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SOUTHERN COMPANY
Energy to Serve Your World℠

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U. S. Nuclear Regulatory Commission
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Washington, DC 20555

Joseph M. Farley Nuclear Plant – Unit 1
Cycle 18 Core Operating Limits Report Revision 2

Ladies and Gentlemen:

In accordance with Technical Specification 5.6.5.d, Southern Nuclear Operating Company submits the enclosed Core Operating Limits Report (COLR) revision for Farley Nuclear Plant Unit 1 Cycle 18. The Revision 2 COLR reflects changes to the W(Z) Curves (Figures 4 – 7).

If there are any questions, please advise.

Respectfully submitted,

Dave Morey

MGE/kw: colr08.doc

Enclosure:
FNP Core Operating Limits Report Unit 1 - Cycle 18 Revision 2

A001

cc: Southern Nuclear Operating Company
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U. S. Nuclear Regulatory Commission, Washington, D. C.
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U. S. Nuclear Regulatory Commission, Region II
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ENCLOSURE

Core Operating Limits Report

Joseph M. Farley Nuclear Plant

Unit 1 - Cycle 18 Revision 2

December 2001

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for FNP UNIT 1 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 (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 $F_Q(Z) \leq \frac{F_Q^{RTP}}{P} * K(Z)$ for P > 0.5

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

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

2.6.5 W(Z) values are provided in Figures 4 through 7.

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 8.

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
4644	1.020
4848	1.023
5052	1.021
5256	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

$T'' \leq 577.2°F$

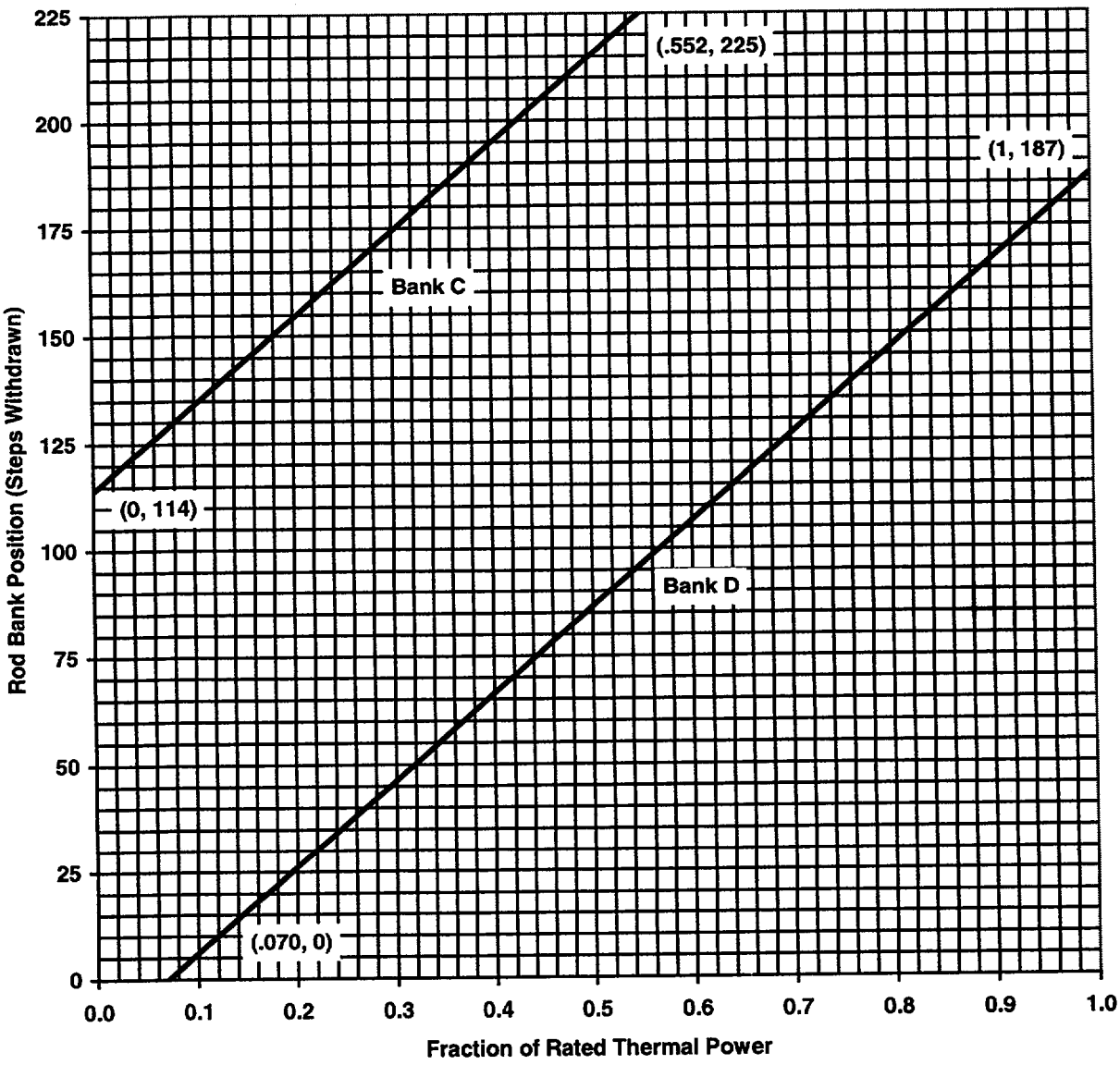
$K_4 = 1.10$	$K_5 = 0.02/°F$ for increasing T_{avg}	$K_6 = 0.00109/°F$ when $T > T''$
	$K_5 = 0/°F$ for decreasing T_{avg}	$K_6 = 0/°F$ when $T \leq T''$

