SOUTH CAROLINA ELECTRIC & GAS COMPANY

VIRGIL C. SUMMER NUCLEAR STATION

CORE OPERATING LIMITS REPORT

CYCLE 8

Revision 0

April 14, 1993

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1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for V. C. Summer Station Cycle 8 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

2.2 Shutdown Rod Insertion Limits (Specification 3.1.3.5):

The shutdown rods shall be withdrawn to at least 225 steps.

2.3 Control Rod Insertion Limits (Specification 3.1.3.6):

The Control Bank Insertion Limits are specified by Figure 2.

Figure 1

Moderator Temperature Coefficient vs. Power Level

V. C. Summer - Cycle 8

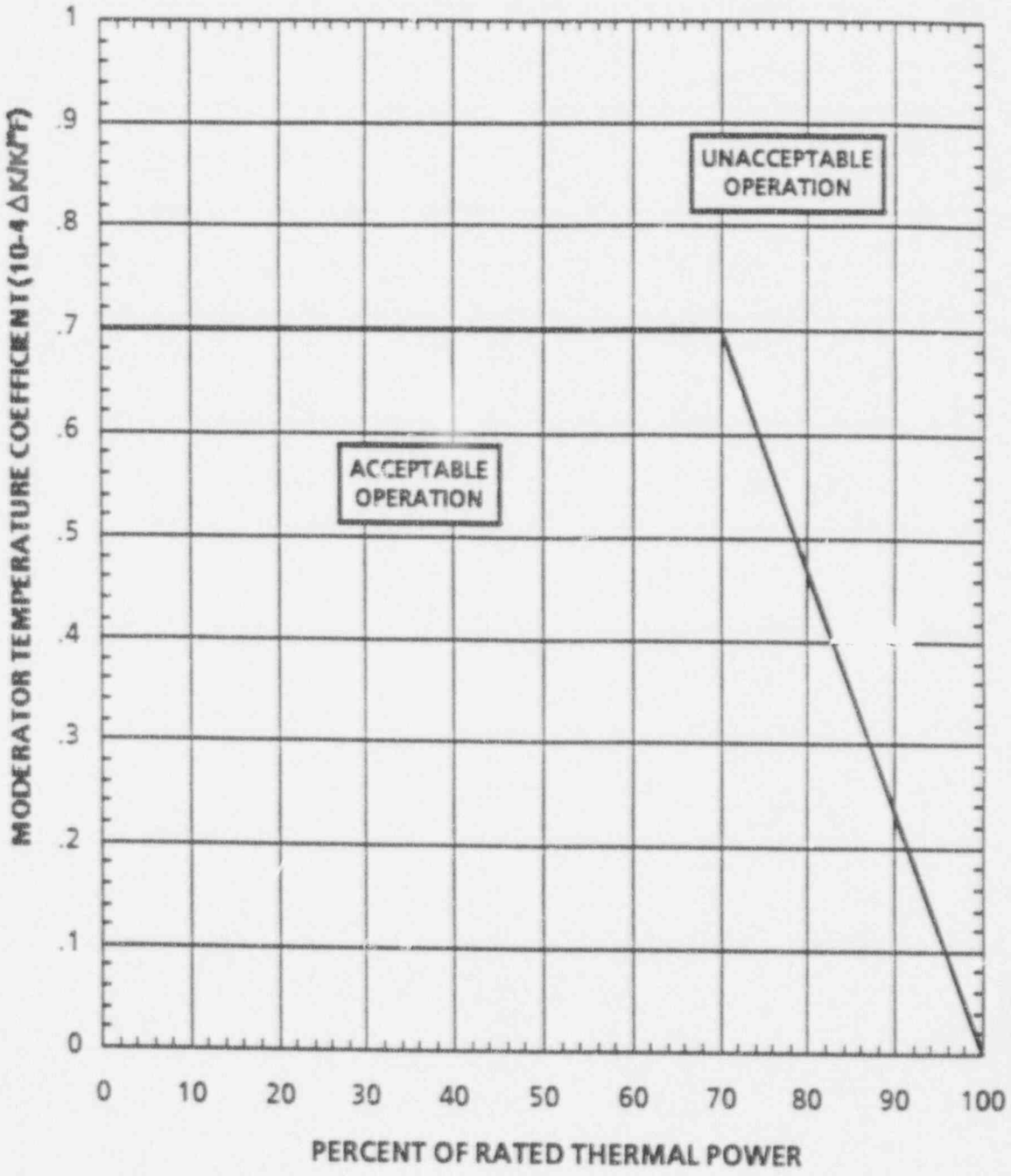
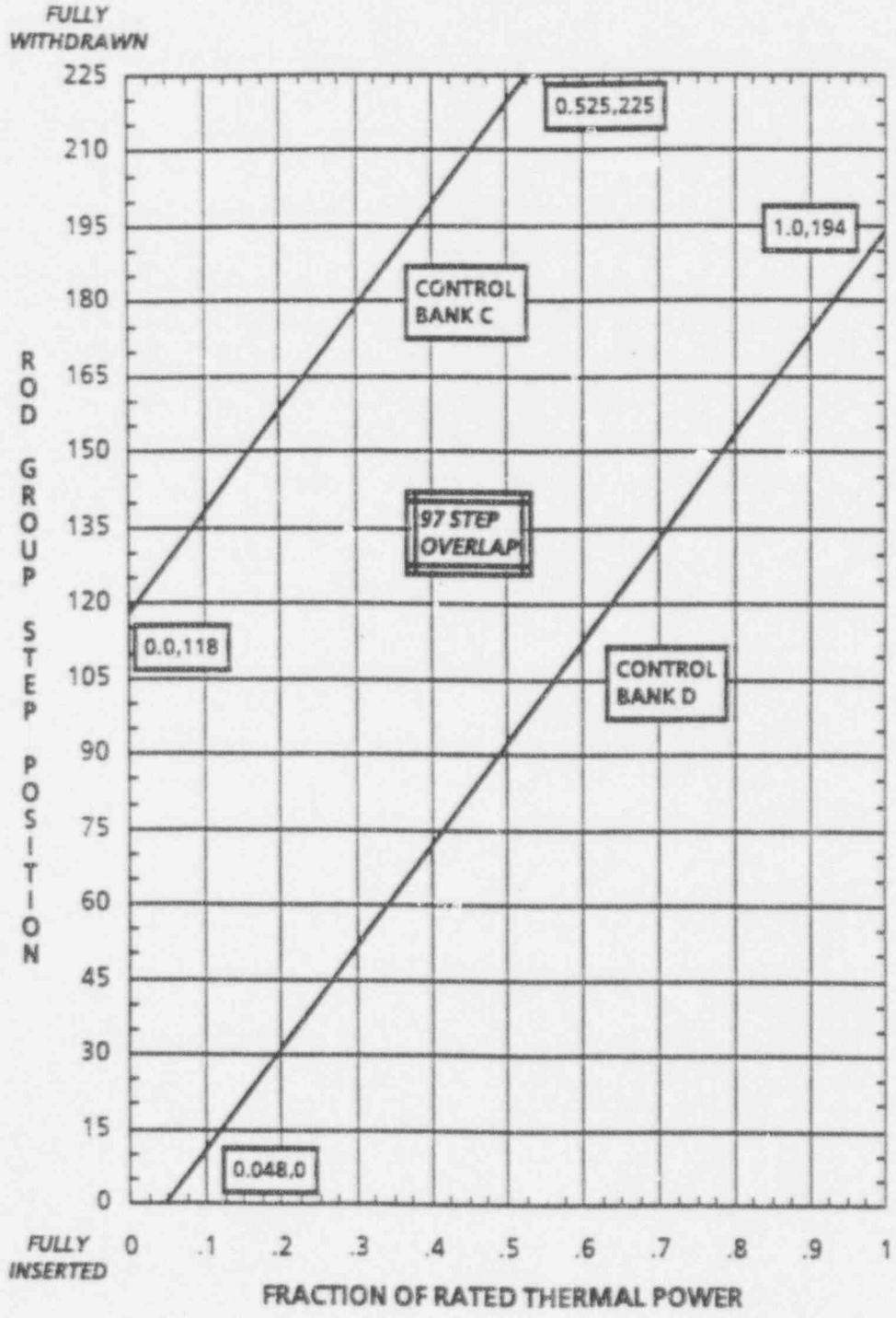


