Charles R. Pierce
Regulatory Affairs Director

Southern Nuclear
Operating Company, Inc.
40 Inverness Center Parkway
Post Office Box 1295
Birmingham, AL 35242

Tel 205.992.7872
Fax 205.992.7601

May 18, 2015

Docket Nos.: 50-348 NL-15-0909

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

Joseph M. Farley Nuclear Plant – Unit 1
Cycle 27 Core Operating Limits Report

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 the Joseph M. Farley Nuclear Plant (FNP) - Unit 1 Cycle 27 Version 1.

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

Sincerely,

C. R. Pierce

C.R. Pierce
Regulatory Affairs Director

CRP/RMJ

Enclosure: Core Operating Limits Report for FNP Unit 1 Cycle 27 Version 1

cc: Southern Nuclear Operating Company
Mr. S. E. Kuczynski, Chairman, President & CEO
Mr. D. G. Bost, Executive Vice President & Chief Nuclear Officer
Ms. C. A. Gayheart, Vice President – Farley
Mr. M. D. Meier, Vice President – Regulatory Affairs
Mr. D. R. Madison, Vice President – Fleet Operations
Mr. B. J. Adams, Vice President – Engineering
Ms. B. L. Taylor, Regulatory Affairs Manager - Farley
RTYPE: CFA04.054

U. S. Nuclear Regulatory Commission
Mr. V. M. McCree, Regional Administrator
Mr. S. A. Williams, NRR Project Manager - Farley
Mr. P. K. Niebaum, Senior Resident Inspector - Farley

Joseph M. Farley Nuclear Plant – Unit 1
Cycle 27 Core Operating Limits Report

Enclosure

Core Operating Limits Report for FNP Unit 1 Cycle 27 Version 1

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for FNP UNIT 1 CYCLE 27 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 (with $k_{eff} \geq 1$)

The Technical Specifications affected by this report are listed below:

2.1.1 Reactor Core Safety Limits for THERMAL POWER
3.1.1 SHUTDOWN MARGIN - MODES 2 (with $k_{eff} < 1$), 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
3.3.1 Reactor Trip System Instrumentation Overtemperature ΔT (OTΔT) and Overpower ΔT (OPΔT) Setpoint Parameter Values for Table 3.3.1-1
3.4.1 RCS DNB Parameters for Pressurizer Pressure, RCS Average Temperature, and RCS Total Flow Rate
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 (with $k_{eff} \geq 1.0$) (Technical Requirement 13.1.1)

2.1.1 The SHUTDOWN MARGIN shall be greater than or equal to 1.77 percent $\Delta k/k$.

2.2 SHUTDOWN MARGIN - MODES 2 (with $k_{eff} < 1.0$), 3, 4 and 5 (Specification 3.1.1)

2.2.1 Modes 2 ($k_{eff} < 1.0$), 3 and 4 - The SHUTDOWN MARGIN shall be greater than or equal to 1.77 percent $\Delta k/k$.

2.2.2 Mode 5 - The SHUTDOWN MARGIN shall be greater than or equal to 1.0 percent $\Delta k/k$.

2.3 Moderator Temperature Coefficient (Specification 3.1.3)

2.3.1 The Moderator Temperature Coefficient (MTC) limits are:

The BOL/ARO-MTC shall be less than or equal to $+0.7 \times 10^{-4}$ $\Delta k/k/°F$ for power levels up to 70 percent RTP with a linear ramp to 0 $\Delta k/k/°F$ at 100 percent RTP.

The EOL/ARO/RTP-MTC shall be less negative than -4.3×10^{-4} $\Delta k/k/°F$.

2.3.2 The MTC Surveillance limits are:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to -3.65×10^{-4} $\Delta k/k/°F$.

The 100 ppm/ARO/RTP-MTC should be less negative than -4.0×10^{-4} $\Delta k/k/°F$.

where: BOL stands for Beginning of Cycle Life
ARO stands for All Rods Out
EOL stands for End of Cycle Life
RTP stands for RATED THERMAL POWER

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 1.

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

2.6.1 $F_Q(Z) \le \frac{F_Q^{RTP}}{P} * K(Z)$ for P > 0.5

$F_Q(Z) \le \frac{F_Q^{RTP}}{0.5} * K(Z)$ for P ≤ 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 2.

