

VOGTLE ELECTRIC GENERATING PLANT (VEGP) UNIT 2 CYCLE 4

CORE OPERATING LIMITS REPORT

SEPTEMBER 1993

Vogtle Electric Generating Plant Unit 1 and Unit 2

Core Operating Limits Report

Unit 2 Cycle 4

September 1993

Revision Insertion Instructions

<u>Item</u>	<u>Instructions</u>
Active COLR List	Replace
Unit 2 Report Pages 1-11 and Title Page	Replace with Pages 1-12 and Title Page

Vogtle Electric Generating Plant Unit 1 and Unit 2

Active Core Operating Limits Report List

September 1993

Unit 1 Cycle 5

March 1993

Unit 2 Cycle 4

September 1993

## COLR for VEGP UNIT 2 CYCLE 4

### 1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for VEGP UNIT 2 CYCLE 4 has been prepared in accordance with the requirements of Technical Specification 6.8.1.6.

The Technical Specifications affected by this report are listed below:

3/4.1.1.1	SHUTDOWN MARGIN - MODES 1 and 2
3/4.1.1.2	SHUTDOWN MARGIN - MODES 3, 4 and 5
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
3/4.2.2	Heat Flux Hot Channel Factor - $F_Q(Z)$
3/4.2.3	Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}^N$

## 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 Specification 6.8.1.6.

### 2.1 SHUTDOWN MARGIN - MODES 1 AND 2 (Specification 3/4.1.1.1)

2.1.1 The SHUTDOWN MARGIN shall be greater than or equal to  $1.3\% \Delta k/k$ .

### 2.2 SHUTDOWN MARGIN - MODES 3, 4 AND 5 (Specification 3/4.1.1.2)

2.2.1 The SHUTDOWN MARGIN shall be greater than or equal to the limits shown in Figures 1 and 2.

### 2.3 Moderator Temperature Coefficient (Specification 3/4.1.1.3)

2.3.1 The Moderator Temperature Coefficient (MTC) limits are:

The BOL/ARO/HZP - MTC shall be less positive than  $+0.7 \times 10^{-4} \Delta k/k/^{\circ}F$  for power levels up to 70% RTP with a linear ramp to  $0 \Delta k/k/^{\circ}F$  at 100% RTP.

The EOL/ARO/RTP-MTC shall be less negative than  $-5.5 \times 10^{-4} \Delta k/k/^{\circ}F$ .\*

2.3.2 The MTC Surveillance limit is:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to  $-4.75 \times 10^{-4} \Delta k/k/^{\circ}F$ .\*

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

### 2.4 Shutdown Rod Insertion Limit (Specification 3/4.1.3.5)

2.4.1 The shutdown rods shall be withdrawn to a position greater than or equal to 225 steps.

### 2.5 Control Rod Insertion Limits (Specification 3/4.1.3.6)

2.5.1 The control rod banks shall be limited in physical insertion as shown in Figure 3.

\* Applicable over full-power T-average range of  $584.4^{\circ}F$  through  $588.4^{\circ}$ , inclusive.

2.6 Axial Flux Difference (Specification 3/4.2.1)  
{RAOC methodology}

2.6.1 The Axial Flux Difference (AFD) Acceptable Operation Limits are provided in Figure 4.

2.7 Heat Flux Hot Channel Factor -  $F_o(Z)$  (Specification 3/4.2.2)  
{ $F_o$  methodology}

$$2.7.1 \quad F_o(Z) \leq \frac{F_o^{RTP}}{P} * K(Z) \quad \text{for } P > 0.5$$

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

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

$$2.7.2 \quad F_o^{RTP} = 2.50$$

2.7.3  $K(Z)$  is provided in Figure 5.

$$2.7.4 \quad F_o^C(Z) \leq \frac{F_o^{RTP} * K(Z)}{P * W(Z)} \quad \text{for } P > 0.5$$

$$F_o^C(Z) \leq \frac{F_o^{RTP} * K(Z)}{0.5 * W(Z)} \quad \text{for } P \leq 0.5$$

2.7.5  $W(Z)$  values are provided in Figures 6 through 8.

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2.8 Nuclear Enthalpy Rise Hot Channel Factor -  $F_{AH}^N$  (Specification 3/4.2.3)

