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Vogtle Electric Generating Plant, Unit 2
Cycle 19 Core Operating Limits Report Version 2

Ladies and Gentlemen:

In accordance with Technical Specification 5.6.5.d, Southern Nuclear Operating Company (SNC) submits the enclosed Core Operating Limits Report (COLR) for Vogtle Electric Generating Plant, Unit 2 Cycle 19. Please note that the COLR was incremented to Version 2 to maintain consistency with the Reload Evaluation (RE) version number. The RE was revised to correct an error in a drawing number which did not affect the COLR. There were no changes made to Version 1 of the COLR.

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

Respectfully submitted,

C. R. Pierce

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Regulatory Affairs Director

CPR/RMJ

Enclosure: Unit 2 Cycle 19 Core Operating Limits Report

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Vogtle Electric Generating Plant, Unit 2
Cycle 19 Core Operating Limits Report Version 2

Enclosure

Unit 2 Cycle 19 Core Operating Limits Report

VOGTLE ELECTRIC GENERATING PLANT (VEGP) UNIT 2 CYCLE 19

CORE OPERATING LIMITS REPORT

Version 2

December 2015

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for VEGP Unit 2 Cycle 19 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 Channnel Factor - $F^N_{\Delta H}$
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 $+0.7 \times 10^{-4}$ $\Delta k/k/°F$ for power levels up to 70% RTP with a linear ramp to 0 $\Delta k/k/°F$ at 100% RTP.

The EOL/ARO/RTP-MTC shall be less negative than -5.50×10^{-4} $\Delta k/k/°F$.[1]

2.3.2 The MTC Surveillance limits are:

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

The revised predicted near-EOL 300 ppm MTC shall be calculated using Figure 6 and the following algorithm:

Revised Predicted MTC = Predicted MTC* + AFD Correction** + Predictive Correction***

where,
* Predicted MTC is calculated from Figure 6 at the burnup corresponding to the measurement of 300 ppm at RTP conditions,
** AFD Correction is the more negative value of:
{0 pcm/°F or (ΔAFD * AFD Sensitivity)}
where: ΔAFD is the measured AFD minus the predicted AFD from an incore flux map taken at or near the burnup corresponding to 300 ppm,
AFD Sensitivity = 0.08 pcm/°F / ΔAFD
***Predictive Correction is -3 pcm/°F.

The 60 ppm/ARO/RTP-MTC should be less negative than -5.35×10^{-4} $\Delta k/k/°F$.[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 $$F_Q(Z) \le \frac{F_Q^{RTP}}{P} \cdot K(Z) \quad \text{for P} > 0.5$$

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

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

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

2.6.3 K(Z) is provided in Figure 4.

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

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

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 - $F^N_{\Delta H}$ (Specification 3.2.2)

2.7.1 $F^N_{\Delta H} \leq F^{RTP}_{\Delta H} \cdot (1 + PF_{\Delta H} \cdot (1 - P))$

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

2.7.2 $F^{RTP}_{\Delta H} = 1.65$

2.7.3 $PF_{\Delta H} = 0.3$

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 1817 ppm.[2]

[2] This concentration bounds the condition of $k_{eff} \leq 0.95$ (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.