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

$F_Q(Z) \le \frac{F_Q^{RTP} * K(Z)}{0.5 * W(Z)}$ for P ≤ 0.5

2.6.5 Full Power W(Z) values are provided in Table 4.
Part Power (48% RTP) W(Z) values are provided in Table 5.

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

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

2.7.2 $F_{\Delta H}^{RTP} = 1.70$

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 3.

2.9 Boron Concentration (Specification 3.9.1)

2.9.1 The boron concentration shall be greater than or equal to 2000 ppm.[1]

2.10 Reactor Core Safety Limits for THERMAL POWER (Specification 2.1.1)

2.10.1 In MODES 1 and 2, the combination of THERMAL POWER, Reactor Coolant System (RCS) highest loop average temperature, and pressurizer pressure shall not exceed the safety limits specified in Figure 4.

2.11 Reactor Trip System Instrumentation Overtemperature ΔT (OTΔT) and Overpower ΔT (OPΔT) Setpoint Parameter Values for Table 3.3.1-1 (Specification 3.3.1)

2.11.1 The Reactor Trip System Instrumentation Overtemperature ΔT (OTΔT) and Overpower ΔT (OPΔT) setpoint parameter values for TS Table 3.3.1-1 are listed in COLR Tables 2 and 3.

2.12 RCS DNB Parameters for Pressurizer Pressure, RCS Average Temperature, and RCS Total Flow Rate (Specification 3.4.1)

2.12.1 RCS DNB parameters for pressurizer pressure, RCS average temperature, and RCS total flow rate shall be within the limits specified below:

a. Pressurizer pressure ≥ 2209 psig;
b. RCS average temperature ≤ 580.3°F; and
c. The minimum RCS total flow rate shall be ≥ 273,900 GPM when using the precision heat balance method and ≥ 274,800 GPM when using the elbow tap method.

[1] 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
30	1.0370
150	1.0370
354	1.0338
559	1.0302
763	1.0264
967	1.0238
1172	1.0222
1376	1.0201
1580	1.0200
4237	1.0200
4441	1.0204
4645	1.0244
4850	1.0245
5463	1.0248
5667	1.0246
6076	1.0338
6280	1.0304
6485	1.0265
6689	1.0208
6893	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

Reactor Trip System Instrumentation - Overtemperature ΔT (OTΔT)
Setpoint Parameter Values

$T' \leq 577.2°F$	$P' = 2235$ psig	
$K_1 = 1.17$	$K_2 = 0.017/°F$	$K_3 = 0.000825/psi$
$\tau_1 \geq 30$ sec	$\tau_2 \leq 4$ sec	
$\tau_4 = 0$ sec	$\tau_5 \leq 6$ sec	$\tau_6 \leq 6$ sec

$f_1(\Delta I) =$	$-2.48\{23 + (q_t - q_b)\}$	when $(q_t - q_b) \leq -23\%$ RTP
	0% of RTP	when -23% RTP $< (q_t - q_b) \leq 15\%$ RTP
	$2.05\{(q_t - q_b) - 15\}$	when $(q_t - q_b) > 15\%$ RTP

Table 3

Reactor Trip System Instrumentation - Overpower ΔT (OPΔT)
Setpoint Parameter Values

$T'' \leq 577.2°F$

$K_4 = 1.10$	$K_5 = 0.02/°F$ for increasing T_{avg}	$K_6 = 0.00109/°F$ when $T > T''$
	$K_5 = 0/°F$ for decreasing T_{avg}	$K_6 = 0/°F$ when $T \leq T''$

$\tau_3 \geq 10$ sec
$\tau_4 = 0$ sec
$\tau_5 \leq 6$ sec
$\tau_6 \leq 6$ sec

$f_2(\Delta I) = 0\%$ RTP for all ΔI

Table 4
RAOC W(Z)

