RXE-92-002

CPSES UNIT 1 CYCLE 3

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 3 has been prepared in accordance with the requirements of Technical Specification 6.9.1.6.

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 Limits
3/4.2.1	Axial Flux Difference
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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 Specifications 6.9.1.6.

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2.2.1 The shutdown rods shall be fully withdrawn. Fully withdrawn shall be the condition where shutdown rods are at a position within the interval of 222 and 231 steps withdrawn, inclusive.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 $F_Q^{RTP} = 2.32$

2.5.2 K(Z) is provided in Figure 3

2.5.3 Elevation dependent W(Z) values for load follow operation 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.

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

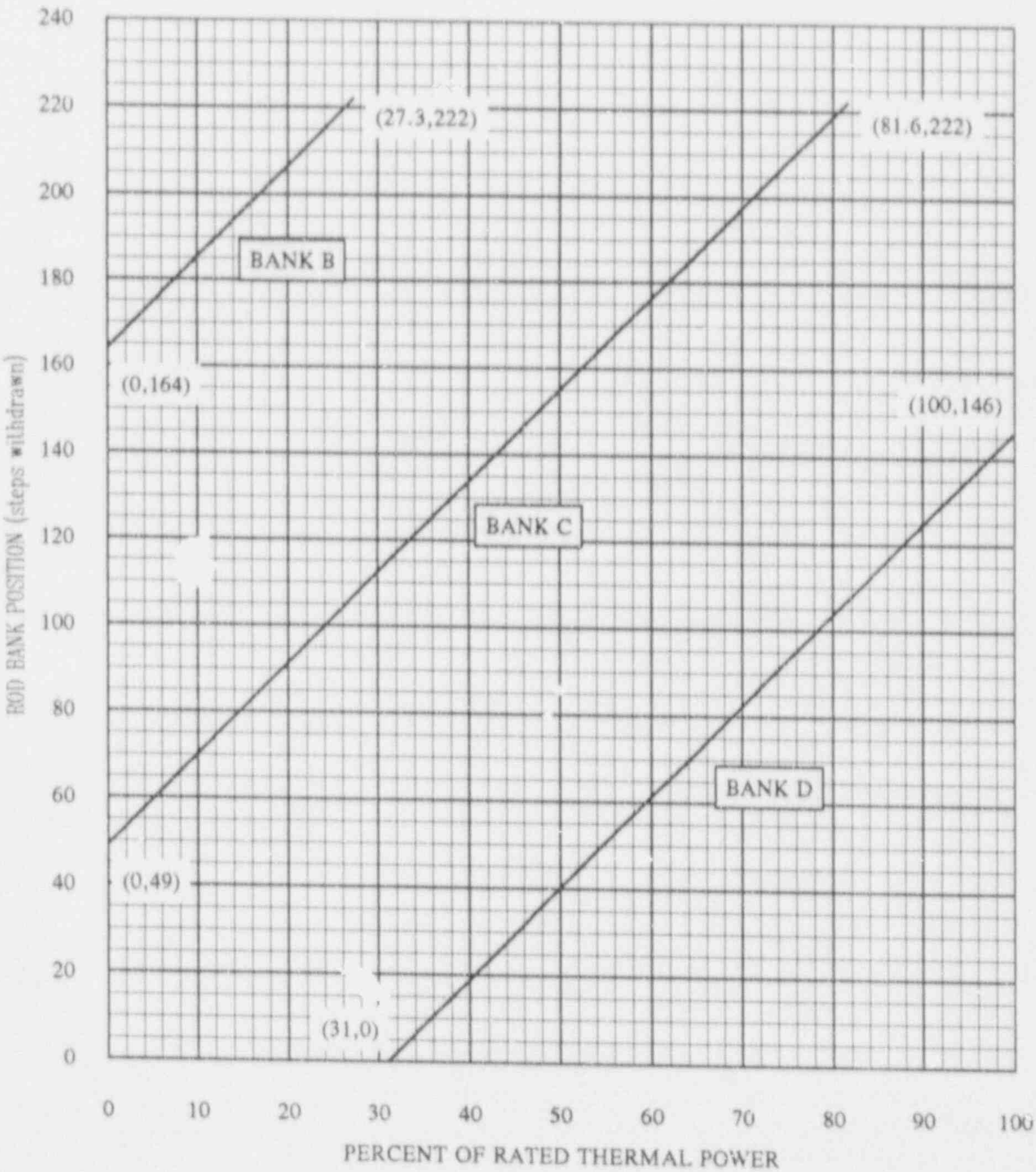
$$F^{N}_{\Delta H} \leq F^{RTP}_{\Delta H} \left[1 + PF_{\Delta H} (1-P)\right]$$

