

VOGTLE ELECTRIC GENERATING PLANT (VEGP) UNIT 2 CYCLE 8

CORE OPERATING LIMITS REPORT

REVISION 0

OCTOBER 1999

COLR for VEGP UNIT 2 CYCLE 8

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for VEGP UNIT 2 CYCLE 8 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

The Technical Specifications affected by this report are listed below:

3.1.1 SHUTDOWN MARGIN - MODES 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

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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 (Technical Requirement 13.1.1)

2.1.1 The SHUTDOWN MARGIN shall be greater than or equal to 1.30 percent $\Delta k/k$.

2.2 SHUTDOWN MARGIN - MODES 3, 4 AND 5 (Specification 3.1.1)

2.2.1 The SHUTDOWN MARGIN shall be greater than or equal to the limits shown in Figures 1 and 2.

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 positive than $+0.7 \times 10^{-4} \Delta k/k/^\circ F$ for power levels up to 70% RTP with a linear ramp to 0 $\Delta k/k/^\circ F$ at 100% RTP.

The EOL/ARO/RTP-MTC shall be less negative than $-5.5 \times 10^{-4} \Delta k/k/^\circ F$.*

2.3.2 The MTC Surveillance limits are:

The 300 ppm/ARO/RTP-MTC should be less negative than or equal to $-4.75 \times 10^{-4} \Delta k/k/^\circ F$.*

The 60 ppm/ARO/RTP-MTC should be less negative than $-5.35 \times 10^{-4} \Delta k/k/^\circ F$.*

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2.4.1 The shutdown banks shall be withdrawn to a position greater than or equal to 225 steps.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 banks shall be limited in physical insertion as shown in Figure 3.

* Applicable for full-power T-average of 586.4°F.

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2.6 Heat Flux Hot Channel Factor - F_q(Z) (Specification 3.2.1)

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

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

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

$$2.6.2 \quad F_q = 2.50$$

2.6.3 K(Z) is provided in Figure 4.

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

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

2.6.5 W(Z) values are provided in Figures 6 through 9.

2.6.6 The F_q(Z) penalty factors are provided in Table 1.

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2.7 Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}^N$ (Specification 3.2.2)

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

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

$$2.7.2 \quad F_{\Delta H}^{RTP} = 1.65$$

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

2.8 Axial Flux Difference (Specification 3.2.3)

2.8.1 The Axial Flux Difference (AFD) Acceptable Operation Limits are provided in Figure 5.

2.9 Boron Concentration (Specification 3.9.1)

2.9.1 The boron concentration shall be greater than or equal to 1936 ppm.#

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 B^{10} depletion.

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TABLE 1

$F_Q(Z)$ PENALTY FACTOR

Cycle Burnup (MWD/MTU)	$F_Q(Z)$ Penalty Factor
2704	1.020
2916	1.023
3129	1.026
3342	1.027
3555	1.027
3980	1.027
4193	1.026
4406	1.029
4619	1.027
4831	1.025
5044	1.022
5257	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.

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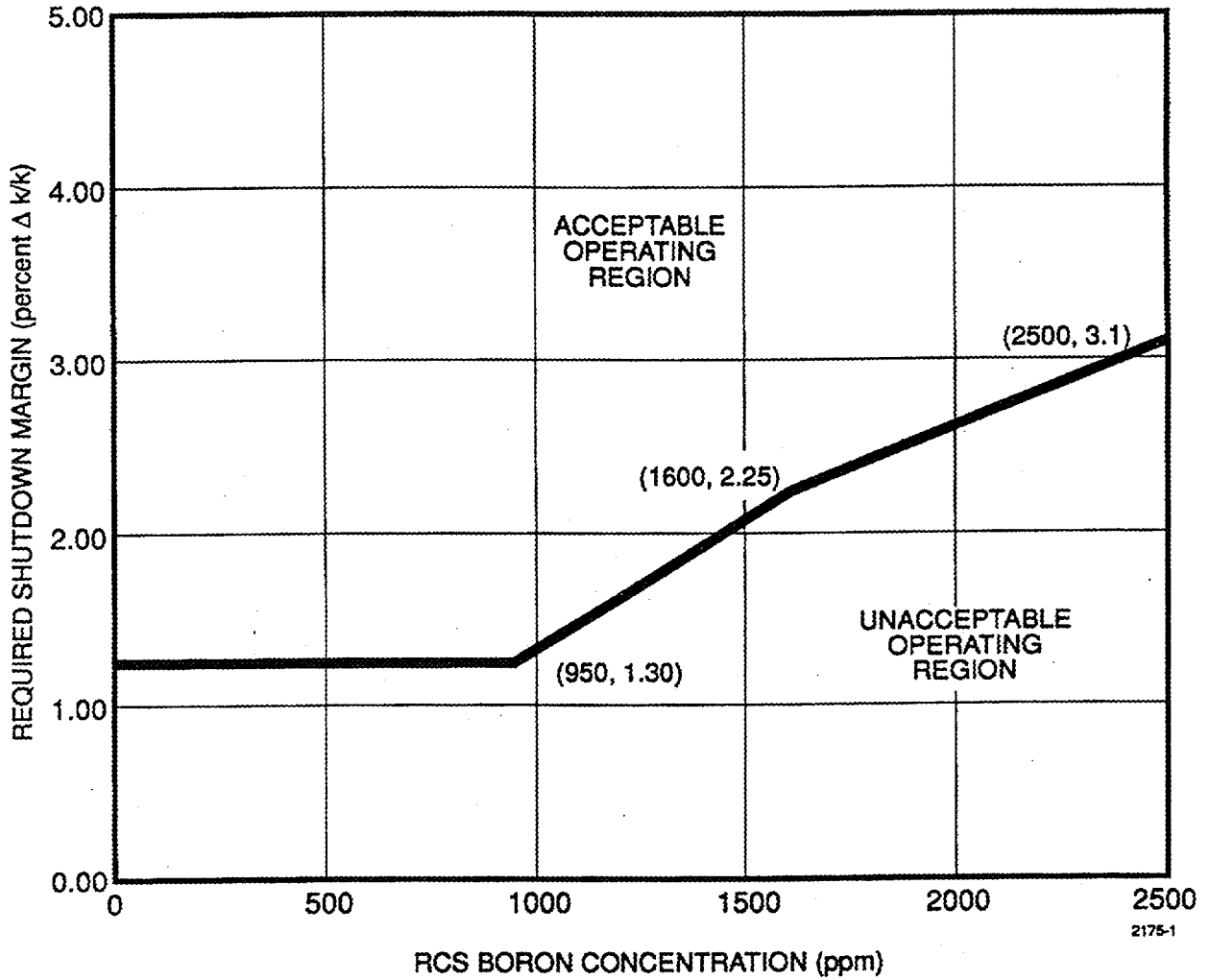