$$2.8.1 \quad F_{AH}^N \leq F_{AH}^{RTP} * (1 + PF_{AH} * (1-P))$$

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

$$2.8.2a \quad F_{AH}^{RTP} = 1.53 \text{ for LOPAR fuel, and}$$

$$2.8.2b \quad F_{AH}^{RTP} = 1.65 \text{ for VANTAGE 5 fuel}$$

$$2.8.3 \quad PF_{AH} = 0.3 \text{ for LOPAR and VANTAGE 5 fuel}$$

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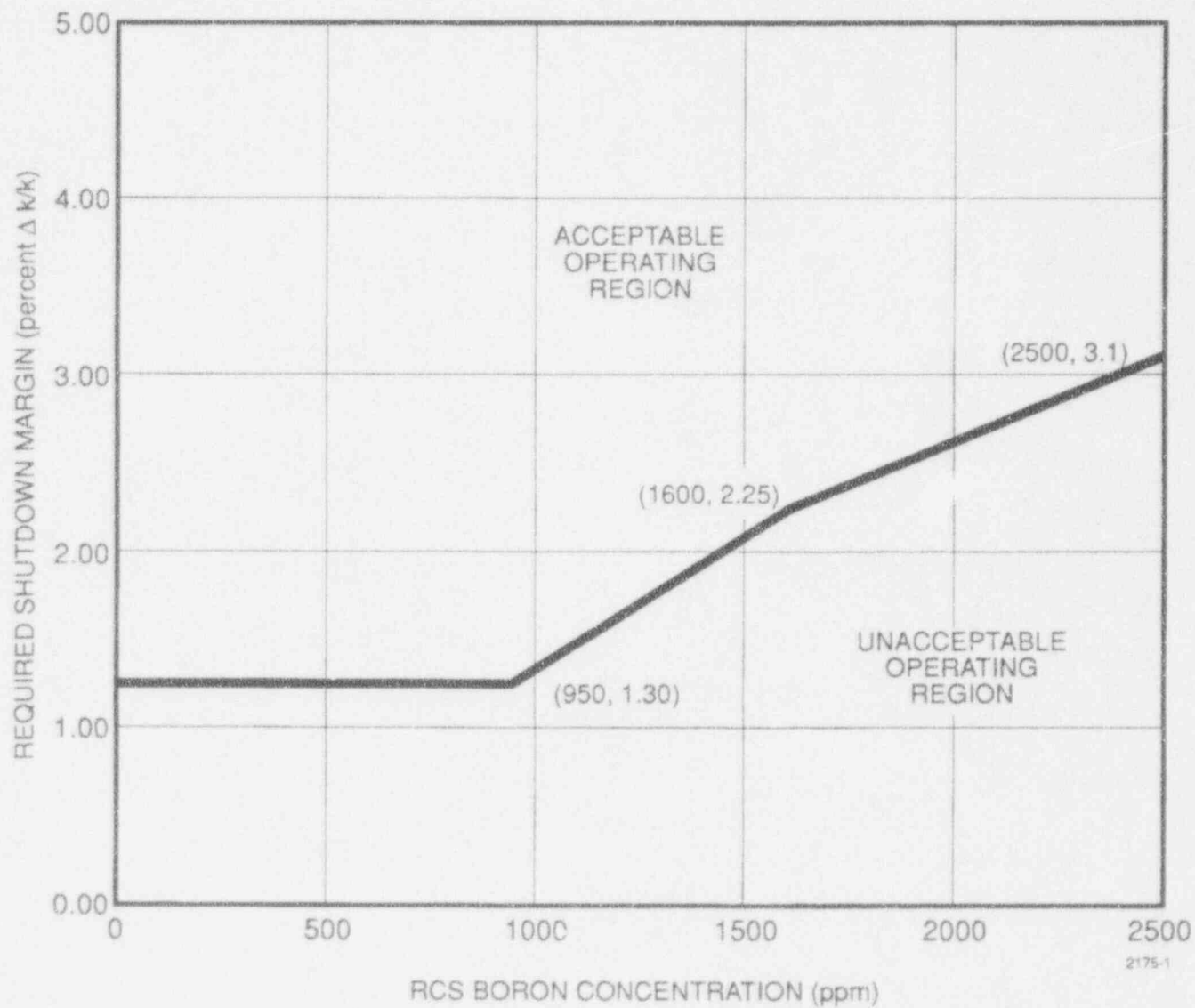


FIGURE 1

REQUIRED SHUTDOWN MARGIN FOR MODES 3 AND 4 (MODE 4 WITH AT LEAST ONE REACTOR COOLANT PUMP RUNNING)



