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SUBJECT: COMANCHE PEAK NUCLEAR POWER PLANT
DOCKET NO. 50-446 (UNIT 2)
CORE OPERATING LIMITS REPORT

Dear Sir or Madam:

Enclosed is Revision 0 of the Core Operating Limits Report for Comanche Peak Nuclear Power Plant (CPNPP) Unit 2, Cycle 17. This report is prepared and submitted pursuant to Technical Specification 5.6.5.

This communication contains no new licensing basis commitments regarding CPNPP Unit 2.

A001
NRR

Should you have any questions, please contact Carl Corbin at (254) 897-0121.

Sincerely,

Timothy A. Hope

Enclosure – Unit 1 Cycle 17 Core Operating Limits Report, Revision 0

c - Kriss Kennedy, Region IV
Margaret M. Watford, NRR
Resident Inspectors, Comanche Peak

ERX-17-001, Rev. 0

CPNPP UNIT 2 CYCLE 17

CORE OPERATING LIMITS REPORT

March 2017

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for CPNPP UNIT 2 CYCLE 17 has been prepared in accordance with the requirements of Technical Specification 5.6.5.

The Technical Specifications affected by this report are listed below:

SL 2.1	SAFETY LIMITS (SLs)
LCO 3.1.1	SHUTDOWN MARGIN (SDM)
LCO 3.1.3	MODERATOR TEMPERATURE COEFFICIENT (MTC)
LCO 3.1.4	ROD GROUP ALIGNMENT LIMITS
LCO 3.1.5	SHUTDOWN BANK INSERTION LIMITS
LCO 3.1.6	CONTROL BANK INSERTION LIMITS
LCO 3.1.8	PHYSICS TESTS EXCEPTIONS - MODE 2
LCO 3.2.1	HEAT FLUX HOT CHANNEL FACTOR ($F_Q(Z)$)
LCO 3.2.2	NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR ($F^N_{\Delta H}$)
LCO 3.2.3	AXIAL FLUX DIFFERENCE (AFD)
LCO 3.3.1	REACTOR TRIP SYSTEM (RTS) INSTRUMENTATION
LCO 3.4.1	RCS PRESSURE, TEMPERATURE, AND FLOW DEPARTURE FROM NUCLEATE BOILING (DNB) LIMITS
LCO 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 the NRC-approved methodologies specified in Technical Specification 5.6.5b, Items 1 through 4 and 7 through 15. These limits have been determined such that all applicable limits of the safety analysis are met.

2.1 SAFETY LIMITS (SLs) (SL 2.1)

2.1.1 In MODES 1 and 2, the combination of thermal power, reactor coolant system highest loop average temperature, and pressurizer pressure shall not exceed the safety limits specified in Figure 1.

2.2 SHUTDOWN MARGIN (SDM) (LCO 3.1.1)

2.2.1 The SDM shall be greater than or equal to 1.3% $\Delta k/k$ in MODE 2 with $K_{eff} < 1.0$, and in MODES 3, 4, and 5.

2.3 MODERATOR TEMPERATURE COEFFICIENT (MTC) (LCO 3.1.3)

2.3.1 The MTC upper and lower limits, respectively, are:

The BOL/ARO/HZP-MTC shall be less positive than +5 pcm/°F.
The EOL/ARO/RTP-MTC shall be less negative than -40 pcm/°F.

2.3.2 SR 3.1.3.2

The MTC surveillance limit is:

The 300 ppm/ARO/RTP-MTC shall be less negative than or equal to -31 pcm/°F.

The 60 ppm/ARO/RTP-MTC shall be less negative than or equal to -38 pcm/°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 ROD GROUP ALIGNMENT LIMITS (LCO 3.1.4)

2.4.1 The SDM shall be greater than or equal to 1.3% $\Delta k/k$ in MODES 1 and 2.

2.5 SHUTDOWN BANK INSERTION LIMITS (LCO 3.1.5)

2.5.1 The shutdown rods shall be fully withdrawn. Fully withdrawn shall be the condition where shutdown rods are at a position within the interval of 218 and 231 steps withdrawn, inclusive.

2.6 CONTROL BANK INSERTION LIMITS (LCO 3.1.6)

2.6.1 The control banks shall be limited in physical insertion as shown in Figure 2.

2.6.2 The control banks shall always be withdrawn and inserted in the prescribed sequence. For withdrawal, the sequence is control bank A, control bank B, control bank C, and control bank D. The insertion sequence is the reverse of the withdrawal sequence.

2.6.3 A 115 step Tip-to-Tip relationship between each sequential control bank shall be maintained.

2.7 PHYSICS TESTS EXCEPTIONS - MODE 2 (LCO 3.1.8)

2.7.1 The SDM shall be greater than or equal to 1.3% $\Delta k/k$ in MODE 2 during PHYSICS TESTS.

2.8 HEAT FLUX HOT CHANNEL FACTOR ($F_Q(Z)$) (LCO 3.2.1)

2.8.1 $F_Q(Z) \leq \frac{F_Q^{RTP}}{P} [K(Z)]$ for $P > 0.5$

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

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

2.8.2 F_Q^{RTP} = 2.50

2.8.3 K(Z) is provided in Figure 3.

2.8.4 Elevation and burnup dependent W(Z) values are provided in Figures 4, 5, 6, 7 and 8. For W(Z) data at a desired burnup not listed in the figures, but less than the maximum listed burnup, values at 3 or more burnup steps should be used to interpolate the W(Z) data to the desired burnup with a polynomial type fit that uses the nearest three burnup steps. For W(Z) data at a desired burnup outside of the listed burnup steps, a linear extrapolation of the W(Z) data for the nearest two burnup steps can be used.

