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SOUTHERN COMPANY
Energy to Serve Your World℠

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

Joseph M. Farley Nuclear Plant – Unit 2
Cycle 16 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 16.

If there are any questions, please advise.

Respectfully submitted,

J. B. Beasley, Jr.

MGE/sdl: colr09.doc

Enclosure: FNP Core Operating Limits Report Unit 2 – Cycle 16

A001

cc: Southern Nuclear Operating Company
Mr. D. E. Grissette, General Manager – Farley

U. S. Nuclear Regulatory Commission, Washington, D. C.
Mr. F. Rinaldi, Licensing Project Manager – Farley

U. S. Nuclear Regulatory Commission, Region II
Mr. L. A. Reyes, Regional Administrator
Mr. T. P. Johnson, Senior Resident Inspector – Farley

ENCLOSURE

Core Operating Limits Report

Joseph M. Farley Nuclear Plant

Unit 2 – Cycle 16 Revision 0

July 2002

JOSEPH M. FARLEY NUCLEAR PLANT

CORE OPERATING LIMITS REPORT

UNIT 2 CYCLE 16

JULY 2002

REVISION 0

APPROVED FOR ISSUE:

9-24-02

OPERATIONS MANAGER / DATE

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for FNP UNIT 2 CYCLE 16 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/HZP-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
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: $P = \frac{THERMAL\ POWER}{RATED\ THERMAL\ POWER}$

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.

[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	1.062
150	1.062
354	1.070
558	1.072
763	1.071
967	1.064
1171	1.054
1375	1.042
1579	1.030
1783	1.020
5663	1.021
5867	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

$T'' \leq 577.2°F$

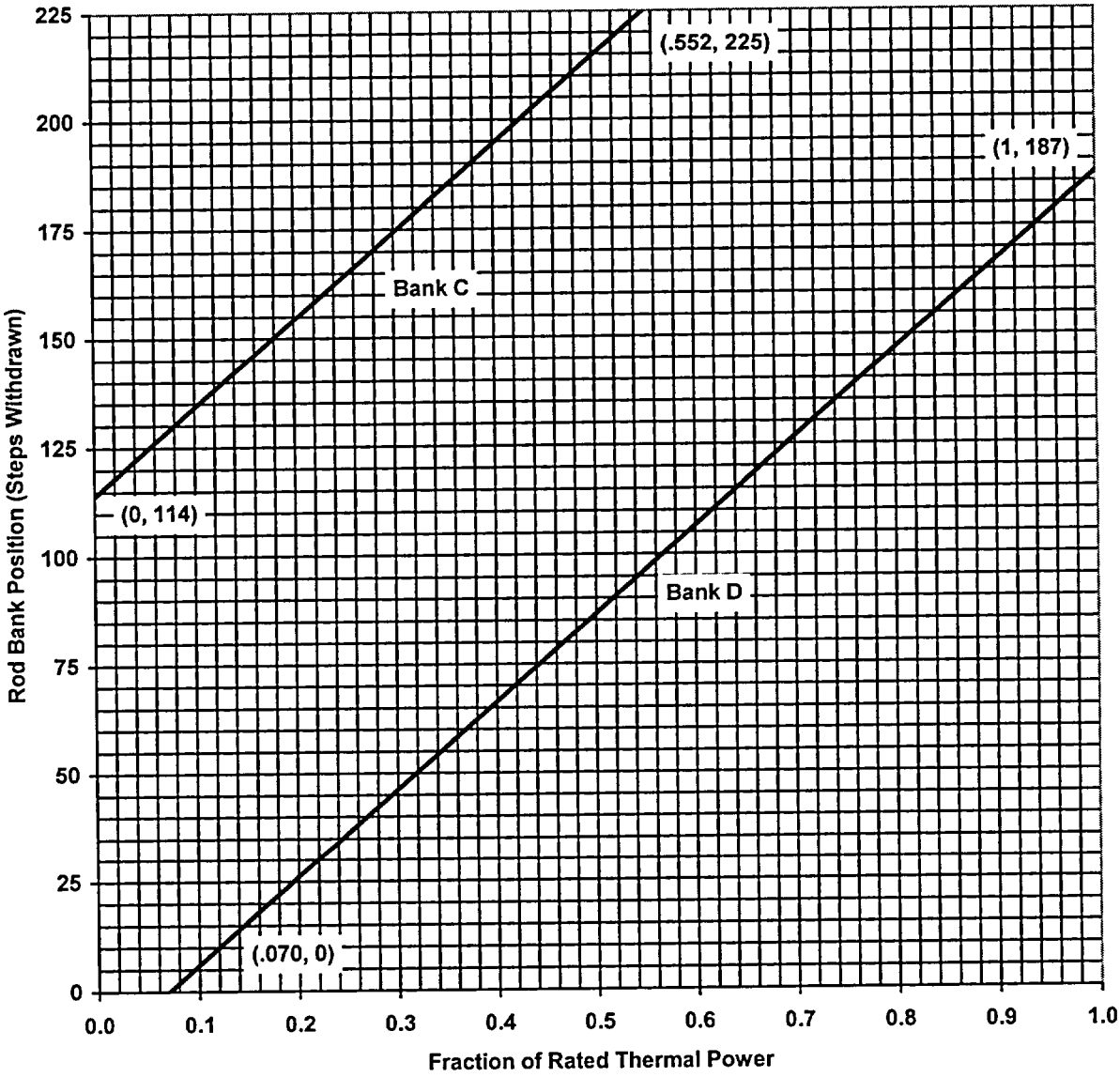
$K_4 = 1.10$	$K_5 = 0.02/°F$ for increasing T_{avg}	$K_6 = 0.00109/°F$ when $T > T''$
	$K_5 = 0/°F$ for decreasing T_{avg}	$K_6 = 0/°F$ when $T \leq T''$