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

$f_2(\Delta I) = 0\%$ RTP for all ΔI

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

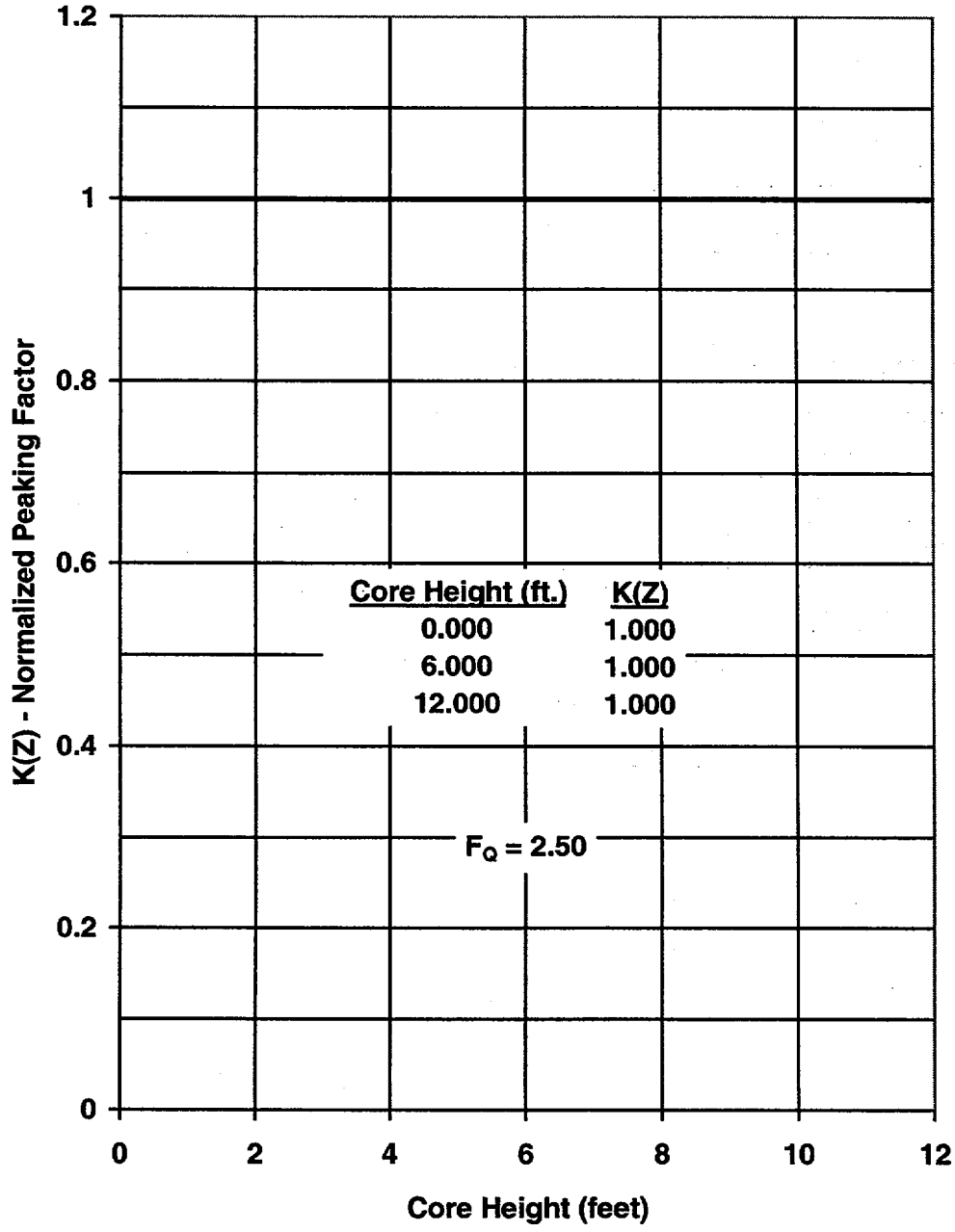


Figure 3
Axial Flux Difference Limits as a Function of
Rated Thermal Power for RAOC