FIGURE 1
REQUIRED SHUTDOWN MARGIN FOR MODES 3 AND 4 (MODE 4 WITH AT LEAST ONE REACTOR COOLANT PUMP RUNNING)

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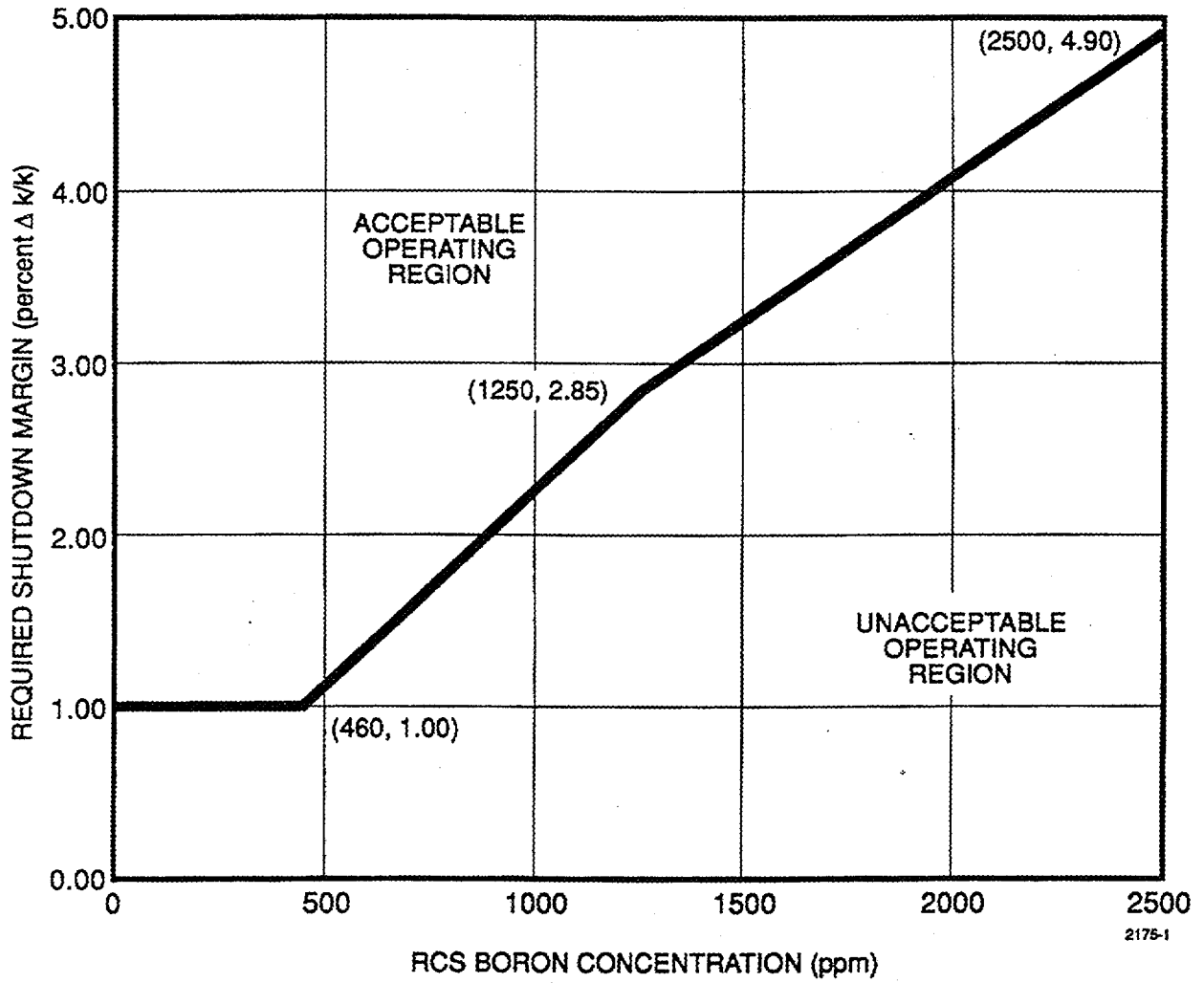
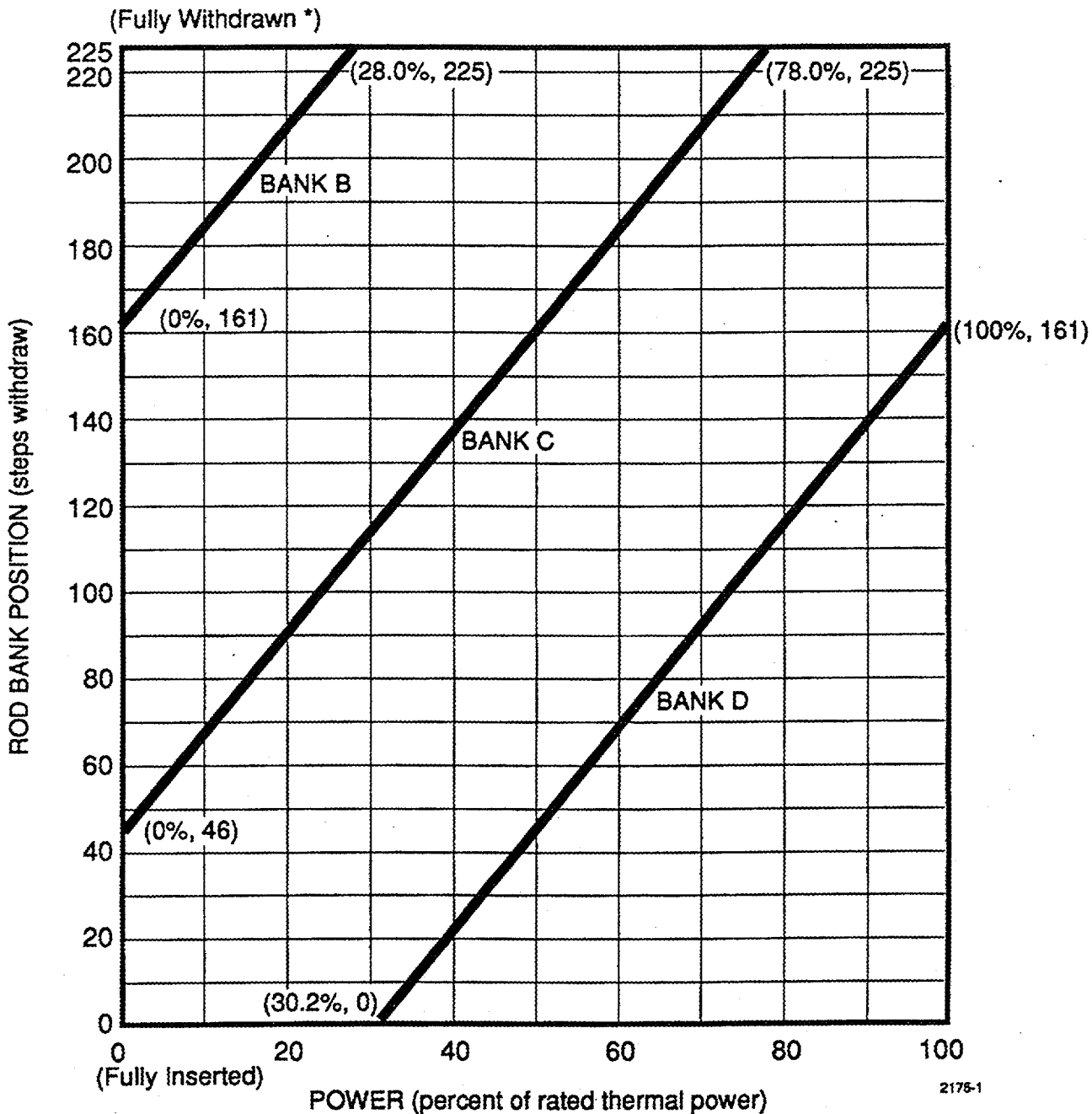


FIGURE 2

REQUIRED SHUTDOWN MARGIN FOR MODES 4 AND 5 (MODE 4 WITH NO REACTOR COOLANT PUMPS RUNNING)

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* 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 115 steps.

