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U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Ref 10 CFR 50.36(c)(5)

Subject: Comanche Peak Nuclear Power Plant (CPNPP)
Docket No. 50-446
Core Operating Limits Report (COLR), Unit 2 Cycle 21, (ERX-23-001, Revision 0)

Dear Sir of Madam:

Enclosed is the Core Operating Limits Report (COLR) for Comanche Peak Nuclear Power Plant (CPNPP) Unit 2, Cycle 21, (ERX-23-001, Rev. 0). This report is prepared and submitted pursuant to Technical Specification 5.6.5.

This communication contains no new commitments regarding CPNPP Unit 2.

Should you have any questions, please contact Nic Boehmisch at (254) 897-5064 or nicholas.boehmisch@luminant.com.

Sincerely,

Jack C. Hicks

Jack C. Hicks

Enclosure: Unit 2 Cycle 21 Core Operating Limits Report, (ERX-23-001, Rev. 0)

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ERX-23-001, Rev. 0

CPNPP UNIT 2 CYCLE 21

CORE OPERATING LIMITS REPORT

April 2023

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1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for CPNPP UNIT 2 CYCLE 21 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
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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% Δk/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.

2.5.2 The SDM shall be greater than or equal to 1.3% Δk/k in MODE 1, MODE 2 with any control bank not fully inserted.

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.

2.6.4 The SDM shall be greater than or equal to 1.3% Δk/k in MODE 1, MODE 2 with keff ≥ 1.0.

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% Δk/k in MODE 2 during PHYSICS TESTS.

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

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

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

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

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 ≥ 1915 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	3.11
150	3.11
366	5.76
581	7.82
797	8.28
1012	8.17
1228	7.51
1444	6.54
1659	5.45
1875	4.52
2091	4.40
2306	4.05
2522	3.47
2737	2.86
2953	2.27
3169	2.00
6834	2.00
7050	2.22
7265	2.58
7481	2.95
7697	3.24
7912	3.37
8128	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