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

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

2.6.2 $PF_{\Delta H} = 0.2$

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

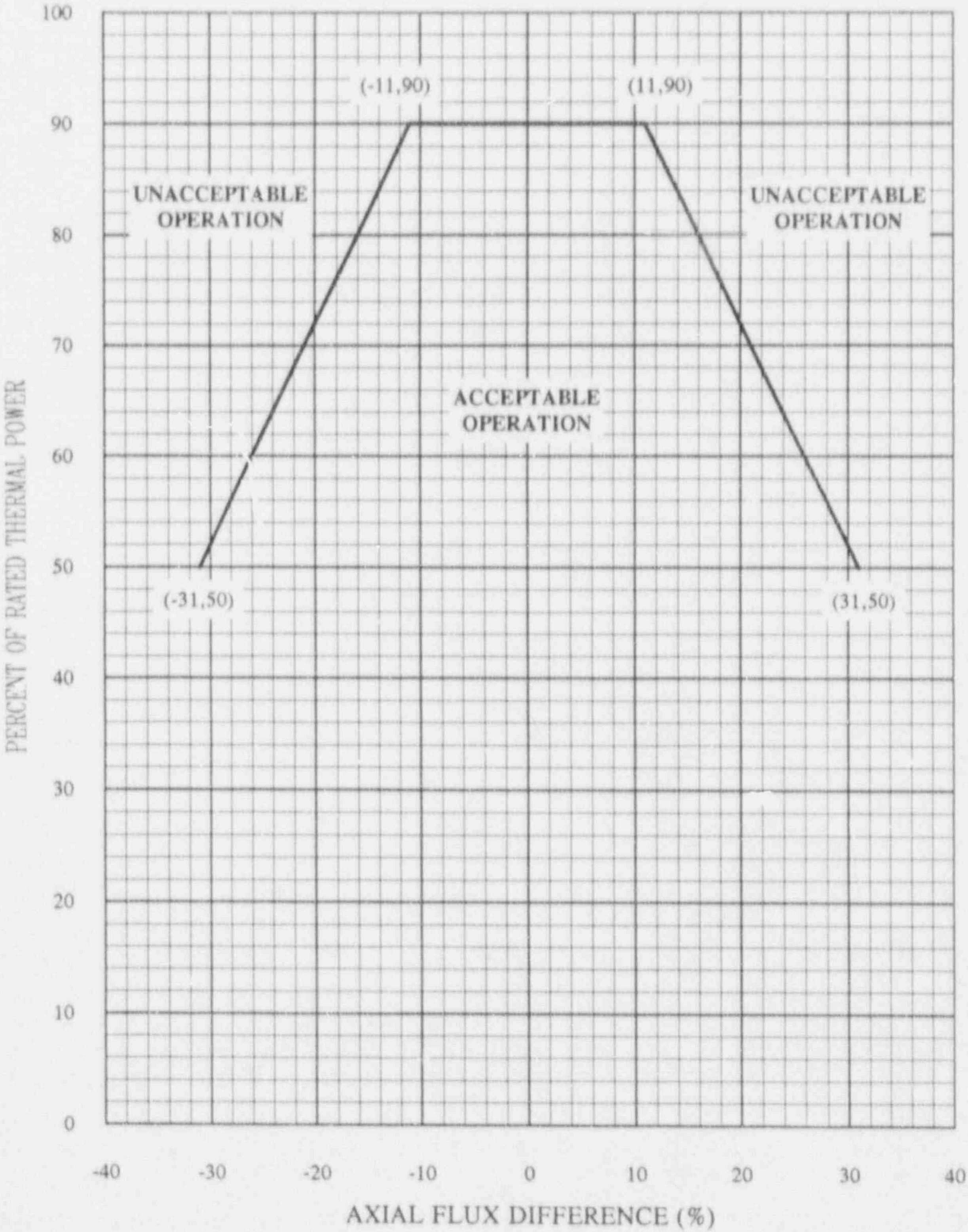


FIGURE 3 K(Z) - NORMALIZED $F_Q(Z)$ AS A FUNCTION OF CORE HEIGHT

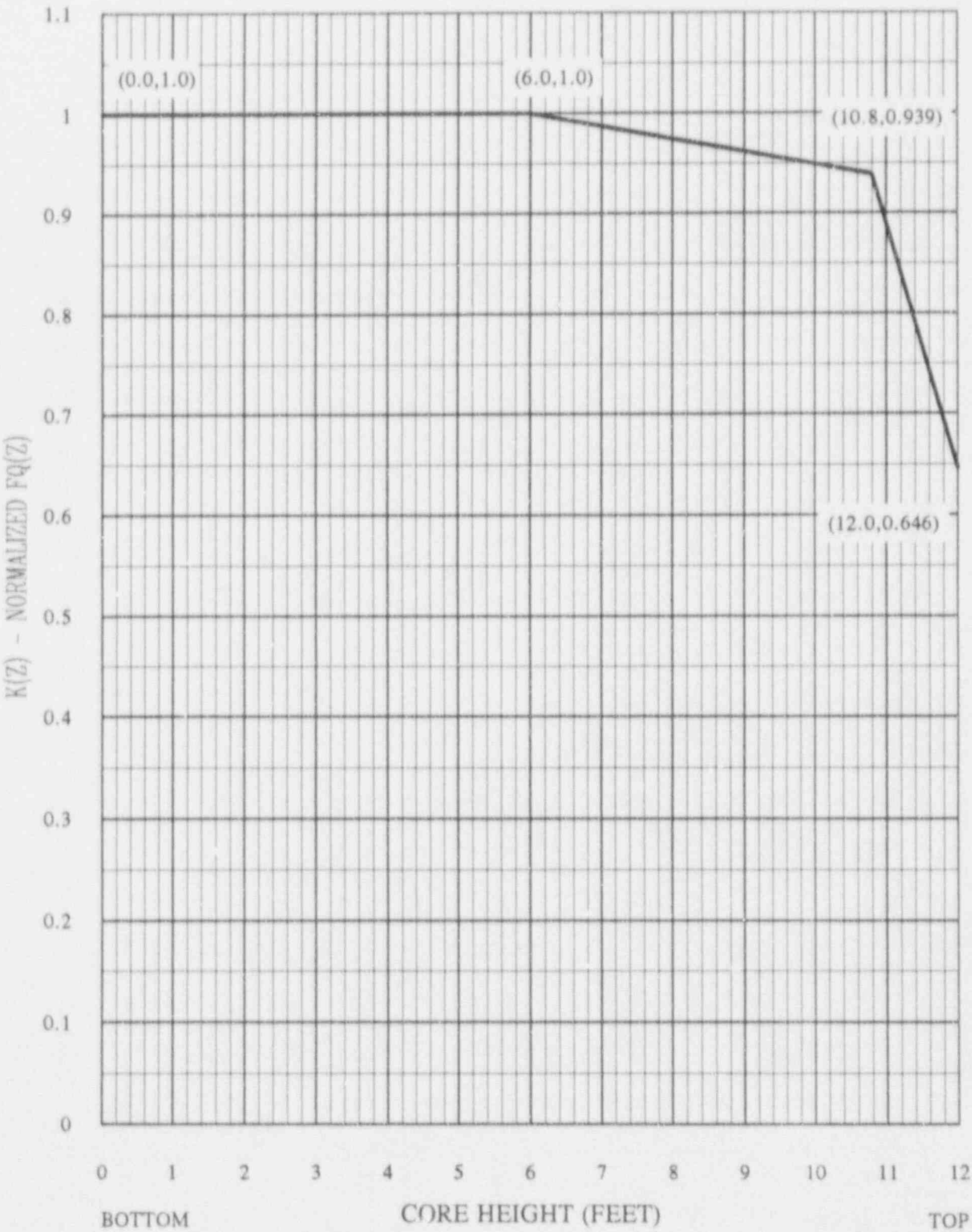
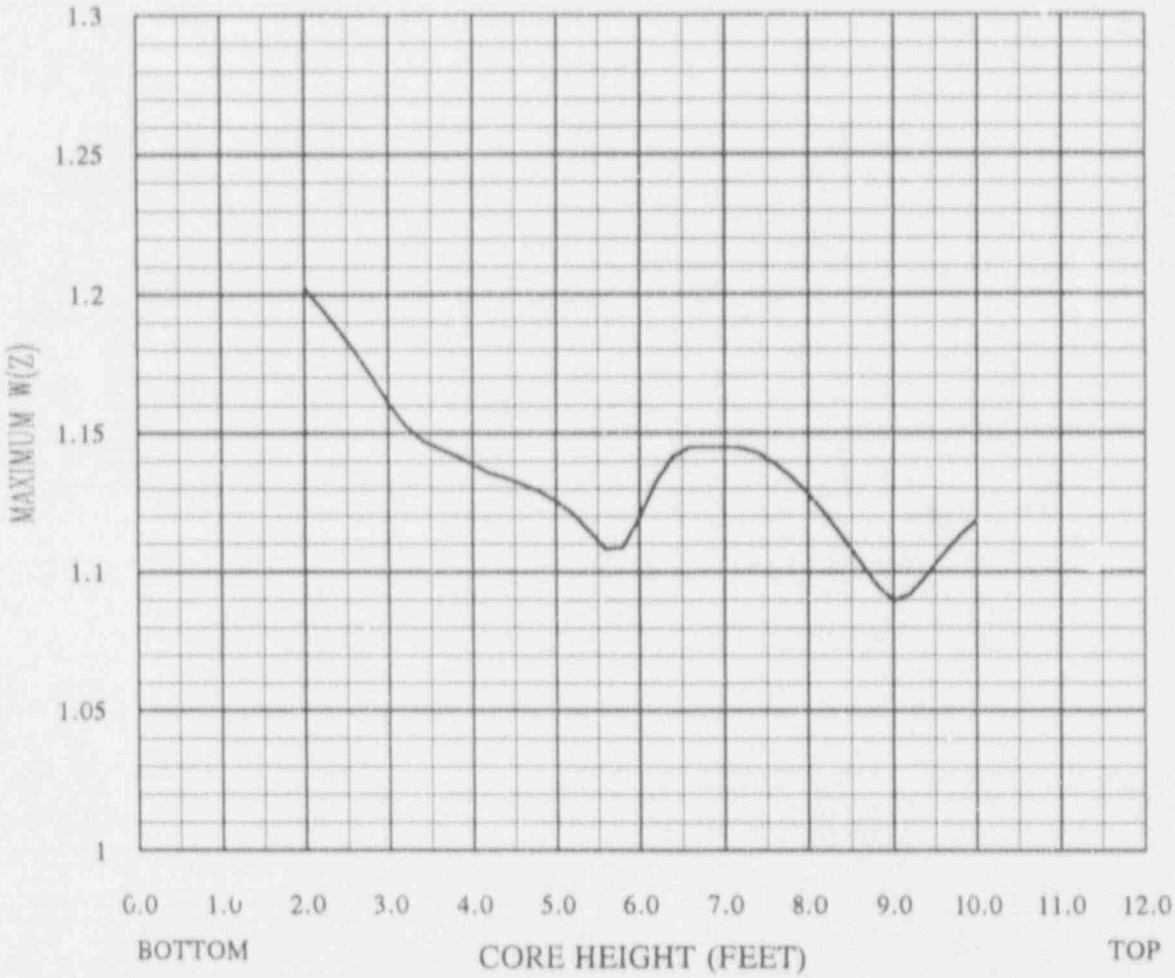