2.8.5 SR 3.2.1.2

If the two most recent $F_Q(Z)$ evaluations show an increase in the expression

maximum over Z [$F_Q^C(Z)$ / K(Z)],

the burnup dependent values in Table 1 shall be used instead of a constant 2% to increase $F_Q^W(Z)$ per Surveillance Requirement 3.2.1.2, Note a. A constant factor of 2% shall be used for all cycle burnups that are outside the range of Table 1.

2.9 NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR ($F^N_{\Delta H}$) (LCO 3.2.2)

2.9.1 $F^N_{\Delta H} \leq F^{RTP}_{\Delta H} [1 + PF_{\Delta H} (1-P)]$

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

2.9.2 $F^{RTP}_{\Delta H}$ = 1.60 for all Fuel Assembly Regions

2.9.3 $PF_{\Delta H}$ = 0.3

2.10 AXIAL FLUX DIFFERENCE (AFD) (LCO 3.2.3)

2.10.1 The AFD Acceptable Operation Limits are provided in Figure 9.

2.11 REACTOR TRIP SYSTEM (RTS) INSTRUMENTATION (LCO 3.3.1)

2.11.1 The numerical values pertaining to the Overtemperature N-16 reactor trip setpoint are listed below;

K_1 = 1.15

K_2 = 0.0139 /°F

K_3 = 0.00071 /psig

T_c° = indicated loop specific T_c at Rated Thermal Power, °F

P^1 ≥ 2235 psig

τ_1 ≥ 10 sec

τ_2 ≤ 3 sec

$f_1(\Delta q) = -2.78 \cdot \{(q_t-q_b) + 18\%\}$ when $(q_t-q_b) \leq -18\%$ RTP

$= 0\%$ when -18% RTP $< (q_t-q_b) < +10.0\%$ RTP

$= 2.34 \cdot \{(q_t-q_b) - 10.0\%\}$ when $(q_t-q_b) \geq +10.0\%$ RTP

2.12 RCS PRESSURE, TEMPERATURE, AND FLOW DEPARTURE FROM NUCLEATE BOILING (DNB) LIMITS (LCO 3.4.1)

2.12.1 RCS DNB parameters for pressurizer pressure, RCS average temperature, and RCS total flow rate shall be within the surveillance limits specified below:

2.12.2 SR 3.4.1.1

Pressurizer pressure ≥ 2220 psig (4 channels)

≥ 2222 psig (3 channels)

The pressurizer pressure limits correspond to the analytical limit of 2205 psig used in the safety analysis with allowance for measurement uncertainty. These uncertainties are based on the use of control board indications and the number of available channels.

2.12.3 SR 3.4.1.2

RCS average temperature ≤ 592 °F (4 channels)

≤ 591 °F (3 channels)

The RCS average temperature limits correspond to the analytical limit of 595.2 °F which is bounded by that used in the safety analysis with allowance for measurement uncertainty. These uncertainties are based on the use of control board indications and the number of available channels.

2.12.4 SR 3.4.1.3

The RCS total flow rate shall be ≥ 408,000 gpm.

2.12.5 SR 3.4.1.4

The RCS total flow rate based on precision heat balance shall be ≥ 408,000 gpm.

The required RCS flow, based on an elbow tap differential pressure instrument measurement prior to MODE 1 after the refueling outage, shall be greater than 327,000 gpm.

2.13 <u>BORON CONCENTRATION</u> (LCO 3.9.1)

2.13.1 The required refueling boron concentration is ≥ 1938 ppm.

3.0 <u>REFERENCES</u>

Technical Specification 5.6.5.

Table 1
$F_Q(Z)$ MARGIN DECREASES IN EXCESS OF 2% PER 31 EFPD

Cycle Burnup (MWD/MTU)	Maximum Decrease In $F_Q(Z)$ MARGIN (Percent)
0	4.11
150	4.11
365	4.65
580	4.65
796	4.42
1011	3.96
1226	3.28
1441	2.55
1657	2.00
4455	2.00
4670	2.17
4885	2.65
5101	2.84
5316	3.03
5531	2.81
5746	2.55
5962	2.22
6177	2.00

Note: All cycle burnups outside the range of the table shall use a constant 2% decrease in $F_Q(Z)$ margin for compliance with Surveillance Requirement 3.2.1.2, Note a. Linear interpolation is acceptable to determine the $F_Q(Z)$ margin decrease for cycle burnups which fall between the specified burnups.

