Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

SEP 2 9 2000

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

10 CFR 50.4

Gentlemen:

In the Matter of)
Tennessee Valley Authority)

Docket No. 50-390

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - CORE OPERATING LIMITS REPORT (COLR) CYCLE 4 REVISION 0

This letter provides the WBN Unit 1 Cycle 4 COLR as required by Technical Specification Section 5.9.5.d. The enclosed report dated September 2000, has been approved by the plant operations review committee (PORC) and is acceptable for use during Cycle 4.

If you should have any questions concerning this letter, please contact me at (423)365-1824.

Sincerely,

P. L. Pace
Manager, Licensing and Industry Affairs

Enclosure
cc: See page 2

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SEP 2 9 2000

cc (Enclosure):
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L36 000906 800

QA Record

WATTS BAR NUCLEAR PLANT UNIT 1, CYCLE 4

CORE OPERATING LIMITS REPORT

REVISION 0

September 2000

Prepared:

Nuclear Fuel / 9-12-2000 Date

Reviewed:

Reactor Engineering Supervisor / 9-13-00 Date

Approved:

Operations Manager / 9/13/00 Date

PORC Chairman / 9/14/00 Date

Revision 0

Pages affected

Reason for revision

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Watts Bar Unit 1 Cycle 4 has been prepared in accordance with the requirements of Technical Specification (TS) 5.9.5.

The TSs affected by this report are listed below:

3.1.4 Moderator Temperature Coefficient (MTC)
3.1.6 Shutdown Bank Insertion Limit
3.1.7 Control Bank Insertion Limits
3.2.1 Heat Flux Hot Channel Factor ($F_Q(Z)$)
3.2.2 Nuclear Enthalpy Rise Hot Channel Factor ($F_{\Delta H}^N$)
3.2.3 Axial Flux Difference (AFD)
3.9.1 Boron Concentration

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 TS 5.9.5.

The following abbreviations are used in this section:

BOL -- Beginning of Cycle Life
ARO -- All Rods Out
HZP -- Hot Zero THERMAL POWER
EOL -- End of Cycle Life
RTP -- RATED THERMAL POWER

2.1 Moderator Temperature Coefficient - MTC (LCO 3.1.4)

2.1.1 The MTC limits are:

The BOL/ARO/HZP-MTC shall be less positive than or equal to 0 Δk/k/°F (upper limit). With the measured BOL/ARO/HZP-MTC more positive than -0.30×10^{-5} Δk/k/°F (as-measured criterion), establish control rod withdrawal limits to ensure the MTC remains less positive than or equal to 0 Δk/k/°F (upper limit) for all times in core life.

2.1.1 (continued)

The EOL ARO/RTP-MTC shall be less negative than or equal to -4.50×10^{-4} $\Delta k/k/°F$ (lower limit).

2.1.2 The 300 ppm surveillance limit is:

The measured 300 ppm ARO/RTP-MTC should be less negative than or equal to -3.75×10^{-4} $\Delta k/k/°F$.

2.1.3 The 60 ppm surveillance limit is:

The measured 60 ppm ARO/RTP-MTC should be less negative than or equal to -4.28×10^{-4} $\Delta k/k/°F$.

2.2 <u>Shutdown Bank Insertion Limits</u> (LCO 3.1.6)

2.2.1 The shutdown banks shall be withdrawn to a position greater than or equal to 225 steps withdrawn.

2.3 <u>Control Bank Insertion Limits</u> (LCO 3.1.7)

2.3.1 The control banks shall be limited in physical insertion as shown in Figure 1.

2.3.2 Table 1 shows the control rod bank overlap positions.

2.4 <u>Heat Flux Hot Channel Factor - ($F_Q(Z)$)</u> (LCO 3.2.1)

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

$$F_Q(Z) \leq \frac{CFQ}{.5} * K(Z) \quad \text{for } P \leq 0.5$$

$$\text{where } P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$$

2.4.1 CFQ = 2.50

2.4.2 K(Z) is provided in Figure 2.

2.4.3 $F_Q^c(Z) = F_Q^m(Z) * 1.0815$

where: $F_Q^m(Z)$ is the measured value of $F_Q(Z)$ obtained from incore flux map results and 1.0815 is a factor that accounts for fuel manufacturing tolerances and flux map measurement uncertainty.

2.4.4 $F_Q^w(Z) = F_Q^c(Z) * W(Z)$

where: W(Z) values are provided in Figures 4 through 13. The figures provide sufficient information to determine W(Z) versus core height for all cycle burnups.

2.4.5 $F_Q^W(Z)$ Penalty Factor

Table A.1 shows $F_Q^W(Z)$ margin penalties that are greater than 1.0200 for the burnup window between 8477 MWD/MTU and 9666 MWD/MTU, inclusive. These values shall be used to increase $F_Q^W(Z)$ as per Surveillance Requirement 3.2.1.2.a. A penalty factor of 1.02 shall be used for all cycle burnups outside of the above specified range.

2.5 <u>Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}^N$</u> (LCO 3.2.2)

$$F_{\Delta H}^N \leq F_{\Delta H}^{RTP} * (1 + PF * [1 - P])$$

$$\text{where } P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$$

$F_{\Delta H}^{RTP} = 1.65$

PF = 0.3

2.6 <u>AXIAL FLUX DIFFERENCE - AFD</u> (LCO 3.2.3)

2.6.1 The AFD Limits are provided in Figure 3.

2.7 <u>Refueling Boron Concentration</u> (LCO 3.9.1)

2.7.1 The refueling boron concentration shall be $\geq$ 2000 ppm.

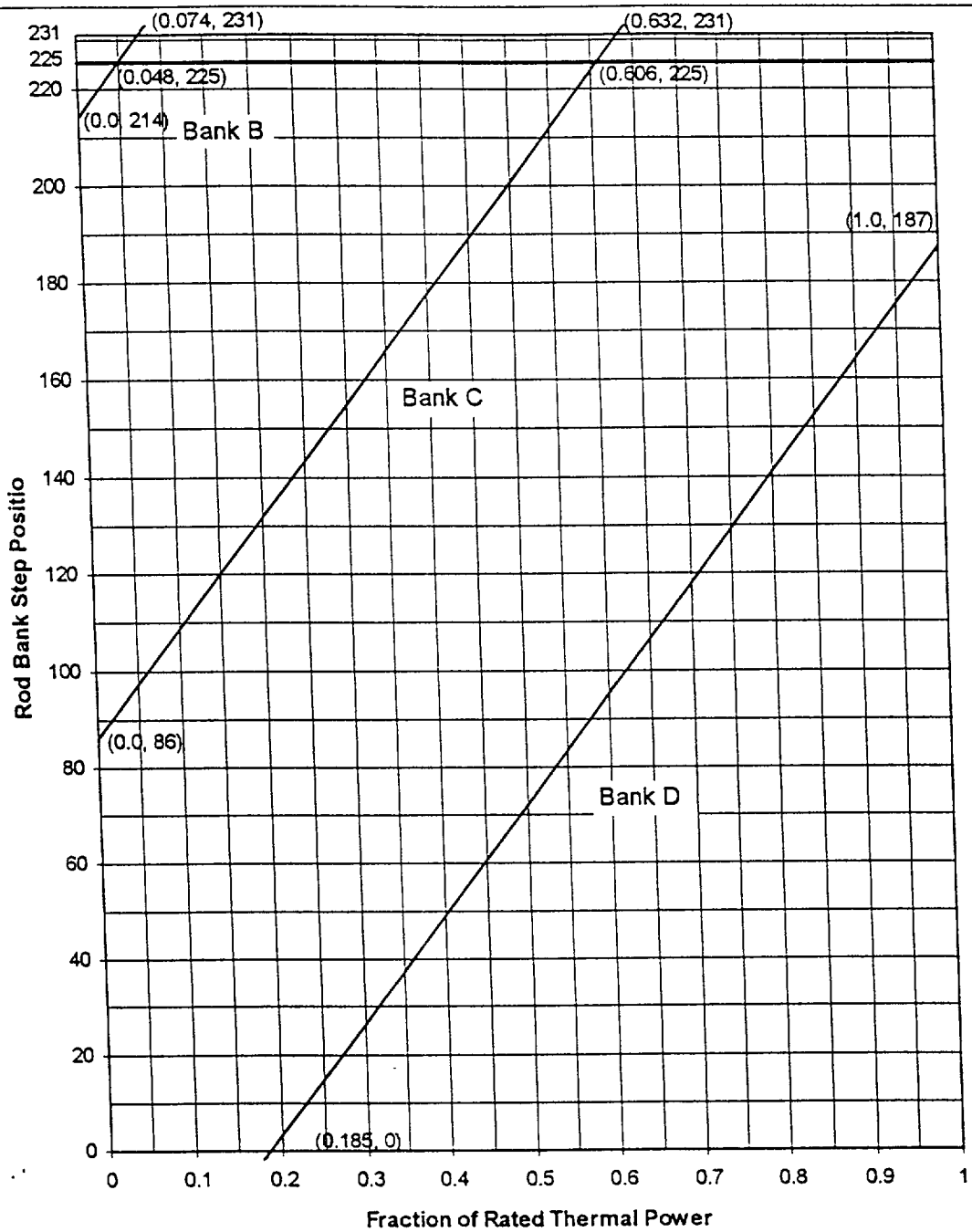


Figure 1
Control Bank Insertion Limits Versus
Thermal Power Four Loop Operation

Fully withdrawn region shall be the condition where shutdown and control banks are at a position within the interval of ≥ 225 and ≤ 231 steps withdrawn.

