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

Vogtle Electric Generating Plant – Unit 2
Core Operating Limits Report, Cycle 23, Version 1

Ladies and Gentlemen:

In accordance with Technical Specification (TS) 5.6.5.d for Vogtle Electric Generating Plant (VEGP), Southern Nuclear Operating Company (SNC) submits the VEGP Core Operating Limits Report (COLR) for Unit 2, Cycle 23, Version 1.

This letter contains no NRC commitments. If you have any questions, please contact Ryan Joyce at 205.992.6468.

Respectfully submitted,



Cheryl A. Gayheart
Regulatory Affairs Director

CAG/dsp/cbg

Enclosure: VEGP Unit 2 COLR, Cycle 23, Version 1

cc: Regional Administrator
NRR Project Manager – Vogtle 1 & 2
Senior Resident Inspector – Vogtle 1 & 2
RType: CVC7000

**Vogtle Electric Generating Plant – Unit 2
Core Operating Limits Report, Cycle 23, Version 1**

Enclosure

VEGP Unit 2 COLR, Cycle 23, Version 1

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for VEGP Unit 2 Cycle 23 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 - $F_{\Delta H}^N$
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 as 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 $-5.35 \times 10^{-4} \Delta k/k/^{\circ}F$.¹

2.3.2 The MTC Surveillance limits are:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to $-4.60 \times 10^{-4} \Delta k/k/^{\circ}F$.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:

$\{0 \text{ pcm}/^{\circ}F \text{ or } (\Delta AFD * AFD \text{ Sensitivity})\}$

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,

$AFD \text{ Sensitivity} = 0.08 \text{ pcm}/^{\circ}F / \Delta AFD$

***Predictive Correction is $-3 \text{ pcm}/^{\circ}F$.

The 60 ppm/ARO/RTP-MTC should be less negative than $-5.20 \times 10^{-4} \Delta k/k/^{\circ}F$.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 582.0 to 587.0 $^{\circ}F$.

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)

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

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

$$\text{where: } P = \frac{\text{THERMALPOWER}}{\text{RATEDTHERMALPOWER}}$$

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

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)

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

$$\text{where: } P = \frac{THERMALPOWER}{RATEDTHERMALPOWER}$$

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

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

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 2000 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 B¹⁰ depletion.

Table 1
F_Q(Z) PENALTY FACTOR

Burnup (MWD/MTU)	Penalty Factor
0	1.0659
150	1.0659
367	1.0635
584	1.0602
801	1.0546
1018	1.0473
1235	1.0395
1453	1.0313
1670	1.0236
1887	1.0200
8833	1.0200
9051	1.0240
9268	1.0224
9485	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 1.0200 shall be used.

Table 2
RAOC W(Z)