$\tau_3 \geq 10$ 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

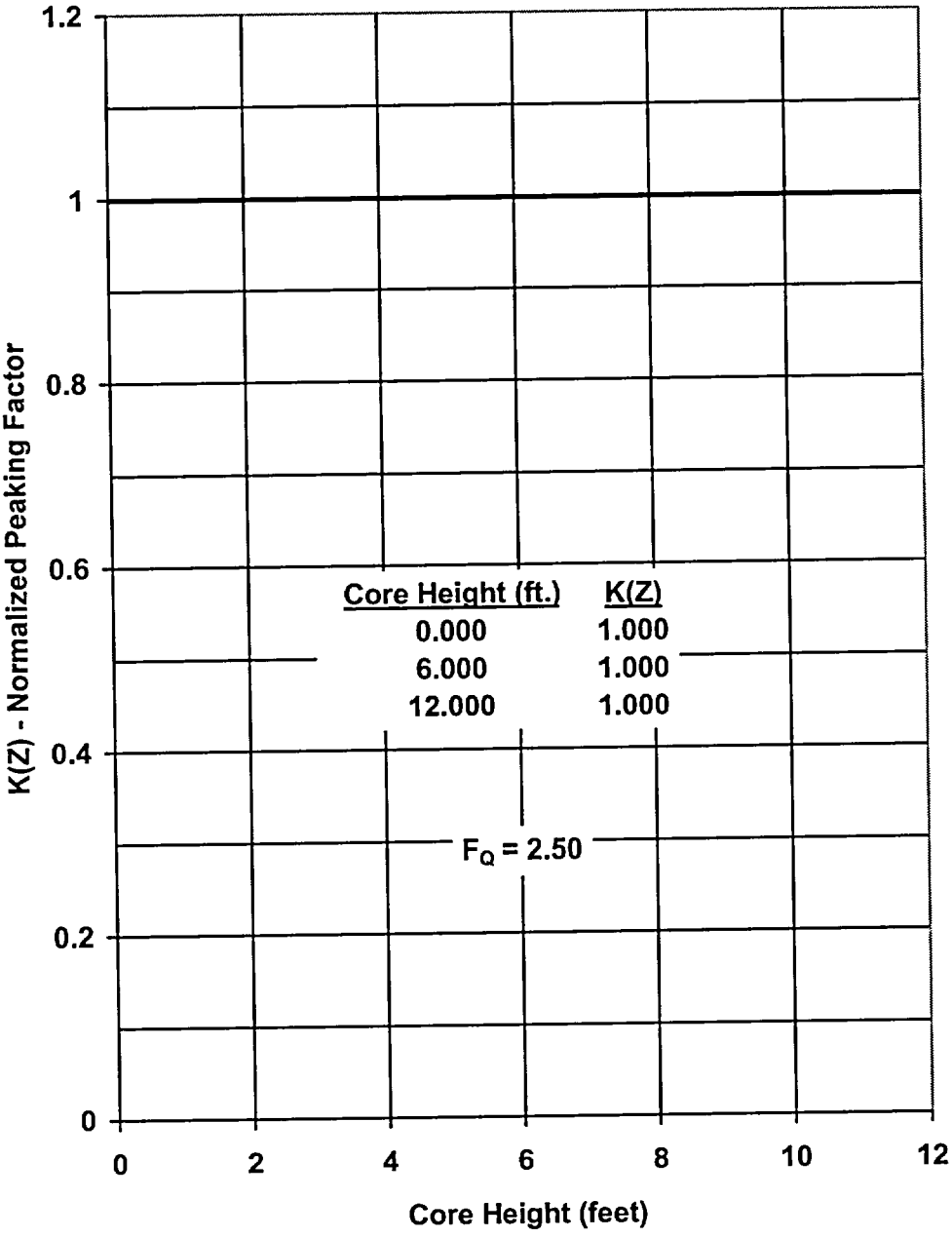


Figure 3
Axial Flux Difference Limits as a Function of Rated Thermal Power for RAOC

