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April 23, 2004

Docket No.: 50-364

NL-04-0698

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

Joseph M. Farley Nuclear Plant – Unit 2
Cycle 17 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 Farley Nuclear Plant Unit 2 Cycle 17.

This letter contains no NRC commitments. If there are any questions, please advise.

Sincerely,

L. M. Stinson

LMS/WAS/sdl

Enclosure: FNP Core Operating Limits Report Unit 2 – Cycle 17, February 2004

cc: Southern Nuclear Operating Company
Mr. J. B. Beasley, Jr., Executive Vice President
Mr. D. E. Grissette, General Manager – Plant Farley
RTYPE: CFA04.054; LC# 14020

U. S. Nuclear Regulatory Commission
Mr. L. A. Reyes, Regional Administrator (2 copies)
Mr. S. E. Peters, NRR Project Manager – Farley
Mr. C. A. Patterson, Senior Resident Inspector – Farley

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ENCLOSURE

Core Operating Limits Report

Joseph M. Farley Nuclear Plant

Unit 2 – Cycle 17 Revision 0

February 2004

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for FNP UNIT 2 CYCLE 17 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 Δk/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 Δk/k.

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

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 than or equal to $+0.7 \times 10^{-4}$ Δk/k/°F for power levels up to 70 percent RTP with a linear ramp to 0 Δk/k/°F at 100 percent RTP.

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

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

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

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 $P \le 0.5$

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 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 $P \le 0.5$

2.6.5 W(Z) values are provided in Table 4.

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 $F^N_{\Delta H} \leq F^{RTP}_{\Delta H} * \left(1 + PF_{\Delta H} * (1 - P)\right)$

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

2.7.2 $F^{RTP}_{\Delta H} = 1.70$

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 ≥ 263,400 GPM when using the precision heat balance method and ≥ 264,200 GPM when using the elbow tap method.

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[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
5461	1.020
5666	1.023
5870	1.027
6074	1.028
6279	1.024
6483	1.021
6687	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

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

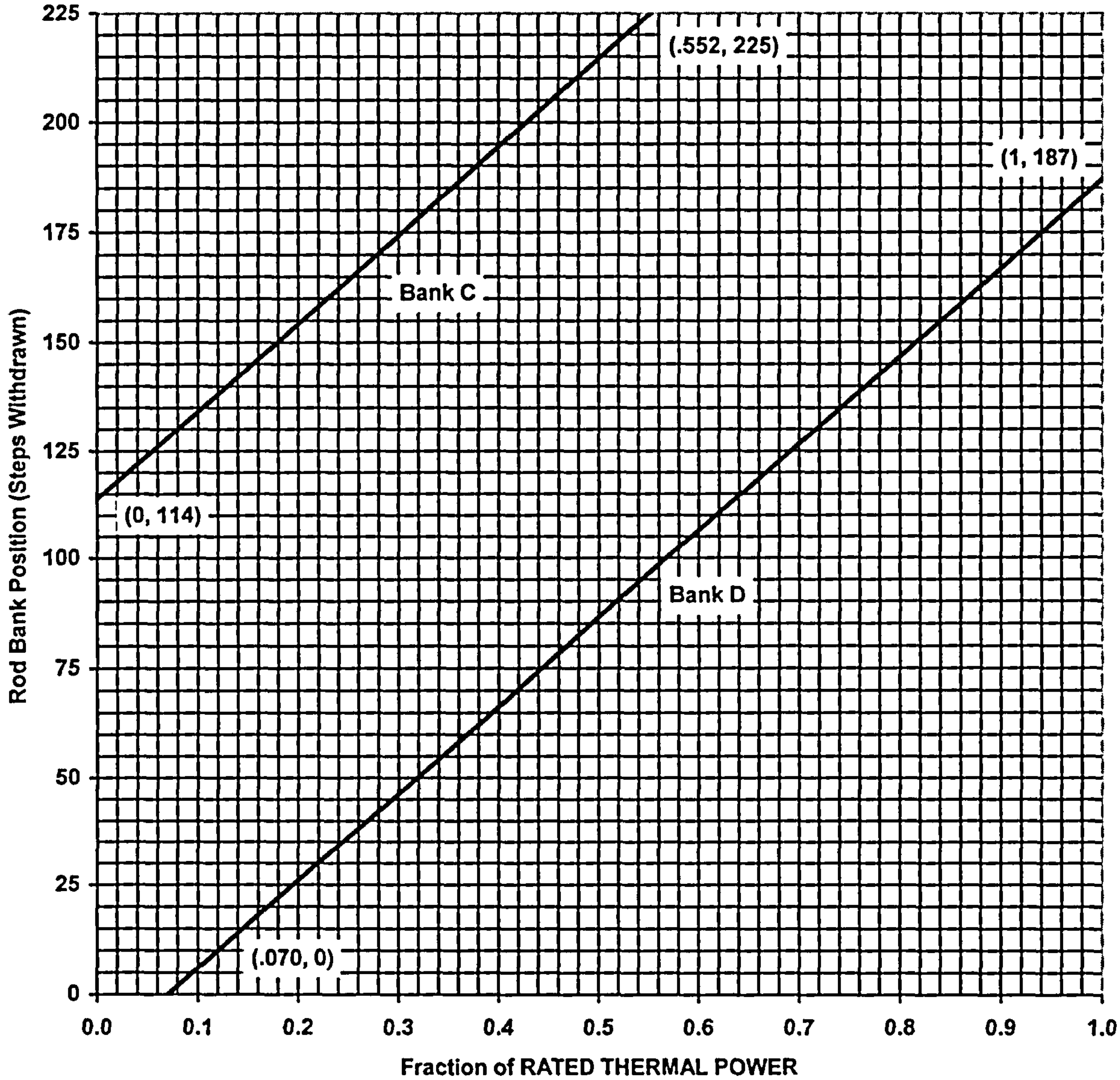
Table 4
RAOC W(Z)