Figure 1
Reactor Core Safety Limits

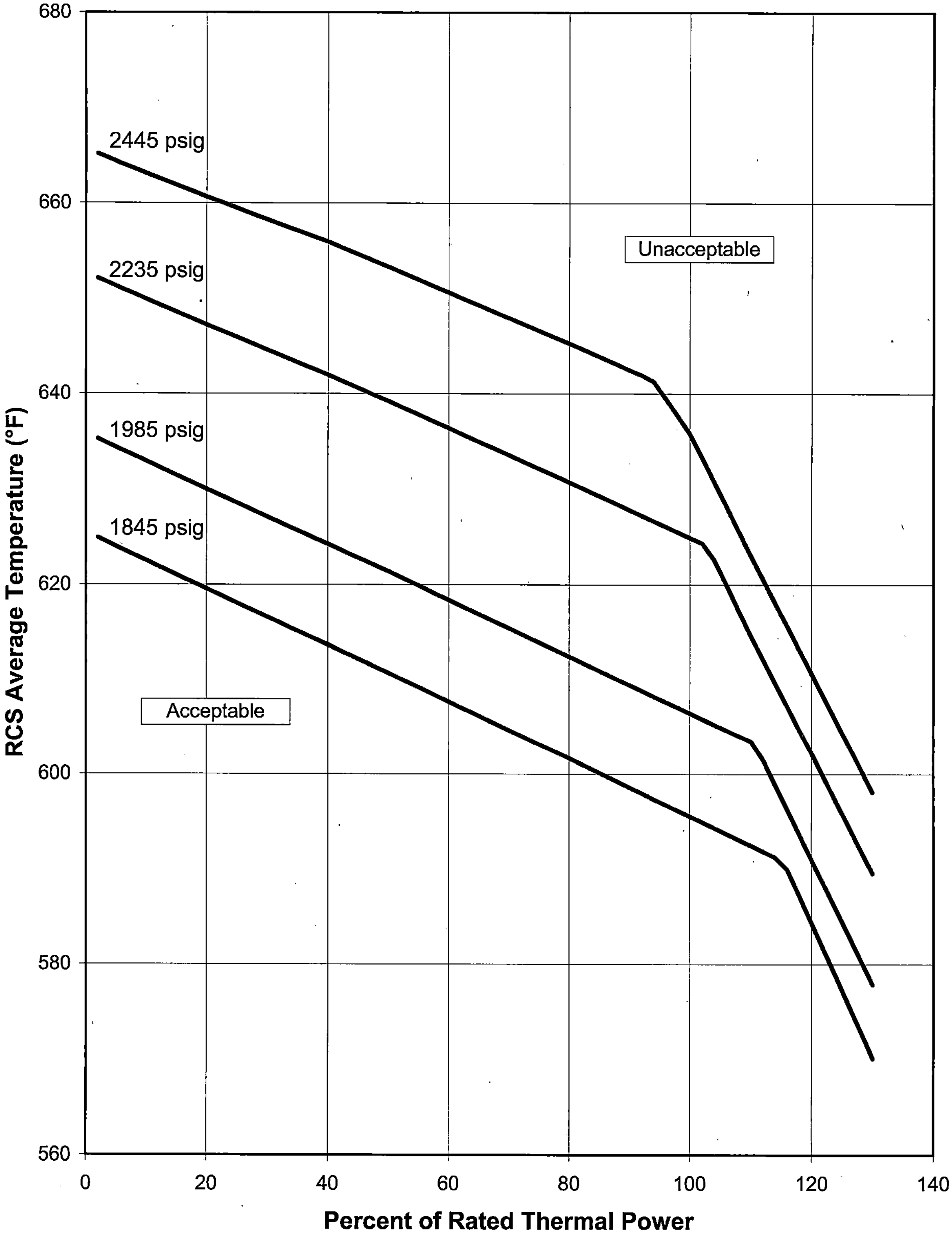
