SOUTH CAROLINA ELECTRIC & GAS COMPANY

VIRGIL C. SUMMER NUCLEAR STATION

CORE OPERATING LIMITS REPORT

CYCLE 6

Revision 0

May 18, 1990

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1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for V. C. Summer Station Cycle 6 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/ARO/RTP-MTC shall be less negative than -5×10^{-4} $\Delta k/k/°F$.

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} $\Delta k/k/°F$.

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

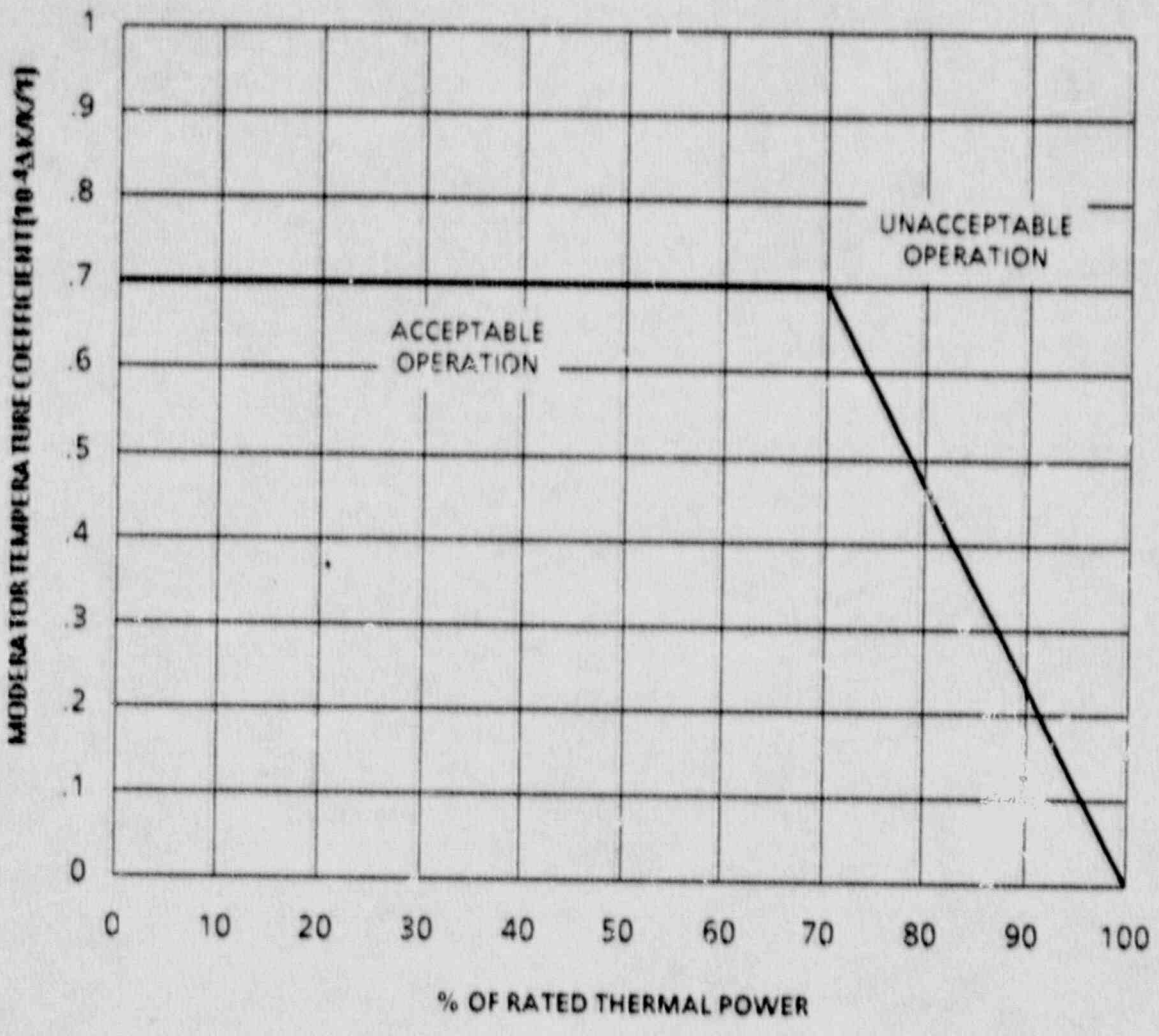


FIGURE 1
MODERATOR TEMPERATURE COEFFICIENT VS POWER LEVEL

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The shutdown rods shall be withdrawn to at least 230 steps.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

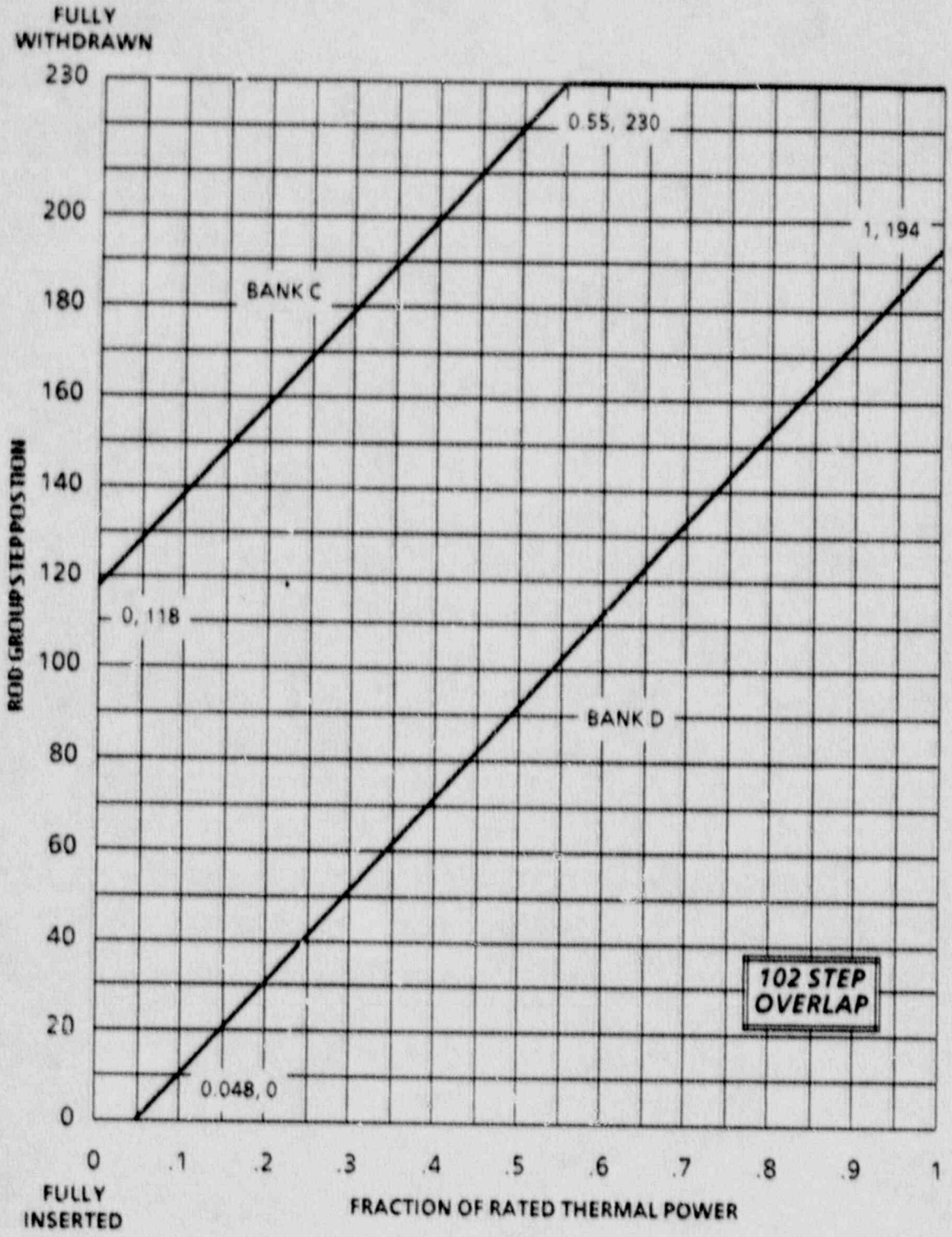


FIGURE 2 - ROD GROUP INSERTION LIMITS VERSUS THERMAL POWER FOR THREE LOOP OPERATION

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 operation for BOL, MOL and EOL are:

