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NL-10-0662

U. S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D. C. 20555-0001

Vogtle Electric Generating Plant-Unit 2  
Cycle 15 Version 2 Core Operating Limits Report

Ladies and Gentlemen:

In accordance with Technical Specification 5.6.5.d, Southern Nuclear Operating Company submits the enclosed Core Operating Limits Report (COLR) for Vogtle Electric Generating Plant (VEGP) Unit 2 Cycle 15 Version 2. Two fuel assemblies were removed from the reload design based on inspection results. This version of the COLR was generated to reflect the redesigned core.

This letter contains no NRC commitments. If there are any questions, please contact Jack Stringfellow at (205)992-7037.

Respectfully submitted,

A handwritten signature in black ink that reads "Mark J. Ajluni". The signature is written in a cursive, flowing style.

M. J. Ajluni  
Manager - Nuclear Licensing

MJA /PAH/lac

Enclosure: Core Operating Limits Report VEGP Unit 2 Cycle 15 Version 2

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State of Georgia  
Mr. C. Clark, Commissioner-Department of Natural Resources

**Vogtle Electric Generating Plant – Unit 2  
Cycle 15 Core Operating Limits Report**

**Enclosure**

**Core Operating Limits Report VEGP Unit 2 Cycle 15, Version 2**

Vogtle Electric Generating Plant Unit 2

Core Operating Limits Report

Unit 2 Cycle 15  
Version 2

March 2010

Revision Insertion Instructions

<u>Item</u>	<u>Instructions</u>
Active COLR List	Replace.
Unit 2 Report and Title Page	Replace.

Vogtle Electric Generating Plant Unit 1 and Unit 2

Active Core Operating Limits Report List

March 2010

Unit 1 Cycle 16 Revision 1

October 2009

Unit 2 Cycle 15 Version 2

March 2010

VOGTLE ELECTRIC GENERATING PLANT (VEGP) UNIT 2 CYCLE 15

CORE OPERATING LIMITS REPORT

Version 2

March 2010

## 1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for VEGP Unit 2 Cycle 15 Redesign has been prepared in accordance with the requirements of Technical Specification 5.6.5.

The Technical Requirement affected by this report is listed below:

13.1.1 SHUTDOWN MARGIN - MODES 1 and 2

The Technical Specifications affected by this report are listed below:

3.1.1 SHUTDOWN MARGIN - MODES 3, 4 and 5  
3.1.3 Moderator Temperature Coefficient  
3.1.5 Shutdown Bank Insertion Limits  
3.1.6 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  
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 NRC-approved methodologies including those specified in Technical Specification 5.6.5.

### 2.1 SHUTDOWN MARGIN - MODES 1 and 2 (Technical Requirement 13.1.1)

2.1.1 The SHUTDOWN MARGIN shall be greater than or equal to 1.30 percent  $\Delta k/k$ .

### 2.2 SHUTDOWN MARGIN - MODES 3, 4 and 5 (Specification 3.1.1)

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 3.1.3)

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  $-5.50 \times 10^{-4} \Delta k/k/^{\circ}F$ .<sup>1</sup>

2.3.2 The MTC Surveillance limits are:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to  $-4.75 \times 10^{-4} \Delta k/k/^{\circ}F$ .<sup>1</sup>

The 60 ppm/ARO/RTP-MTC should be less negative than  $-5.35 \times 10^{-4} \Delta k/k/^{\circ}F$ .<sup>1</sup>

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

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<sup>1</sup> Applicable for full-power T-average of 584.4 to 587.4°F.



