

Charles R. Pierce
Regulatory Affairs Director

**Southern Nuclear
Operating Company, Inc.**
40 Inverness Center Parkway
Post Office Box 1295
Birmingham, Alabama 35201

Tel 205.992.7872
Fax 205.992.7601



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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Vogtle Electric Generating Plant, Unit 2
Unit 2 Cycle 18 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 18, Version 1.

This letter contains no NRC commitments. If you have any questions, please contact Ken McElroy at (205) 992-7369.

Respectfully submitted,

A handwritten signature in cursive script that reads "C. R. Pierce".

C. R. Pierce
Regulatory Affairs Director

CRP/RMJ

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cc: Southern Nuclear Operating Company

Mr. S. E. Kuczynski, Chairman, President & CEO

Mr. D. G. Bost, Executive Vice President & Chief Nuclear Officer

Mr. D. R. Madison, Vice President – Fleet Operations

Mr. B. L. Ivey, Vice President – Regulatory Affairs

Mr. B. K. Taber, Vice President – Vogtle 1 & 2

Mr. B. J. Adams, Vice President – Engineering

Mr. G.W. Gunn, Regulatory Affairs Manager – Vogtle 1 & 2 (Acting)

RType: CVC7000

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Mr. V. M. McCree, Regional Administrator

Mr. R. E. Martin, NRR Senior Project Manager – Vogtle 1 & 2

Mr. L. M. Cain, Senior Resident Inspector – Vogtle 1 & 2

**Vogtle Electric Generating Plant
Unit 2 Cycle 18 Core Operating Limits Report**

Enclosure

Core Operating Limits Report, VEGP Unit 2 Cycle 18, Version 1

VOGTLE ELECTRIC GENERATING PLANT (VEGP) UNIT 2 CYCLE 18

CORE OPERATING LIMITS REPORT

Version 1

August 2014

Westinghouse Non-Proprietary Class 3

APPENDIX A
VOGTLE ELECTRIC GENERATING PLANT (VEGP) UNIT 2 CYCLE 18
CORE OPERATING LIMITS REPORT (COLR)

Version 1

August 2014

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for VEGP Unit 2 Cycle 18 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 $-5.50 \times 10^{-4} \Delta k/k/^\circ F$.¹

2.3.2 The MTC Surveillance limits are:

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

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

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

¹ Applicable for full-power T-average of 583.8 to 586.8 °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
$$F_Q(Z) \leq \frac{F_Q^{RTP}}{P} \cdot K(Z) \quad \text{for } P > 0.5$$

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

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

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

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

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

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

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 1793 ppm.²

² 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^{10} depletion. The boron concentration includes credit for Samarium.

Table 1
F_Q(Z) PENALTY FACTOR

| Cycle Burnup (MWD/MTU) | F _Q (Z) Penalty Factor | Cycle Burnup (MWD/MTU) | F _Q (Z) Penalty Factor |
|---------------------------|-----------------------------------|---------------------------|-----------------------------------|
| 0 | 1.0591 | 6241 | 1.0259 |
| 150 | 1.0591 | 6458 | 1.0265 |
| 368 | 1.0628 | 6893 | 1.0241 |
| 585 | 1.0652 | 7111 | 1.0243 |
| 803 | 1.0661 | 7328 | 1.0244 |
| 1020 | 1.0640 | 7546 | 1.0243 |
| 1455 | 1.0495 | 7763 | 1.0241 |
| 1890 | 1.0338 | 8199 | 1.0236 |
| 2325 | 1.0200 | 8416 | 1.0233 |
| 5806 | 1.0200 | 8851 | 1.0200 |