FIGURE 3

ROD BANK INSERTION LIMITS VERSUS % OF RATED THERMAL POWER

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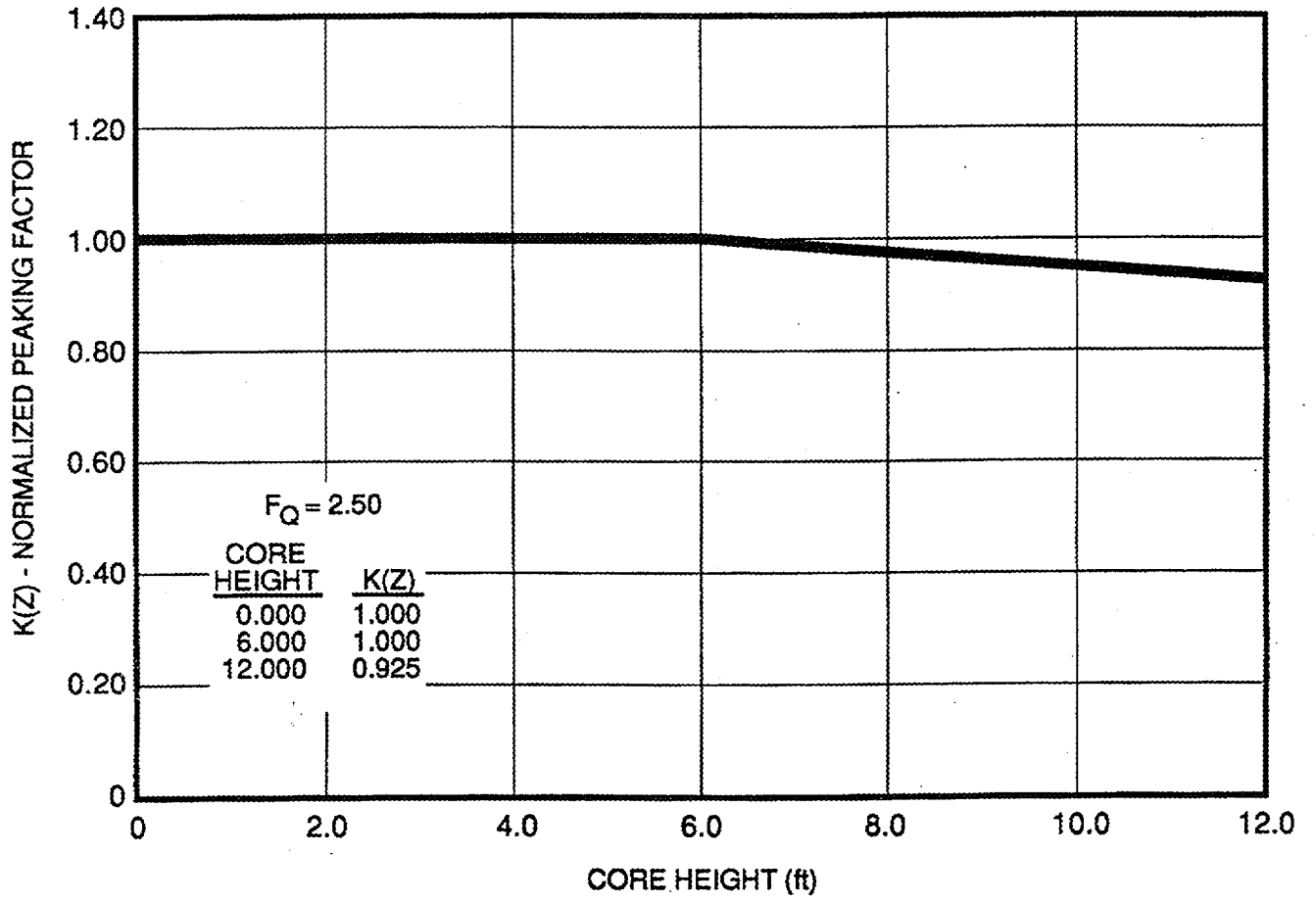