2.4 Shutdown Bank Insertion Limits (Specification 3.1.5)

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

2.5 Control Bank Insertion Limits (Specification 3.1.6)

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

2.6 Heat Flux Hot Channel Factor -  $F_Q(Z)$  (Specification 3.2.1)

$$2.6.1 \quad F_Q(Z) \leq \frac{F_Q^{RTP}}{P} \cdot K(Z) \quad \text{for } P > 0.5$$

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

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

$$2.6.2 \quad F_Q^{RTP} = 2.50$$

2.6.3  $K(Z)$  is provided in Figure 4.

$$2.6.4 \quad F_Q(Z) \leq \frac{F_Q^{RTP} \cdot K(Z)}{P \cdot W(Z)} \quad \text{for } P > 0.5$$

$$F_Q(Z) \leq \frac{F_Q^{RTP} \cdot K(Z)}{0.5 \cdot W(Z)} \quad \text{for } P \leq 0.5$$

2.6.5  $W(Z)$  values are provided in Table 2.

2.6.6 The  $F_Q(Z)$  penalty factors are provided in Table 1.

2.7 Nuclear Enthalpy Rise Hot Channel Factor -  $F_{\Delta H}^N$  (Specification 3.2.2)

$$2.7.1 \quad F_{\Delta H}^N \leq F_{\Delta H}^{RTP} \cdot (1 + PF_{\Delta H} \cdot (1 - P))$$

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

$$2.7.2 \quad F_{\Delta H}^{RTP} = 1.65$$

$$2.7.3 \quad PF_{\Delta H} = 0.3$$

2.8 Axial Flux Difference (Specification 3.2.3)

2.8.1 The Axial Flux Difference (AFD) Acceptable Operation Limits are provided in Figure 5.

2.9 Boron Concentration (Specification 3.9.1)

2.9.1 The boron concentration shall be greater than or equal to 1815 ppm.<sup>1</sup>

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<sup>1</sup>This concentration bounds the condition of  $k_{\text{eff}} \leq 0.95$  (all rods in less the most reactive rod) and subcriticality (all rods out) over the entire cycle. This concentration includes additional boron to address uncertainties and B<sup>10</sup> depletion.

**Table 1**  
 **$F_Q(Z)$  PENALTY FACTOR**

Cycle Burnup (MWD/MTU)	$F_Q(Z)$ Penalty Factor
30	1.028
150	1.028
367	1.029
584	1.029
801	1.028
1018	1.025
1235	1.021
1453	1.020

**Notes:**

1. The Penalty Factor, to be applied to  $F_Q(Z)$  in accordance with SR 3.2.1.2, is the maximum factor by which  $F_Q(Z)$  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 SR 3.0.2) starting from the burnup at which the  $F_Q(Z)$  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 1.020 shall be used.

