FARLEY NUCLEAR PLANT (FNP) UNIT 2 CYCLE 14

CORE OPERATING LIMITS REPORT

OCTOBER 1999

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Joseph M. Farley Unit 2 Cycle 14 has been prepared in accordance with the requirements of Technical Specification 6.9.1.11.

The Technical Specifications affected by this report are listed below:

3/4.1.1.1	SHUTDOWN MARGIN - MODES 1, 2, 3 and 4
3/4.1.1.2	SHUTDOWN MARGIN - MODE 5
3/4.1.1.3	Moderator Temperature Coefficient
3/4.1.3.5	Shutdown Rod Insertion Limit
3/4.1.3.6	Control Rod Insertion Limits
3/4.2.1	Axial Flux Difference
3/4.2.2	Heat Flux Hot Channel Factor - $F_Q(Z)$
3/4.2.3	Nuclear Enthalpy Rise Hot Channel Factor - $F^N_{\Delta H}$

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 the NRC-approved methodologies specified in Technical Specifications 6.9.1.11.

2.1 SHUTDOWN MARGIN - MODES 1, 2, 3 and 4 (Specification 3/4.1.1.1)

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

2.2 SHUTDOWN MARGIN - MODE 5 (Specification 3/4.1.1.2)

2.2.1 The SHUTDOWN MARGIN shall be greater than or equal to 1.0 percent $\Delta k/k$.

2.3 Moderator Temperature Coefficient (Specification 3/4.1.1.3)

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 limit is:

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 Rod Insertion Limit (Specification 3/4.1.3.5)

2.4.1 The shutdown rods shall be withdrawn to a position greater than or equal to 225 steps.

2.5 Control Rod Insertion Limits (Specification 3/4.1.3.6)

2.5.1 The control rod banks shall be limited in physical insertion as shown in Figure 1.

2.6 Axial Flux Difference (Specification 3/4.2.1)

[Relaxed Axial Offset Control (RAOC) Methodology]

2.6.1 The Axial Flux Difference (AFD) acceptable operation limits are provided in Figure 2.

2.7 Heat Flux Hot Channel Factor - $F_Q(Z)$ (Specification 3/4.2.2)

[F_Q Methodology]

2.7.1 $$F_Q(Z) \leq \frac{F_Q^{RTP}}{P} \cdot K(Z) \quad for\ P > 0.5$$

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

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

2.7.2 $F_Q^{RTP} = 2.50$

2.7.3 K(Z) is provided in Figure 3.

2.7.4 $$F_Q^C(Z) \leq \frac{F_Q^{RTP} \cdot K(Z)}{P \cdot W(Z)} \quad for\ P > 0.5$$

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

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

2.7.6 The $F_Q^C(Z)$ penalty factors are provided in Table 1.

2.8 Nuclear Enthalpy Rise Hot Channel Factor - $F^N_{\Delta H}$ (Specification 3/4.2.3)

2.8.1 $$F^N_{\Delta H} \leq F^{RTP}_{\Delta H} \cdot (1 + PF_{\Delta H} \cdot (1 - P))$$

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

2.8.2 $$F^{RTP}_{\Delta H} = 1.70$$

2.8.3 $$PF_{\Delta H} = 0.3$$

Table 1
$F_Q^C(Z)$ PENALTY FACTOR

Cycle Burnup (MWD/MTU)	$F_Q^C(Z)$ Penalty Factor
All Burnups	1.0200

Notes:

1. The Penalty Factor, to be applied to $F_Q^C(Z)$ in accordance with surveillance requirement 4.2.2.2.f, is the maximum factor by which $F_Q^C(Z)$ 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 Technical Specification 4.0.2) starting from the burnup at which the $F_Q^C(Z)$ was determined.

