

QA RECORD

SEQUOYAH NUCLEAR PLANT UNIT 1, CYCLE 6

CORE OPERATING LIMITS REPORT

REVISION 1

NOVEMBER 21, 1991

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1038U

COLR FOR SEQUOYAH UNIT 1, CYCLE 6

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Sequoyah Unit 1, Cycle 6, has been prepared in accordance with the requirements of Technical Specification (TS) 6.9.1.14.

The TSs affected by this report are listed below:

- 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
- 3/4.2.3 Nuclear Enthalpy Hot Channel Factor

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 TS 6.9.1.14.

2.1 Moderator Temperature Coefficient (Specification 3/4.1.1.3) [3/4.1.1.3]

2.1.1 The moderator temperature coefficient (MTC) limits are:

The BOL/ARO/HZF-MTC shall be less positive than $0 \Delta k/k/^{\circ}F$ (BOL limit); With the measured BOL/ARO/HZF-MTC more positive than $-1.18 \times 10^{-5} \Delta k/k/^{\circ}F$ (as-measured MTC limit), establish control rod withdrawal limits to ensure the MTC remains less positive than $0 \Delta k/k/^{\circ}F$ for all times in core life.

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

2.1.2 The 300 ppm surveillance limit is:

The measured 300 ppm/ARO/RTP-MTC should be less negative than or equal to $-3.1 \times 10^{-4} \Delta k/k/^{\circ}F$.

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

*Indicates revision 1 changes.

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2.2 Shutdown Rod Insertion Limit (Specification 3/4.1.3.5)
[3/4.1.3.5]

2.2.1 The shutdown rods shall be withdrawn to a position as defined below:

<u>Cycle Burnup (MWD/MTU)</u>	<u>Steps Withdrawn</u>
$\leq 2,000$	≥ 226 to ≤ 231
$> 2,000$ to $< 14,000$	≥ 222 to ≤ 231
$\geq 14,000$	≥ 226 to ≤ 231

2.3 Control Rod Insertion Limit (Specification 3/4.1.3.6)
[3/4.1.3.6]

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

2.4 Axial Flux Difference (Specification 3/4.2.1)
[3/4.2.1]

2.4.1 The axial flux difference (AFD) limits are provided in Figure 2.

2.5 Heat Flux Hot Channel Factor - $F_Q(Z)$ (Specification 3/4.2.2)
[3/4.2.2]

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

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

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

2.5.1 $F_Q^{RTP} = 2.32$

2.5.2 $K(Z)$ is provided in Figure 3.

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2.5.3 Note that the $W(Z)$ values required by TS SR 4.2.2.2 are provided in Figures 4 through 7. This information is sufficient to determine $W(Z)$ versus core height for all cycle burnups through the use of three point interpolation.

2.6 Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}^N$ (Specification 3/4.2.3)
[3/4.2.3]