	Axial Point	Elevation (feet)	150 MWD/MTU	3000 MWD/MTU	8000 MWD/MTU	12000 MWD/MTU	16000 MWD/MTU	20000 MWD/MTU
*	1-5	12.072 – 11.267	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	6	11.066	1.3208	1.3905	1.3305	1.2998	1.2263	1.2382
	7	10.865	1.2951	1.3779	1.3249	1.2954	1.2225	1.2320
	8	10.664	1.2800	1.3569	1.3138	1.2868	1.2108	1.2224
	9	10.462	1.2661	1.3333	1.3005	1.2779	1.1996	1.2102
	10	10.261	1.2426	1.3096	1.2863	1.2663	1.2031	1.2052
	11	10.060	1.2217	1.2811	1.2698	1.2537	1.2091	1.2090
	12	9.859	1.2105	1.2500	1.2509	1.2390	1.2157	1.2101
	13	9.658	1.2105	1.2183	1.2364	1.2340	1.2135	1.2090
	14	9.456	1.2078	1.1994	1.2231	1.2303	1.2142	1.2085
	15	9.255	1.1975	1.1986	1.2246	1.2222	1.2099	1.2061
	16	9.054	1.1917	1.2004	1.2286	1.2136	1.2047	1.2114
	17	8.853	1.1992	1.1980	1.2283	1.2037	1.2020	1.2282
	18	8.652	1.2022	1.1964	1.2264	1.1964	1.2090	1.2405
	19	8.450	1.2059	1.1916	1.2213	1.1988	1.2197	1.2490
	20	8.249	1.2077	1.1870	1.2177	1.2000	1.2314	1.2585
	21	8.048	1.2106	1.1833	1.2142	1.2079	1.2412	1.2672
	22	7.847	1.2142	1.1804	1.2111	1.2133	1.2488	1.2753
	23	7.646	1.2138	1.1778	1.2122	1.2166	1.2540	1.2876
	24	7.444	1.2117	1.1736	1.2104	1.2182	1.2578	1.2966
	25	7.243	1.2066	1.1671	1.2050	1.2159	1.2572	1.3002
	26	7.042	1.1998	1.1591	1.1972	1.2111	1.2537	1.2997
	27	6.841	1.1915	1.1516	1.1881	1.2050	1.2487	1.2971
	28	6.640	1.1813	1.1445	1.1772	1.1970	1.2425	1.2918
	29	6.438	1.1707	1.1379	1.1649	1.1874	1.2366	1.2837
	30	6.237	1.1620	1.1336	1.1514	1.1777	1.2295	1.2728
	31	6.036	1.1558	1.1310	1.1371	1.1671	1.2213	1.2599
	32	5.835	1.1488	1.1277	1.1262	1.1593	1.2116	1.2486
	33	5.634	1.1432	1.1258	1.1237	1.1572	1.2025	1.2401
	34	5.432	1.1396	1.1341	1.1255	1.1631	1.2003	1.2352
	35	5.231	1.1397	1.1447	1.1357	1.1672	1.2024	1.2351
	36	5.030	1.1473	1.1543	1.1445	1.1709	1.2032	1.2343
	37	4.829	1.1543	1.1635	1.1530	1.1754	1.2045	1.2335
	38	4.628	1.1609	1.1720	1.1609	1.1789	1.2045	1.2316
	39	4.426	1.1668	1.1799	1.1681	1.1812	1.2030	1.2277
	40	4.225	1.1716	1.1867	1.1744	1.1825	1.2000	1.2222
	41	4.024	1.1757	1.1928	1.1800	1.1827	1.1968	1.2166
	42	3.823	1.1786	1.1975	1.1846	1.1834	1.1940	1.2090
	43	3.622	1.1833	1.2043	1.1878	1.1842	1.1900	1.1987
	44	3.420	1.1894	1.2129	1.1918	1.1838	1.1853	1.1875
	45	3.219	1.1935	1.2203	1.1959	1.1831	1.1800	1.1773
	46	3.018	1.2016	1.2304	1.2029	1.1818	1.1762	1.1734
	47	2.817	1.2120	1.2504	1.2109	1.1901	1.1815	1.1808
	48	2.616	1.2235	1.2731	1.2224	1.2037	1.1924	1.1934
	49	2.414	1.2401	1.2947	1.2402	1.2163	1.2029	1.2054
	50	2.213	1.2579	1.3167	1.2594	1.2292	1.2136	1.2176
	51	2.012	1.2753	1.3380	1.2776	1.2409	1.2228	1.2279
	52	1.811	1.2924	1.3590	1.2955	1.2522	1.2316	1.2378
	53	1.610	1.3086	1.3786	1.3125	1.2634	1.2408	1.2483
	54	1.408	1.3238	1.3969	1.3287	1.2743	1.2503	1.2593
	55	1.207	1.3382	1.4139	1.3438	1.2847	1.2597	1.2704
	56	1.006	1.3515	1.4291	1.3576	1.2948	1.2692	1.2820
*	57-61	0.805 – 0.000	1.0000	1.0000	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 582.0 to 587.0°F.