(Fully withdrawn - 225 to 231 steps, inclusive)

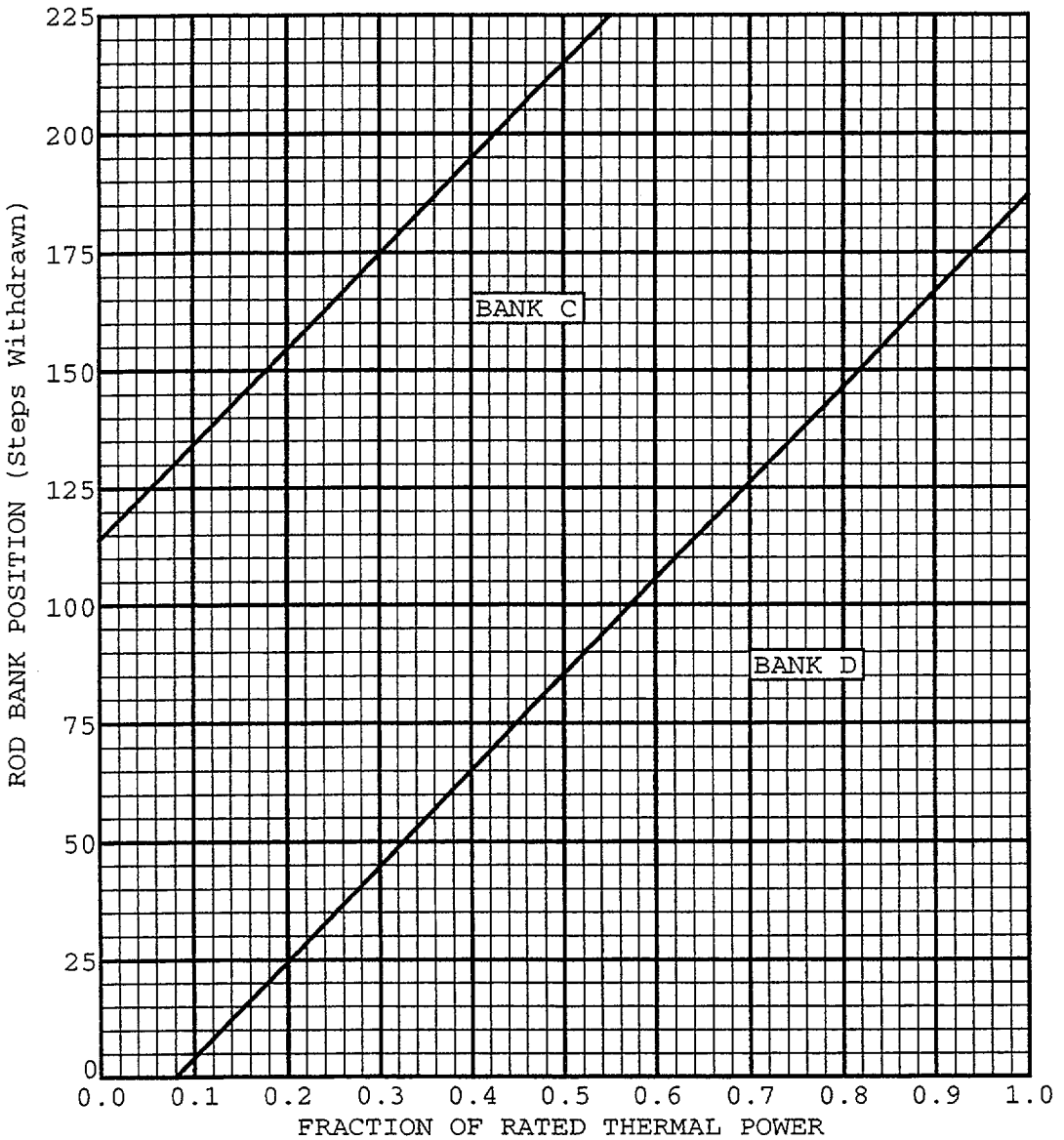


Figure 1
Rod Bank Insertion Limits versus Rated Thermal Power

