

Vogtle Electric Generating Plant Unit 1 and Unit 2

Core Operating Limits Report

Unit 1 Cycle 6

September 1994

Revision Insertion Instructions

<u>Item</u>	<u>Instructions</u>
Active COLR List	Replace
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Vogtle Electric Generating Plant Unit 1 and Unit 2

Active Core Operating Limits Report List

September 1994

Unit 1 Cycle 6

September 1994

Unit 2 Cycle 4, Revision 1

August 1994

VOGTLE ELECTRIC GENERATING PLANT (VEGP) UNIT 1 CYCLE 6

CORE OPERATING LIMITS REPORT

SEPTEMBER 1994

## COLR for VEGP UNIT 1 CYCLE 6

### 1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for VEGP UNIT 1 CYCLE 6 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 - $F(Z)$
3/4.2.3	Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}^N$

## COLR for VEGP UNIT 1 CYCLE 6

### 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 percent  $\Delta k/k$ .

#### 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 percent RTP with a linear ramp to 0  $\Delta k/k/^{\circ}F$  at 100 percent RTP.

The EOL/ARO/RTP-MTC shall be less negative than  $-5.50 \times 10^{-4} \Delta k/k/^{\circ}F$ .\*

- 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.

\*Based on full-power T-average in the range of 584.4 to 588.4°F, inclusive.

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## 2.6 Axial Flux Difference (Specification 3/4.2.1) {relaxed axial offset control (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 - $F_q(Z)$ (Specification 3/4.2.2) { $F_q$ methodology}

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

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

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

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

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

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

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

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

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2.7.6 The  $F_q^C(Z)$  penalty factors are provided in table 1.

2.8 Nuclear Thermal Penalty Rise Hot Channel Factor -  $F_{\Delta H}^N$  (Specification 3/4.2.3)

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

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

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

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

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

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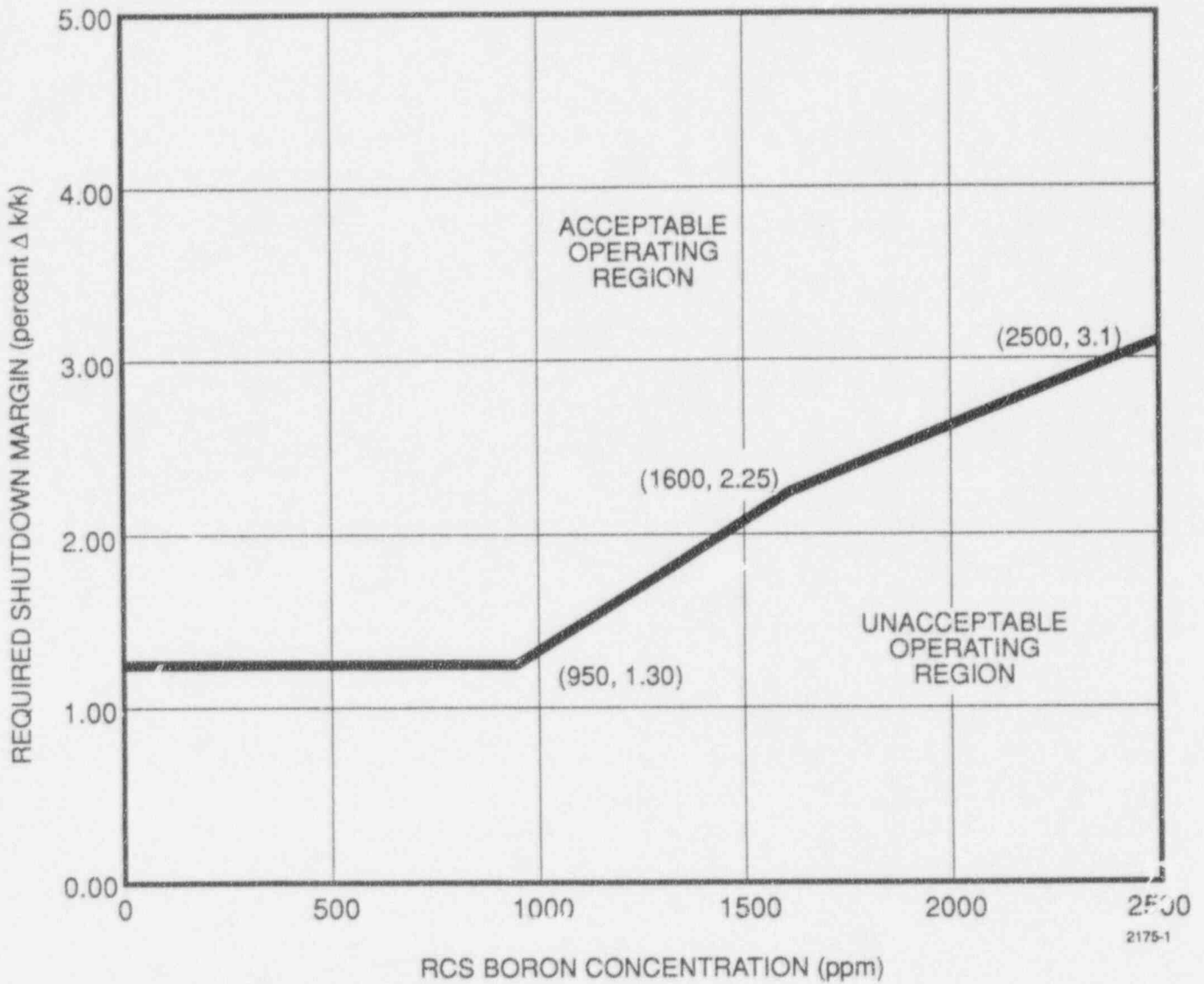