Figure 2

Rod Group Insertion Limits vs. Thermal Power

for Three Loop Operation

V. C. Summer - Cycle 8



2.4 Axial Flux Difference (Specification 3.2.1):

2.4.1 The Axial Flux Difference (AFD) Limits for RAOC operation for Cycle 8 are shown in Figure 3.

2.4.2 The Axial Flux Difference (AFD) target band during base load operations for Cycle 8 is:

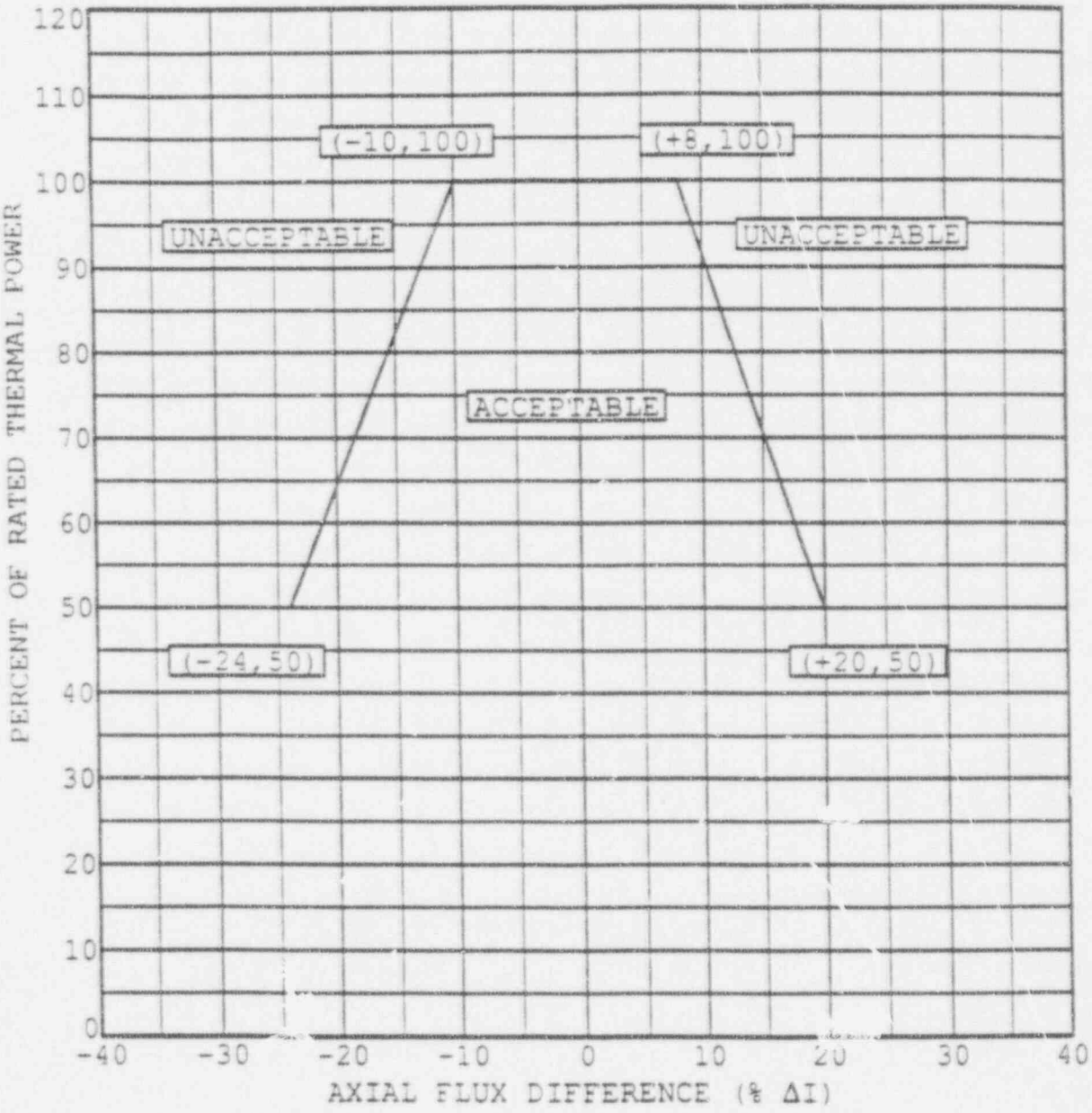
BOL - EOL (0 - 19000 MWD/MTU): + or - 5% about a measured target value.

2.4.2 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

V. C. Summer - Cycle 8



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 4

2.5.3 Elevation dependent W(z) values for RAOC operation at 150, 4000, 10000, and 16000 MWD/MTU are shown in Figures 5 through 8, 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 5 through 7 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 6 through 8.

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 9 through 11, 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 4