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

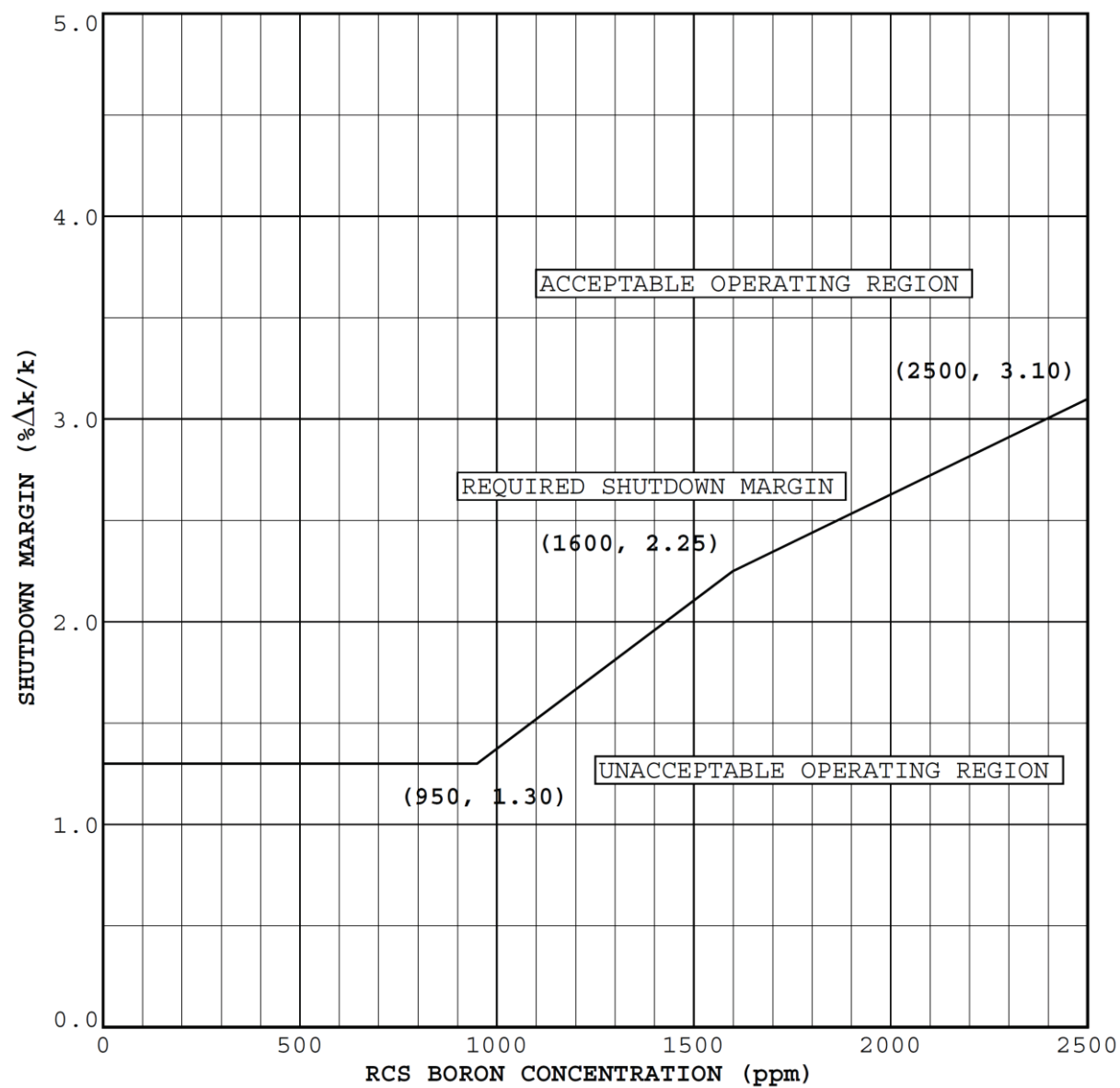


FIGURE 2
REQUIRED SHUTDOWN MARGIN FOR MODES 4 AND 5 (MODE 4 WHEN FIGURE 1 NOT APPLICABLE)