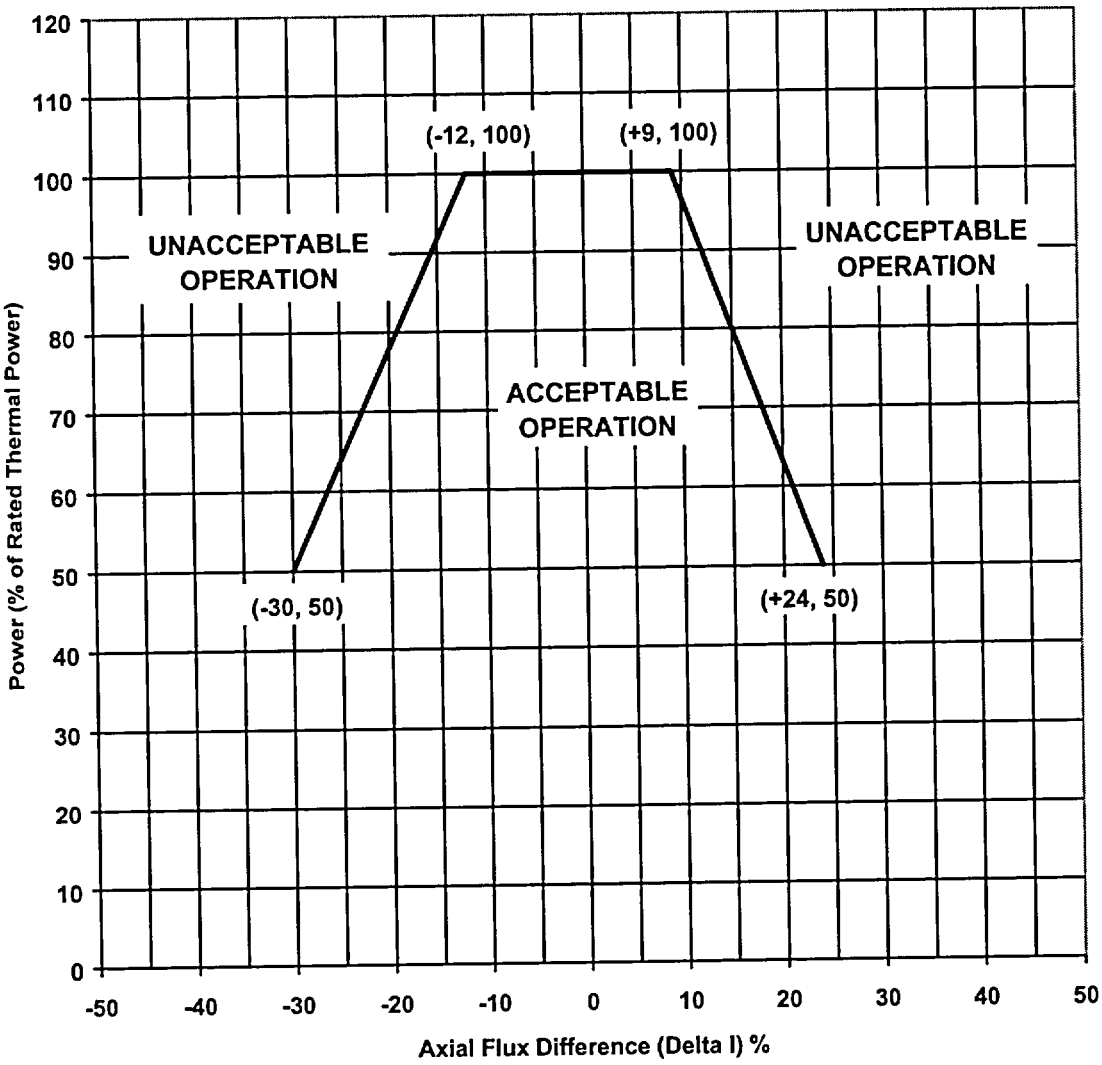
