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Operating Company, Inc.
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FNP-019-NRC-DC

APRIL 3, 2000

MR. L. MARK PADOVAN
U. S. NUCLEAR REGULATORY COMMISSION
MAIL STOP O-8H12 PD II-1
WASHINGTON, DC 20555

DEAR SIR,

ATTACHED IS REVISION 3 OF THE CORE OPERATING LIMITS REPORT. PLEASE FILE IN THE
NEW IMPROVED TECH SPEC BOOK.

IF YOU HAVE QUESTIONS PLEASE CALL ME AT 334-899-5156 EXTENSION 3402.

SINCERELY,

A handwritten signature in cursive script that reads "Donnie Hardy". The signature is written in dark ink and is positioned above a horizontal line.

DONNIE HARDY

DOCUMENT CONTROL SUPERVISOR

CC: FILE
A:LETTERS
RTYPE: A4.54

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FARLEY NUCLEAR PLANT (FNP) UNIT 2 CYCLE 14

CORE OPERATING LIMITS REPORT REVISION 3

MARCH 2000



APPROVED BY:

CDell / 3.31.00
OPERATIONS MANAGER DATE



1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for FNP UNIT 2 CYCLE 14 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:

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

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

2.3.2 The MTC Surveillance limits are:

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

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

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)

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

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

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

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

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

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

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

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)

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

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

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

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

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

¹This 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 B¹⁰ depletion.



Table 1
 $F_Q(Z)$ PENALTY FACTOR

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

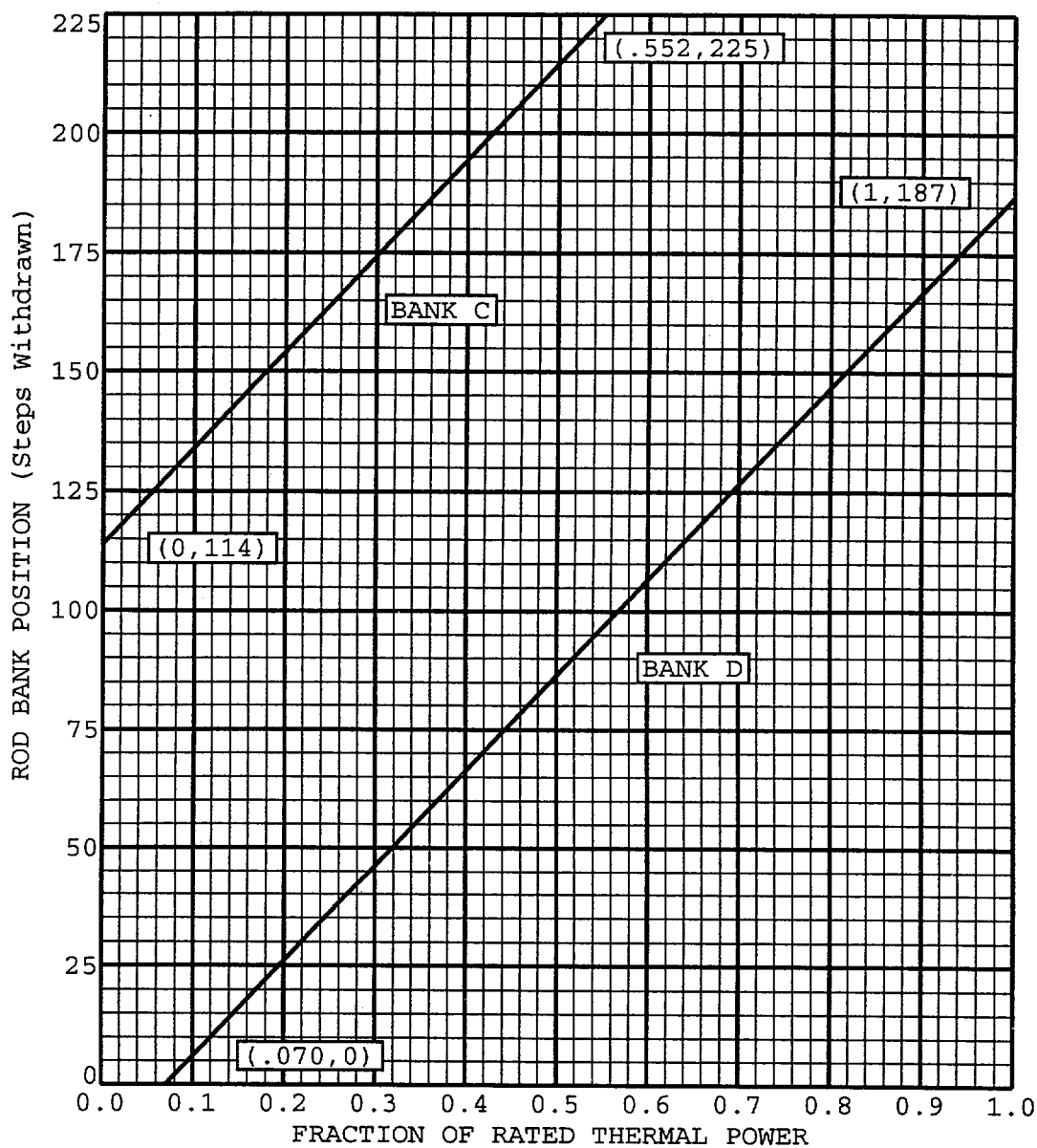
Notes:

