

Dave Morey
Vice President
Farley Project

Southern Nuclear
Operating Company, Inc.
Post Office Box 1295
Birmingham, Alabama 35201
Tel 205.992.5131



November 7, 2001

Docket No.: 50-348

NEL-01-0267

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

Joseph M. Farley Nuclear Plant - Unit 1
Cycle 18 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 for Farley Nuclear Plant Unit 1 Cycle 18.

If there are any questions, please advise.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Dave Morey".
Dave Morey

MGE/kw: colr06.doc

Enclosure:
Core Operating Limits Report Unit 1 - Cycle 18

ADD1

Page 2

U. S. Nuclear Regulatory Commission

cc: Southern Nuclear Operating Company
Mr. L. M. Stinson, 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 1 - Cycle 18
September 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 $k_{\text{eff}} \geq 1$)

The Technical Specifications affected by this report are listed below:

- 3.1.1 SHUTDOWN MARGIN - MODES 2 (with $k_{\text{eff}} < 1$), 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 Channel 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, including those specified in Technical Specification 5.6.5.

2.1 SHUTDOWN MARGIN - MODES 1 AND 2 (with $k_{\text{eff}} \geq 1.0$) (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 $k_{\text{eff}} < 1.0$), 3, 4 and 5 (Specification 3.1.1)

2.2.1 Modes 2 ($k_{\text{eff}} < 1.0$), 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 $+0.7 \times 10^{-4} \Delta k/k/^{\circ}\text{F}$ for power levels up to 70 percent RTP with a linear ramp to 0 $\Delta k/k/^{\circ}\text{F}$ at 100 percent RTP.

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

2.3.2 The MTC Surveillance limits are:

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

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

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)

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

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

$$\text{where: } P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$$

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

2.6.3 $K(Z)$ is provided in Figure 2.

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

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

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)

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

$$\text{where: } P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$$

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

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

2.8 Axial Flux Difference (Specification 3.2.3)

2.8.1 The Axial Flux Difference (AFD) acceptable operation limits are provided in Figure 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

¹ 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

Cycle Burnup (MWD/MTU)	$F_Q(Z)$ Penalty Factor
4644	1.020
4848	1.023
5052	1.021
5256	1.020