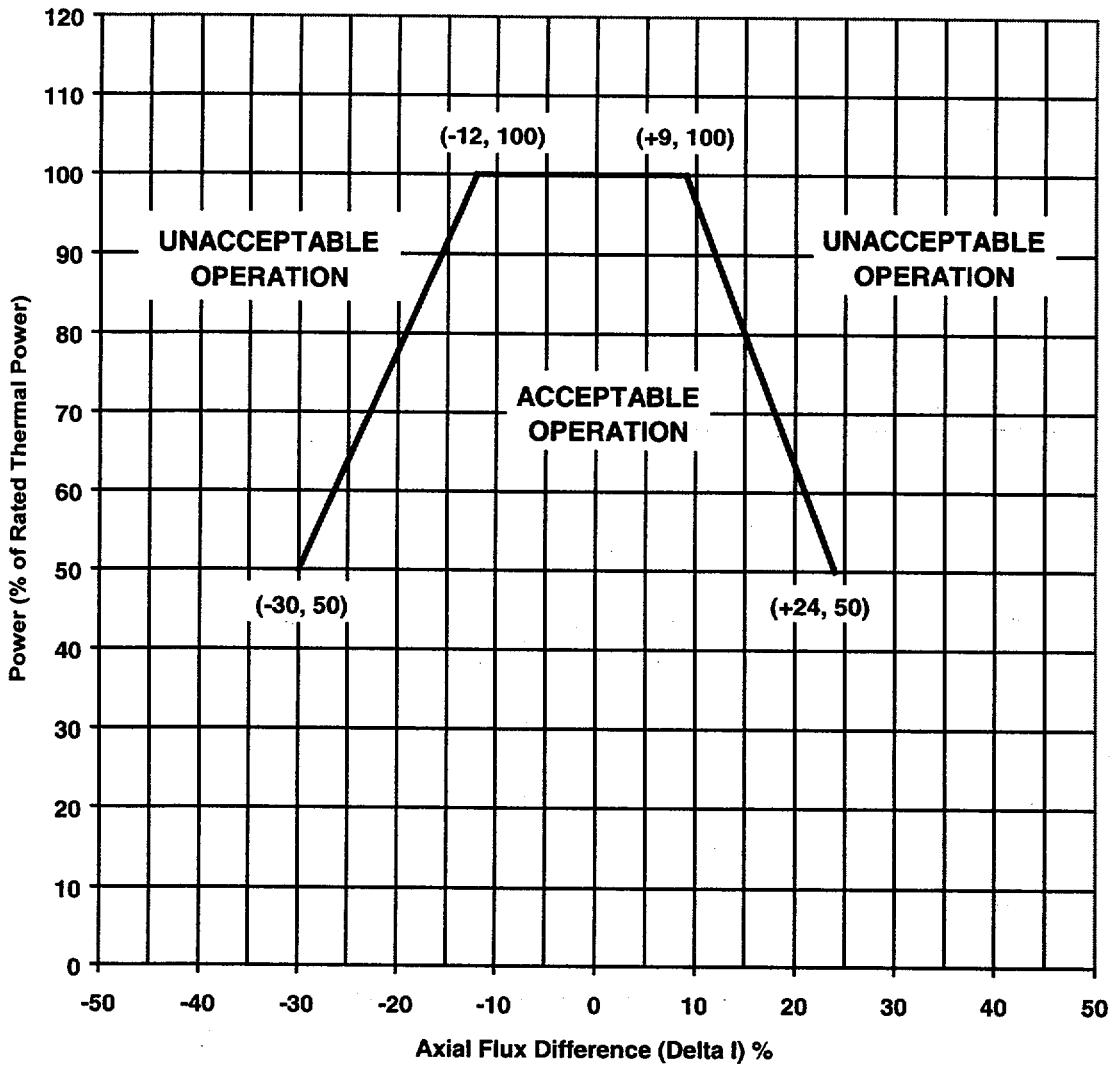