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

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

2.6.1 $F_{\Delta H}^{RTP} = 1.55$

2.6.2 $PF_{\Delta H} = 0.3$

COLR For Sequoyah Unit 1 Cycle 6

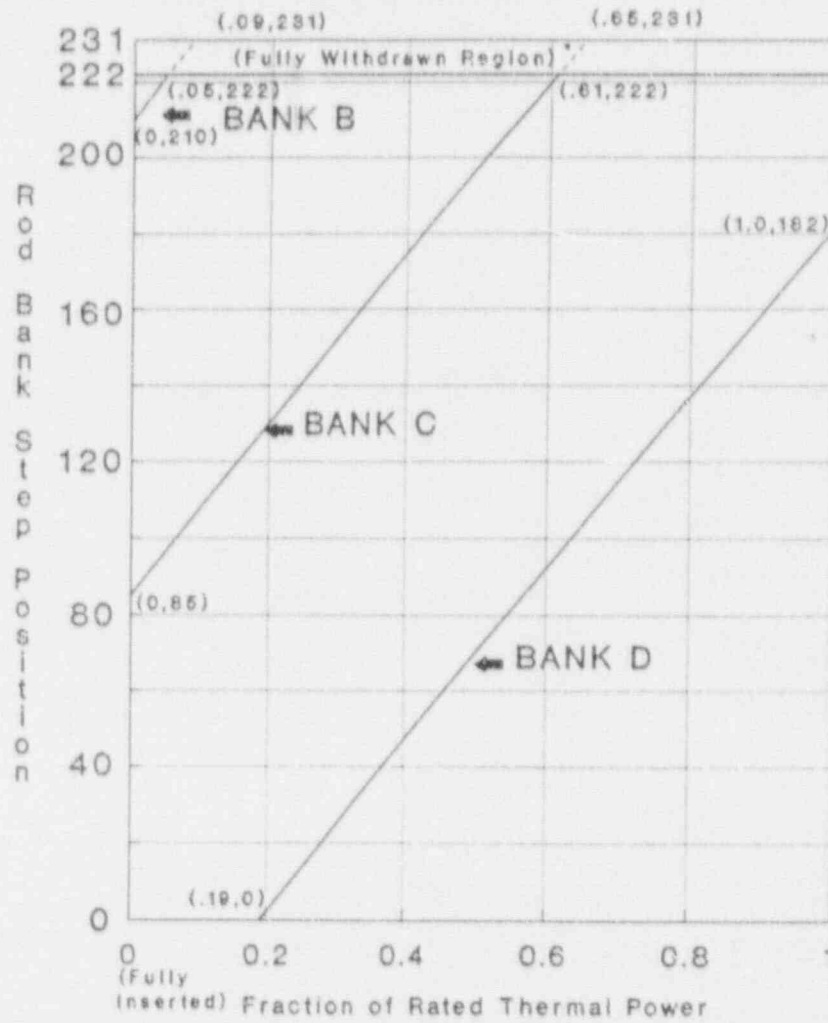


FIGURE 1

Rod Bank Insertion Limits Versus
Thermal Power Four Loop Operation

* Fully withdrawn region shall be the condition where shutdown and control banks are at a position within the interval of ± 222 and ± 231 steps withdrawn, inclusive.

Fully withdrawn shall be the position as defined below.

Cycle Burnup (MWd/MTU)