BOL (0 - 4000 MWD/MTU) : + or - 5% about a measured target value

MOL (4000 - 10000 MWD/MTU) : + or - 5% about a measured target value

EOL (10000 - 18000 MWD/MTU) : + or - 5% about a measured target value

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

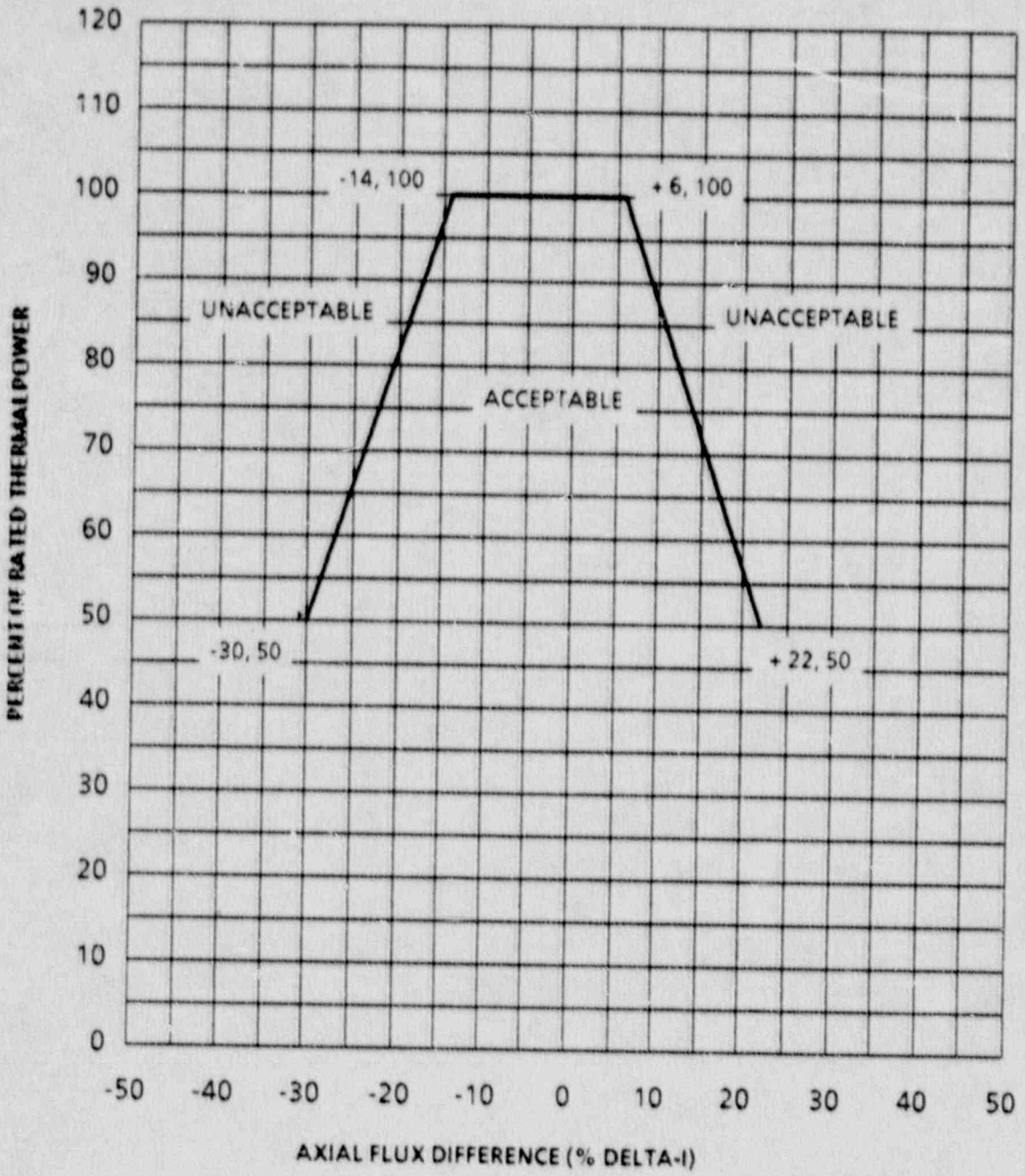


FIGURE 3

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

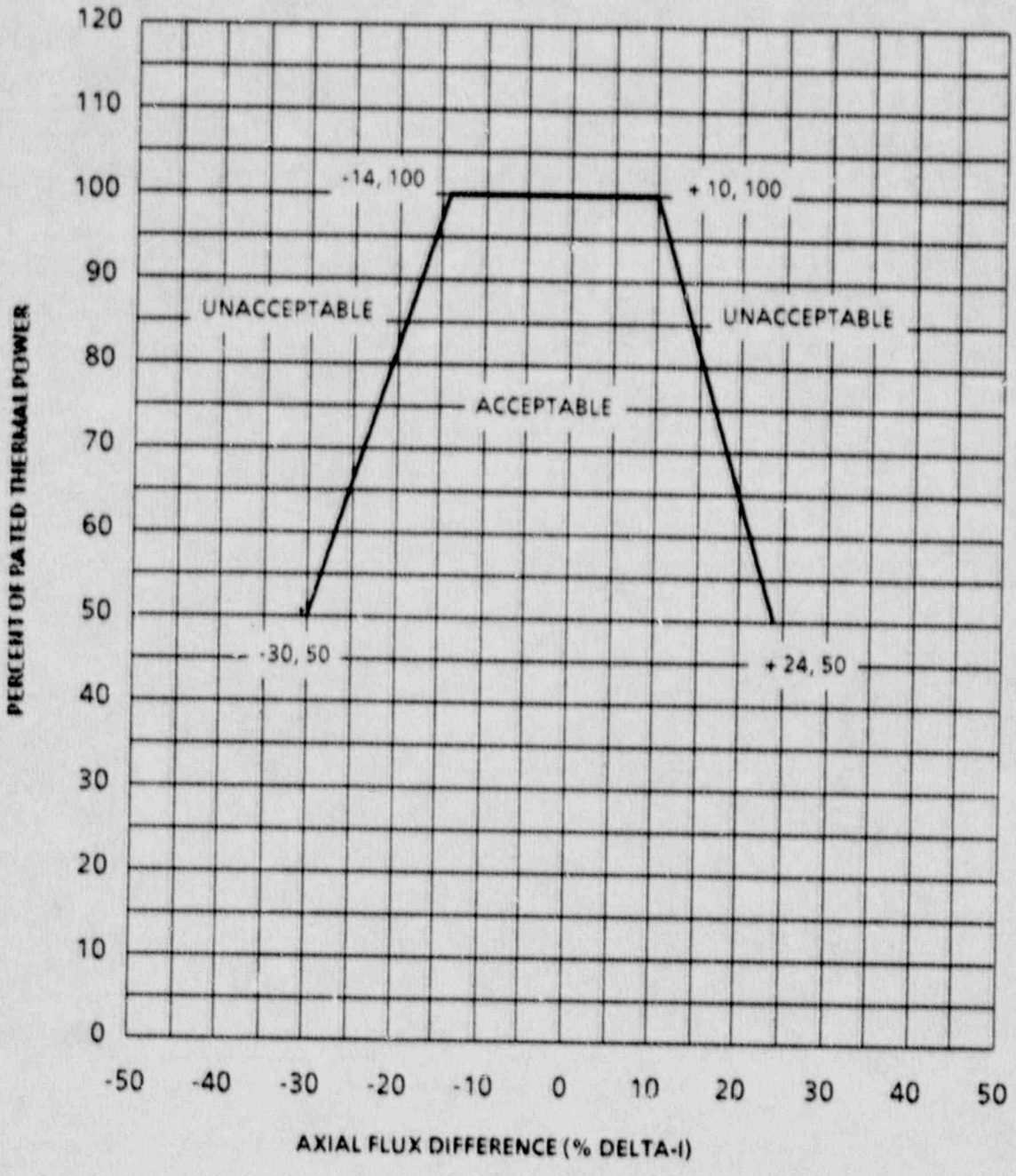


FIGURE 4

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

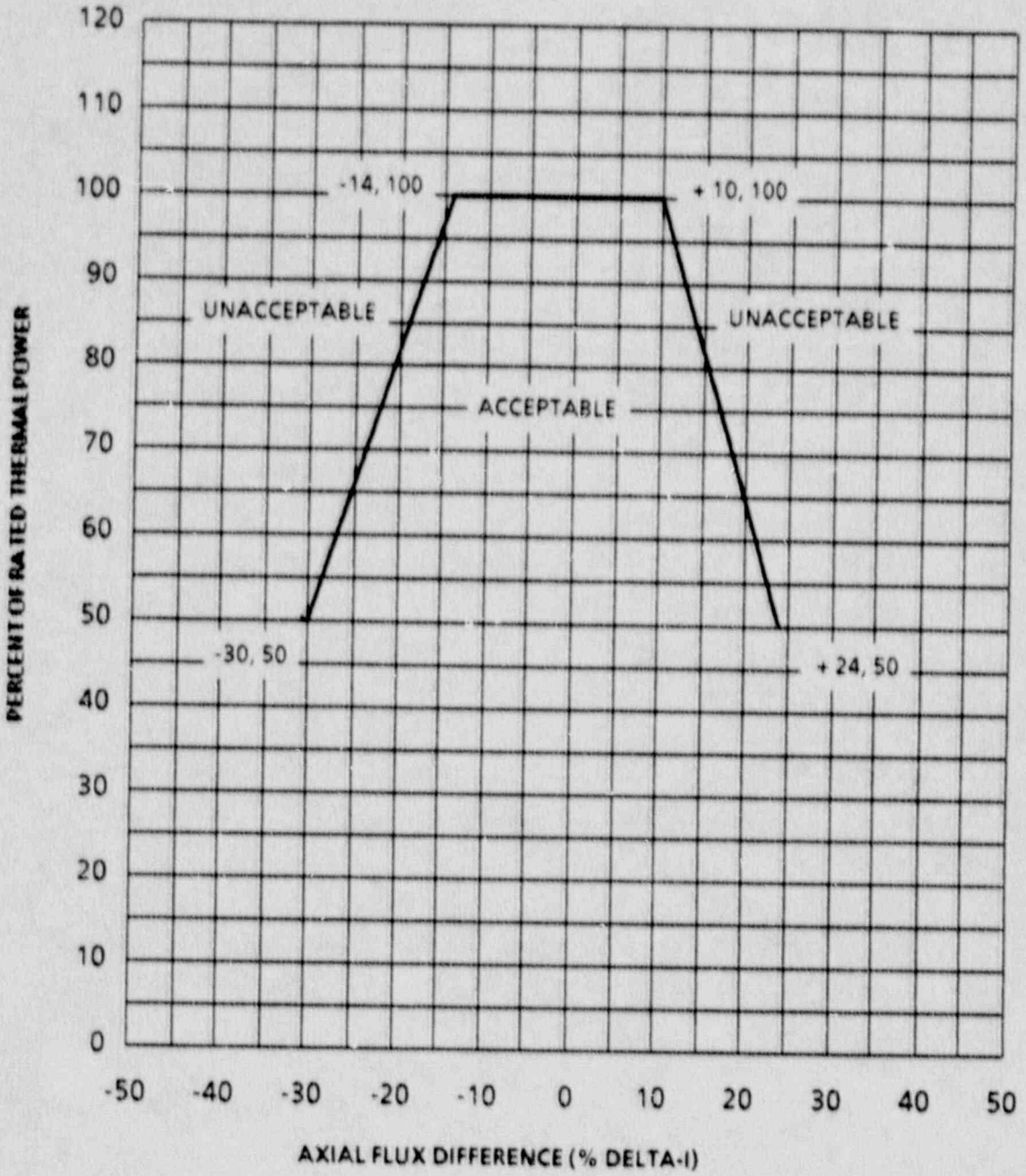


FIGURE 5

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.