	Axial Point	Elevation (feet)	150 MWD/MTU	3000 MWD/MTU	10000 MWD/MTU	14000 MWD/MTU	18000 MWD/MTU
*	1	12.00	1.0000	1.0000	1.0000	1.0000	1.0000
*	2	11.80	1.0000	1.0000	1.0000	1.0000	1.0000
*	3	11.60	1.0000	1.0000	1.0000	1.0000	1.0000
*	4	11.40	1.0000	1.0000	1.0000	1.0000	1.0000
*	5	11.20	1.0000	1.0000	1.0000	1.0000	1.0000
	6	11.00	1.1135	1.1146	1.2697	1.2319	1.2220
	7	10.80	1.1112	1.1168	1.2666	1.2294	1.2196
	8	10.60	1.1076	1.1134	1.2611	1.2246	1.2149
	9	10.40	1.1060	1.1185	1.2546	1.2188	1.2094
	10	10.20	1.1060	1.1291	1.2476	1.2160	1.2042
	11	10.00	1.1141	1.1334	1.2396	1.2149	1.1992
	12	9.80	1.1167	1.1316	1.2314	1.2131	1.1941
	13	9.60	1.1206	1.1297	1.2251	1.2102	1.1884
	14	9.40	1.1173	1.1220	1.2270	1.2063	1.1989
	15	9.20	1.1203	1.1225	1.2343	1.2032	1.2104
	16	9.00	1.1230	1.1223	1.2390	1.2109	1.2295
	17	8.80	1.1319	1.1255	1.2382	1.2153	1.2419
	18	8.60	1.1414	1.1356	1.2403	1.2193	1.2508
	19	8.40	1.1526	1.1452	1.2505	1.2301	1.2618
	20	8.20	1.1629	1.1543	1.2583	1.2441	1.2811
	21	8.00	1.1715	1.1617	1.2633	1.2548	1.2978
	22	7.80	1.1781	1.1672	1.2660	1.2629	1.3112
	23	7.60	1.1817	1.1701	1.2656	1.2679	1.3209
	24	7.40	1.1840	1.1717	1.2636	1.2714	1.3286
	25	7.20	1.1841	1.1711	1.2578	1.2707	1.3311
	26	7.00	1.1827	1.1689	1.2505	1.2674	1.3298
	27	6.80	1.1797	1.1655	1.2424	1.2637	1.3264
	28	6.60	1.1748	1.1603	1.2322	1.2579	1.3202
	29	6.40	1.1692	1.1543	1.2205	1.2502	1.3115
	30	6.20	1.1630	1.1478	1.2074	1.2407	1.3003
	31	6.00	1.1555	1.1401	1.1931	1.2297	1.2871
	32	5.80	1.1471	1.1317	1.1806	1.2175	1.2726
	33	5.60	1.1380	1.1265	1.1712	1.2064	1.2557
	34	5.40	1.1327	1.1393	1.1595	1.2031	1.2360
	35	5.20	1.1433	1.1514	1.1540	1.2002	1.2337
	36	5.00	1.1517	1.1631	1.1535	1.1958	1.2298
	37	4.80	1.1612	1.1742	1.1525	1.1908	1.2245
	38	4.60	1.1713	1.1847	1.1506	1.1864	1.2173
	39	4.40	1.1808	1.1947	1.1478	1.1809	1.2083
	40	4.20	1.1891	1.2035	1.1441	1.1741	1.1979
	41	4.00	1.1973	1.2115	1.1397	1.1664	1.1860
	42	3.80	1.2082	1.2187	1.1337	1.1563	1.1714
	43	3.60	1.2201	1.2250	1.1300	1.1453	1.1539
	44	3.40	1.2304	1.2302	1.1281	1.1379	1.1395
	45	3.20	1.2393	1.2347	1.1250	1.1308	1.1283
	46	3.00	1.2475	1.2478	1.1219	1.1284	1.1241
	47	2.80	1.2549	1.2774	1.1175	1.1286	1.1304
	48	2.60	1.2790	1.3109	1.1215	1.1296	1.1416
	49	2.40	1.3079	1.3433	1.1320	1.1307	1.1533
	50	2.20	1.3359	1.3764	1.1429	1.1405	1.1673
	51	2.00	1.3639	1.4090	1.1530	1.1507	1.1799
	52	1.80	1.3913	1.4411	1.1629	1.1602	1.1919
	53	1.60	1.4170	1.4711	1.1728	1.1701	1.2043
	54	1.40	1.4411	1.4992	1.1827	1.1803	1.2170
	55	1.20	1.4634	1.5250	1.1923	1.1904	1.2297
	56	1.00	1.4835	1.5481	1.2015	1.2004	1.2425
*	57	0.80	1.0000	1.0000	1.0000	1.0000	1.0000
*	58	0.60	1.0000	1.0000	1.0000	1.0000	1.0000
*	59	0.40	1.0000	1.0000	1.0000	1.0000	1.0000
*	60	0.20	1.0000	1.0000	1.0000	1.0000	1.0000
*	61	0.00	1.0000	1.0000	1.0000	1.0000	1.0000