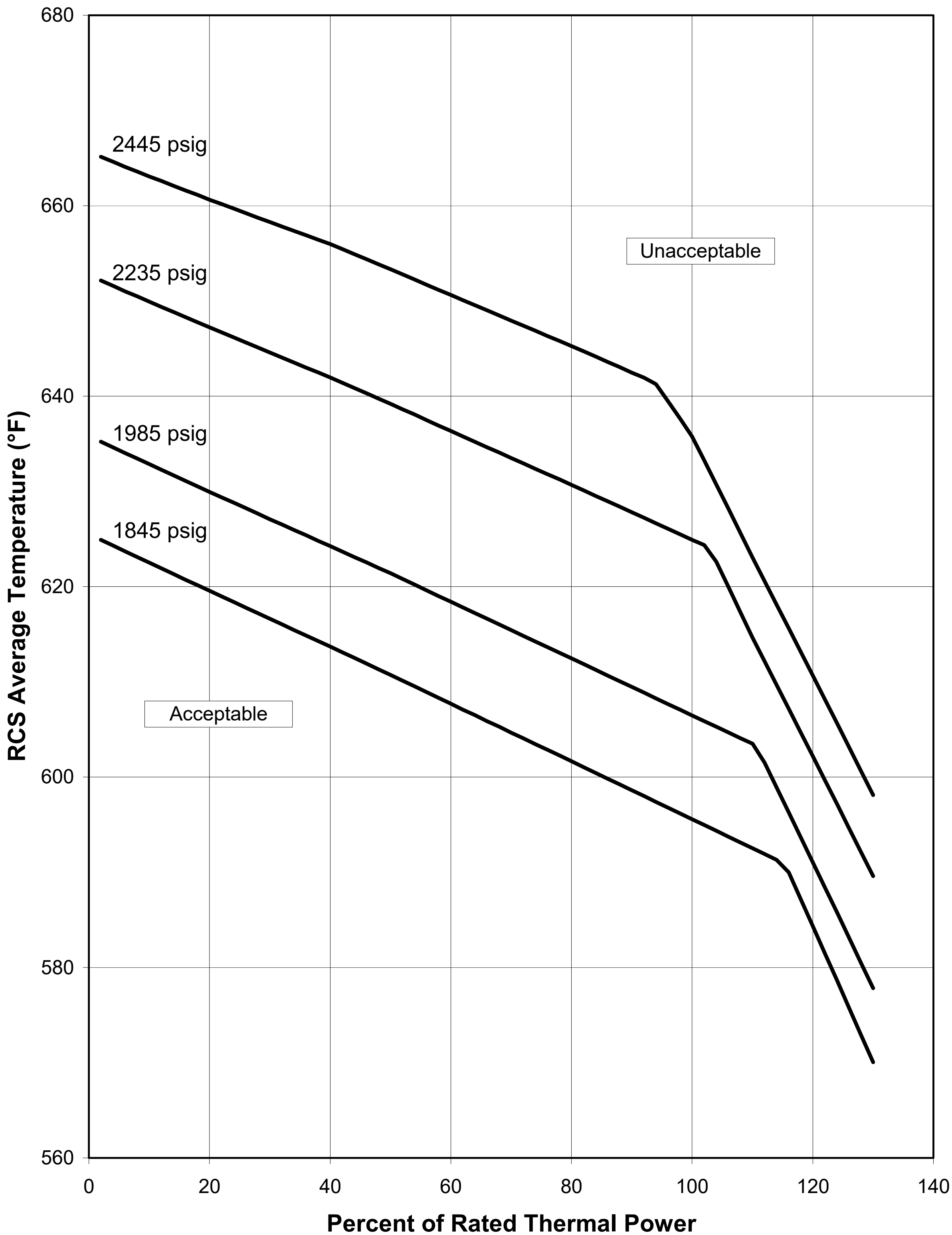