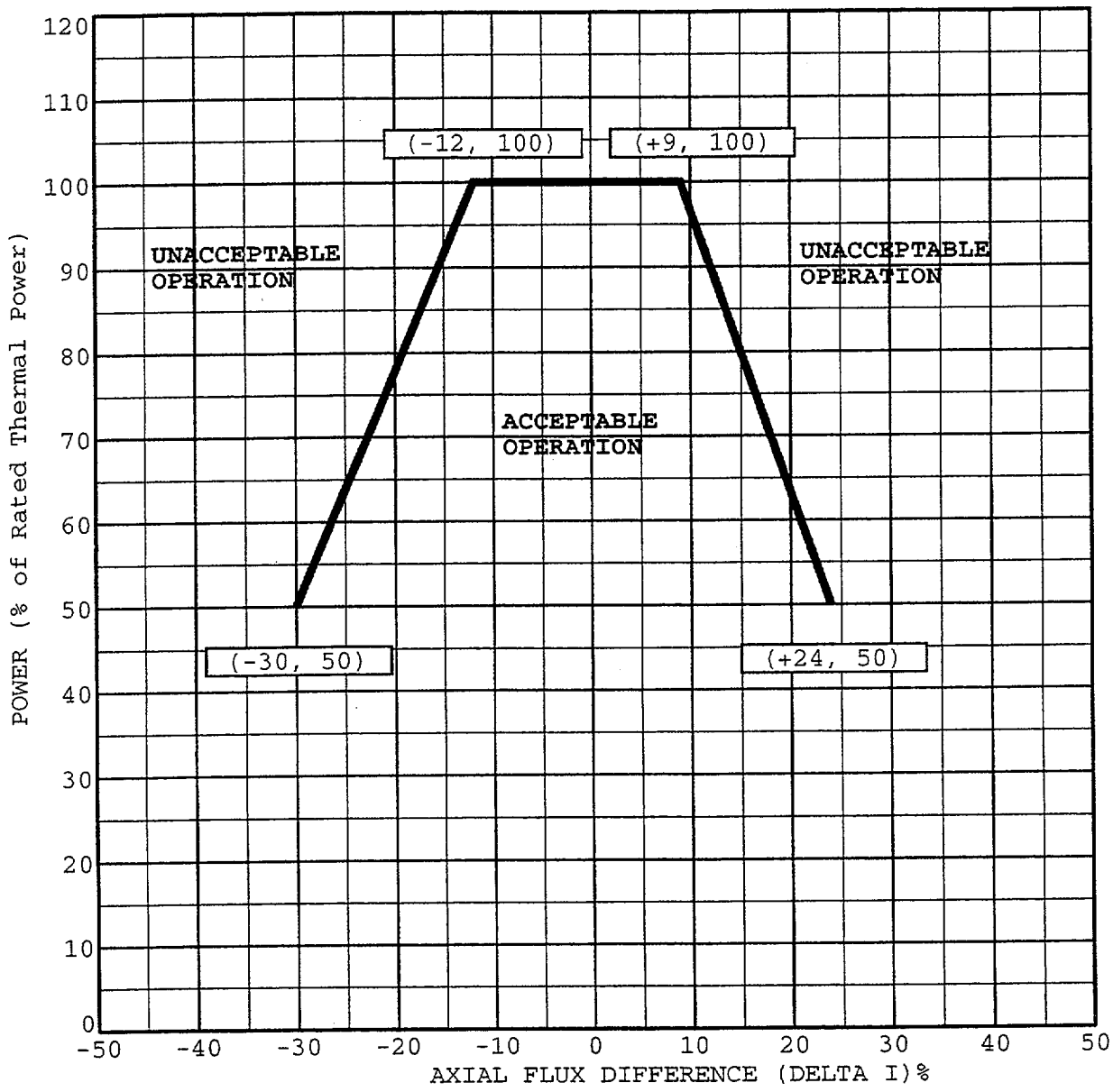


Figure 2
Axial Flux Difference Limits as a Function of Rated Thermal Power for RAOC