* **Top and bottom 5 axial points excluded per Technical Specification B3.2.1.**

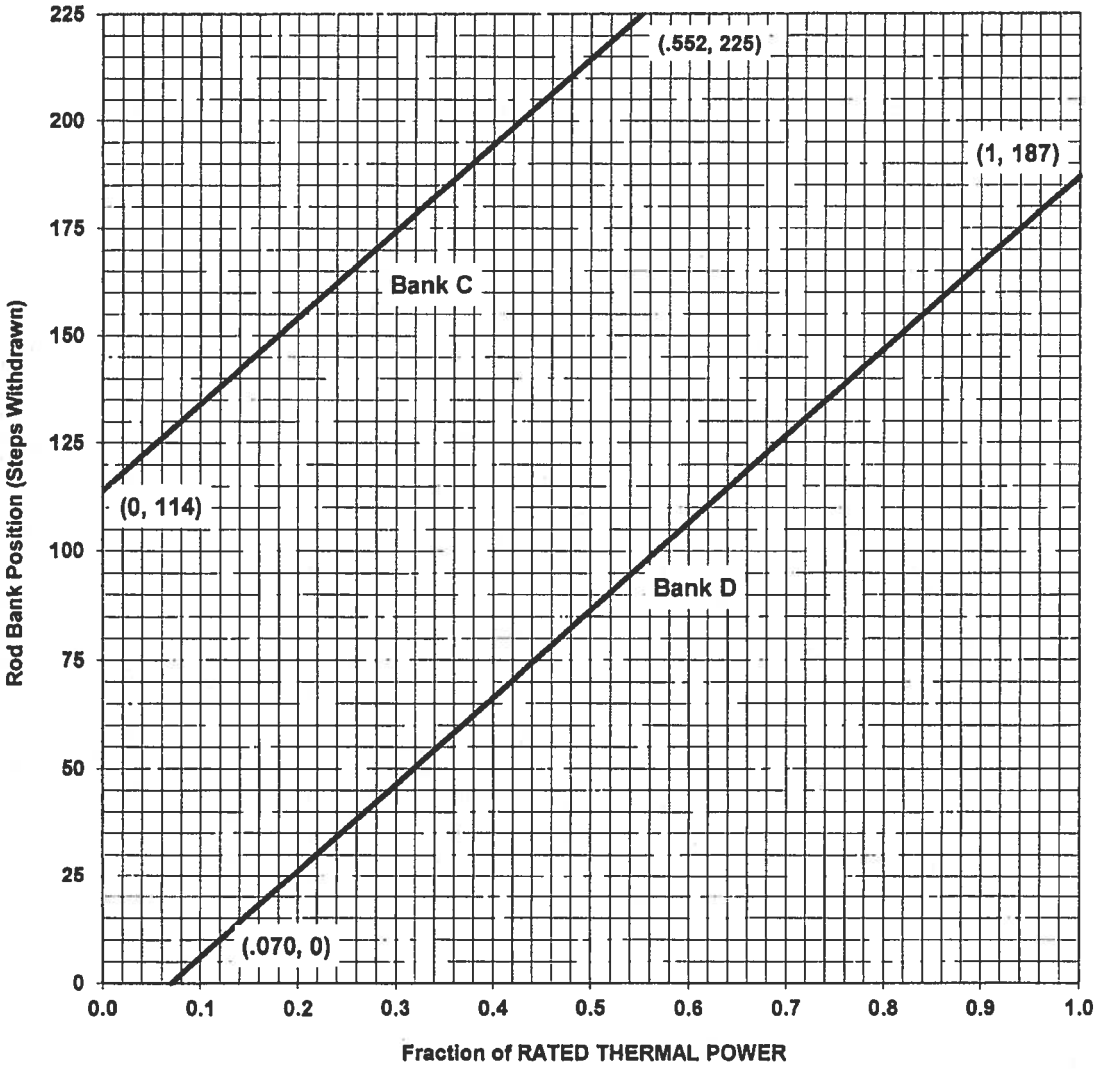
Table 5
Part Power (48%) RAOC W(Z)