Table 1
$F_Q(Z)$ PENALTY FACTOR

Cycle Burnup (MWD/MTU)	$F_Q(Z)$ Penalty Factor
0	1.0206
150	1.0206
368	1.0289
585	1.0288
803	1.0277
1021	1.0264
1238	1.0253
1456	1.0249
1674	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	1.3491	1.4036	1.2718	1.2176
	7	10.865	1.3360	1.3901	1.2657	1.2183
	8	10.664	1.3198	1.3784	1.2559	1.2000
	9	10.462	1.3045	1.3652	1.2430	1.1891
	10	10.261	1.2874	1.3434	1.2296	1.1886
	11	10.060	1.2640	1.3163	1.2144	1.1881
	12	9.859	1.2596	1.3056	1.2032	1.1873
	13	9.658	1.2633	1.3001	1.1961	1.1860
	14	9.456	1.2629	1.2893	1.1889	1.1843
	15	9.255	1.2542	1.2786	1.1820	1.1851
	16	9.054	1.2460	1.2643	1.1785	1.1996
	17	8.853	1.2434	1.2437	1.1734	1.2030
	18	8.652	1.2388	1.2282	1.1714	1.2134
	19	8.450	1.2405	1.2234	1.1793	1.2249
	20	8.249	1.2417	1.2134	1.1857	1.2367
	21	8.048	1.2414	1.2121	1.1902	1.2481
	22	7.847	1.2425	1.2084	1.1929	1.2582
	23	7.646	1.2413	1.2023	1.1935	1.2699
	24	7.444	1.2381	1.1948	1.1930	1.2790
	25	7.243	1.2318	1.1845	1.1894	1.2830
	26	7.042	1.2236	1.1726	1.1838	1.2832
	27	6.841	1.2138	1.1598	1.1772	1.2813
	28	6.640	1.2017	1.1456	1.1699	1.2768
	29	6.438	1.1887	1.1318	1.1635	1.2697
	30	6.237	1.1760	1.1276	1.1571	1.2600
	31	6.036	1.1644	1.1240	1.1501	1.2483
	32	5.835	1.1553	1.1194	1.1422	1.2375
	33	5.634	1.1488	1.1146	1.1408	1.2299
	34	5.432	1.1434	1.1141	1.1501	1.2219
	35	5.231	1.1423	1.1200	1.1587	1.2227
	36	5.030	1.1410	1.1278	1.1665	1.2238
	37	4.829	1.1443	1.1350	1.1733	1.2254
	38	4.628	1.1480	1.1418	1.1792	1.2256
	39	4.426	1.1510	1.1481	1.1841	1.2239
	40	4.225	1.1529	1.1533	1.1878	1.2206
	41	4.024	1.1539	1.1593	1.1902	1.2159
	42	3.823	1.1540	1.1669	1.1929	1.2084
	43	3.622	1.1553	1.1740	1.1971	1.1985
	44	3.420	1.1596	1.1799	1.2010	1.1879
	45	3.219	1.1641	1.1853	1.2031	1.1783
	46	3.018	1.1666	1.1878	1.2083	1.1784
	47	2.817	1.1756	1.2039	1.2144	1.1896
	48	2.616	1.1876	1.2282	1.2255	1.2025
	49	2.414	1.1989	1.2522	1.2385	1.2151
	50	2.213	1.2102	1.2768	1.2513	1.2278
	51	2.012	1.2215	1.3013	1.2633	1.2386
	52	1.811	1.2334	1.3255	1.2749	1.2488
	53	1.610	1.2468	1.3484	1.2863	1.2595
	54	1.408	1.2600	1.3699	1.2975	1.2705
	55	1.207	1.2726	1.3899	1.3082	1.2815
	56	1.006	1.2846	1.4081	1.3184	1.2928
*	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)