≤ 2000
 > 2000 to $\leq 14,000$
 $\geq 14,000$

Step Withdrawn

± 226 to ± 231
 ± 222 to ± 231
 ± 226 to ± 231

COLR For Sequoyah Unit 1 Cycle 6

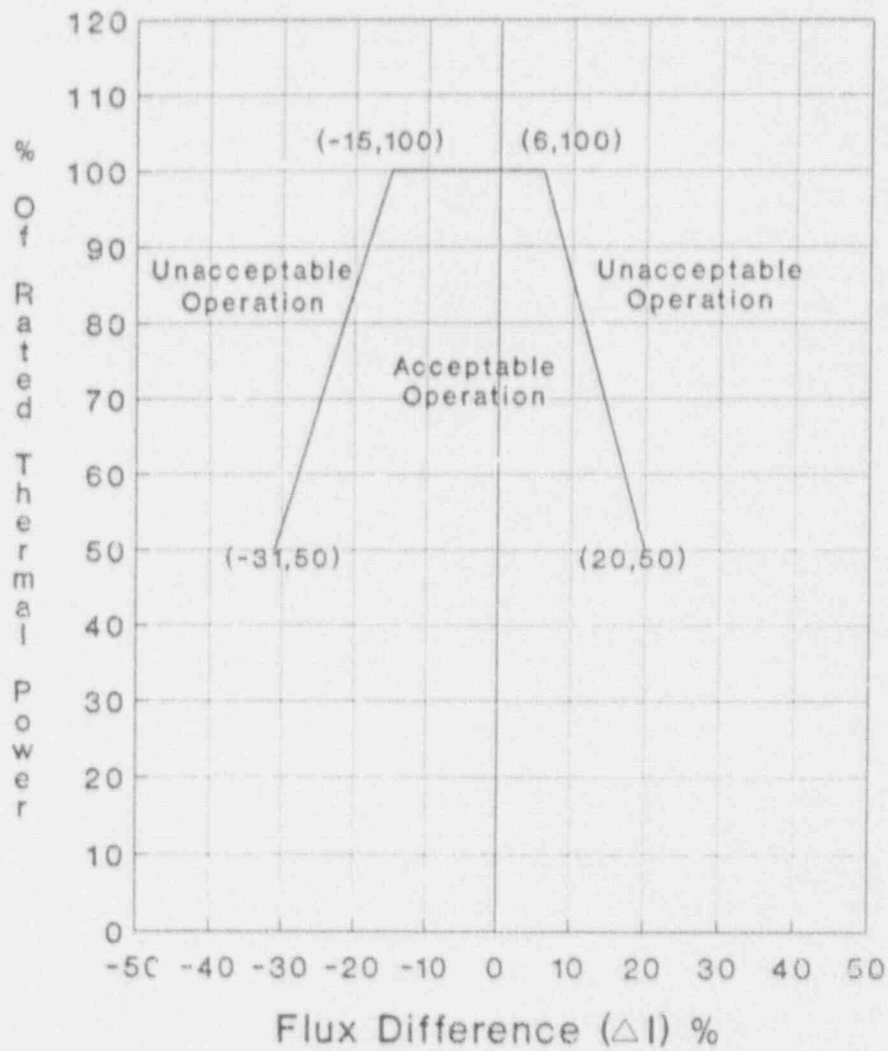