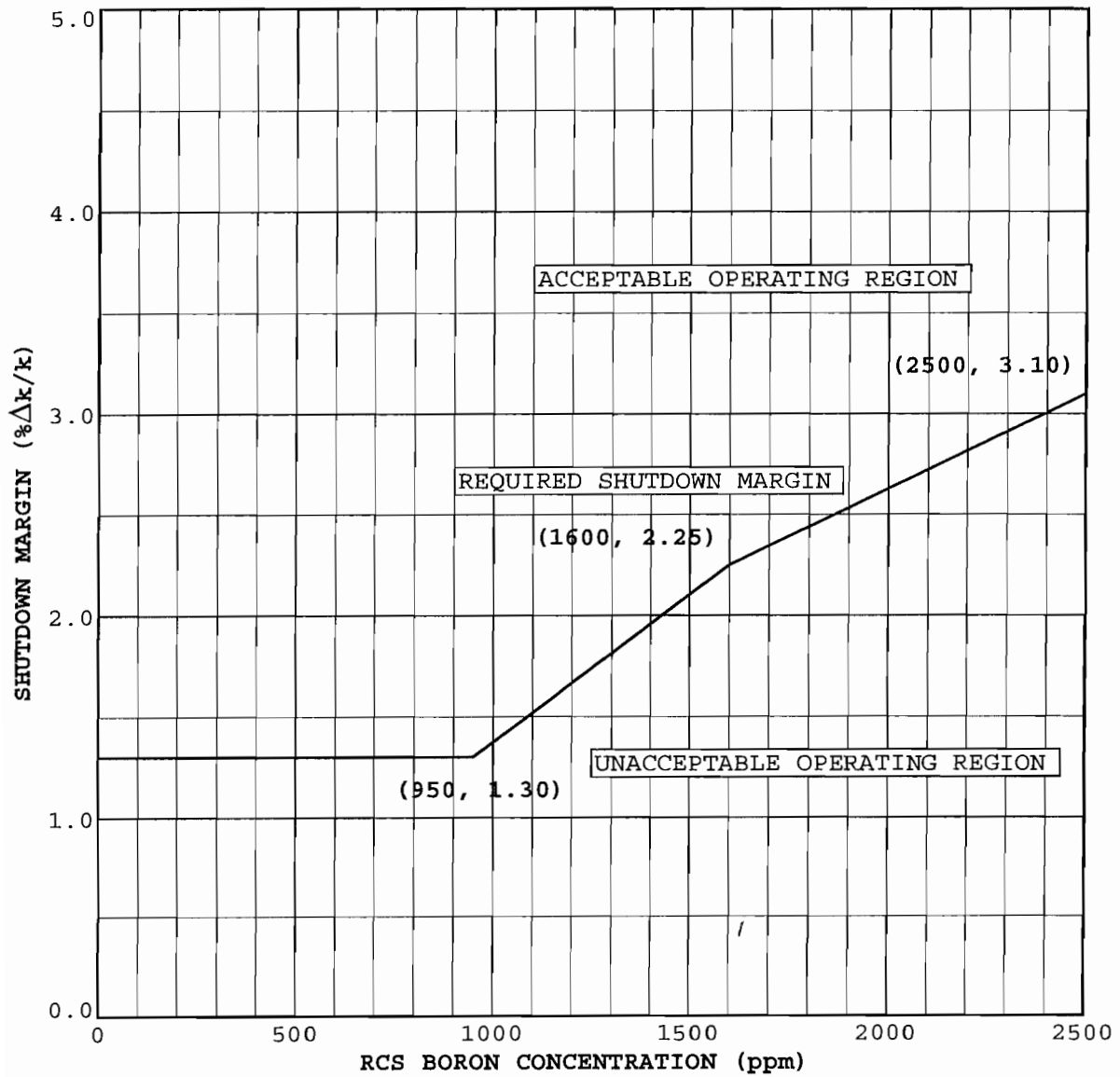
**Table 2**  
**RAOC W(Z)**

	Axial Point	Elevation (feet)	150 MWD/MTU	4000 MWD/MTU	12000 MWD/MTU	20000 MWD/MTU
*	1	12.00	1.0000	1.0000	1.0000	1.0000
*	2	11.80	1.0000	1.0000	1.0000	1.0000
*	3	11.60	1.0000	1.0000	1.0000	1.0000
*	4	11.40	1.0000	1.0000	1.0000	1.0000
*	5	11.20	1.0000	1.0000	1.0000	1.0000
	6	11.00	1.2758	1.4673	1.3282	1.2021
	7	10.80	1.2768	1.4520	1.3174	1.1880
	8	10.60	1.2755	1.4338	1.3052	1.1810
	9	10.40	1.2706	1.4105	1.2909	1.1787
	10	10.20	1.2597	1.3854	1.2744	1.1765
	11	10.00	1.2463	1.3577	1.2557	1.1781
	12	9.80	1.2389	1.3253	1.2436	1.1805
	13	9.60	1.2353	1.2998	1.2400	1.1815
	14	9.40	1.2296	1.2829	1.2373	1.1868
	15	9.20	1.2208	1.2622	1.2288	1.2011
	16	9.00	1.2133	1.2423	1.2204	1.2123
	17	8.80	1.2115	1.2291	1.2116	1.2235
	18	8.60	1.2143	1.2258	1.2098	1.2335
	19	8.40	1.2224	1.2259	1.2155	1.2426
	20	8.20	1.2271	1.2244	1.2181	1.2554
	21	8.00	1.2341	1.2254	1.2243	1.2647
	22	7.80	1.2393	1.2250	1.2292	1.2754
	23	7.60	1.2408	1.2212	1.2306	1.2860
	24	7.40	1.2398	1.2152	1.2297	1.2921
	25	7.20	1.2362	1.2071	1.2263	1.2950
	26	7.00	1.2303	1.1971	1.2207	1.2947
	27	6.80	1.2224	1.1853	1.2131	1.2914
	28	6.60	1.2131	1.1726	1.2035	1.2853