FIGURE 1

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



COLR FOR VEGP UNIT 1 CYCLE 6

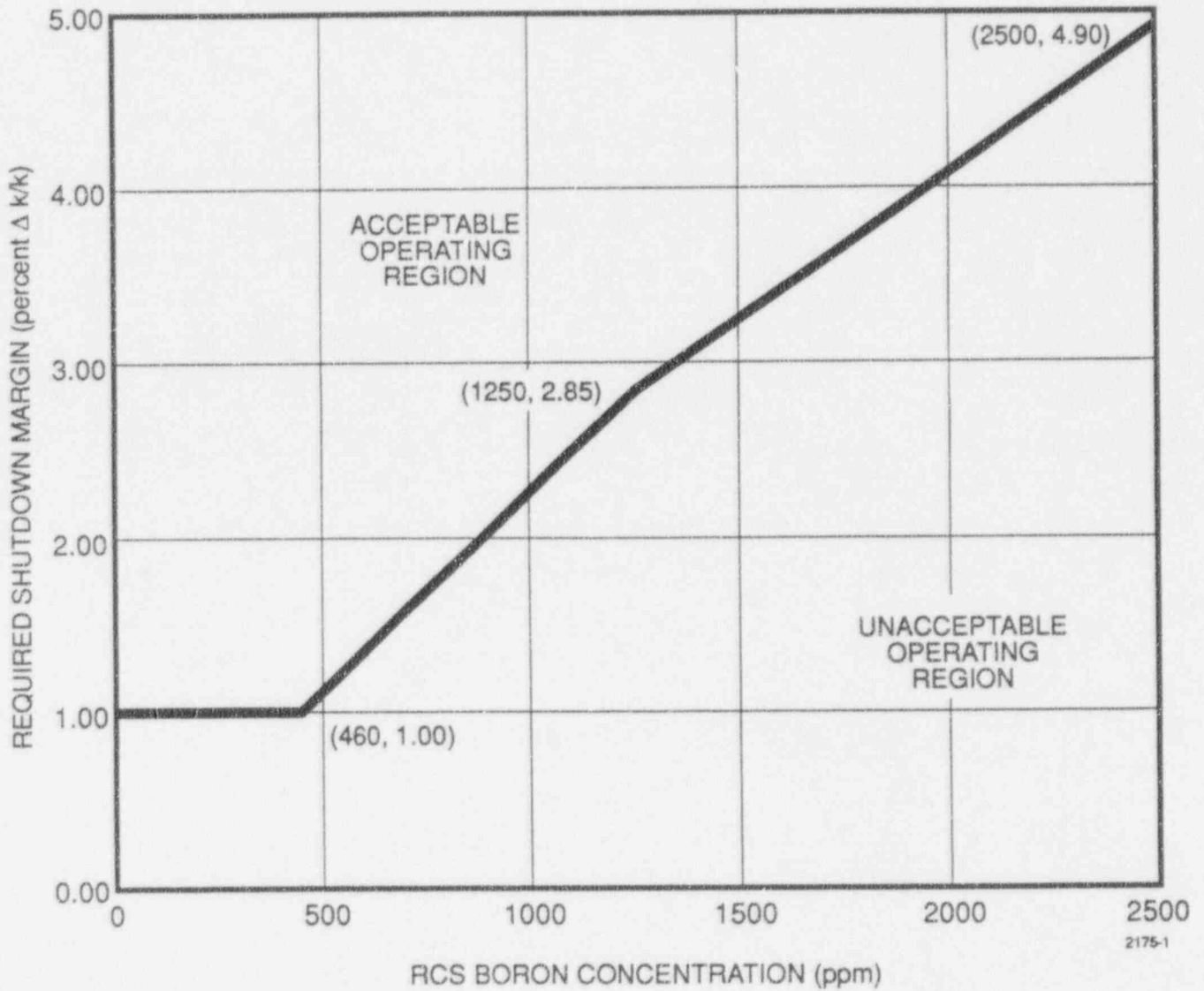
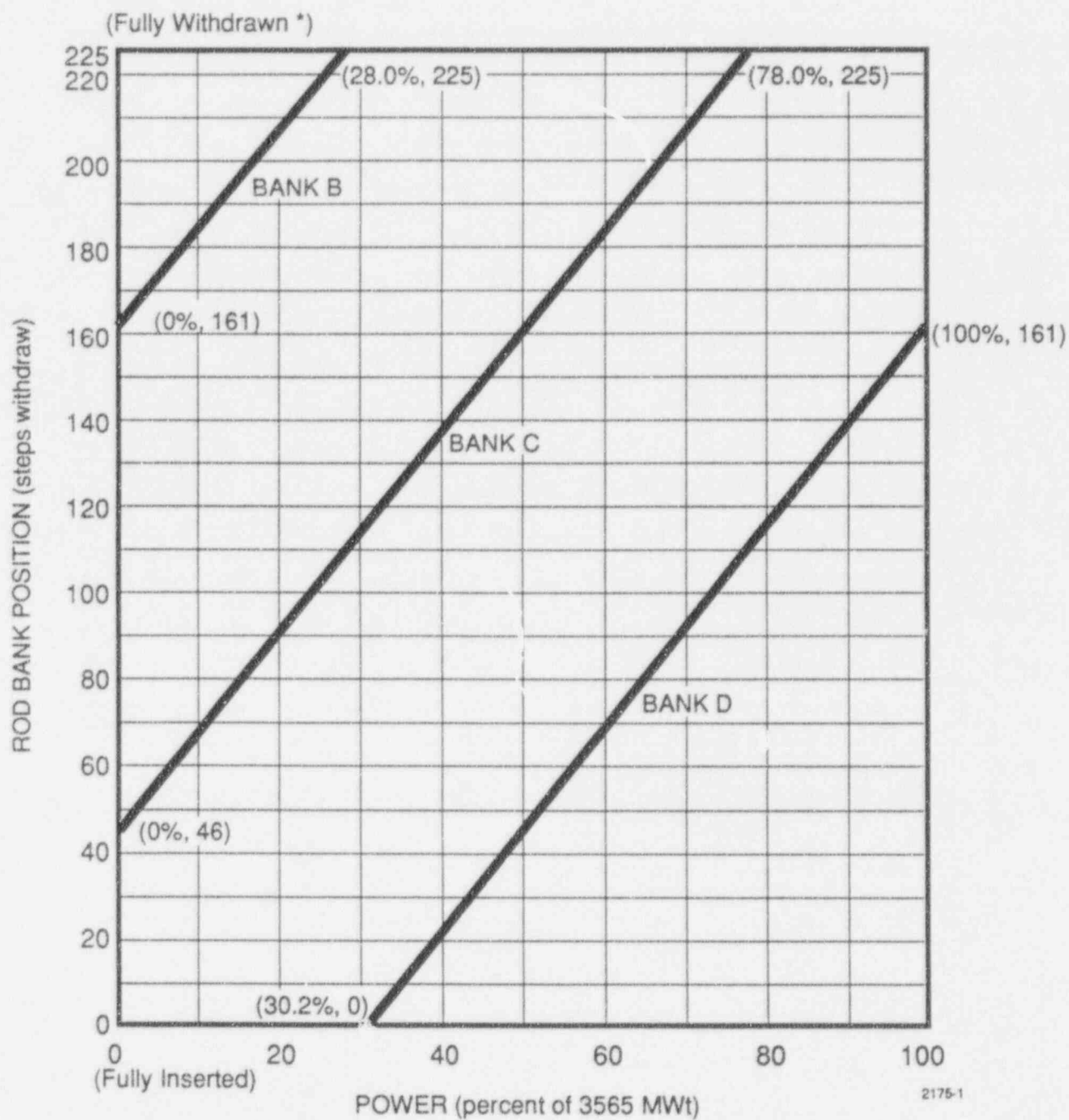