FIGURE 2

Axial Flux Difference Limits As
A Function Of Rated Thermal Power

COLR For Sequoyah Unit 1 Cycle 6

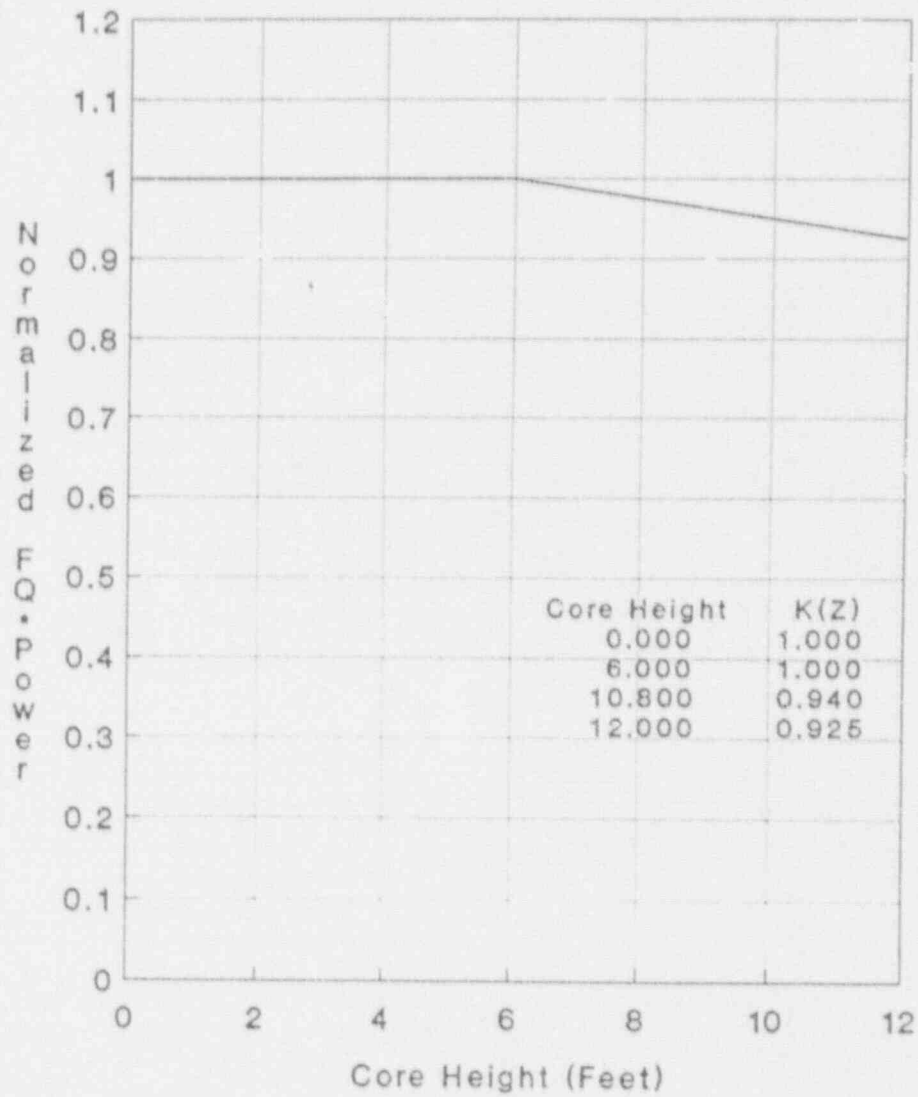
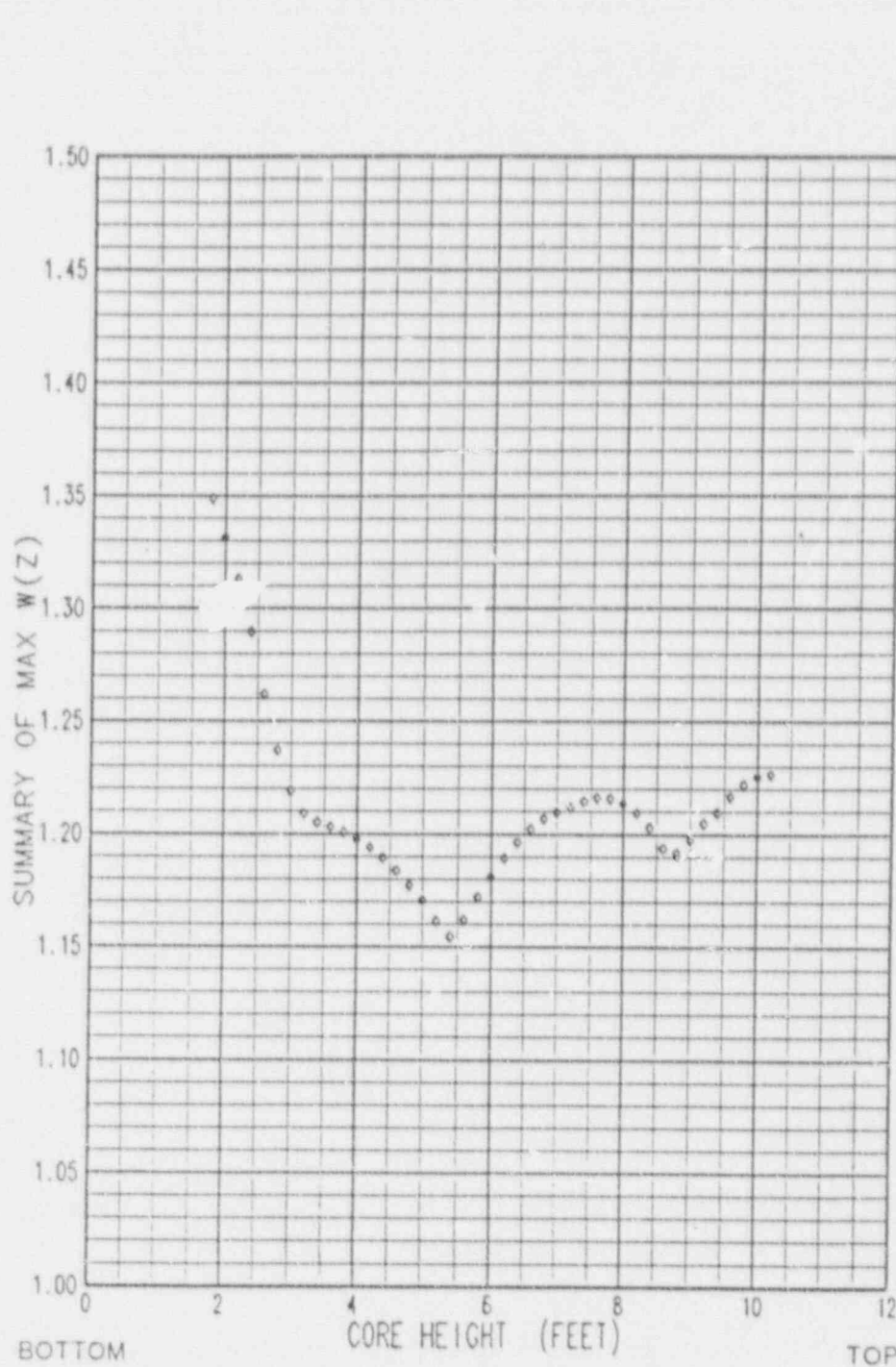