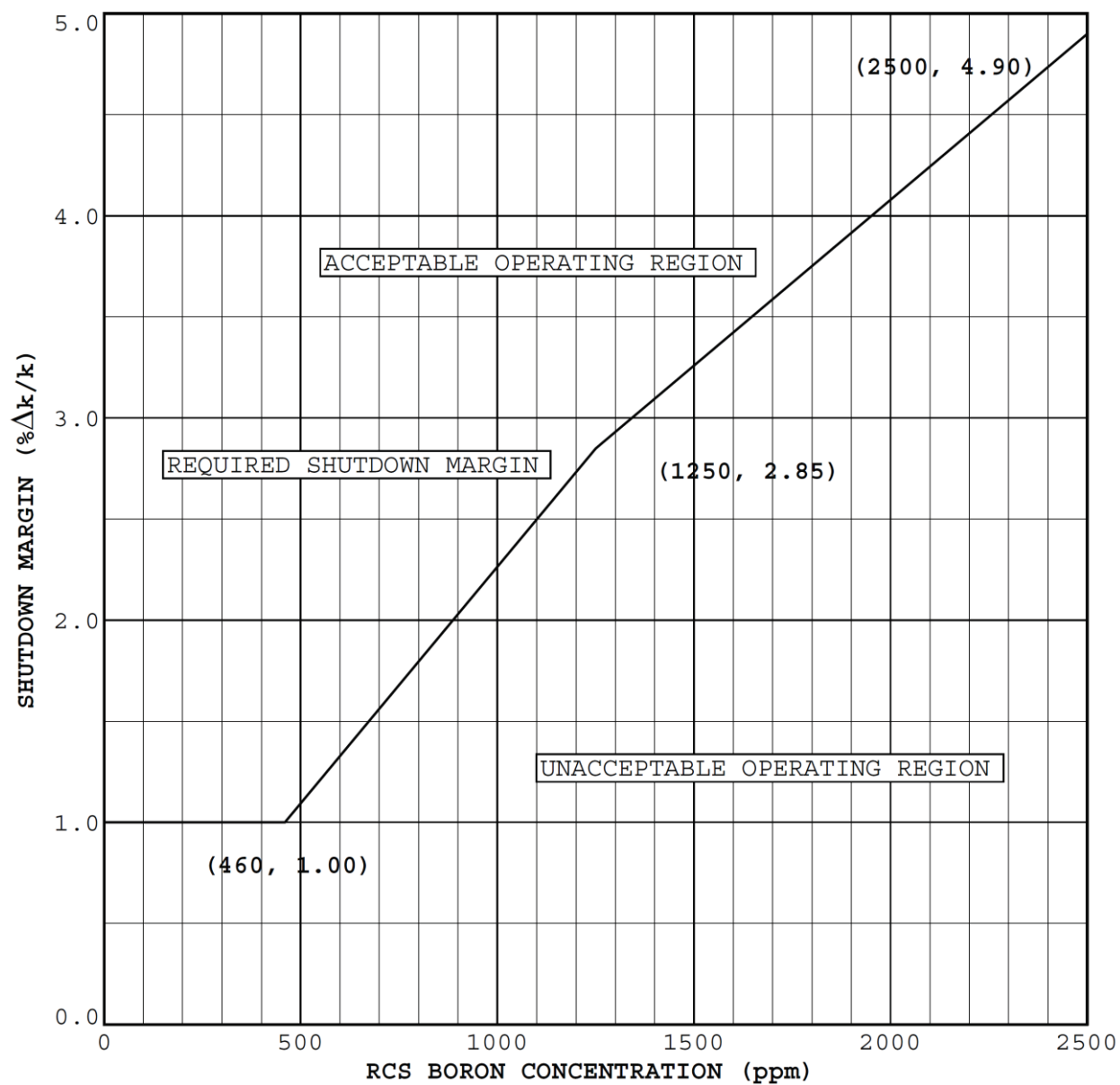