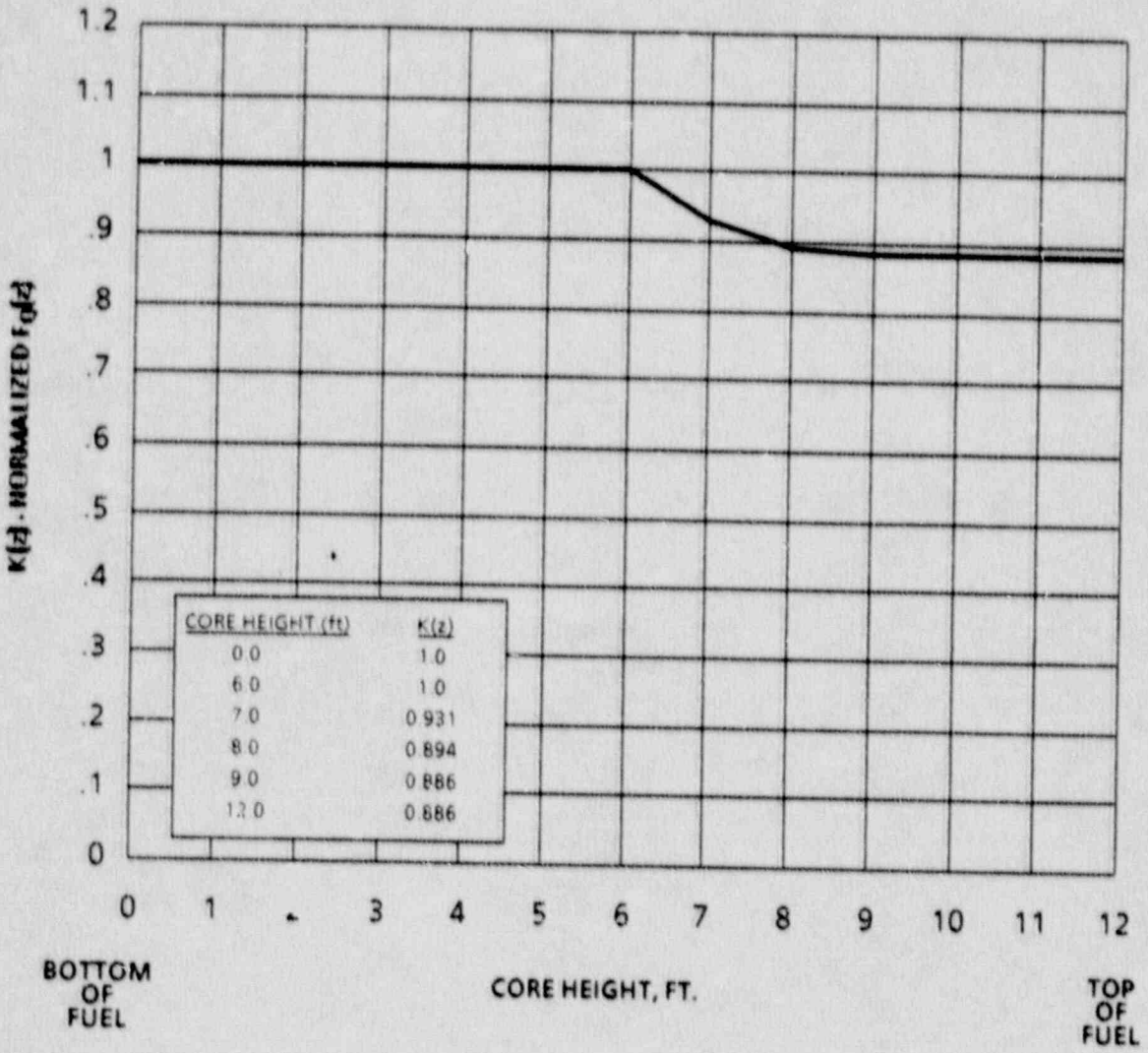


FIGURE 6
K(z) - NORMALIZED $F_Q(z)$ AS A FUNCTION OF CORE HEIGHT

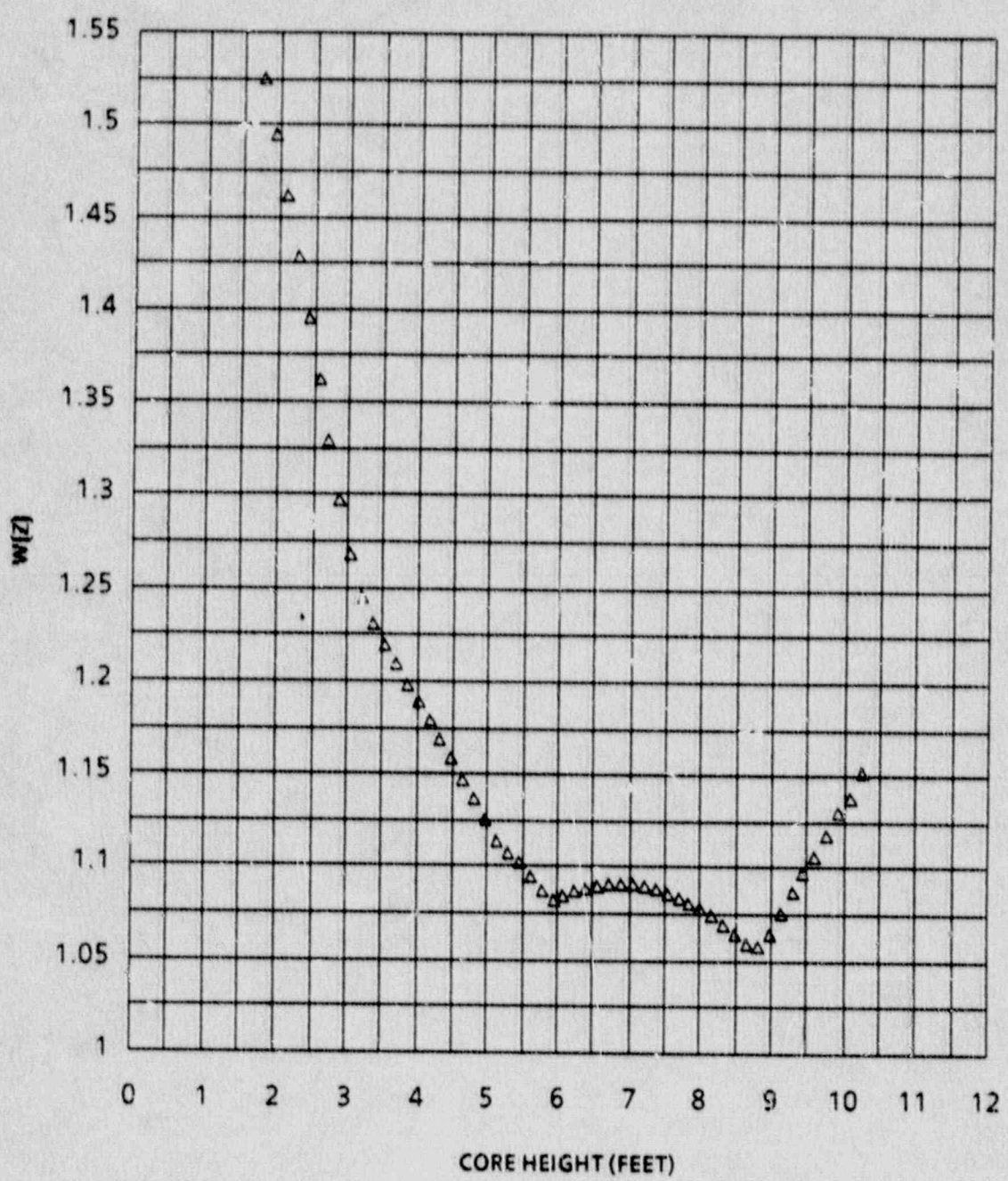


FIGURE 7

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

DATA FOR FIGURE

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

Core Height	W(z)	Core Height	W(z)
0.0000	1.0000	6.0800	1.0853
0.1600	1.0000	6.2400	1.0881
0.3200	1.0000	6.4000	1.0895
0.4800	1.0000	6.5600	1.0907
0.6400	1.0000	6.7200	1.0914
0.8000	1.0000	6.8800	1.0915
0.9600	1.0000	7.0400	1.0911
1.1200	1.0000	7.2000	1.0901
1.2800	1.0000	7.3600	1.0886
1.4400	1.0000	7.5200	1.0868
1.6000	1.0000	7.6800	1.0846
1.7600	1.5264	7.8400	1.0818
1.9200	1.4948	8.0000	1.0785
2.0800	1.4622	8.1600	1.0746
2.2400	1.4291	8.3200	1.0704
2.4000	1.3958	8.4800	1.0650
2.5600	1.3627	8.6400	1.0599
2.7200	1.3298	8.8000	1.0588
2.8800	1.2979	8.9600	1.0647
3.0400	1.2687	9.1200	1.0764
3.2000	1.2462	9.2800	1.0878
3.3600	1.2313	9.4400	1.0976
3.5200	1.2199	9.6000	1.1070
3.6800	1.2095	9.7600	1.1190
3.8400	1.1989	9.9200	1.1306
4.0000	1.1891	10.080	1.1390
4.1600	1.1794	10.240	1.1522
4.3200	1.1693	10.400	1.0000
4.4800	1.1588	10.560	1.0000
4.6400	1.1480	10.720	1.0000
4.8000	1.1369	10.880	1.0000
4.9600	1.1255	11.040	1.0000
5.1200	1.1152	11.200	1.0000
5.2800	1.1084	11.360	1.0000
