SOUTH CAROLINA ELECTRIC & GAS COMPANY

VIRGIL C. SUMMER NUCLEAR STATION

CORE OPERATING LIMITS REPORT

CYCLE 7

Revision 0

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1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for V. C. Summer Station Cycle 7 has been prepared in accordance with the requirements of Technical Specification 6.9.1.11.

The Technical Specifications affected by this report are listed below:

3.1.1.3	Moderator Temperature Coefficient
3.1.3.5	Shutdown Rod Insertion Limit
3.1.3.6	Control Rod Insertion Limits
3.2.1	Axial Flux Difference
3.2.2	Heat Flux Hot Channel Factor
3.2.3	RCS Flow Rate and 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 subsections which follow. These limits have been developed using the NRC-approved methodologies specified in Technical Specification 6.9.1.11.

2.1 Moderator Temperature Coefficient (Specification 3.1.1.3)

2.1.1 The Moderator Temperature Coefficient (MTC) limits are:

The BOL/ARO-MTC shall be less positive than the limits shown in Figure 1.
The EOL/APO/RTP-MTC shall be less negative than -5×10^{-4} $\Delta k/k/^{\circ}F$.

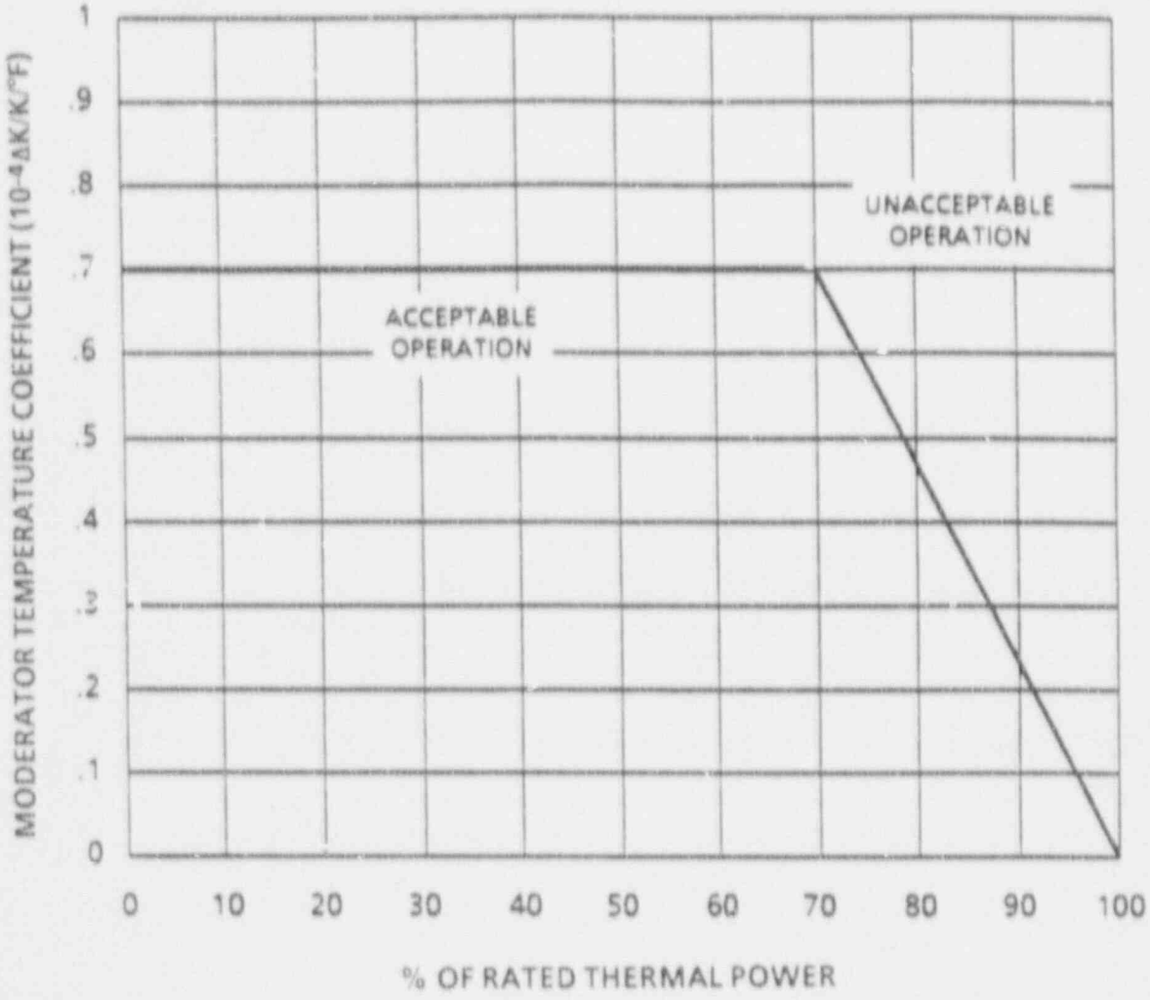
2.1.2 The MTC Surveillance limit is:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to -4.1×10^{-4} $\Delta k/k/^{\circ}F$.

where: BOL stands for Beginning of Cycle Life
ARO stands for All Rods Out
RTP stands for RATED THERMAL POWER
EOL stands for End of Cycle Life

FIGURE 1

MODERATOR TEMPERATURE COEFFICIENT VS. POWER LEVEL



2.2 Shutdown Rod Insertion Limits (Specification 3.1.3.5)

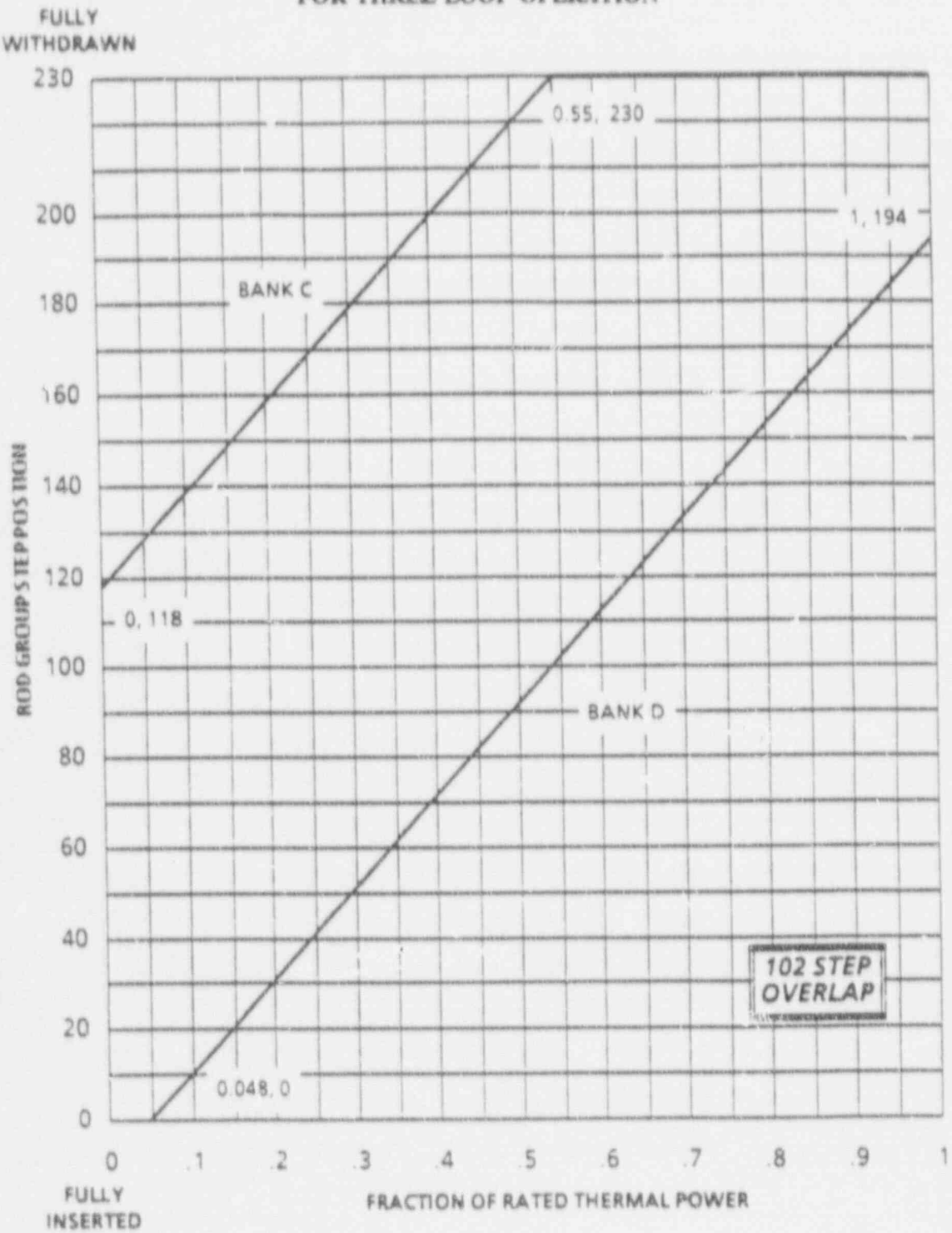
The shutdown rods shall be withdrawn to at least 230 steps.

2.3 Control Rod Insertion Limits (Specification 3.1.3.6)

The Control Bank Insertion Limits are specified by Figure 2.