FIGURE 3

K(Z) - Normalized Fq(Z) as a Function of Core Height



HEIGHT (FEET)	MAX W(Z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.0000
1.4000	1.0000
1.6000	1.0000
1.8000	1.3487
2.0000	1.3313
2.2000	1.3130
2.4000	1.2896
2.6000	1.2620
2.8000	1.2369
3.0000	1.2189
3.2000	1.2091
3.4000	1.2051
3.6000	1.2030
3.8000	1.2006
4.0000	1.1977
4.2000	1.1940
4.4000	1.1894
4.6000	1.1838
4.8000	1.1773
5.0000	1.1706
5.2000	1.1615
5.4000	1.1546
5.6000	1.1619
5.8000	1.1720
6.0000	1.1811
6.2000	1.1893
6.4000	1.1964
6.6000	1.2023
6.8000	1.2069
7.0000	1.2097
7.2000	1.2119
7.4000	1.2146
7.6000	1.2162
7.8000	1.2159
8.0000	1.2136
8.2000	1.2095
8.4000	1.2030
8.6000	1.1939
8.8000	1.1918
9.0000	1.1977
9.2000	1.2048
9.4000	1.2097
9.6000	1.2169
9.8000	1.2221
10.0000	1.2256
10.2000	1.2266
10.4000	1.0000
10.6000	1.0000
10.8000	1.0000
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