	29	6.40	1.2033	1.1605	1.1928	1.2766
	30	6.20	1.1929	1.1498	1.1821	1.2656
	31	6.00	1.1805	1.1407	1.1696	1.2522
	32	5.80	1.1701	1.1332	1.1586	1.2413
	33	5.60	1.1605	1.1278	1.1569	1.2356
	34	5.40	1.1540	1.1272	1.1646	1.2348
	35	5.20	1.1598	1.1338	1.1699	1.2380
	36	5.00	1.1659	1.1403	1.1739	1.2400
	37	4.80	1.1700	1.1456	1.1770	1.2397
	38	4.60	1.1737	1.1503	1.1787	1.2374
	39	4.40	1.1762	1.1542	1.1792	1.2329
	40	4.20	1.1776	1.1574	1.1785	1.2263
	41	4.00	1.1778	1.1592	1.1757	1.2177
	42	3.80	1.1771	1.1623	1.1756	1.2072
	43	3.60	1.1753	1.1670	1.1787	1.1955
	44	3.40	1.1732	1.1711	1.1804	1.1846
	45	3.20	1.1768	1.1752	1.1813	1.1764
	46	3.00	1.1861	1.1813	1.1808	1.1703
	47	2.80	1.1972	1.1969	1.1840	1.1728
	48	2.60	1.2106	1.2205	1.1950	1.1834
	49	2.40	1.2288	1.2425	1.2045	1.1932
	50	2.20	1.2466	1.2646	1.2141	1.2029
	51	2.00	1.2639	1.2866	1.2239	1.2127
	52	1.80	1.2810	1.3081	1.2336	1.2227
	53	1.60	1.2977	1.3289	1.2433	1.2330
	54	1.40	1.3139	1.3487	1.2529	1.2435
	55	1.20	1.3293	1.3673	1.2622	1.2541
	56	1.00	1.3434	1.3837	1.2707	1.2641
*	57	0.80	1.0000	1.0000	1.0000	1.0000
*	58	0.60	1.0000	1.0000	1.0000	1.0000
*	59	0.40	1.0000	1.0000	1.0000	1.0000
*	60	0.20	1.0000	1.0000	1.0000	1.0000
*	61	0.00	1.0000	1.0000	1.0000	1.0000