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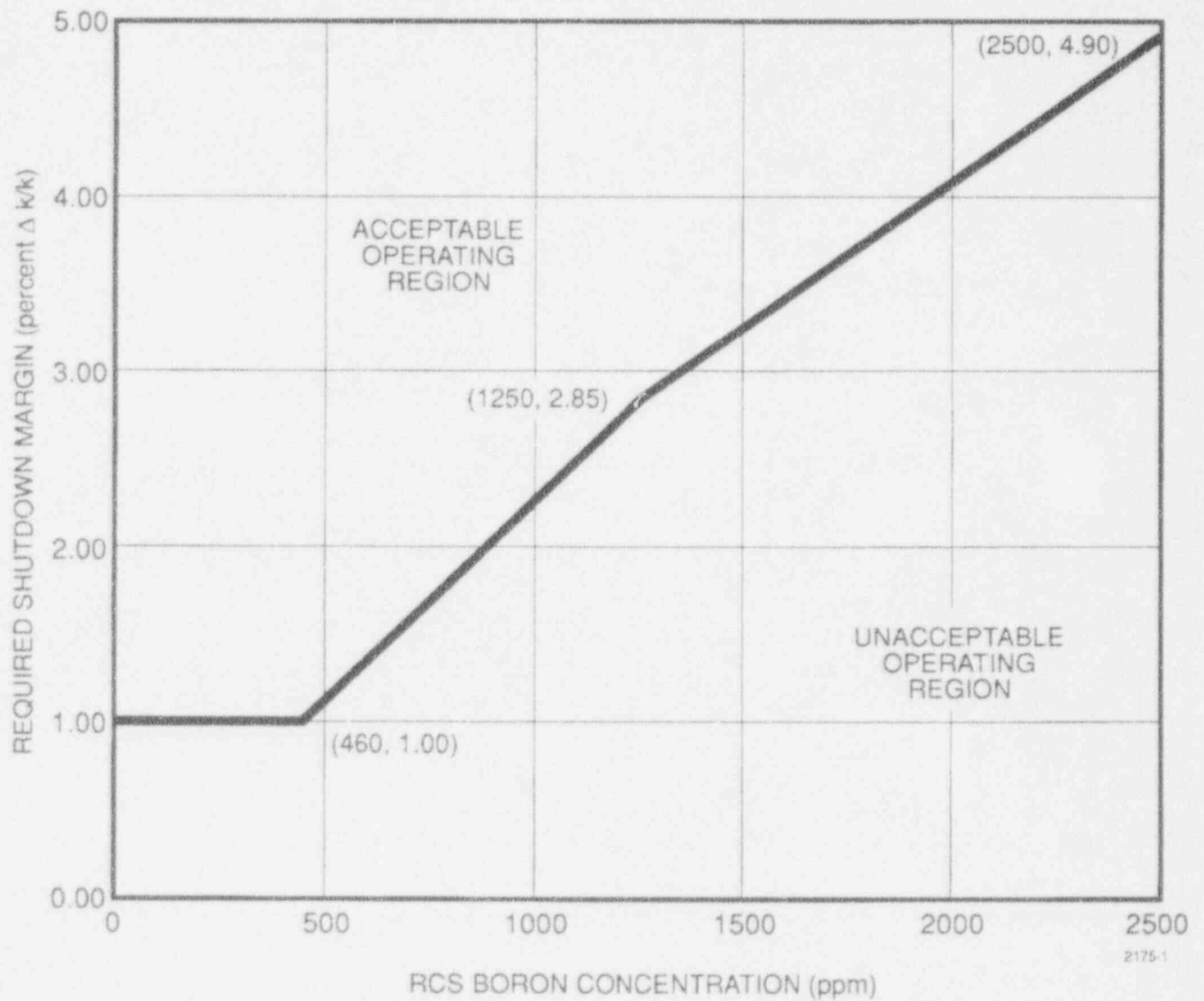
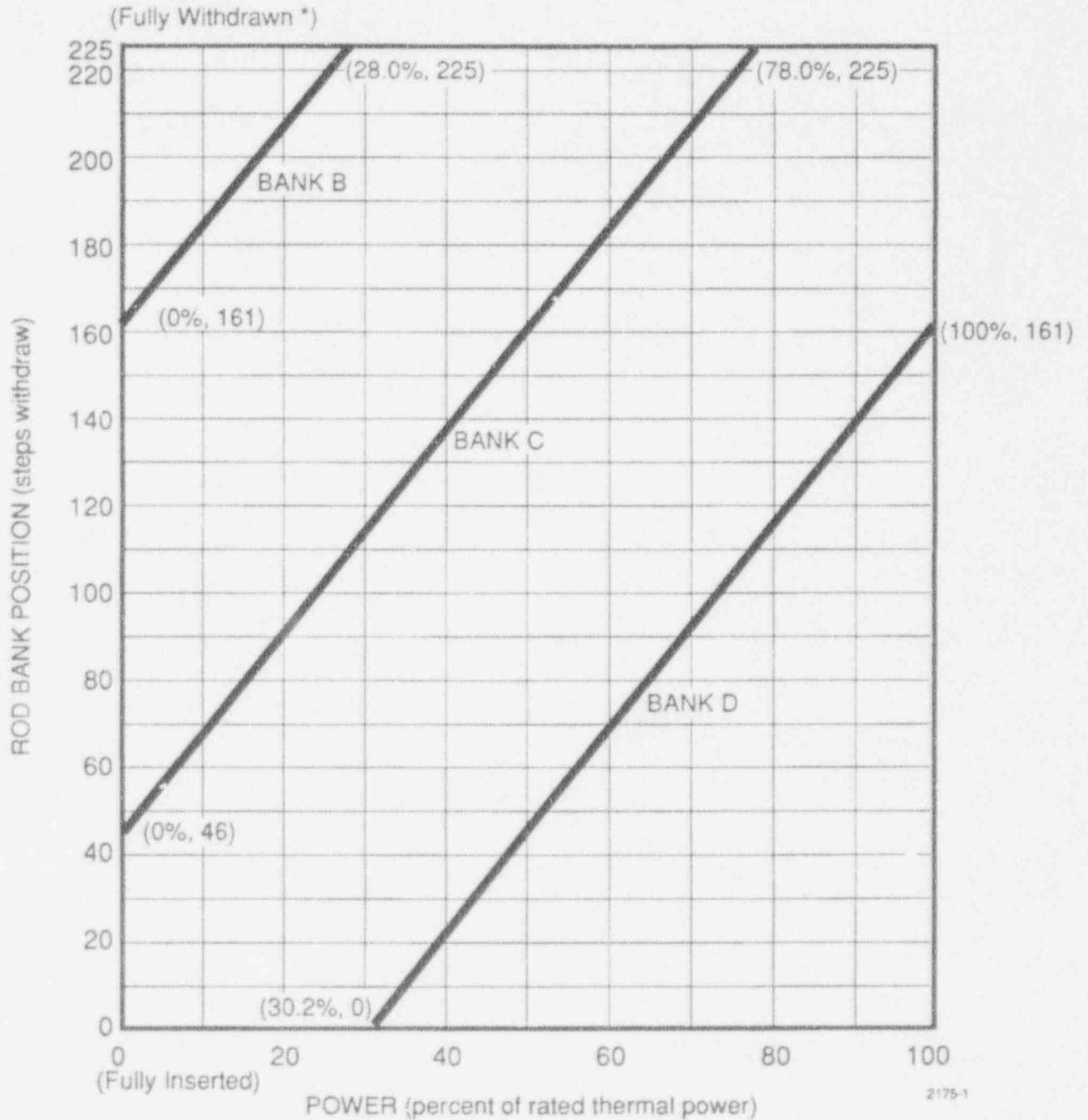


FIGURE 2

REQUIRED SHUTDOWN MARGIN FOR MODES 4 AND 5 (MODE 4 WITH NO REACTOR COOLANT PUMPS RUNNING)

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\* Fully withdrawn shall be the condition where control rods are at a position within the interval  $\geq 225$  and  $\leq 231$  steps withdrawn.