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 |
|-------------|------------------|-------------|--------------|---------------|---------------|
| * 1-5 | 12.072 – 11.267 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 6 | 11.066 | 1.3351 | 1.3680 | 1.2203 | 1.2465 |
| 7 | 10.865 | 1.3271 | 1.3584 | 1.2230 | 1.2436 |
| 8 | 10.664 | 1.3071 | 1.3490 | 1.2236 | 1.2326 |
| 9 | 10.462 | 1.2854 | 1.3357 | 1.2229 | 1.2175 |
| 10 | 10.261 | 1.2690 | 1.3157 | 1.2226 | 1.2050 |
| 11 | 10.060 | 1.2510 | 1.2939 | 1.2232 | 1.1937 |
| 12 | 9.859 | 1.2304 | 1.2708 | 1.2266 | 1.1974 |
| 13 | 9.658 | 1.2306 | 1.2469 | 1.2197 | 1.2013 |
| 14 | 9.456 | 1.2273 | 1.2308 | 1.2121 | 1.2046 |
| 15 | 9.255 | 1.2252 | 1.2187 | 1.2096 | 1.2073 |
| 16 | 9.054 | 1.2213 | 1.2042 | 1.2054 | 1.2108 |
| 17 | 8.853 | 1.2197 | 1.1924 | 1.1938 | 1.2112 |
| 18 | 8.652 | 1.2201 | 1.1927 | 1.1869 | 1.2104 |
| 19 | 8.450 | 1.2238 | 1.1965 | 1.1904 | 1.2138 |
| 20 | 8.249 | 1.2239 | 1.1984 | 1.1944 | 1.2237 |
| 21 | 8.048 | 1.2287 | 1.1986 | 1.2037 | 1.2395 |
| 22 | 7.847 | 1.2299 | 1.1962 | 1.2096 | 1.2518 |
| 23 | 7.646 | 1.2288 | 1.1921 | 1.2136 | 1.2623 |
| 24 | 7.444 | 1.2256 | 1.1867 | 1.2160 | 1.2712 |
| 25 | 7.243 | 1.2196 | 1.1789 | 1.2149 | 1.2758 |
| 26 | 7.042 | 1.2114 | 1.1695 | 1.2111 | 1.2768 |
| 27 | 6.841 | 1.2018 | 1.1590 | 1.2056 | 1.2757 |
| 28 | 6.640 | 1.1908 | 1.1506 | 1.1989 | 1.2728 |
| 29 | 6.438 | 1.1783 | 1.1417 | 1.1902 | 1.2700 |
| 30 | 6.237 | 1.1655 | 1.1326 | 1.1810 | 1.2654 |
| 31 | 6.036 | 1.1548 | 1.1257 | 1.1711 | 1.2595 |
| 32 | 5.835 | 1.1466 | 1.1209 | 1.1605 | 1.2521 |
| 33 | 5.634 | 1.1383 | 1.1165 | 1.1607 | 1.2430 |
| 34 | 5.432 | 1.1349 | 1.1188 | 1.1627 | 1.2376 |
| 35 | 5.231 | 1.1362 | 1.1290 | 1.1700 | 1.2380 |
| 36 | 5.030 | 1.1418 | 1.1378 | 1.1765 | 1.2409 |
| 37 | 4.829 | 1.1465 | 1.1464 | 1.1821 | 1.2415 |
| 38 | 4.628 | 1.1517 | 1.1544 | 1.1865 | 1.2401 |
| 39 | 4.426 | 1.1569 | 1.1619 | 1.1898 | 1.2367 |
| 40 | 4.225 | 1.1610 | 1.1685 | 1.1917 | 1.2315 |
| 41 | 4.024 | 1.1642 | 1.1744 | 1.1929 | 1.2249 |
| 42 | 3.823 | 1.1673 | 1.1795 | 1.1935 | 1.2154 |
| 43 | 3.622 | 1.1729 | 1.1835 | 1.1930 | 1.2032 |
| 44 | 3.420 | 1.1789 | 1.1882 | 1.1915 | 1.1906 |
| 45 | 3.219 | 1.1835 | 1.1925 | 1.1899 | 1.1771 |
| 46 | 3.018 | 1.1873 | 1.2046 | 1.1930 | 1.1743 |
| 47 | 2.817 | 1.1934 | 1.2243 | 1.2051 | 1.1825 |
| 48 | 2.616 | 1.2079 | 1.2478 | 1.2186 | 1.1945 |
| 49 | 2.414 | 1.2243 | 1.2721 | 1.2317 | 1.2062 |
| 50 | 2.213 | 1.2404 | 1.2968 | 1.2449 | 1.2181 |
| 51 | 2.012 | 1.2567 | 1.3215 | 1.2571 | 1.2282 |
| 52 | 1.811 | 1.2728 | 1.3459 | 1.2687 | 1.2378 |
| 53 | 1.610 | 1.2883 | 1.3691 | 1.2801 | 1.2480 |
| 54 | 1.408 | 1.3032 | 1.3911 | 1.2913 | 1.2588 |
| 55 | 1.207 | 1.3175 | 1.4117 | 1.3020 | 1.2697 |
| 56 | 1.006 | 1.3310 | 1.4303 | 1.3123 | 1.2811 |
| * 57-61 | 0.805 – 0.000 | 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 583.8 to 586.8°F.