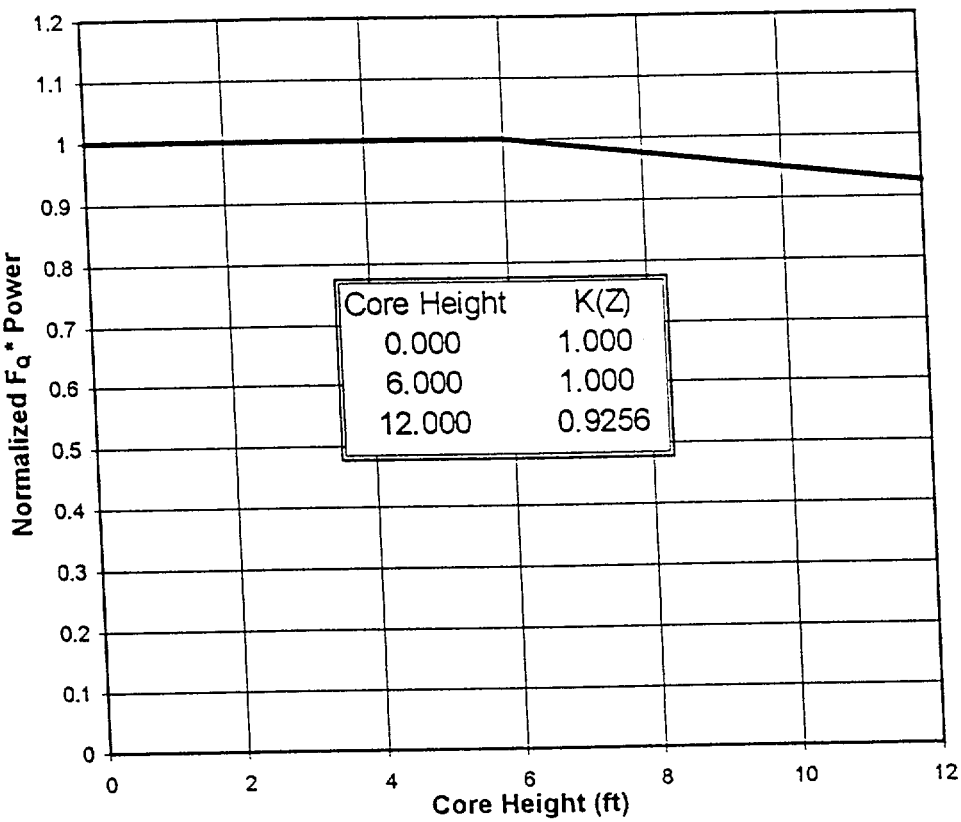


Figure 2
K(Z)-Normalized Fq(Z) as a Function of Core Height

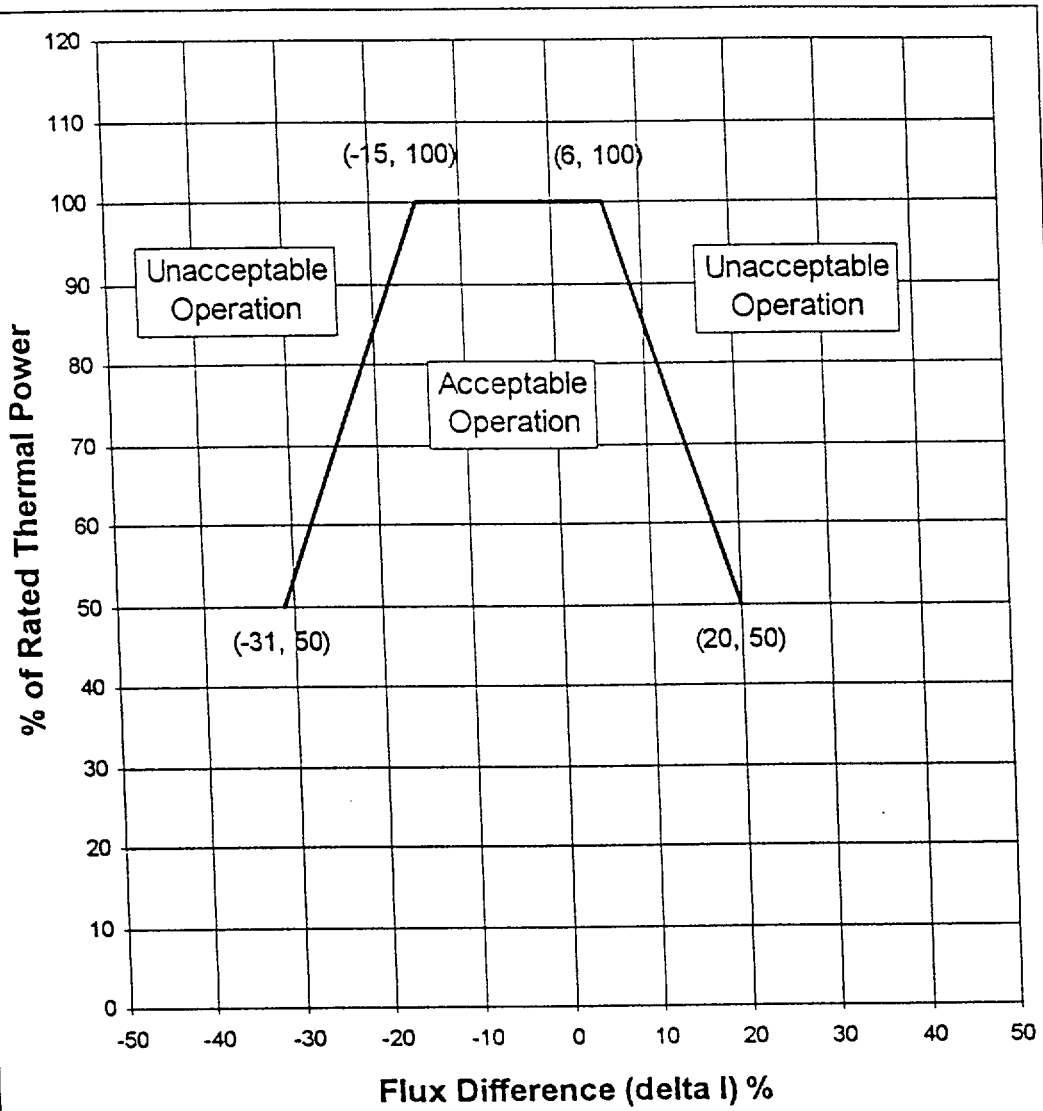
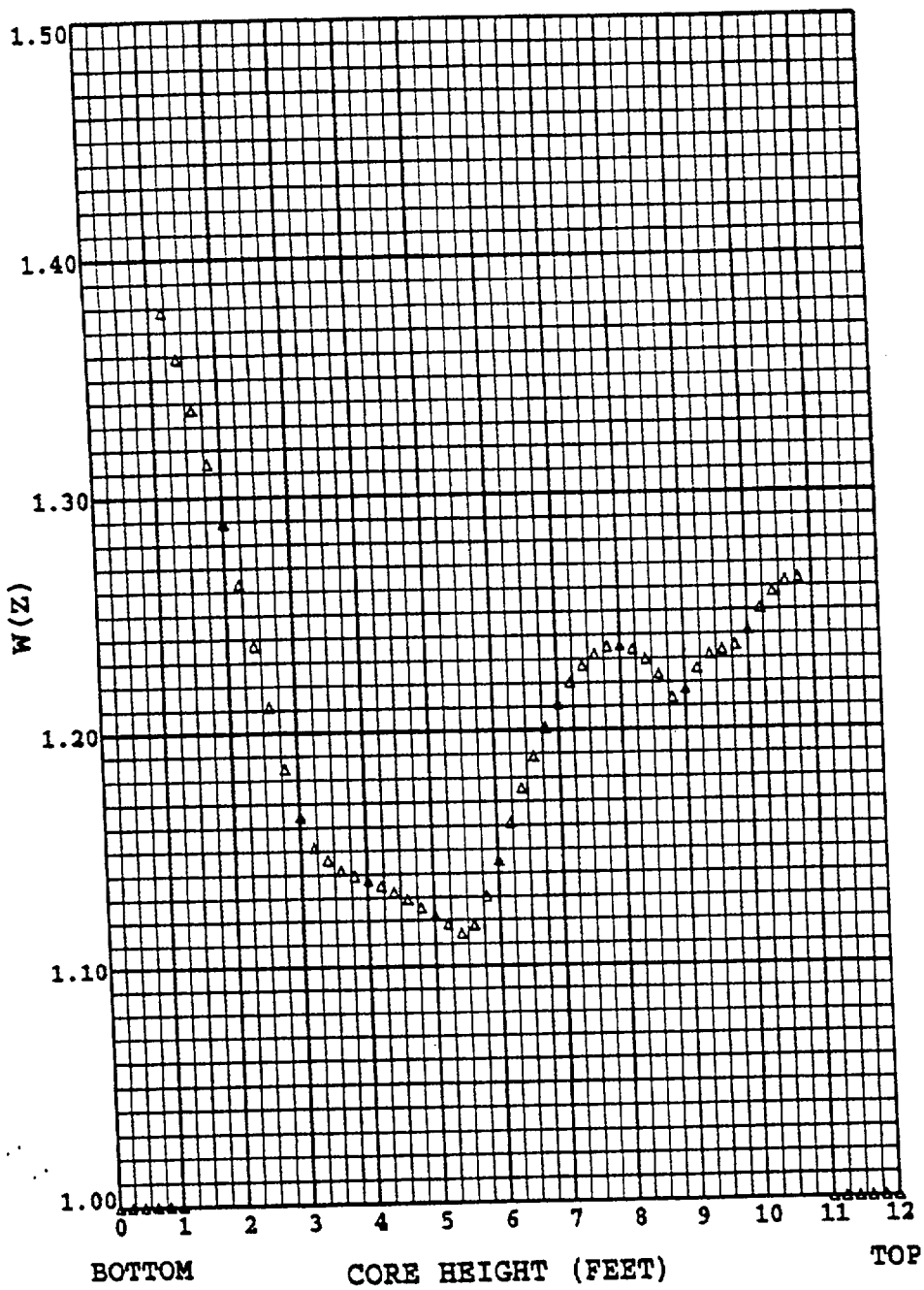