5.4400	1.1029	11.520	1.0000
5.6000	1.0961	11.680	1.0000
5.7600	1.0881	11.840	1.0000
5.9200	1.0833	12.000	1.0000

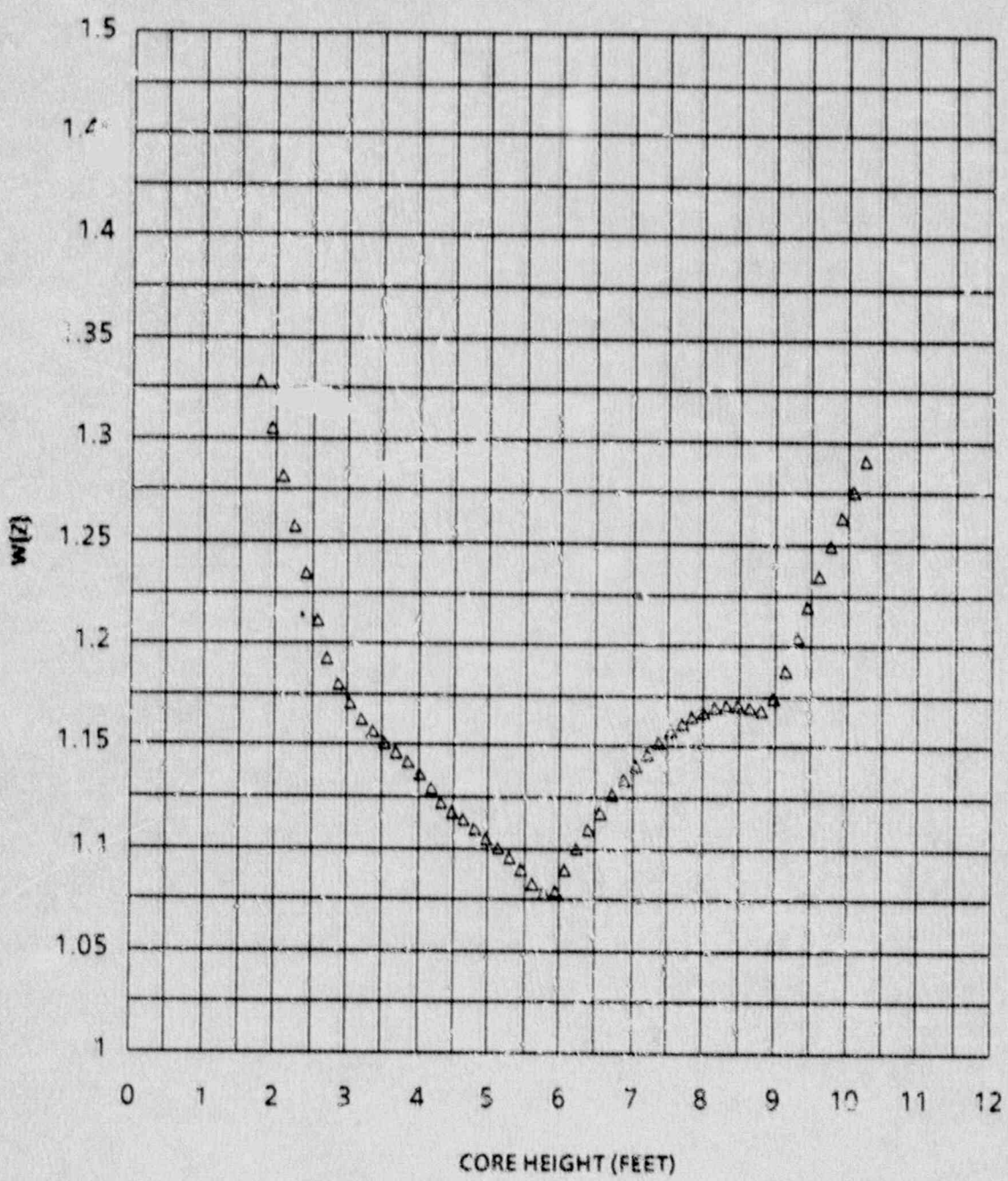


FIGURE 8

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)
0.0000	1.0000	6.0800	1.0897
0.1600	1.0000	6.2400	1.1008
0.3200	1.0000	6.4000	1.1097
0.4800	1.0000	6.5600	1.1185
0.6400	1.0000	6.7200	1.1268
0.8000	1.0000	6.8800	1.1343
0.9600	1.0000	7.0400	1.1412
1.1200	1.0000	7.2000	1.1474
1.2800	1.0000	7.3600	1.1530
1.4400	1.0000	7.5200	1.1580
1.6000	1.0000	7.6800	1.1623
1.7600	1.3287	7.8400	1.1657
1.9200	1.3058	8.0000	1.1683
2.0800	1.2823	8.1600	1.1700
2.2400	1.2585	8.3200	1.1709
2.4000	1.2347	8.4800	1.1711
2.5600	1.2120	8.6400	1.1702
2.7200	1.1934	8.8000	1.1688
2.8800	1.1800	8.9600	1.1743
3.0400	1.1710	9.1200	1.1886
3.2000	1.1637	9.2800	1.2045
3.3600	1.1570	9.4400	1.2199
3.5200	1.1519	9.6000	1.2352
3.6800	1.1473	9.7600	1.2503
3.8400	1.1419	9.9200	1.2641
4.0000	1.1362	10.080	1.2766
4.1600	1.1298	10.240	1.2919
4.3200	1.1229	10.400	1.0000
4.4800	1.1179	10.560	1.0000
4.6400	1.1145	10.720	1.0000
4.8000	1.1105	10.880	1.0000
4.9600	1.1059	11.040	1.0000
5.1200	1.1010	11.200	1.0000
5.2800	1.0957	11.360	1.0000
5.4400	1.0899	11.520	1.0000
5.6000	1.0838	11.680	1.0000
5.7600	1.0789	11.840	1.0000
5.9200	1.0793	12.000	1.0000