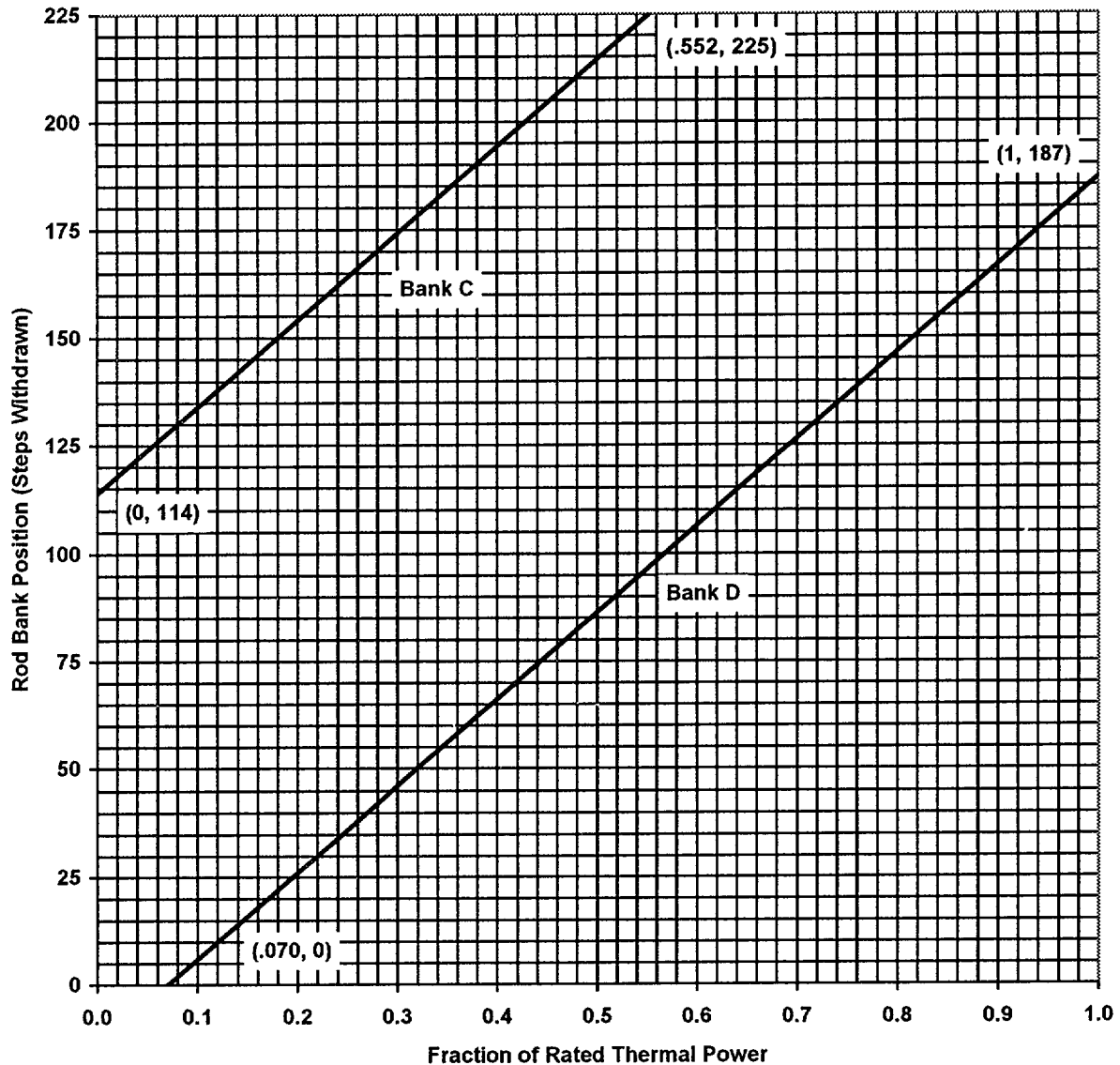
Notes:

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.