K(z) - Normalized $F_Q(z)$ as a Function of Core Height

V. C. Summer - Cycle 8

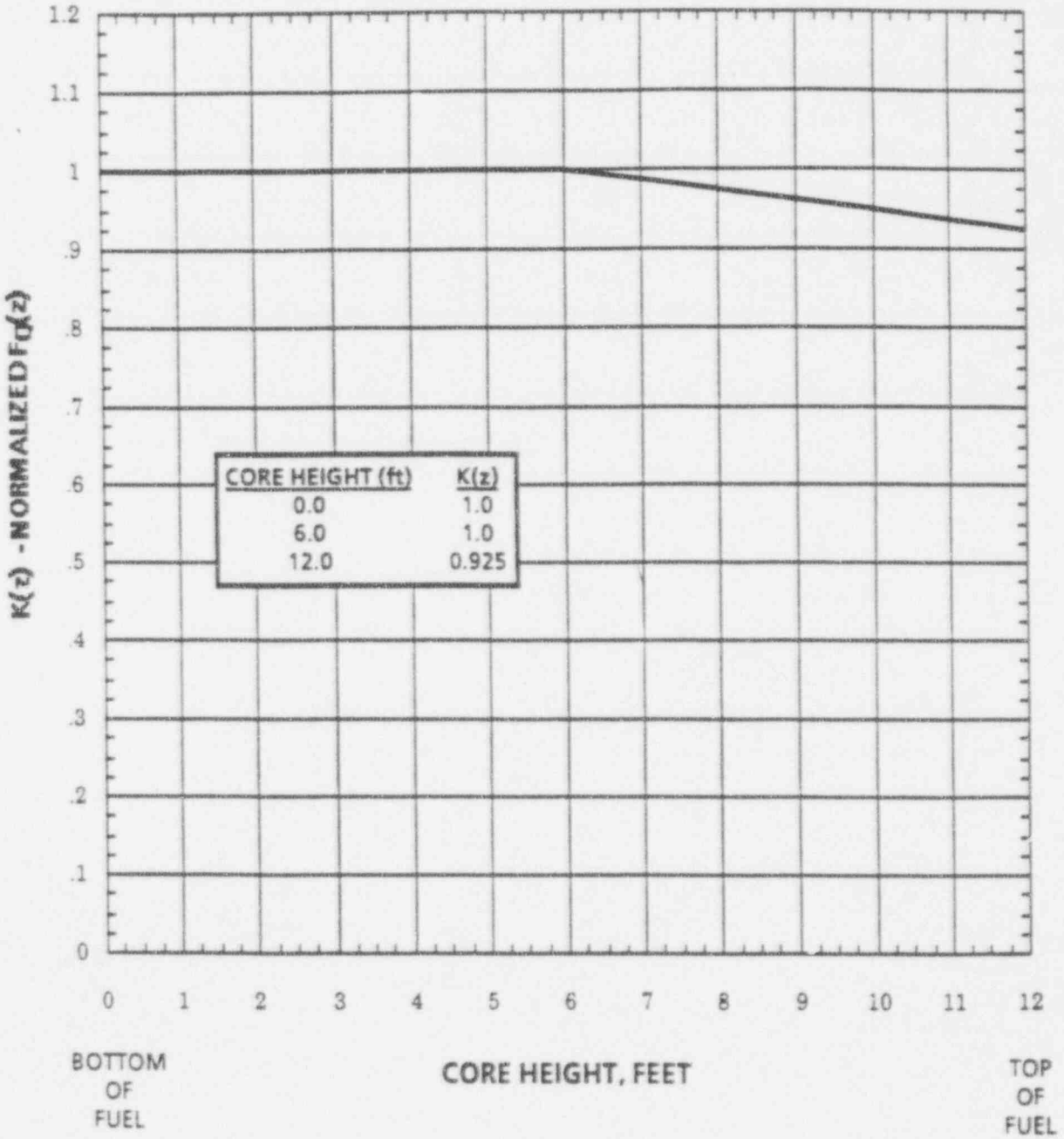
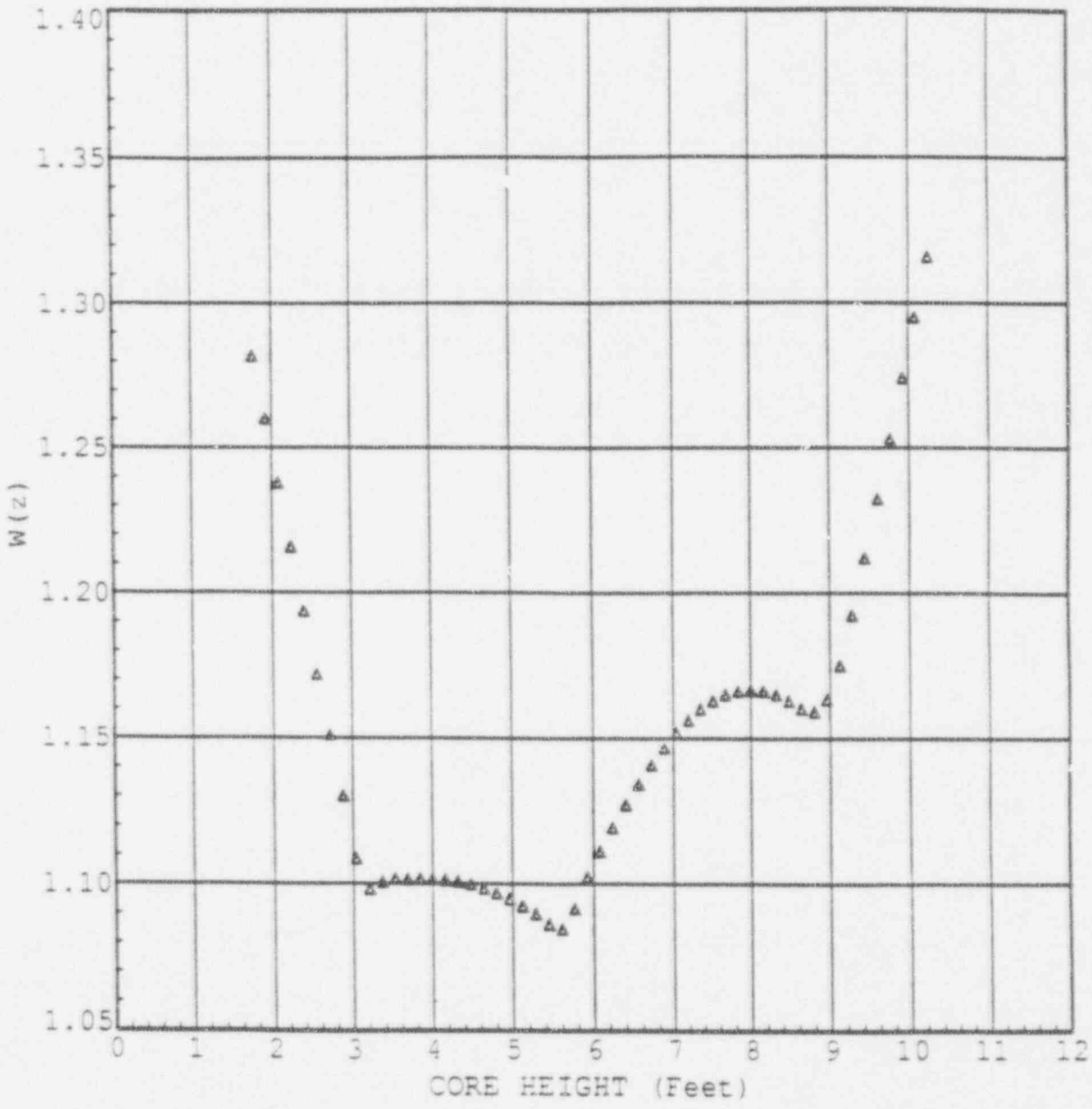