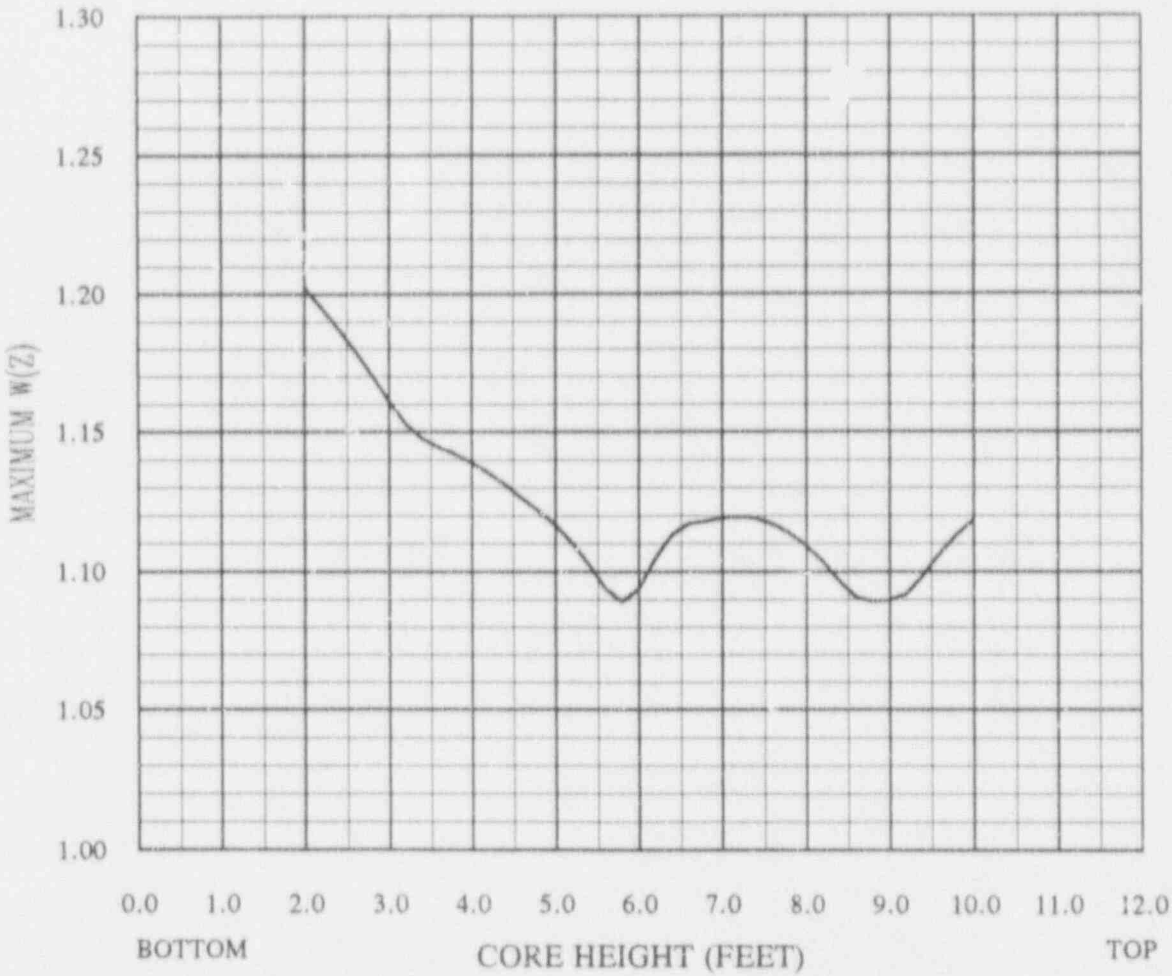
FIGURE 4 W(Z) AS A FUNCTION OF CORE HEIGHT
MAXIMUM LOAD FOLLOW



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.1392	32	1.1327	43	1.1128
11	1.2026	22	1.1358	33	1.1414	44	1.1040
12	1.1955	23	1.1340	34	1.1448	45	1.0957
13	1.1877	24	1.1317	35	1.1450	46	1.0898
14	1.1795	25	1.1291	36	1.1450	47	1.0917
15	1.1705	26	1.1257	37	1.1445	48	1.0986
16	1.1611	27	1.1211	38	1.1427	49	1.1064
17	1.1529	28	1.1149	39	1.1392	50	1.1134
18	1.1476	29	1.1083	40	1.1345	51	1.1186
19	1.1446	30	1.1088	41	1.1285	52 - 61	---
20	1.1420	31	1.1197	42	1.1211		