	Axial Point	Elevation (feet)	150 MWD/MTU
*	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	1.1607
	7	10.80	1.1520
	8	10.60	1.1427
	9	10.40	1.1361
	10	10.20	1.1309
	11	10.00	1.1252
	12	9.80	1.1134
	13	9.60	1.1083
	14	9.40	1.0933
	15	9.20	1.0805
	16	9.00	1.0662
	17	8.80	1.0663
	18	8.60	1.0697
	19	8.40	1.0752
	20	8.20	1.0757
	21	8.00	1.0792
	22	7.80	1.0822
	23	7.60	1.0827
	24	7.40	1.0840
	25	7.20	1.0847
	26	7.00	1.0842
	27	6.80	1.0805
	28	6.60	1.0787
	29	6.40	1.0778
	30	6.20	1.0713
	31	6.00	1.0675
	32	5.80	1.0636
	33	5.60	1.0604
	34	5.40	1.0607
	35	5.20	1.0760
	36	5.00	1.0897
	37	4.80	1.1047
	38	4.60	1.1207
	39	4.40	1.1356
	40	4.20	1.1493
	41	4.00	1.1635
	42	3.80	1.1811
	43	3.60	1.1997
	44	3.40	1.2174
	45	3.20	1.2340
	46	3.00	1.2498
	47	2.80	1.2648
	48	2.60	1.2958
	49	2.40	1.3321
	50	2.20	1.3677
	51	2.00	1.4039
	52	1.80	1.4397
	53	1.60	1.4746
	54	1.40	1.5088
	55	1.20	1.5423
	56	1.00	1.5720
*	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 5 axial points excluded per Technical Specification B3.2.1.**

Figure 1
Rod Bank Insertion Limits versus Rated Thermal Power

Fully Withdrawn – 225 to 231 steps, inclusive



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 128 steps.