FIGURE 4

SEQUOYAH UNIT 1 CYCLE 6
RAOC SUMMARY OF MAX W(Z) AT 150 MWD/MTU

* TOP AND BOTTOM 15% EXCLUDED AS PER TECH SPEC 4.2.2.G

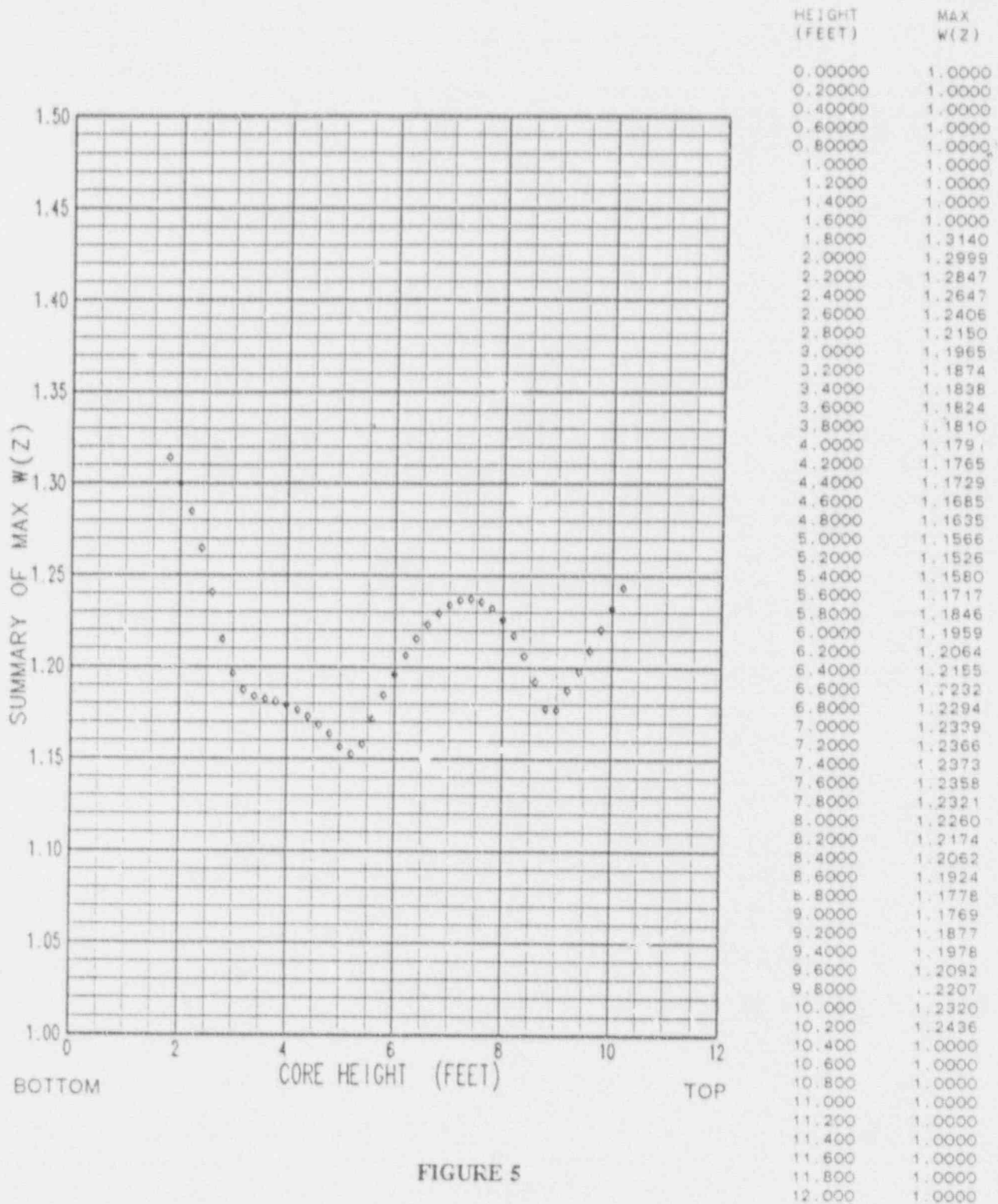
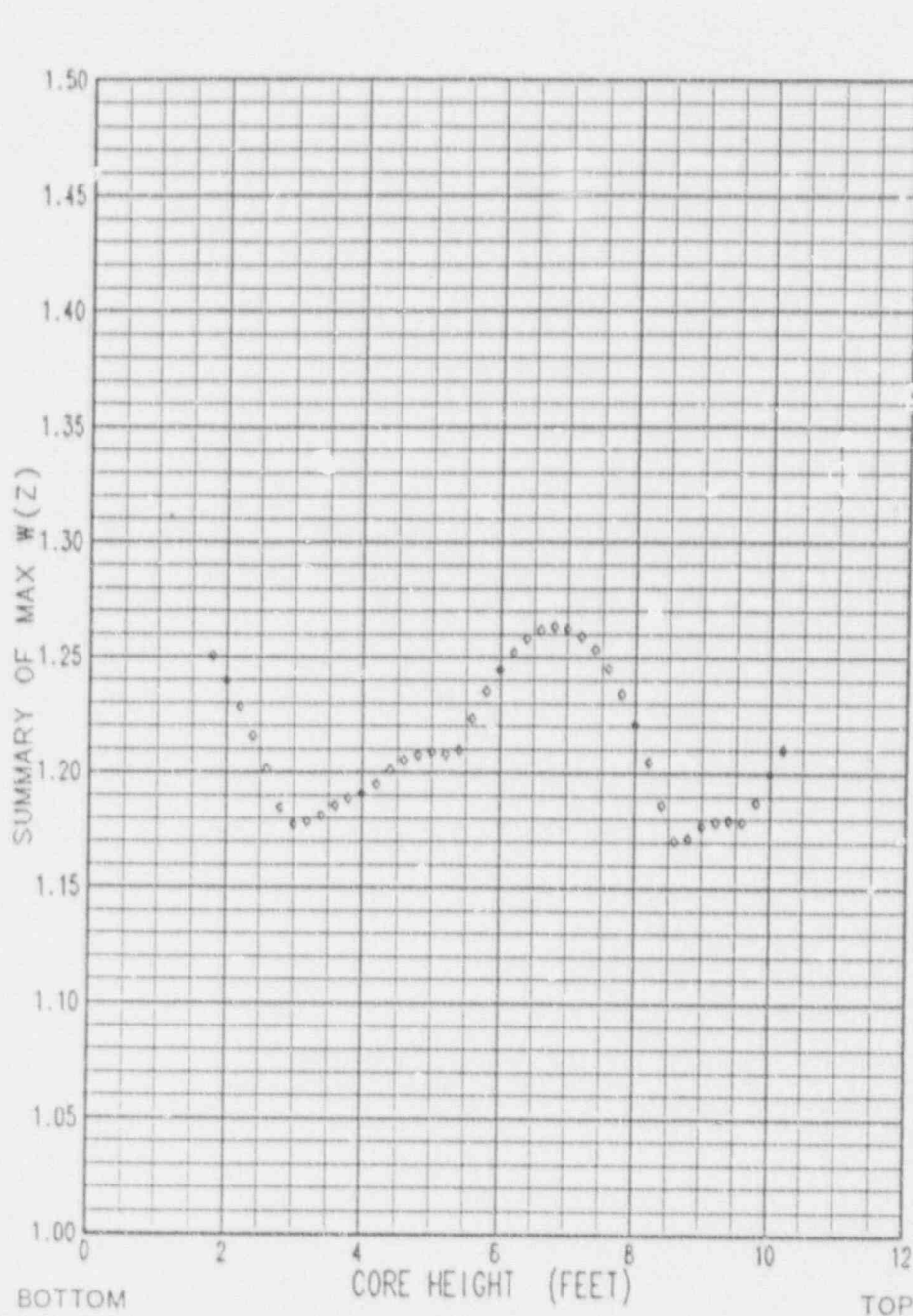