Figure 5

RAOC W(z) at 150 MWD/MTU

V. C. Summer - Cycle 8



Data for Figure 5

RAOC W(z) at 150 MWD/MTU

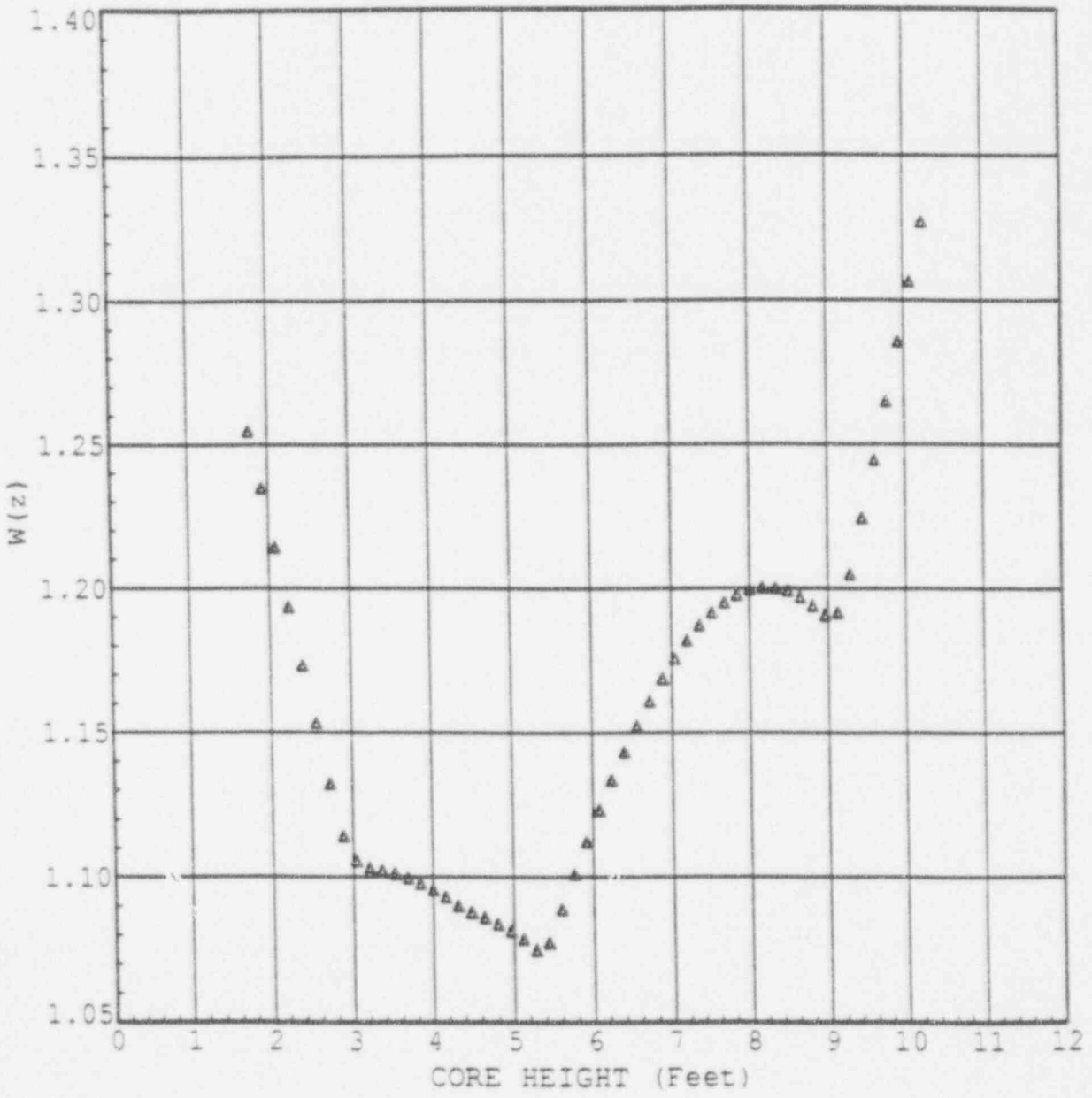
V. C. Summer - Cycle 8

Core Height	W(Z)	Core Height	W(Z)
.0000	1.0000	6.0800	1.1111
.1600	1.0000	6.2400	1.1192
.3200	1.0000	6.4000	1.1271
.4800	1.0000	6.5600	1.1342
.6400	1.0000	6.7200	1.1408
.8000	1.0000	6.8800	1.1466
.9600	1.0000	7.0400	1.1518
1.1200	1.0000	7.2000	1.1562
1.2800	1.0000	7.3600	1.1599
1.4400	1.0000	7.5200	1.1628
1.6000	1.0000	7.6800	1.1649
1.7600	1.2816	7.8400	1.1661
1.9200	1.2600	8.0000	1.1665
2.0800	1.2379	8.1600	1.1662
2.2400	1.2157	8.3200	1.1650
2.4000	1.1936	8.4800	1.1628
2.5600	1.1717	8.6400	1.1601
2.7200	1.1510	8.8000	1.1590
2.8800	1.1300	8.9600	1.1634
3.0400	1.1084	9.1200	1.1750
3.2000	1.0982	9.2800	1.1922
3.3600	1.1006	9.4400	1.2120
3.5200	1.1018	9.6000	1.2324
3.6800	1.1014	9.7600	1.2532
3.8400	1.1016	9.9200	1.2741
4.0000	1.1016	10.0800	1.2950
4.1600	1.1012	10.2400	1.3157
4.3200	1.1006	10.4000	1.0000
4.4800	1.0997	10.5600	1.0000
4.6400	1.0984	10.7200	1.0000
4.8000	1.0968	10.8800	1.0000
4.9600	1.0948	11.0400	1.0000
5.1200	1.0924	11.2000	1.0000
5.2800	1.0897	11.3600	1.0000
5.4400	1.0862	11.5200	1.0000
5.6000	1.0845	11.6800	1.0000
5.7600	1.0915	11.8400	1.0000
5.9200	1.1023	12.0000	1.0000