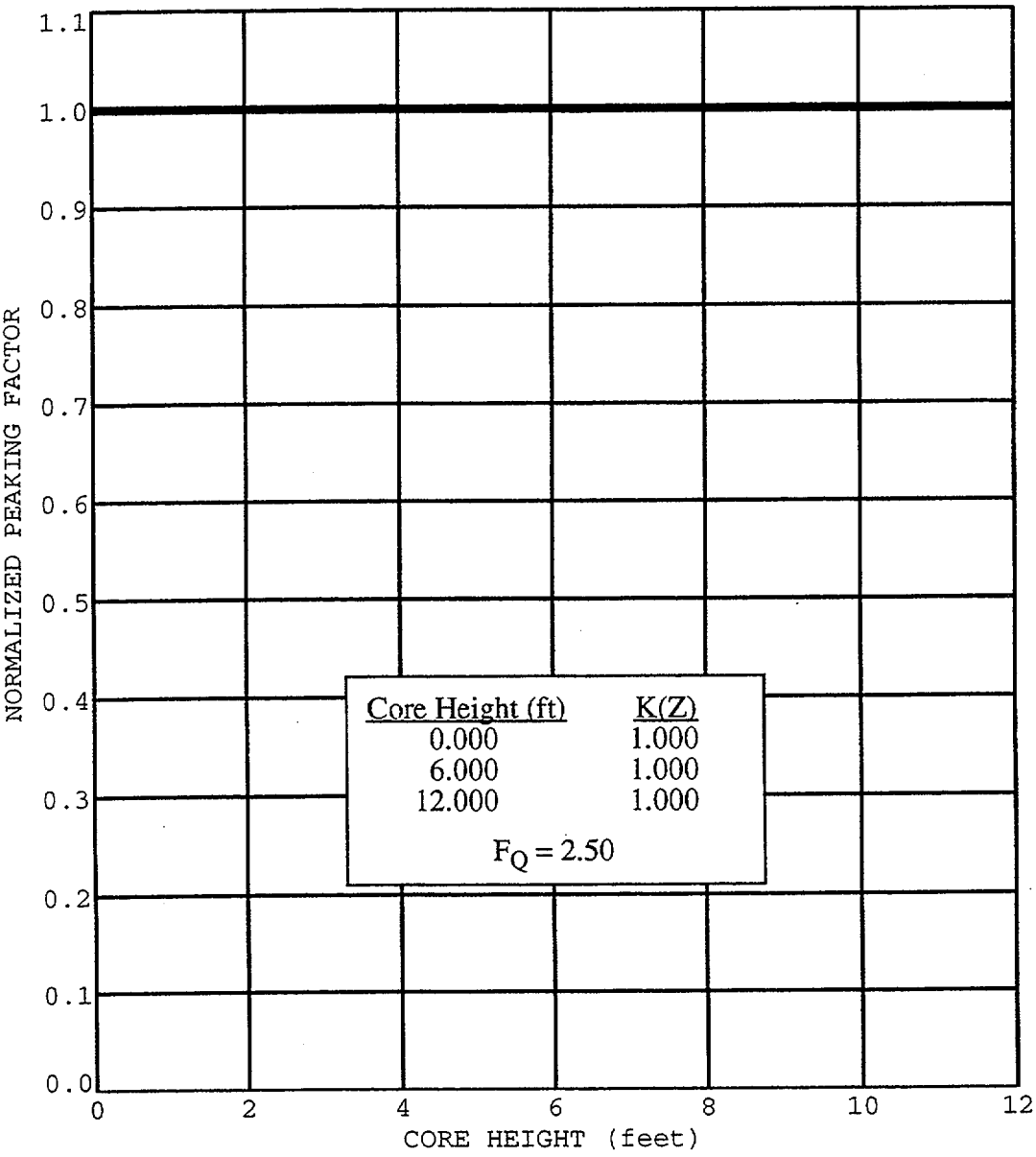