FIGURE 2

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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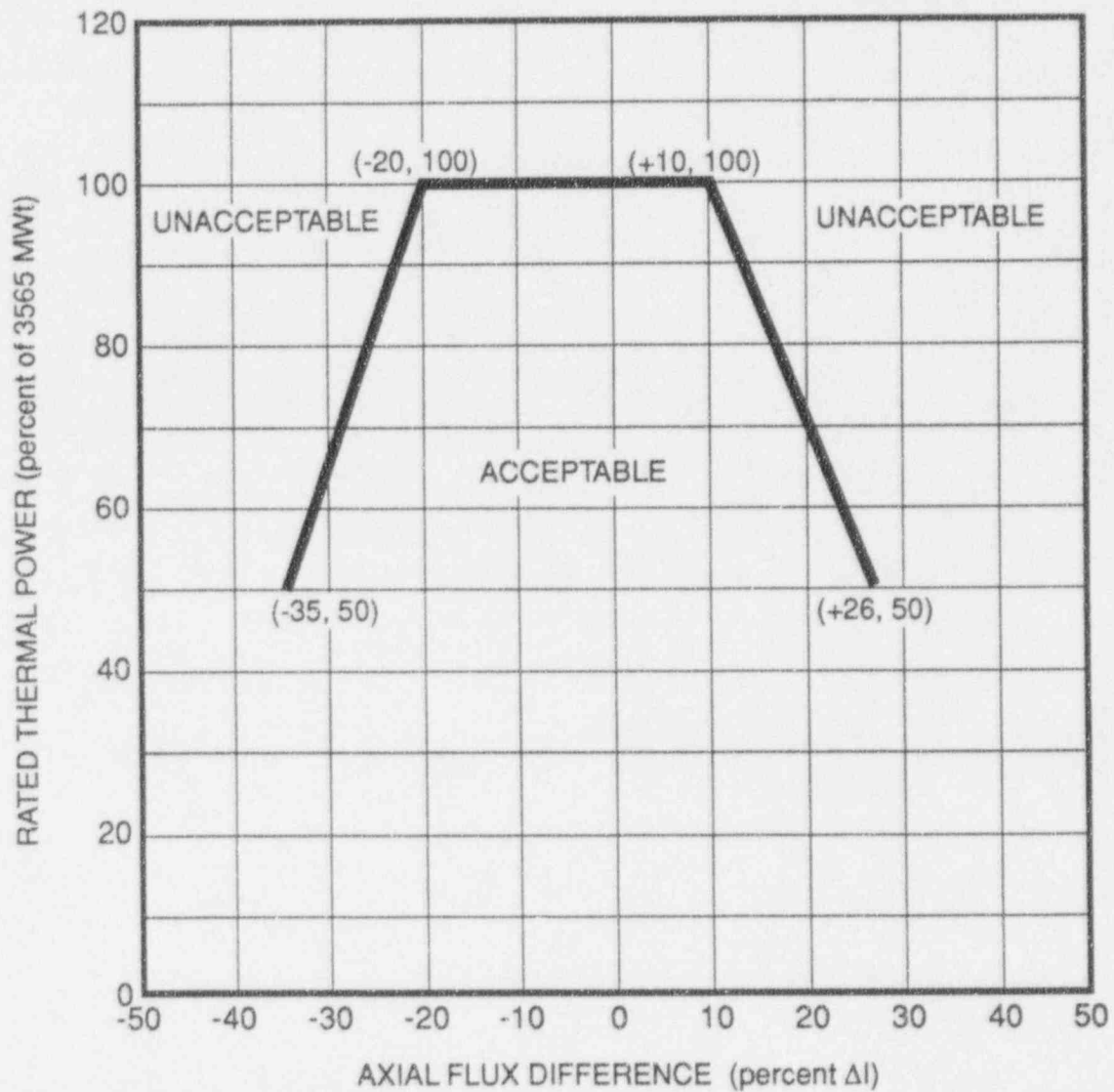