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.



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

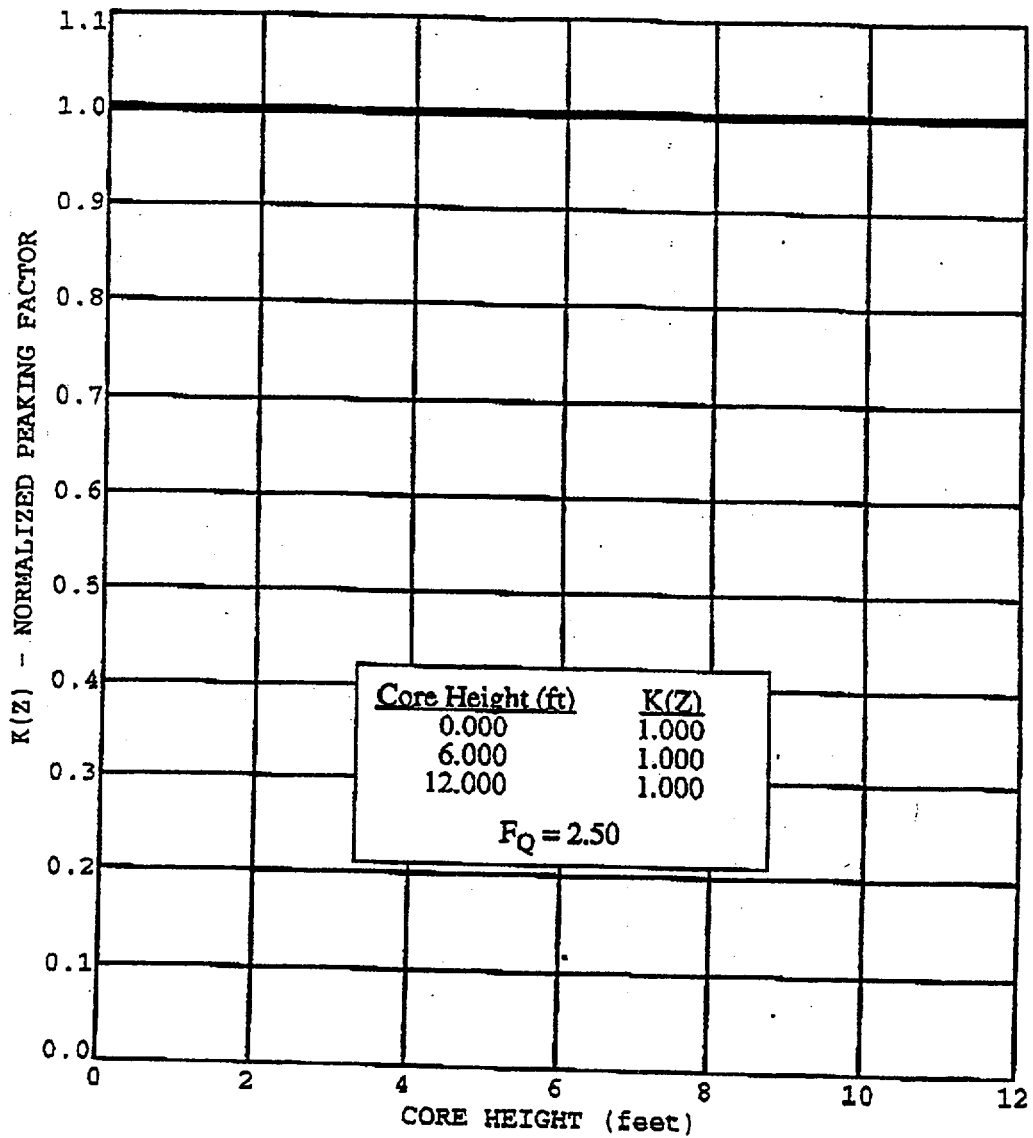




Figure 3
Axial Flux Difference Limits as a Function of
Rated Thermal Power for RAOC