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

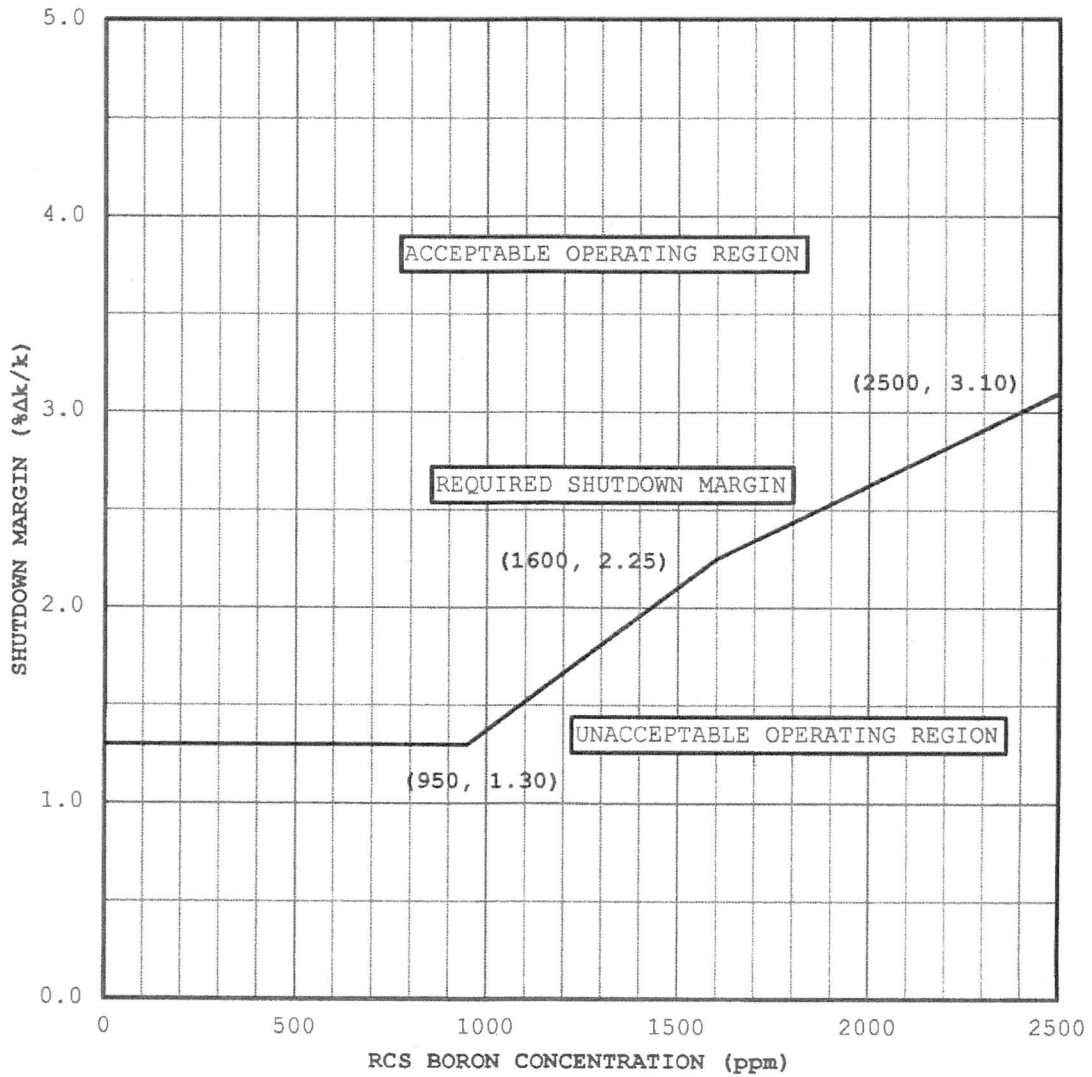


FIGURE 2
REQUIRED SHUTDOWN MARGIN FOR MODES 4 AND 5 (MODE 4 WHEN FIGURE 1 NOT APPLICABLE)