Figure 3

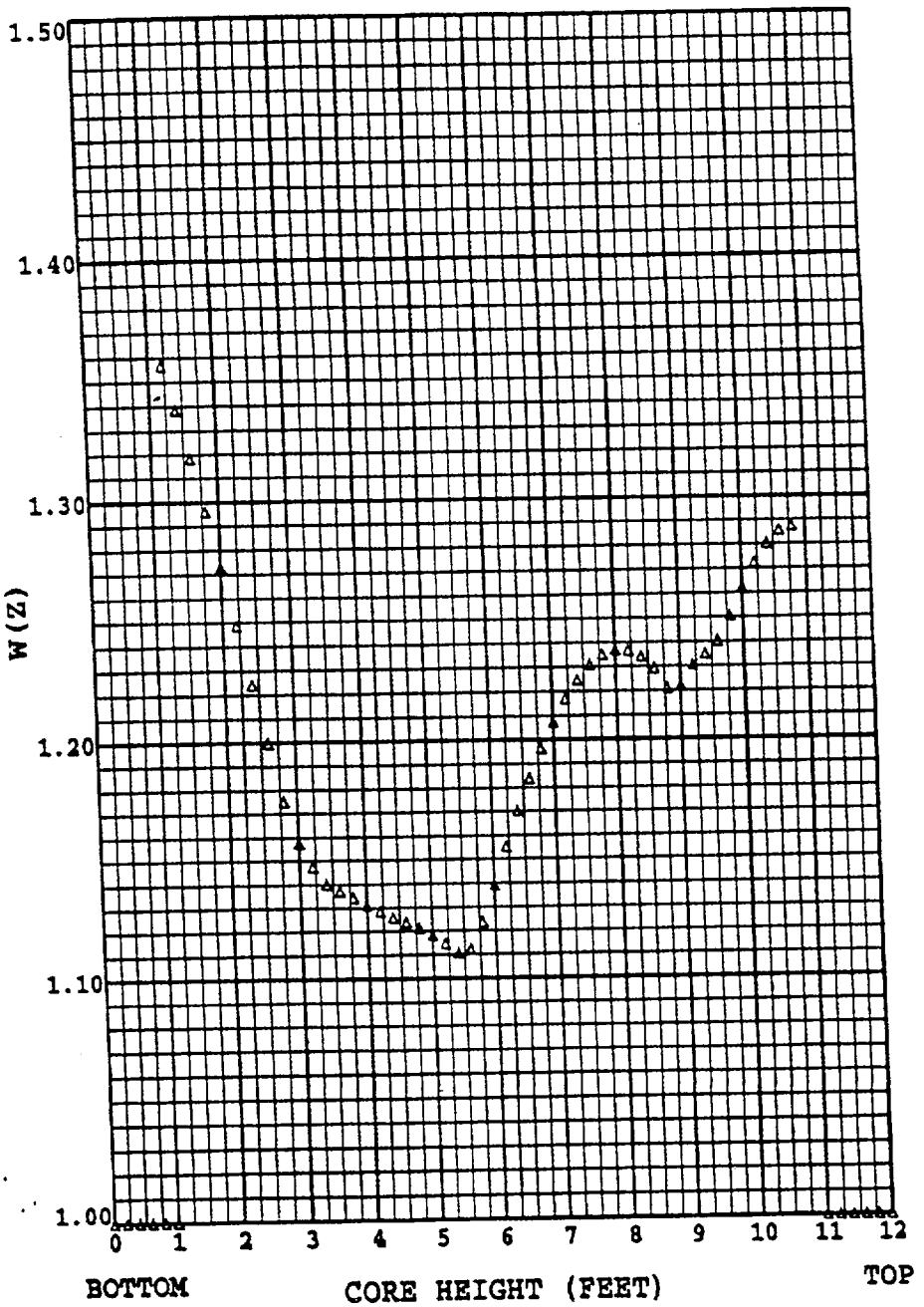
Axial Flux Difference Acceptable Operation Limits as a Function of Rated Thermal Power (RAOC)



Height (feet)	Max. W(z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.3782
1.4000	1.3589
1.6000	1.3373
1.8000	1.3139
2.0000	1.2891
2.2000	1.2633
2.4000	1.2372
2.6000	1.2112
2.8000	1.1848
3.0000	1.1646
3.2000	1.1515
3.4000	1.1461
3.6000	1.1417
3.8000	1.1392
4.0000	1.1373
4.2000	1.1350
4.4000	1.1323
4.6000	1.1291
4.8000	1.1254
5.0000	1.1222
5.2000	1.1184
5.4000	1.1144
5.6000	1.1180
5.8000	1.1301
6.0000	1.1454
6.2000	1.1611
6.4000	1.1755
6.6000	1.1888
6.8000	1.2008
7.0000	1.2112
7.2000	1.2201
7.4000	1.2271
7.6000	1.2321
7.8000	1.2350
8.0000	1.2357
8.2000	1.2339
8.4000	1.2298
8.6000	1.2233
8.8000	1.2134
9.0000	1.2171
9.2000	1.2258
9.4000	1.2316
9.6000	1.2334
9.8000	1.2353
10.0000	1.2417
10.2000	1.2506
10.4000	1.2575
10.6000	1.2620
10.8000	1.2631
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

Figure 4

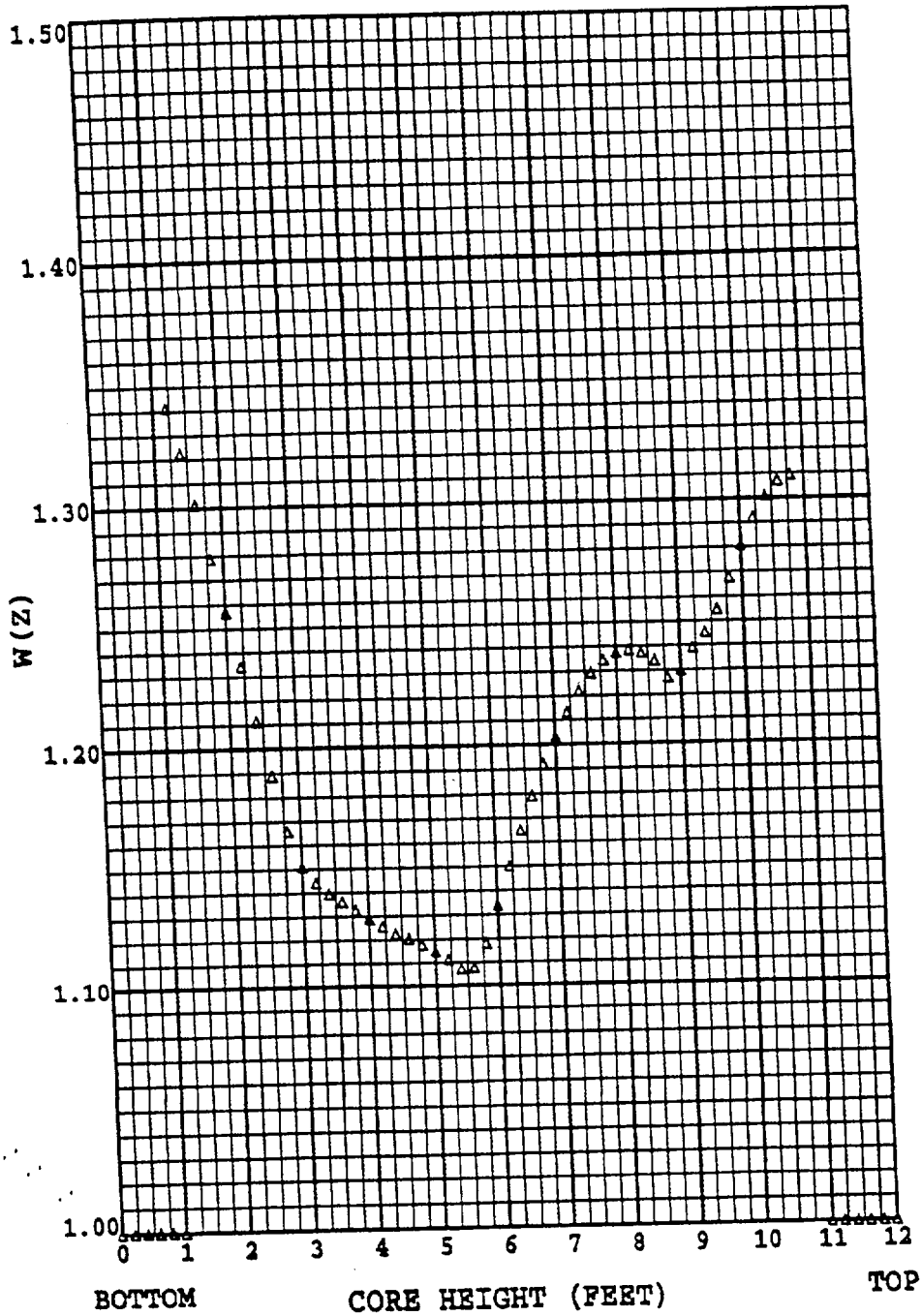
RAOC Summary of Max W(z) at 150 MWD/MTU With HFP AFD Band of -15/+6%
(Top and Bottom 10% Excluded)