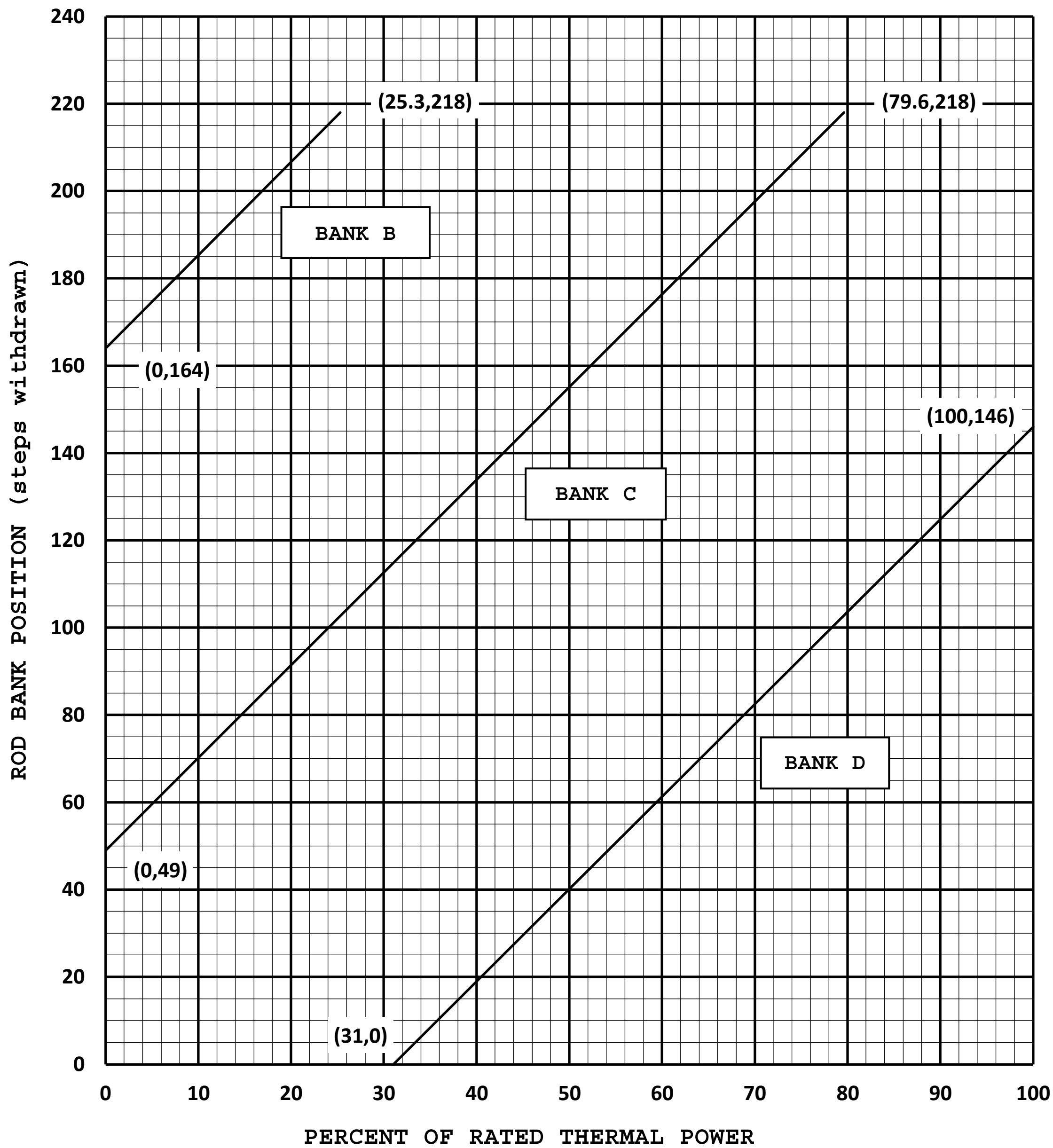