FIGURE 2

ROD GROUP INSERTION LIMITS VERSUS THERMAL POWER FOR THREE LOOP OPERATION



2.4 Axial Flux Difference (Specification 3.2.1)

2.4.1 The Axial Flux Difference (AFD) Limits for RAOC operation for Beginning-of-Cycle Life (BOL), Middle-of-Cycle Life (MOL), and End-of-Cycle Life (EOL) are shown in Figures 3 through 5, respectively. The cycle burnup ranges applicable to each limit are indicated in each of the figures.

2.4.2 The Axial Flux Difference (AFD) target bands during base load operations for BOL, MOL and EOL are:

BOL (0 - 4000 MWD/MTU) : + or - 5% about a measured target value,
MOL (4600 - 10000 MWD/MTU) : + or - 5% about a measured target value,
EOL (10000 - 18000 MWD/MTU) : + or - 5% about a measured target value.

2.4.2 The minimum allowable power level for base load operation, API^{ND}, is 85% of RATED THERMAL POWER.

FIGURE 3

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER FOR CYCLE BURNUP 0-4000 MWD/MTU

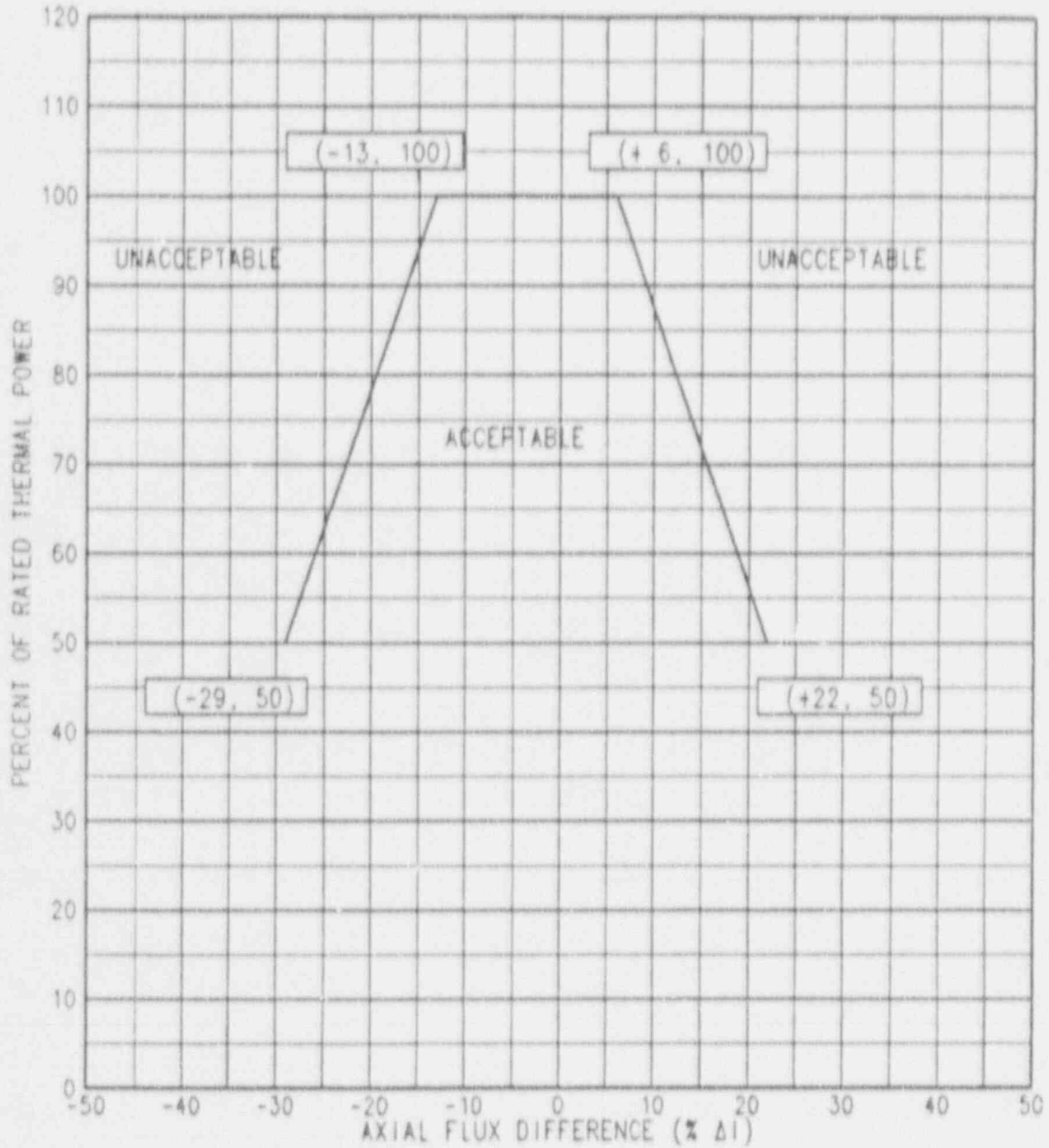


FIGURE 4

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER FOR CYCLE BURNUP 4000-10000 MWD/MTU

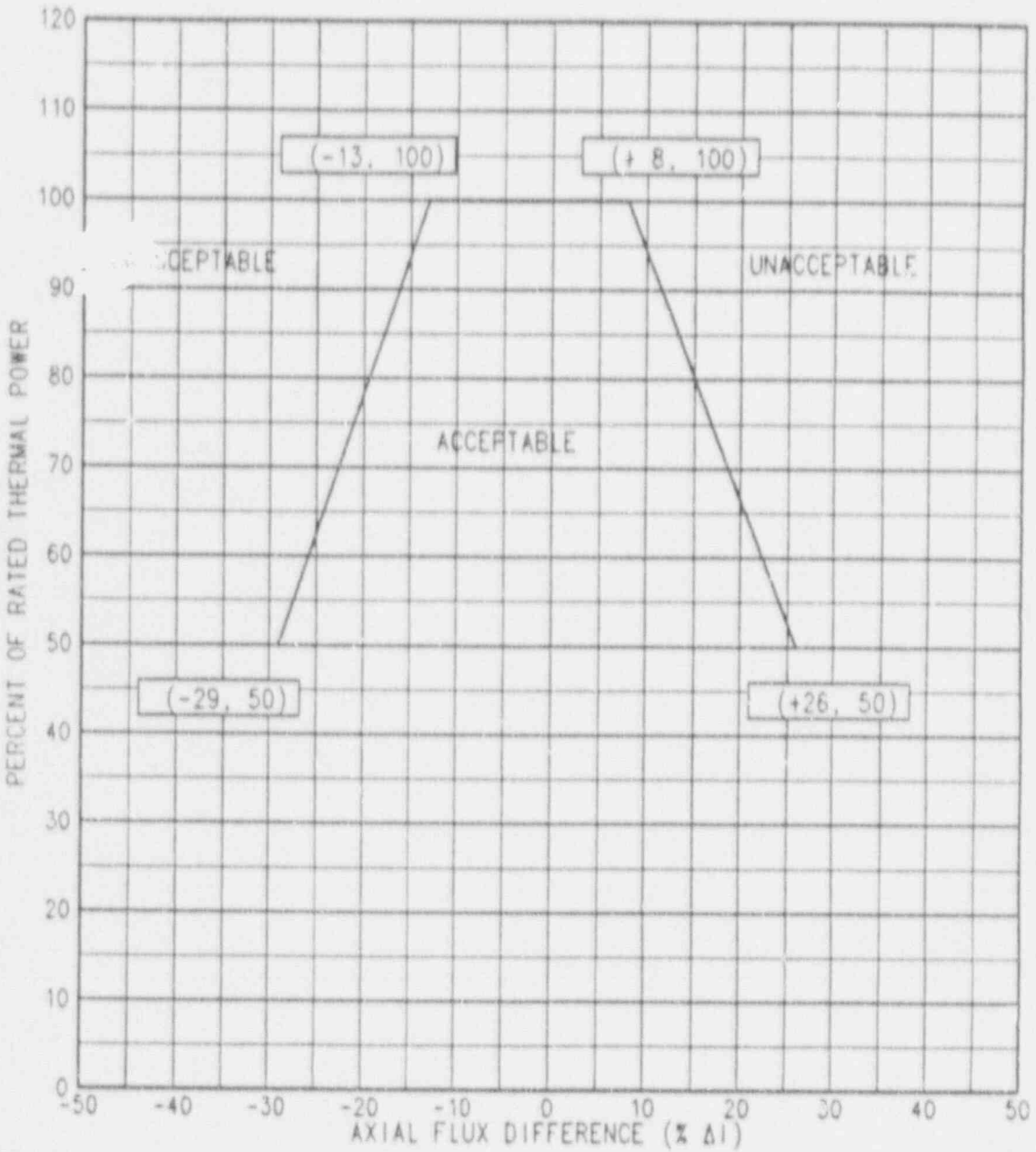
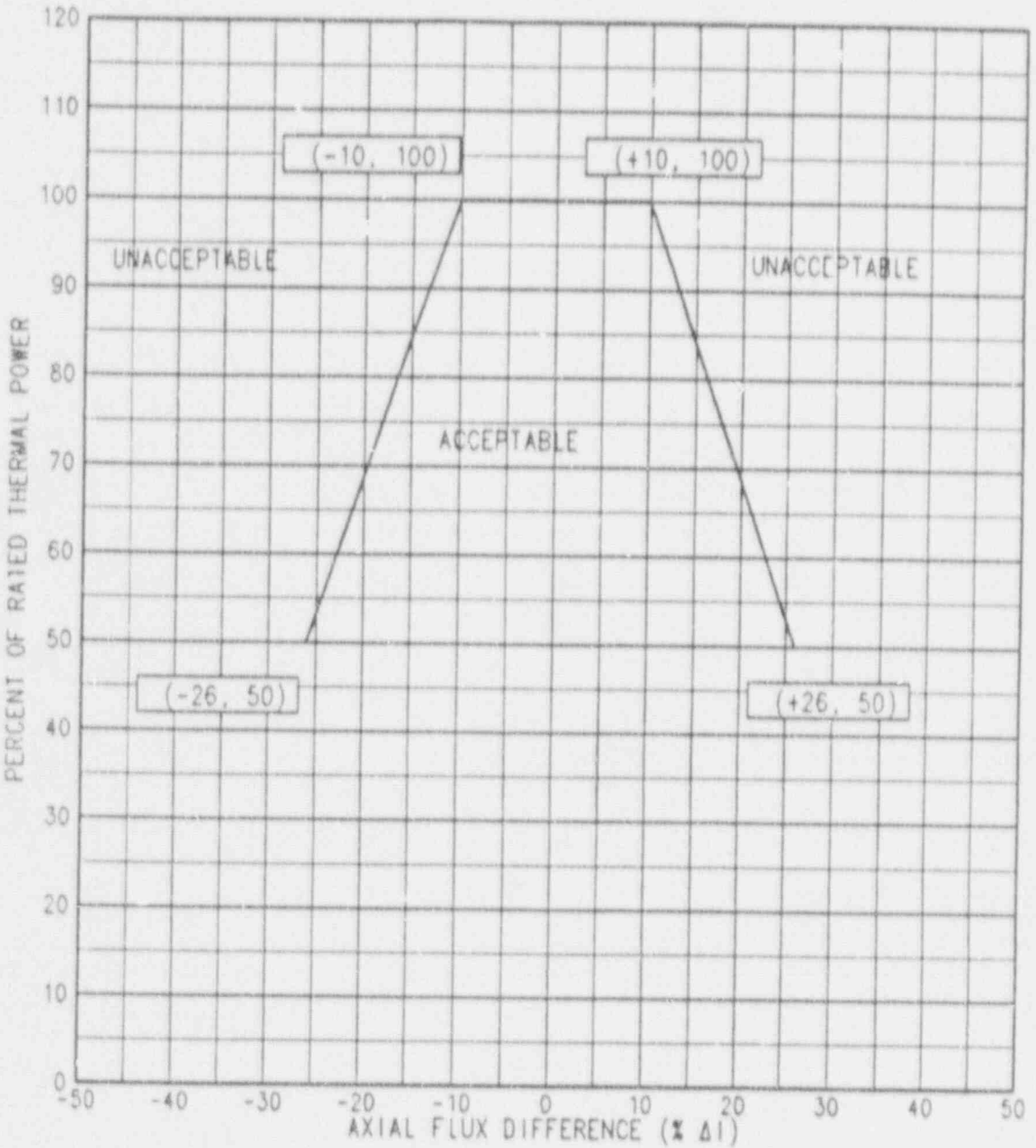