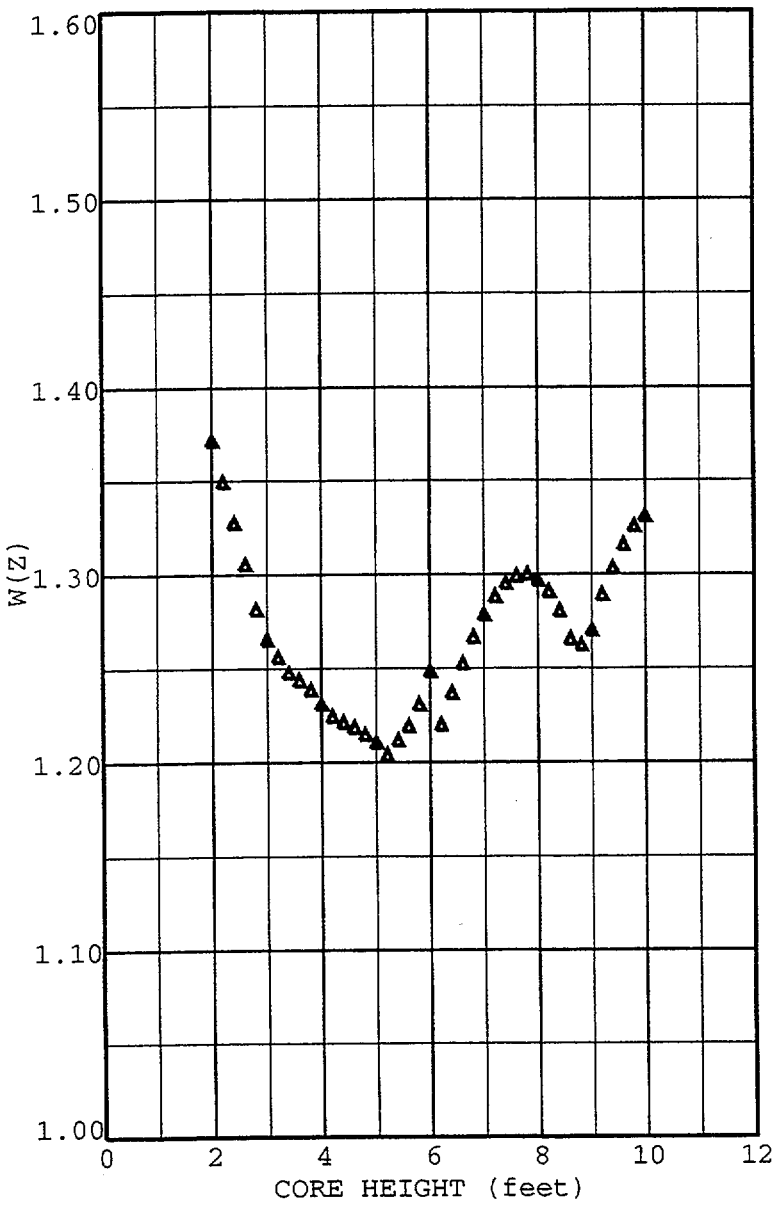