FIGURE 3  
ROD BANK INSERTION LIMITS VERSUS THERMAL POWER

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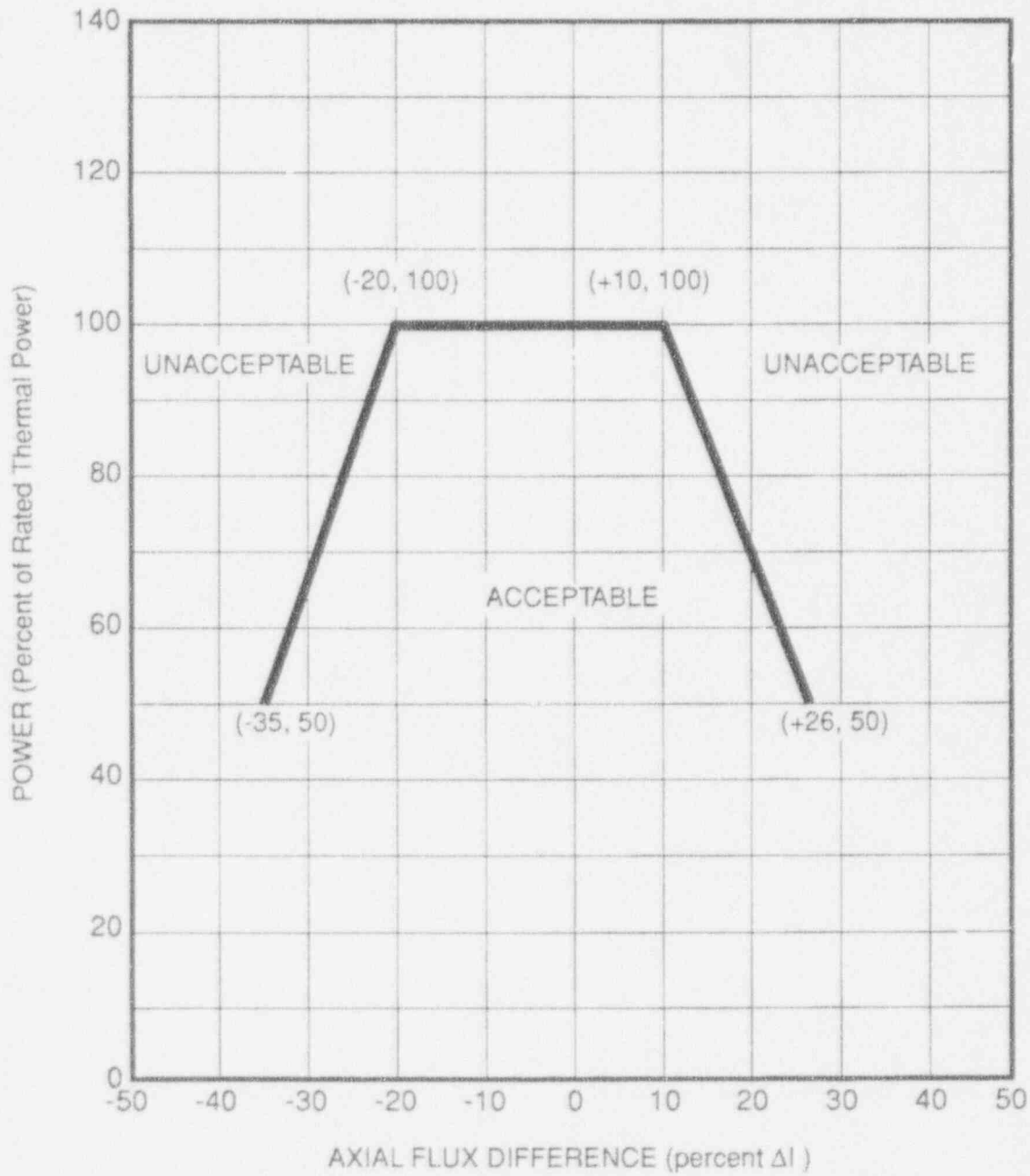