FIGURE 5

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER FOR CYCLE BURNUP 10000 MWD/MTU - EOL



2.5 Heat Flux Hot Channel Factor - $F_Q(Z)$ (Specification 3.2.2)

$$F_Q(Z) \leq \frac{F_Q^{RTP}}{P} * K(Z) \quad for\ P > 0.5$$

$$F_Q(Z) \leq \frac{F_Q^{RTP}}{0.5} * K(Z) \quad for\ P \leq 0.5$$

$$where:\ P = \frac{Thermal\ Power}{Rated\ Thermal\ Power}$$

2.5.1 $F_Q^{RTP} = 2.45$

2.5.2 K(Z) is provided in Figure 6

2.5.3 Elevation dependent W(z) values for RAOC operation at 150, 4000, 10000, and 16000 MWD/MTU are shown in Figures 7 through 10, respectively. This information is sufficient to determine W(z) versus core height in the range of 0 MWD/MTU to EOL burnup. Three point interpolation of the data in Figures 7 through 9 is sufficient to determine RAOC W(z) versus core height between a Cycle burnup of 0 to 4000 MWD/MTU. For Cycle burnups between 4000 MWD/MTU and EOL burnup, W(z) versus core height may be obtained through three point interpolation of the data in Figures 8 through 10.

2.5.4 Elevation dependent $W(z)_{BL}$ values for base load operation between 85 and 100% of rated thermal power with the item 2.4.2 specified target band about a measured target value at 150, 8000, and 16000 MWD/MTU are shown in Figures 11 through 13, respectively. This information is sufficient to determine $W(z)_{BL}$ versus core height for burnups in the range of 0 MWD/MTU to EOL burnup through the use of three point interpolation.

FIGURE 6

K(z) - NORMALIZED $F_Q(z)$ AS A FUNCTION OF CORE HEIGHT

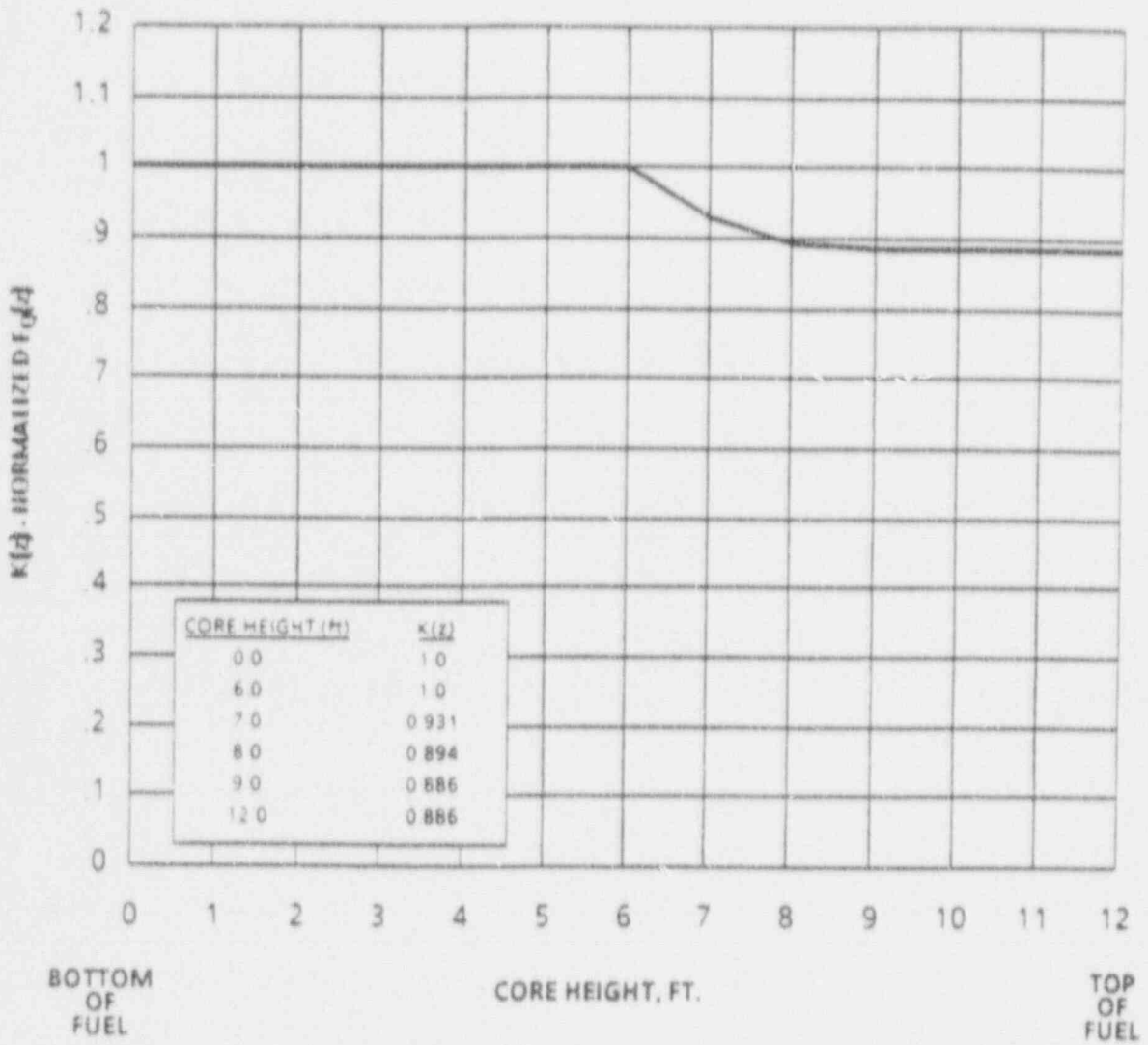
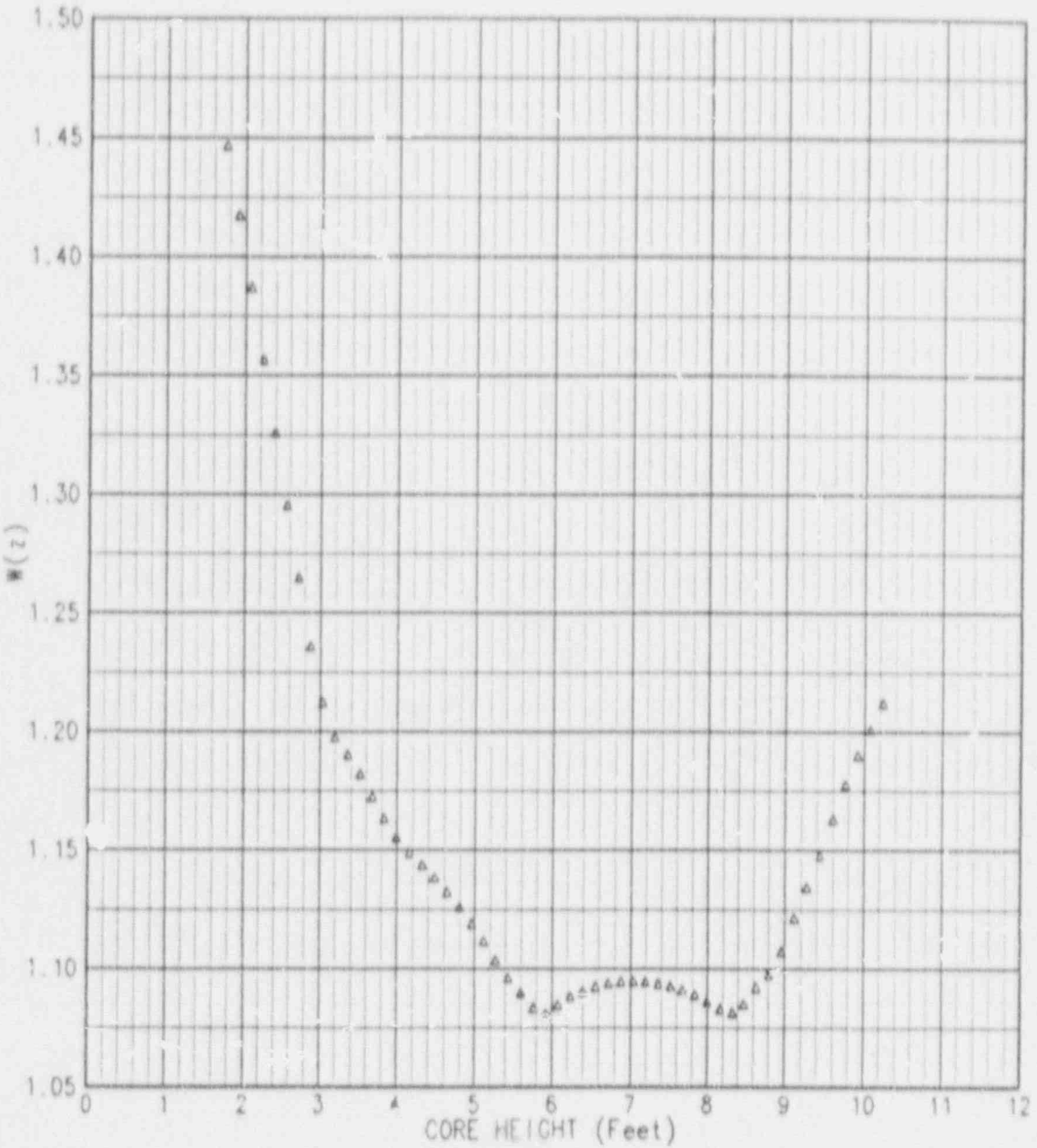