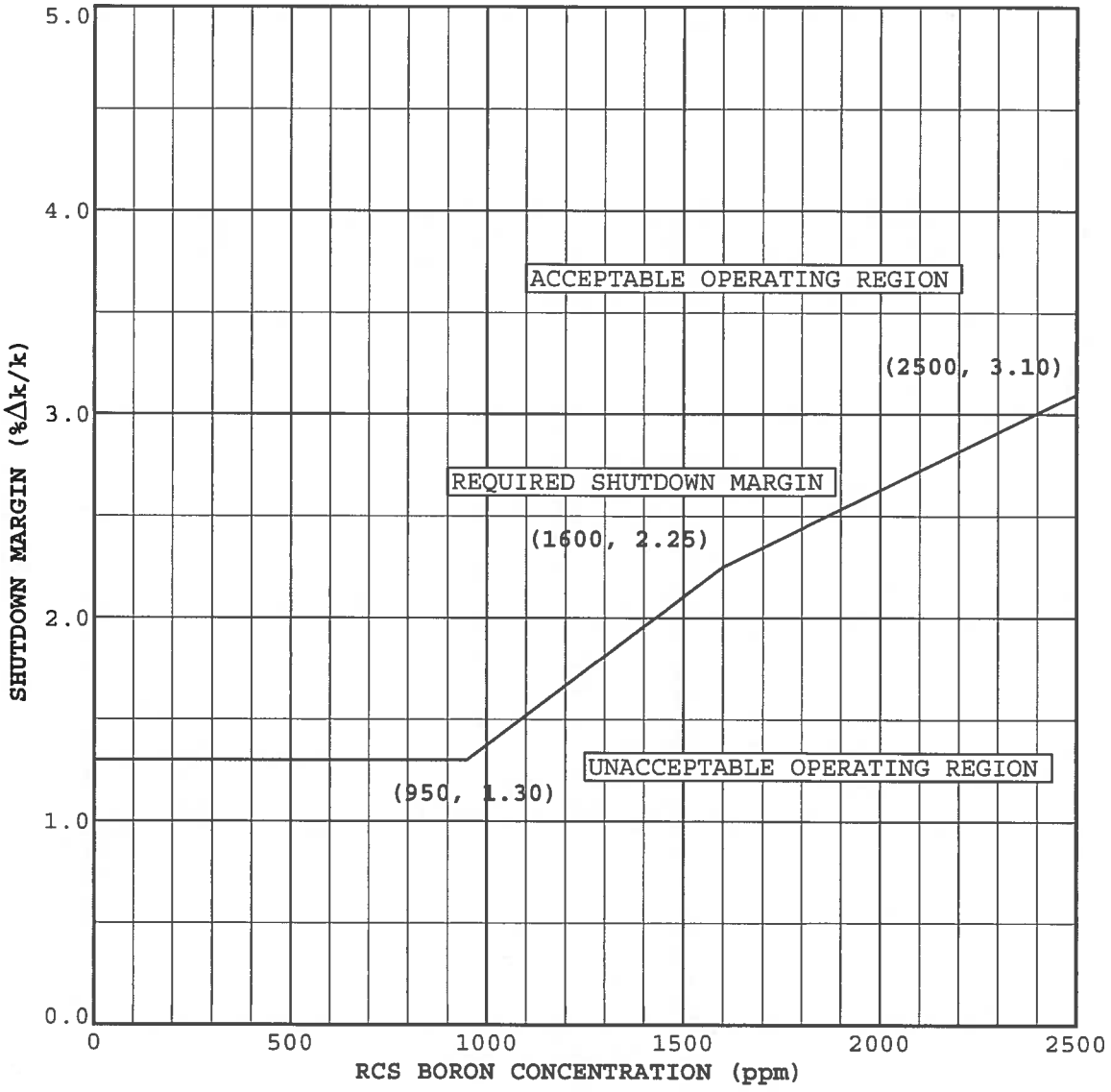


FIGURE 2
REQUIRED SHUTDOWN MARGIN FOR MODES 4 AND 5 (MODE 4 WHEN FIGURE 1 NOT APPLICABLE)

