

VOGTLE ELECTRIC GENERATING PLANT (VEGP) UNIT 1 CYCLE 6

CORE OPERATING LIMITS REPORT

OCTOBER 1995

REVISION 1

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 - $F_Q(Z)$ |
| 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2.4.1 The shutdown rods shall be withdrawn to a position greater than or equal to 225 steps.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.

COLR for VEGP UNIT 1 CYCLE 6

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.

COLR for VEGP UNIT 1 CYCLE 6

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

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

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

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

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

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

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

COLR FOR VEGP UNIT 1 CYCLE 6

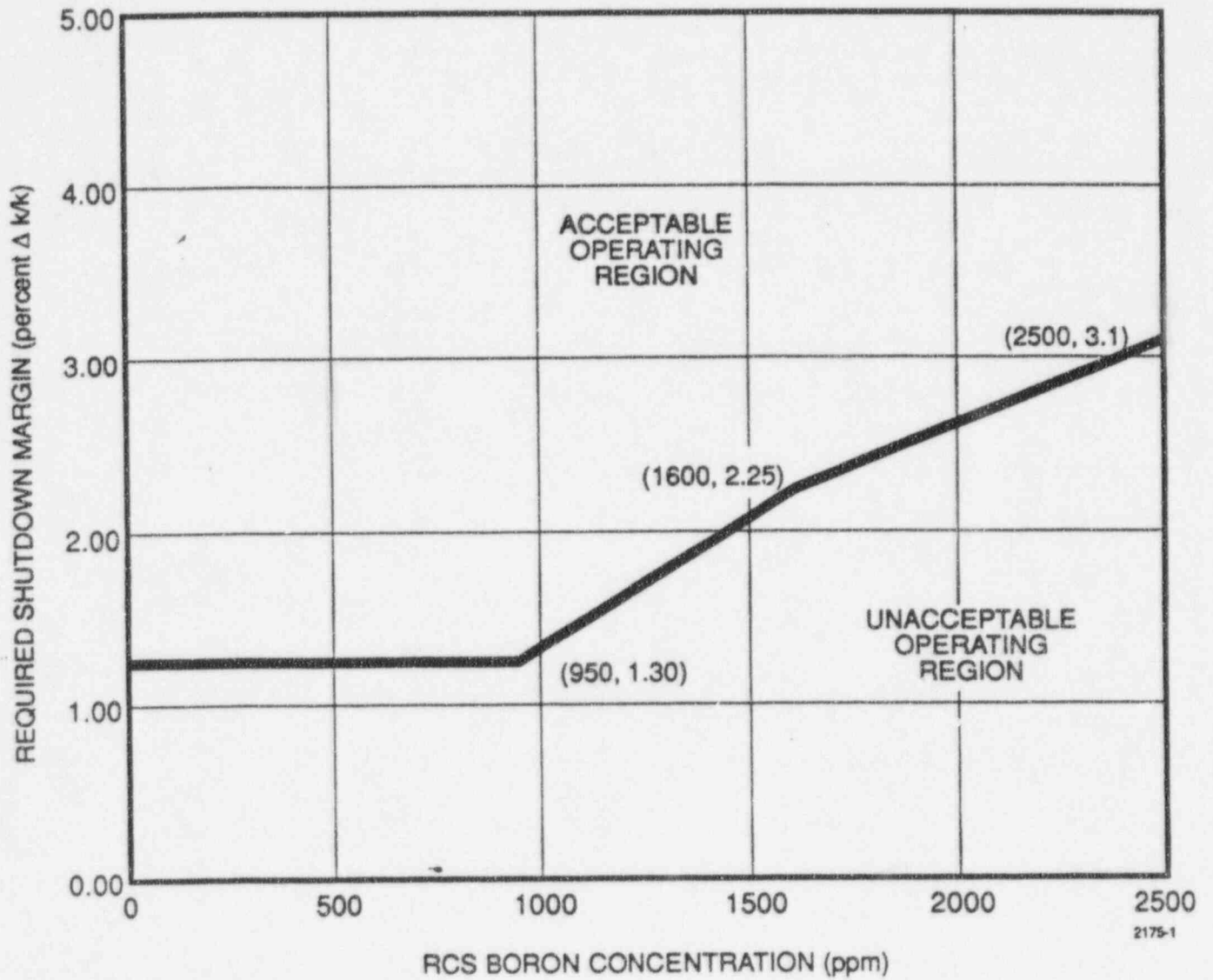


FIGURE 1

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

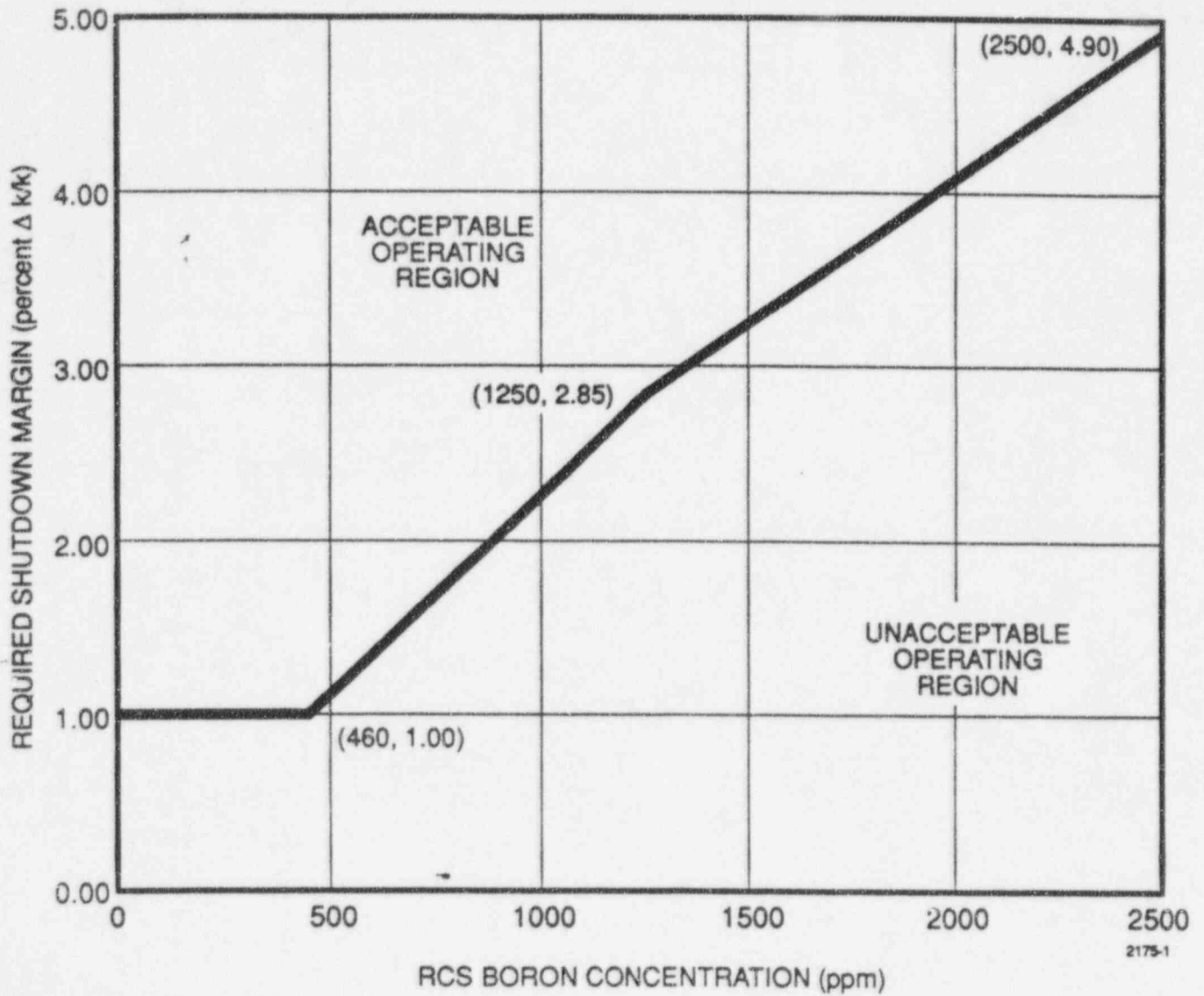
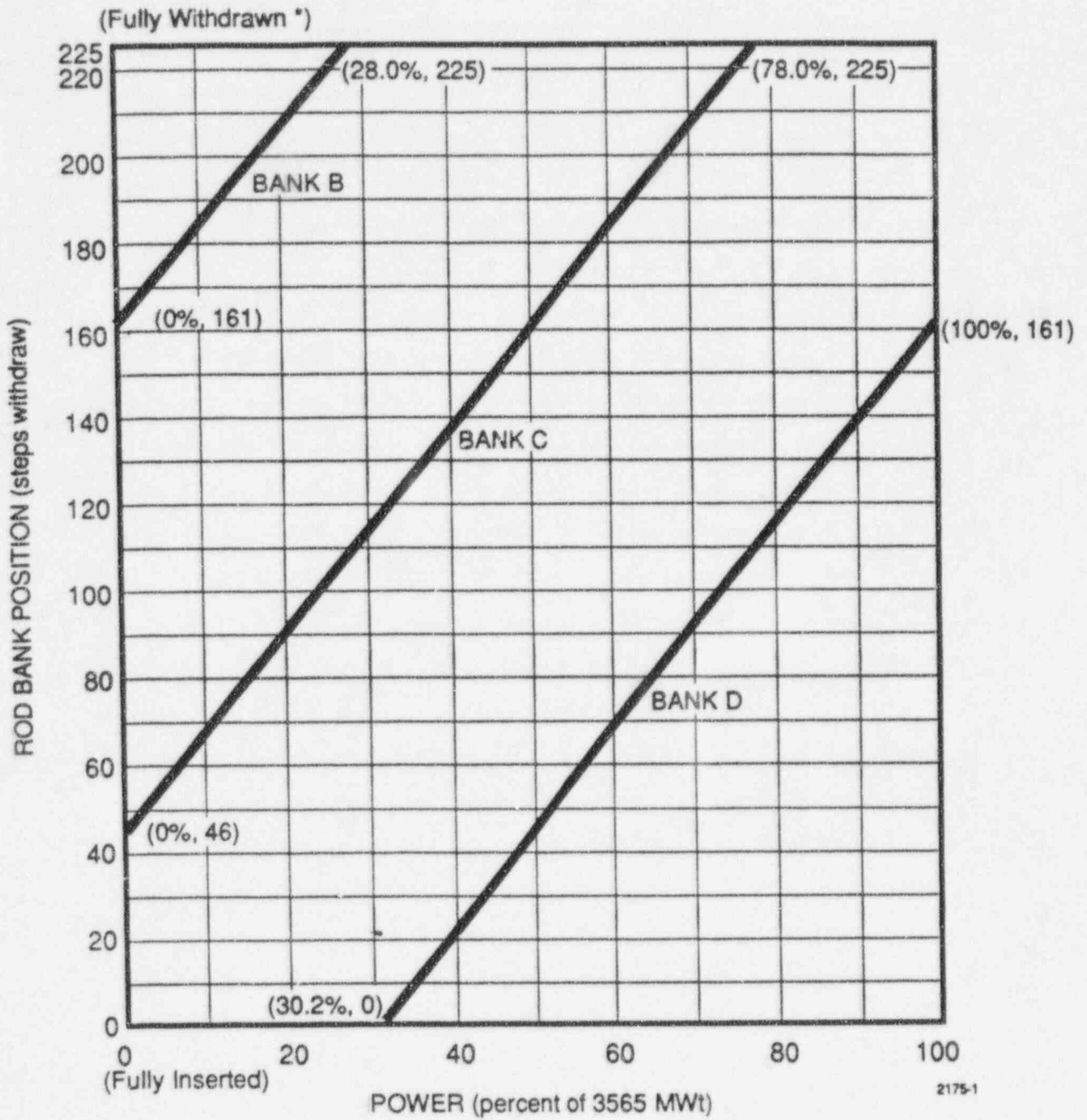


FIGURE 2

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

COLR FOR VEGP UNIT 1 CYCLE 6



* Fully withdrawn shall be the condition where control rods are at a position within the interval ≥ 225 and ≤ 231 steps withdrawn.