FIGURE 7

V. C. SUMMER RAOC W(z) AT 150 MWD/MTU



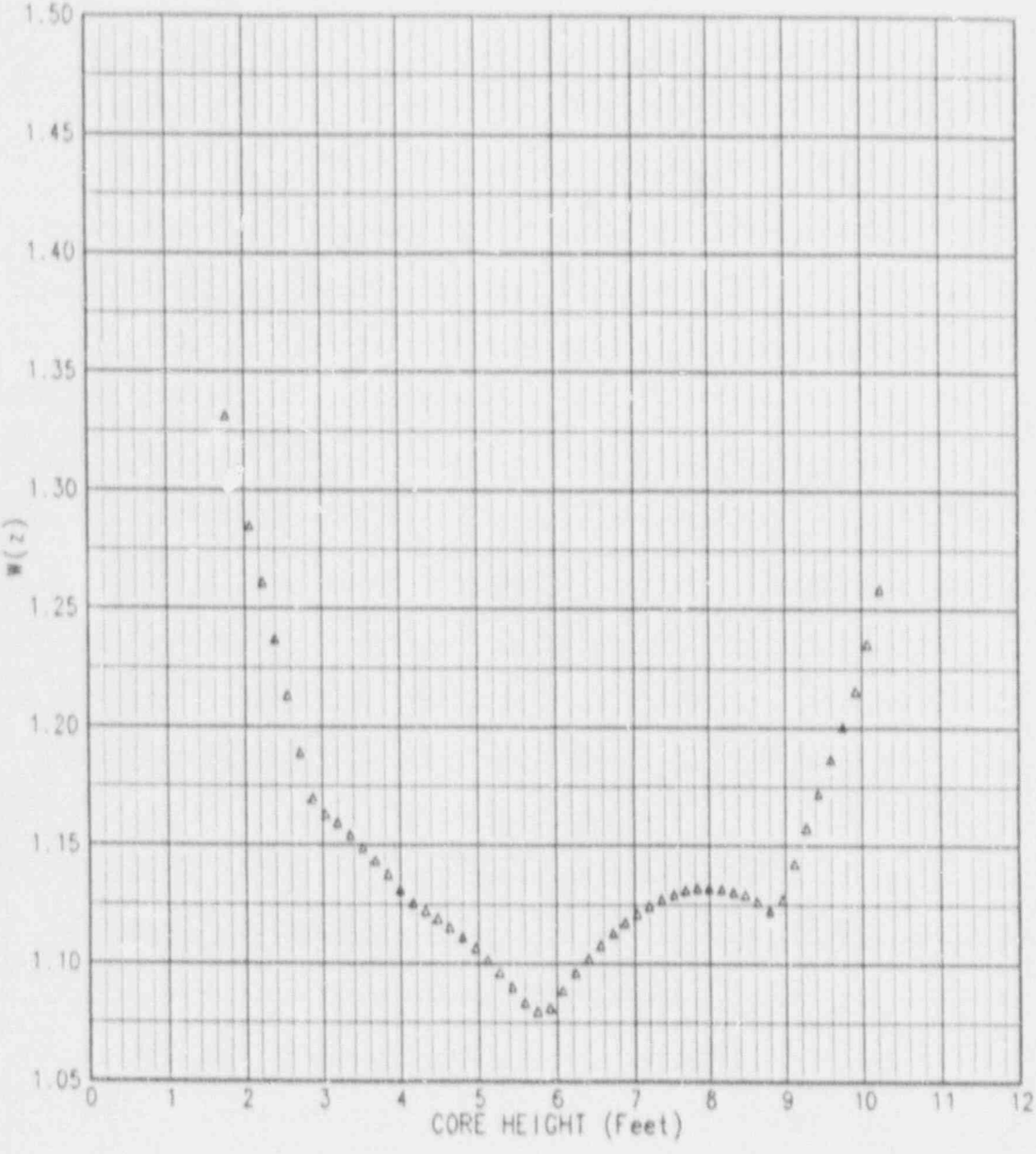
DATA FOR FIGURE 7

V. C. SUMMER RAOC W(z) AT 150 MWD/MTU

Core Height	W(Z)	Core Height	W(Z)
0.00000	1.0000	6.0800	1.0849
0.16000	1.0000	6.2400	1.0885
0.32000	1.0000	6.4000	1.0907
0.48000	1.0000	6.5600	1.0926
0.64000	1.0000	6.7200	1.0940
0.80000	1.0000	6.8800	1.0948
0.96000	1.0000	7.0400	1.0950
1.1200	1.0000	7.2000	1.0947
1.2800	1.0000	7.3600	1.0939
1.4400	1.0000	7.5200	1.0928
1.6000	1.0000	7.6800	1.0912
1.7600	1.4468	7.8400	1.0891
1.9200	1.4175	8.0000	1.0863
2.0800	1.3873	8.1600	1.0833
2.2400	1.3567	8.3200	1.0818
2.4000	1.3261	8.4800	1.0854
2.5600	1.2956	8.6400	1.0924
2.7200	1.2651	8.8000	1.0980
2.8800	1.2361	8.9600	1.1075
3.0400	1.2124	9.1200	1.1216
3.2000	1.1978	9.2800	1.1346
3.3600	1.1905	9.4400	1.1480
3.5200	1.1823	9.6000	1.1633
3.6800	1.1728	9.7600	1.1778
3.8400	1.1635	9.9200	1.1904
4.0000	1.1554	10.080	1.2013
4.1600	1.1490	10.240	1.2121
4.3200	1.1439	10.400	1.0000
4.4800	1.1386	10.560	1.0000
4.6400	1.1323	10.720	1.0000
4.8000	1.1261	10.880	1.0000
4.9600	1.1192	11.040	1.0000
5.1200	1.1118	11.200	1.0000
5.2800	1.1037	11.360	1.0000
5.4400	1.0963	11.520	1.0000
5.6000	1.0900	11.680	1.0000
5.7600	1.0837	11.840	1.0000
5.9200	1.0812	12.000	1.0000