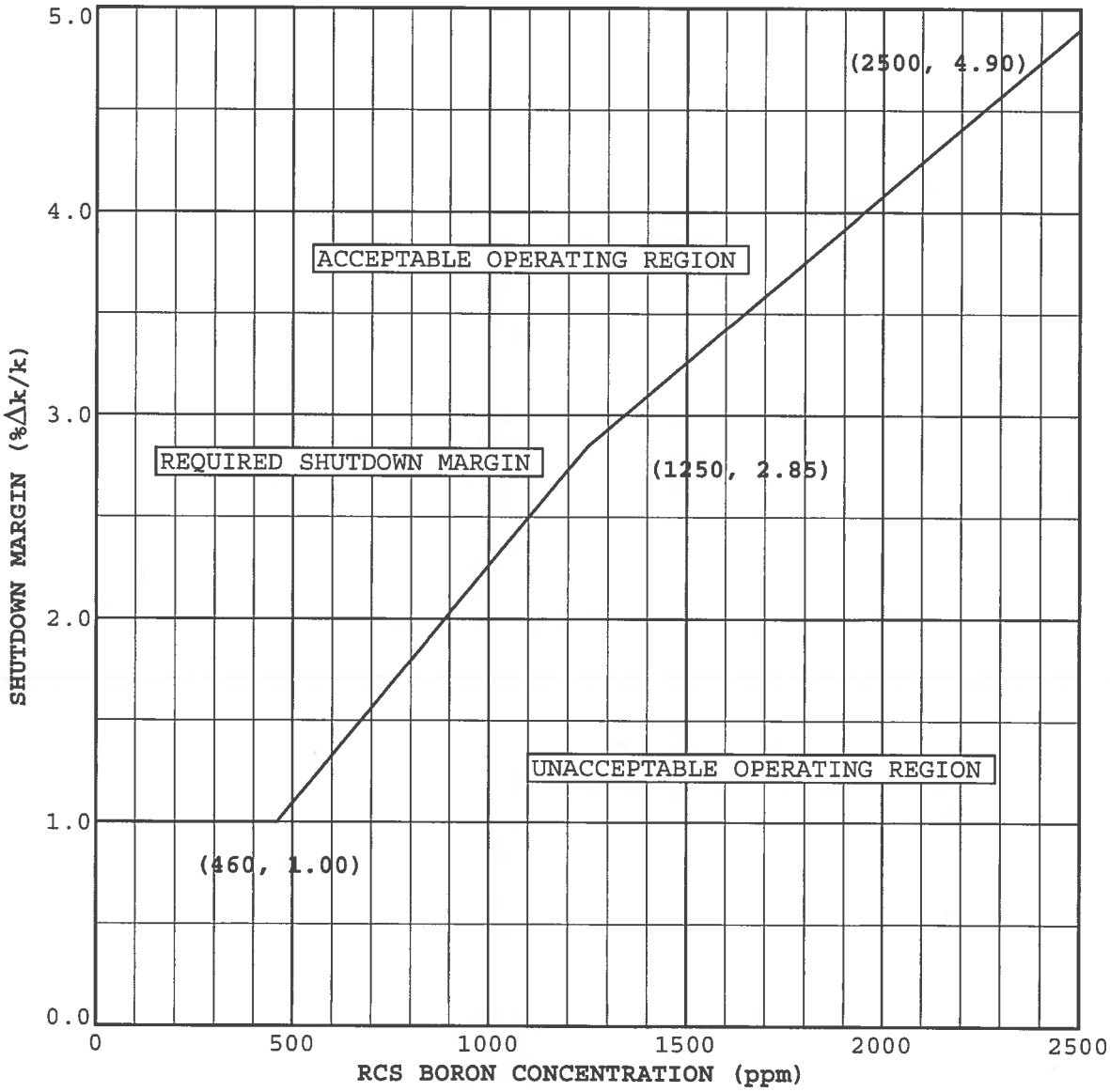