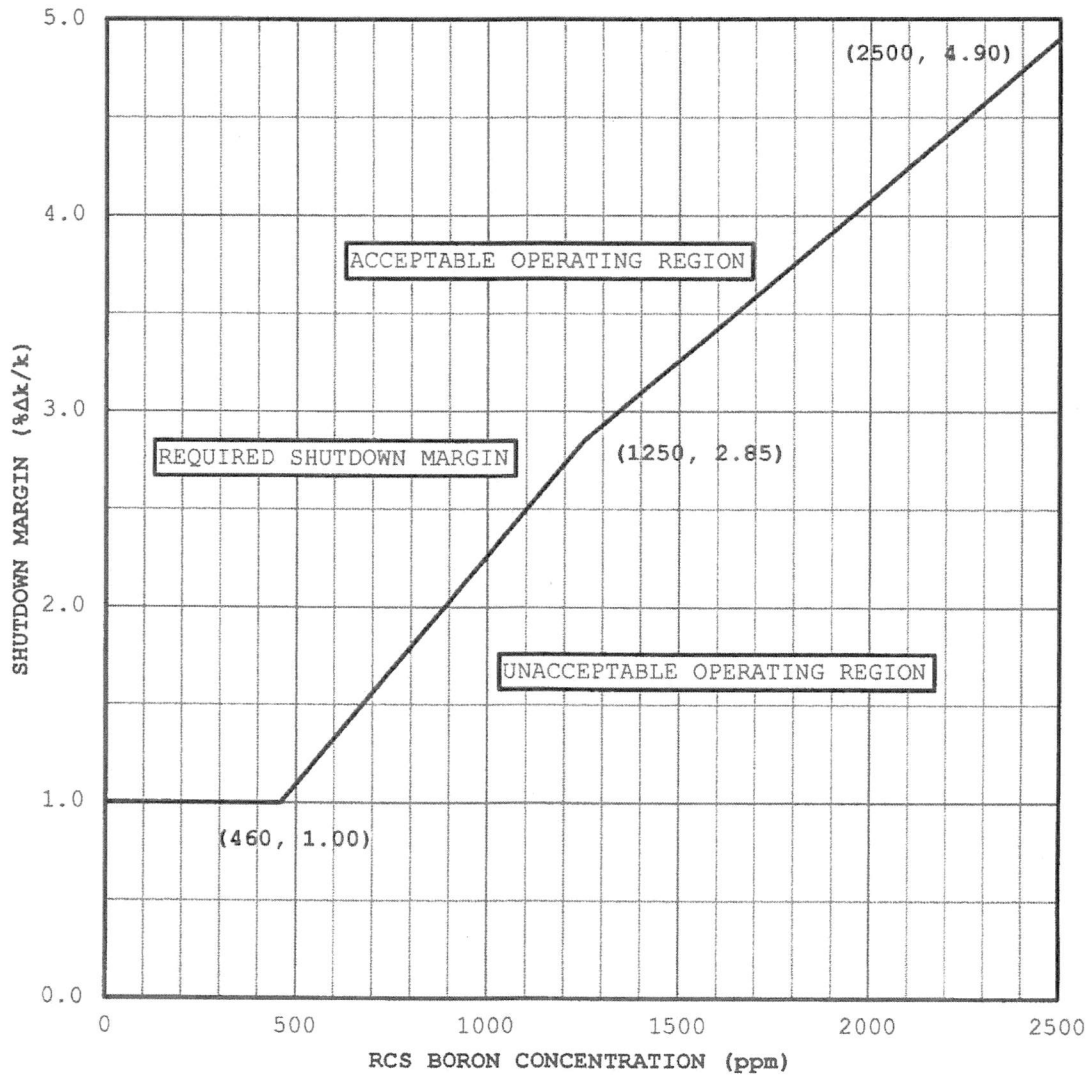