FIGURE 4

$K(Z)$ - NORMALIZED $F_Q(Z)$ AS A FUNCTION OF CORE HEIGHT

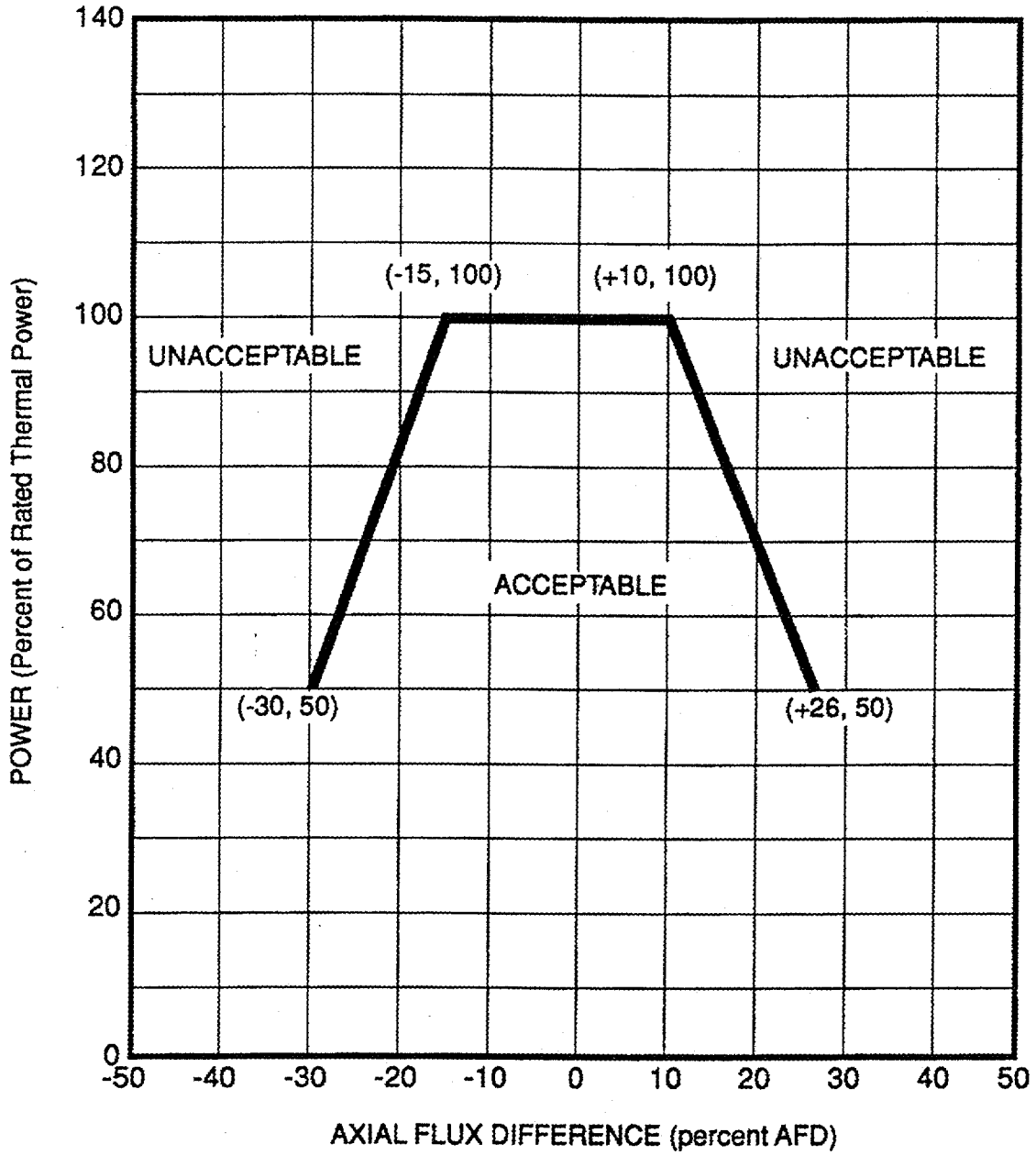
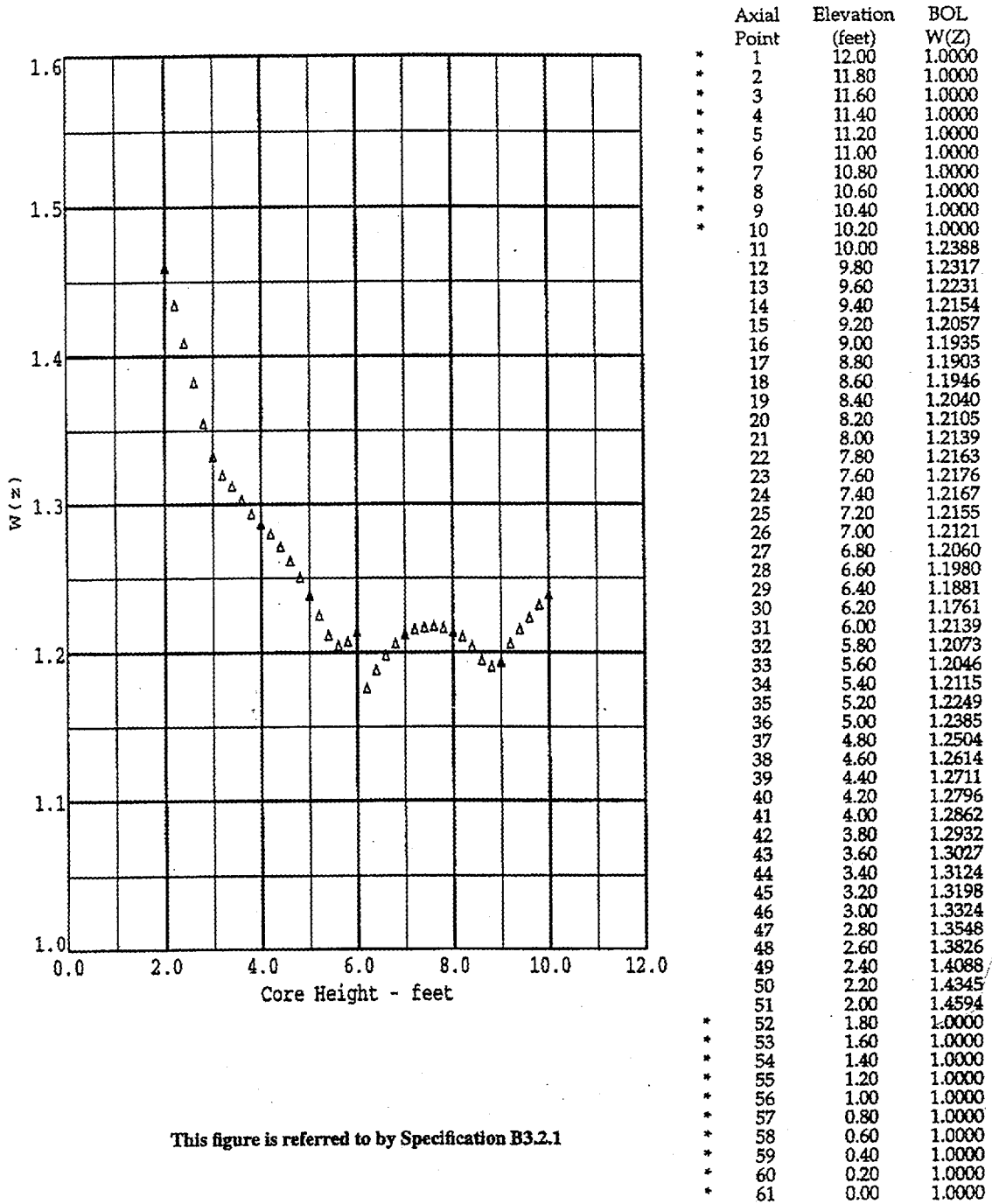