Figure 6

RAOC W(z) at 4000 MWD/MTU

V. C. Summer - Cycle 8



Data for Figure 6

RAOC W(z) at 4000 MWD/MTU

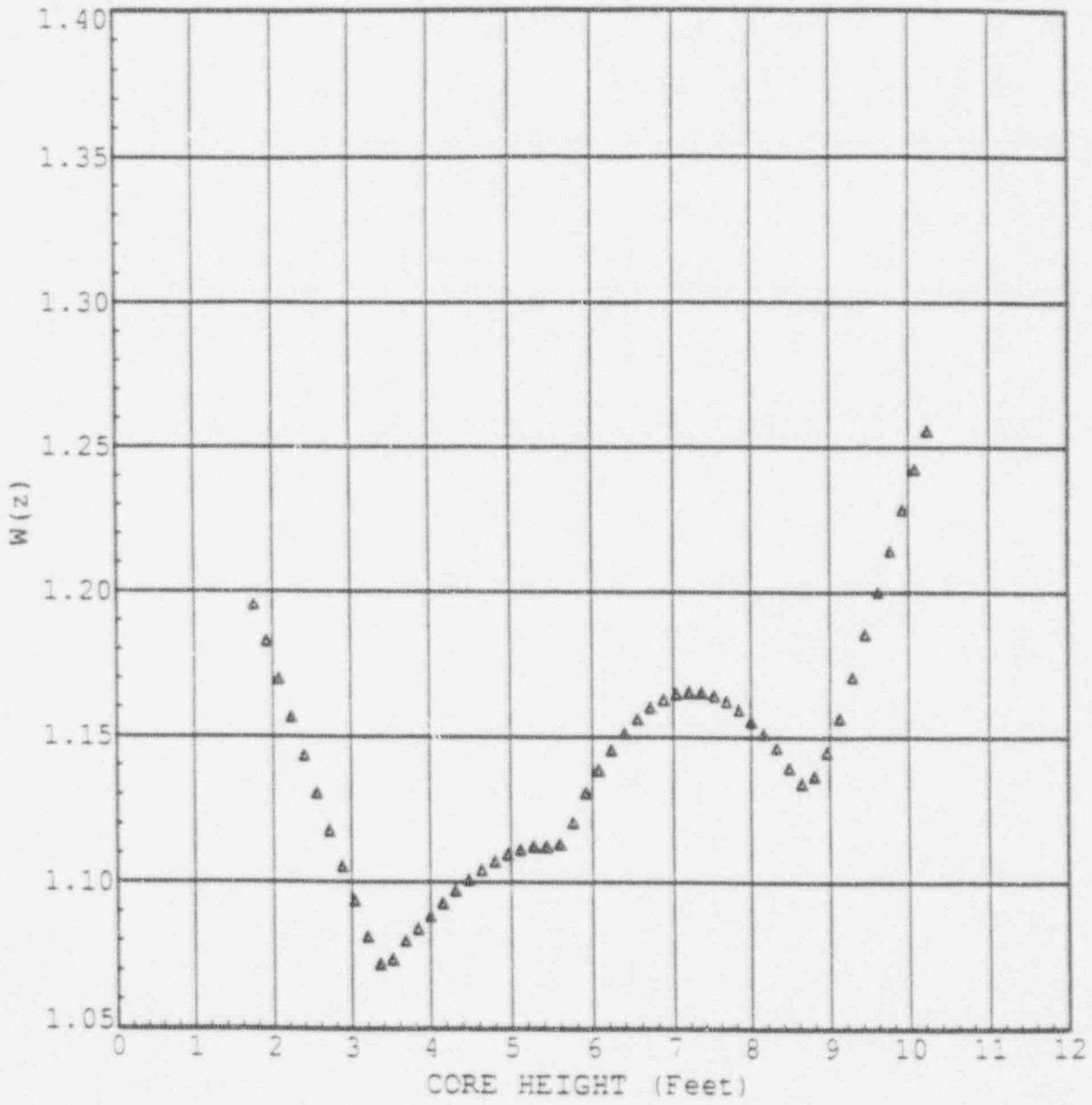
V. C. Summer - Cycle 8

Core Height	W(Z)	Core Height	W(Z)
.0000	1.0000	6.0800	1.1230
.1600	1.0000	6.2400	1.1334
.3200	1.0000	6.4000	1.1432
.4800	1.0000	6.5600	1.1523
.6400	1.0000	6.7200	1.1608
.8000	1.0000	6.8800	1.1686
.9600	1.0000	7.0400	1.1756
1.1200	1.0000	7.2000	1.1818
1.2800	1.0000	7.3600	1.1871
1.4400	1.0000	7.5200	1.1915
1.6000	1.0000	7.6800	1.1951
1.7600	1.2546	7.8400	1.1978
1.9200	1.2347	8.0000	1.1995
2.0800	1.2143	8.1600	1.2003
2.2400	1.1936	8.3200	1.2001
2.4000	1.1732	8.4800	1.1991
2.5600	1.1532	8.6400	1.1970
2.7200	1.1322	8.8000	1.1939
2.8800	1.1141	8.9600	1.1906
3.0400	1.1056	9.1200	1.1916
3.2000	1.1030	9.2800	1.2048
3.3600	1.1022	9.4400	1.2245
3.5200	1.1010	9.6000	1.2446
3.6800	1.0994	9.7600	1.2650
3.8400	1.0977	9.9200	1.2857
4.0000	1.0956	10.0800	1.3064
4.1600	1.0931	10.2400	1.3270
4.3200	1.0901	10.4000	1.0000
4.4800	1.0878	10.5600	1.0000
4.6400	1.0860	10.7200	1.0000
4.8000	1.0837	10.8800	1.0000
4.9600	1.0814	11.0400	1.0000
5.1200	1.0786	11.2000	1.0000
5.2800	1.0748	11.3600	1.0000
5.4400	1.0774	11.5200	1.0000
5.6000	1.0888	11.6800	1.0000
5.7600	1.1009	11.8400	1.0000
5.9200	1.1121	12.0000	1.0000