Figure 2
K(Z) – Normalized $F_Q(Z)$ as a Function of Core Height

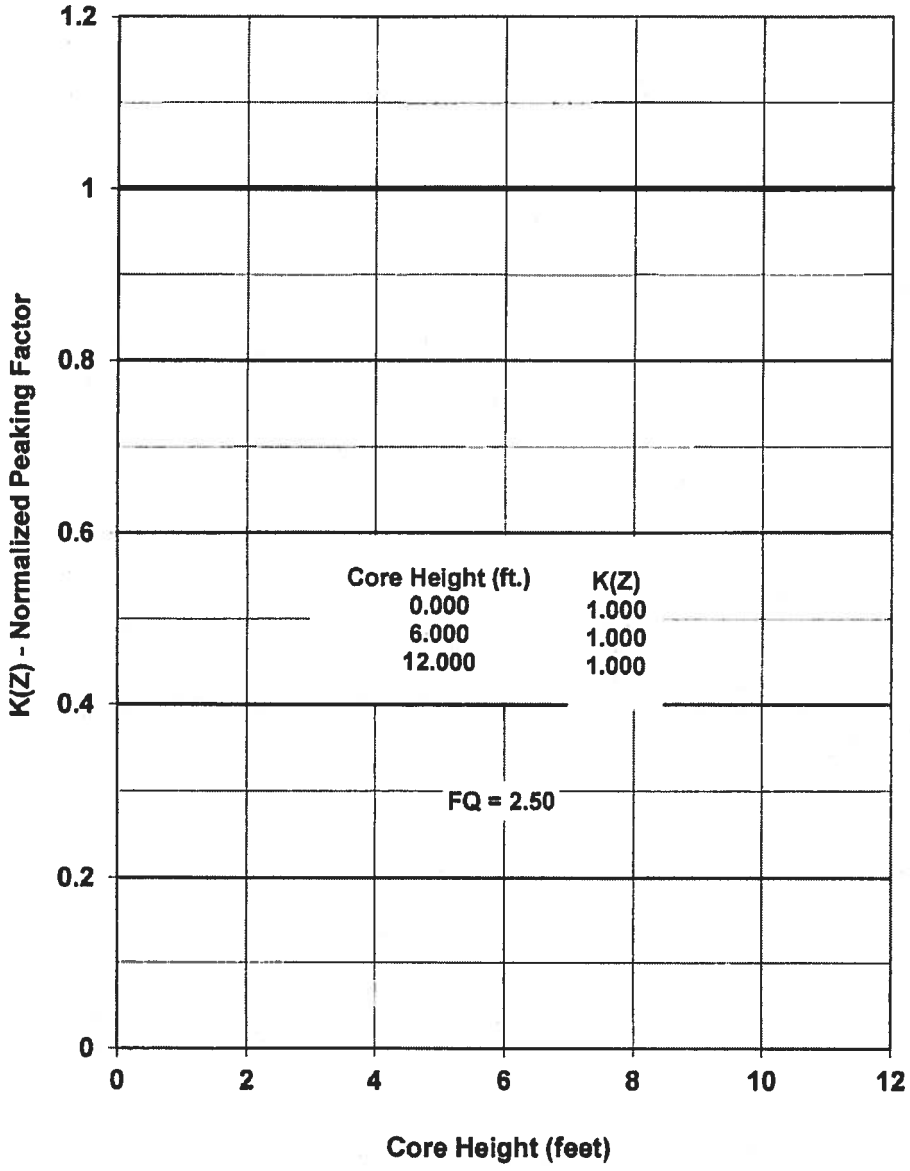


Figure 3
Axial Flux Difference Limits as a Function of
Rated Thermal Power for RAOC

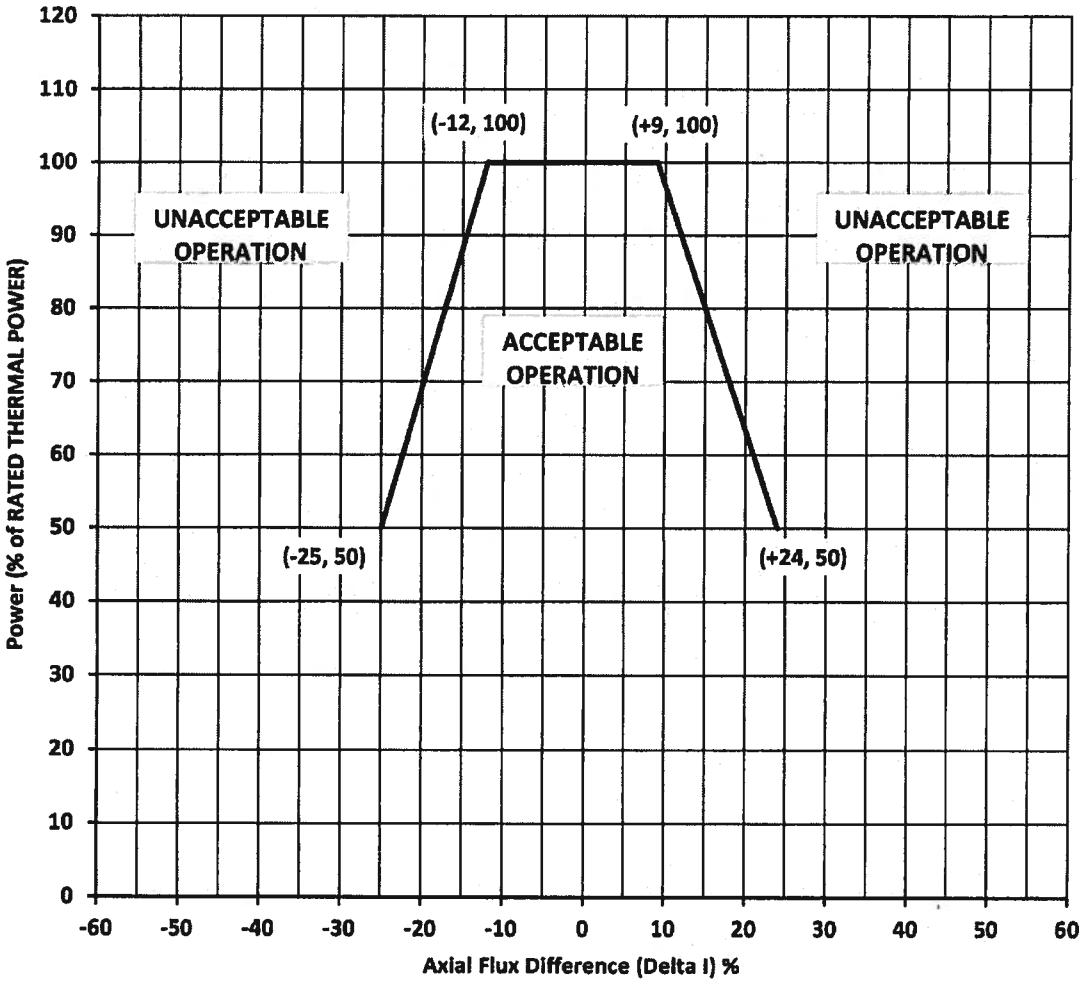


Figure 4
Reactor Core Safety Limits