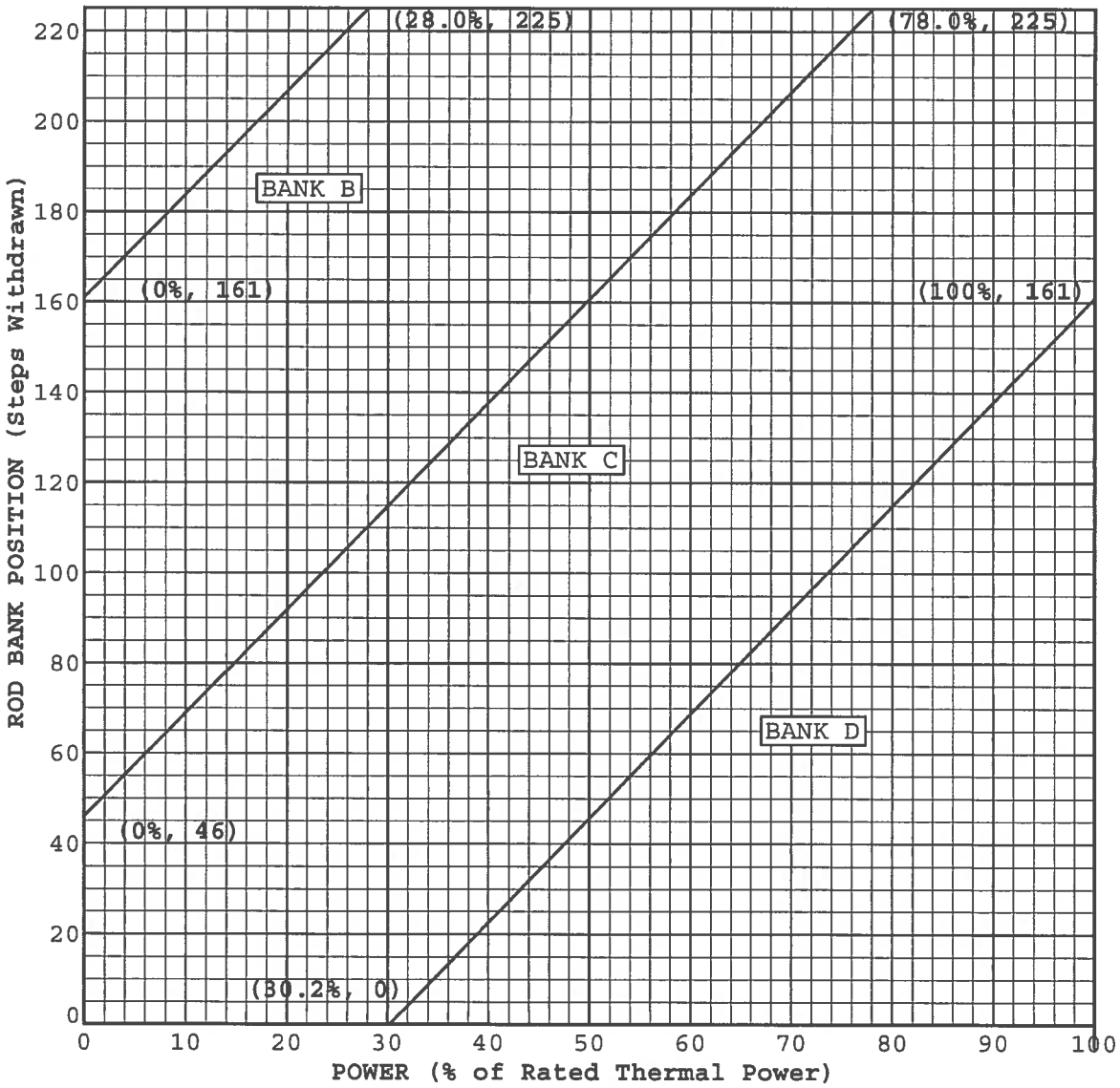