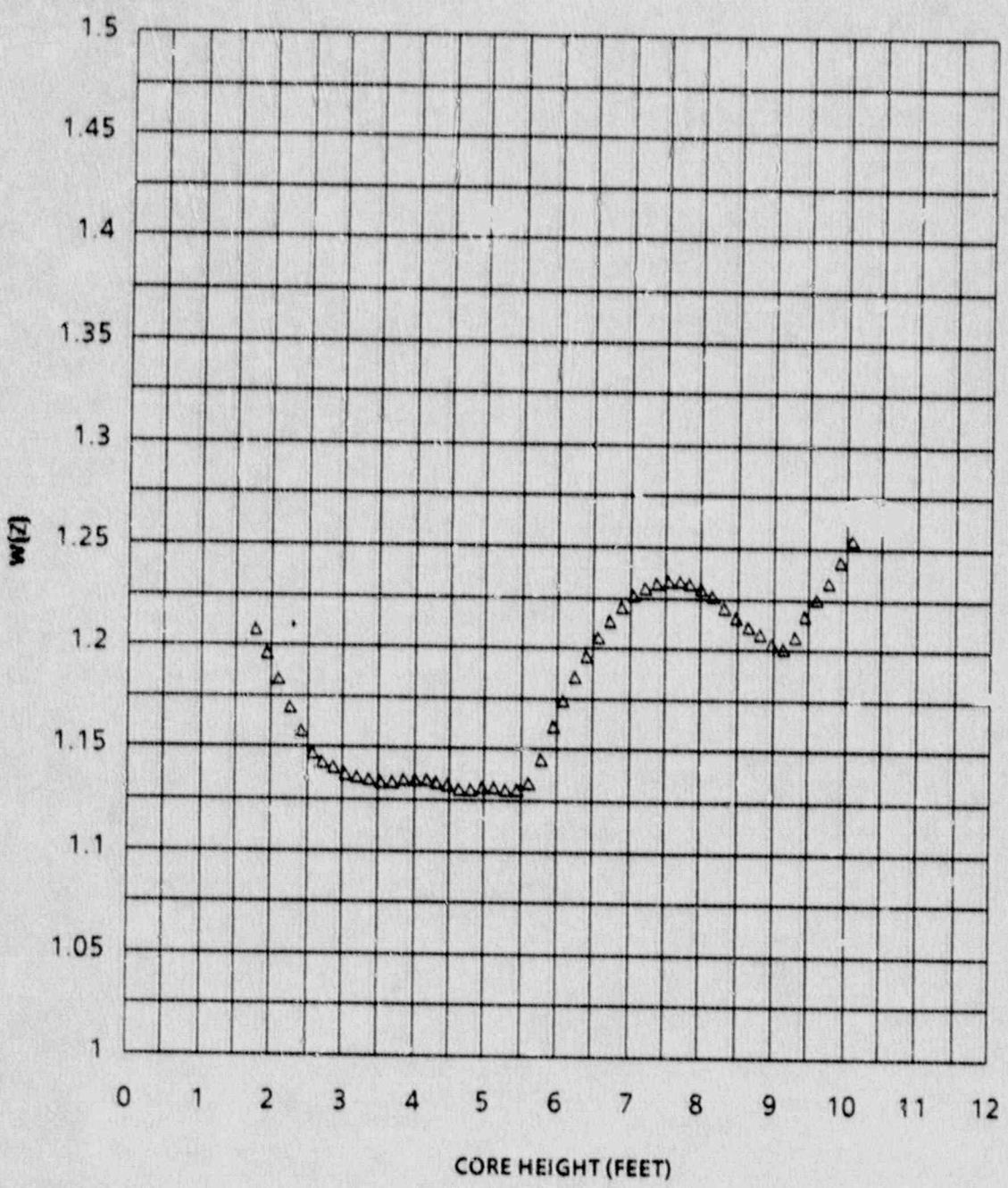


FIGURE 9

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)
0.0000	1.0000	6.0800	1.1747
0.1500	1.0000	6.2400	1.1861
0.3200	1.0000	6.4000	1.1968
0.4800	1.0000	6.5600	1.2061
0.6400	1.0000	6.7200	1.2141
0.8000	1.0000	6.8800	1.2209
0.9600	1.0000	7.0400	1.2263
1.1200	1.0000	7.2000	1.2303
1.2800	1.0000	7.3600	1.2330
1.4400	1.0000	7.5200	1.2343
1.6000	1.0000	7.6800	1.2342
1.7600	1.2086	7.8400	1.2329
1.9200	1.1964	8.0000	1.2303
2.0800	1.1838	8.1600	1.2264
2.2400	1.1706	8.3200	1.2211
2.4000	1.1580	8.4800	1.2161
2.5600	1.1484	8.6400	1.2119
2.7200	1.1432	8.8000	1.2081
2.8800	1.1410	8.9600	1.2037
3.0400	1.1383	9.1200	1.2012
3.2000	1.1361	9.2800	1.2077
3.3600	1.1350	9.4400	1.2177
3.5200	1.1344	9.6000	1.2254
3.6800	1.1345	9.7600	1.2338
3.8400	1.1352	9.9200	1.2438
4.0000	1.1355	10.080	1.2548
4.1600	1.1353	10.240	1.2662
4.3200	1.1345	10.400	1.0000
4.4800	1.1328	10.560	1.0000
4.6400	1.1311	10.720	1.0000
4.8000	1.1310	10.880	1.0000
4.9600	1.1317	11.040	1.0000
5.1200	1.1320	11.200	1.0000
5.2800	1.1311	11.360	1.0000
5.4400	1.1308	11.520	1.0000
5.6000	1.1345	11.680	1.0000
5.7600	1.1464	11.840	1.0000
5.9200	1.1618	12.000	1.0000