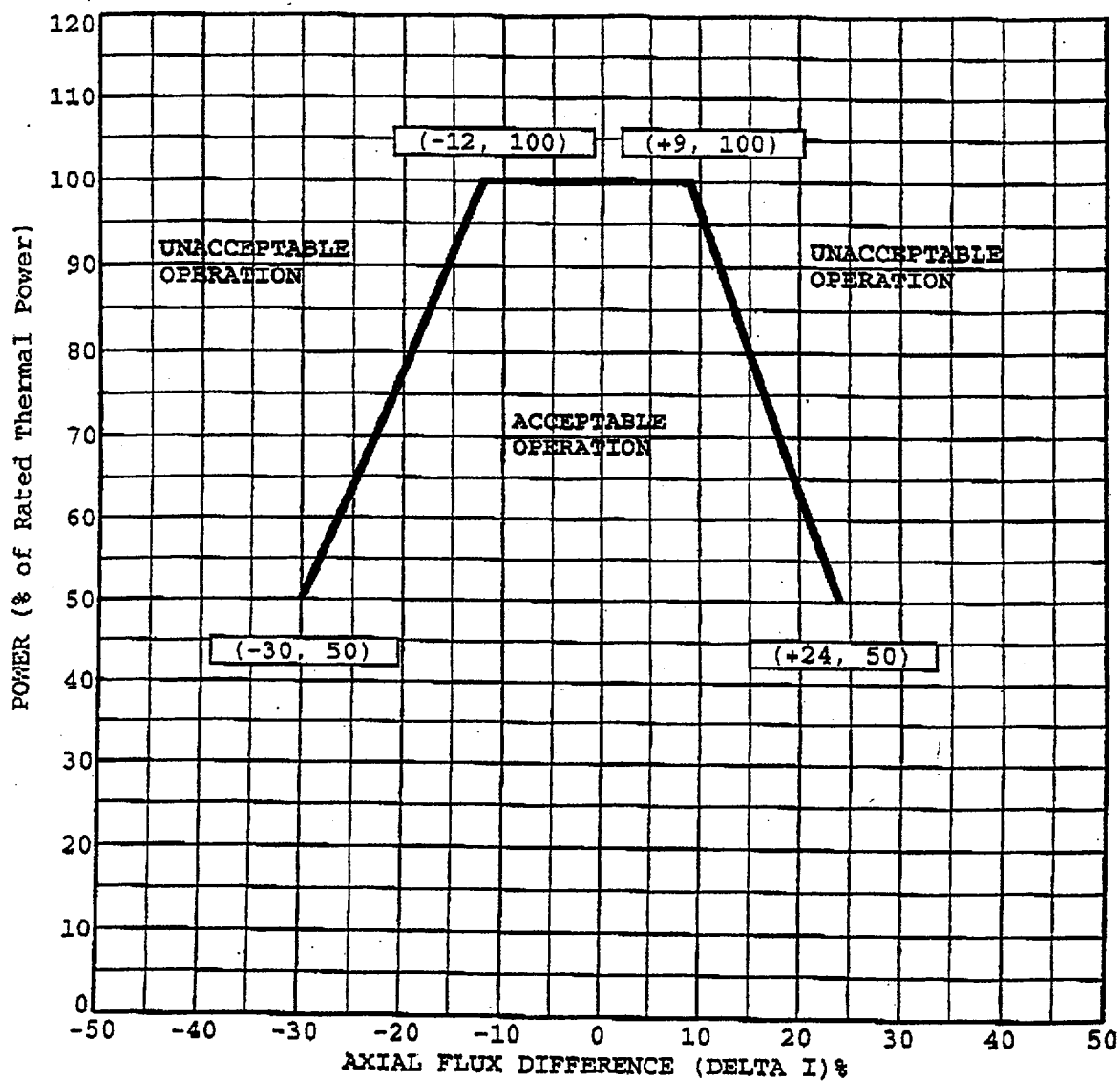