FIGURE 2

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

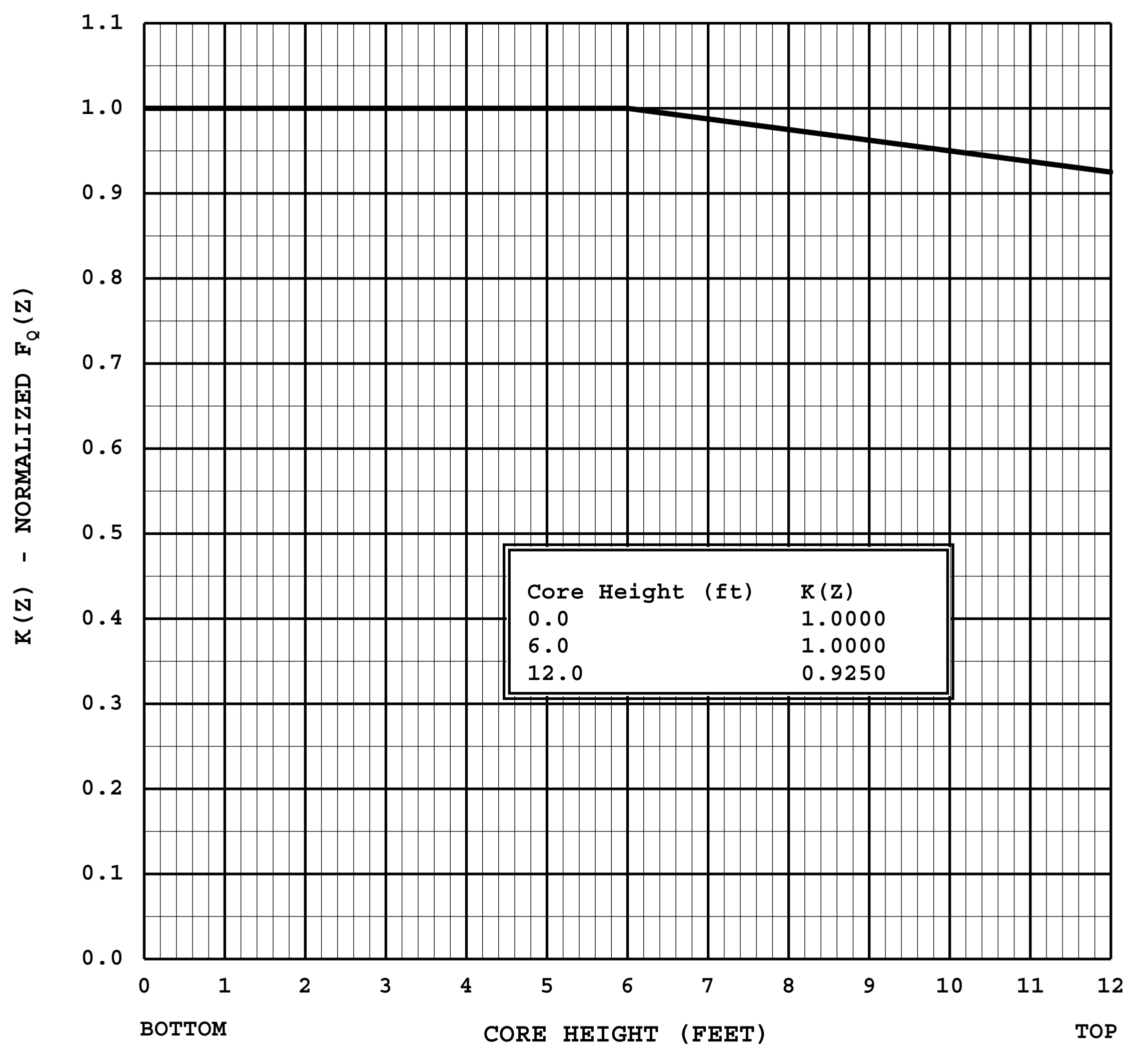
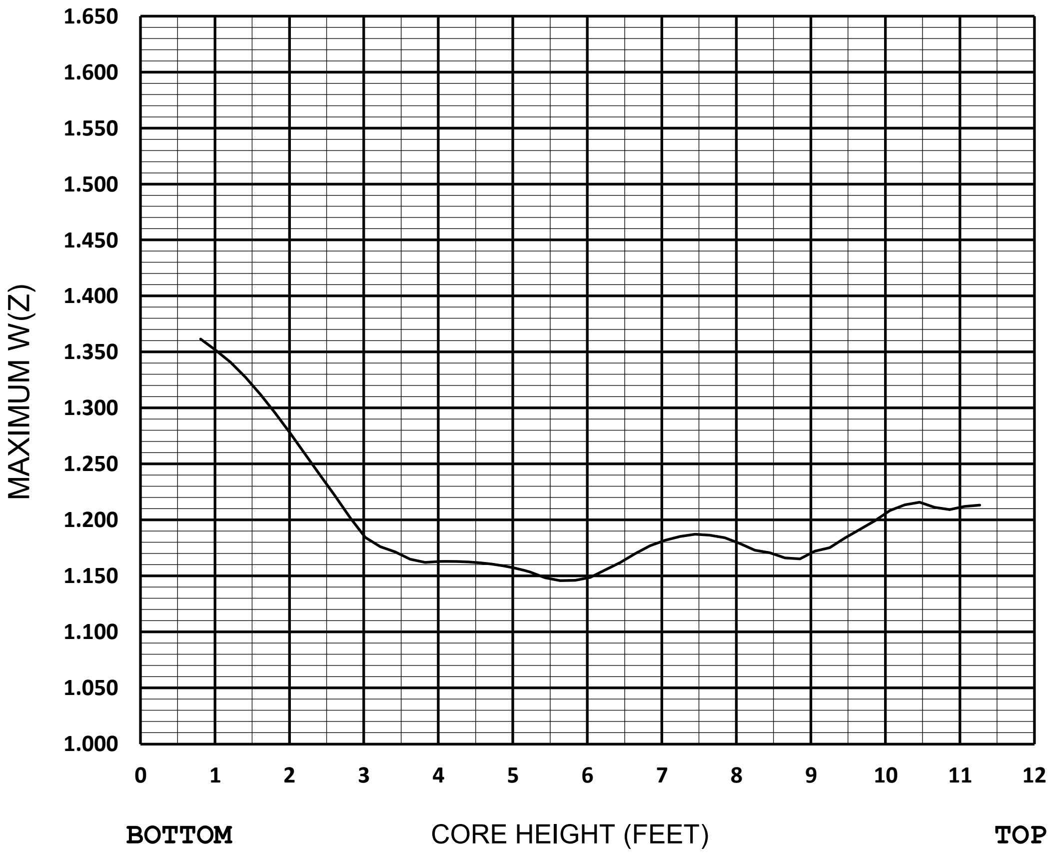