FIGURE 5

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF % OF RATED THERMAL POWER FOR RAOC

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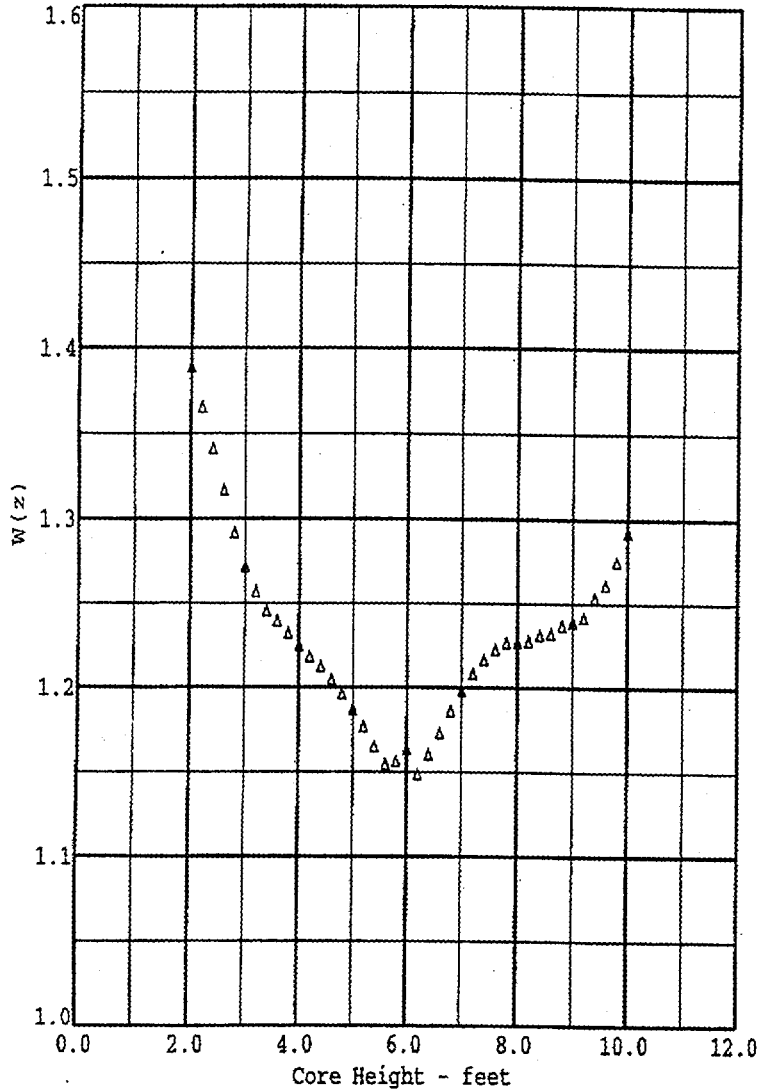