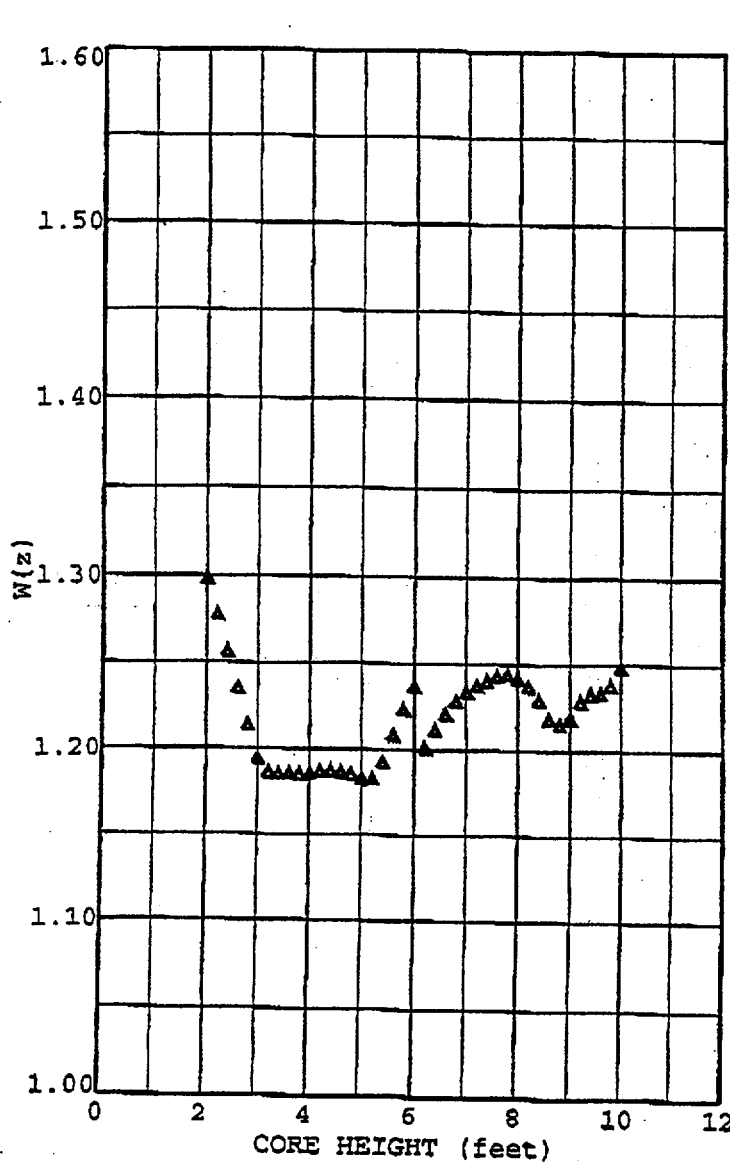