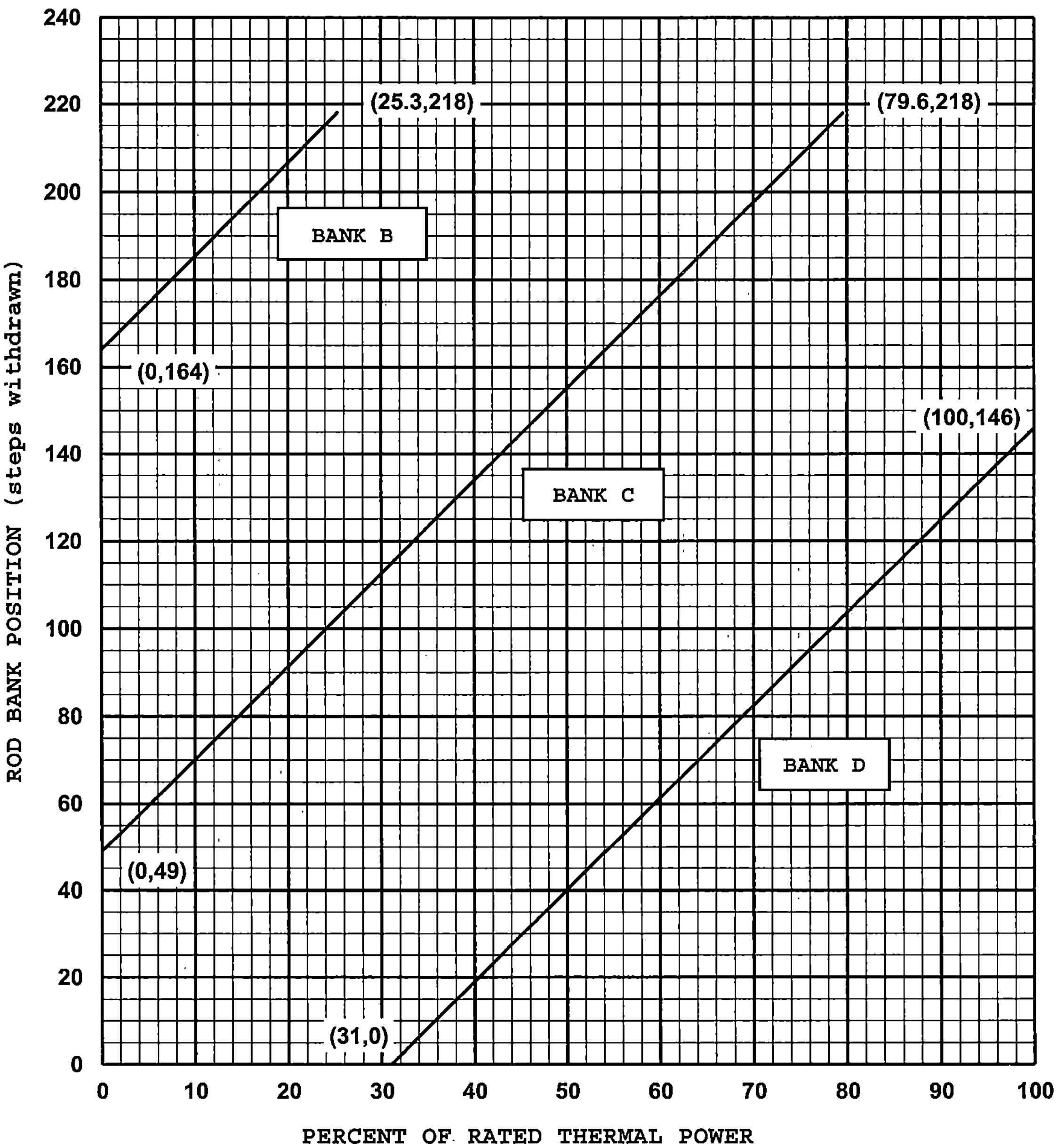