	Axial Point	Elevation (feet)	150 MWD/MTU	4000 MWD/MTU	10000 MWD/MTU	19000 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	1.0000	1.0000	1.0000	1.0000
*	7	10.80	1.0000	1.0000	1.0000	1.0000
*	8	10.60	1.0000	1.0000	1.0000	1.0000
*	9	10.40	1.0000	1.0000	1.0000	1.0000
*	10	10.20	1.0000	1.0000	1.0000	1.0000
	11	10.00	1.2024	1.2407	1.2595	1.2305
	12	9.80	1.1963	1.2284	1.2591	1.2374
	13	9.60	1.1914	1.2181	1.2593	1.2448
	14	9.40	1.1883	1.2131	1.2603	1.2524
	15	9.20	1.1829	1.2045	1.2588	1.2570
	16	9.00	1.1750	1.1986	1.2584	1.2667
	17	8.80	1.1745	1.2056	1.2638	1.2754
	18	8.60	1.1830	1.2095	1.2764	1.2906
	19	8.40	1.1941	1.2183	1.2888	1.3149
	20	8.20	1.2039	1.2245	1.2975	1.3338
	21	8.00	1.2124	1.2283	1.3033	1.3492
	22	7.80	1.2189	1.2297	1.3059	1.3612
	23	7.60	1.2232	1.2289	1.3057	1.3695
	24	7.40	1.2256	1.2260	1.3026	1.3741
	25	7.20	1.2263	1.2212	1.2969	1.3754
	26	7.00	1.2251	1.2148	1.2888	1.3746
	27	6.80	1.2225	1.2068	1.2785	1.3713
	28	6.60	1.2186	1.1975	1.2661	1.3649
	29	6.40	1.2134	1.1870	1.2521	1.3557
	30	6.20	1.2070	1.1754	1.2363	1.3439
	31	6.00	1.1540	1.1400	1.1954	1.3034
	32	5.80	1.1472	1.1283	1.1776	1.2872
	33	5.60	1.1488	1.1255	1.1626	1.2681
	34	5.40	1.1624	1.1342	1.1545	1.2478
	35	5.20	1.1740	1.1409	1.1516	1.2334
	36	5.00	1.1846	1.1468	1.1513	1.2314
	37	4.80	1.1946	1.1523	1.1508	1.2273
	38	4.60	1.2037	1.1568	1.1489	1.2214
	39	4.40	1.2117	1.1606	1.1461	1.2136
	40	4.20	1.2186	1.1636	1.1422	1.2038
	41	4.00	1.2244	1.1650	1.1375	1.1922
	42	3.80	1.2287	1.1683	1.1313	1.1790
	43	3.60	1.2324	1.1735	1.1261	1.1641
	44	3.40	1.2386	1.1779	1.1243	1.1510
	45	3.20	1.2497	1.1826	1.1234	1.1398
	46	3.00	1.2626	1.1901	1.1276	1.1302
	47	2.80	1.2742	1.2047	1.1357	1.1245
	48	2.60	1.2867	1.2245	1.1424	1.1258
	49	2.40	1.3037	1.2431	1.1494	1.1390
	50	2.20	1.3209	1.2614	1.1563	1.1517
	51	2.00	1.3370	1.2814	1.1633	1.1641
*	52	1.80	1.0000	1.0000	1.0000	1.0000
*	53	1.60	1.0000	1.0000	1.0000	1.0000
*	54	1.40	1.0000	1.0000	1.0000	1.0000
*	55	1.20	1.0000	1.0000	1.0000	1.0000
*	56	1.00	1.0000	1.0000	1.0000	1.0000
*	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 15% 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