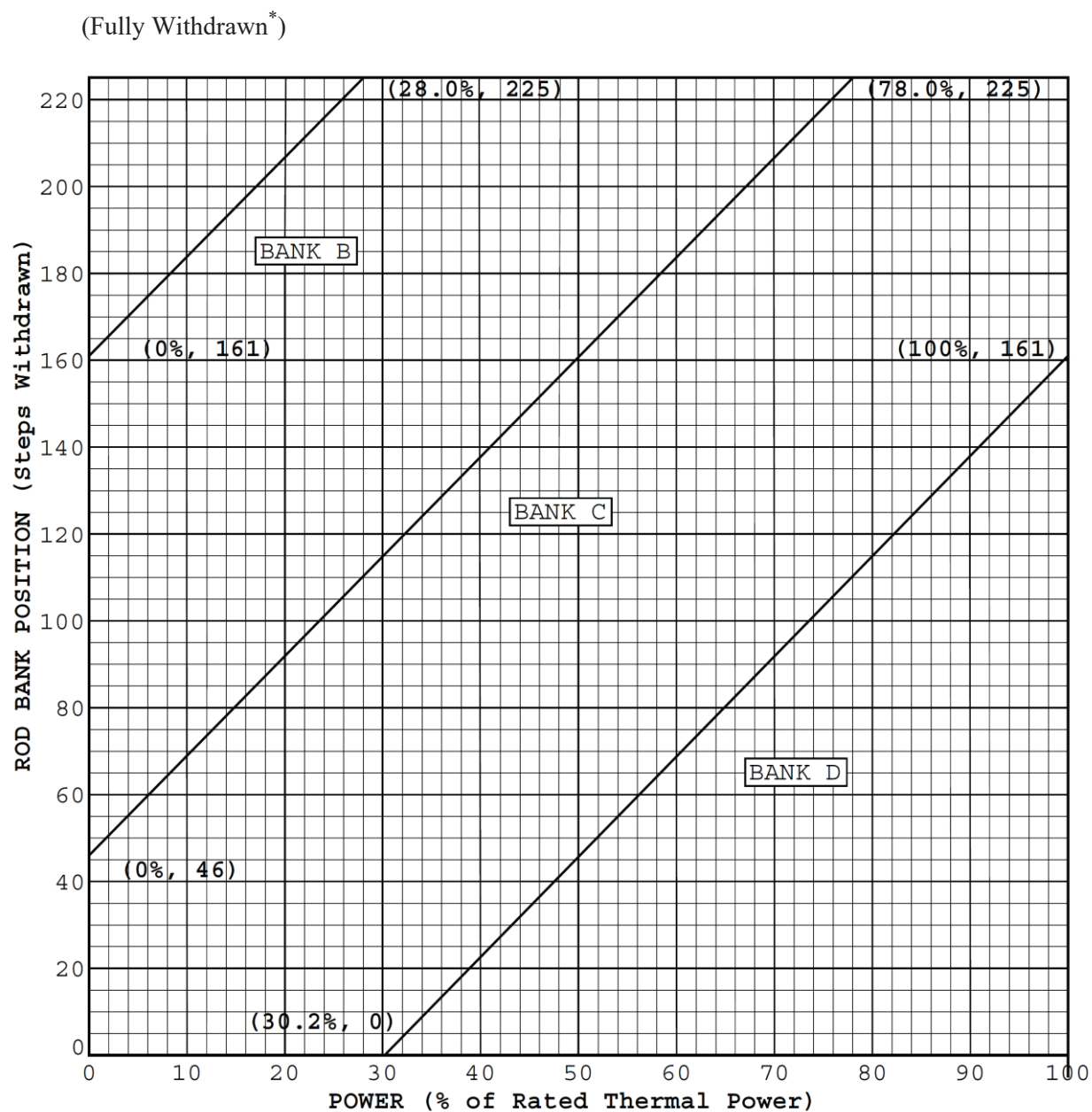