FIGURE 8

V. C. SUMMER RAOC W(z) AT 4000 MWD/MTU



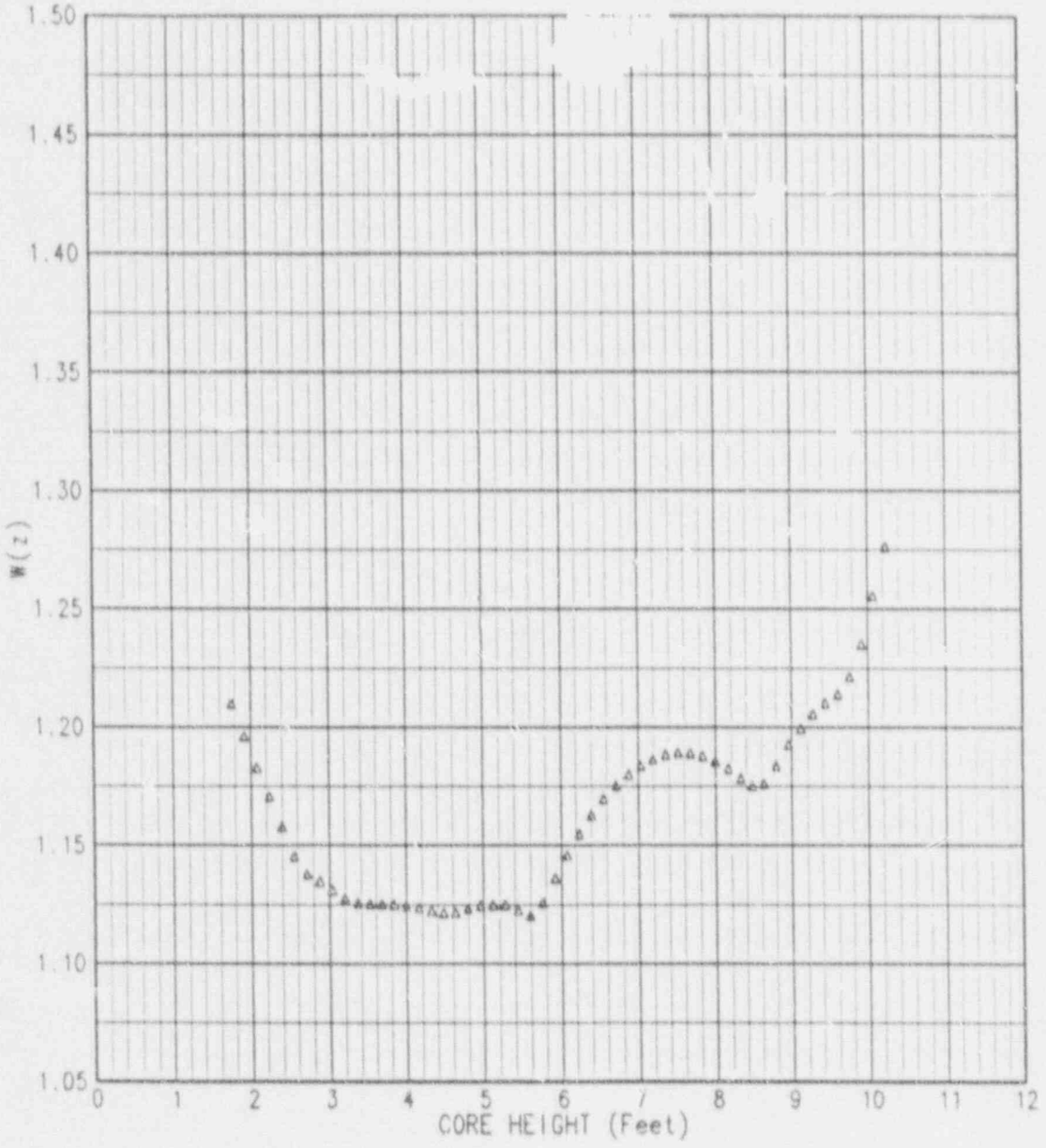
DATA FOR FIGURE 8

V. C. SUMMER RAOC W(z) AT 4000 MWD/MTU

Core Height	W(Z)	Core Height	W(Z)
0.00000	1.0000	6.0800	1.0888
0.16000	1.0000	6.2400	1.0963
0.32000	1.0000	6.4000	1.1023
0.48000	1.0000	6.5600	1.1080
0.64000	1.0000	6.7200	1.1131
0.80000	1.0000	6.8800	1.1175
0.96000	1.0000	7.0400	1.1213
1.1200	1.0000	7.2000	1.1245
1.2800	1.0000	7.3600	1.1273
1.4400	1.0000	7.5200	1.1295
1.6000	1.0000	7.6800	1.1311
1.7600	1.3315	7.8400	1.1320
1.9200	1.3086	8.0000	1.1322
2.0800	1.2850	8.1600	1.1317
2.2400	1.2610	8.3200	1.1305
2.4000	1.2371	8.4800	1.1292
2.5600	1.2133	8.6400	1.1265
2.7200	1.1892	8.8000	1.1227
2.8800	1.1700	8.9600	1.1273
3.0400	1.1630	9.1200	1.1427
3.2000	1.1596	9.2800	1.1578
3.3600	1.1543	9.4400	1.1722
3.5200	1.1489	9.6000	1.1869
3.6800	1.1436	9.7600	1.2006
3.8400	1.1378	9.9200	1.2158
4.0000	1.1312	10.080	1.2357
4.1600	1.1255	10.240	1.2588
4.3200	1.1222	10.400	1.0000
4.4800	1.1191	10.560	1.0000
4.6400	1.1153	10.720	1.0000
4.8000	1.1112	10.880	1.0000
4.9600	1.1066	11.040	1.0000
5.1200	1.1016	11.200	1.0000
5.2800	1.0963	11.360	1.0000
5.4460	1.0901	11.520	1.0000
5.6000	1.0837	11.680	1.0000
5.7600	1.0798	11.840	1.0000
5.9200	1.0813	12.000	1.0000