Height (feet)	Max. W(z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.3568
1.4000	1.3386
1.6000	1.3182
1.8000	1.2961
2.0000	1.2727
2.2000	1.2485
2.4000	1.2241
2.6000	1.1997
2.8000	1.1751
3.0000	1.1574
3.2000	1.1473
3.4000	1.1402
3.6000	1.1372
3.8000	1.1343
4.0000	1.1311
4.2000	1.1284
4.4000	1.1258
4.6000	1.1237
4.8000	1.1212
5.0000	1.1183
5.2000	1.1147
5.4000	1.1107
5.6000	1.1122
5.8000	1.1236
6.0000	1.1393
6.2000	1.1553
6.4000	1.1701
6.6000	1.1838
6.8000	1.1963
7.0000	1.2073
7.2000	1.2168
7.4000	1.2247
7.6000	1.2309
7.8000	1.2350
8.0000	1.2370
8.2000	1.2367
8.4000	1.2342
8.6000	1.2292
8.8000	1.2209
9.0000	1.2222
9.2000	1.2306
9.4000	1.2350
9.6000	1.2403
9.8000	1.2506
10.0000	1.2624
10.2000	1.2726
10.4000	1.2804
10.6000	1.2857
10.8000	1.2874
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

Figure 5

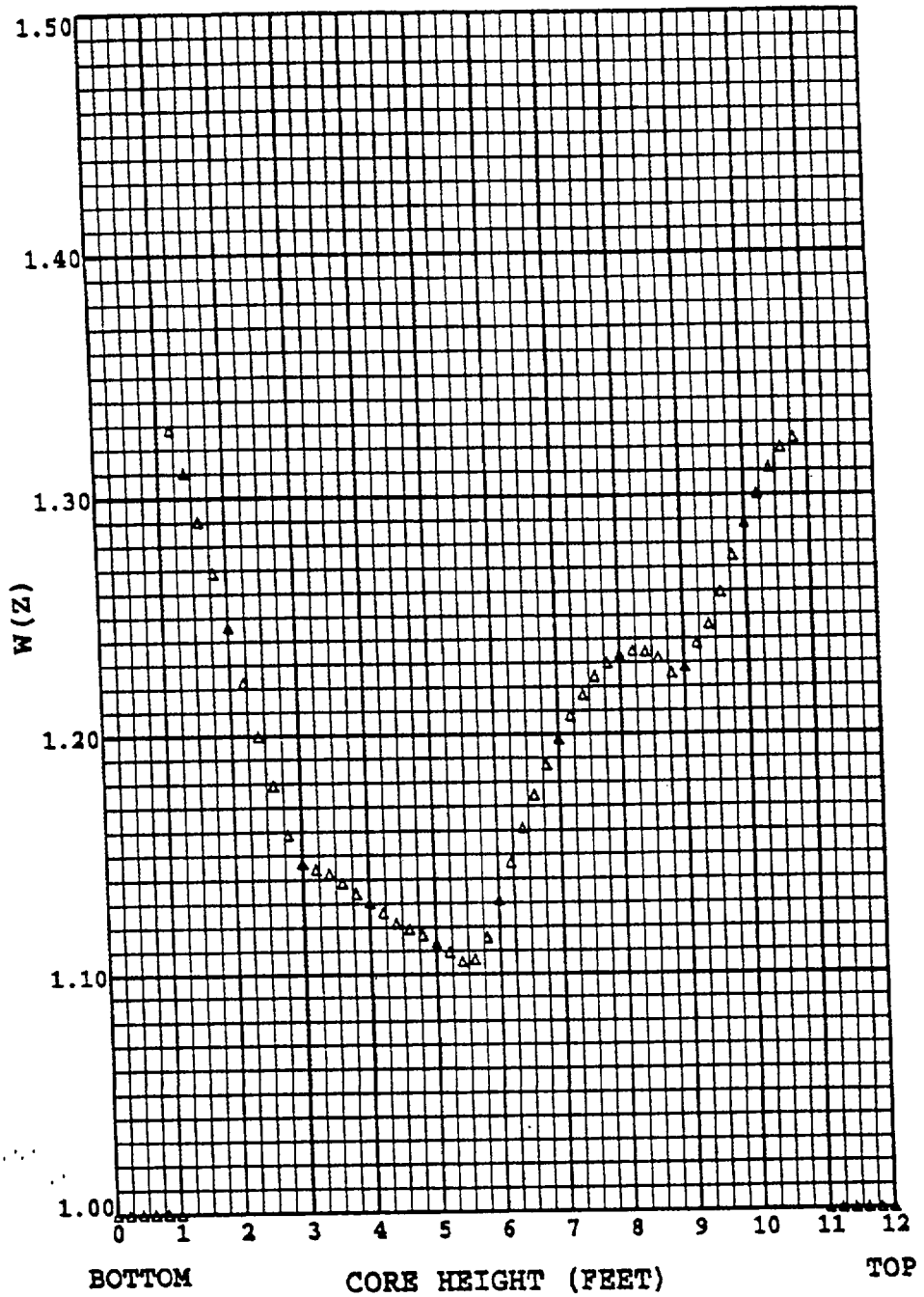
RAOC Summary of Max W(z) at 1000 MWD/MTU With HFP AFD Band of -15/+6%
(Top and Bottom 10% Excluded)



Height (feet)	Max. W(z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.3414
1.4000	1.3225
1.6000	1.3013
1.8000	1.2788
2.0000	1.2569
2.2000	1.2343
2.4000	1.2114
2.6000	1.1888
2.8000	1.1659
3.0000	1.1509
3.2000	1.1442
3.4000	1.1395
3.6000	1.1363
3.8000	1.1326
4.0000	1.1290
4.2000	1.1257
4.4000	1.1224
4.6000	1.1202
4.8000	1.1178
5.0000	1.1149
5.2000	1.1114
5.4000	1.1074
5.6000	1.1077
5.8000	1.1180
6.0000	1.1340
6.2000	1.1501
6.4000	1.1651
6.6000	1.1791
6.8000	1.1920
7.0000	1.2033
7.2000	1.2133
7.4000	1.2221
7.6000	1.2292
7.8000	1.2345
8.0000	1.2377
8.2000	1.2386
8.4000	1.2375
8.6000	1.2340
8.8000	1.2270
9.0000	1.2297
9.2000	1.2393
9.4000	1.2454
9.6000	1.2548
9.8000	1.2677
10.0000	1.2809
10.2000	1.2920
10.4000	1.3009
10.6000	1.3071
10.8000	1.3095
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