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

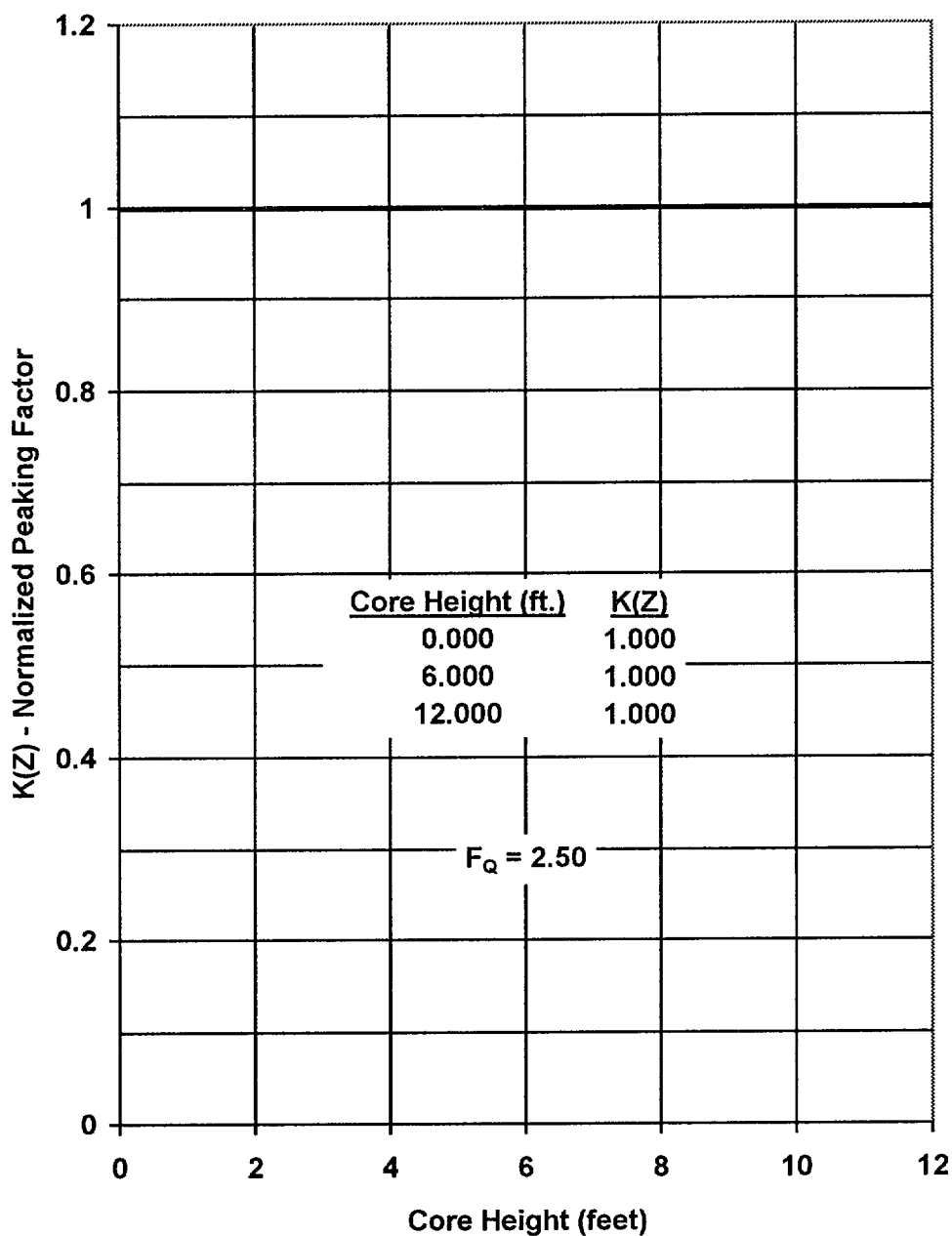




Figure 3
Axial Flux Difference Limits as a Function of
Rated Thermal Power for RAOC