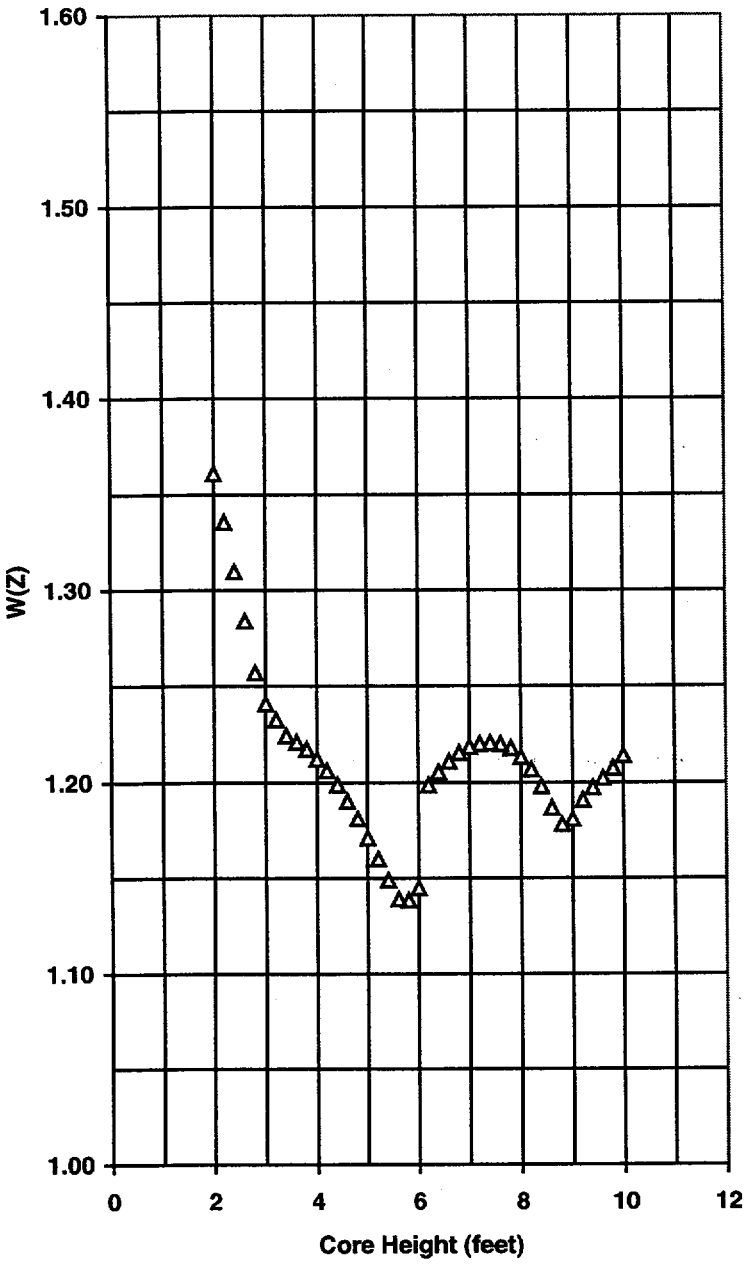