Figure 4
RAOC W(Z) at 150 MWD/MTU



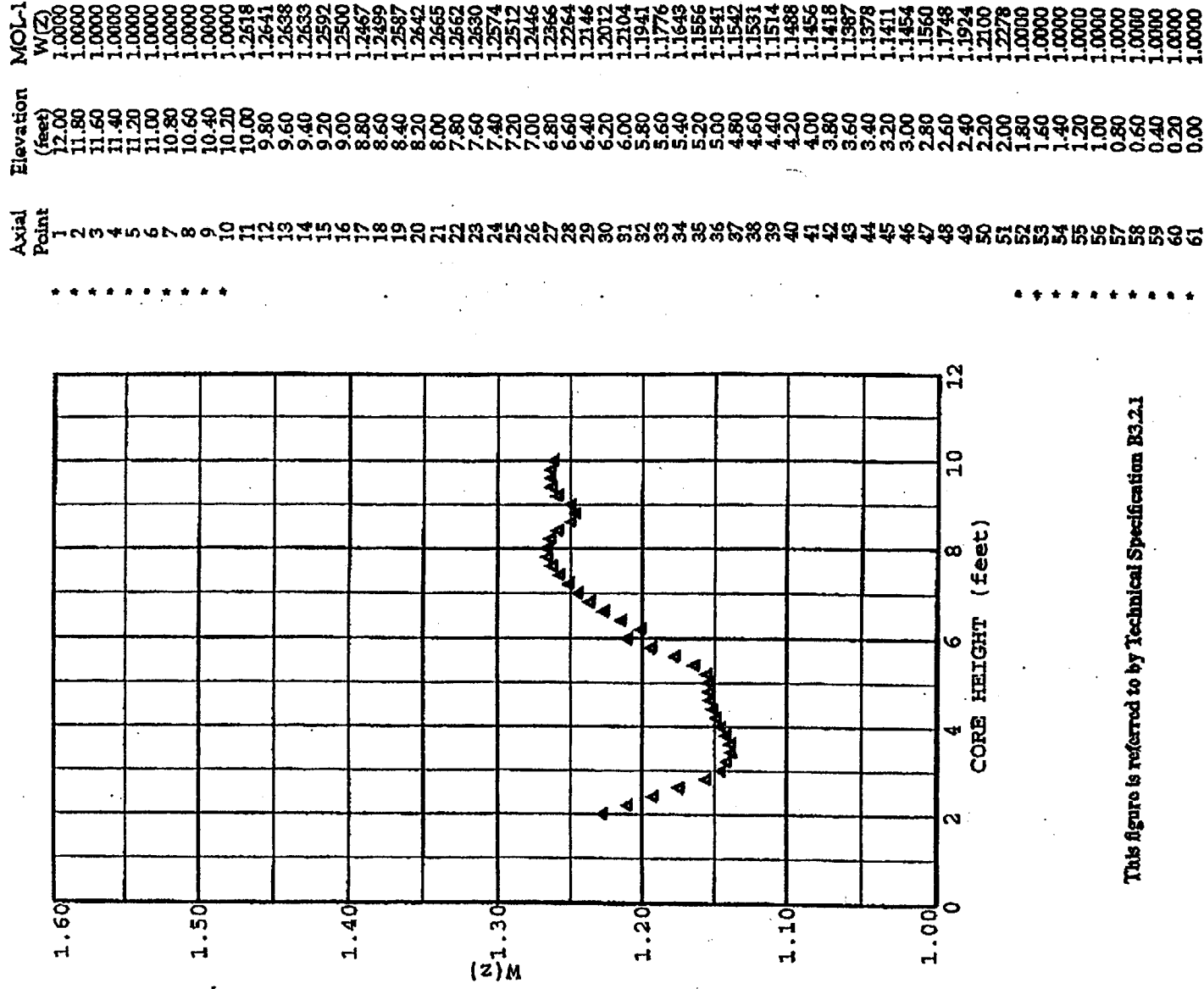
This figure is referred to by Technical Specification B3.2.1