FIGURE 4

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

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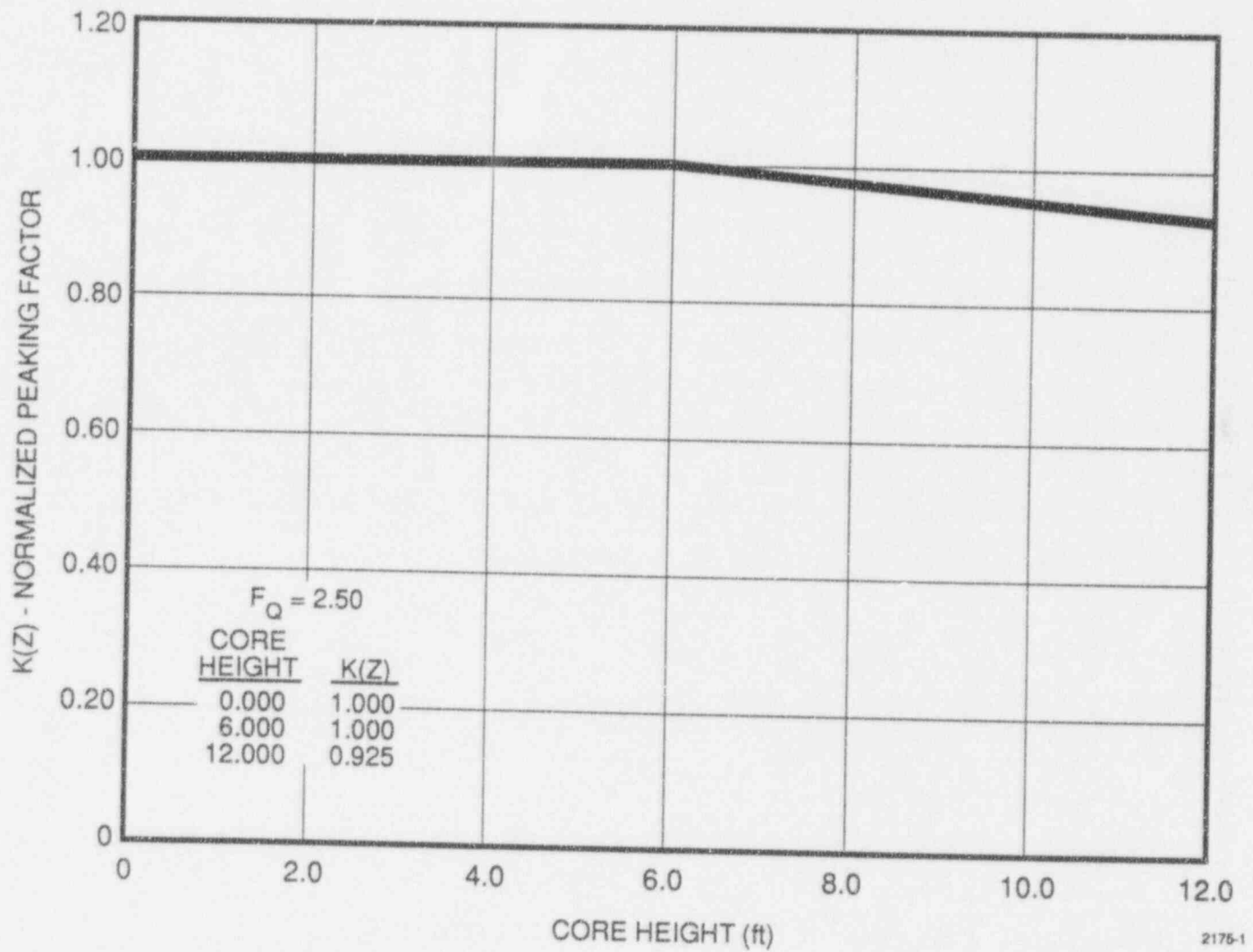