FIGURE 4

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER  
FOR RAOC

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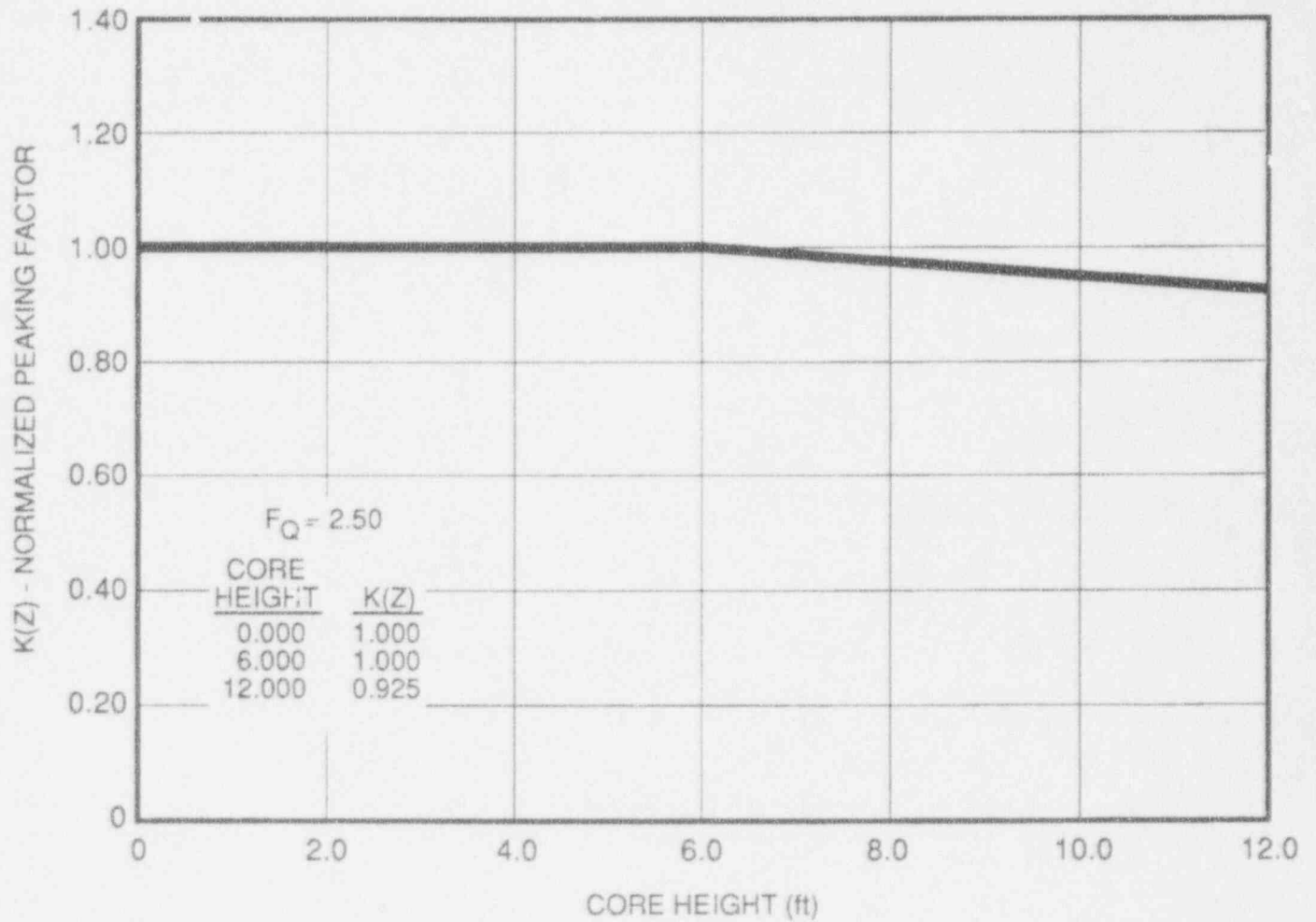


FIGURE 5

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

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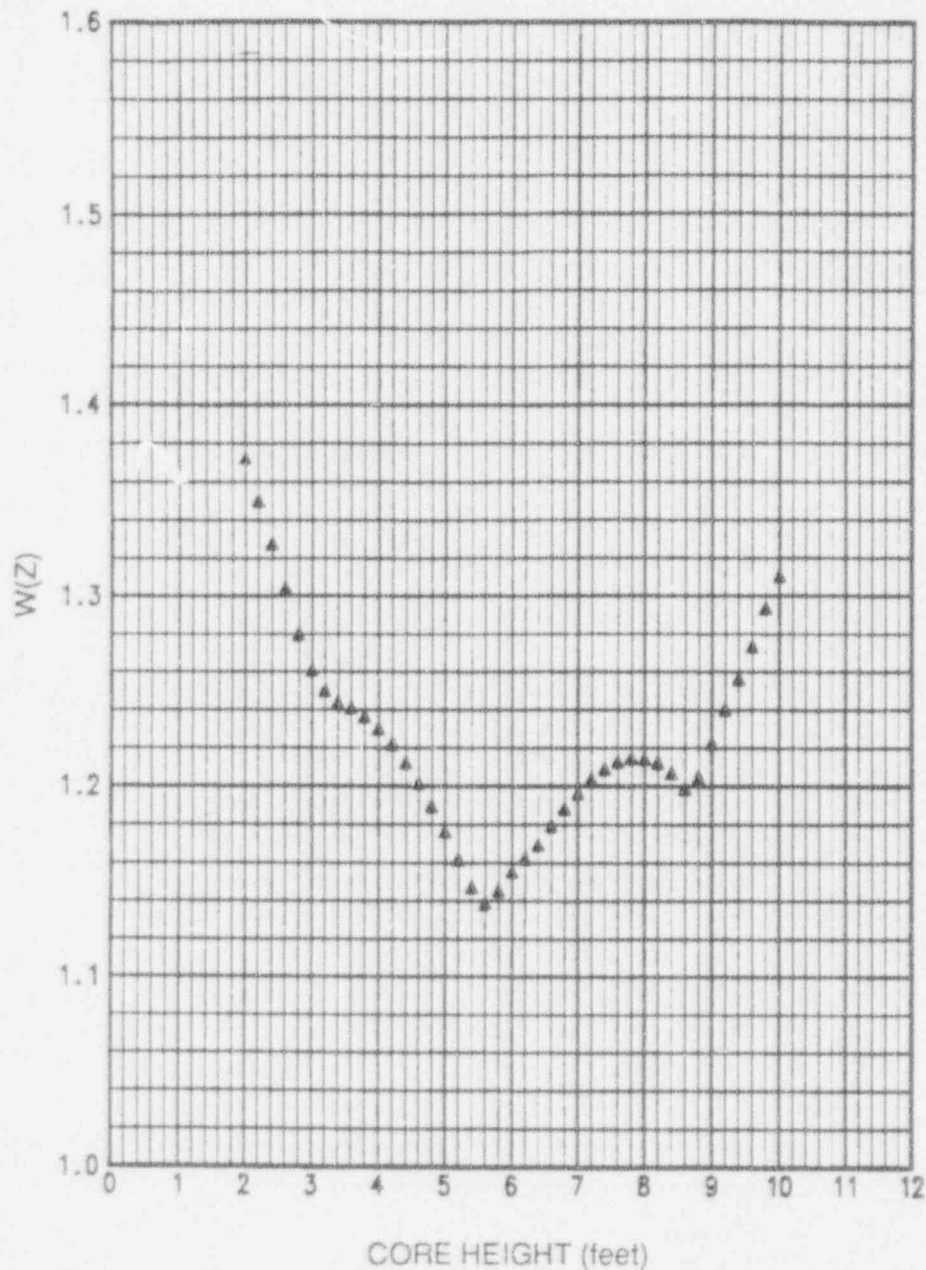