FIGURE 9

V. C. SUMMER RAOC W(z) AT 10000 MWD/MTU



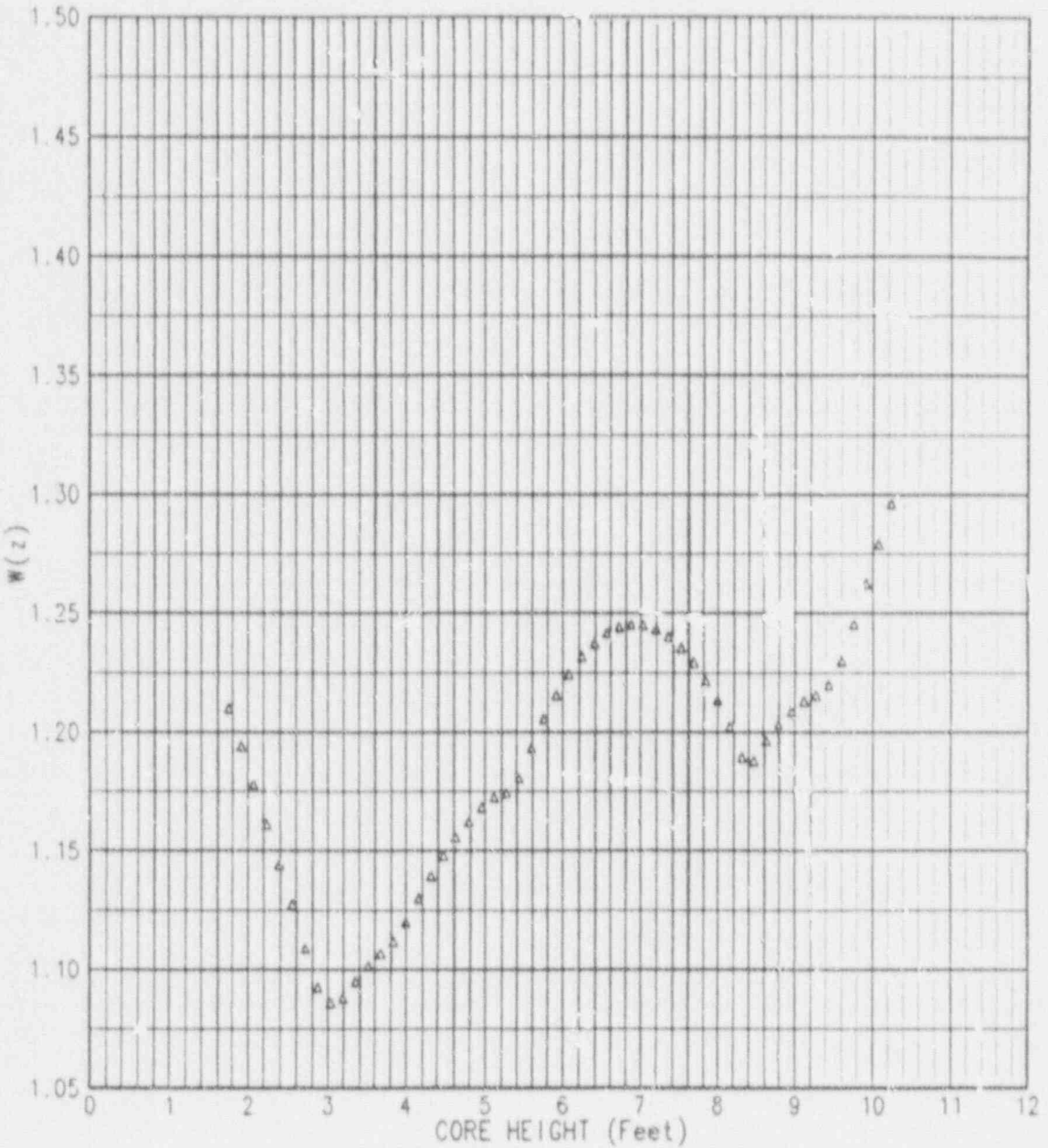
DATA FOR FIGURE 9

V. C. SUMMER RAOC W(z) AT 10000 MWD/MTU

Core Height	W(Z)	Core Height	W(Z)
0.00000	1.0000	6.0800	1.1461
0.16000	1.0000	6.2400	1.1550
0.32000	1.0000	6.4000	1.1630
0.48000	1.0000	6.5600	1.1699
0.64000	1.0000	6.7200	1.1756
0.80000	1.0000	6.8800	1.1802
0.96000	1.0000	7.0400	1.1838
1.1200	1.0000	7.2000	1.1866
1.2800	1.0000	7.3600	1.1886
1.4400	1.0000	7.5200	1.1894
1.6000	1.0000	7.6800	1.1891
1.7600	1.2099	7.8400	1.1879
1.9200	1.1963	8.0000	1.1858
2.0800	1.1830	8.1600	1.1827
2.2400	1.1707	8.3200	1.1786
2.4000	1.1581	8.4800	1.1754
2.5600	1.1455	8.6400	1.1763
2.7200	1.1380	8.8000	1.1840
2.8800	1.1350	8.9600	1.1928
3.0400	1.1312	9.1200	1.1985
3.2000	1.1277	9.2800	1.2037
3.3600	1.1257	9.4400	1.2103
3.5200	1.1252	9.6000	1.2141
3.6800	1.1252	9.7600	1.2215
3.8400	1.1251	9.9200	1.2354
4.0000	1.1247	10.080	1.2557
4.1600	1.1239	10.240	1.2764
4.3200	1.1225	10.400	1.0000
4.4800	1.1216	10.560	1.0000
4.6400	1.1218	10.720	1.0000
4.8000	1.1234	10.880	1.0000
4.9600	1.1247	11.040	1.0000
5.1200	1.1250	11.200	1.0000
5.2800	1.1250	11.360	1.0000
5.4430	1.1228	11.520	1.0000
5.6000	1.1206	11.680	1.0000
5.7600	1.1258	11.840	1.0000
5.9200	1.1362	12.000	1.0000

FIGURE 10

V. C. SUMMER RAOC W(z) AT 16000 MWD/MTU



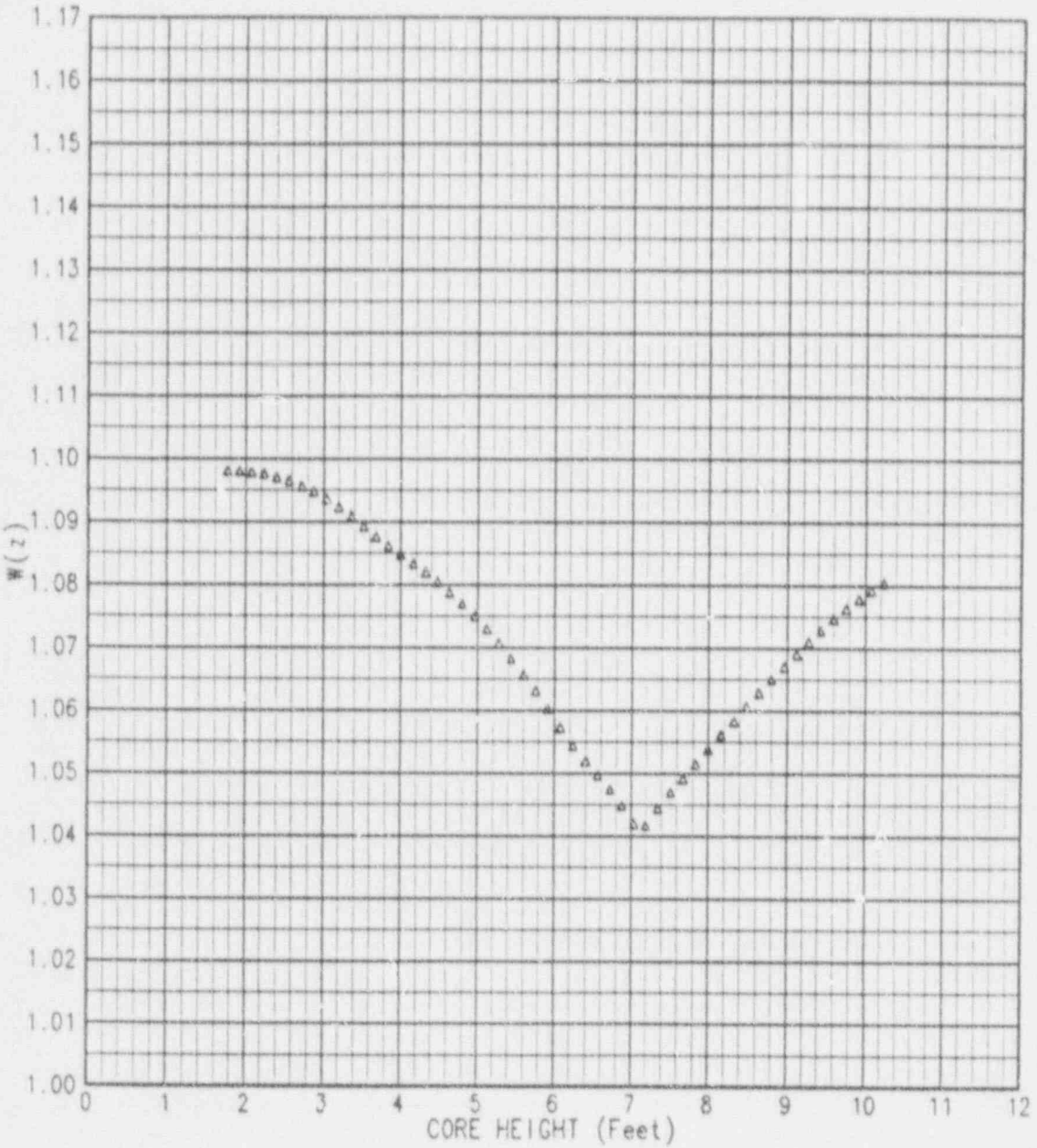
DATA FOR FIGURE 10

V. C. SUMMER RAOC W(z) AT 16000 MWD/MTU

Core Height	W(Z)	Core Height	W(Z)
0.00000	1.0000	6.0800	1.2245
0.16000	1.0000	6.2400	1.2319
0.32000	1.0000	6.4000	1.2376
0.48000	1.0000	6.5600	1.2413
0.64000	1.0000	6.7200	1.2444
0.80000	1.0000	6.8800	1.2454
0.96000	1.0000	7.0400	1.2451
1.1200	1.0000	7.2000	1.2434
1.2800	1.0000	7.3600	1.2403
1.4400	1.0000	7.5200	1.2356
1.6000	1.0000	7.6800	1.2294
1.7600	1.2099	7.8400	1.2217
1.9200	1.1942	8.0000	1.2135
2.0800	1.1780	8.1600	1.2025
2.2400	1.1612	8.3200	1.1895
2.4000	1.1444	8.4800	1.1880
2.5600	1.1275	8.6400	1.1966
2.7200	1.1090	8.8000	1.2034
2.8800	1.0927	8.9600	1.2087
3.0400	1.0861	9.1200	1.2132
3.2000	1.0882	9.2800	1.2156
3.3600	1.0951	9.4400	1.2200
3.5200	1.1017	9.6000	1.2301
3.6800	1.1068	9.7600	1.2454
3.8400	1.1119	9.9200	1.2628
4.0000	1.1200	10.080	1.2793
4.1600	1.1300	10.240	1.2963
4.3200	1.1395	10.400	1.0000
4.4800	1.1481	10.560	1.0000
4.6400	1.1558	10.720	1.0000
4.8000	1.1624	10.880	1.0000
4.9600	1.1683	11.040	1.0000
5.1200	1.1726	11.200	1.0000
5.2800	1.1744	11.360	1.0000
5.4400	1.1806	11.520	1.0000
5.6000	1.1934	11.680	1.0000
5.7600	1.2056	11.840	1.0000
5.9200	1.2157	12.000	1.0000