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	1.2487
12	9.80	1.2380
13	9.60	1.2335
14	9.40	1.2328
15	9.20	1.2283
16	9.00	1.2188
17	8.80	1.2151
18	8.60	1.2182
19	8.40	1.2292
20	8.20	1.2370
21	8.00	1.2417
22	7.80	1.2439
23	7.60	1.2439
24	7.40	1.2403
25	7.20	1.2374
26	7.00	1.2336
27	6.80	1.2281
28	6.60	1.2206
29	6.40	1.2115
30	6.20	1.2009
31	6.00	1.2365
32	5.80	1.2230
33	5.60	1.2081
34	5.40	1.1923
35	5.20	1.1828
36	5.00	1.1827
37	4.80	1.1857
38	4.60	1.1867
39	4.40	1.1873
40	4.20	1.1870
41	4.00	1.1857
42	3.80	1.1851
43	3.60	1.1854
44	3.40	1.1853
45	3.20	1.1861
46	3.00	1.1944
47	2.80	1.2136
48	2.60	1.2350
49	2.40	1.2561
50	2.20	1.2773
51	2.00	1.2983
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

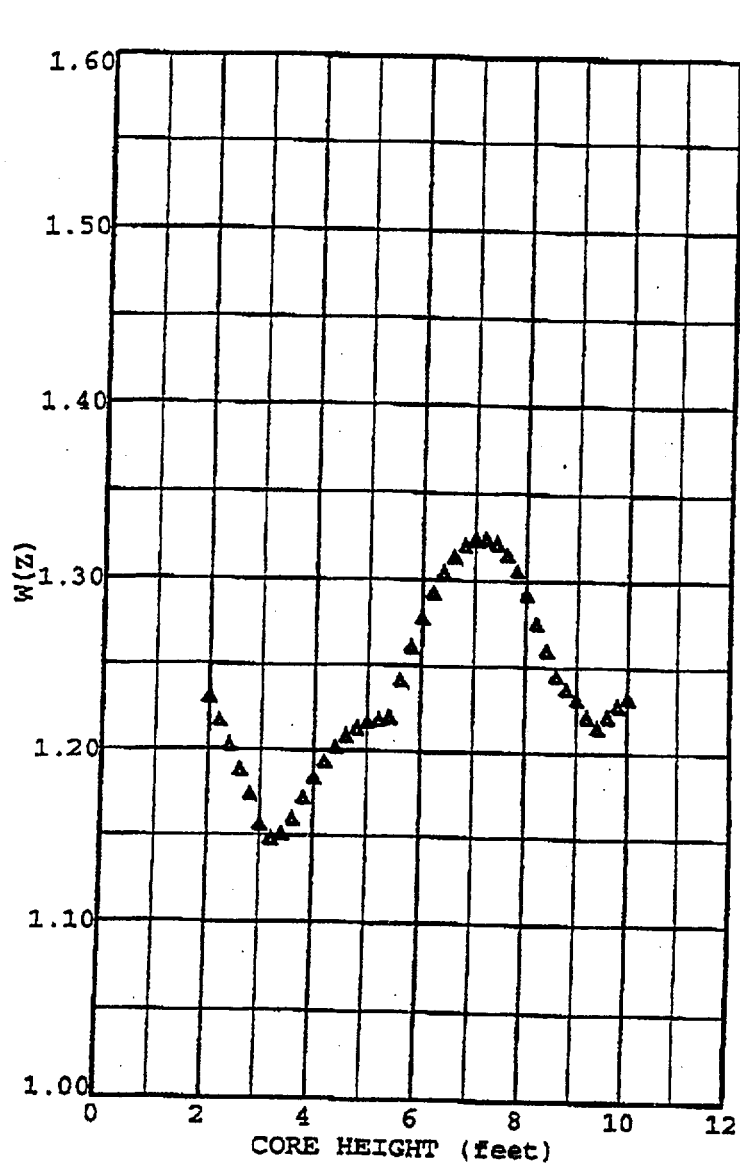