FIGURE 6

RAOC W(Z) AT 150 MWD/MTU

Axial Point	Elevation (feet)	BOL W(z)
* 1	12.00	1.0000
* 2	11.80	1.0000
* 3	11.60	1.0000
* 4	11.40	1.0000
* 5	11.20	1.0000
* 6	11.00	1.0000
* 7	10.80	1.0000
* 8	10.60	1.0000
* 9	10.40	1.0000
* 10	10.20	1.0000
11	10.00	1.3103
12	9.80	1.2936
13	9.60	1.2734
14	9.40	1.2563
15	9.20	1.2404
16	9.00	1.2225
17	8.80	1.2051
18	8.60	1.1985
19	8.40	1.2069
20	8.20	1.2122
21	8.00	1.2143
22	7.80	1.2148
23	7.60	1.2129
24	7.40	1.2091
25	7.20	1.2036
26	7.00	1.1964
27	6.80	1.1883
28	6.60	1.1791
29	6.40	1.1694
30	6.20	1.1622
31	6.00	1.1553
32	5.80	1.1451
33	5.60	1.1384
34	5.40	1.1471
35	5.20	1.1618
36	5.00	1.1763
37	4.80	1.1894
38	4.60	1.2016
39	4.40	1.2125
40	4.20	1.2220
41	4.00	1.2300
42	3.80	1.2364
43	3.60	1.2411
44	3.40	1.2442
45	3.20	1.2500
46	3.00	1.2609
47	2.80	1.2798
48	2.60	1.3043
49	2.40	1.3274
50	2.20	1.3499
51	2.00	1.3722
* 52	1.80	1.0000
* 53	1.60	1.0000
* 54	1.40	1.0000
* 55	1.20	1.0000
* 56	1.00	1.0000
* 57	0.80	1.0000
* 58	0.60	1.0000
* 59	0.40	1.0000
* 60	0.20	1.0000
* 61	0.00	1.0000

\* Top and Bottom 15%  
Excluded per  
Technical Specification 4.2.2.2

This figure is referred to by Technical Specifications 4.2.2.2d, B3/4.2.2  
Data applicable over a temperature range of 584.4 to 588.4 F.