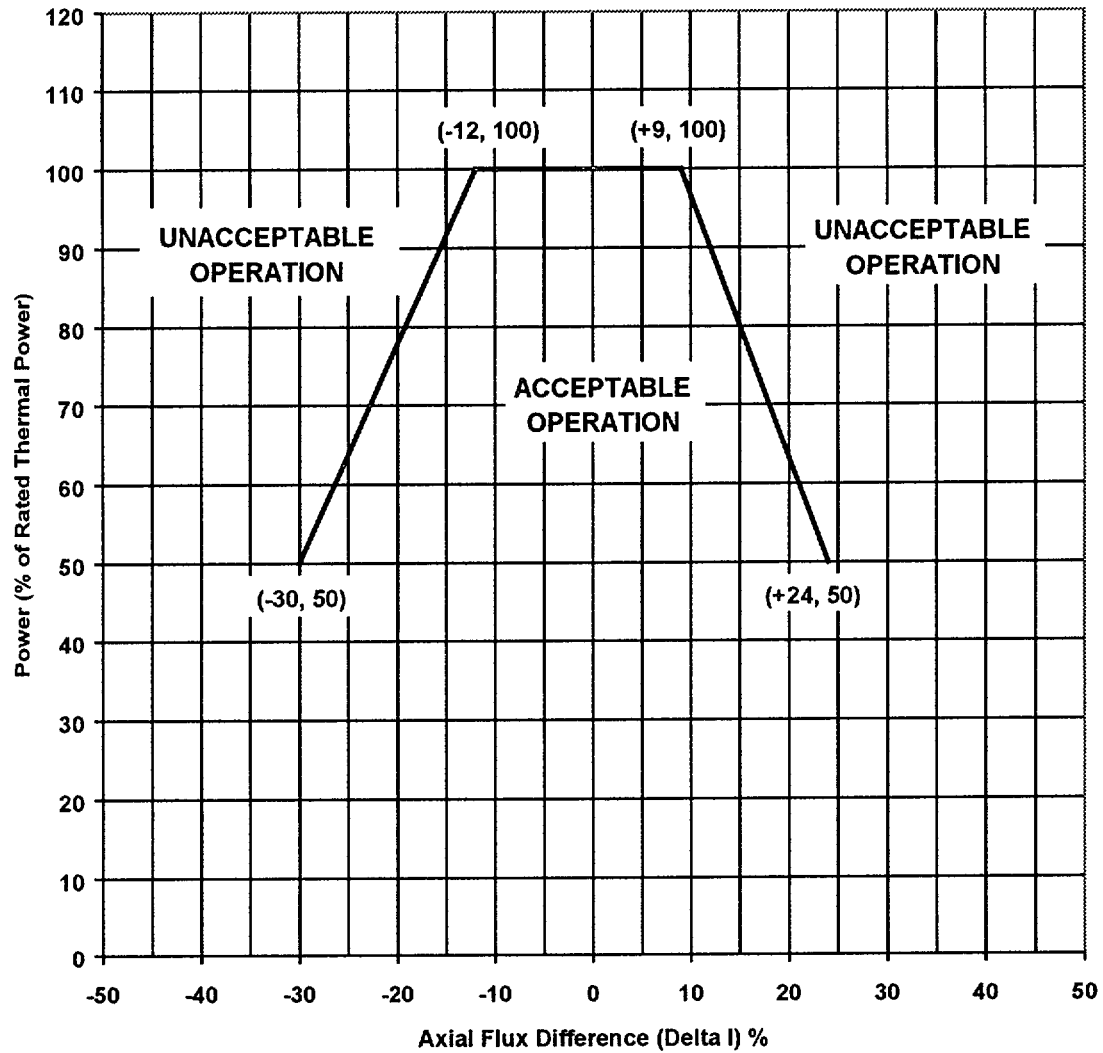
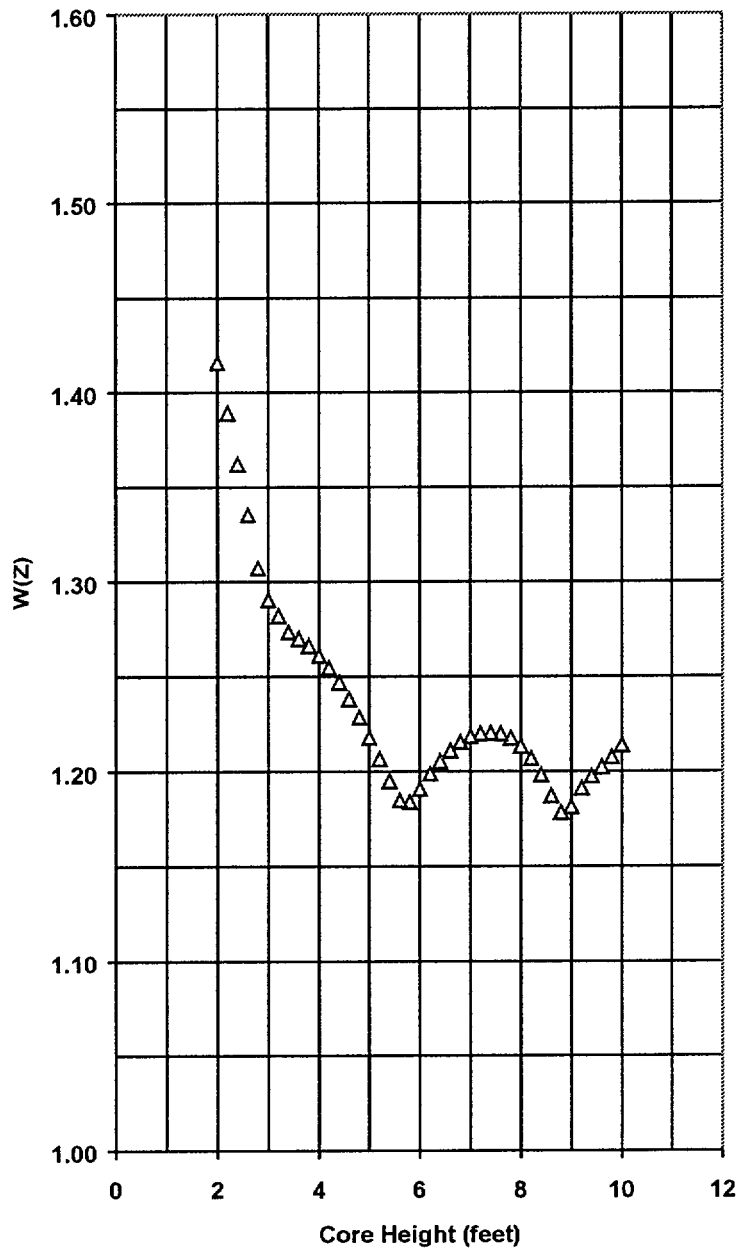