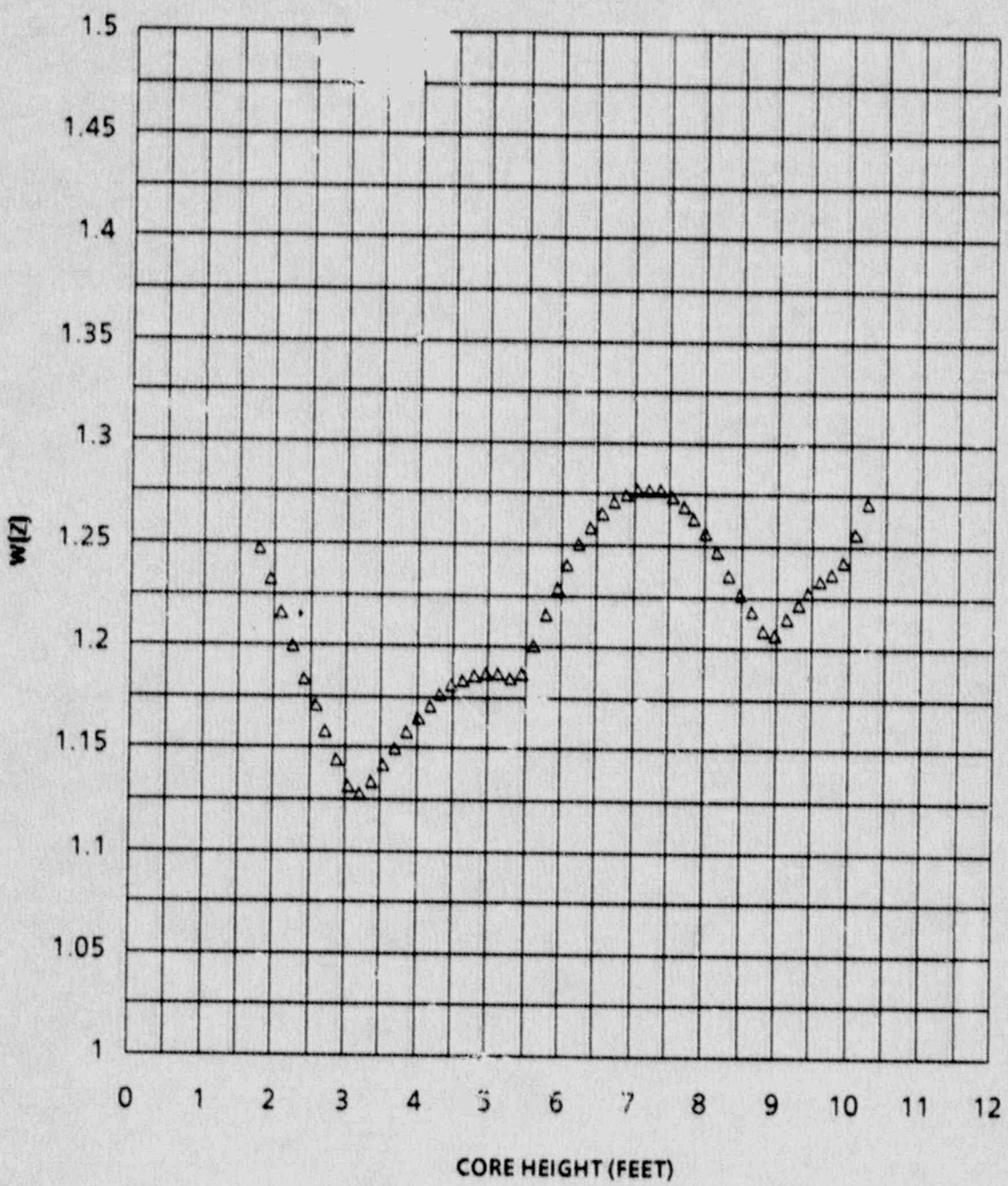


FIGURE 10

V. C. SUMMER RA[illegible] MWD/MTU

DATA FOR FIGURE 10

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

Core Height	W(z)	Core Height	W(z)
0.0000	1.0000	6.0800	1.2408
0.1600	1.0000	6.2400	1.2509
0.3200	1.0000	6.4000	1.2595
0.4800	1.0000	6.5600	1.2665
0.6400	1.0000	6.7200	1.2717
0.8000	1.0000	6.8800	1.2754
0.9600	1.0000	7.0400	1.2775
1.1200	1.0000	7.2000	1.2781
1.2800	1.0000	7.3600	1.2772
1.4400	1.0000	7.5200	1.2745
1.6000	1.0000	7.6800	1.2701
1.7600	1.2478	7.8400	1.2640
1.9200	1.2323	8.0000	1.2565
2.0800	1.2163	8.1600	1.2472
2.2400	1.2000	8.3200	1.2360
2.4000	1.1846	8.4800	1.2267
2.5600	1.1713	8.6400	1.2186
2.7200	1.1585	8.8000	1.2091
2.8800	1.1452	8.9600	1.2069
3.0400	1.1324	9.1200	1.2147
3.2000	1.1280	9.2800	1.2221
3.3600	1.1339	9.4400	1.2283
3.5200	1.1423	9.6000	1.2340
3.6800	1.1506	9.7600	1.2375
3.8400	1.1583	9.9200	1.2432
4.0000	1.1653	10.080	1.2566
4.1600	1.1715	10.240	1.2721
4.3200	1.1769	10.400	1.0000
4.4800	1.1812	10.560	1.0000
4.6400	1.1845	10.720	1.0000
4.8000	1.1866	10.880	1.0000
4.9600	1.1880	11.040	1.0000
5.1200	1.1878	11.200	1.0000
5.2800	1.1847	11.360	1.0000
5.4400	1.1878	11.520	1.0000
5.6000	1.2014	11.680	1.0000
5.7600	1.2161	11.840	1.0000
5.9200	1.2291	12.000	1.0000