This figure is referred to by Specification B3.2.1

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

FIGURE 6
RAOC W(Z) AT150 MWD/MTU

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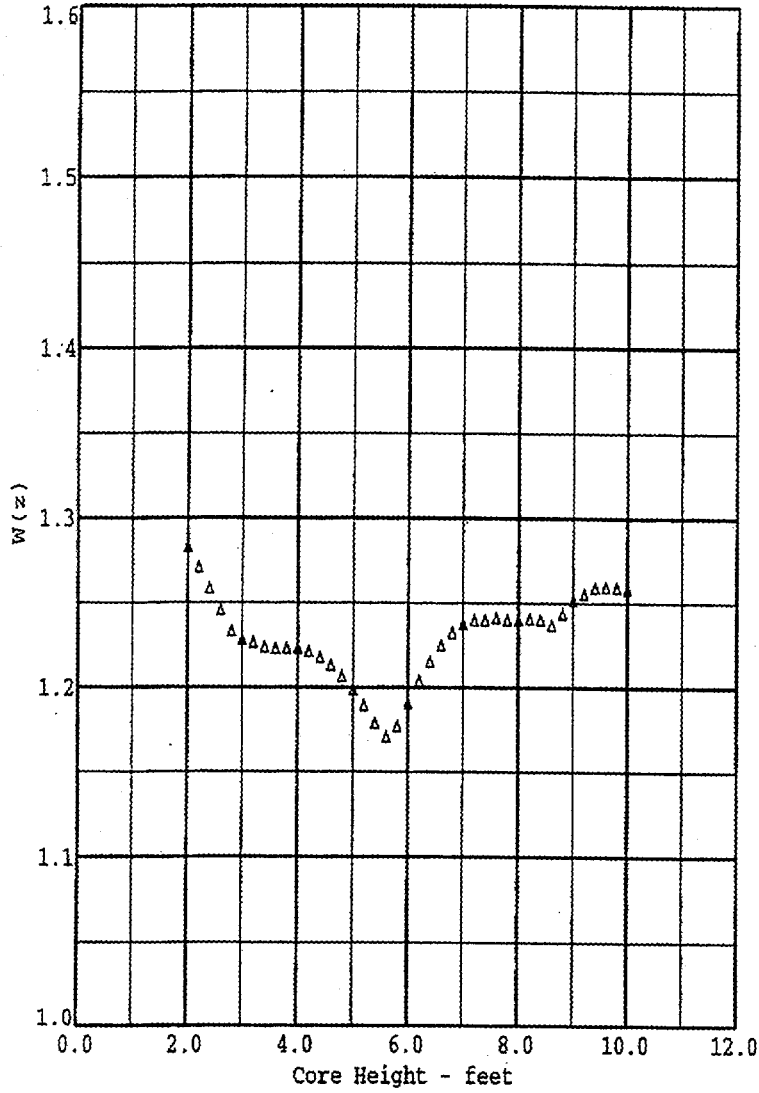
Axial Point	Elevation (feet)	MOL-1 W(Z)
*	1	12.00
*	2	11.80
*	3	11.60
*	4	11.40
*	5	11.20
*	6	11.00
*	7	10.80
*	8	10.60
*	9	10.40
*	10	10.20
*	11	10.00
*	12	9.80
*	13	9.60
*	14	9.40
*	15	9.20
*	16	9.00
*	17	8.80
*	18	8.60
*	19	8.40
*	20	8.20
*	21	8.00
*	22	7.80
*	23	7.60
*	24	7.40
*	25	7.20
*	26	7.00
*	27	6.80
*	28	6.60
*	29	6.40
*	30	6.20
*	31	6.00
*	32	5.80
*	33	5.60
*	34	5.40
*	35	5.20
*	36	5.00
*	37	4.80
*	38	4.60
*	39	4.40
*	40	4.20
*	41	4.00
*	42	3.80
*	43	3.60
*	44	3.40
*	45	3.20
*	46	3.00
*	47	2.80
*	48	2.60
*	49	2.40
*	50	2.20
*	51	2.00
*	52	1.80
*	53	1.60
*	54	1.40
*	55	1.20
*	56	1.00
*	57	0.80
*	58	0.60
*	59	0.40
*	60	0.20
*	61	0.00