Figure 4
RAOC W(Z) at 150 MWD/MTU



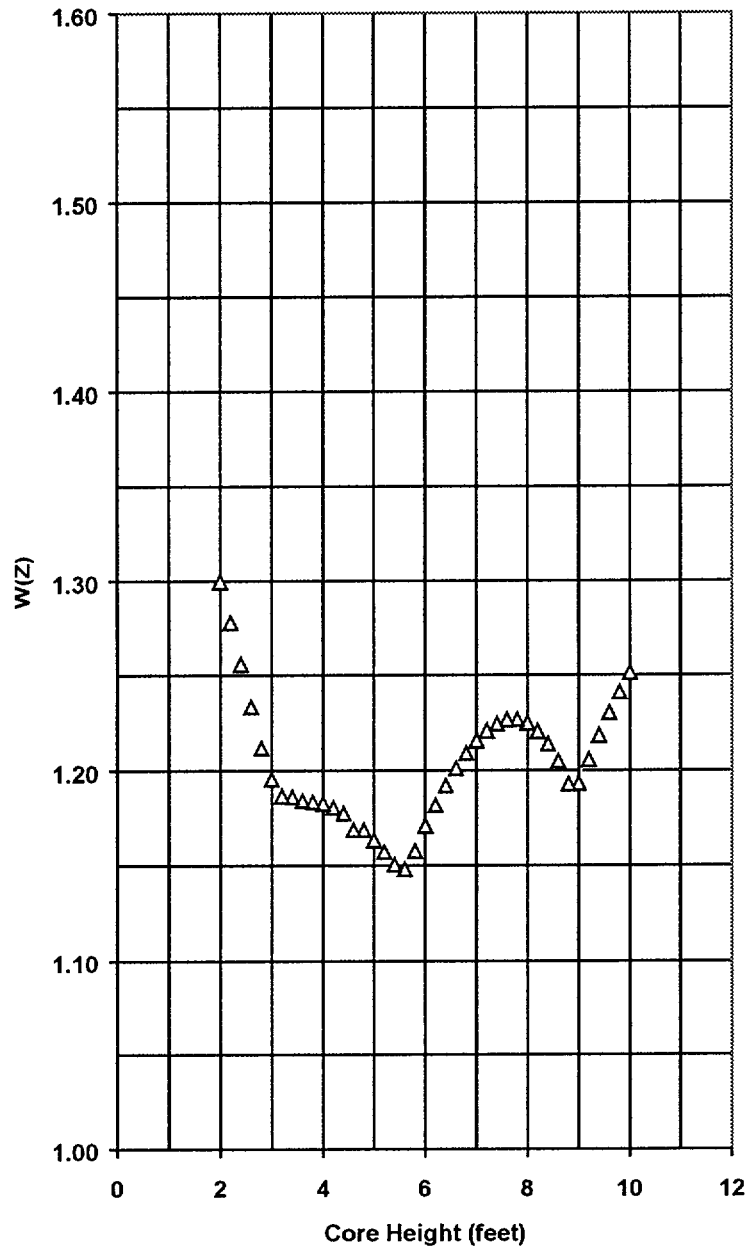
This figure is referred to by Technical Specification B3.2.1.