Figure 4
RAOC W(Z) at 150 MWD/MTU

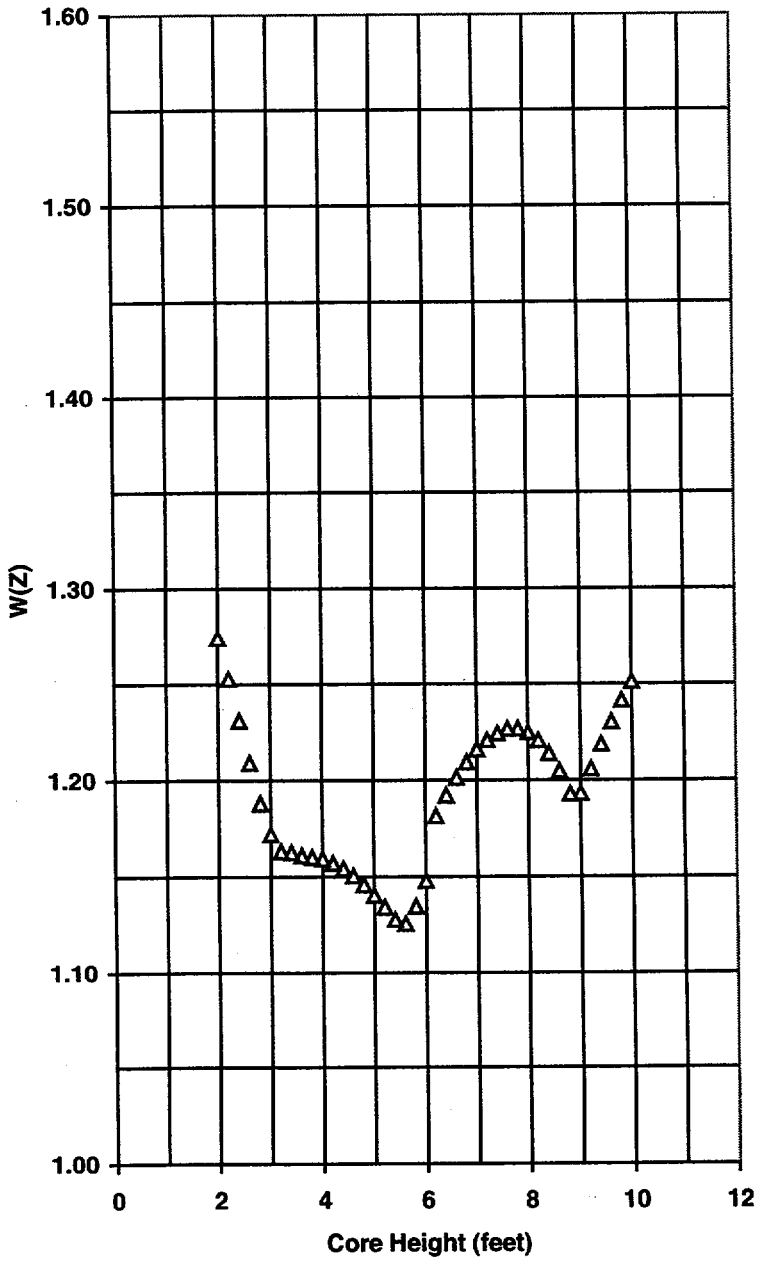


	Axial Point	Elevation (feet)	BOL W(Z)
*	1	12.00	1.0000
*	2	11.80	1.0000
*	3	11.60	1.0000
*	4	11.40	1.0000
*	5	11.20	1.0000
*	6	11.00	1.0000
*	7	10.80	1.0000
*	8	10.60	1.0000
*	9	10.40	1.0000
*	10	10.20	1.0000
	11	10.00	1.2141
	12	9.80	1.2076
	13	9.60	1.2024
	14	9.40	1.1975
	15	9.20	1.1911
	16	9.00	1.1812
	17	8.80	1.1783
	18	8.60	1.1871
	19	8.40	1.1982
	20	8.20	1.2069
	21	8.00	1.2134
	22	7.80	1.2178
	23	7.60	1.2201
	24	7.40	1.2205
	25	7.20	1.2201
	26	7.00	1.2186
	27	6.80	1.2156
	28	6.60	1.2111
	29	6.40	1.2055
	30	6.20	1.1989
	31	6.00	1.1450
	32	5.80	1.1385
	33	5.60	1.1392
	34	5.40	1.1491
	35	5.20	1.1604
	36	5.00	1.1712
	37	4.80	1.1814
	38	4.60	1.1907
	39	4.40	1.1990
	40	4.20	1.2063
	41	4.00	1.2124
	42	3.80	1.2174
	43	3.60	1.2210
	44	3.40	1.2244
	45	3.20	1.2326
	46	3.00	1.2409
	47	2.80	1.2569
	48	2.60	1.2839
	49	2.40	1.3100
	50	2.20	1.3358
	51	2.00	1.3612
*	52	1.80	1.0000
*	53	1.60	1.0000
*	54	1.40	1.0000
*	55	1.20	1.0000
*	56	1.00	1.0000
*	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 15% Excluded per Technical Specification B3.2.1.