FIGURE 2

ROD BANK INSERTION LIMITS VERSUS THERMAL POWER



NOTES:

1. Fully withdrawn shall be the condition where control rods are at a position within the interval of 218 and 231 steps withdrawn, inclusive.

2. Control Bank A shall be fully withdrawn.

FIGURE 3

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

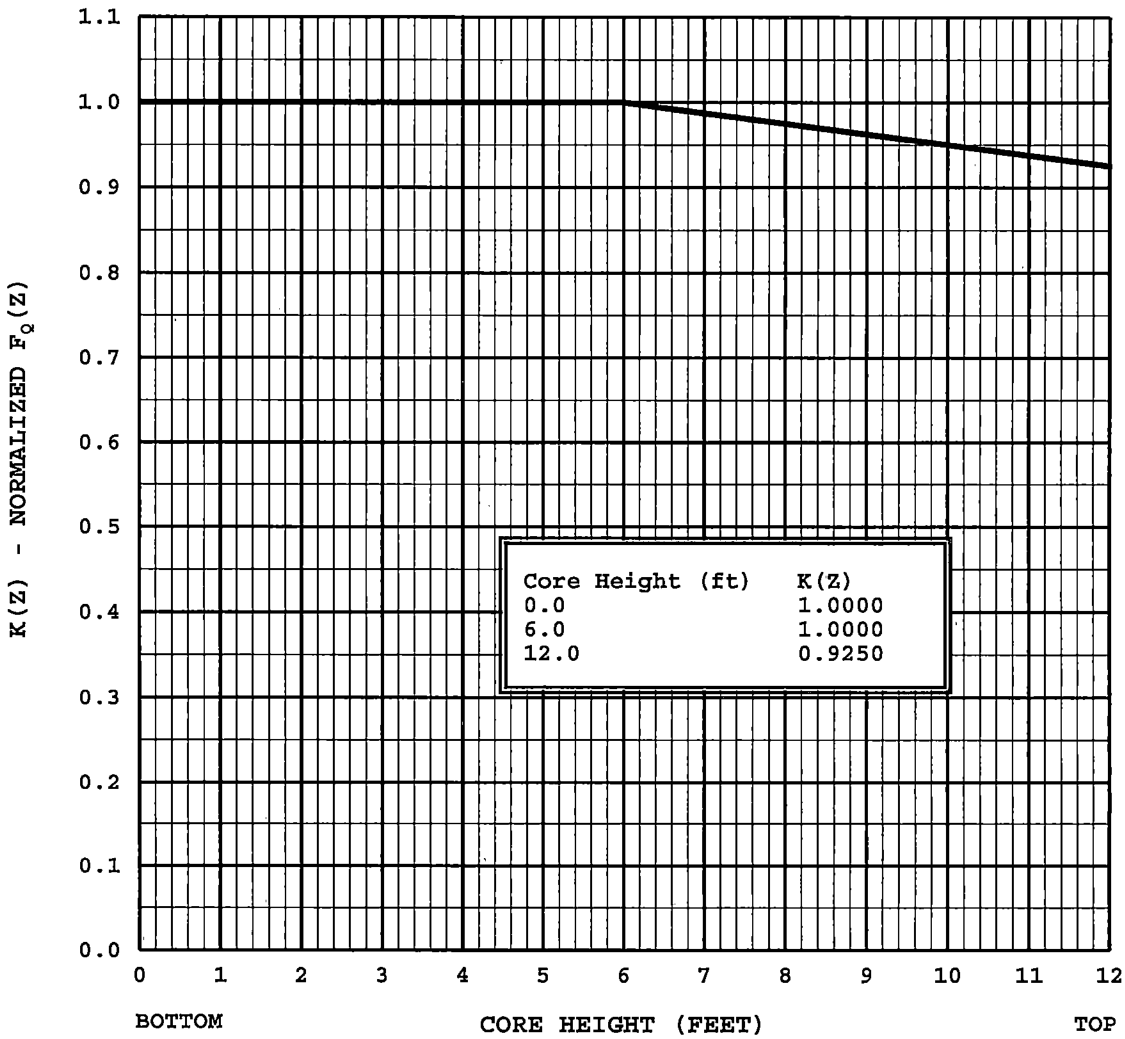
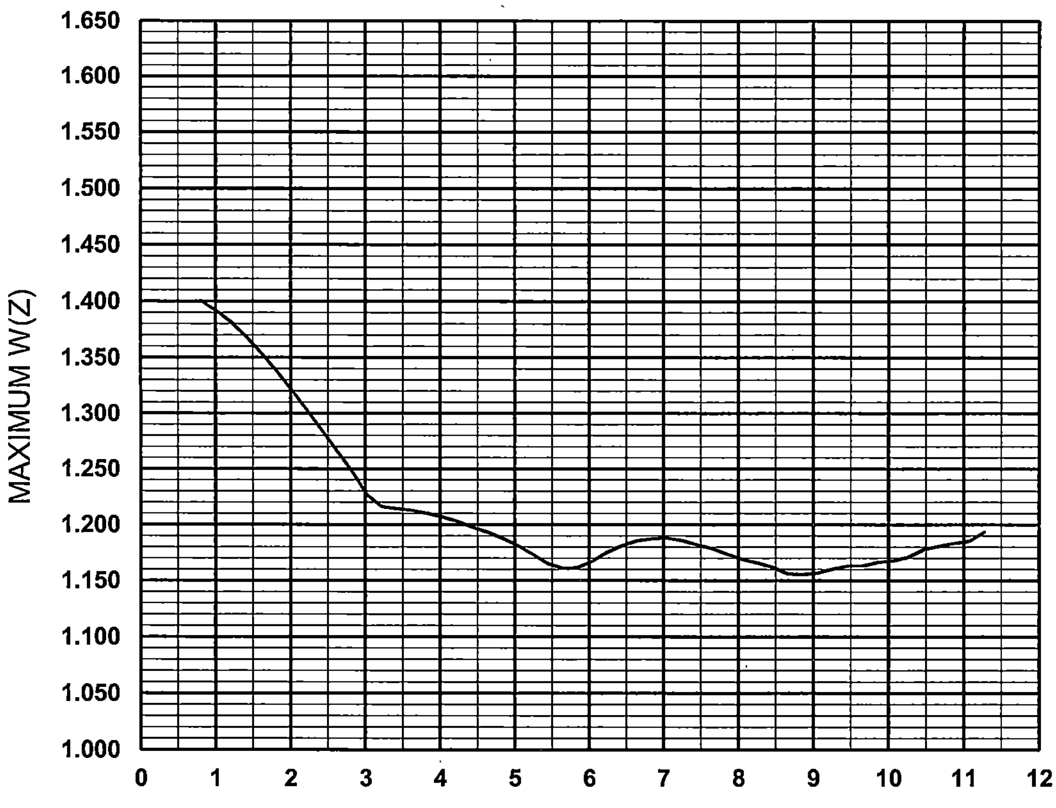


FIGURE 4

W(Z) AS A FUNCTION OF CORE HEIGHT
(150 MWD/MTU)