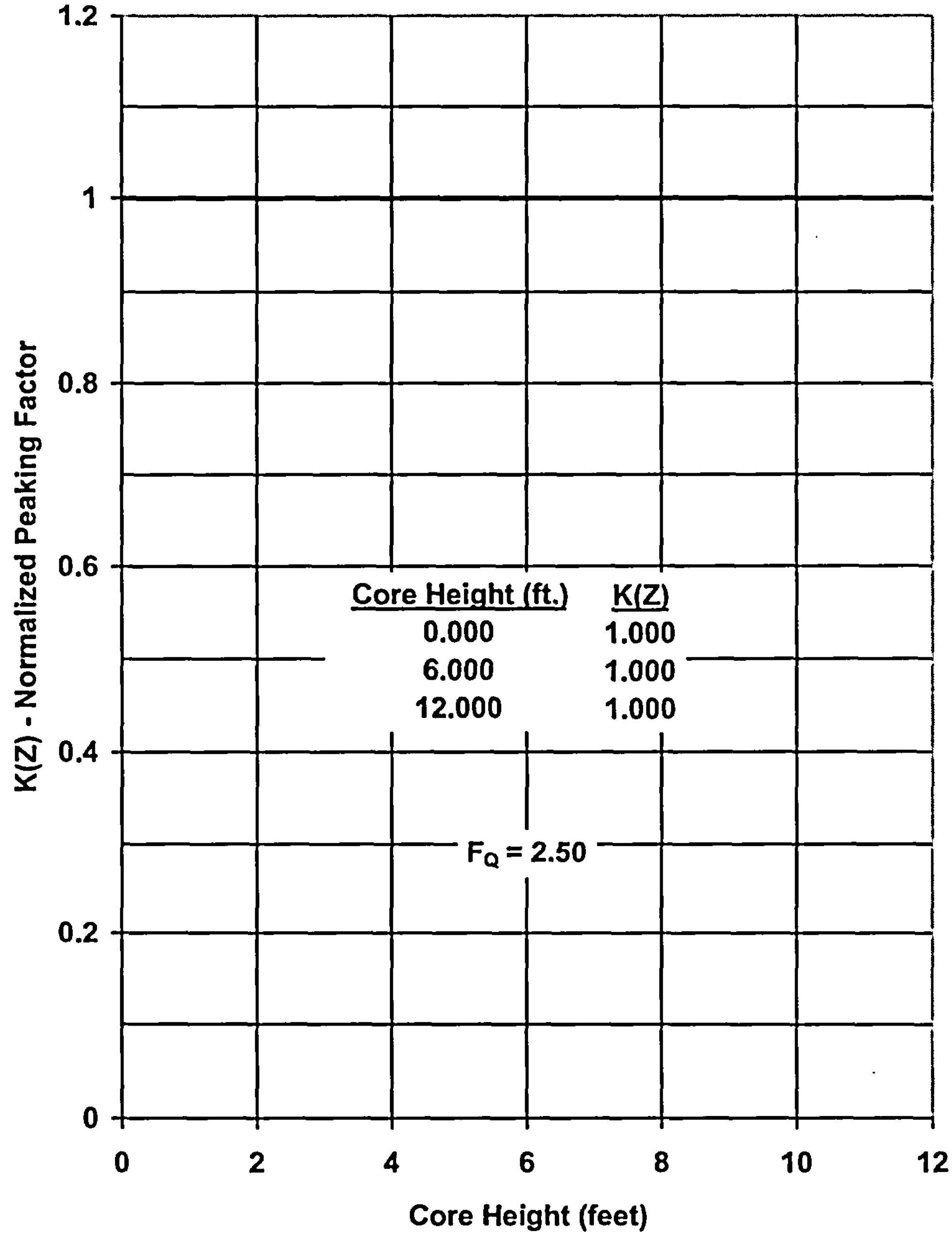


Figure 3
Axial Flux Difference Limits as a Function of Rated Thermal Power for RAOC