This figure is referred to by Specification B3.2.1

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

FIGURE 7
RAOC W(Z) at 4000 MWD/MTU

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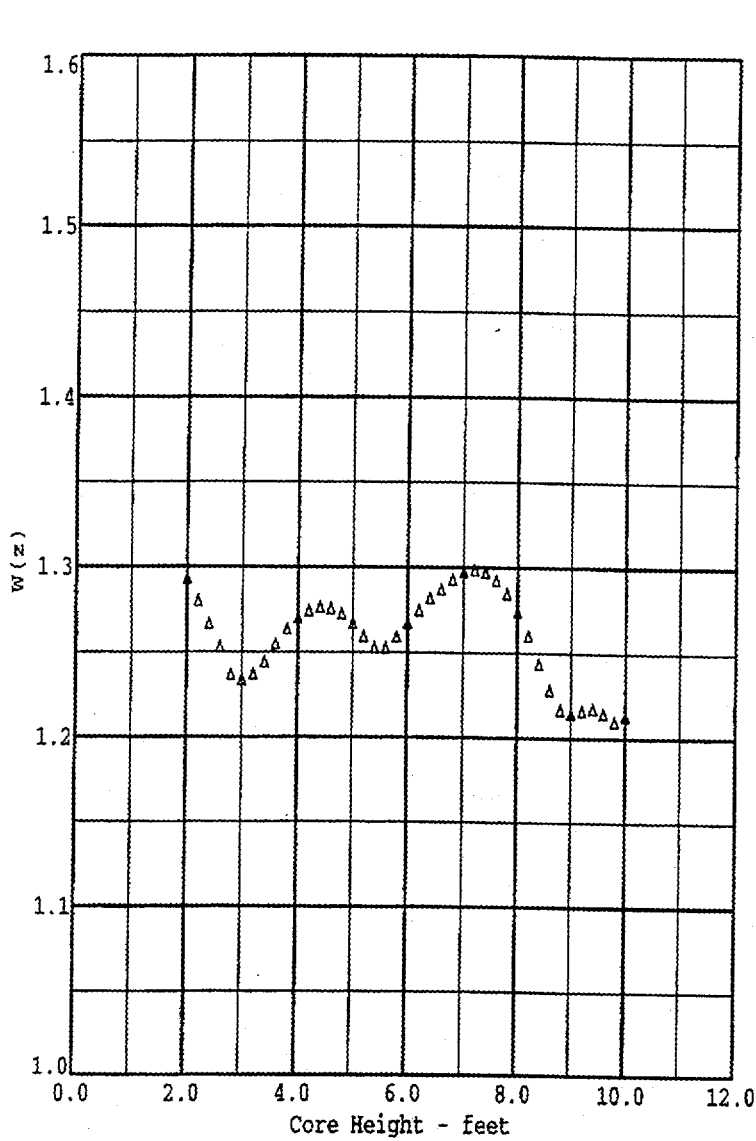
This figure is referred to by Specification B3.2.1

Axial Point	Elevation (feet)	MOL-2 W(Z)
*	1	12.00
*	2	11.80
*	3	11.60
*	4	11.40
*	5	11.20
*	6	11.00
*	7	10.80
*	8	10.60
*	9	10.40
*	10	10.20
*	11	10.00
*	12	9.80
*	13	9.60
*	14	9.40
*	15	9.20
*	16	9.00
*	17	8.80
*	18	8.60
*	19	8.40
*	20	8.20
*	21	8.00
*	22	7.80
*	23	7.60
*	24	7.40
*	25	7.20
*	26	7.00
*	27	6.80
*	28	6.60
*	29	6.40
*	30	6.20
*	31	6.00
*	32	5.80
*	33	5.60
*	34	5.40
*	35	5.20
*	36	5.00
*	37	4.80
*	38	4.60
*	39	4.40
*	40	4.20
*	41	4.00
*	42	3.80
*	43	3.60
*	44	3.40
*	45	3.20
*	46	3.00
*	47	2.80
*	48	2.60
*	49	2.40
*	50	2.20
*	51	2.00
*	52	1.80
*	53	1.60
*	54	1.40
*	55	1.20
*	56	1.00
*	57	0.80
*	58	0.60
*	59	0.40
*	60	0.20
*	61	0.00

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

FIGURE 8
RAOC W(Z) AT 12000 MWD/MTU

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This figure is referred to by 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 1.2132
*	12	9.80 1.2098
*	13	9.60 1.2148
*	14	9.40 1.2176
*	15	9.20 1.2162
*	16	9.00 1.2145
*	17	8.80 1.2167
*	18	8.60 1.2285
*	19	8.40 1.2435
*	20	8.20 1.2600
*	21	8.00 1.2740
*	22	7.80 1.2846
*	23	7.60 1.2923
*	24	7.40 1.2968
*	25	7.20 1.2983
*	26	7.00 1.2971
*	27	6.80 1.2928
*	28	6.60 1.2869
*	29	6.40 1.2818
*	30	6.20 1.2747
*	31	6.00 1.2674
*	32	5.80 1.2591
*	33	5.60 1.2526
*	34	5.40 1.2527
*	35	5.20 1.2593
*	36	5.00 1.2670
*	37	4.80 1.2725
*	38	4.60 1.2756
*	39	4.40 1.2763
*	40	4.20 1.2744
*	41	4.00 1.2701
*	42	3.80 1.2636
*	43	3.60 1.2547
*	44	3.40 1.2441
*	45	3.20 1.2371
*	46	3.00 1.2337
*	47	2.80 1.2367
*	48	2.60 1.2530
*	49	2.40 1.2666
*	50	2.20 1.2798
*	51	2.00 1.2930
*	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 9
RAOC W(Z) AT 20000 MWD/MTU