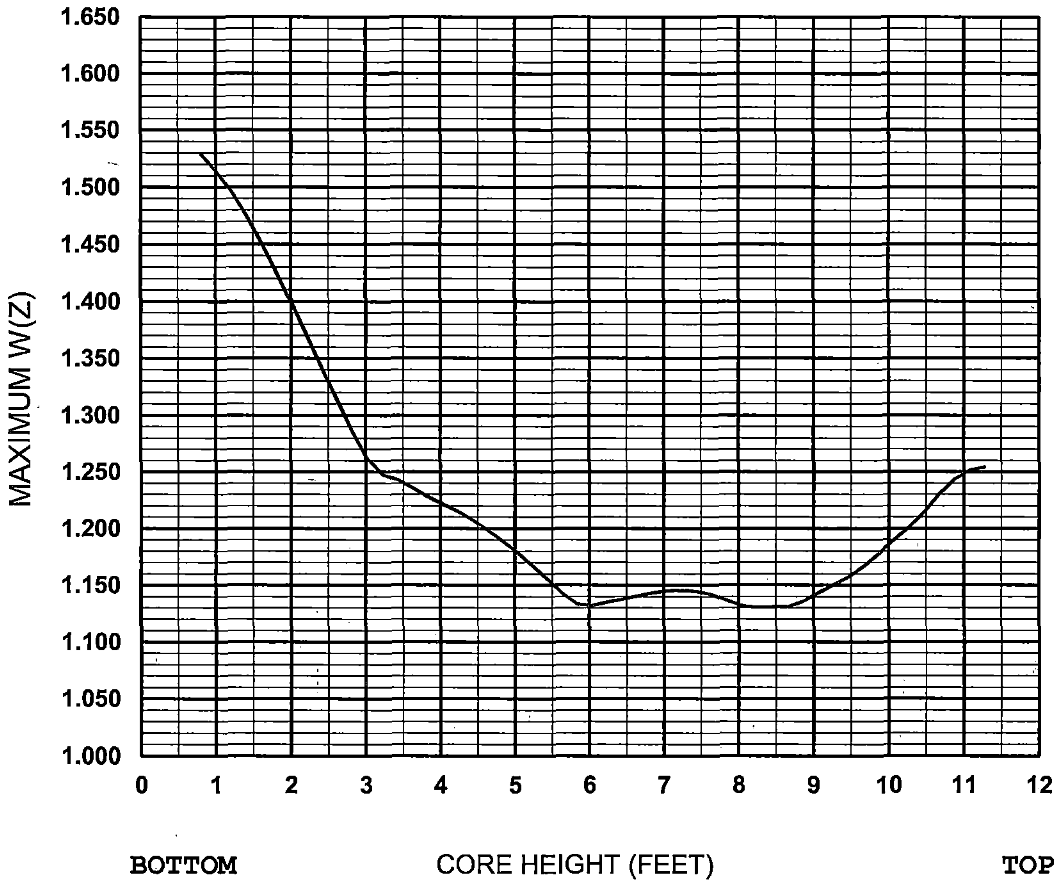


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1563	30	1.1618	16	1.2269
57	1.1936	43	1.1620	29	1.1613	15	1.2481
56	1.1856	42	1.1660	28	1.1656	14	1.2664
55	1.1834	41	1.1692	27	1.1738	13	1.2851
54	1.1809	40	1.1739	26	1.1818	12	1.3033
53	1.1782	39	1.1789	25	1.1882	11	1.3210
52	1.1713	38	1.1821	24	1.1936	10	1.3380
51	1.1681	37	1.1860	23	1.1980	9	1.3540
50	1.1667	36	1.1883	22	1.2028	8	1.3688
49	1.1635	35	1.1879	21	1.2070	7	1.3816
48	1.1632	34	1.1857	20	1.2101	6	1.3918
47	1.1605	33	1.1814	19	1.2126	5	1.4007
46	1.1571	32	1.1754	18	1.2144	1 - 4	---
45	1.1556	31	1.1676	17	1.2161		

Core Height (ft) = (Node - 1) * 0.201317

FIGURE 5

W(Z) AS A FUNCTION OF CORE HEIGHT
(3,000 MWD/MTU)