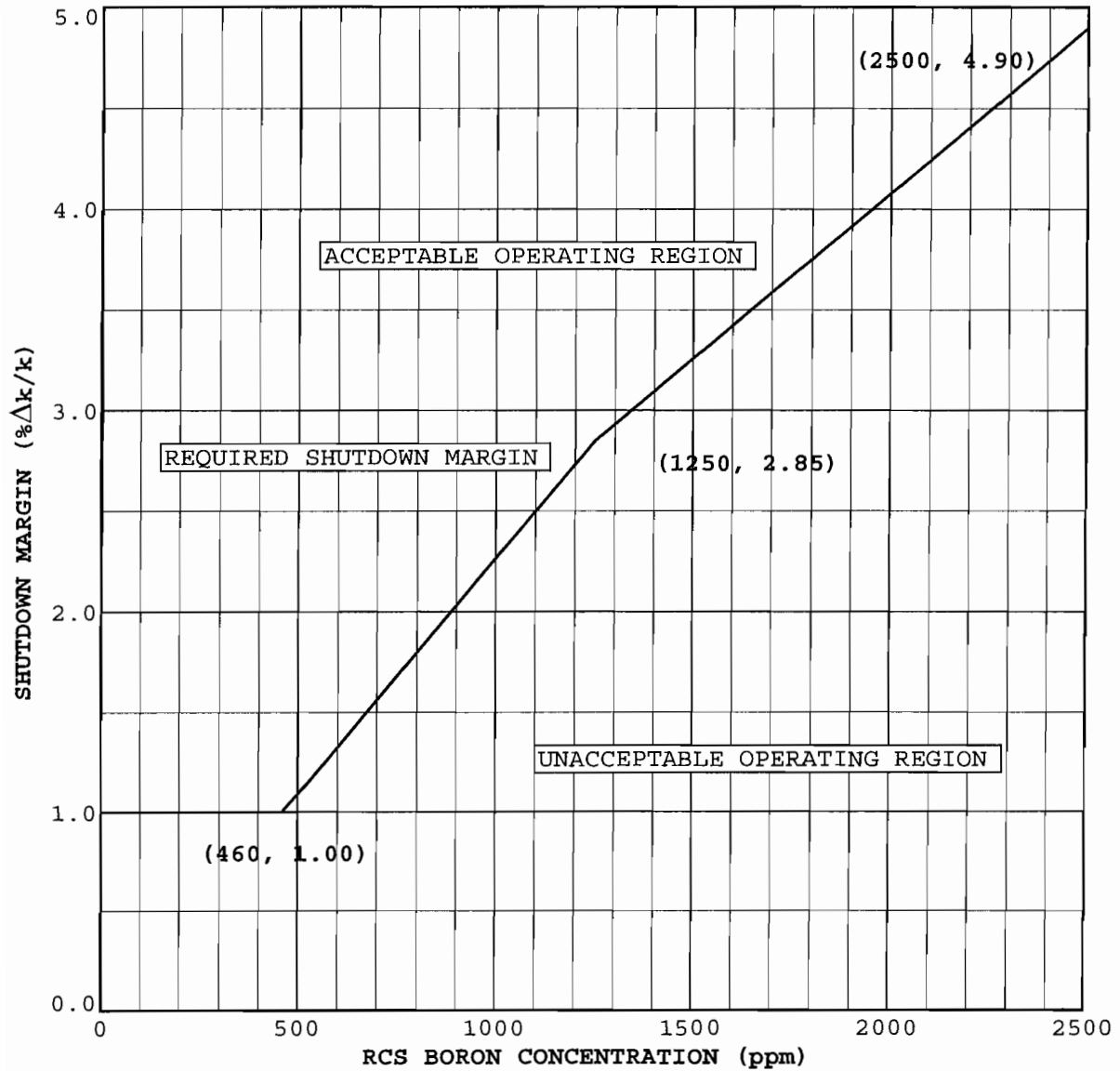
\* Top and Bottom 5 Points Excluded per Technical Specification B3.2.1.

These W(Z) values are consistent with Figure 5, and are valid over the HFP  $T_{avg}$  temperature range from 584.4 to 587.4°F.