This figure is referred to by Technical Specification B3.2.1.

Figure 5
RAOC W(Z) at 4000 MWD/MTU

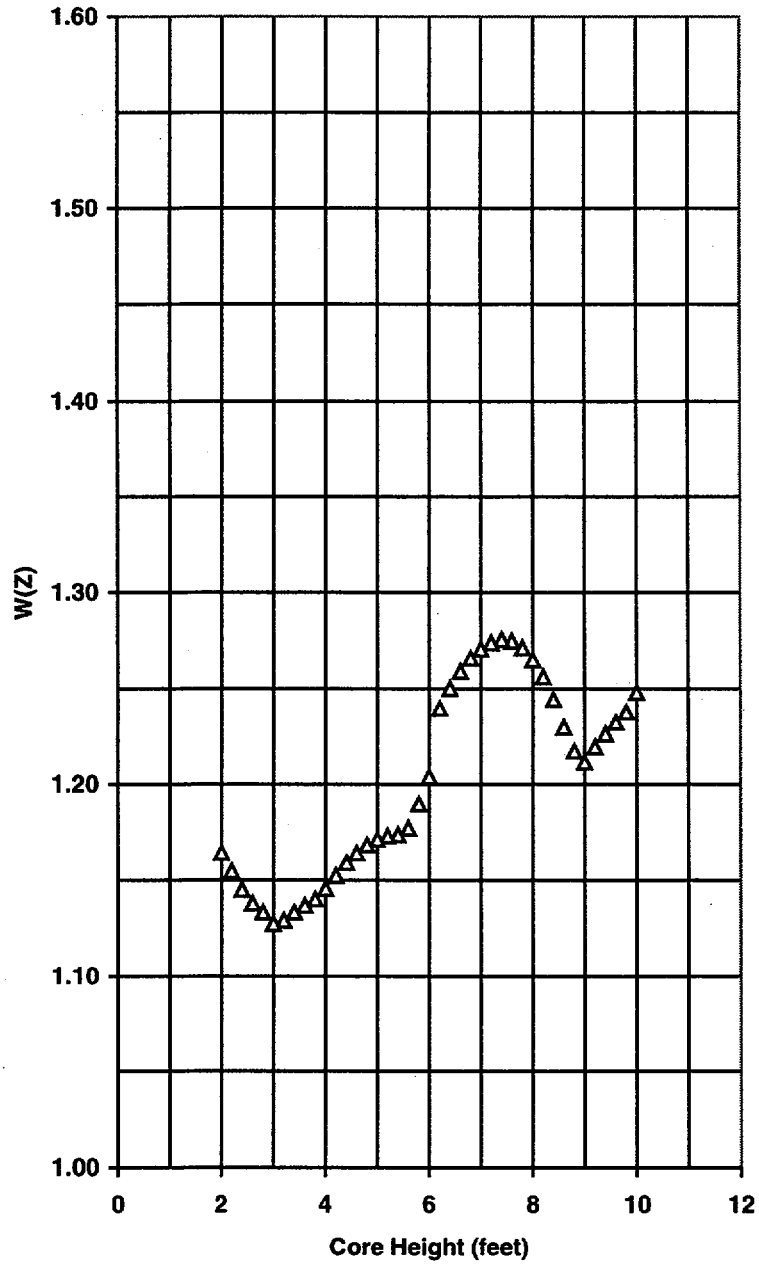


	Axial Point	Elevation (feet)	MOL-1 W(Z)
*	1	12.00	1.0000
*	2	11.80	1.0000
*	3	11.60	1.0000
*	4	11.40	1.0000
*	5	11.20	1.0000
*	6	11.00	1.0000
*	7	10.80	1.0000
*	8	10.60	1.0000
*	9	10.40	1.0000
*	10	10.20	1.0000
	11	10.00	1.2512
	12	9.80	1.2412
	13	9.60	1.2303
	14	9.40	1.2185
	15	9.20	1.2058
	16	9.00	1.1931
	17	8.80	1.1928
	18	8.60	1.2049
	19	8.40	1.2139
	20	8.20	1.2205
	21	8.00	1.2248
	22	7.80	1.2268
	23	7.60	1.2266
	24	7.40	1.2243
	25	7.20	1.2208
	26	7.00	1.2158
	27	6.80	1.2093
	28	6.60	1.2013
	29	6.40	1.1921
	30	6.20	1.1817
	31	6.00	1.1478
	32	5.80	1.1347
	33	5.60	1.1254
	34	5.40	1.1276
	35	5.20	1.1342
	36	5.00	1.1404
	37	4.80	1.1458
	38	4.60	1.1505
	39	4.40	1.1544
	40	4.20	1.1573
	41	4.00	1.1594
	42	3.80	1.1603
	43	3.60	1.1610
	44	3.40	1.1628
	45	3.20	1.1633
	46	3.00	1.1721
	47	2.80	1.1881
	48	2.60	1.2092
	49	2.40	1.2311
	50	2.20	1.2528
	51	2.00	1.2742
*	52	1.80	1.0000
*	53	1.60	1.0000
*	54	1.40	1.0000
*	55	1.20	1.0000
*	56	1.00	1.0000
*	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 15% Excluded per Technical Specification B3.2.1.

This figure is referred to by Technical Specification B3.2.1.