Figure 3
K(Z)
Normalized $F_Q(Z)$ as a Function of Core Height

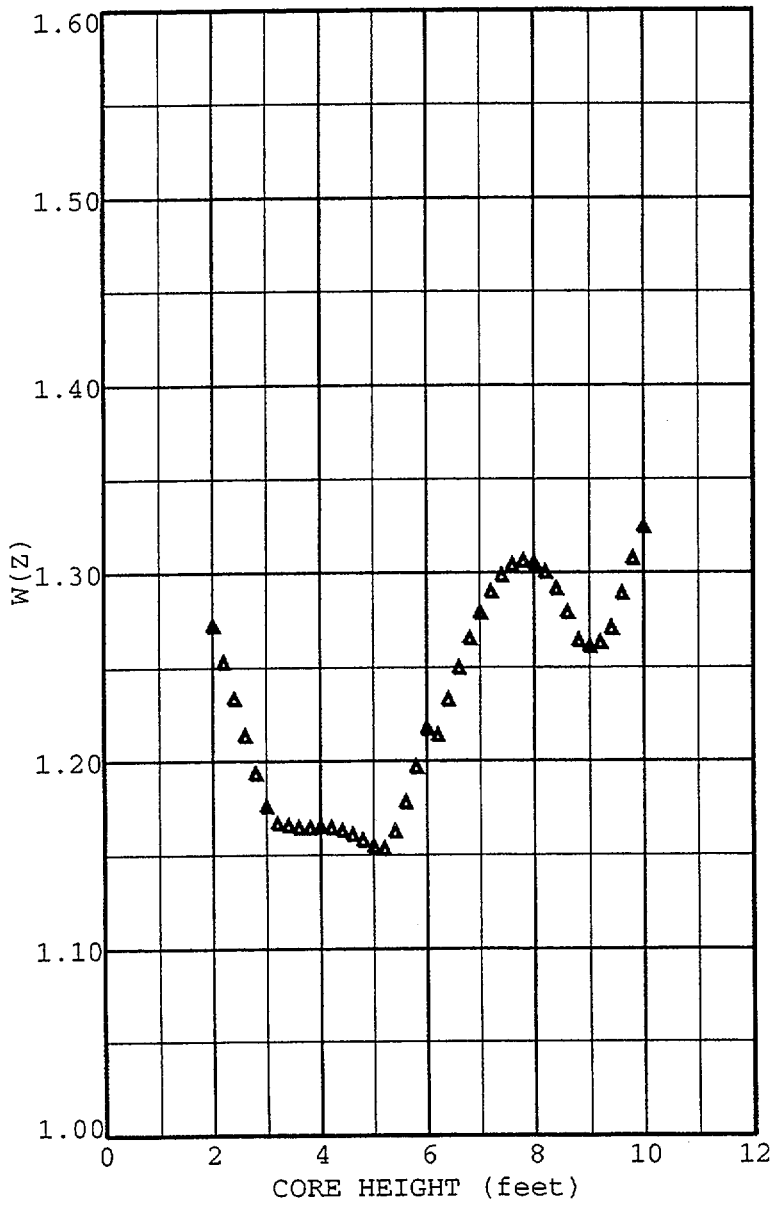


This figure is referred to by Technical Specifications 4.2.2.2d, B3/4.2.2.

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	1.3309
	12	9.80	1.3255
	13	9.60	1.3157
	14	9.40	1.3034
	15	9.20	1.2892
	16	9.00	1.2703
	17	8.80	1.2624
	18	8.60	1.2656
	19	8.40	1.2806
	20	8.20	1.2910
	21	8.00	1.2971
	22	7.80	1.2999
	23	7.60	1.2991
	24	7.40	1.2951
	25	7.20	1.2882
	26	7.00	1.2786
	27	6.80	1.2667
	28	6.60	1.2527
	29	6.40	1.2370
	30	6.20	1.2199
	31	6.00	1.2487
	32	5.80	1.2308
	33	5.60	1.2193
	34	5.40	1.2116
	35	5.20	1.2039
	36	5.00	1.2104
	37	4.80	1.2146
	38	4.60	1.2185
	39	4.40	1.2212
	40	4.20	1.2245
	41	4.00	1.2310
	42	3.80	1.2387
	43	3.60	1.2438
	44	3.40	1.2478
	45	3.20	1.2563
	46	3.00	1.2657
	47	2.80	1.2814
	48	2.60	1.3053
	49	2.40	1.3276
	50	2.20	1.3496
	51	2.00	1.3716
*	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 4.2.2.2