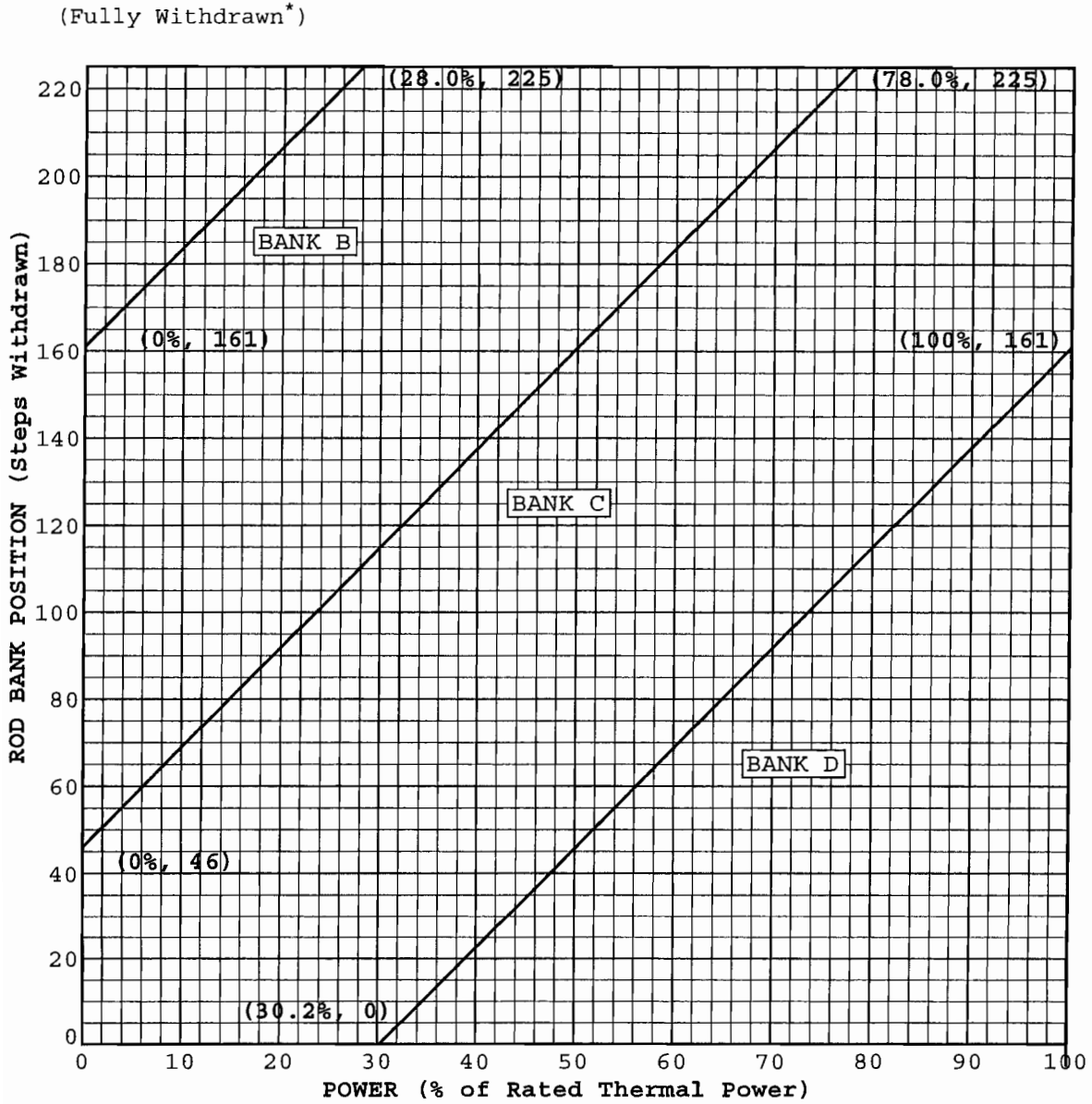
**FIGURE 1**  
**REQUIRED SHUTDOWN MARGIN FOR MODES 3 AND 4 (FOUR LOOPS FILLED AND VENTED AND AT LEAST ONE REACTOR COOLANT PUMP RUNNING)**