FIGURE 3
ROD BANK INSERTION LIMITS VERSUS % OF RATED THERMAL POWER



*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

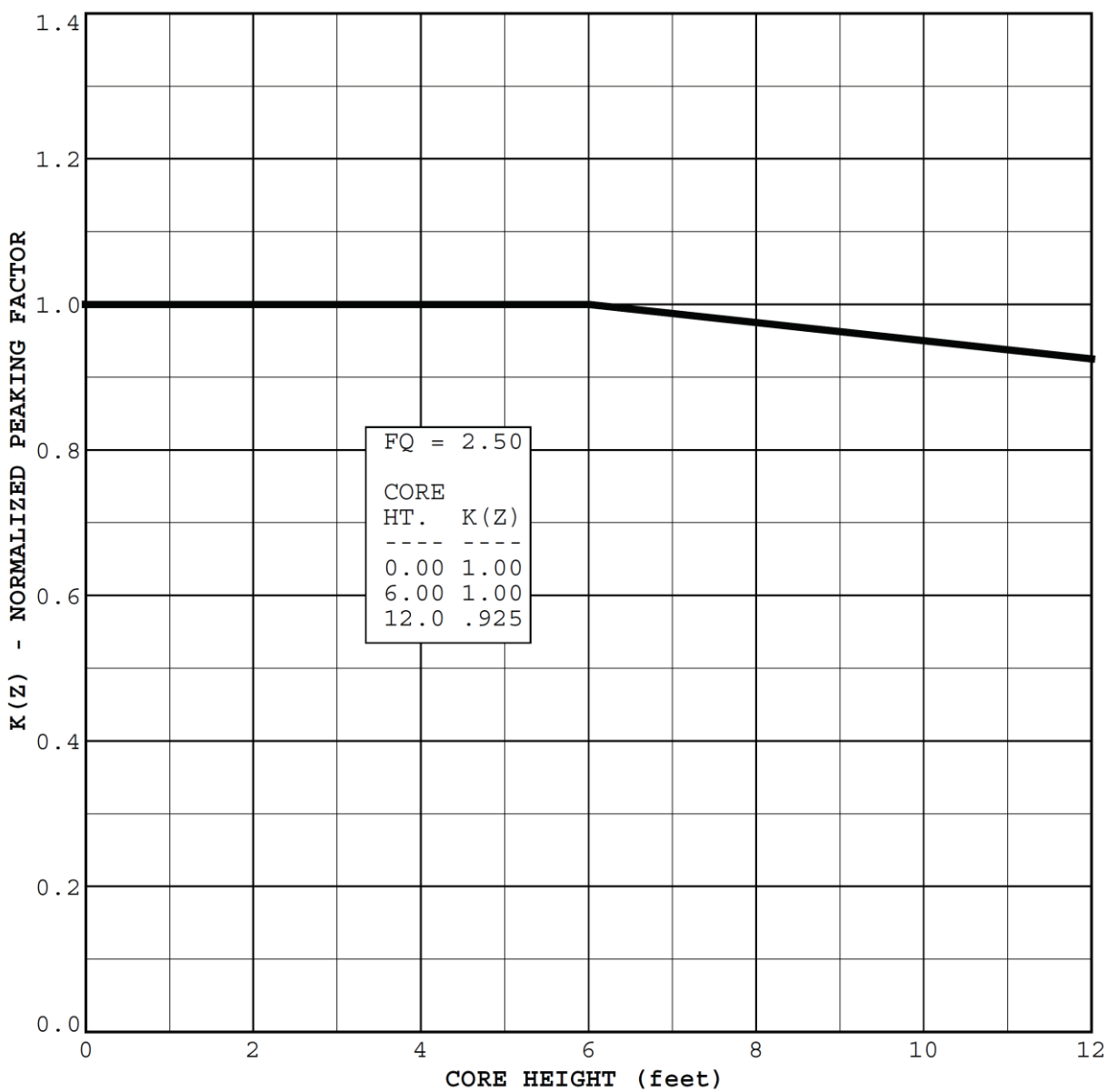


FIGURE 5
AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF % RATED THERMAL POWER
FOR RAOC