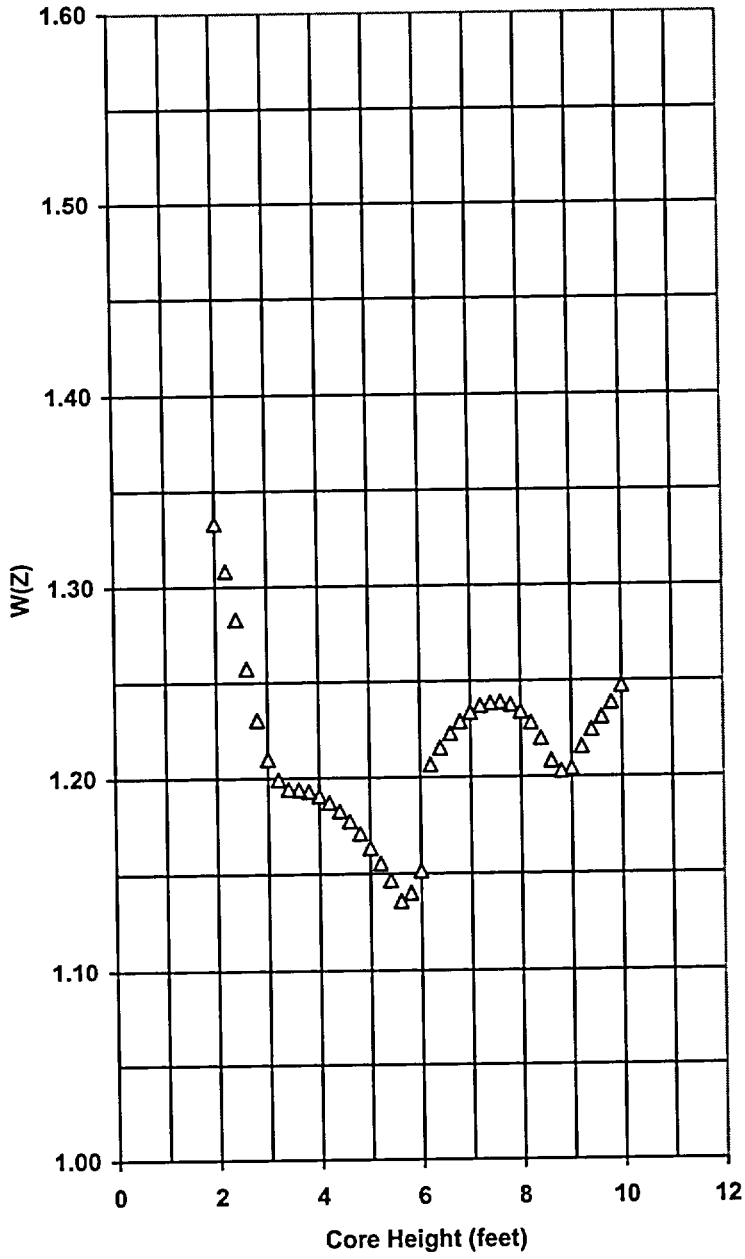