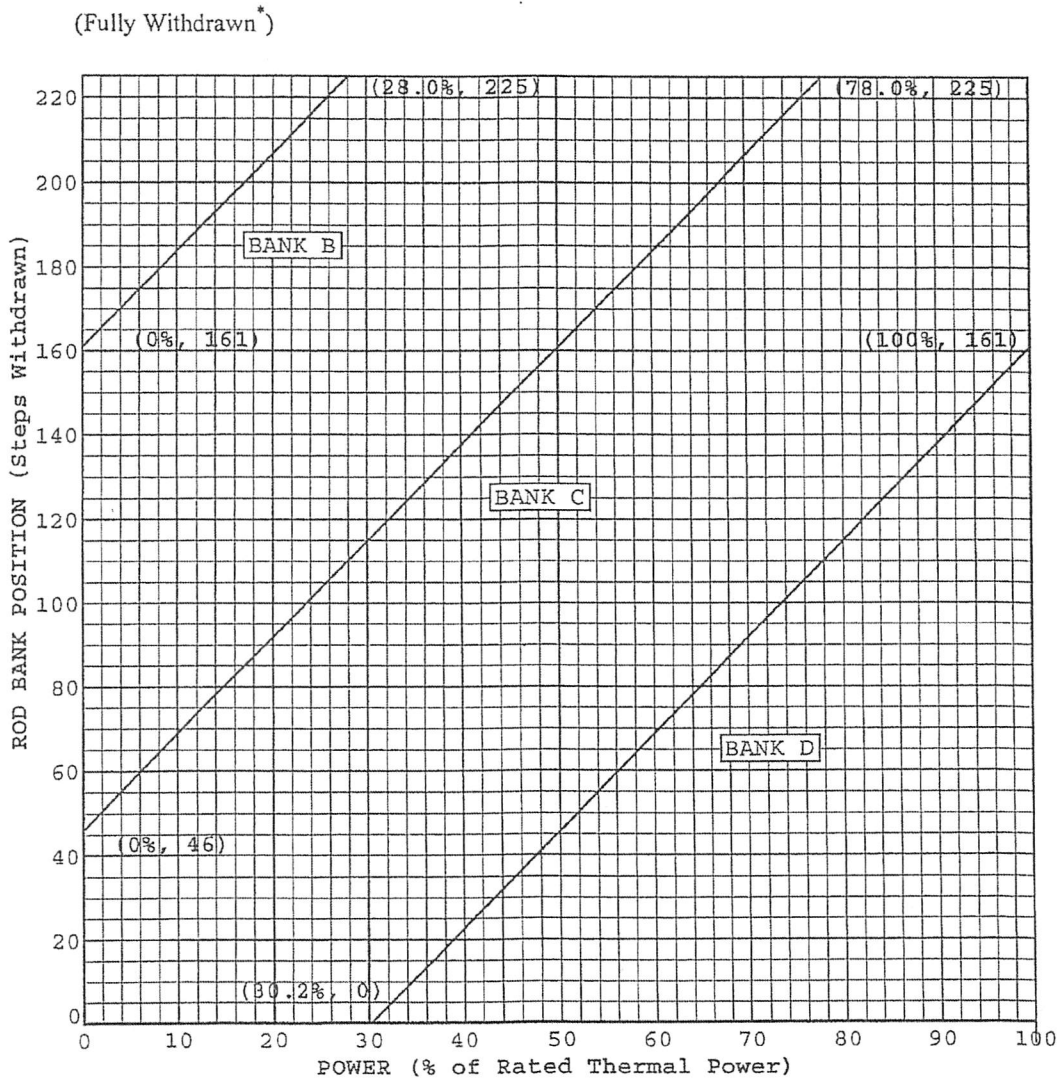