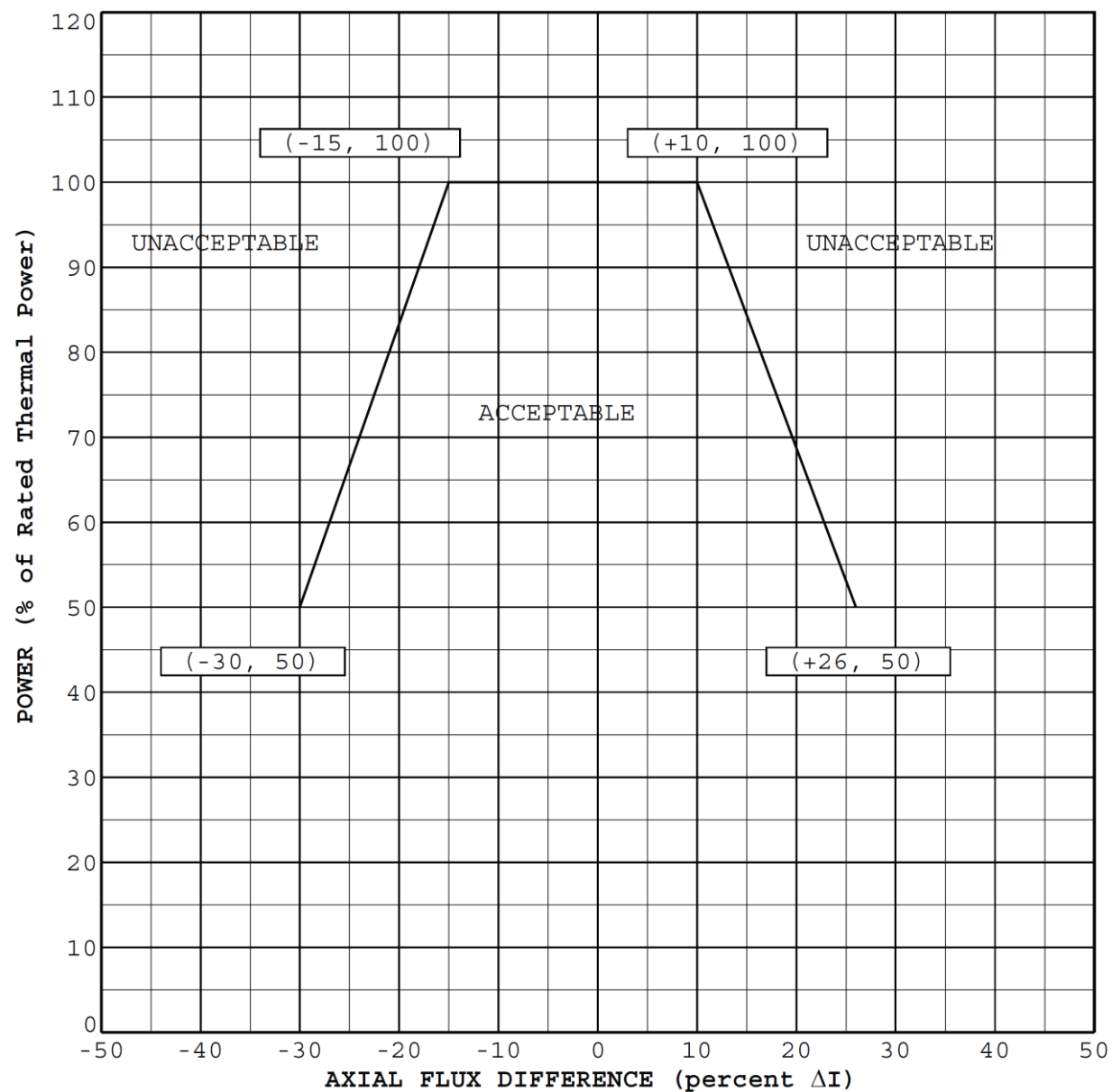
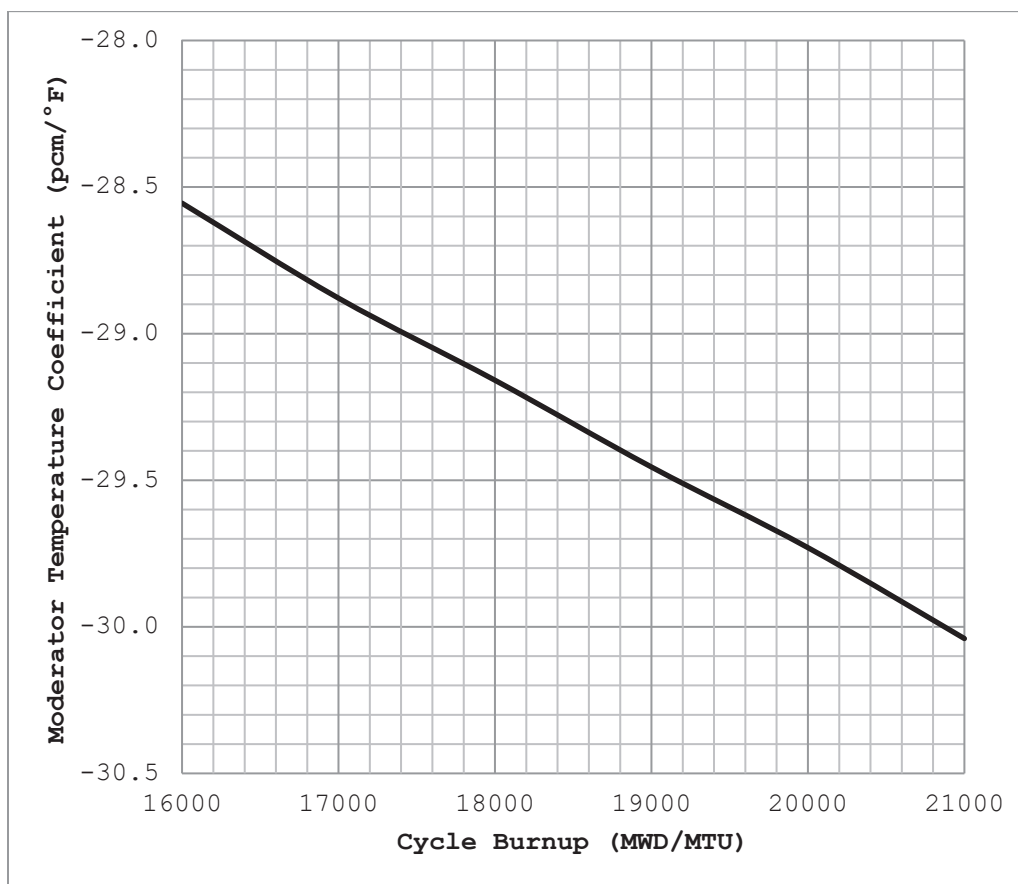


FIGURE 6
PREDICTED HFP 300 PPM MTC VS CYCLE BURNUP



Cycle Burnup (MWD/MTU)	Moderator Temperature Coefficient (pcm/°F)
16000	-28.56
17000	-28.88
18000	-29.16
19000	-29.46
20000	-29.73
21000	-30.04