Figure 6
RAOC W(Z) at 10000 MWD/MTU

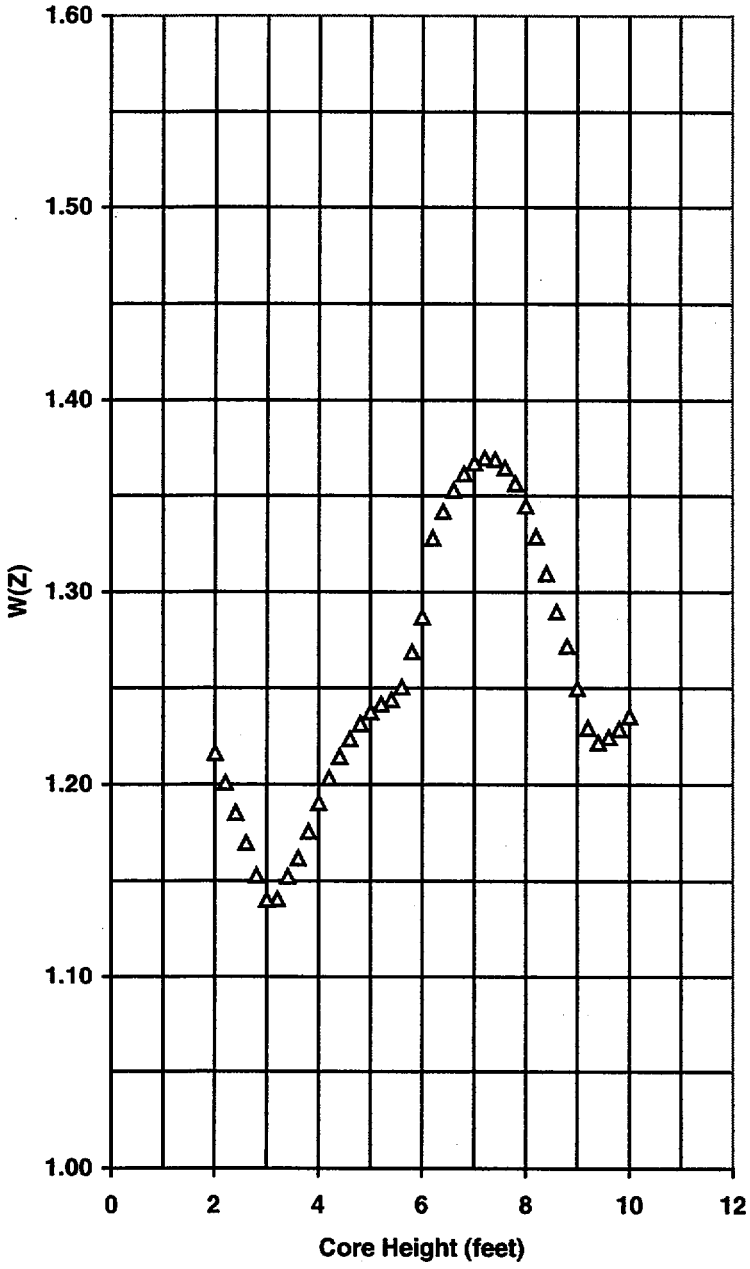


	Axial Point	Elevation (feet)	MOL-2 W(Z)
*	1	12.00	1.0000
*	2	11.80	1.0000
*	3	11.60	1.0000
*	4	11.40	1.0000
*	5	11.20	1.0000
*	6	11.00	1.0000
*	7	10.80	1.0000
*	8	10.60	1.0000
*	9	10.40	1.0000
*	10	10.20	1.0000
	11	10.00	1.2482
	12	9.80	1.2377
	13	9.60	1.2323
	14	9.40	1.2262
	15	9.20	1.2196
	16	9.00	1.2116
	17	8.80	1.2175
	18	8.60	1.2297
	19	8.40	1.2444
	20	8.20	1.2561
	21	8.00	1.2650
	22	7.80	1.2712
	23	7.60	1.2747
	24	7.40	1.2755
	25	7.20	1.2738
	26	7.00	1.2707
	27	6.80	1.2659
	28	6.60	1.2590
	29	6.40	1.2502
	30	6.20	1.2397
	31	6.00	1.2039
	32	5.80	1.1898
	33	5.60	1.1772
	34	5.40	1.1737
	35	5.20	1.1730
	36	5.00	1.1714
	37	4.80	1.1684
	38	4.60	1.1642
	39	4.40	1.1589
	40	4.20	1.1523
	41	4.00	1.1456
	42	3.80	1.1401
	43	3.60	1.1368
	44	3.40	1.1332
	45	3.20	1.1291
	46	3.00	1.1274
	47	2.80	1.1332
	48	2.60	1.1379
	49	2.40	1.1451
	50	2.20	1.1546
	51	2.00	1.1643
*	52	1.80	1.0000
*	53	1.60	1.0000
*	54	1.40	1.0000
*	55	1.20	1.0000
*	56	1.00	1.0000
*	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 15% Excluded per Technical Specification B3.2.1.

This figure is referred to by Technical Specification B3.2.1.