Figure 4
RAOC W(Z) at 150 MWD/MTU

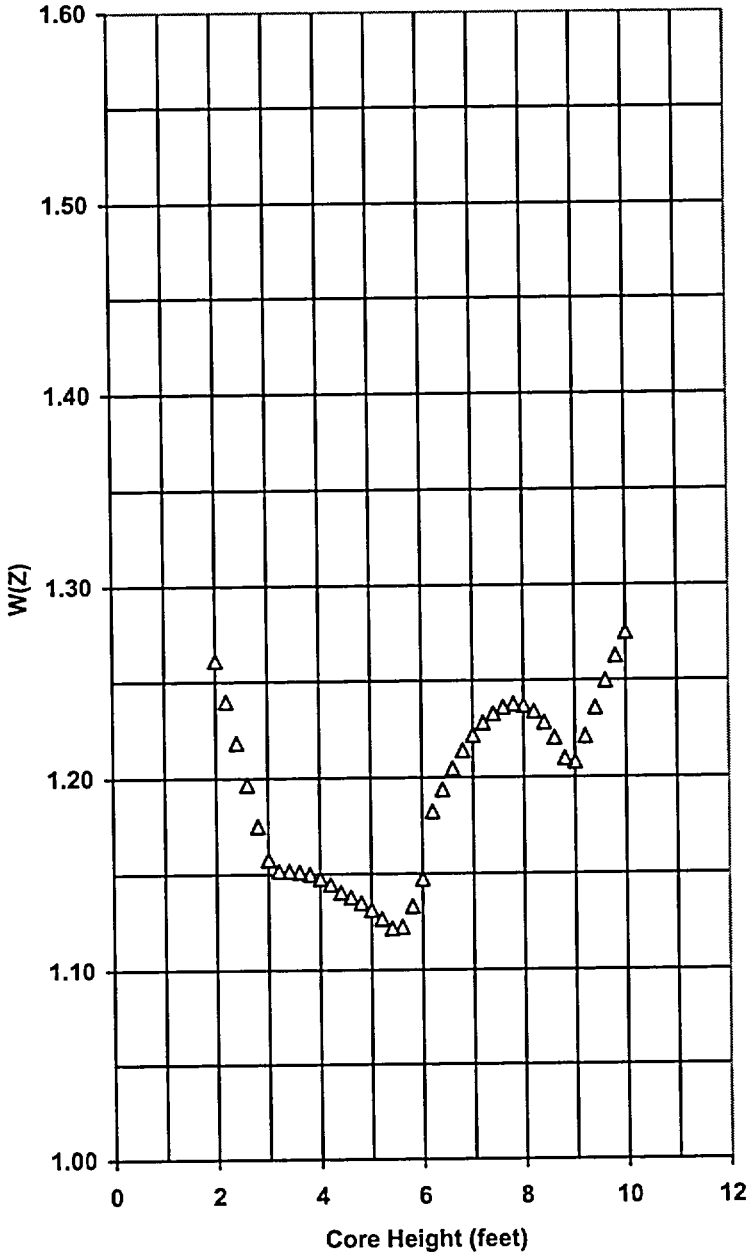


This figure is referred to by Technical Specification B3.2.1.