FIGURE 3
ROD BANK INSERTION LIMITS VERSUS THERMAL POWER

COLR FOR VEGP UNIT 1 CYCLE 6

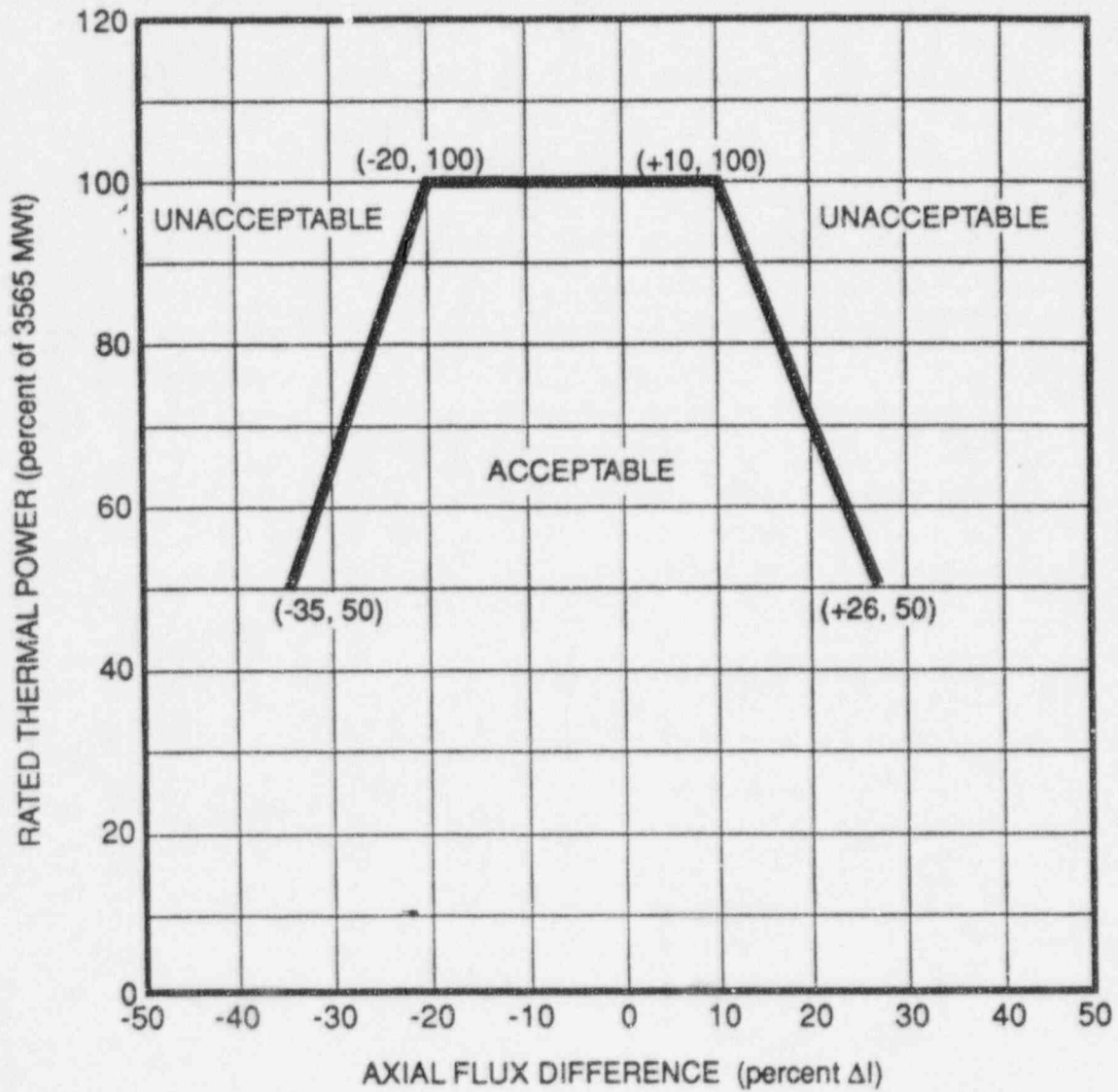


FIGURE 4

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