This figure is referred to by Technical Specification B3.2.1

* 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

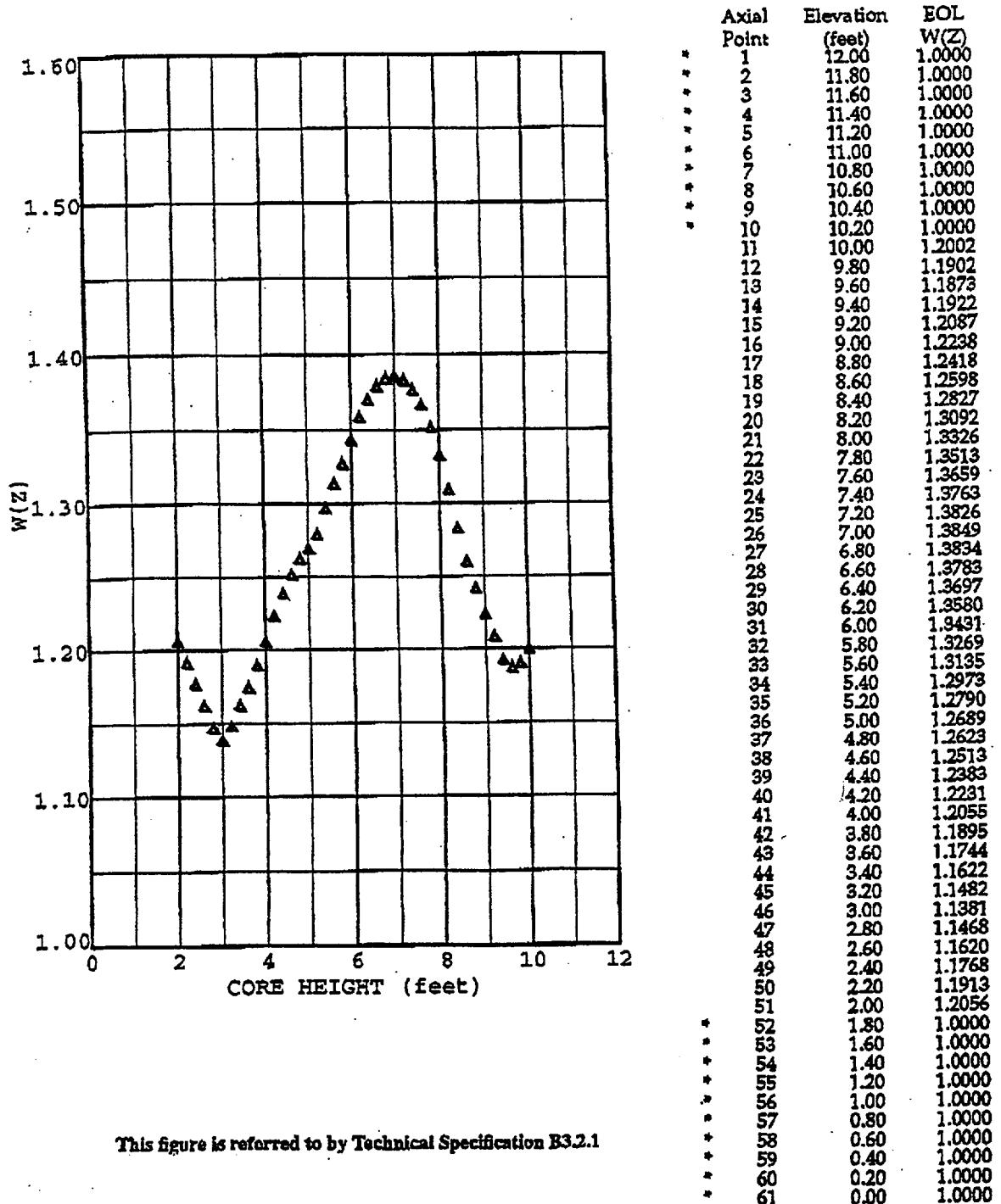
Axial Point	Elevation (feet)	MOL-2 W(Z)
1	12.00	1.0000
2	11.80	1.0000
3	11.60	1.0000
4	11.40	1.0000
5	11.20	1.0000
6	11.00	1.0000
7	10.80	1.0000
8	10.60	1.0000
9	10.40	1.0000
10	10.20	1.0000
11	10.00	1.2324
12	9.80	1.2281
13	9.60	1.2215
14	9.40	1.2148
15	9.20	1.2214
16	9.00	1.2312
17	8.80	1.2371
18	8.60	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 B3.2.1



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Figure 7
RAOC W(Z) at 16000 MWD/MTU



This figure is referred to by Technical Specification B3.2.1

* Top and Bottom 15% Excluded per
Technical Specification B3.2.1