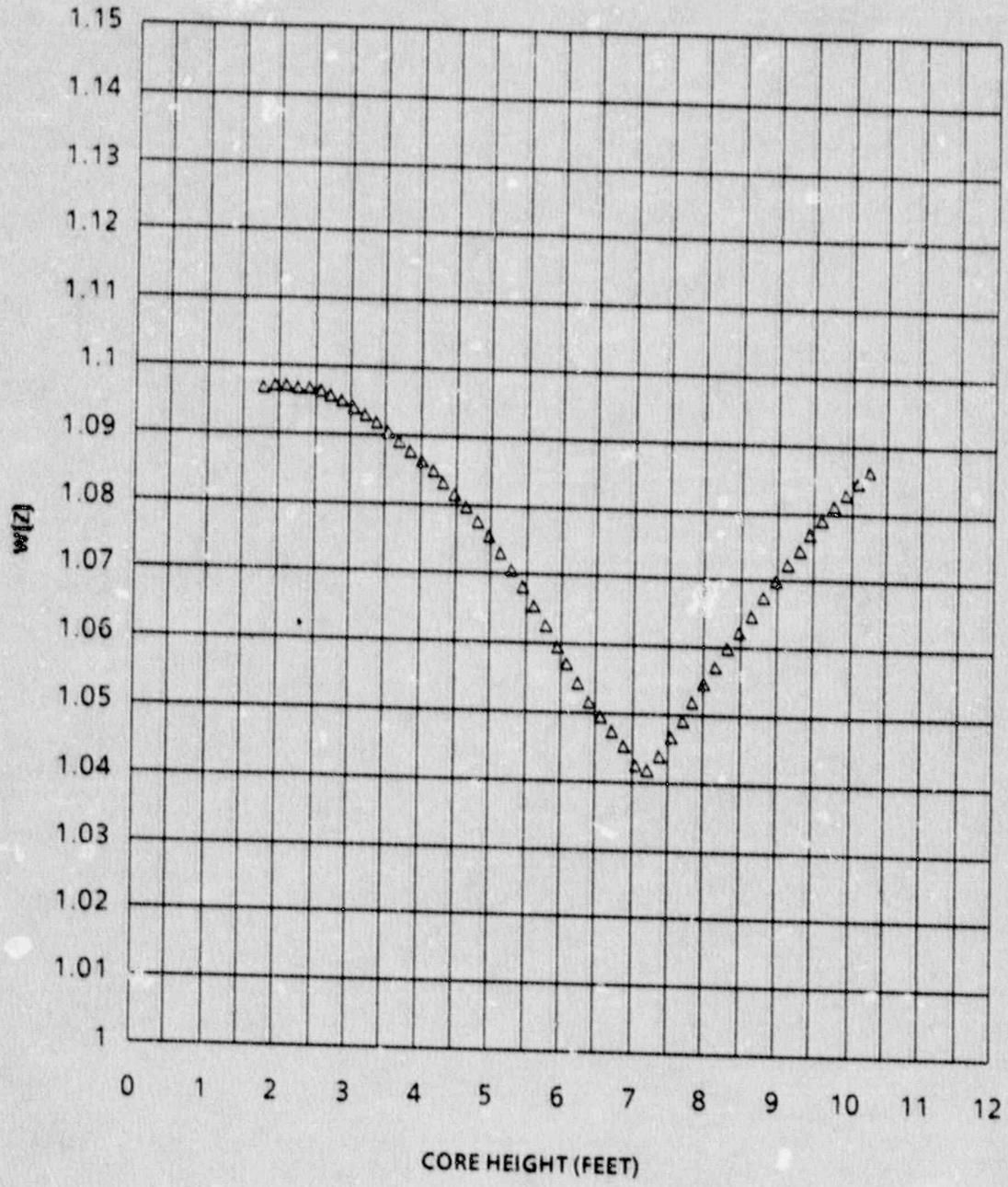


FIGURE 11

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)
0.0000	1.0000	6.0800	1.0573
0.1600	1.0000	6.2400	1.0545
0.3200	1.0000	6.4000	1.0518
0.4800	1.0000	6.5600	1.0495
0.6400	1.0000	6.7200	1.0476
0.8000	1.0000	6.8800	1.0455
0.9600	1.0000	7.0400	1.0428
1.1200	1.0000	7.2000	1.0419
1.2800	1.0000	7.3600	1.0441
1.4400	1.0000	7.5200	1.0468
1.6000	1.0000	7.6800	1.0494
1.7600	1.0969	7.8400	1.0520
1.9200	1.0971	8.0000	1.0547
2.0800	1.0971	8.1600	1.0573
2.2400	1.0970	8.3200	1.0599
2.4000	1.0968	8.4800	1.0625
2.5600	1.0964	8.6400	1.0651
2.7200	1.0958	8.8000	1.0676
2.8800	1.0951	8.9600	1.0701
3.0400	1.0942	9.1200	1.0725
3.2000	1.0932	9.2800	1.0748
3.3600	1.0920	9.4400	1.0770
3.5200	1.0906	9.6000	1.0792
3.6800	1.0892	9.7600	1.0812
3.8400	1.0878	9.9200	1.0831
4.0000	1.0864	10.080	1.0848
4.1600	1.0849	10.240	1.0864
4.3200	1.0833	10.400	1.0000
4.4800	1.0816	10.560	1.0000
4.6400	1.0798	10.720	1.0000
4.8000	1.0777	10.880	1.0000
4.9600	1.0756	11.040	1.0000
5.1200	1.0733	11.200	1.0000
5.2800	1.0708	11.360	1.0000
5.4400	1.0683	11.520	1.0000
5.6000	1.0656	11.680	1.0000
5.7600	1.0627	11.840	1.0000
5.9200	1.0598	12.000	1.0000

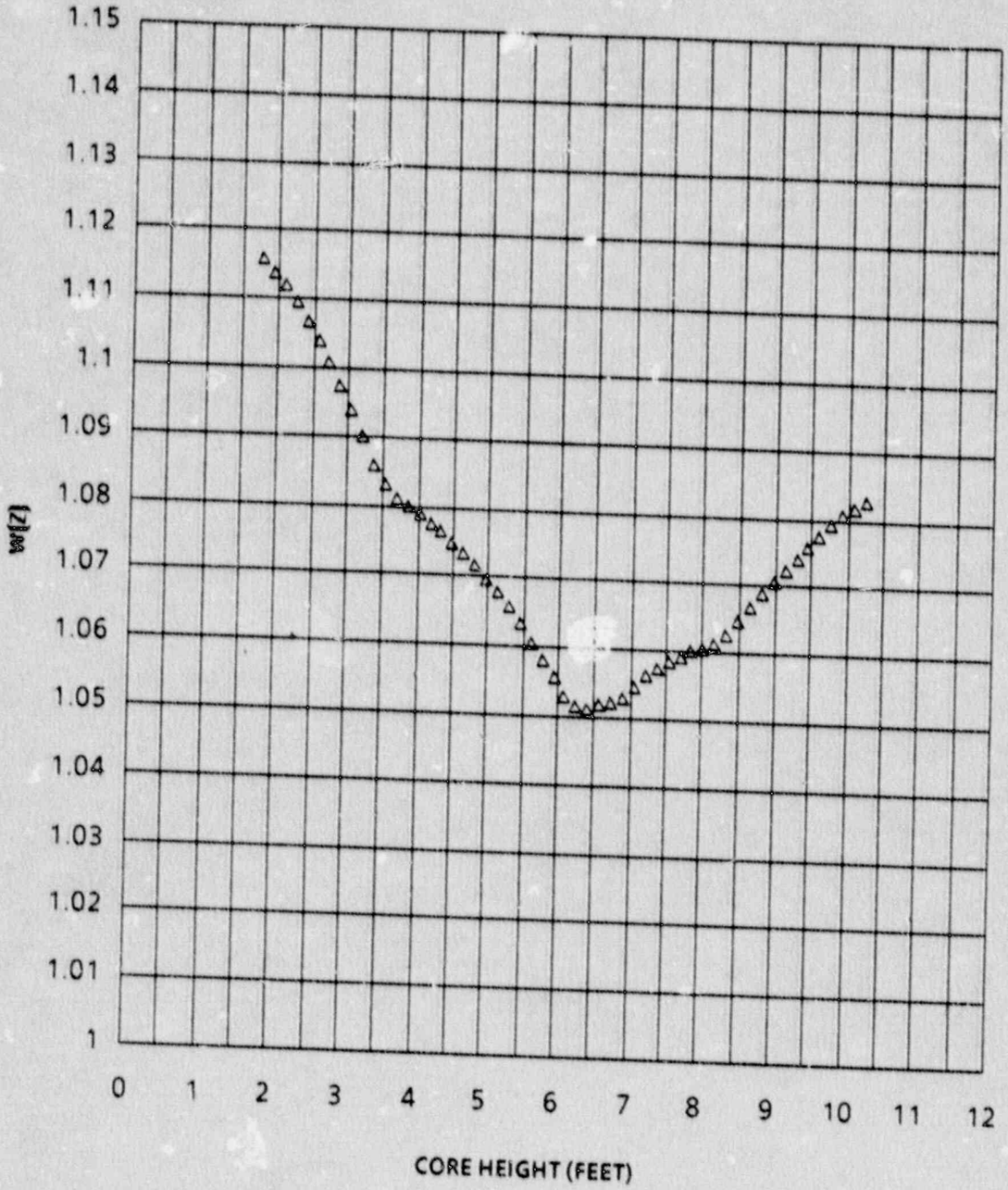


FIGURE 12

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)
0.0000	1.0000	6.0800	1.0532
0.1600	1.0000	6.2400	1.0517
0.3200	1.0000	6.4000	1.0515
0.4800	1.0000	6.5600	1.0520
0.6400	1.0000	6.7200	1.0525
0.8000	1.0000	6.8800	1.0532
0.9600	1.0000	7.0400	1.0548
1.1200	1.0000	7.2000	1.0565
1.2800	1.0000	7.3600	1.0576
1.4400	1.0000	7.5200	1.0586
1.6000	1.0000	7.6800	1.0595
1.7600	1.1158	7.8400	1.0603
1.9200	1.1140	8.0000	1.0608
2.0800	1.1120	8.1600	1.0615
2.2400	1.1096	8.3200	1.0630
2.4000	1.1070	8.4800	1.0650
2.5600	1.1041	8.6400	1.0671
2.7200	1.1010	8.8000	1.0691
2.8800	1.0977	8.9600	1.0709
3.0400	1.0942	9.1200	1.0726
3.2000	1.0903	9.2800	1.0744
3.3600	1.0862	9.4400	1.0761
3.5200	1.0833	9.6000	1.0778
3.6800	1.0814	9.7600	1.0794
3.8400	1.0803	9.9200	1.0808
4.000	1.0792	10.080	1.0821
4.160	1.0779	10.240	1.0831
4.3200	1.0766	10.400	1.0000
4.4800	1.0751	10.560	1.0000
4.6400	1.0735	10.720	1.0000
4.8000	1.0718	10.880	1.0000
4.9600	1.0699	11.040	1.0000
5.1200	1.0679	11.200	1.0000
5.2800	1.0658	11.360	1.0000
5.4400	1.0634	11.520	1.0000
5.6000	1.0607	11.680	1.0000
5.7600	1.0583	11.840	1.0000
5.9200	1.0559	12.000	1.0000