COLR FOR VEGP UNIT 1 CYCLE 6

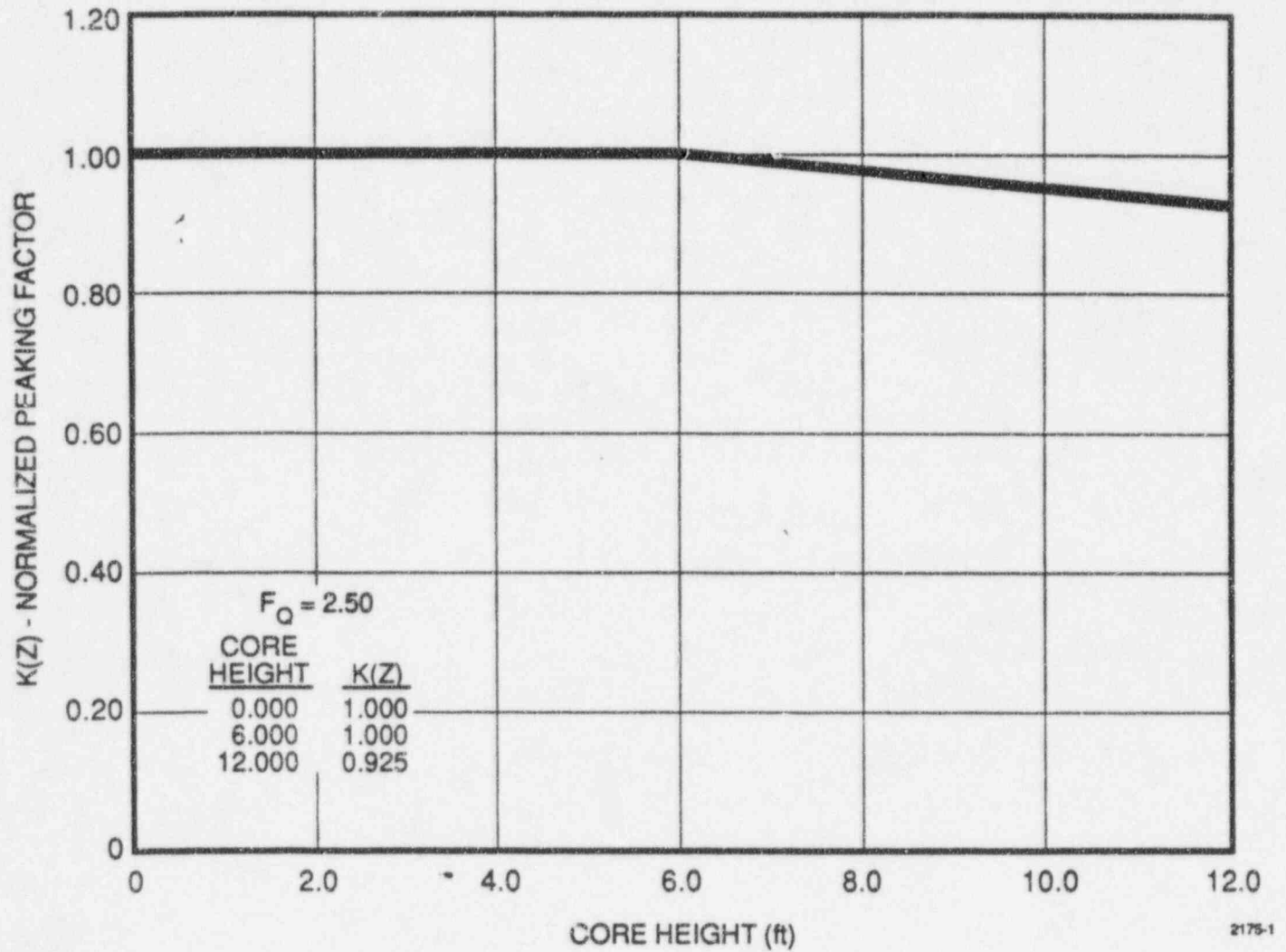


FIGURE 5

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

COLR FOR VEGP UNIT 1 CYCLE 6