FIGURE 5

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

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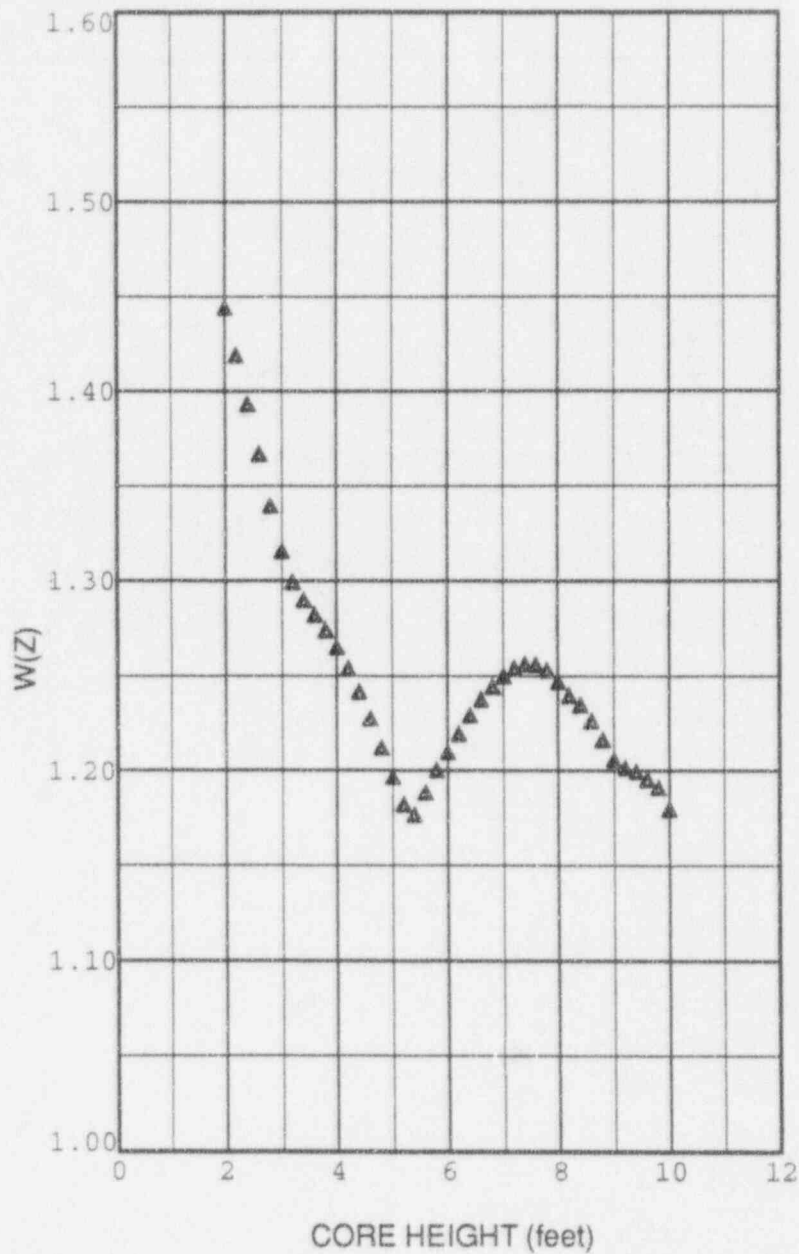


FIGURE 6  
RAOC W(Z) AT 150 MWD/MTU

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	1.1795
12	9.80	1.1909
13	9.60	1.1953
14	9.40	1.1991
15	9.20	1.2011
16	9.00	1.2054
17	8.80	1.2159
18	8.60	1.2258
19	8.40	1.2343
20	8.20	1.2392
21	8.00	1.2468
22	7.80	1.2527
23	7.60	1.2555
24	7.40	1.2559
25	7.20	1.2539
26	7.00	1.2497
27	6.80	1.2441
28	6.60	1.2371
29	6.40	1.2288
30	6.20	1.2191
31	6.00	1.2094
32	5.80	1.2000
33	5.60	1.1882
34	5.40	1.1762
35	5.20	1.1818
36	5.00	1.1965
37	4.80	1.2118
38	4.60	1.2272
39	4.40	1.2412
40	4.20	1.2536
41	4.00	1.2646
42	3.80	1.2738
43	3.60	1.2818
44	3.40	1.2895
45	3.20	1.2989
46	3.00	1.3152
47	2.80	1.3393
48	2.60	1.3669
49	2.40	1.3932
50	2.20	1.4187
51	2.00	1.4437
* 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