Figure 7

RAOC W(z) at 10000 MWD/MTU

V. C. Summer - Cycle 8



Data for Figure 7

RAOC W(z) at 10000 MWD/MTU

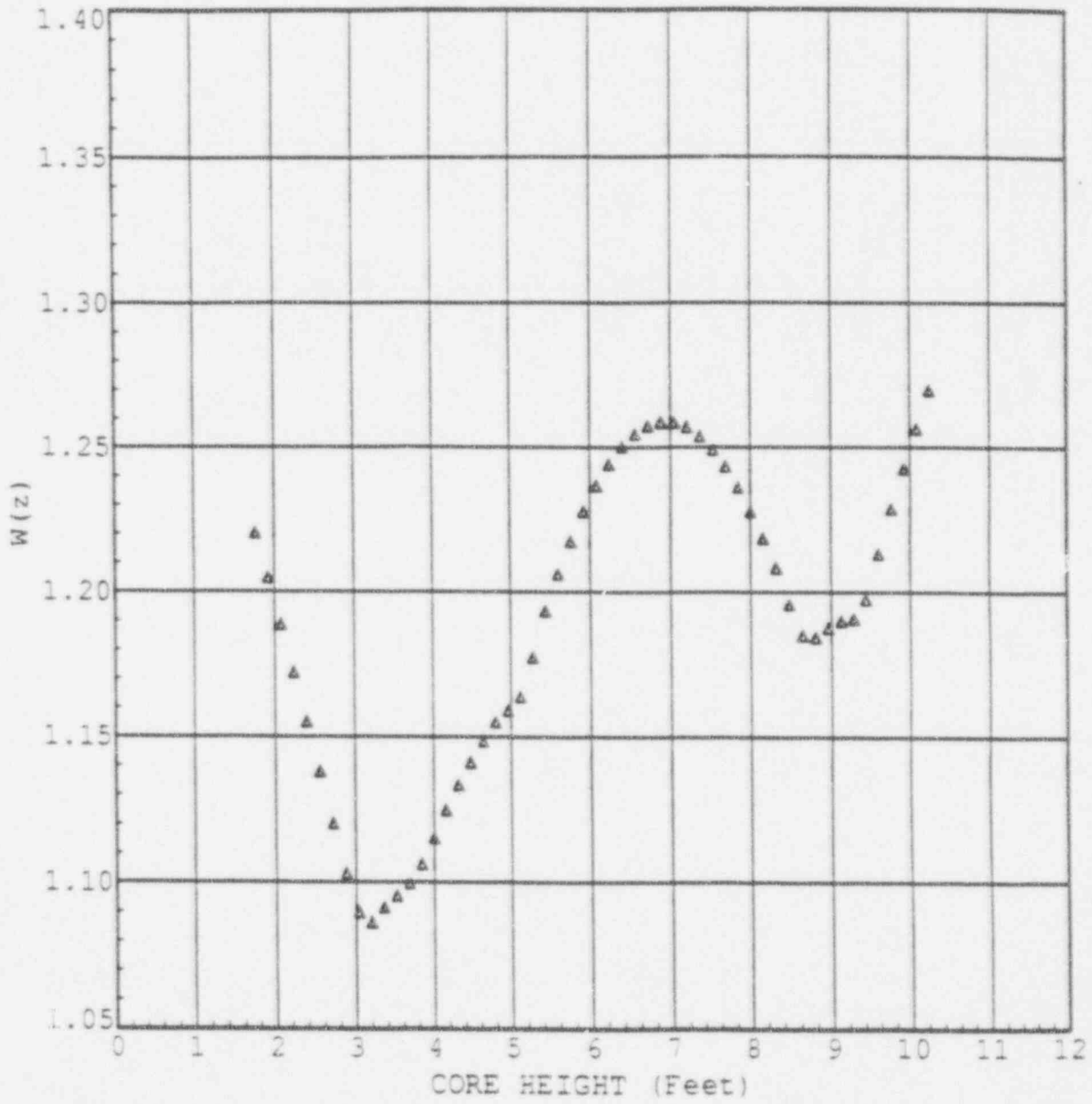
V. C. Summer - Cycle 8

Core Height	W(Z)	Core Height	W(Z)
.0000	1.0000	6.0800	1.1385
.1600	1.0000	6.2400	1.1453
.3200	1.0000	6.4000	1.1513
.4800	1.0000	6.5600	1.1562
.6400	1.0000	6.7200	1.1601
.8000	1.0000	6.8800	1.1629
.9600	1.0000	7.0400	1.1647
1.1200	1.0000	7.2000	1.1655
1.2800	1.0000	7.3600	1.1653
1.4400	1.0000	7.5200	1.1642
1.6000	1.0000	7.6800	1.1622
1.7600	1.1955	8.8400	1.1593
1.9200	1.1828	8.0000	1.1555
2.0800	1.1698	8.1600	1.1512
2.2400	1.1566	8.3200	1.1464
2.4000	1.1434	8.4800	1.1395
2.5600	1.1304	8.6400	1.1341
2.7200	1.1176	8.8000	1.1366
2.8800	1.1053	8.9600	1.1448
3.0400	1.0937	9.1200	1.1566
3.2000	1.0814	9.2800	1.1708
3.3600	1.0720	9.4400	1.1856
3.5200	1.0737	9.6000	1.2001
3.6800	1.0799	9.7600	1.2144
3.8400	1.0841	9.9200	1.2286
4.0000	1.0884	10.0800	1.2425
4.1600	1.0928	10.2400	1.2558
4.3200	1.0970	10.4000	1.0000
4.4800	1.1008	10.5600	1.0000
4.6400	1.1042	10.7200	1.0000
4.8000	1.1071	10.8800	1.0000
4.9600	1.1094	11.0400	1.0000
5.1200	1.1111	11.2000	1.0000
5.2800	1.1123	11.3600	1.0000
5.4400	1.1122	11.5200	1.0000
5.6000	1.1130	11.6800	1.0000
5.7600	1.1204	11.8400	1.0000
5.9200	1.1306	12.0000	1.0000

Figure 8

RAOC W(z) at 16000 MWD/MTU

V. C. Summer - Cycle 8



Data for Figure 8

RAOC W(z) at 16000 MWD/MTU

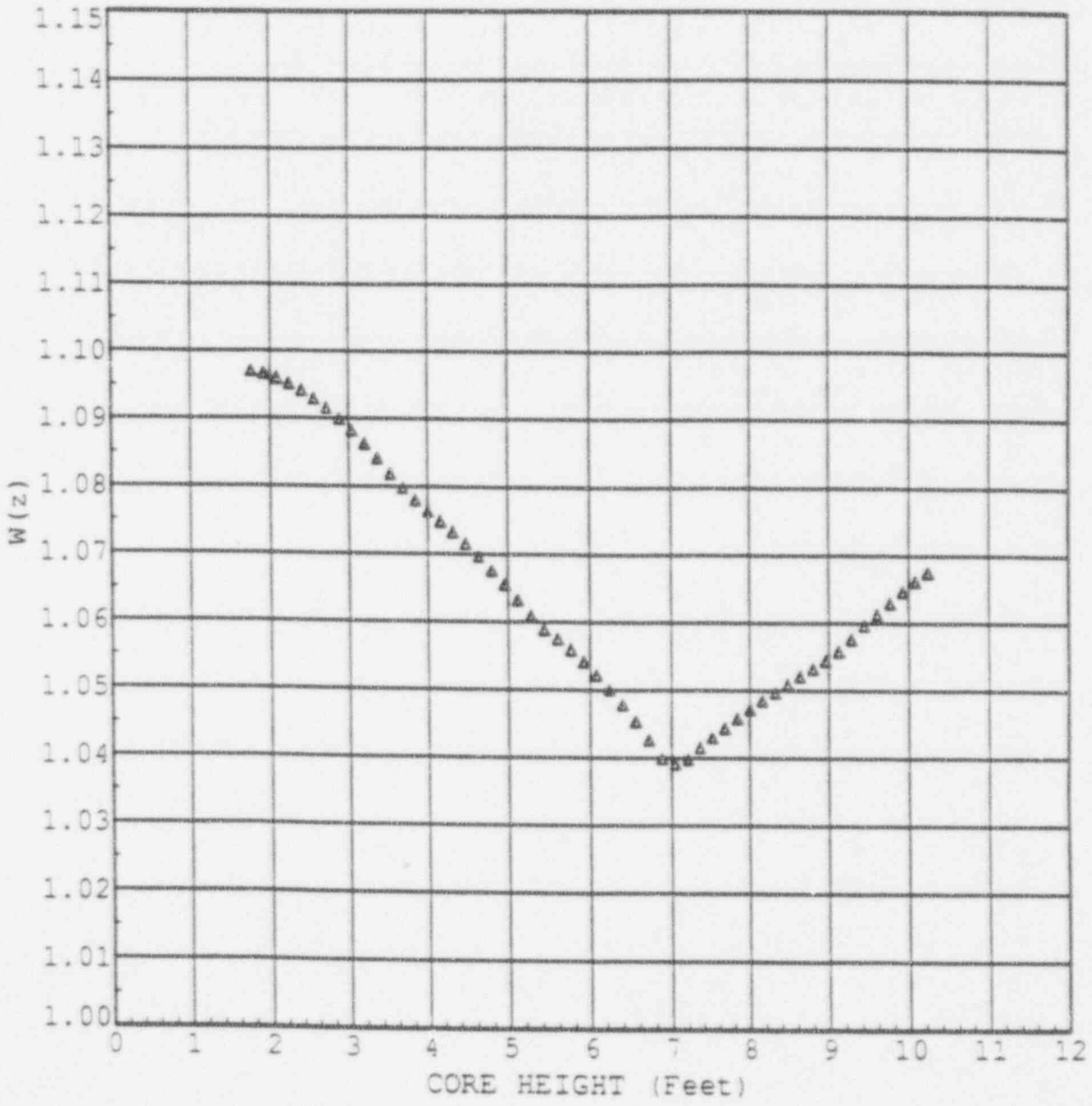
V. C. Summer - Cycle 8

Core Height	W(Z)	Core Height	W(Z)
.0000	1.0000	6.0800	1.2367
.1600	1.0000	6.2400	1.2441
.3200	1.0000	6.4000	1.2501
.4800	1.0000	6.5600	1.2545
.6400	1.0000	6.7200	1.2574
.8000	1.0000	6.8800	1.2587
.9600	1.0000	7.0400	1.2586
1.1200	1.0000	7.2000	1.2569
1.2800	1.0000	7.3600	1.2538
1.4400	1.0000	7.5200	1.2492
1.6000	1.0000	7.6800	1.2434
1.7600	1.2202	7.8400	1.2362
1.9200	1.2047	8.0000	1.2278
2.0800	1.1886	8.1600	1.2185
2.2400	1.1720	8.3200	1.2084
2.4000	1.1550	8.4800	1.1956
2.5600	1.1378	8.6400	1.1850
2.7200	1.1201	8.8000	1.1842
2.8800	1.1029	8.9600	1.1876
3.0400	1.0896	9.1200	1.1900
3.2000	1.0861	9.2800	1.1907
3.3600	1.0913	9.4400	1.1975
3.5200	1.0954	9.6000	1.2133
3.6800	1.0995	9.7600	1.2288
3.8400	1.1062	9.9200	1.2425
4.0000	1.1151	10.0800	1.2563
4.1600	1.1247	10.2400	1.2696
4.3200	1.1333	10.4000	1.0000
4.4800	1.1411	10.5600	1.0000
4.6400	1.1484	10.7200	1.0000
4.8000	1.1550	10.8800	1.0000
4.9600	1.1589	11.0400	1.0000
5.1200	1.1637	11.2000	1.0000
5.2800	1.1773	11.3600	1.0000
5.4400	1.1932	11.5200	1.0000
5.6000	1.2060	11.6800	1.0000
5.7600	1.2174	11.8400	1.0000
5.9200	1.2279	12.0000	1.0000