	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 2472
	12	9 80	1 2382
	13	9 60	1.2307
	14	9 40	1 2242
	15	9 20	1 2154
	16	9 00	1 2041
	17	8 80	1 2029
	18	8 60	1.2082
	19	8 40	1 2198
	20	8 20	1 2280
	21	8 00	1 2338
	22	7 80	1 2375
	23	7 60	1 2388
	24	7.40	1.2383
	25	7 20	1 2369
	26	7 00	1 2335
	27	6 80	1 2288
	28	6 60	1 2225
	29	6 40	1 2150
	30	6 20	1.2065
	31	6 00	1 1513
	32	5 80	1 1401
	33	5 60	1 1358
	34	5 40	1 1466
	35	5 20	1 1554
	36	5 00	1.1633
	37	4 80	1 1708
	38	4 60	1 1772
	39	4 40	1 1827
	40	4 20	1 1872
	41	4 00	1 1906
	42	3 80	1.1930
	43	3 60	1 1940
	44	3 40	1 1944
	45	3 20	1 1992
	46	3 00	1 2099
	47	2 80	1 2302
	48	2.60	1.2573
	49	2 40	1 2828
	50	2 20	1 3082
	51	2 00	1 3332
*	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.

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

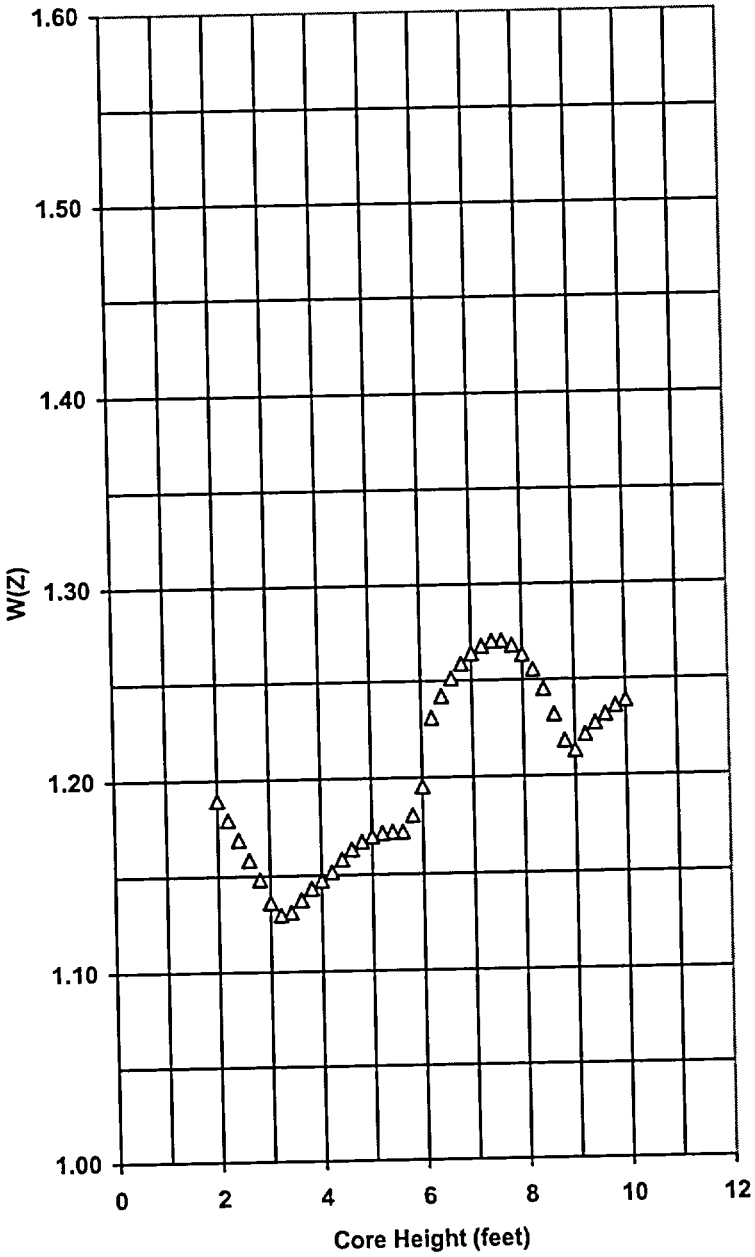


This figure is referred to by Technical Specification B3.2.1.

	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 2747
	12	9 80	1.2627
	13	9 60	1 2497
	14	9 40	1 2357
	15	9 20	1 2210
	16	9 00	1 2079
	17	8 80	1 2097
	18	8 60	1 2204
	19	8 40	1 2283
	20	8 20	1.2339
	21	8 00	1 2370
	22	7 80	1 2377
	23	7 60	1 2361
	24	7 40	1 2327
	25	7 20	1 2280
	26	7 00	1 2217
	27	6 80	1.2138
	28	6 60	1 2045
	29	6 40	1 1939
	30	6 20	1 1823
	31	6 00	1 1472
	32	5 80	1 1330
	33	5 60	1 1223
	34	5 40	1.1216
	35	5 20	1 1265
	36	5 00	1 1312
	37	4 80	1 1348
	38	4 60	1 1378
	39	4 40	1 1404
	40	4 20	1 1445
	41	4 00	1 1476
	42	3 80	1.1498
	43	3.60	1 1510
	44	3 40	1 1515
	45	3 20	1 1517
	46	3 00	1 1576
	47	2 80	1 1751
	48	2 60	1 1969
	49	2 40	1 2184
	50	2.20	1.2398
	51	2 00	1 2610
*	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