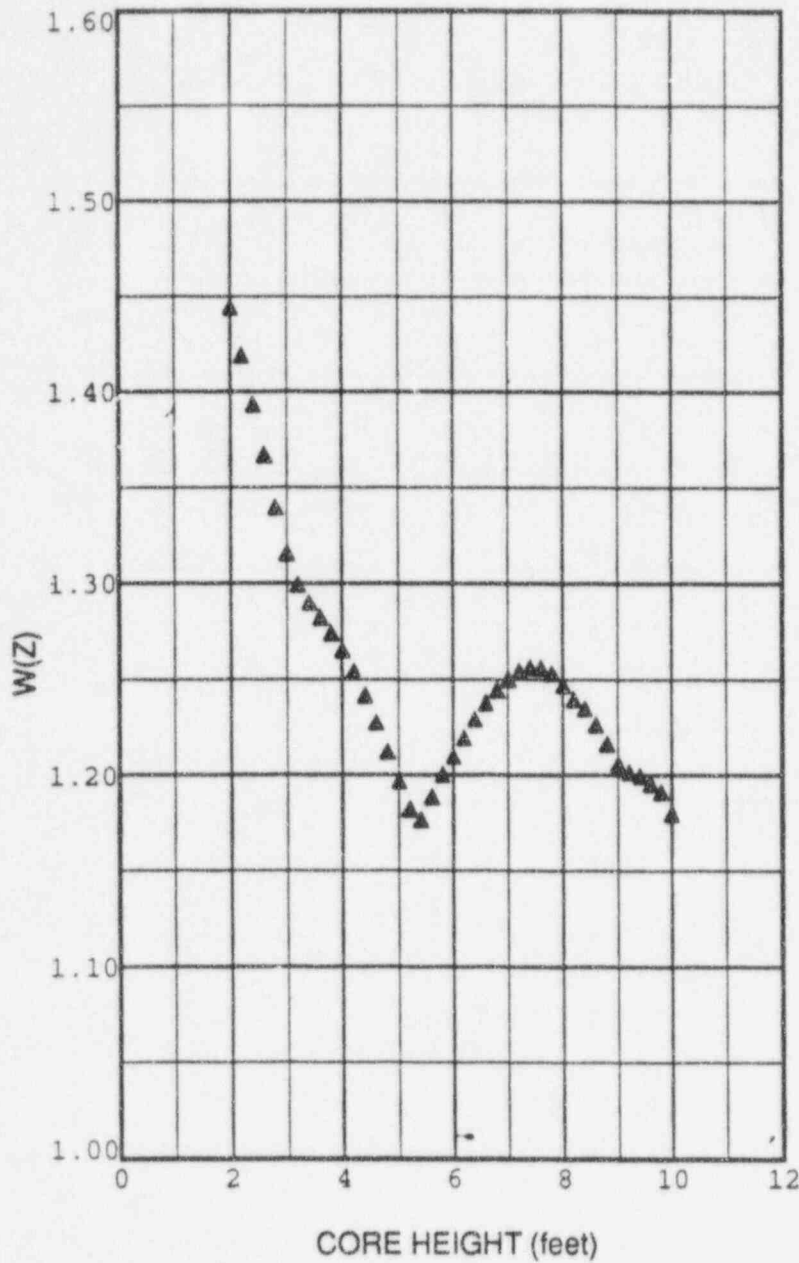


FIGURE 6
RAOC W(Z) AT 150 MWD/MTU

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	1.2432
*	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