Figure 6

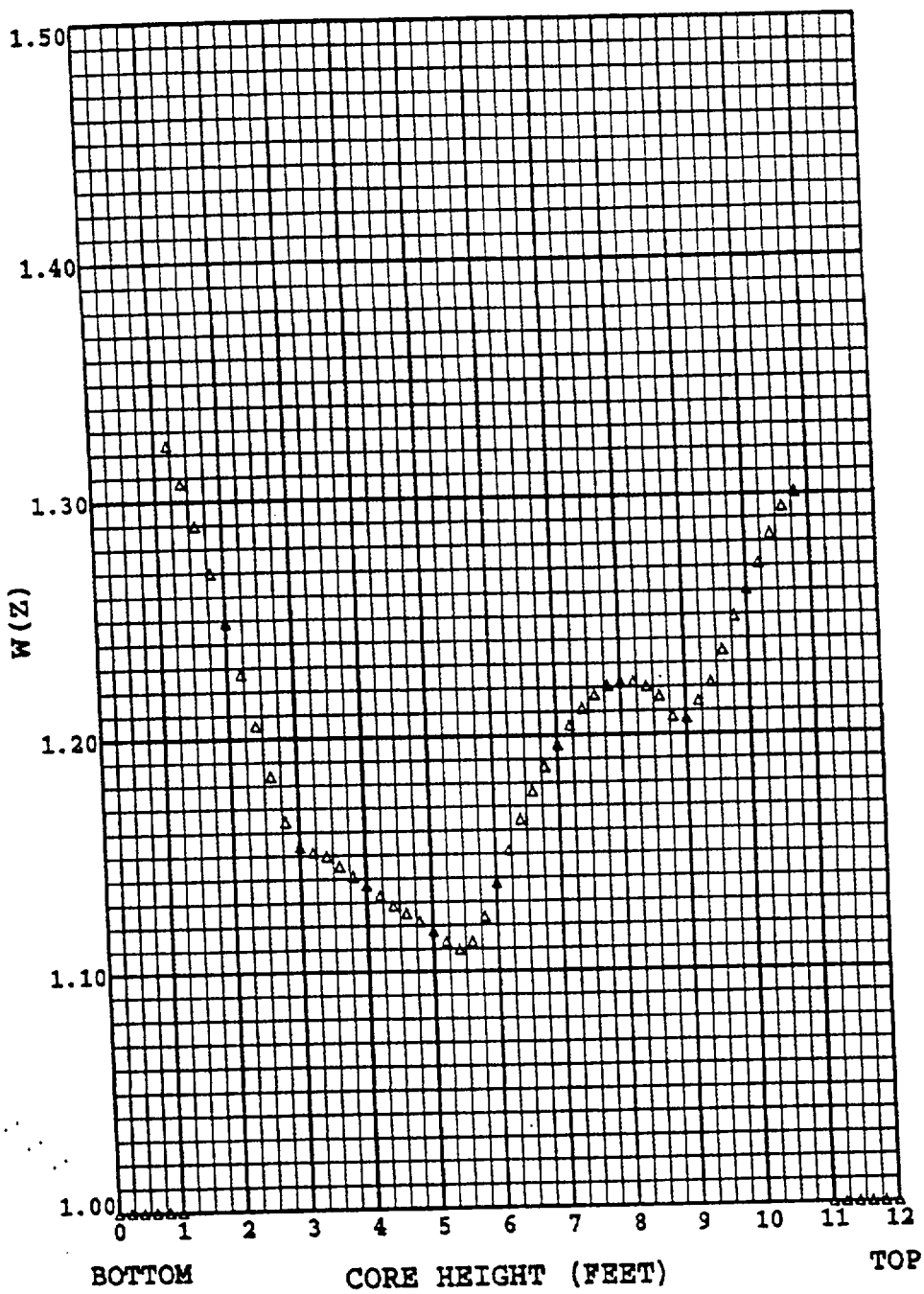
RAOC Summary of Max W(z) at 2000 MWD/MTU With HFP AFD Band of -15/+6%
(Top and Bottom 10% Excluded)



Height (feet)	Max. W(z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.3283
1.4000	1.3104
1.6000	1.2904
1.8000	1.2687
2.0000	1.2458
2.2000	1.2224
2.4000	1.1997
2.6000	1.1791
2.8000	1.1586
3.0000	1.1468
3.2000	1.1441
3.4000	1.1422
3.6000	1.1385
3.8000	1.1340
4.0000	1.1301
4.2000	1.1260
4.4000	1.1216
4.6000	1.1191
4.8000	1.1165
5.0000	1.1132
5.2000	1.1094
5.4000	1.1056
5.6000	1.1063
5.8000	1.1154
6.0000	1.1311
6.2000	1.1466
6.4000	1.1611
6.6000	1.1747
6.8000	1.1871
7.0000	1.1980
7.2000	1.2078
7.4000	1.2166
7.6000	1.2241
7.8000	1.2297
8.0000	1.2334
8.2000	1.2349
8.4000	1.2345
8.6000	1.2320
8.8000	1.2255
9.0000	1.2282
9.2000	1.2379
9.4000	1.2459
9.6000	1.2596
9.8000	1.2748
10.0000	1.2883
10.2000	1.3002
10.4000	1.3109
10.6000	1.3193
10.8000	1.3234
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

Figure 7

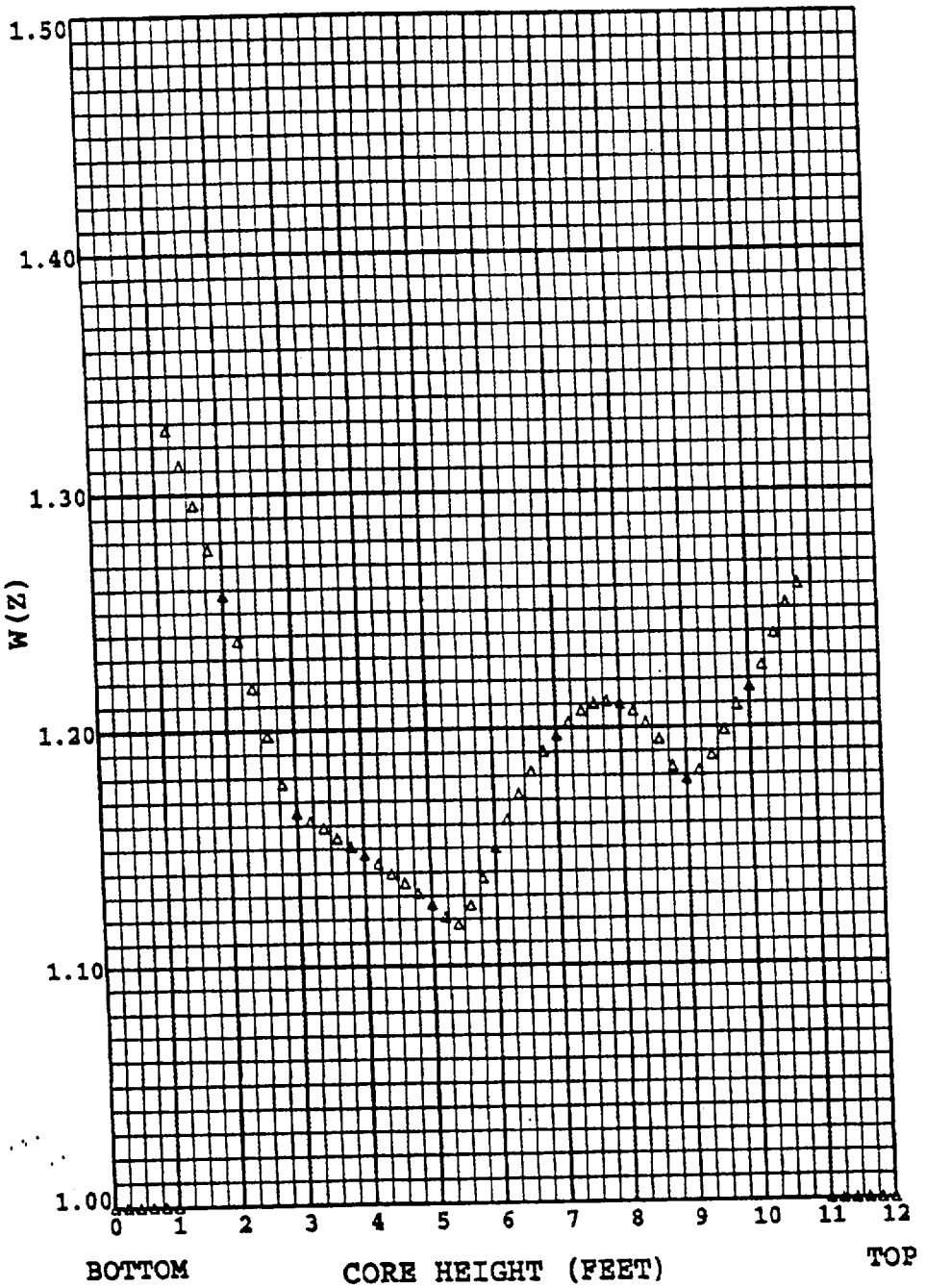
RAOC Summary of Max W(z) at 4000 MWD/MTU With HFP AFD Band of -15/+6%
(Top and Bottom 10% Excluded)



Height (feet)	Max. W(z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.3239
1.4000	1.3077
1.6000	1.2895
1.8000	1.2698
2.0000	1.2489
2.2000	1.2274
2.4000	1.2056
2.6000	1.1840
2.8000	1.1645
3.0000	1.1537
3.2000	1.1515
3.4000	1.1498
3.6000	1.1455
3.8000	1.1411
4.0000	1.1373
4.2000	1.1331
4.4000	1.1285
4.6000	1.1252
4.8000	1.1218
5.0000	1.1177
5.2000	1.1131
5.4000	1.1096
5.6000	1.1128
5.8000	1.1235
6.0000	1.1378
6.2000	1.1516
6.4000	1.1645
6.6000	1.1763
6.8000	1.1869
7.0000	1.1960
7.2000	1.2041
7.4000	1.2112
7.6000	1.2168
7.8000	1.2206
8.0000	1.2225
8.2000	1.2223
8.4000	1.2202
8.6000	1.2161
8.8000	1.2075
9.0000	1.2068
9.2000	1.2140
9.4000	1.2217
9.6000	1.2351
9.8000	1.2489
10.0000	1.2602
10.2000	1.2710
10.4000	1.2832
10.6000	1.2943
10.8000	1.3004
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