**FIGURE 2**  
**REQUIRED SHUTDOWN MARGIN FOR MODES 4 AND 5 (MODE 4 WHEN FIGURE 1 NOT APPLICABLE)**



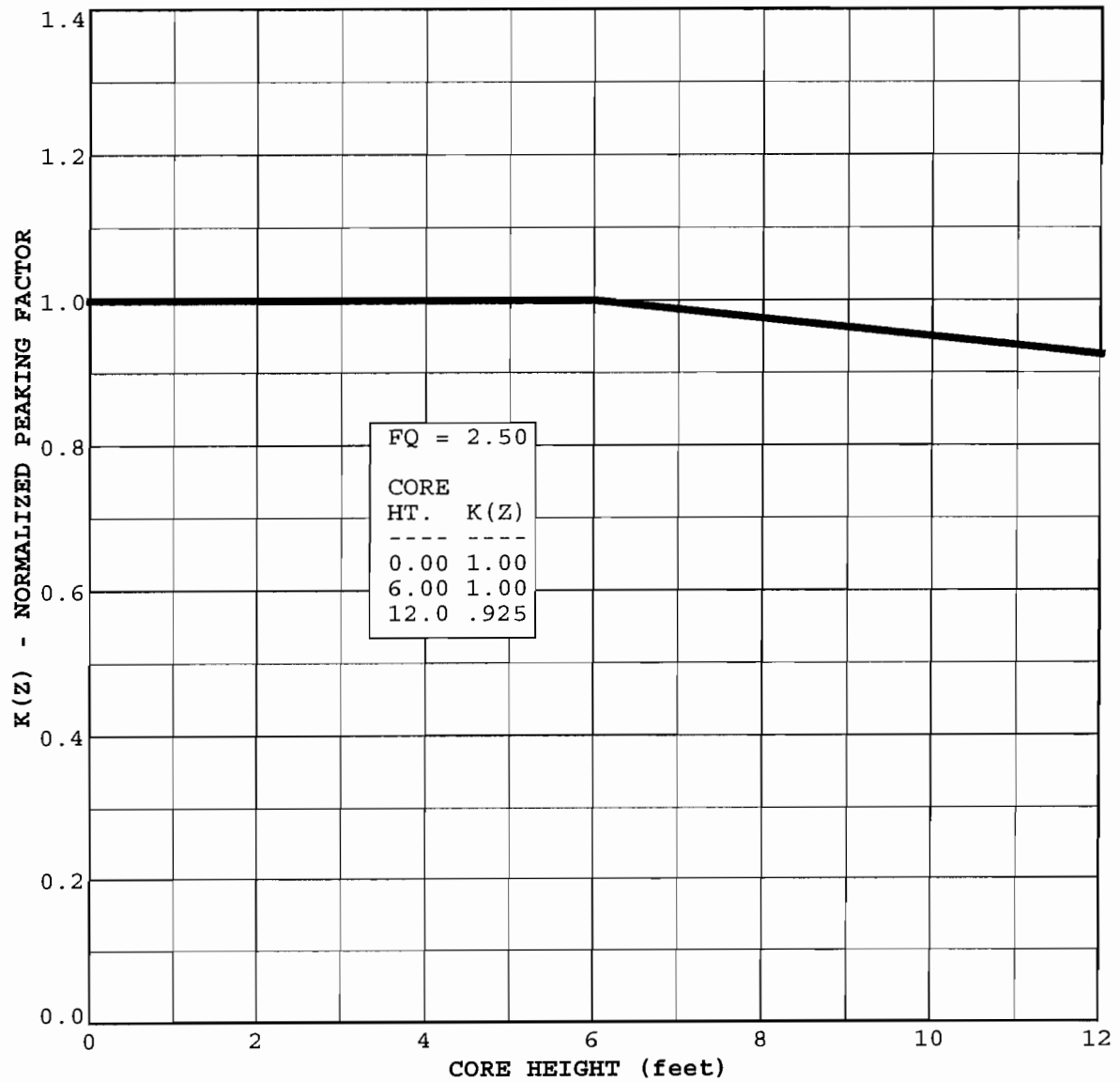
**FIGURE 3  
ROD BANK INSERTION LIMITS VERSUS % OF RATED THERMAL POWER**



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

NOTE: The Rod Bank Insertion Limits are based on the control bank withdrawal sequence A, B, C, D and a control bank tip-to-tip distance of 115 steps.

**FIGURE 4**  
**K(Z) - NORMALIZED  $F_Q(Z)$  AS A FUNCTION OF CORE HEIGHT**





**FIGURE 5**  
**AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF % OF RATED THERMAL POWER FOR RAOC**