FIGURE 3
ROD BANK INSERTION LIMITS VERSUS % OF RATED THERMAL POWER

(Fully Withdrawn*)



*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

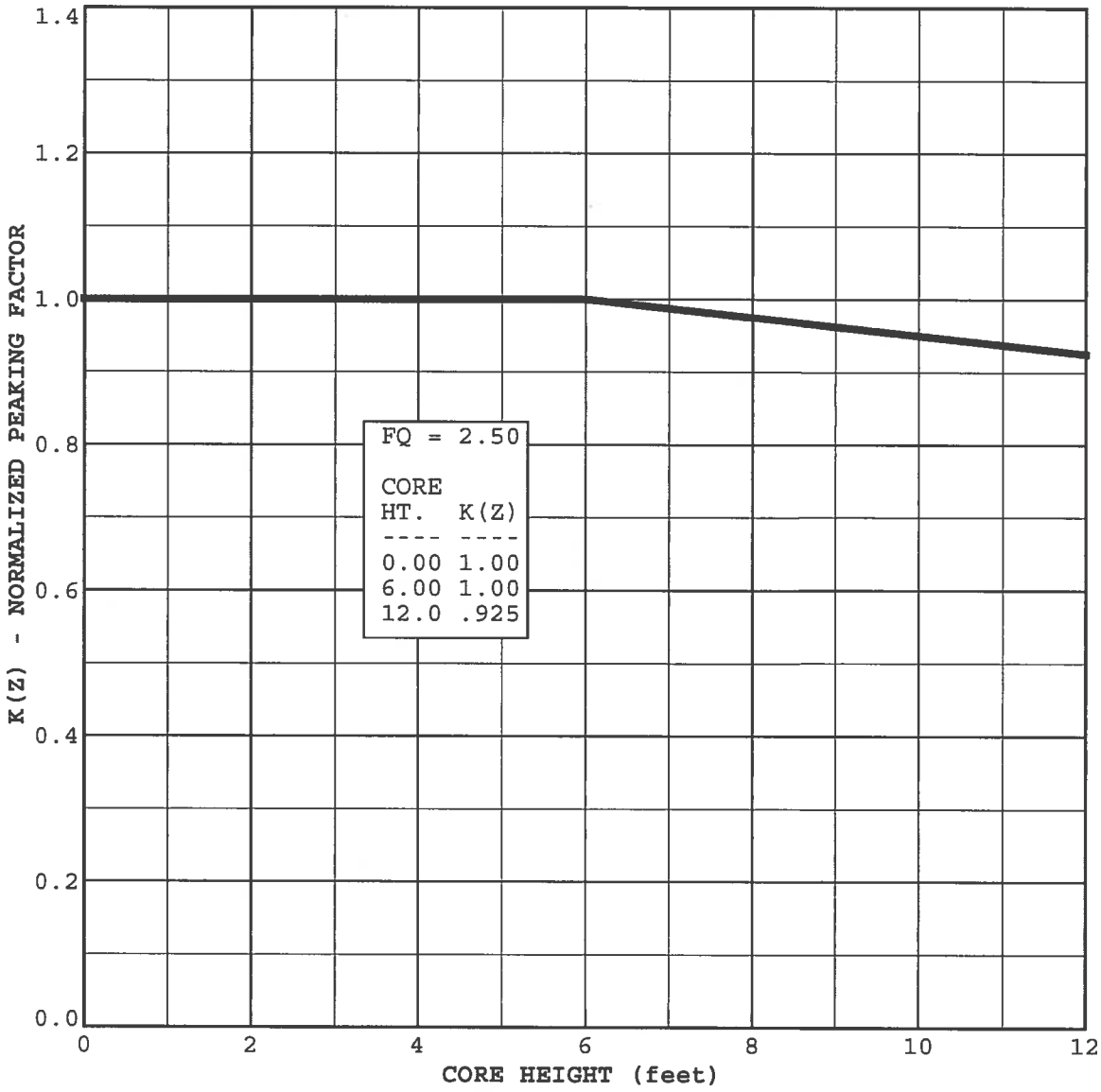


FIGURE 5
AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF % RATED THERMAL POWER FOR RAOC