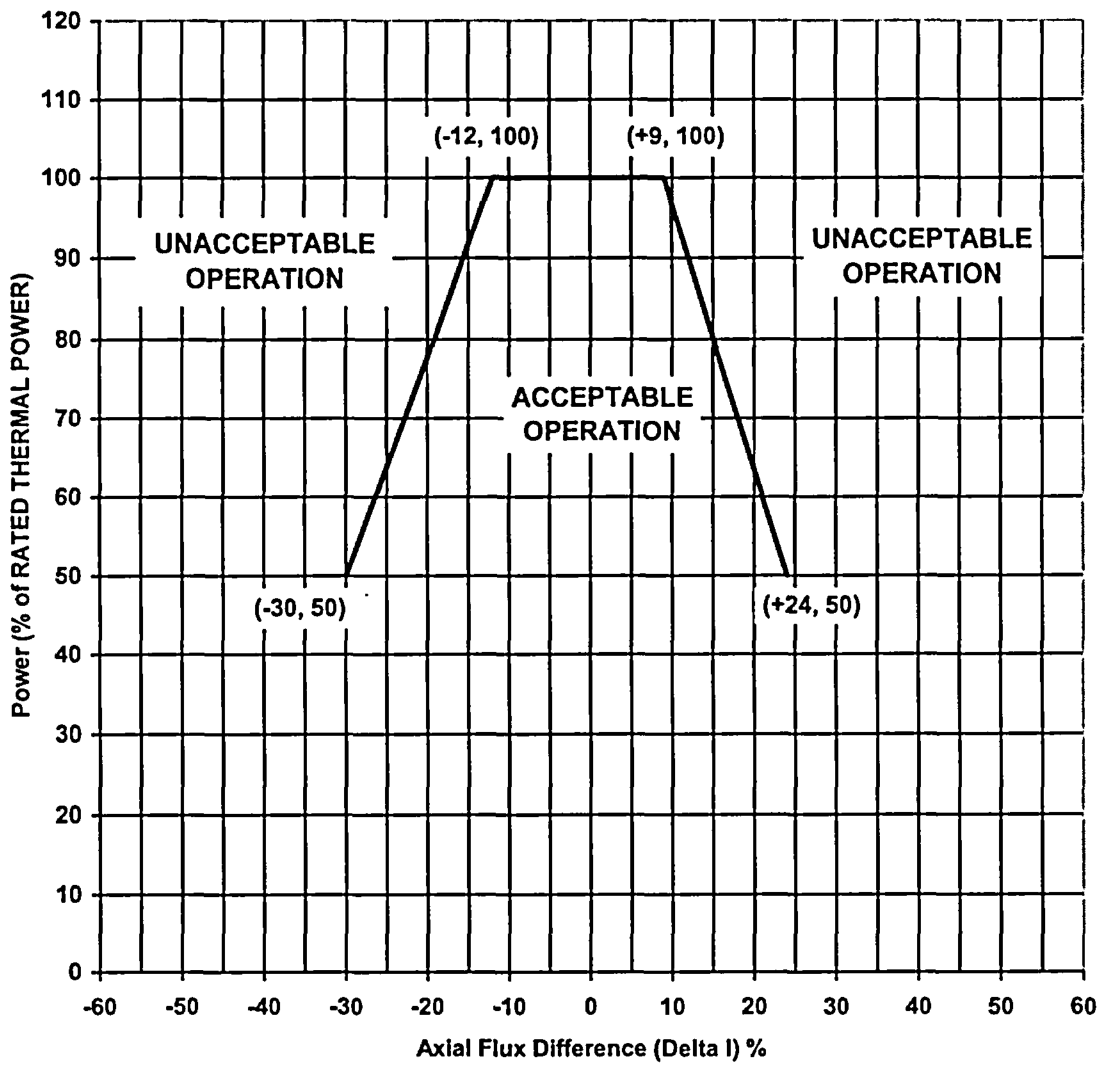


Figure 4
Reactor Core Safety Limits