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

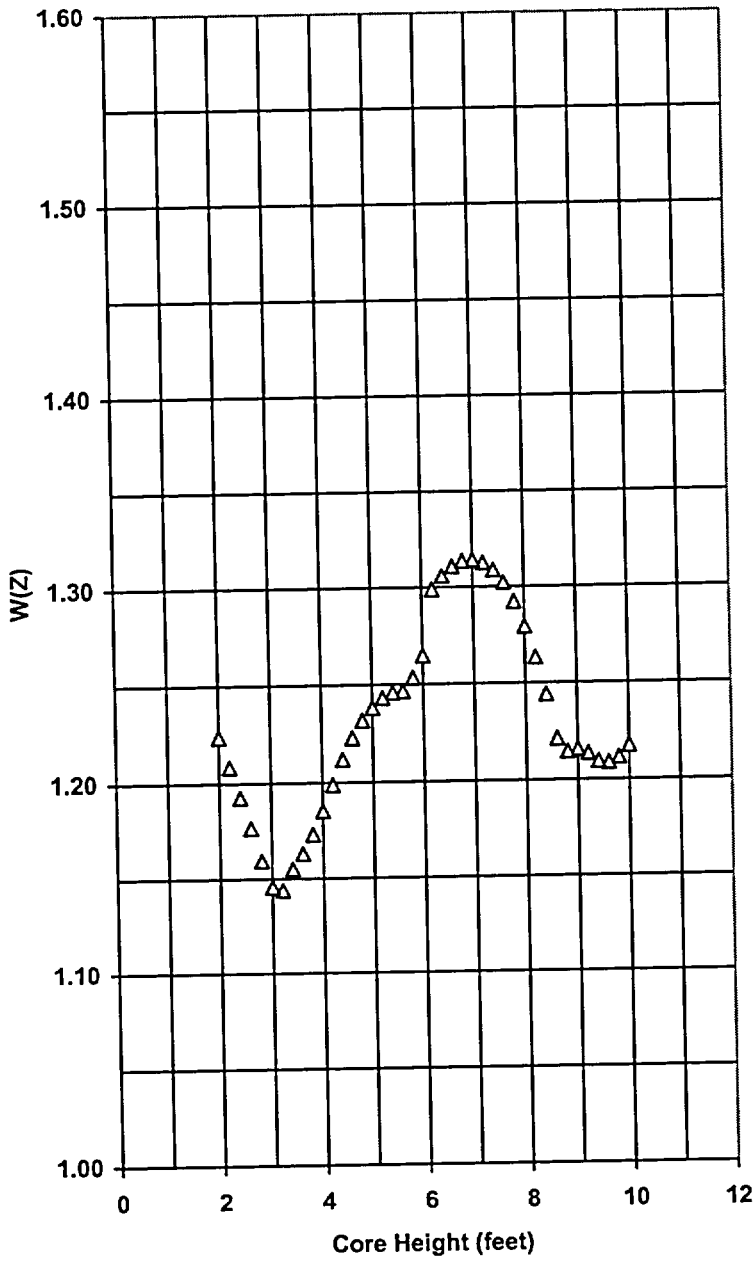


	Axial Point	Elevation (feet)	MOL-2 W(Z)
*	1	12 00	1.0000
*	2	11 80	1 0000
*	3	11 60	1 0000
*	4	11 40	1 0000
*	5	11 20	1 0000
*	6	11 00	1 0000
*	7	10 80	1 0000
*	8	10 60	1 0000
*	9	10 40	1 0000
*	10	10 20	1 0000
	11	10 00	1 2388
	12	9 80	1.2360
	13	9 60	1 2318
	14	9 40	1 2272
	15	9 20	1 2215
	16	9 00	1.2133
	17	8 80	1 2183
	18	8 60	1 2320
	19	8 40	1 2451
	20	8.20	1.2554
	21	8 00	1 2631
	22	7 80	1 2680
	23	7 60	1 2704
	24	7.40	1 2702
	25	7 20	1 2677
	26	7 00	1 2640
	27	6 80	1.2586
	28	6 60	1 2510
	29	6 40	1 2419
	30	6 20	1 2309
	31	6 00	1.1954
	32	5 80	1 1804
	33	5 60	1 1718
	34	5 40	1 1718
	35	5 20	1 1714
	36	5 00	1 1697
	37	4 80	1 1670
	38	4 60	1 1631
	39	4 40	1 1579
	40	4 20	1 1515
	41	4 00	1 1473
	42	3 80	1 1433
	43	3 60	1 1375
	44	3 40	1 1311