Figure 8

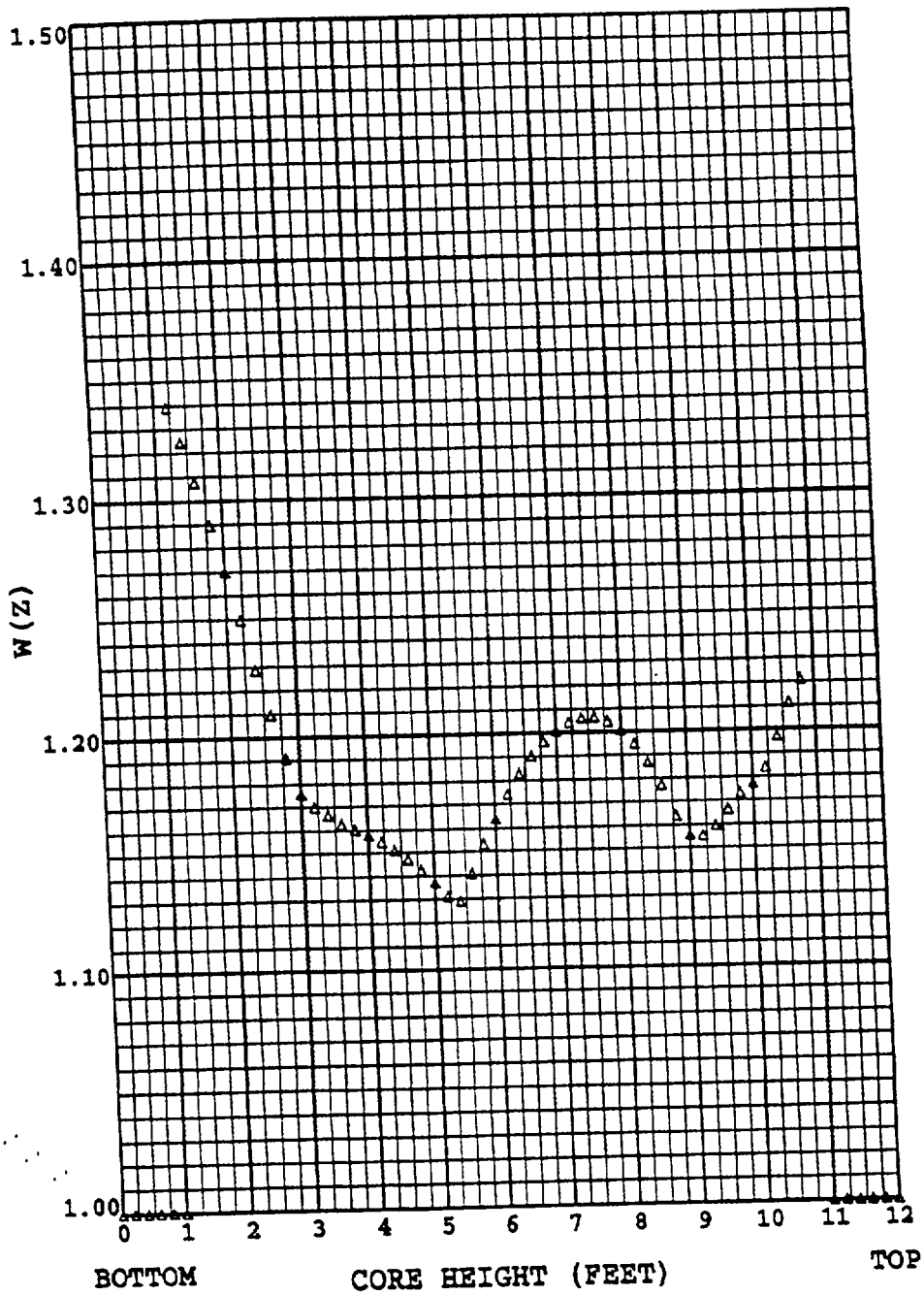
RAOC Summary of Max W(z) at 6000 MWD/MTU With HFP AFD Band of -15/+6%
(Top and Bottom 10% Excluded)



Height (feet)	Max. W(z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.3271
1.4000	1.3121
1.6000	1.2954
1.8000	1.2770
2.0000	1.2576
2.2000	1.2376
2.4000	1.2178
2.6000	1.1977
2.8000	1.1776
3.0000	1.1653
3.2000	1.1617
3.4000	1.1590
3.6000	1.1545
3.8000	1.1507
4.0000	1.1475
4.2000	1.1437
4.4000	1.1394
4.6000	1.1355
4.8000	1.1311
5.0000	1.1263
5.2000	1.1208
5.4000	1.1177
5.6000	1.1259
5.8000	1.1375
6.0000	1.1500
6.2000	1.1618
6.4000	1.1725
6.6000	1.1820
6.8000	1.1902
7.0000	1.1969
7.2000	1.2026
7.4000	1.2072
7.6000	1.2100
7.8000	1.2110
8.0000	1.2100
8.2000	1.2069
8.4000	1.2019
8.6000	1.1950
8.8000	1.1835
9.0000	1.1784
9.2000	1.1818
9.4000	1.1881
9.6000	1.1985
9.8000	1.2090
10.0000	1.2168
10.2000	1.2256
10.4000	1.2388
10.6000	1.2520
10.8000	1.2601
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

Figure 9

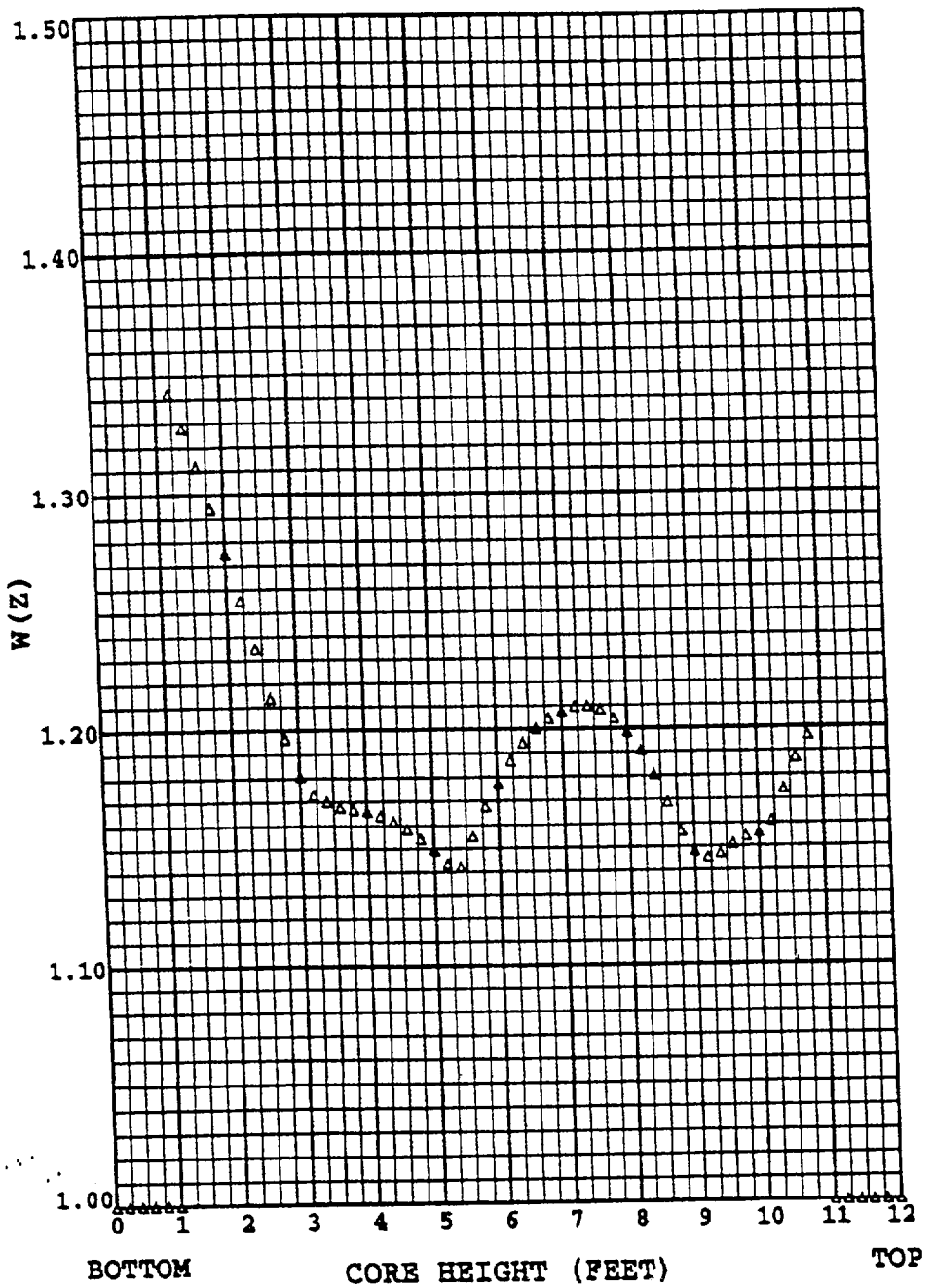
RAOC Summary of Max W(z) at 8000 MWD/MTU With HFP AFD Band of -15/+6%
(Top and Bottom 10% Excluded)



Height (feet)	Max. W(z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.3392
1.4000	1.3244
1.6000	1.3077
1.8000	1.2895
2.0000	1.2700
2.2000	1.2497
2.4000	1.2288
2.6000	1.2096
2.8000	1.1909
3.0000	1.1757
3.2000	1.1700
3.4000	1.1666
3.6000	1.1626
3.8000	1.1601
4.0000	1.1578
4.2000	1.1547
4.4000	1.1512
4.6000	1.1471
4.8000	1.1424
5.0000	1.1372
5.2000	1.1312
5.4000	1.1291
5.6000	1.1408
5.8000	1.1532
6.0000	1.1641
6.2000	1.1742
6.4000	1.1829
6.6000	1.1903
6.8000	1.1962
7.0000	1.2007
7.2000	1.2042
7.4000	1.2062
7.6000	1.2064
7.8000	1.2045
8.0000	1.2007
8.2000	1.1948
8.4000	1.1870
8.6000	1.1771
8.8000	1.1640
9.0000	1.1557
9.2000	1.1554
9.4000	1.1595
9.6000	1.1663
9.8000	1.1730
10.0000	1.1773
10.2000	1.1839
10.4000	1.1972
10.6000	1.2112
10.8000	1.2210
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