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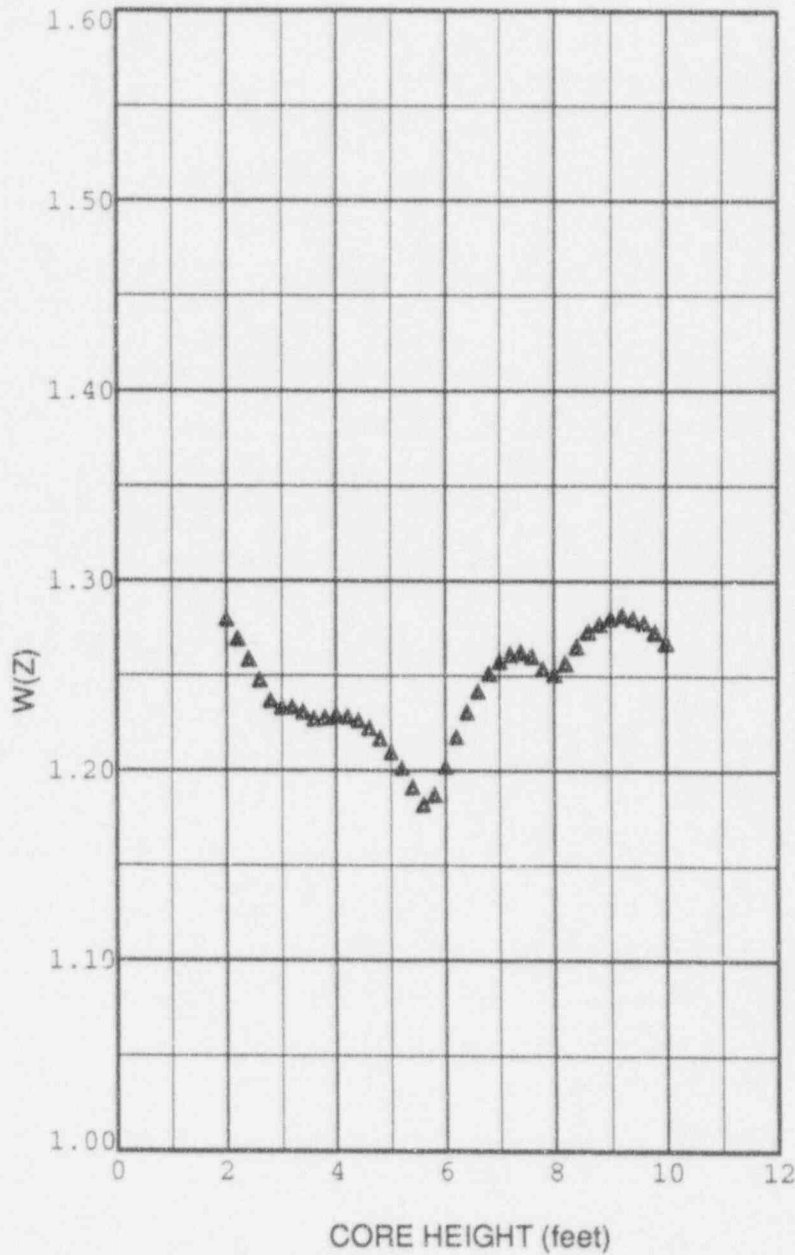


FIGURE 7  
RAOC W(Z) AT 9000 MWD/MTU

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	1.2673
12	9.80	1.2727
13	9.60	1.2778
14	9.40	1.2800
15	9.20	1.2820
16	9.00	1.2803
17	8.80	1.2770
18	8.60	1.2732
19	8.40	1.2654
20	8.20	1.2564
21	8.00	1.2507
22	7.80	1.2536
23	7.60	1.2602
24	7.40	1.2623
25	7.20	1.2613
26	7.00	1.2575
27	6.80	1.2509
28	6.60	1.2417
29	6.40	1.2304
30	6.20	1.2173
31	6.00	1.2017
32	5.80	1.1869
33	5.60	1.1817
34	5.40	1.1910
35	5.20	1.2010
36	5.00	1.2094
37	4.80	1.2165
38	4.60	1.2219
39	4.40	1.2258
40	4.20	1.2280
41	4.00	1.2287
42	3.80	1.2274
43	3.60	1.2269
44	3.40	1.2306
45	3.20	1.2331
46	3.00	1.2327
47	2.80	1.2365
48	2.60	1.2475
49	2.40	1.2585
50	2.20	1.2692
51	2.00	1.2795
* 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