FIGURE 3
ROD BANK INSERTION LIMITS VERSUS % OF RATED THERMAL POWER



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

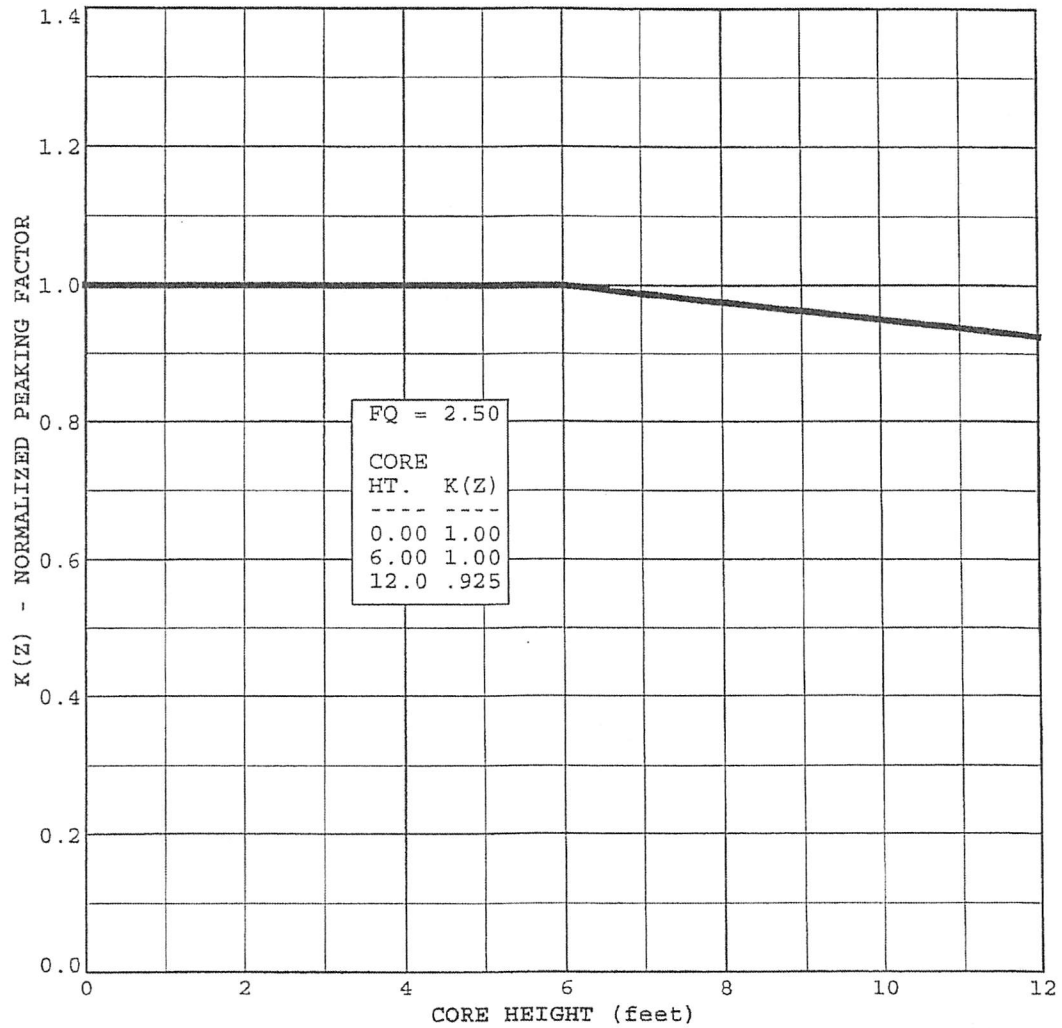


FIGURE 5
AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF % RATED THERMAL POWER FOR RAOC