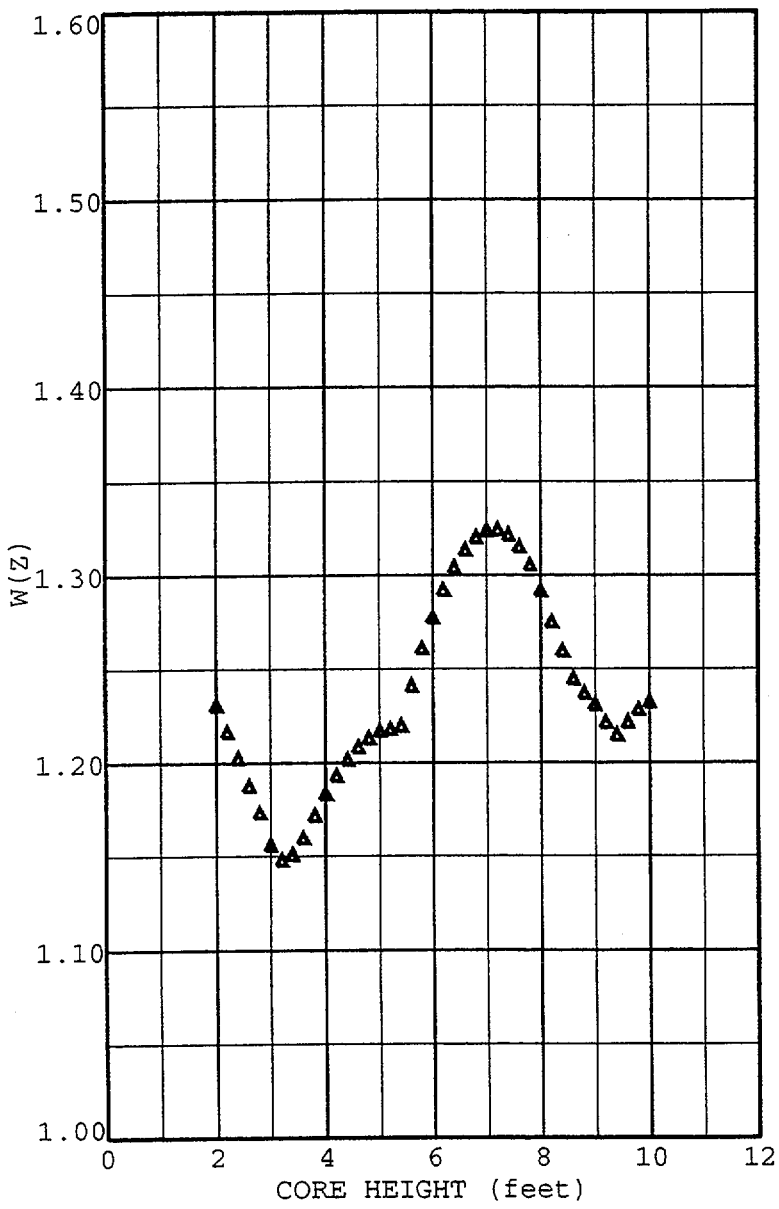


This figure is referred to by Technical Specifications 4.2.2.2d, B3/4.2.2.

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	1.3242
	12	9.80	1.3074
	13	9.60	1.2890
	14	9.40	1.2705
	15	9.20	1.2631
	16	9.00	1.2608
	17	8.80	1.2640
	18	8.60	1.2789
	19	8.40	1.2915
	20	8.20	1.3002
	21	8.00	1.3050
	22	7.80	1.3062
	23	7.60	1.3039
	24	7.40	1.2984
	25	7.20	1.2899
	26	7.00	1.2788
	27	6.80	1.2653
	28	6.60	1.2498
	29	6.40	1.2325
	30	6.20	1.2138
	31	6.00	1.2174
	32	5.80	1.1968
	33	5.60	1.1782
	34	5.40	1.1625
	35	5.20	1.1532
	36	5.00	1.1542
	37	4.80	1.1575
	38	4.60	1.1607
	39	4.40	1.1630
	40	4.20	1.1644
	41	4.00	1.1649
	42	3.80	1.1645
	43	3.60	1.1645
	44	3.40	1.1657
	45	3.20	1.1667
	46	3.00	1.1759
	47	2.80	1.1934
	48	2.60	1.2135
	49	2.40	1.2332
	50	2.20	1.2528
	51	2.00	1.2722
*	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 4.2.2.2