FIGURE 5

SEQUOYAH UNIT 1 CYCLE 6
RAOC SUMMARY OF MAX W(Z) AT 4000 MWD/MTU

* TOP AND BOTTOM 15% EXCLUDED AS PER TECH SPEC 4.2.2.G

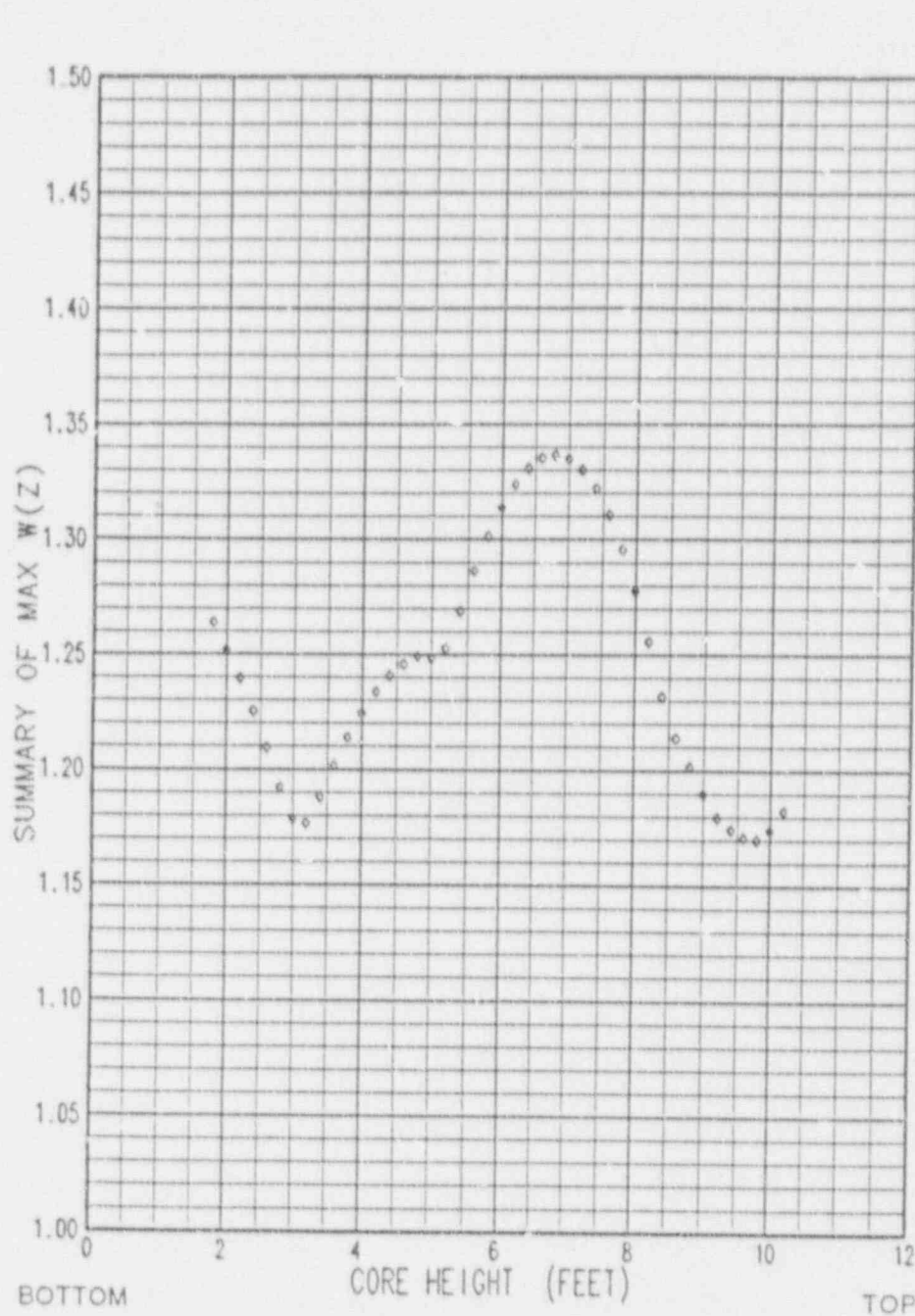


HEIGHT (FEET)	MAX W(Z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.0000
1.4000	1.0000
1.6000	1.0000
1.8000	1.2503
2.0000	1.2397
2.2000	1.2284
2.4000	1.2156
2.6000	1.2013
2.8000	1.1847
3.0000	1.1773
3.2000	1.1785
3.4000	1.1813
3.6000	1.1856
3.8000	1.1888
4.0000	1.1909
4.2000	1.1948
4.4000	1.2010
4.6000	1.2052
4.8000	1.2077
5.0000	1.2090
5.2000	1.2080
5.4000	1.2099
5.6000	1.2233
5.8000	1.2353
6.0000	1.2446
6.2000	1.2524
6.4000	1.2582
6.6000	1.2618
6.8000	1.2633
7.0000	1.2625
7.2000	1.2592
7.4000	1.2535
7.6000	1.2452
7.8000	1.2343
8.0000	1.2209
8.2000	1.2045
8.4000	1.1853
8.6000	1.1706
8.8000	1.1717
9.0000	1.1769
9.2000	1.1787
9.4000	1.1795
9.6000	1.1787
9.8000	1.1875
10.000	1.1995
10.200	1.2102
10.400	1.0000
10.600	1.0000
10.800	1.0000
11.000	1.0000
11.200	1.0000
11.400	1.0000
11.600	1.0000
11.800	1.0000
12.000	1.0000

FIGURE 6

SEQUOYAH UNIT 1 CYCLE 6
RAOC SUMMARY OF MAX W(Z) AT 10000 MWD/MTU

* TOP AND BOTTOM .5% EXCLUDED AS PER TECH SPEC 4.2.2.G



HEIGHT (FEET)	MAX W(Z)
0.0000	1.0000
0.2000	1.0000
0.4000	1.0000
0.6000	1.0000
0.8000	1.0000
1.0000	1.0000
1.2000	1.0000
1.4000	1.0000
1.6000	1.0000
1.8000	1.2638
2.0000	1.2519
2.2000	1.2394
2.4000	1.2252
2.6000	1.2093
2.8000	1.1922
3.0000	1.1785
3.2000	1.1767
3.4000	1.1880
3.6000	1.2016
3.8000	1.2139
4.0000	1.2246
4.2000	1.2337
4.4000	1.2408
4.6000	1.2458
4.8000	1.2493
5.0000	1.2485
5.2000	1.2527
5.4000	1.2689
5.6000	1.2804
5.8000	1.3014
6.0000	1.3129
6.2000	1.3237
6.4000	1.3309
6.6000	1.3353
6.8000	1.3367
7.0000	1.3351
7.2000	1.3302
7.4000	1.3221
7.6000	1.3106
7.8000	1.2957
8.0000	1.2777
8.2000	1.2557
8.4000	1.2319
8.6000	1.2141
8.8000	1.2017
9.0000	1.1899
9.2000	1.1798
9.4000	1.1744
9.6000	1.1711
9.8000	1.1700
10.0000	1.1743
10.2000	1.1826
10.4000	1.0000
10.6000	1.0000
10.8000	1.0000
11.0000	1.0000
11.2000	1.0000
11.4000	1.0000
11.6000	1.0000
11.8000	1.0000
12.0000	1.0000

FIGURE 7

SEQUOYAH UNIT 1 CYCLE 6
RAOC SUMMARY OF MAX W(Z) AT 14000 MWD/MTU

* TOP AND BOTTOM 15% EXCLUDED AS PER TECH SPEC 4.2.2.G