# COLR FOR VEGP UNIT 2 CYCLE 4

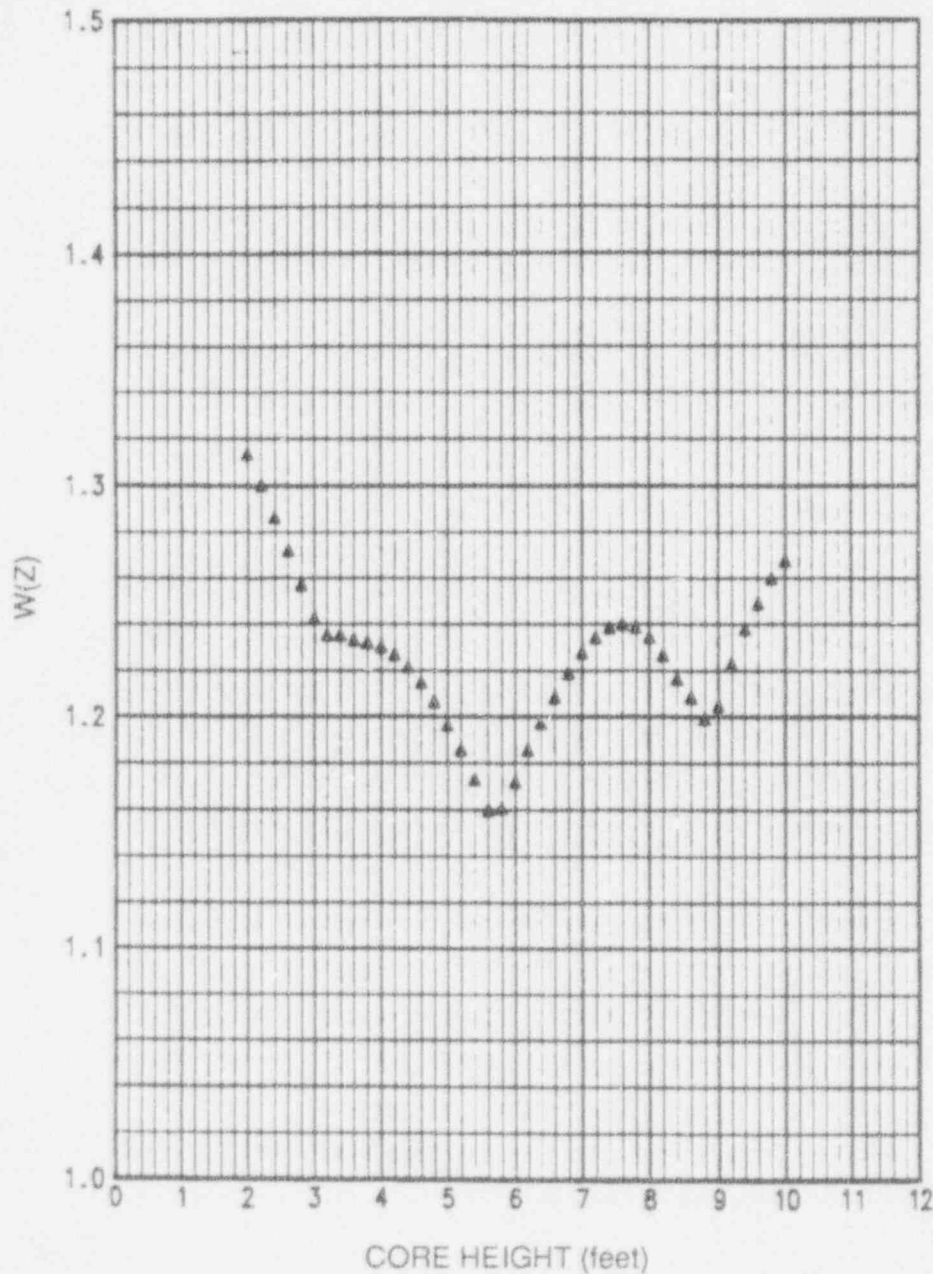


FIGURE 7  
RAOC  $W(z)$  AT 7000 MWD/MTU

Axial Point	Elevation (feet)	MOL $W(z)$
1	12.00	1.0000
2	11.80	1.0000
3	11.60	1.0000
4	11.40	1.0000
5	11.20	1.0000
6	11.00	1.0000
7	10.80	1.0000
8	10.60	1.0000
9	10.40	1.0000
10	10.20	1.0000
11	10.00	1.2676
12	9.80	1.2600
13	9.60	1.2489
14	9.40	1.2380
15	9.20	1.2231
16	9.00	1.2048
17	8.80	1.1992
18	8.60	1.2083
19	8.40	1.2163
20	8.20	1.2265
21	8.00	1.2344
22	7.80	1.2386
23	7.60	1.2400
24	7.40	1.2384
25	7.20	1.2343
26	7.00	1.2277
27	6.80	1.2189
28	6.60	1.2084
29	6.40	1.1974
30	6.20	1.1855
31	6.00	1.1720
32	5.80	1.1606
33	5.60	1.1597
34	5.40	1.1730
35	5.20	1.1856
36	5.00	1.1965
37	4.80	1.2065
38	4.60	1.2148
39	4.40	1.2216
40	4.20	1.2267
41	4.00	1.2302
42	3.80	1.2320
43	3.60	1.2333
44	3.40	1.2353
45	3.20	1.2353
46	3.00	1.2429
47	2.80	1.2572
48	2.60	1.2721
49	2.40	1.2864
50	2.20	1.3002
51	2.00	1.3136
52	1.80	1.0000
53	1.60	1.0000
54	1.40	1.0000
55	1.20	1.0000
56	1.00	1.0000
57	0.80	1.0000
58	0.60	1.0000
59	0.40	1.0000
60	0.20	1.0000
61	0.00	1.0000

\* Top and Bottom 15%  
Excluded per  
Technical Specification 4.2.2.2

This figure is referred to by Technical Specifications 4.2.2.2d, B3/4.2.2  
Data applicable over a temperature range of 584.4 to 588.4 F