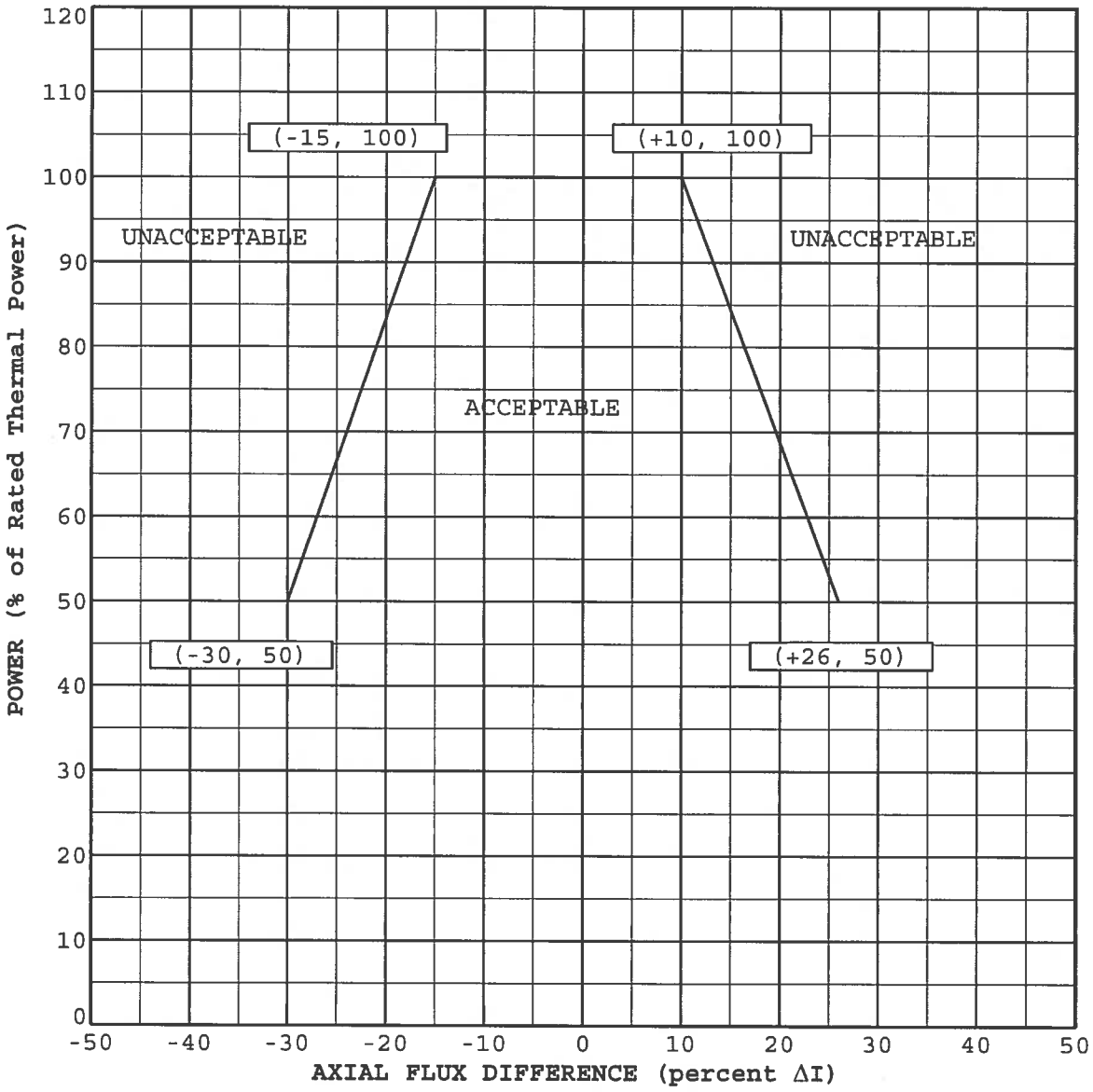
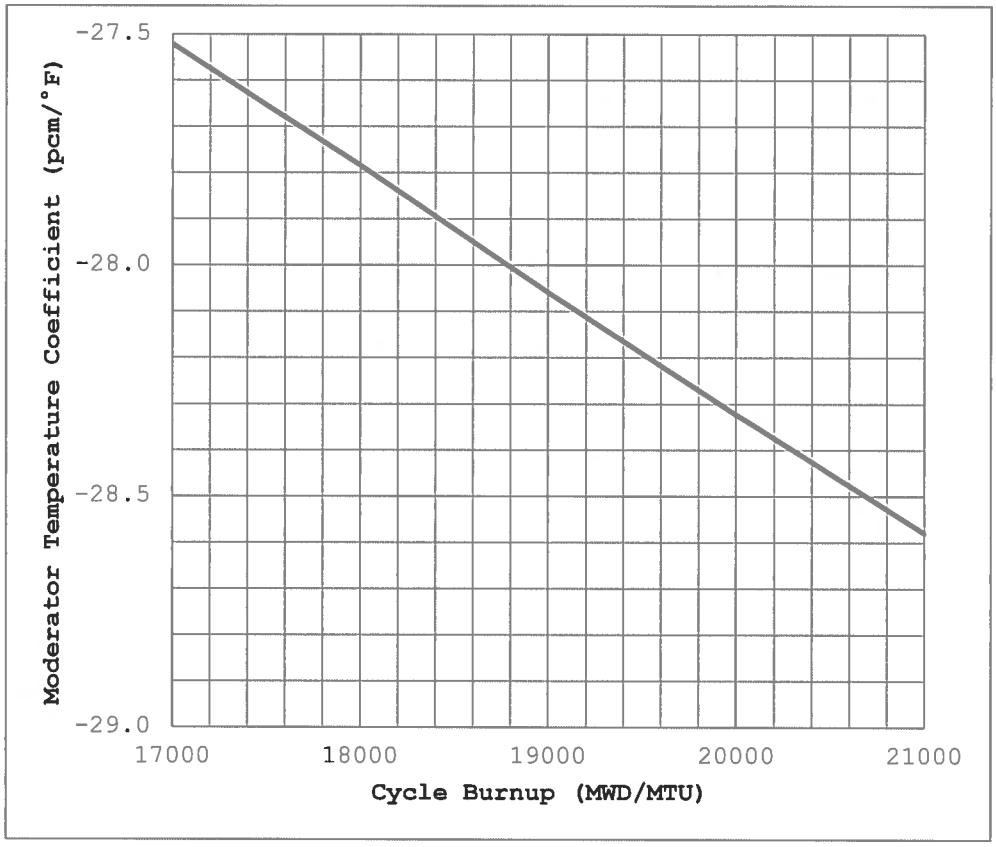


FIGURE 6
PREDICTED HFP 300 PPM MTC VS CYCLE BURNUP



Cycle Burnup (MWD/MTU)	Moderator Temperature Coefficient (pcm/°F)
17000	-27.52
18000	-27.78
19000	-28.06
20000	-28.32
21000	-28.58