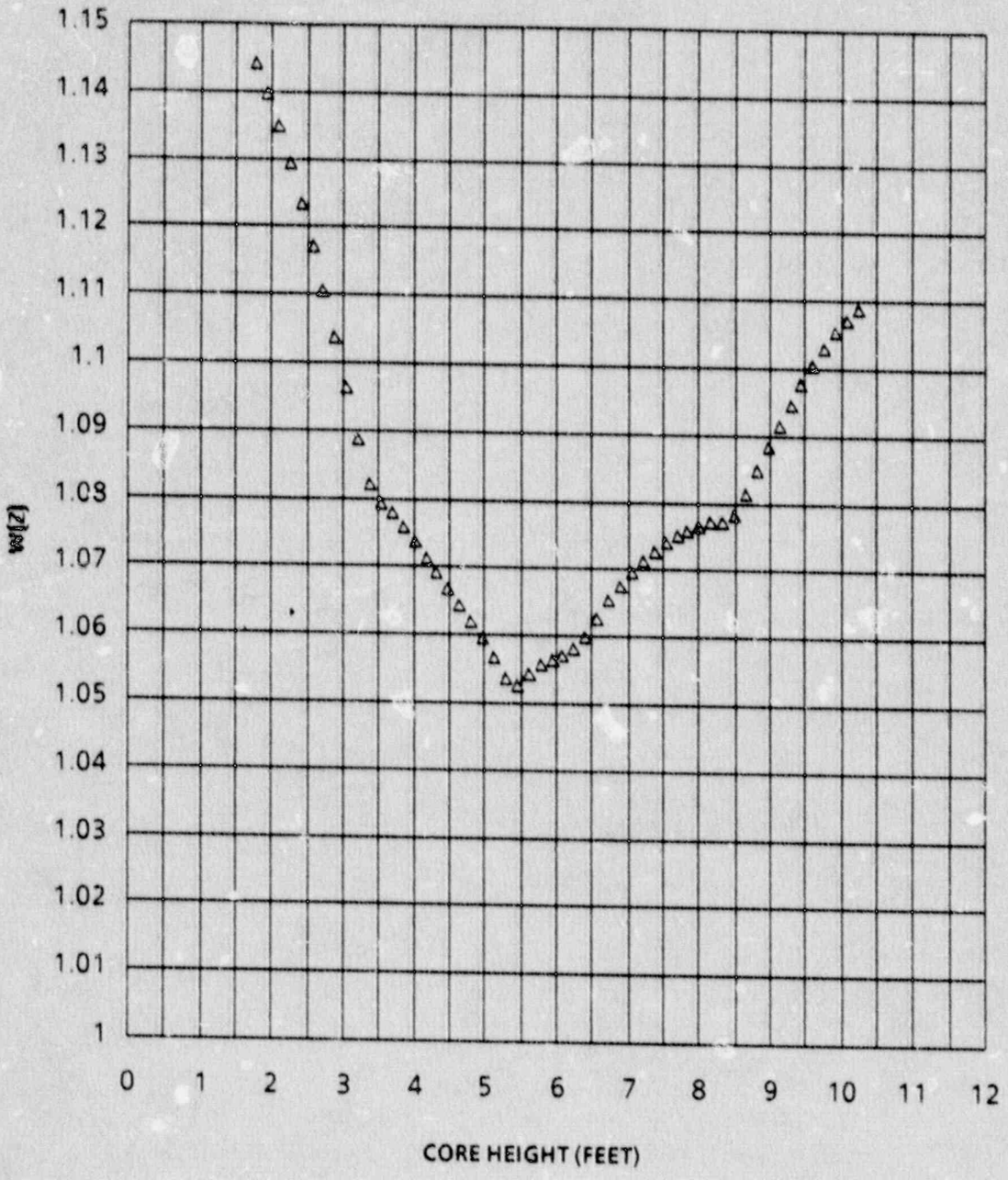


FIGURE 13

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)
0.0000	1.0000	6.0800	1.0573
0.1600	1.0000	6.2400	1.0583
0.3200	1.0000	6.4000	1.0599
0.4800	1.0000	6.5600	1.0627
0.6400	1.0000	6.7200	1.0655
0.8000	1.0000	6.8800	1.0677
0.9600	1.0000	7.0400	1.0697
1.1200	1.0000	7.2000	1.0715
1.2800	1.0000	7.3600	1.0730
1.4400	1.0000	7.5200	1.0743
1.6000	1.0000	7.6800	1.0754
1.7600	1.1446	7.8400	1.0762
1.9200	1.1400	8.0000	1.0769
2.0800	1.1349	8.1600	1.0773
2.2400	1.1293	8.3200	1.0773
2.4000	1.1236	8.4800	1.0786
2.5600	1.1173	8.6400	1.0815
2.7200	1.1107	8.8000	1.0850
2.8800	1.1037	8.9600	1.0885
3.0400	1.0966	9.1200	1.0918
3.2000	1.0890	9.2800	1.0949
3.3600	1.0823	9.4400	1.0979
3.5200	1.0795	9.6000	1.1006
3.6800	1.0782	9.7600	1.1031
3.8400	1.0761	9.9200	1.1054
4.0000	1.0739	10.080	1.1073
4.1600	1.0717	10.240	1.1089
4.3200	1.0695	10.400	1.0000
4.4800	1.0671	10.560	1.0000
4.6400	1.0646	10.720	1.0000
4.8000	1.0621	10.880	1.0000
4.9600	1.0596	11.040	1.0000
5.1200	1.0569	11.200	1.0000
5.2800	1.0539	11.360	1.0000
5.4400	1.0528	11.520	1.0000
5.6000	1.0544	11.680	1.0000
5.7600	1.0558	11.840	1.0000
5.9200	1.0566	12.000	1.0000

2.6 RCS Flow Rate and Nuclear Enthalpy Rise Hot Channel Factor-$F_{\Delta H}^N$ (Specification 3.2.3)

$$R = \frac{F_{\Delta H}^N}{F_{\Delta H}^{RTP} * (1 + PF_{\Delta H} * (1 - P))}$$

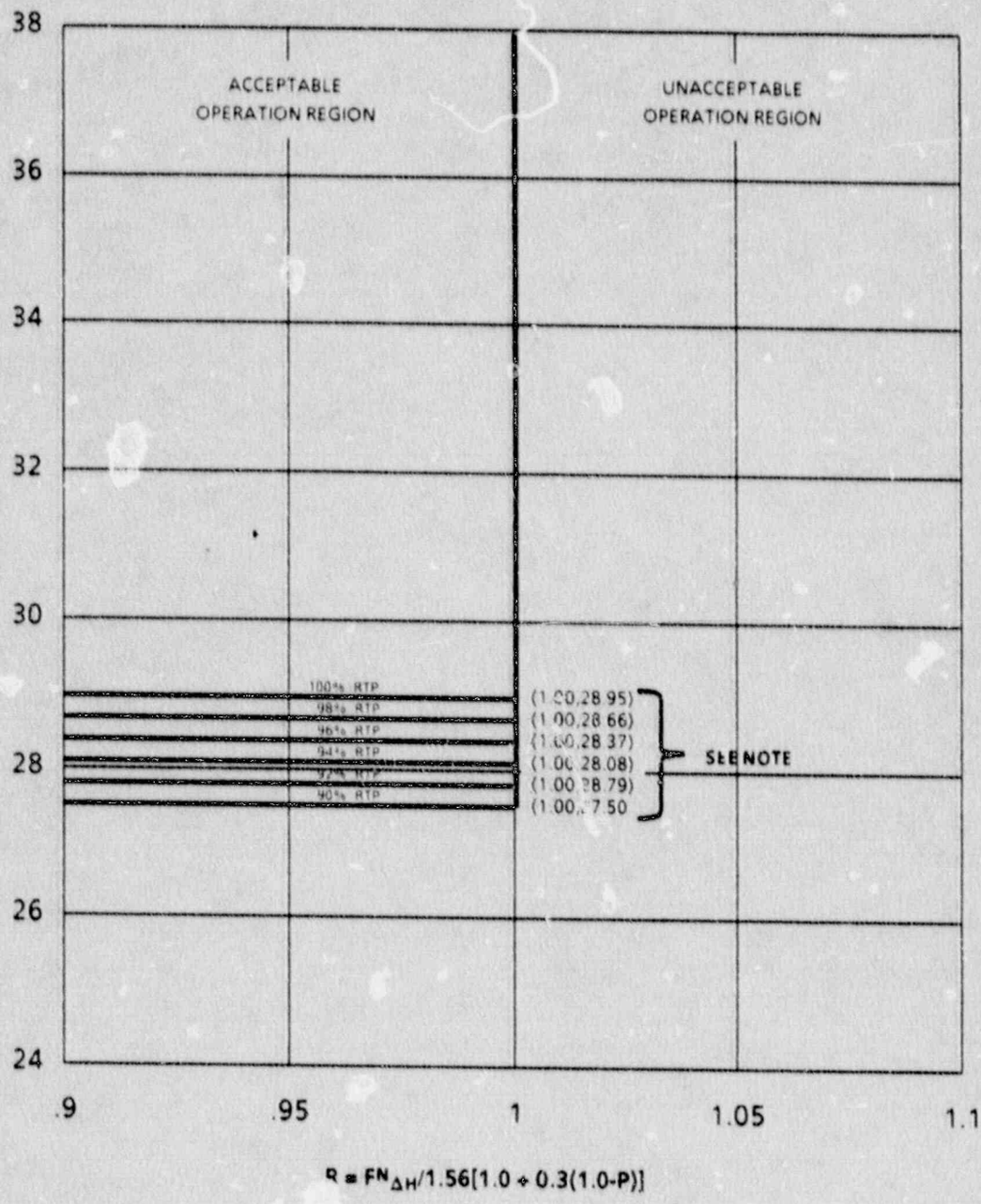
$$Where: P = \frac{Thermal\ Power}{Rated\ Thermal\ Power}$$

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.

MEASUREMENT UNCERTAINTIES OF 2.1% FOR FLOW AND 4.0% FOR INCORE MEASUREMENT OF $F^N_{\Delta H}$ 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

FIGURE 14
RCS TOTAL FLOW RATE VERSUS R FOR THREE LOOP OPERATION