Figure 9

Baseload W(z) at 150 MWD/MTU

V. C. Summer - Cycle 8



Data for Figure 9

Baseload W(z) at 150 MWD/MTU

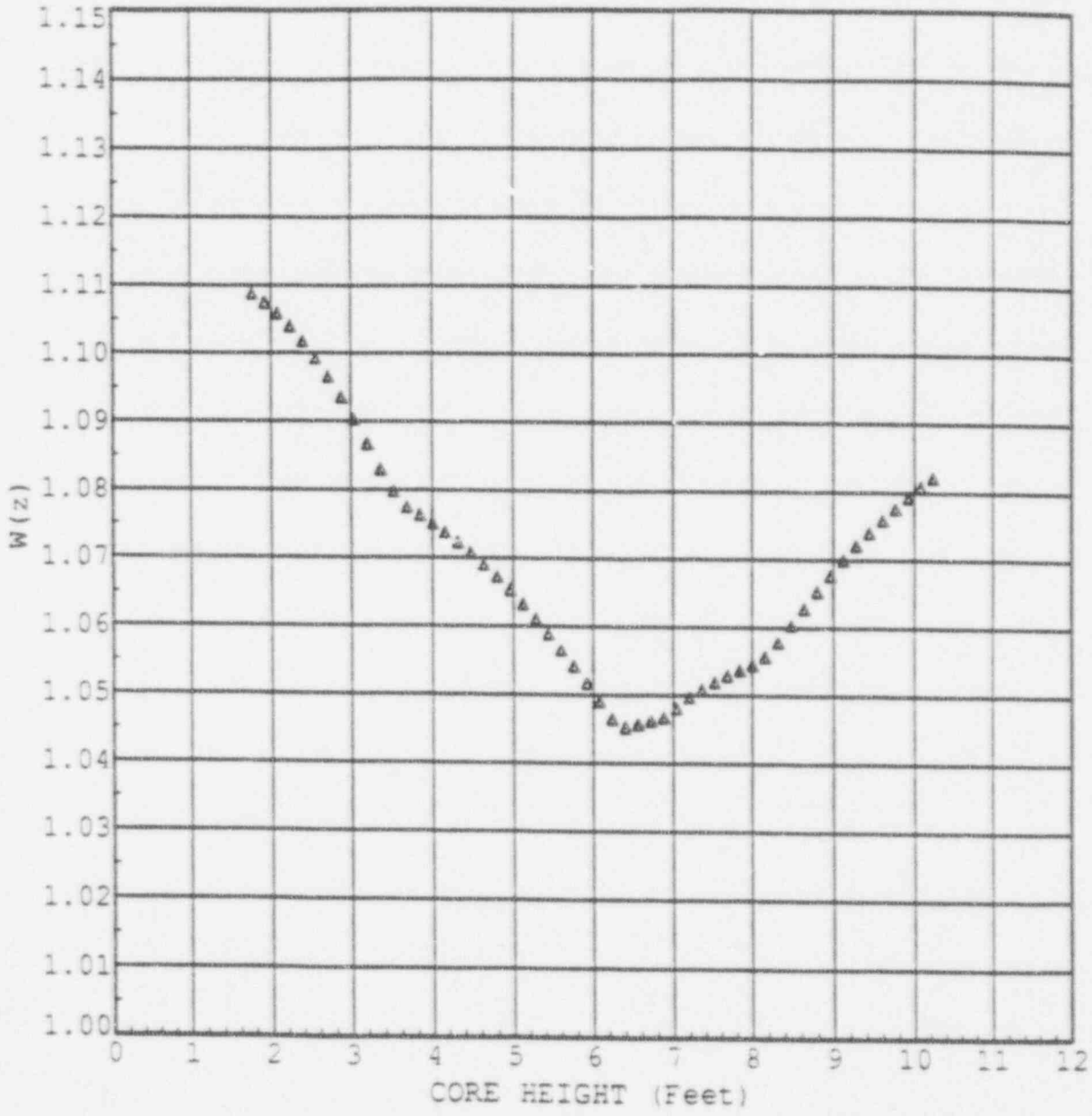
V. C. Summer - Cycle 8

Core Height	W(Z)	Core Height	W(Z)
.0000	1.0000	6.0800	1.0522
.1600	1.0000	6.2400	1.0500
.3200	1.0000	6.4000	1.0478
.4800	1.0000	6.5600	1.0454
.6400	1.0000	6.7200	1.0426
.8000	1.0000	6.8800	1.0399
.9600	1.0000	7.0400	1.0391
1.1200	1.0000	7.2000	1.0398
1.2800	1.0000	7.3600	1.0415
1.4400	1.0000	7.6800	1.0444
1.7600	1.0970	7.8400	1.0458
1.9200	1.0966	8.0000	1.0472
2.0800	1.0959	8.1600	1.0485
2.2400	1.0951	8.3200	1.0497
2.4000	1.0941	8.4800	1.0509
2.5600	1.0929	8.6400	1.0521
2.7200	1.0915	8.8000	1.0532
2.8800	1.0899	8.9600	1.0544
3.0400	1.0882	9.1200	1.0558
3.2000	1.0862	9.2800	1.0576
3.3600	1.0841	9.4400	1.0596
3.5200	1.0818	9.6000	1.0613
3.6800	1.0797	9.7600	1.0630
3.8400	1.0779	9.9200	1.0647
4.0000	1.0763	10.0800	1.0662
4.1600	1.0748	10.2400	1.0675
4.3200	1.0732	10.4000	1.0000
4.4800	1.0715	10.5600	1.0000
4.6400	1.0696	10.7200	1.0000
4.8000	1.0676	10.8800	1.0000
4.9600	1.0655	11.0400	1.0000
5.1200	1.0632	11.2000	1.0000
5.2800	1.0609	11.3600	1.0000
5.4400	1.0589	11.5200	1.0000
5.6000	1.0575	11.6800	1.0000
5.7600	1.0559	11.8400	1.0000
5.9200	1.0541	12.0000	1.0000

