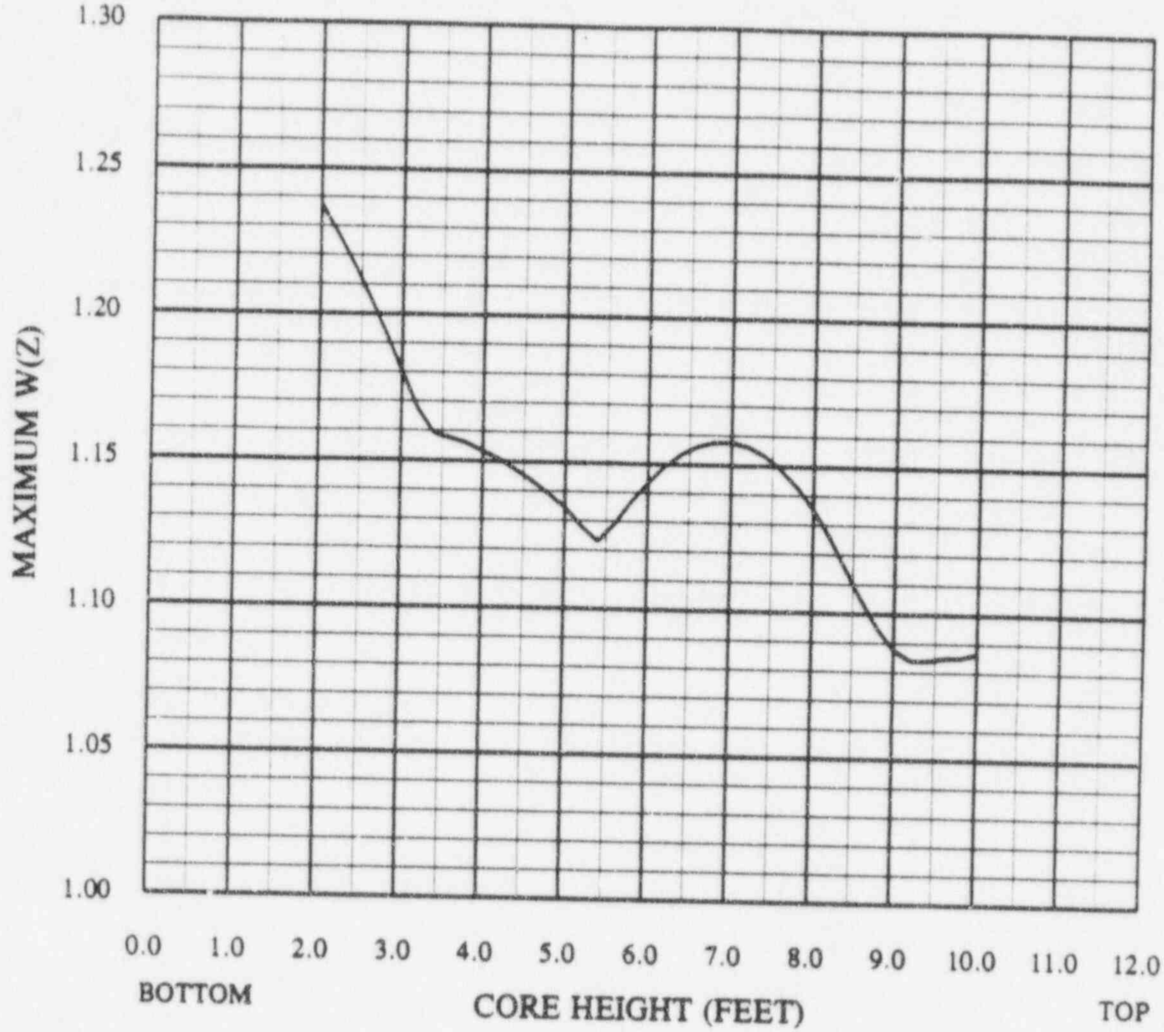
FIGURE 6 W(Z) AS A FUNCTION OF CORE HEIGHT
8000 MWD/MTU



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	—	21	1.1592	32	1.1271	43	1.1100
11	1.2234	22	1.1564	33	1.1317	44	1.1005
12	1.2175	23	1.1533	34	1.1355	45	1.0923
13	1.2111	24	1.1497	35	1.1381	46	1.0870
14	1.2040	25	1.1456	36	1.1394	47	1.0843
15	1.1960	26	1.1409	37	1.1395	48	1.0837
16	1.1876	27	1.1357	38	1.1381	49	1.0849
17	1.1779	28	1.1298	39	1.1354	50	1.0855
18	1.1686	29	1.1232	40	1.1312	51	1.0875
19	1.1638	30	1.1175	41	1.1255	52 - 61	---
20	1.1614	31	1.1199	42	1.1184		

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

FIGURE 7 W(Z) AS A FUNCTION OF CORE HEIGHT
14000 MWD/MTU



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	—	21	1.1533	32	1.1491	43	1.1154
11	1.2375	22	1.1506	33	1.1533	44	1.1047
12	1.2277	23	1.1473	34	1.1562	45	1.0950
13	1.2171	24	1.1435	35	1.1577	46	1.0876
14	1.2058	25	1.1391	36	1.1577	47	1.0840
15	1.1936	26	1.1345	37	1.1563	48	1.0840
16	1.1803	27	1.1281	38	1.1532	49	1.0850
17	1.1674	28	1.1232	39	1.1487	50	1.0851
18	1.1592	29	1.1290	40	1.1427	51	1.0866
19	1.1576	30	1.1368	41	1.1352	52 - 61	—
20	1.1559	31	1.1435	42	1.1260		

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