Figure 7
RAOC W(Z) at 18000 MWD/MTU



	Axial Point	Elevation (feet)	EOL W(Z)
*	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	1.0000
*	7	10.80	1.0000
*	8	10.60	1.0000
*	9	10.40	1.0000
*	10	10.20	1.0000
	11	10.00	1.2352
	12	9.80	1.2287
	13	9.60	1.2245
	14	9.40	1.2216
	15	9.20	1.2294
	16	9.00	1.2499
	17	8.80	1.2717
	18	8.60	1.2897
	19	8.40	1.3097
	20	8.20	1.3289
	21	8.00	1.3447
	22	7.80	1.3564
	23	7.60	1.3645
	24	7.40	1.3688
	25	7.20	1.3696
	26	7.00	1.3670
	27	6.80	1.3614
	28	6.60	1.3528
	29	6.40	1.3417
	30	6.20	1.3280
	31	6.00	1.2868
	32	5.80	1.2685
	33	5.60	1.2504
	34	5.40	1.2437
	35	5.20	1.2414
	36	5.00	1.2374
	37	4.80	1.2313
	38	4.60	1.2235
	39	4.40	1.2144
	40	4.20	1.2033
	41	4.00	1.1905
	42	3.80	1.1756
	43	3.60	1.1618
	44	3.40	1.1524
	45	3.20	1.1404
	46	3.00	1.1400
	47	2.80	1.1529
	48	2.60	1.1696
	49	2.40	1.1854
	50	2.20	1.2008
	51	2.00	1.2162
*	52	1.80	1.0000
*	53	1.60	1.0000
*	54	1.40	1.0000
*	55	1.20	1.0000
*	56	1.00	1.0000
*	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 15% Excluded per Technical Specification B3.2.1.

This figure is referred to by Technical Specification B3.2.1.

Figure 8
Reactor Core Safety Limits