COLR FOR VEGP UNIT 1 CYCLE 6

Axial Point	Elev. (Ft.)	SET (1)		SET (2)	
		14745	17000	14745	17000
		AO (%)	-1.90	-1.94	-5.2
* 1	12.0	1.0000	1.0000	1.0000	1.0000
* 2	11.8	1.0000	1.0000	1.0000	1.0000
* 3	11.6	1.0000	1.0000	1.0000	1.0000
* 4	11.4	1.0000	1.0000	1.0000	1.0000
* 5	11.2	1.0000	1.0000	1.0000	1.0000
* 6	11.0	1.0000	1.0000	1.0000	1.0000
* 7	10.8	1.0000	1.0000	1.0000	1.0000
* 8	10.6	1.0000	1.0000	1.0000	1.0000
* 9	10.4	1.0000	1.0000	1.0000	1.0000
* 10	10.2	1.0000	1.0000	1.0000	1.0000
11	10.0	1.2234	1.1845	1.3461	1.3159
12	9.8	1.2244	1.1837	1.3419	1.3092
13	9.6	1.2269	1.1844	1.3284	1.2925
14	9.4	1.2289	1.1866	1.3141	1.2771
15	9.2	1.2342	1.1938	1.3140	1.2786
16	9.0	1.2404	1.2057	1.3163	1.2889
17	8.8	1.2445	1.2169	1.3124	1.2893
18	8.6	1.2487	1.2272	1.2959	1.2780
19	8.4	1.2535	1.2419	1.2948	1.2866
20	8.2	1.2607	1.2609	1.3018	1.3059
21	8.0	1.2678	1.2777	1.3010	1.3142
22	7.8	1.2767	1.2906	1.2915	1.3069
23	7.6	1.2856	1.3003	1.2922	1.3076
24	7.4	1.2905	1.3067	1.2911	1.3074
25	7.2	1.2921	1.3098	1.2862	1.3038
26	7.0	1.2908	1.3099	1.2775	1.2964
27	6.8	1.2864	1.3070	1.2685	1.2888
28	6.6	1.2801	1.3028	1.2684	1.2909
29	6.4	1.2731	1.2988	1.2586	1.2840
30	6.2	1.2647	1.2937	1.2431	1.2716
31	6.0	1.2532	1.2868	1.2291	1.2620
32	5.8	1.2416	1.2767	1.2152	1.2496
33	5.6	1.2338	1.2664	1.2042	1.2361
34	5.4	1.2374	1.2636	1.2041	1.2296
35	5.2	1.2444	1.2681	1.2074	1.2304
36	5.0	1.2493	1.2717	1.2093	1.2310
37	4.8	1.2527	1.2740	1.2111	1.2317
38	4.6	1.2554	1.2765	1.2132	1.2335
39	4.4	1.2557	1.2761	1.2126	1.2323
40	4.2	1.2537	1.2729	1.2125	1.2310
41	4.0	1.2505	1.2687	1.2131	1.2308
42	3.8	1.2456	1.2631	1.2107	1.2277
43	3.6	1.2401	1.2558	1.2028	1.2180
44	3.4	1.2354	1.2465	1.1917	1.2024
45	3.2	1.2278	1.2337	1.1847	1.1904
46	3.0	1.2271	1.2352	1.1837	1.1915
47	2.8	1.2329	1.2451	1.1891	1.2009
48	2.6	1.2405	1.2529	1.1952	1.2071
49	2.4	1.2505	1.2645	1.2129	1.2264
50	2.2	1.2603	1.2758	1.2255	1.2406
51	2.0	1.2697	1.2867	1.2326	1.2491
* 52	1.8	1.0000	1.0000	1.0000	1.0000
* 53	1.6	1.0000	1.0000	1.0000	1.0000
* 54	1.4	1.0000	1.0000	1.0000	1.0000
* 55	1.2	1.0000	1.0000	1.0000	1.0000
* 56	1.0	1.0000	1.0000	1.0000	1.0000
* 57	0.8	1.0000	1.0000	1.0000	1.0000
* 58	0.6	1.0000	1.0000	1.0000	1.0000
* 59	0.4	1.0000	1.0000	1.0000	1.0000
* 60	0.2	1.0000	1.0000	1.0000	1.0000
* 61	0.0	1.0000	1.0000	1.0000	1.0000