	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	1.2141
	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	1.1908
	32	5.80	1.1840
	33	5.60	1.1848
	34	5.40	1.1951
	35	5.20	1.2068
	36	5.00	1.2180
	37	4.80	1.2287
	38	4.60	1.2383
	39	4.40	1.2470
	40	4.20	1.2546
	41	4.00	1.2609
	42	3.80	1.2661
	43	3.60	1.2698
	44	3.40	1.2734
	45	3.20	1.2819
	46	3.00	1.2905
	47	2.80	1.3072
	48	2.60	1.3353
	49	2.40	1.3624
	50	2.20	1.3892
	51	2.00	1.4156
*	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



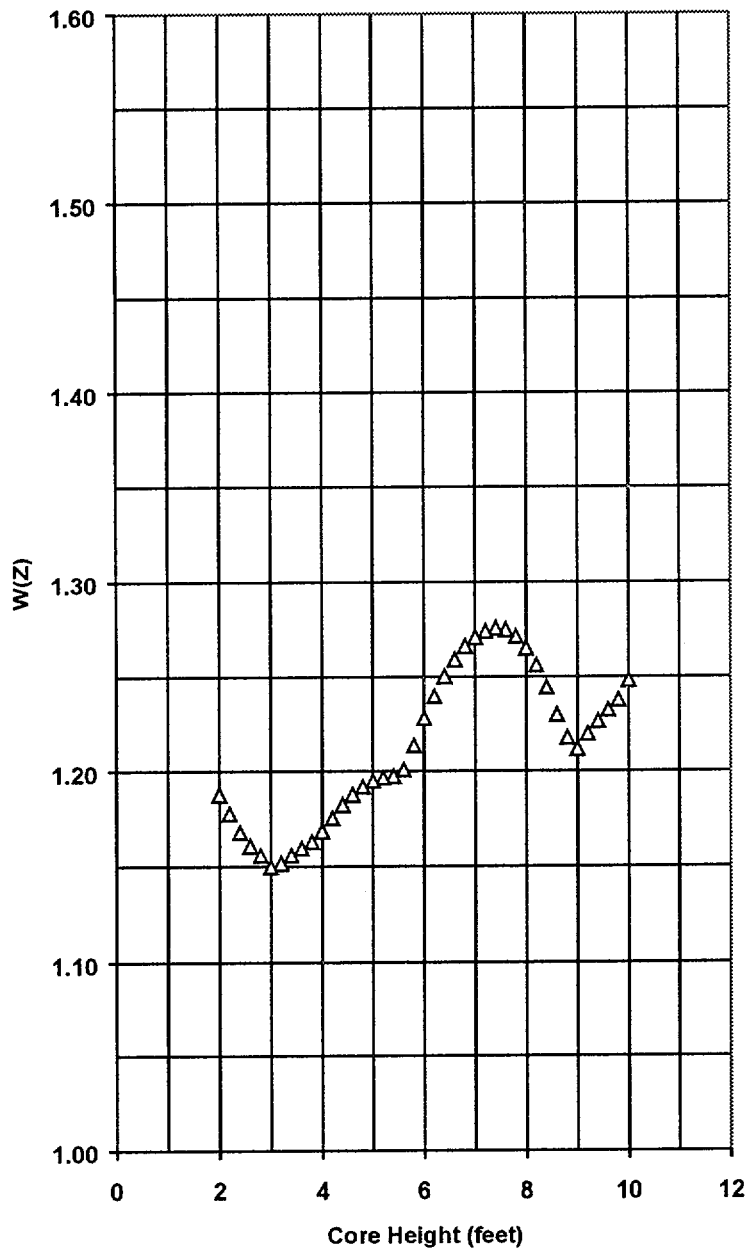
This figure is referred to by Technical Specification B3.2.1.

	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	1.2512
	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	1.1708
	32	5.80	1.1574
	33	5.60	1.1479
	34	5.40	1.1502
	35	5.20	1.1569
	36	5.00	1.1632
	37	4.80	1.1687
	38	4.60	1.1687
	39	4.40	1.1775
	40	4.20	1.1804
	41	4.00	1.1826
	42	3.80	1.1835
	43	3.60	1.1842
	44	3.40	1.1861
	45	3.20	1.1866
	46	3.00	1.1955
	47	2.80	1.2119
	48	2.60	1.2334
	49	2.40	1.2557
	50	2.20	1.2779
	51	2.00	1.2997
*	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