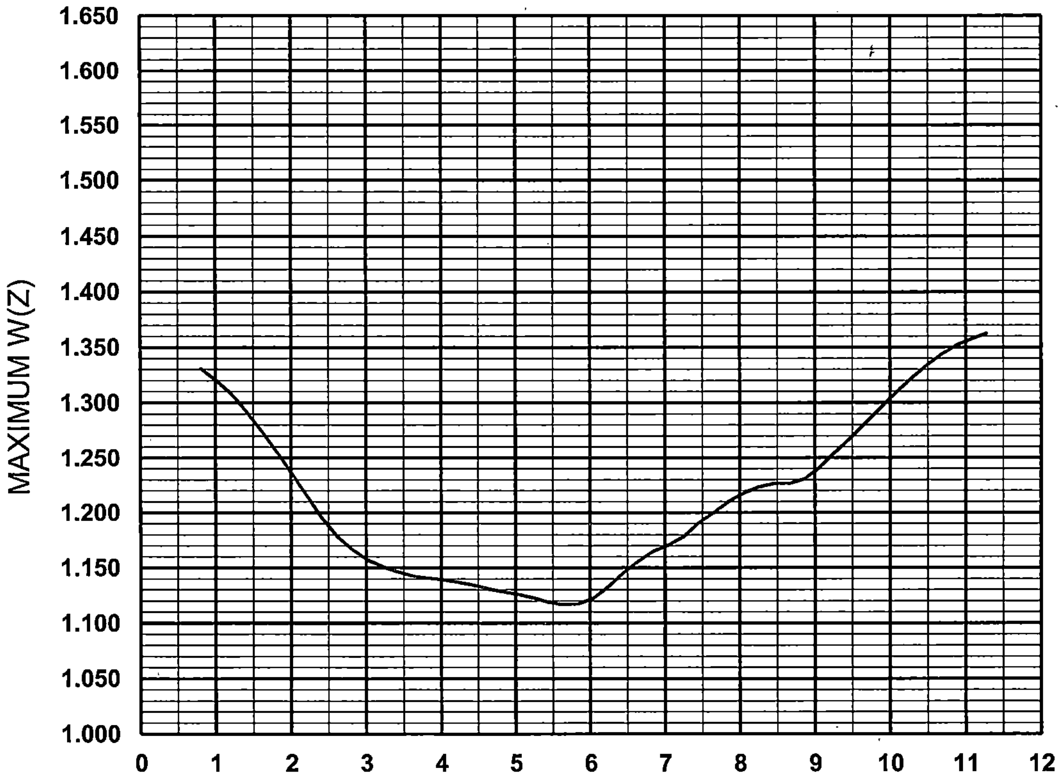


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1310	30	1.1334	16	1.2620
57	1.2543	43	1.1308	29	1.1427	15	1.2866
56	1.2515	42	1.1303	28	1.1554	14	1.3137
55	1.2437	41	1.1318	27	1.1674	13	1.3407
54	1.2306	40	1.1367	26	1.1787	12	1.3691
53	1.2141	39	1.1416	25	1.1893	11	1.3976
52	1.2012	38	1.1445	24	1.1989	10	1.4252
51	1.1897	37	1.1457	23	1.2075	9	1.4513
50	1.1777	36	1.1454	22	1.2152	8	1.4753
49	1.1664	35	1.1434	21	1.2216	7	1.4966
48	1.1571	34	1.1404	20	1.2281	6	1.5136
47	1.1501	33	1.1380	19	1.2358	5	1.5288
46	1.1432	32	1.1353	18	1.2430	1 - 4	---
45	1.1357	31	1.1320	17	1.2477		

Core Height (ft) = (Node - 1) * 0.201317

FIGURE 6

W(Z) AS A FUNCTION OF CORE HEIGHT
(7,000 MWD/MTU)

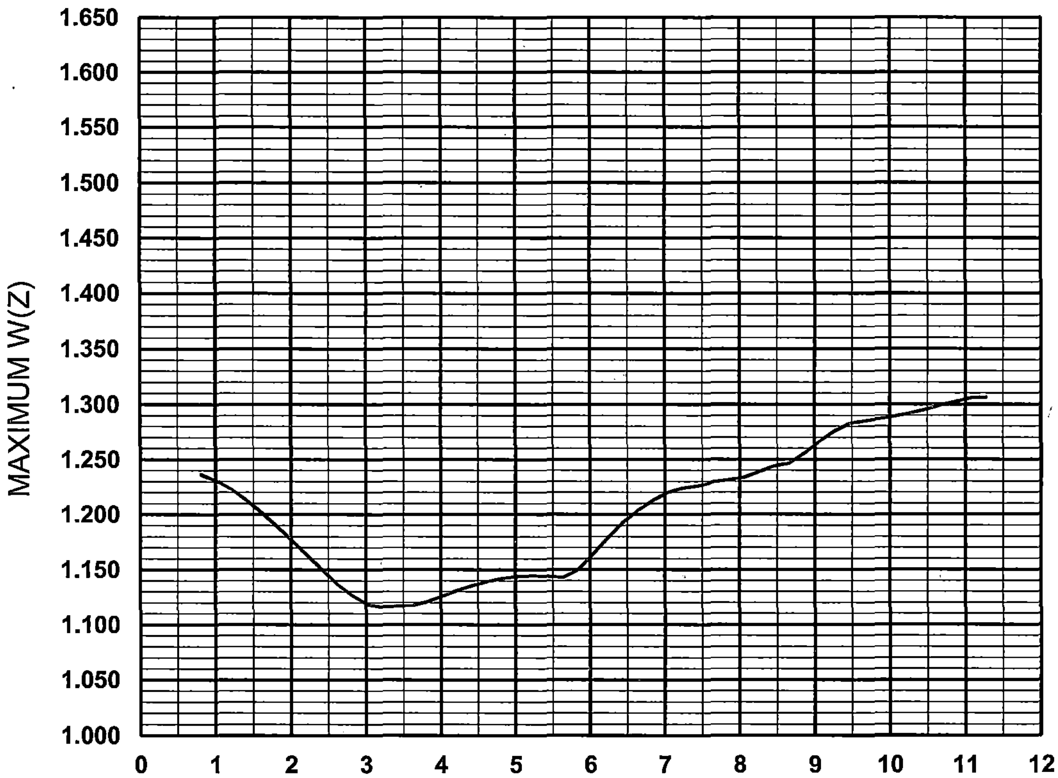


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2268	30	1.1175	16	1.1570
57	1.3626	43	1.2268	29	1.1170	15	1.1662
56	1.3576	42	1.2235	28	1.1192	14	1.1781
55	1.3518	41	1.2181	27	1.1229	13	1.1945
54	1.3434	40	1.2104	26	1.1260	12	1.2148
53	1.3331	39	1.2003	25	1.1284	11	1.2355
52	1.3213	38	1.1908	24	1.1310	10	1.2555
51	1.3086	37	1.1784	23	1.1343	9	1.2746
50	1.2951	36	1.1706	22	1.1371	8	1.2923
49	1.2815	35	1.1651	21	1.1393	7	1.3080
48	1.2679	34	1.1562	20	1.1408	6	1.3203
47	1.2547	33	1.1457	19	1.1425	5	1.3308
46	1.2413	32	1.1329	18	1.1467	1 - 4	---
45	1.2309	31	1.1226	17	1.1508		