FIGURE 11

V. C. SUMMER BASELOAD W(z) AT 150 MWD/MTU

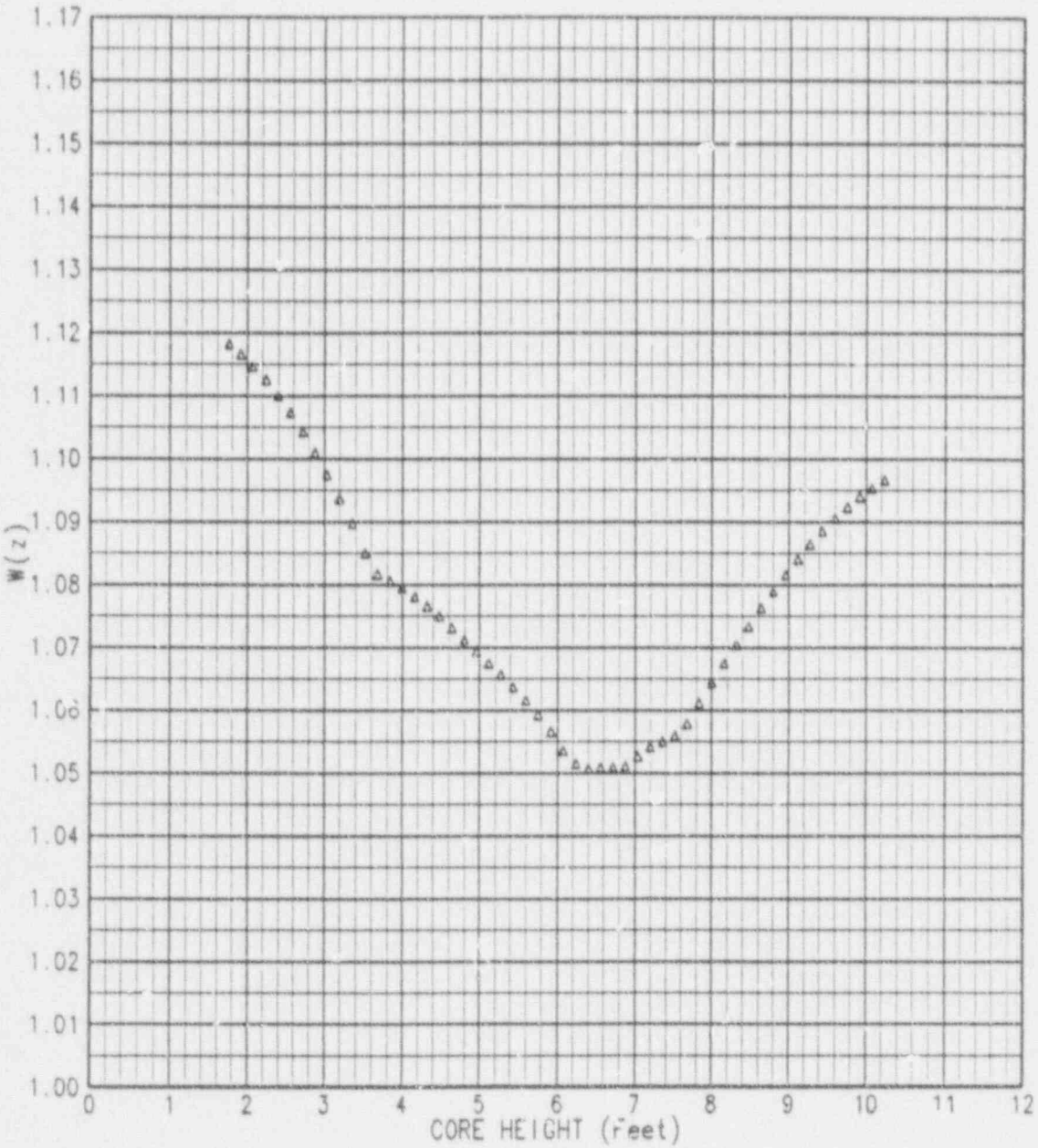


DATA FOR FIGURE 11

V. C. SUMMER BASELOAD W(z) AT 150 MWD/MTU

Core Height	W(Z)	Core Height	W(Z)
0.00000	1.0000	6.0800	1.0573
0.16000	1.0000	6.2400	1.0544
0.32000	1.0000	6.4000	1.0520
0.48000	1.0000	6.5600	1.0497
0.64000	1.0000	6.7200	1.0475
0.80000	1.0000	6.8800	1.0449
0.96000	1.0000	7.0400	1.0420
1.1200	1.0000	7.2000	1.0417
1.2800	1.0000	7.3600	1.0445
1.4400	1.0000	7.5200	1.0470
1.6000	1.0000	7.6800	1.0492
1.7600	1.0981	7.8400	1.0515
1.9200	1.0981	8.0000	1.0539
2.0800	1.0979	8.1600	1.0562
2.2400	1.0976	8.3200	1.0584
2.4000	1.0971	8.4800	1.0607
2.5600	1.0965	8.6400	1.0629
2.7200	1.0957	8.8000	1.0650
2.8800	1.0948	8.9600	1.0671
3.0400	1.0937	9.1200	1.0691
3.2000	1.0924	9.2800	1.0711
3.3600	1.0910	9.4400	1.0729
3.5200	1.0893	9.6000	1.0747
3.6800	1.0877	9.7600	1.0764
3.8400	1.0862	9.9200	1.0779
4.0000	1.0848	10.080	1.0793
4.1600	1.0834	10.240	1.0805
4.3200	1.0820	10.400	1.0000
4.4800	1.0805	10.560	1.0000
4.6400	1.0788	10.720	1.0000
4.8000	1.0770	10.880	1.0000
4.9600	1.0751	11.040	1.0000
5.1200	1.0730	11.200	1.0000
5.2800	1.0707	11.360	1.0000
5.4400	1.0683	11.520	1.0000
5.6000	1.0658	11.680	1.0000
5.7600	1.0632	11.840	1.0000
5.9200	1.0603	12.000	1.0000