	45	3 20	1 1298
	46	3 00	1.1363
	47	2.80	1 1482
	48	2 60	1 1583
	49	2 40	1 1688
	50	2 20	1 1792
	51	2.00	1.1895
*	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 2175
	12	9 80	1 2115
	13	9 60	1 2089
	14	9.40	1.2095
	15	9 20	1 2136
	16	9 00	1 2158
	17	8 80	1 2147
	18	8 60	1 2213
	19	8 40	1 2442
	20	8 20	1 2633
	21	8 00	1 2793
	22	7 80	1 2923
	23	7 60	1.3021
	24	7 40	1 3089
	25	7 20	1 3126
	26	7 00	1 3141
	27	6 80	1 3136
	28	6 60	1 3109
	29	6 40	1 3059
	30	6 20	1 2989
	31	6 00	1 2648
	32	5 80	1 2533
	33	5 60	1 2465
	34	5 40	1 2459
	35	5 20	1 2431
	36	5 00	1 2382
	37	4 80	1 2316
	38	4 60	1 2228
	39	4 40	1 2119
	40	4 20	1.1988
	41	4 00	1 1854
	42	3 80	1 1732
	43	3 60	1 1632
	44	3 40	1 1550
	45	3 20	1.1440
	46	3 00	1 1456
	47	2 80	1 1595
	48	2 60	1 1766
	49	2 40	1 1926
	50	2 20	1.2083
	51	2 00	1 2238
*	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