Core Height (ft) = (Node - 1) * 0.201317

FIGURE 7

W(Z) AS A FUNCTION OF CORE HEIGHT
(12,000 MWD/MTU)

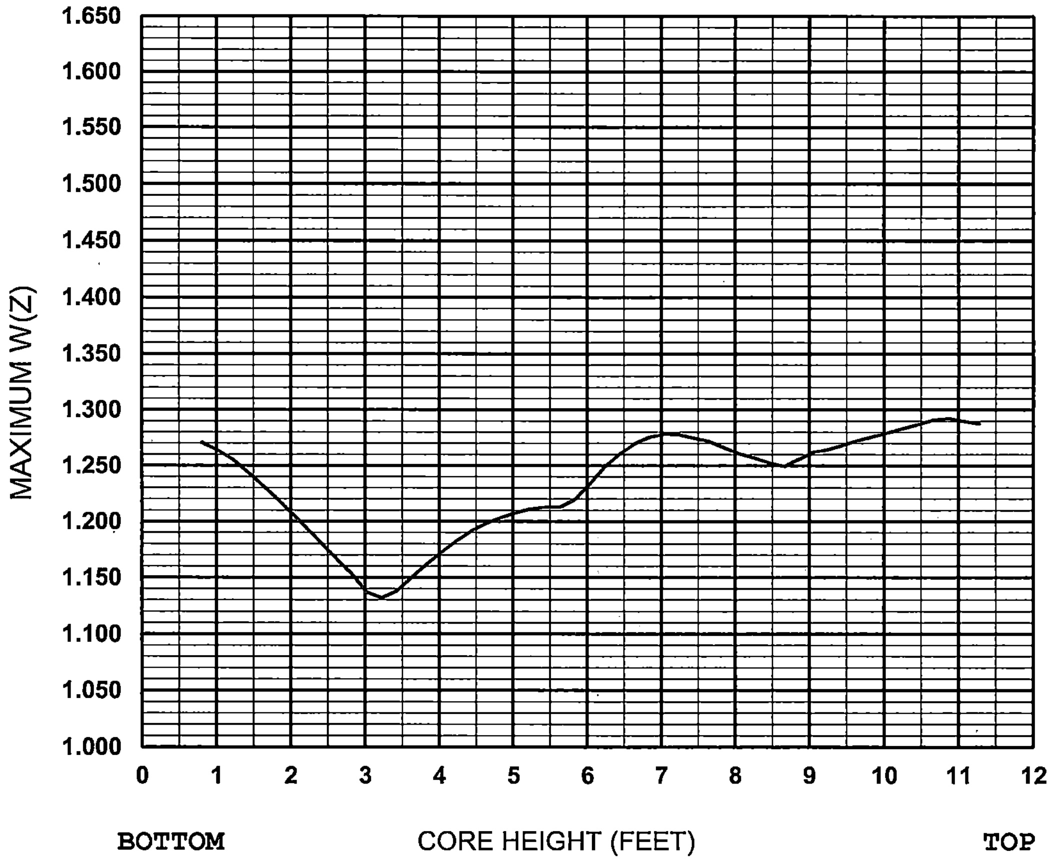


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2468	30	1.1500	16	1.1186
57	1.3064	43	1.2440	29	1.1429	15	1.1266
56	1.3057	42	1.2390	28	1.1441	14	1.1368
55	1.3024	41	1.2338	27	1.1448	13	1.1500
54	1.2994	40	1.2313	26	1.1440	12	1.1633
53	1.2954	39	1.2298	25	1.1423	11	1.1764
52	1.2918	38	1.2263	24	1.1395	10	1.1892
51	1.2892	37	1.2241	23	1.1358	9	1.2016
50	1.2870	36	1.2203	22	1.1315	8	1.2130
49	1.2849	35	1.2133	21	1.1264	7	1.2231
48	1.2825	34	1.2042	20	1.1211	6	1.2306
47	1.2756	33	1.1928	19	1.1175	5	1.2364
46	1.2663	32	1.1794	18	1.1171	1 - 4	---
45	1.2557	31	1.1642	17	1.1161		

Core Height (ft) = (Node - 1) * 0.201317

FIGURE 8

W(Z) AS A FUNCTION OF CORE HEIGHT
(20,000 MWD/MTU)



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2493	30	1.2197	16	1.1370
57	1.2875	43	1.2527	29	1.2130	15	1.1532
56	1.2899	42	1.2572	28	1.2126	14	1.1665
55	1.2923	41	1.2609	27	1.2114	13	1.1803
54	1.2912	40	1.2661	26	1.2078	12	1.1940
53	1.2874	39	1.2716	25	1.2033	11	1.2073
52	1.2833	38	1.2744	24	1.1981	10	1.2204
51	1.2798	37	1.2777	23	1.1910	9	1.2331
50	1.2765	36	1.2786	22	1.1825	8	1.2450
49	1.2728	35	1.2757	21	1.1727	7	1.2559
48	1.2688	34	1.2698	20	1.1618	6	1.2643
47	1.2648	33	1.2608	19	1.1502	5	1.2706
46	1.2622	32	1.2492	18	1.1381	1 - 4	---
45	1.2559	31	1.2340	17	1.1319		

Core Height (ft) = (Node - 1) * 0.201317

FIGURE 9

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF
RATED THERMAL POWER