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

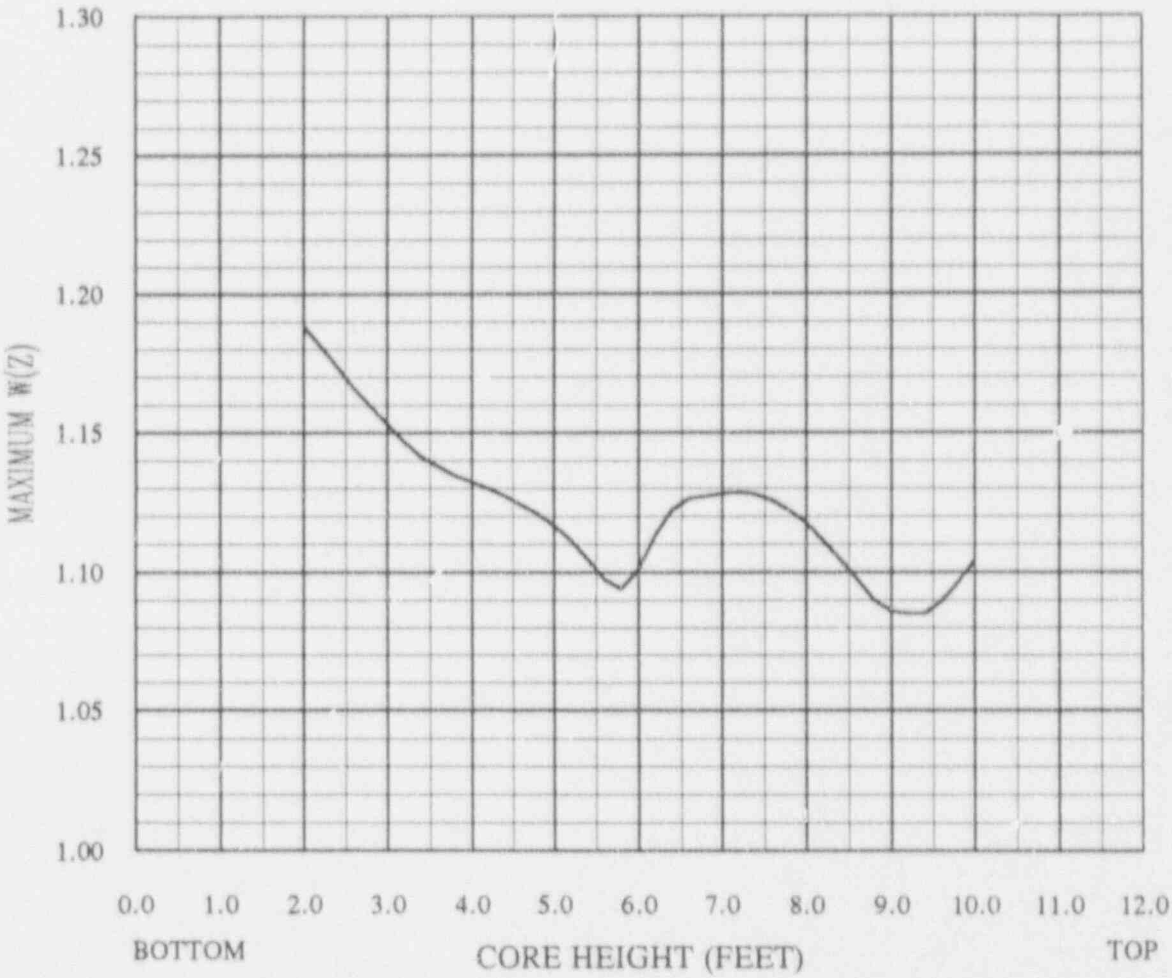
FIGURE 5 W(Z) AS A FUNCTION OF CORE HEIGHT
150 MWD/MTU



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.1392	32	1.1047	43	1.0968
11	1.2026	22	1.1355	33	1.1130	44	1.0908
12	1.1955	23	1.1313	34	1.1171	45	1.0892
13	1.1877	24	1.1266	35	1.1181	46	1.0898
14	1.1795	25	1.1220	36	1.1191	47	1.0917
15	1.1705	26	1.1168	37	1.1197	48	1.0986
16	1.1611	27	1.1103	38	1.1192	49	1.1064
17	1.1529	28	1.1024	39	1.1171	50	1.1134
18	1.1476	29	1.0939	40	1.1139	51	1.1186
19	1.1446	30	1.0892	41	1.1094	52 - 61	---
20	1.1420	31	1.0938	42	1.1036		