# COLR FOR VEGP UNIT 2 CYCLE 4

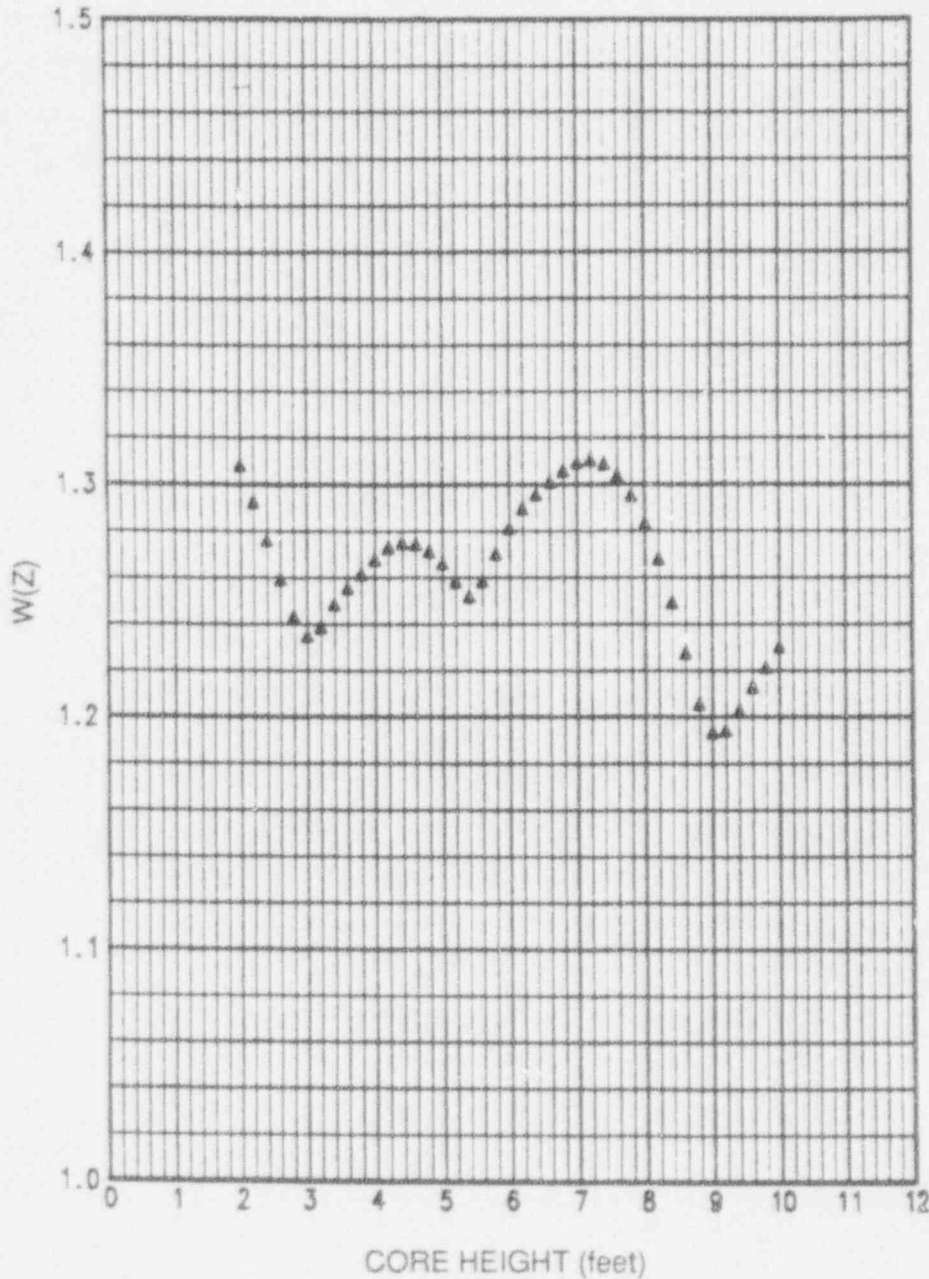


FIGURE 8  
RAOC W(Z) AT 16500 MWD/MTU

Axial Point	Elevation (feet)	EOL W(z)
1	12.00	1.0000
2	11.80	1.0000
3	11.60	1.0000
4	11.40	1.0000
5	11.20	1.0000
6	11.00	1.0000
7	10.80	1.0000
8	10.60	1.0000
9	10.40	1.0000
10	10.20	1.0000
11	10.00	1.2303
12	9.80	1.2215
13	9.60	1.2129
14	9.40	1.2030
15	9.20	1.1944
16	9.00	1.1935
17	8.80	1.2057
18	8.60	1.2276
19	8.40	1.2494
20	8.20	1.2680
21	8.00	1.2833
22	7.80	1.2952
23	7.60	1.3037
24	7.40	1.3088
25	7.20	1.3108
26	7.00	1.3095
27	6.80	1.3059
28	6.60	1.3011
29	6.40	1.2958
30	6.20	1.2896
31	6.00	1.2815
32	5.80	1.2705
33	5.60	1.2586
34	5.40	1.2520
35	5.20	1.2582
36	5.00	1.2663
37	4.80	1.2715
38	4.60	1.2746
39	4.40	1.2751
40	4.20	1.2730
41	4.00	1.2679
42	3.80	1.2616
43	3.60	1.2557
44	3.40	1.2486
45	3.20	1.2384
46	3.00	1.2350
47	2.80	1.2434
48	2.60	1.2594
49	2.40	1.2762
50	2.20	1.2924
51	2.00	1.3083
52	1.80	1.0000
53	1.60	1.0000
54	1.40	1.0000
55	1.20	1.0000
56	1.00	1.0000
57	0.80	1.0000
58	0.60	1.0000
59	0.40	1.0000
60	0.20	1.0000
61	0.00	1.0000

\* Top and Bottom 15%  
Excluded per  
Technical Specification 4.2.2.2

This figure is referred to by Technical Specifications 4.2.2.2d, B3/4.2.2  
Data applicable over a temperature range of 584.4 to 588.4 F