FIGURE 12
V. C. SUMMER BASELOAD W(z) AT 8000 MWD/MTU

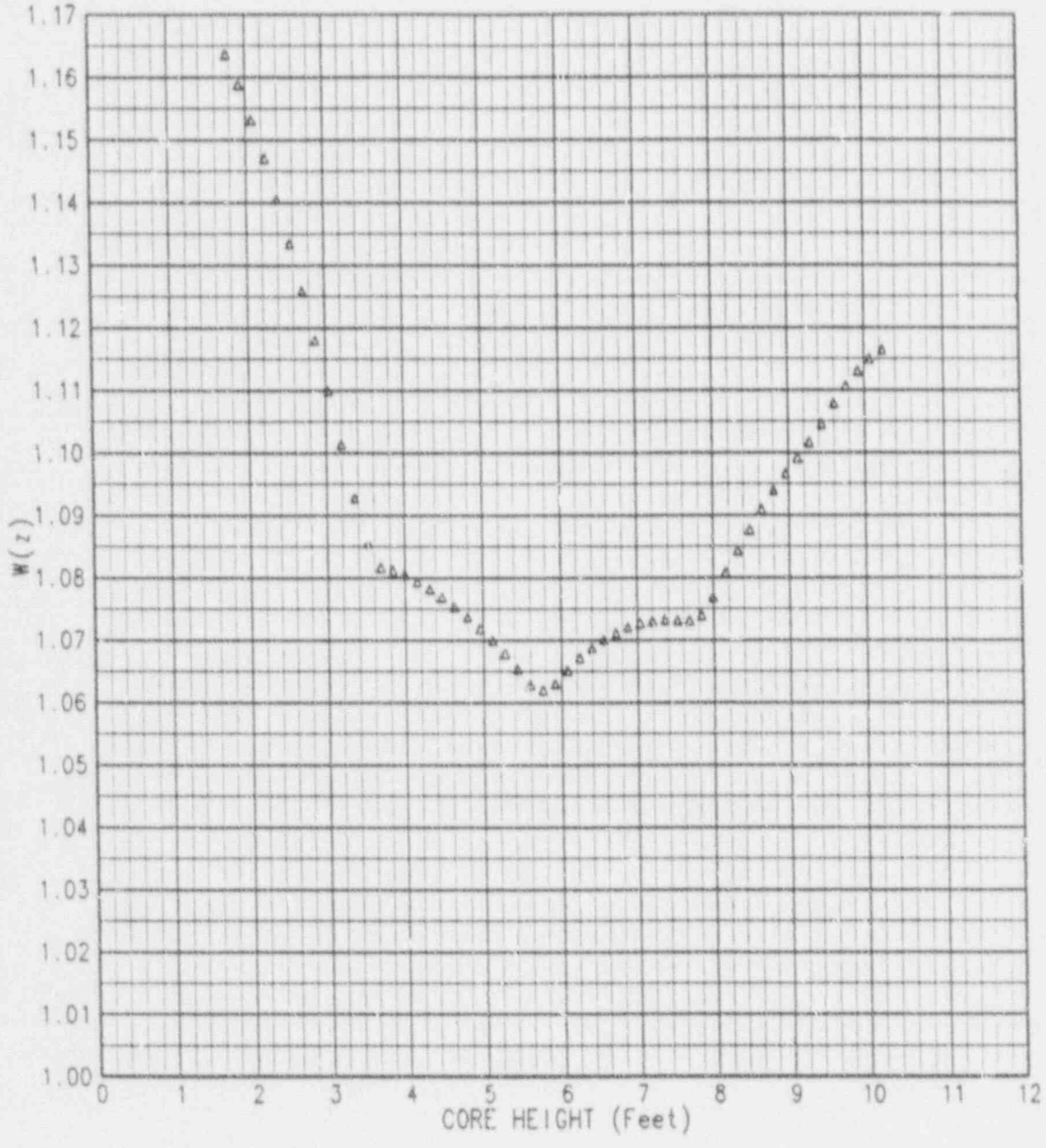


DATA FOR FIGURE 12

V. C. SUMMER BASELOAD W(z) AT 8000 MWD/MTU

Core Height	W(Z)	Core Height	W(Z)
0.00000	1.0000	6.0800	1.0536
0.16000	1.0000	6.2400	1.0515
0.32000	1.0000	6.4000	1.0507
0.48000	1.0000	6.5600	1.0509
0.64000	1.0000	6.7200	1.0510
0.80000	1.0000	6.8800	1.0512
0.96000	1.0000	7.0400	1.0527
1.1200	1.0000	7.2000	1.0542
1.2800	1.0000	7.3600	1.0551
1.4400	1.0000	7.5200	1.0560
1.6000	1.0000	7.6800	1.0579
1.7600	1.1182	7.8400	1.0612
1.9200	1.1166	8.0000	1.0645
2.0800	1.1147	8.1600	1.0675
2.2400	1.1126	8.3200	1.0705
2.4000	1.1101	8.4800	1.0734
2.5600	1.1074	8.6400	1.0763
2.7200	1.1044	8.8000	1.0790
2.8800	1.1011	8.9600	1.0816
3.0400	1.0975	9.1200	1.0841
3.2000	1.0938	9.2800	1.0865
3.3600	1.0898	9.4400	1.0886
3.5200	1.0851	9.6000	1.0906
3.6800	1.0817	9.7600	1.0924
3.8400	1.0806	9.9200	1.0940
4.0000	1.0795	10.080	1.0954
4.1600	1.0781	10.240	1.0967
4.3200	1.0766	10.400	1.0000
4.4800	..0750	10.560	1.0000
4.6400	1.0732	10.720	1.0000
4.8000	1.0713	10.880	1.0000
4.9600	1.0694	11.040	1.0000
5.1200	1.0675	11.200	1.0000
5.2800	1.0657	11.360	1.0000
5.4400	1.0637	11.520	1.0000
5.6000	1.0616	11.680	1.0000
5.7600	1.0593	11.840	1.0000
5.9200	1.0566	12.000	1.0000

FIGURE 13
V. C. SUMMER BASELOAD W(z) AT 16000 MWD/MTU



DATA FOR FIGURE 13

V. C. SUMMER BASELOAD W(z) AT 16000 MWD/MTU

Core Height	W(Z)	Core Height	W(Z)
0.00000	1.0000	6.0800	1.0652
0.16000	1.0000	6.2400	1.0672
0.32000	1.0000	6.4000	1.0688
0.48000	1.0000	6.5600	1.0701
0.64000	1.0000	6.7200	1.0712
0.80000	1.0000	6.8800	1.0721
0.96000	1.0000	7.0400	1.0727
1.1200	1.0000	7.2000	1.0731
1.2800	1.0000	7.3600	1.0733
1.4400	1.0000	7.5200	1.0732
1.6000	1.0000	7.6800	1.0732
1.7600	1.1637	7.8400	1.0740
1.9200	1.1588	8.0000	1.0769
2.0800	1.1532	8.1600	1.0809
2.2400	1.1471	8.3200	1.0844
2.4000	1.1406	8.4800	1.0877
2.5600	1.1335	8.6400	1.0910
2.7200	1.1260	8.8000	1.0940
2.8800	1.1181	8.9600	1.0967
3.0400	1.1100	9.1200	1.0992
3.2000	1.1014	9.2800	1.1017
3.3600	1.0928	9.4400	1.1046
3.5200	1.0856	9.6000	1.1079
3.6800	1.0817	9.7600	1.1107
3.8400	1.0812	9.9200	1.1131
4.0000	1.0806	10.080	1.1151
4.1600	1.0794	10.240	1.1165
4.3200	1.0782	10.400	1.0000
4.4800	1.0769	10.560	1.0000
4.6400	1.0754	10.720	1.0000
4.8000	1.0737	10.880	1.0000
4.9600	1.0719	11.040	1.0000
5.1200	1.0700	11.200	1.0000
5.2800	1.0679	11.360	1.0000
5.4400	1.0654	11.520	1.0000
5.6000	1.0629	11.680	1.0000
5.7600	1.0620	11.840	1.0000
5.9200	1.0630	12.000	1.0000

2.6 RCS Flow Rate and Nuclear Enthalpy Rise Hot Channel Factor - $F^N_{\Delta H}$
(Specification 3.2-3)

$$R = \frac{F^N_{\Delta H}}{F^{RTP}_{\Delta H} * (1 + PF_{\Delta H} * (1 - P))}$$

$$Where: P = \frac{Thermal\ Power}{Rated\ Thermal\ Power}$$

2.6.1 $F_{\Delta H}{}^{RTP} = 1.56$

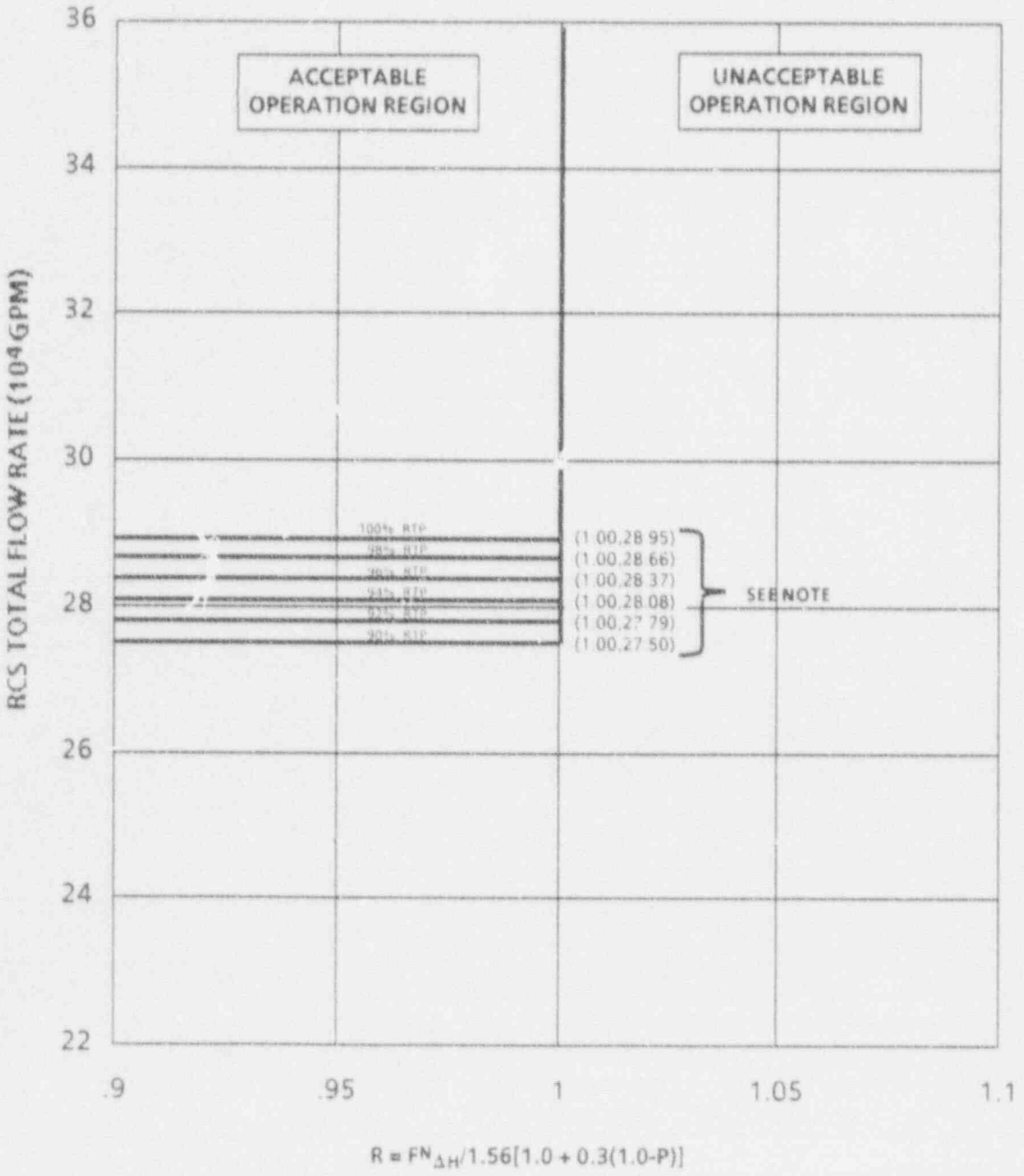
2.6.2 $PF_{\Delta H} = 0.3$

2.6.3 The Acceptable Operation Region from the combination of Reactor Coolant System total flow and R is provided in Figure 14.

FIGURE 14

RCS TOTAL FLOW RATE VS. R THREE LOOP OPERATION

MEASUREMENT UNCERTAINTIES OF 2.1% FOR FLOW AND 4.0% FOR INCORE MEASUREMENT OF $FN_{\Delta H}$ ARE INCLUDED IN THIS FIGURE



NOTE: When operating in this region, the restricted power levels shall be considered to be 100% of rated thermal power (RTP) for Technical Specification Figure 2.1-1