Figure 10

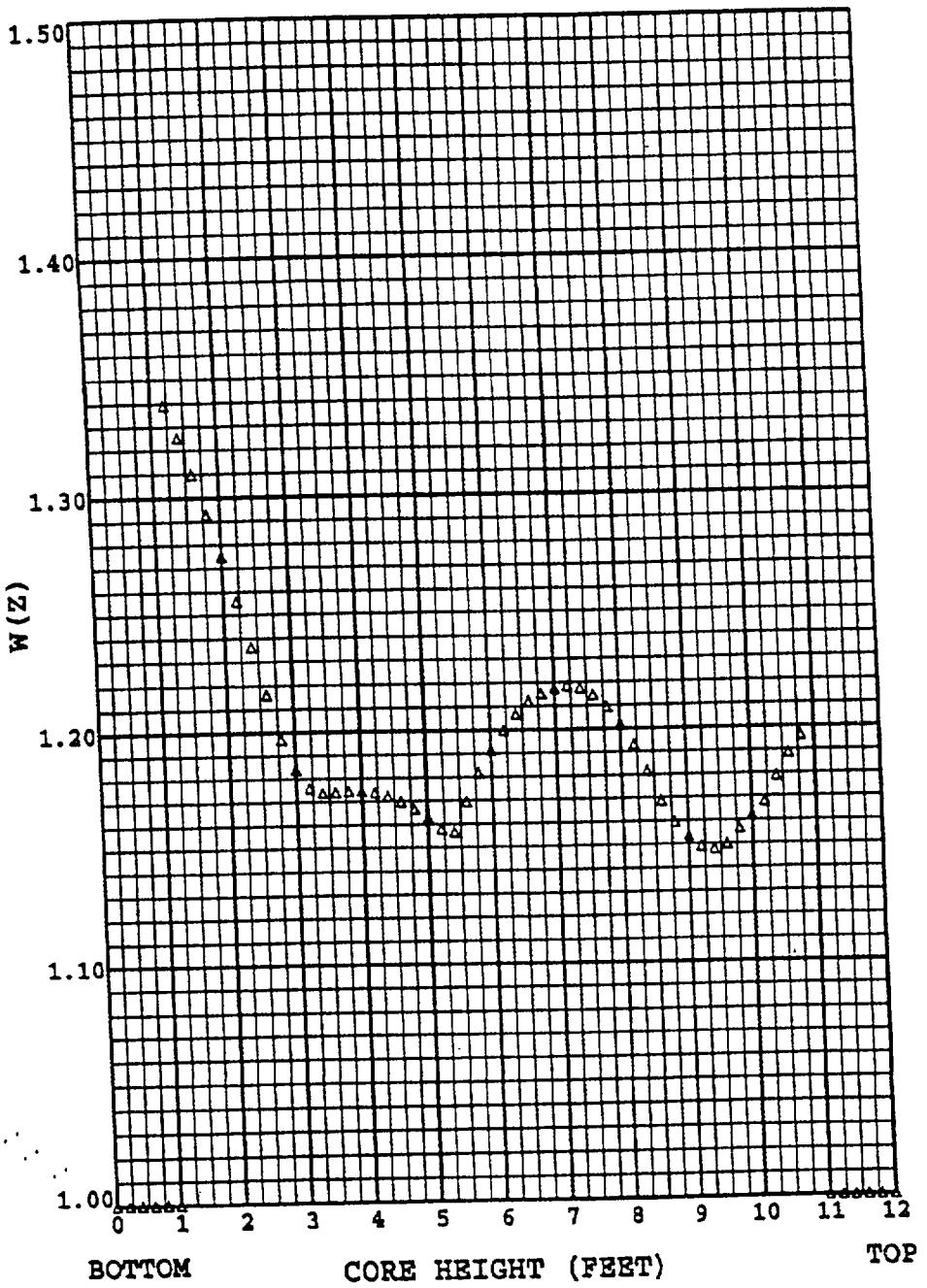
RAOC Summary of Max W(z) at 10000 MWD/MTU With HFP AFD Band of -15/+6%
(Top and Bottom 10% Excluded)



Height (feet)	Max. W(z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.3425
1.4000	1.3280
1.6000	1.3118
1.8000	1.2941
2.0000	1.2751
2.2000	1.2553
2.4000	1.2348
2.6000	1.2139
2.8000	1.1964
3.0000	1.1809
3.2000	1.1731
3.4000	1.1701
3.6000	1.1678
3.8000	1.1668
4.0000	1.1659
4.2000	1.1641
4.4000	1.1617
4.6000	1.1583
4.8000	1.1541
5.0000	1.1494
5.2000	1.1435
5.4000	1.1421
5.6000	1.1551
5.8000	1.1678
6.0000	1.1777
6.2000	1.1867
6.4000	1.1942
6.6000	1.2002
6.8000	1.2045
7.0000	1.2076
7.2000	1.2096
7.4000	1.2098
7.6000	1.2081
7.8000	1.2043
8.0000	1.1986
8.2000	1.1907
8.4000	1.1808
8.6000	1.1690
8.8000	1.1568
9.0000	1.1484
9.2000	1.1456
9.4000	1.1472
9.6000	1.1511
9.8000	1.1543
10.0000	1.1561
10.2000	1.1609
10.4000	1.1744
10.6000	1.1872
10.8000	1.1966
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

Figure 11

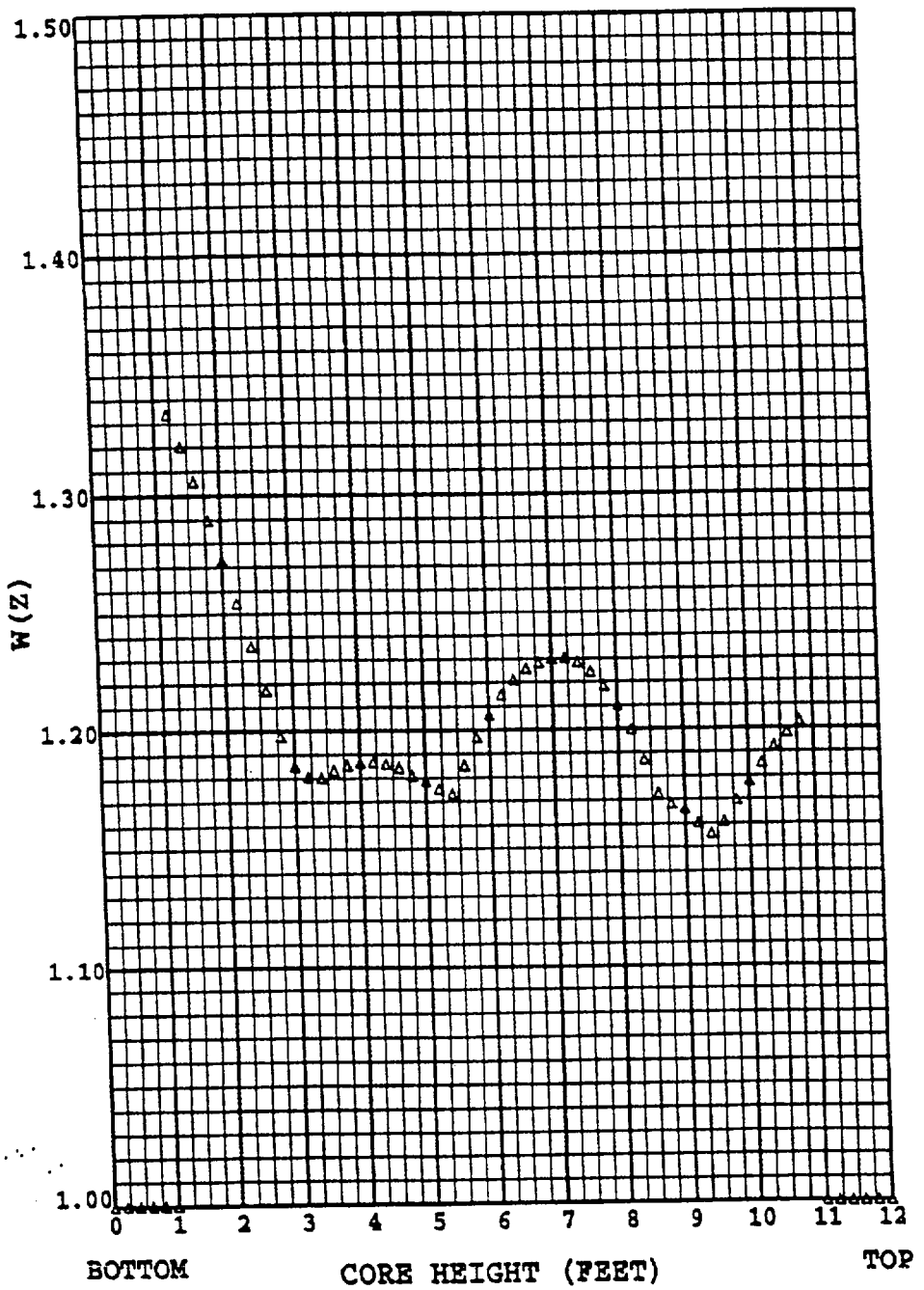
RAOC Summary of Max W(z) at 12000 MWD/MTU With HFP AFD Band of -15/+6%
(Top and Bottom 10% Excluded)