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

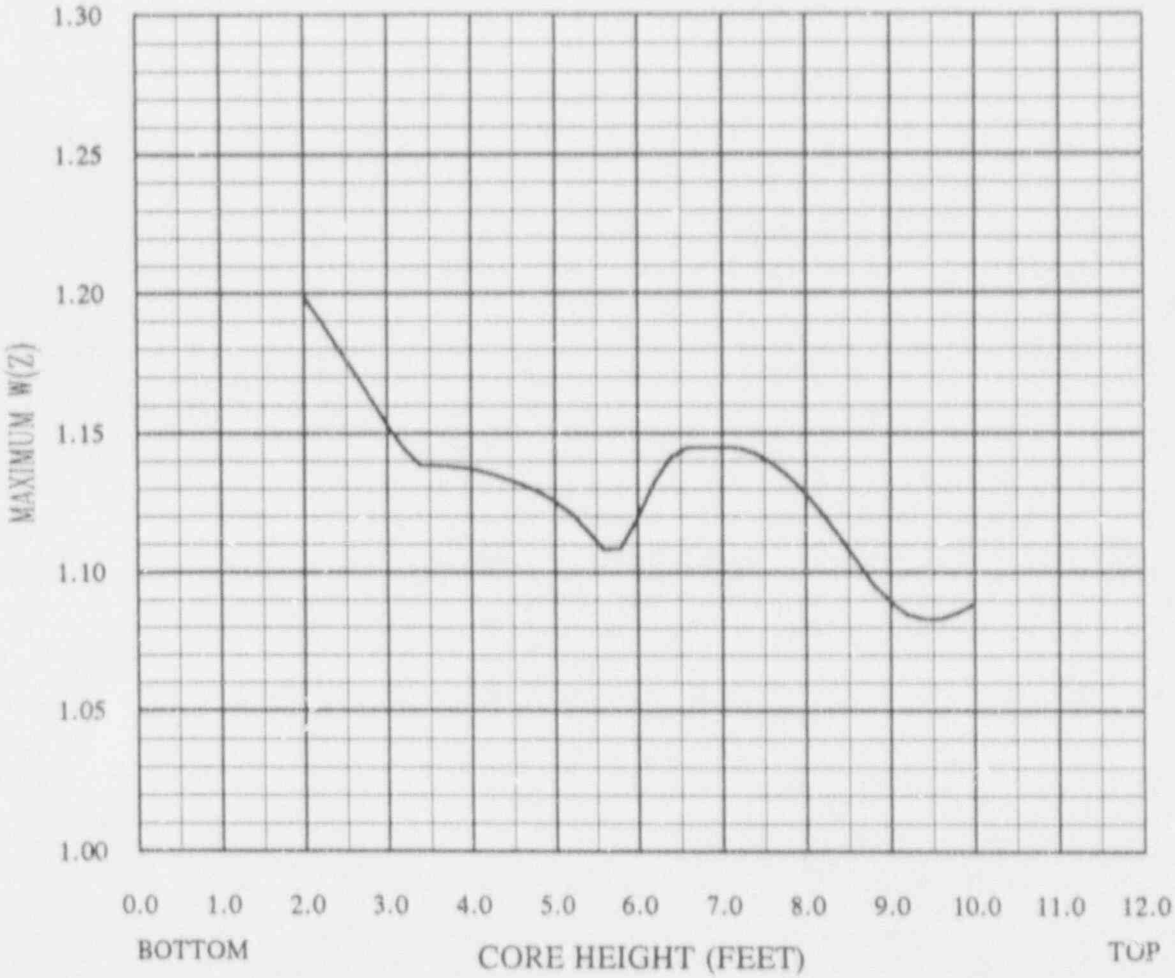
FIGURE 6 W(Z) AS A FUNCTION OF CORE HEIGHT
4000 MWD/MTU



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.1323	32	1.1135	43	1.1049
11	1.1885	22	1.1301	33	1.1224	44	1.0977
12	1.1816	23	1.1275	34	1.1263	45	1.0902
13	1.1742	24	1.1244	35	1.1273	46	1.0861
14	1.1663	25	1.1210	36	1.1282	47	1.0850
15	1.1597	26	1.1169	37	1.1287	48	1.0852
16	1.1532	27	1.1117	38	1.1279	49	1.0895
17	1.1470	28	1.1049	39	1.1256	50	1.0963
18	1.1415	29	1.0977	40	1.1223	51	1.1043
19	1.1378	30	1.0942	41	1.1177	52 - 61	---
20	1.1347	31	1.1011	42	1.1116		

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

FIGURE 7 W(Z) AS A FUNCTION OF CORE HEIGHT
9340 MWD/MTU



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
1 - 10	---	21	1.1371	32	1.1327	43	1.1128
11	1.1991	22	1.1358	33	1.1414	44	1.1040
12	1.1902	23	1.1340	34	1.1448	45	1.0957
13	1.1809	24	1.1317	35	1.1450	46	1.0894
14	1.1719	25	1.1291	36	1.1450	47	1.0849
15	1.1628	26	1.1257	37	1.1445	48	1.0830
16	1.1532	27	1.1211	38	1.1427	49	1.0833
17	1.1445	28	1.1149	39	1.1392	50	1.0853
18	1.1384	29	1.1083	40	1.1345	51	1.0885
19	1.1384	30	1.1088	41	1.1285	52 - 61	---
20	1.1380	31	1.1197	42	1.1211		

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