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

* Top and Bottom 15% Excluded per Technical Specification 4.2.2.2

FIGURE 7

RAOC W(Z) AT 14745 MWD/MTU AND 17000 MWD/MTU, SETS 1 AND 2

COLR FOR VEGP UNIT 1 CYCLE 6

BURNUP		SET (3)		SET (4)	
MWD/MTU):		14745	17000	14745	17000
AO (%):		-8.5	-8.54	-11.5	-11.54
Axial Point	Elev. (Ft.)				
* 1	12.0	1.0000	1.0000	1.0000	1.0000
* 2	11.8	1.0000	1.0000	1.0000	1.0000
* 3	11.6	1.0000	1.0000	1.0000	1.0000
* 4	11.4	1.0000	1.0000	1.0000	1.0000
* 5	11.2	1.0000	1.0000	1.0000	1.0000
* 6	11.0	1.0000	1.0000	1.0000	1.0000
* 7	10.8	1.0000	1.0000	1.0000	1.0000
* 8	10.6	1.0000	1.0000	1.0000	1.0000
* 9	10.4	1.0000	1.0000	1.0000	1.0000
* 10	10.2	1.0000	1.0000	1.0000	1.0000
11	10.0	1.4687	1.4472	1.5802	1.5667
12	9.8	1.4593	1.4348	1.5661	1.5489
13	9.6	1.4300	1.4006	1.5223	1.4989
14	9.4	1.3992	1.3675	1.4766	1.4498
15	9.2	1.3937	1.3634	1.4662	1.4405
16	9.0	1.3962	1.3722	1.4671	1.4478
17	8.8	1.3800	1.3618	1.4414	1.4276
18	8.6	1.3431	1.3288	1.3861	1.3749
19	8.4	1.3361	1.3314	1.3737	1.3721
20	8.2	1.3430	1.3509	1.3804	1.3917
21	8.0	1.3341	1.3507	1.3643	1.3839
22	7.8	1.3063	1.3232	1.3197	1.3380
23	7.6	1.2989	1.3149	1.3049	1.3216
24	7.4	1.2917	1.3080	1.2922	1.3086
25	7.2	1.2803	1.2978	1.2749	1.2924
26	7.0	1.2642	1.2829	1.2521	1.2706
27	6.8	1.2506	1.2706	1.2343	1.2540
28	6.6	1.2567	1.2790	1.2461	1.2682
29	6.4	1.2441	1.2692	1.2310	1.2558
30	6.2	1.2214	1.2494	1.2017	1.2293
31	6.0	1.2049	1.2372	1.1830	1.2147
32	5.8	1.1889	1.2225	1.1649	1.1978
33	5.6	1.1747	1.2057	1.1478	1.1782
34	5.4	1.1708	1.1956	1.1405	1.1646
35	5.2	1.1704	1.1926	1.1367	1.1583
36	5.0	1.1694	1.1903	1.1330	1.1533
37	4.8	1.1695	1.1894	1.1317	1.1510
38	4.6	1.1709	1.1906	1.1325	1.1515
39	4.4	1.1695	1.1885	1.1302	1.1486
40	4.2	1.1712	1.1891	1.1337	1.1511
41	4.0	1.1757	1.1928	1.1417	1.1584
42	3.8	1.1759	1.1924	1.1442	1.1602
43	3.6	1.1654	1.1802	1.1315	1.1458
44	3.4	1.1480	1.1583	1.1082	1.1182
45	3.2	1.1415	1.1470	1.1023	1.1076
46	3.0	1.1403	1.1478	1.1008	1.1081
47	2.8	1.1453	1.1566	1.1055	1.1164
48	2.6	1.1498	1.1613	1.1086	1.1197
49	2.4	1.1752	1.1884	1.1410	1.1538
50	2.2	1.1907	1.2054	1.1591	1.1733
51	2.0	1.1955	1.2115	1.1618	1.1773
* 52	1.8	1.0000	1.0000	1.0000	1.0000
* 53	1.6	1.0000	1.0000	1.0000	1.0000
* 54	1.4	1.0000	1.0000	1.0000	1.0000
* 55	1.2	1.0000	1.0000	1.0000	1.0000
* 56	1.0	1.0000	1.0000	1.0000	1.0000
* 57	0.8	1.0000	1.0000	1.0000	1.0000
* 58	0.6	1.0000	1.0000	1.0000	1.0000
* 59	0.4	1.0000	1.0000	1.0000	1.0000
* 60	0.2	1.0000	1.0000	1.0000	1.0000
* 61	0.0	1.0000	1.0000	1.0000	1.0000

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

* Top and Bottom 15% Excluded per Technical Specification 4.2.2.2

FIGURE 8

RAOC W(Z) AT 14745 MWD/MTU AND 17000 MWD/MTU, SETS 3 AND 4

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.