Height (feet)	Max. W(z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.3392
1.4000	1.3253
1.6000	1.3098
1.8000	1.2929
2.0000	1.2748
2.2000	1.2559
2.4000	1.2363
2.6000	1.2162
2.8000	1.1969
3.0000	1.1839
3.2000	1.1759
3.4000	1.1738
3.6000	1.1739
3.8000	1.1745
4.0000	1.1745
4.2000	1.1737
4.4000	1.1721
4.6000	1.1696
4.8000	1.1666
5.0000	1.1630
5.2000	1.1578
5.4000	1.1566
5.6000	1.1694
5.8000	1.1818
6.0000	1.1914
6.2000	1.1998
6.4000	1.2066
6.6000	1.2119
6.8000	1.2152
7.0000	1.2174
7.2000	1.2184
7.4000	1.2175
7.6000	1.2145
7.8000	1.2094
8.0000	1.2023
8.2000	1.1932
8.4000	1.1818
8.6000	1.1686
8.8000	1.1597
9.0000	1.1535
9.2000	1.1490
9.4000	1.1478
9.6000	1.1498
9.8000	1.1567
10.0000	1.1622
10.2000	1.1679
10.4000	1.1788
10.6000	1.1887
10.8000	1.1961
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

Figure 12

RAOC Summary of Max W(z) at 14000 MWD/MTU With HFP AFD Band of -15/+6%
(Top and Bottom 10% Excluded)



Height (feet)	Max. W(z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.3338
1.4000	1.3205
1.6000	1.3058
1.8000	1.2898
2.0000	1.2727
2.2000	1.2548
2.4000	1.2363
2.6000	1.2173
2.8000	1.1978
3.0000	1.1851
3.2000	1.1807
3.4000	1.1805
3.6000	1.1833
3.8000	1.1854
4.0000	1.1866
4.2000	1.1869
4.4000	1.1861
4.6000	1.1843
4.8000	1.1809
5.0000	1.1789
5.2000	1.1754
5.4000	1.1734
5.6000	1.1851
5.8000	1.1969
6.0000	1.2064
6.2000	1.2147
6.4000	1.2211
6.6000	1.2258
6.8000	1.2285
7.0000	1.2301
7.2000	1.2304
7.4000	1.2285
7.6000	1.2244
7.8000	1.2183
8.0000	1.2100
8.2000	1.1998
8.4000	1.1872
8.6000	1.1728
8.8000	1.1685
9.0000	1.1662
9.2000	1.1604
9.4000	1.1558
9.6000	1.1607
9.8000	1.1699
10.0000	1.1780
10.2000	1.1856
10.4000	1.1924
10.6000	1.1981
10.8000	1.2028
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

Figure 13

RAOC Summary of Max W(z) at 16000 MWD/MTU With HFP AFD Band of -15/+6%
(Top and Bottom 10% Excluded)

Table A.1

F_Q Margin Penalty Factors

Burnup (MWD/MTU)	Penalty Factor
8477	1.0206
8625	1.0212
8774	1.0217
8923	1.0222
9071	1.0224
9220	1.0222
9369	1.0218
9517	1.0211
9666	1.0203

Note: All cycle burnups outside the range of the table shall use a 1.02 penalty factor on $F_Q^W(Z)$ margin for compliance with 3.2.1.2.a Surveillance Requirements. Linear interpolation is adequate for intermediate cycle burnups.

Table 1: Control Rod Overlap Determination

Bank Overlap Counter (Steps)	A Bank	B Bank	C Bank	D Bank
0	0			
2	2			
4	4			
6	6			
8	8			
10	10			
12	12			
14	14			
16	16			
18	18			
20	20			
22	22			
24	24			
26	26			
28	28			
30	30			
32	32			
34	34			
36	36			
38	38			
40	40			
42	42			
44	44			
46	46			
48	48			
50	50			
52	52			
54	54			
56	56			
58	58			
60	60			
62	62			
64	64			
66	66			
68	68			
70	70			

Bank Overlap Counter (Steps)	A Bank	B Bank	C Bank	D Bank
72	72			
74	74			
76	76			
78	78			
80	80			
82	82			
84	84			
86	86			
88	88			
90	90			
92	92			
94	94			
96	96			
98	98			
100	100			
102	102			
104	104			
106	106			
108	108			
110	110			
112	112			
114	114			
116	116			
118	118			
120	120			
122	122			
124	124			
126	126			
128	128	0		
130	130	2		
132	132	4		
134	134	6		
136	136	8		
138	138	10		
140	140	12		
142	142	14		

Table 1: Control Rod Overlap Determination

Bank Overlap Counter (Steps)	A Bank	B Bank	C Bank	D Bank
144	144	16		
146	146	18		
148	148	20		
150	150	22		
152	152	24		
154	154	26		
156	156	28		
158	158	30		
160	160	32		
162	162	34		
164	164	36		
166	166	38		
168	168	40		
170	170	42		
172	172	44		
174	174	46		
176	176	48		
178	178	50		
180	180	52		
182	182	54		
184	184	56		
186	186	58		
188	188	60		
190	190	62		
192	192	64		
194	194	66		
196	196	68		
198	198	70		
200	200	72		
202	202	74		
204	204	76		
206	206	78		
208	208	80		
210	210	82		
212	212	84		
214	214	86		
216	216	88		
218	218	90		

Bank Overlap Counter (Steps)	A Bank	B Bank	C Bank	D Bank
220	220	92		
222	222	94		
224	224	96		
226	226	98		
228	228	100		
230	230	102		
232	232	104		
234		106		
236		108		
238		110		
240		112		
242		114		
244		116		
246		118		
248		120		
250		122		
252		124		
254		126		
256		128	0	
258		130	2	
260		132	4	
262		134	6	
264		136	8	
266		138	10	
268		140	12	
270		142	14	
272		144	16	
274		146	18	
276		148	20	
278		150	22	
280		152	24	
282		154	26	
284		156	28	
286		158	30	
288		160	32	
290		162	34	
292		164	36	
294		166	38	

Table 1: Control Rod Overlap Determination

Bank Overlap Counter (Steps)	A Bank	B Bank	C Bank	D Bank
296		168	40	
298		170	42	
300		172	44	
302		174	46	
304		176	48	
306		178	50	
308		180	52	
310		182	54	
312		184	56	
314		186	58	
316		188	60	
318		190	62	
320		192	64	
322		194	66	
324		196	68	
326		198	70	
328		200	72	
330		202	74	
332		204	76	
334		206	78	
336		208	80	
338		210	82	
340		212	84	
342		214	86	
344		216	88	
346		218	90	
348		220	92	
350		222	94	
352		224	96	
354		226	98	
356		228	100	
358		230	102	
360		232	104	
362			106	
364			108	
366			110	
368			112	

Bank Overlap Counter (Steps)	A Bank	B Bank	C Bank	D Bank
370			114	
372			116	
374			118	
376			120	
378			122	
380			124	
382			126	
384			128	0
386			130	2
388			132	4
390			134	6
392			136	8
394			138	10
396			140	12
398			142	14
400			144	16
402			146	18
404			148	20
406			150	22
408			152	24
410			154	26
412			156	28
414			158	30
416			160	32
418			162	34
420			164	36
422			166	38
424			168	40
426			170	42
428			172	44
430			174	46
432			176	48
434			178	50
436			180	52
438			182	54
440			184	56
442			186	58

Table 1: Control Rod Overlap Determination

Bank Overlap Counter (Steps)	A Bank	B Bank	C Bank	D Bank
444			188	60
446			190	62
448			192	64
450			194	66
452			196	68
454			198	70
456			200	72
458			202	74
460			204	76
462			206	78
464			208	80
466			210	82
468			212	84
470			214	86
472			216	88
474			218	90
476			220	92
478			222	94
480			224	96
482			226	98
484			228	100
486			230	102
488			232	104
490				106
492				108
494				110
496				112
498				114
500				116
502				118
504				120
.506				122
508				124
510				126
512				128
514				130
516				132

Bank Overlap Counter (Steps)	A Bank	B Bank	C Bank	D Bank
518				134
520				136
522				138
524				140
526				142
528				144
530				146
532				148
534				150
536				152
538				154
540				156
542				158
544				160
546				162
548				164
550				166
552				168
554				170
556				172
558				174
560				176
562				178
564				180
566				182
568				184
570				186
572				188
574				190
576				192
578				194
580				196
582				198
584				200
586				202
588				204
590				206

Table 1: Control Rod Overlap Determination

Bank Overlap Counter (Steps)	A Bank	B Bank	C Bank	D Bank
592				208
594				210
596				212
598				214
600				216
602				218
604				220
606				222
608				224
610				226
612				228
614				230
616				232

This information is provided in 2 step increments. One step increments can be derived by interpolation. Fully withdrawn region shall be the condition where shutdown and control banks are at a position within the interval of $\geq$ 225 and $\leq$ 231 steps withdrawn. The Table indicates a maximum step of 232 to be consistent with 2 step increments.