# COLR FOR VEGP UNIT 1 CYCLE 6

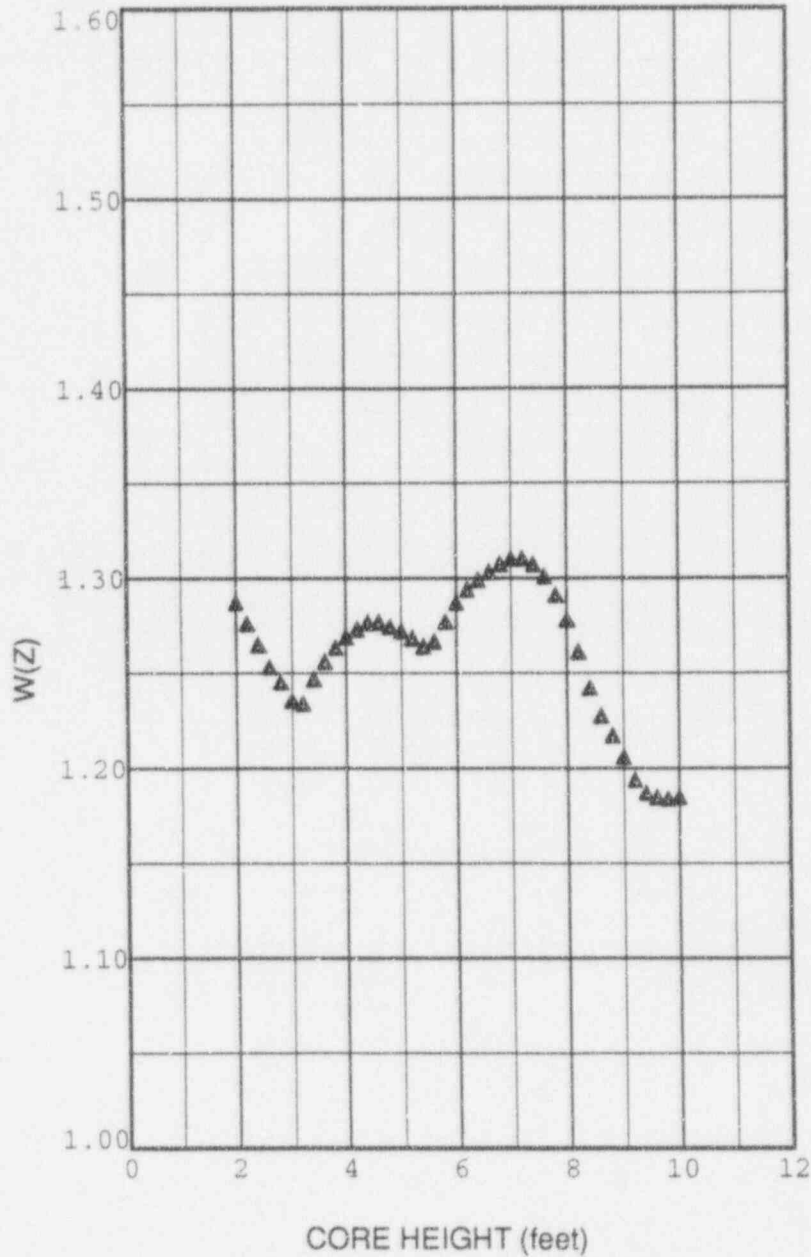


FIGURE 8  
RAOC W(Z) AT 17000 MWD/MTU

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	1.1845
12	9.80	1.1837
13	9.60	1.1844
14	9.40	1.1866
15	9.20	1.1938
16	9.00	1.2057
17	8.80	1.2169
18	8.60	1.2272
19	8.40	1.2419
20	8.20	1.2609
21	8.00	1.2777
22	7.80	1.2906
23	7.60	1.3003
24	7.40	1.3067
25	7.20	1.3098
26	7.00	1.3099
27	6.80	1.3070
28	6.60	1.3028
29	6.40	1.2988
30	6.20	1.2937
31	6.00	1.2868
32	5.80	1.2767
33	5.60	1.2664
34	5.40	1.2636
35	5.20	1.2581
36	5.00	1.2717
37	4.80	1.2740
38	4.60	1.2765
39	4.40	1.2761
40	4.20	1.2729
41	4.00	1.2687
42	3.80	1.2631
43	3.60	1.2558
44	3.40	1.2465
45	3.20	1.2337
46	3.00	1.2352
47	2.80	1.2451
48	2.60	1.2529
49	2.40	1.2645
50	2.20	1.2758
51	2.00	1.2867
* 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

## COLR for VEGP UNIT 1 CYCLE 6

TABLE 1

 $F_0^c(Z)$  PENALTY FACTOR

Cycle Burnup (MWD/MTU)	$F_0^c(Z)$ Penalty Factor
0	1.0357
150	1.0357
362	1.0340
574	1.0353
786	1.0342
998	1.0311
1210	1.0280
1422	1.0226
1634	1.0200

## Notes:

1. The Penalty Factor, to be applied to  $F_0^c(Z)$  in accordance with surveillance requirement 4.2.2.2.f, is the maximum factor by which  $F_0^c(Z)$  is expected to increase over a 39 EFPD interval (surveillance interval of 31 EFPD plus the maximum allowable extension not to exceed 25% of the surveillance interval per Technical Specification 4.0.2) starting from the burnup at which the  $F_0^c(Z)$  was determined.
2. Linear interpolation is adequate for intermediate cycle burnups.
3. For all cycle burnups outside the range of the table, a penalty factor of 1.0200 shall be used.