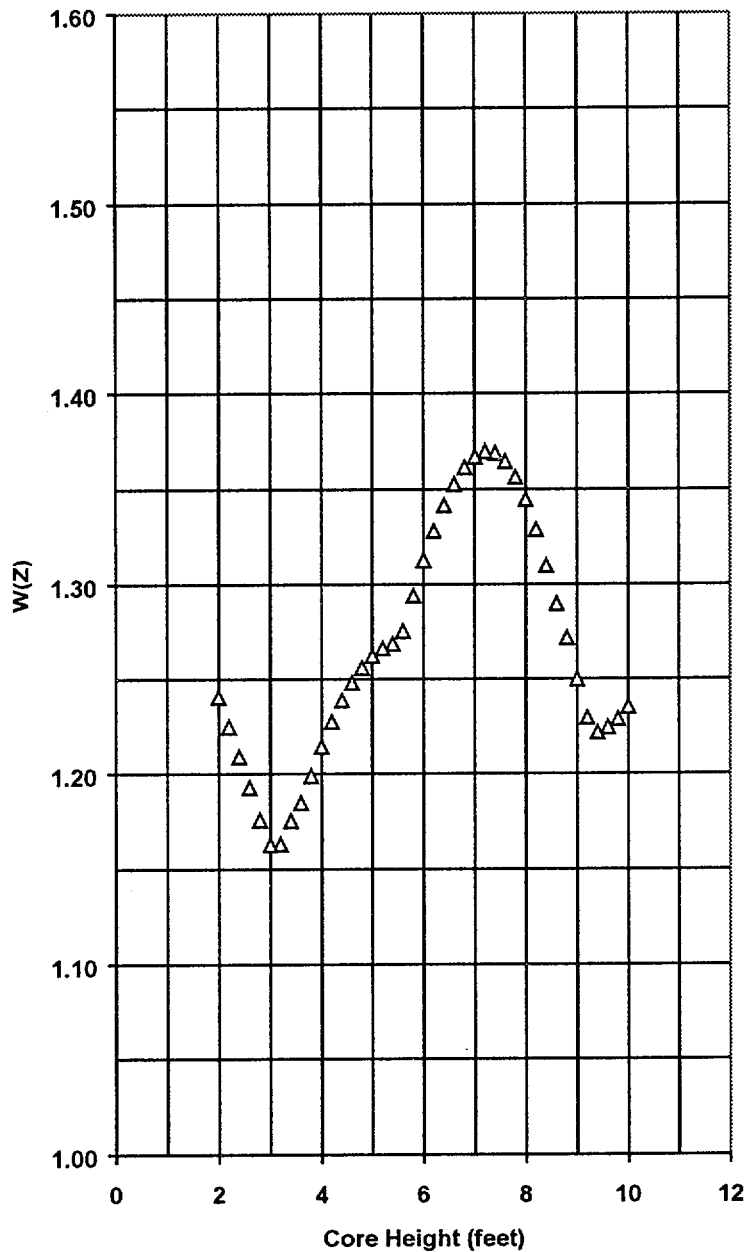
This figure is referred to by Technical Specification B3.2.1.

	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	1.2280
	32	5.80	1.2136
	33	5.60	1.2007
	34	5.40	1.1972
	35	5.20	1.1965
	36	5.00	1.1948
	37	4.80	1.1918
	38	4.60	1.1875
	39	4.40	1.1821
	40	4.20	1.1753
	41	4.00	1.1685
	42	3.80	1.1629
	43	3.60	1.1595
	44	3.40	1.1559
	45	3.20	1.1517
	46	3.00	1.1499
	47	2.80	1.1559
	48	2.60	1.1607
	49	2.40	1.1680
	50	2.20	1.1777
	51	2.00	1.1876
*	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 7
RAOC W(Z) at 18000 MWD/MTU



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

	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	1.3125
	32	5.80	1.2939
	33	5.60	1.2754
	34	5.40	1.2686
	35	5.20	1.2662
	36	5.00	1.2621
	37	4.80	1.2559
	38	4.60	1.2480
	39	4.40	1.2387
	40	4.20	1.2274
	41	4.00	1.2143
	42	3.80	1.1991
	43	3.60	1.1850
	44	3.40	1.1754
	45	3.20	1.1632
	46	3.00	1.1628
	47	2.80	1.1760
	48	2.60	1.1930
	49	2.40	1.2091
	50	2.20	1.2248
	51	2.00	1.2405
*	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.