Figure 10

Baseload W(z) at 8000 MWD/MTU

V. C. Summer - Cycle 8



Data for Figure 10

Baseload W(z) at 8000 MWD/MTU

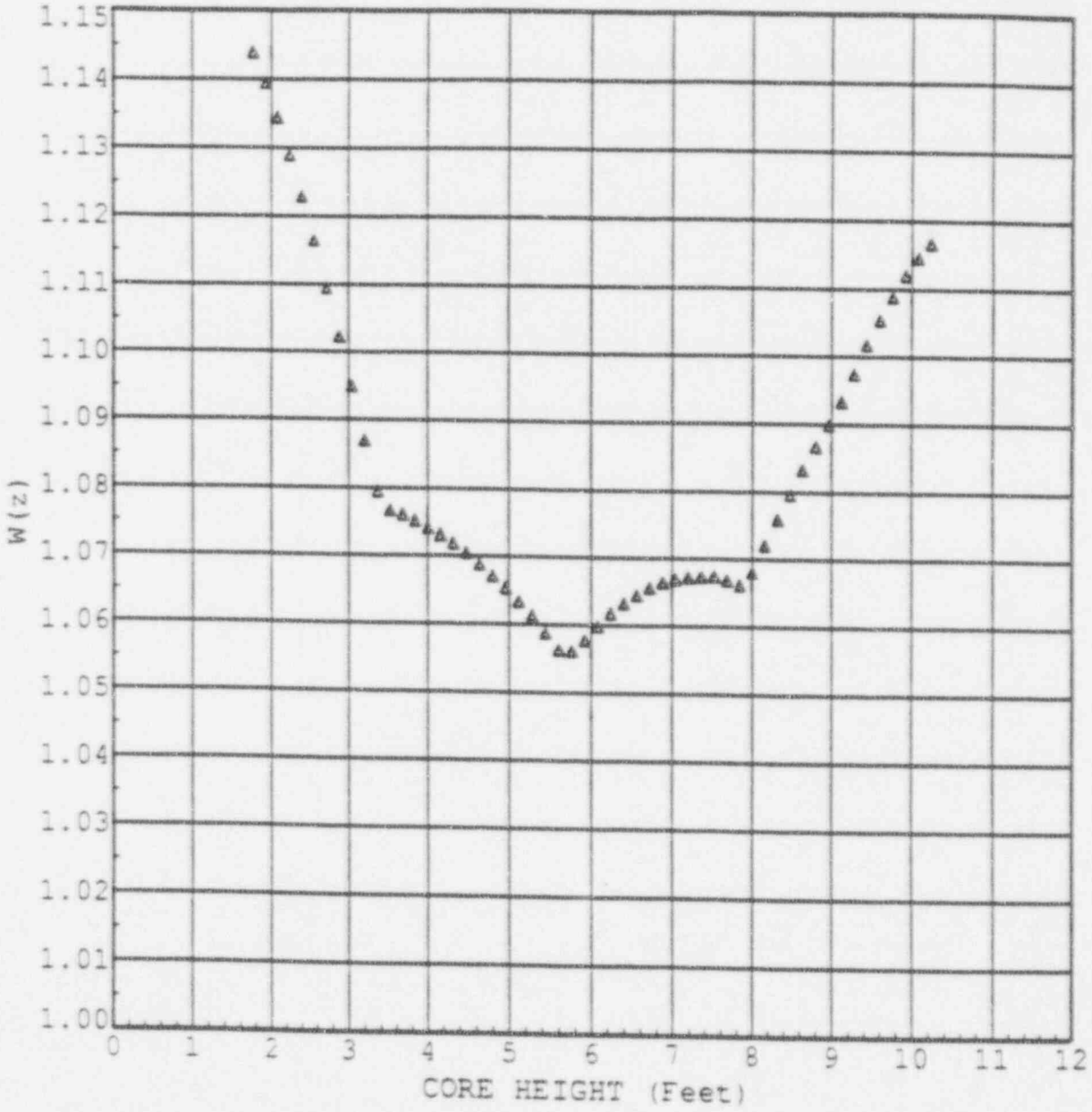
V. C. Summer - Cycle 8

Core Height	W(Z)	Core Height	W(Z)
.0000	1.0000	6.0800	1.0490
.1600	1.0000	6.2400	1.0465
.3200	1.0000	6.4000	1.0452
.4800	1.0000	6.5600	1.0457
.6400	1.0000	6.7200	1.0462
.8000	1.0000	6.8800	1.0467
.9600	1.0000	7.0400	1.0481
1.1200	1.0000	7.2000	1.0497
1.2800	1.0000	7.3600	1.0508
1.4400	1.0000	7.5200	1.0519
1.6000	1.0000	7.6800	1.0529
1.7600	1.1087	7.8400	1.0537
1.9200	1.1074	8.0000	1.0545
2.0800	1.1058	8.1600	1.0557
2.2400	1.1039	8.3200	1.0578
2.4000	1.1017	8.4800	1.0603
2.5600	1.0992	8.6400	1.0628
2.7200	1.0965	8.8000	1.0653
2.8800	1.0935	8.9600	1.0677
3.0400	1.0902	9.1200	1.0721
3.3600	1.0829	9.4400	1.0740
3.5200	1.0797	9.6000	1.0759
3.6800	1.0774	9.7600	1.0776
3.8400	1.0762	9.9200	1.0792
4.0000	1.0750	10.0800	1.0807
4.1600	1.0736	10.2400	1.0821
4.3200	1.0722	10.4000	1.0000
4.4800	1.0707	10.5600	1.0000
4.6400	1.0690	10.7200	1.0000
4.8000	1.0672	10.8800	1.0000
4.9600	1.0653	11.0400	1.0000
5.1200	1.0632	11.2000	1.0000
5.2800	1.0611	11.3600	1.0000
5.4400	1.0589	11.5200	1.0000
5.6000	1.0565	11.6800	1.0000
5.7600	1.0542	11.8400	1.0000
5.9200	1.0517	12.0000	1.0000

Figure 11

Baseload W(z) at 16000 MWD/MTU

V. C. Summer - Cycle 8



Data for Figure 11

Baseload W(z) at 16000 MWD/MTU

V. C. Summer - Cycle 8

Core Height	W(Z)	Core Height	W(Z)
.0000	1.0000	6.0800	1.0598
.1600	1.0000	6.2400	1.0617
.3200	1.0000	6.4000	1.0632
.4800	1.0000	6.5600	1.0656
.8000	1.0000	6.8800	1.0664
.9600	1.0000	7.0400	1.0669
1.1200	1.0000	7.2000	1.0672
1.2800	1.0000	7.3600	1.0673
1.4400	1.0000	7.5200	1.0674
1.6000	1.0000	7.6800	1.0668
1.7600	1.1438	7.8400	1.0661
1.9200	1.1394	8.0000	1.0681
2.0800	1.1344	8.1600	1.0720
2.2400	1.1289	8.3200	1.0759
2.4000	1.1228	8.4800	1.0796
2.5600	1.1164	8.6400	1.0832
2.7200	1.1094	8.8000	1.0867
2.8800	1.1022	8.9600	1.0899
3.0400	1.0949	9.1200	1.0933
3.2000	1.0869	9.2800	1.0974
3.3600	1.0794	9.4400	1.1017
3.5200	1.0766	9.6000	1.1054
3.6800	1.0760	9.7600	1.1088
3.8400	1.0751	9.9200	1.1119
4.0000	1.0741	10.0800	1.1145
4.1600	1.0730	10.2400	1.1166
4.3200	1.0718	10.4000	1.0000
4.4800	1.0704	10.5600	1.0000
4.6400	1.0688	10.7200	1.0000
4.8000	1.0671	10.8800	1.0000
4.9600	1.0653	11.0400	1.0000
5.1200	1.0633	11.2000	1.0000
5.2800	1.0613	11.3600	1.0000
5.4400	1.0588	11.5200	1.0000
5.6000	1.0563	11.6800	1.0000
5.7600	1.0561	11.8400	1.0000
5.9200	1.0577	12.0000	1.0000

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

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

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

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 12.

Figure 12

RCS Total Flow Rate vs. Three Loop Operation

V. C. Summer - Cycle 8