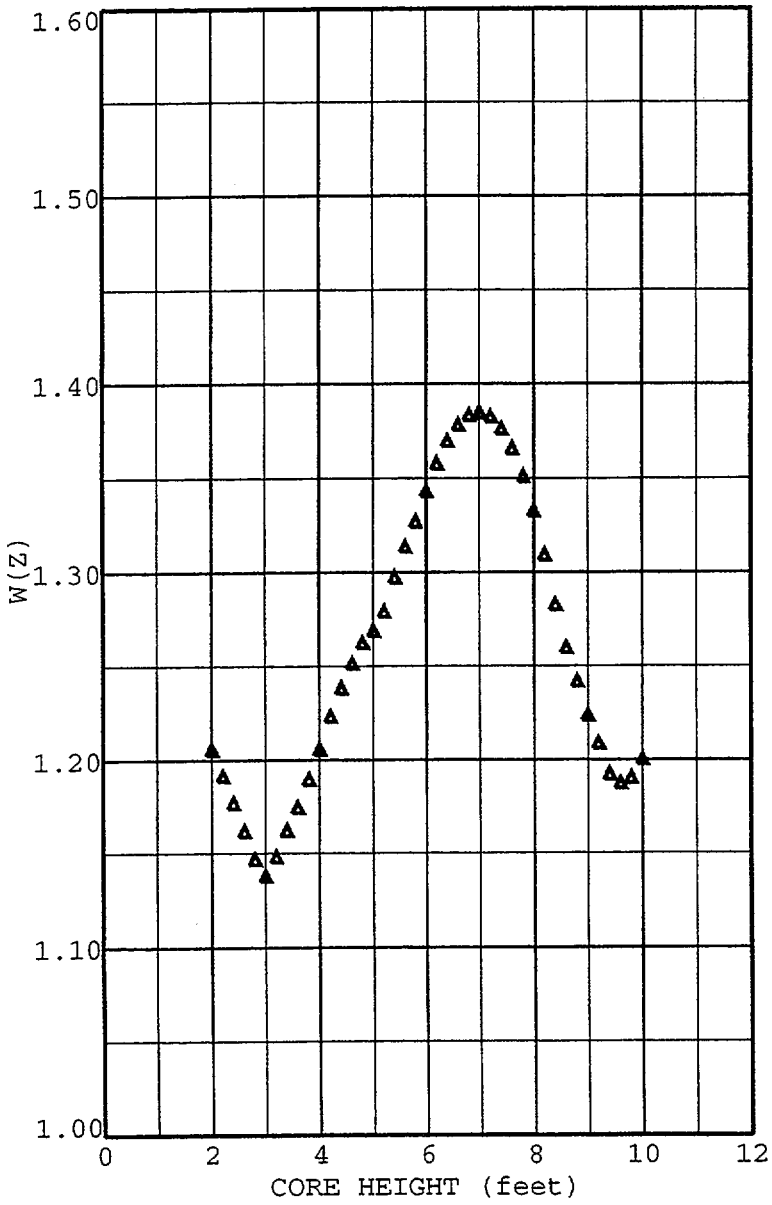


This figure is referred to by Technical Specifications 4.2.2.2d, B3/4.2.2.

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	1.2324
	12	9.80	1.2281
	13	9.60	1.2215
	14	9.40	1.2148
	15	9.20	1.2214
	16	9.00	1.2312
	17	8.80	1.2371
	18	8.60	1.2447
	19	8.40	1.2596
	20	8.20	1.2749
	21	8.00	1.2917
	22	7.80	1.3053
	23	7.60	1.3151
	24	7.40	1.3215
	25	7.20	1.3243
	26	7.00	1.3238
	27	6.80	1.3201
	28	6.60	1.3135
	29	6.40	1.3040
	30	6.20	1.2920
	31	6.00	1.2773
	32	5.80	1.2610
	33	5.60	1.2411
	34	5.40	1.2198
	35	5.20	1.2180
	36	5.00	1.2170
	37	4.80	1.2131
	38	4.60	1.2083
	39	4.40	1.2016
	40	4.20	1.1931
	41	4.00	1.1833
	42	3.80	1.1717
	43	3.60	1.1597
	44	3.40	1.1508
	45	3.20	1.1480
	46	3.00	1.1559
	47	2.80	1.1733
	48	2.60	1.1878
	49	2.40	1.2024
	50	2.20	1.2167
	51	2.00	1.2308
*	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 4.2.2.2



This figure is referred to by Technical Specifications 4.2.2.2d, B3/4.2.2.

Figure 7
RAOC W(Z) at 16000 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	1.2002
	12	9.80	1.1902
	13	9.60	1.1873
	14	9.40	1.1922
	15	9.20	1.2087
	16	9.00	1.2238
	17	8.80	1.2418
	18	8.60	1.2598
	19	8.40	1.2827
	20	8.20	1.3092
	21	8.00	1.3326
	22	7.80	1.3513
	23	7.60	1.3659
	24	7.40	1.3763
	25	7.20	1.3826
	26	7.00	1.3849
	27	6.80	1.3834
	28	6.60	1.3783
	29	6.40	1.3697
	30	6.20	1.3580
	31	6.00	1.3431
	32	5.80	1.3269
	33	5.60	1.3135
	34	5.40	1.2973
	35	5.20	1.2790
	36	5.00	1.2689
	37	4.80	1.2623
	38	4.60	1.2513
	39	4.40	1.2383
	40	4.20	1.2231
	41	4.00	1.2055
	42	3.80	1.1895
	43	3.60	1.1744
	44	3.40	1.1622
	45	3.20	1.1482
	46	3.00	1.1381
	47	2.80	1.1468
	48	2.60	1.1620
	49	2.40	1.1768
	50	2.20	1.1913
	51	2.00	1.2056
*	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 4.2.2.2