FIGURE 4

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

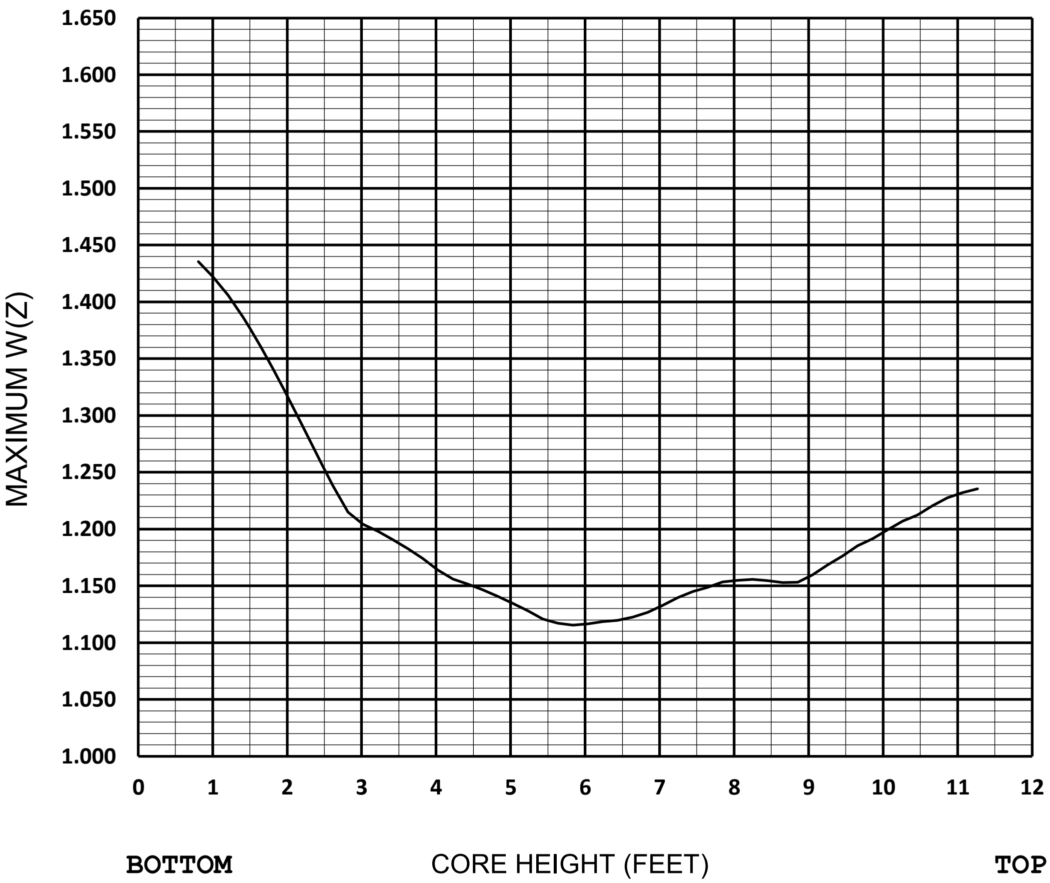


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1660	30	1.1462	16	1.1844
57	1.2133	43	1.1707	29	1.1459	15	1.2017
56	1.2121	42	1.1730	28	1.1483	14	1.2212
55	1.2093	41	1.1788	27	1.1534	13	1.2399
54	1.2112	40	1.1842	26	1.1569	12	1.2588
53	1.2159	39	1.1864	25	1.1595	11	1.2774
52	1.2135	38	1.1871	24	1.1611	10	1.2954
51	1.2085	37	1.1853	23	1.1623	9	1.3120
50	1.1991	36	1.1819	22	1.1629	8	1.3274
49	1.1916	35	1.1769	21	1.1630	7	1.3409
48	1.1837	34	1.1698	20	1.1622	6	1.3518
47	1.1753	33	1.1617	19	1.1648	5	1.3617
46	1.1720	32	1.1553	18	1.1714	1 - 4	---
45	1.1651	31	1.1486	17	1.1762		

Core Height (ft) = (Node - 1) * 0.2012

FIGURE 5

W(Z) AS A FUNCTION OF CORE HEIGHT
(5,000 MWD/MTU)

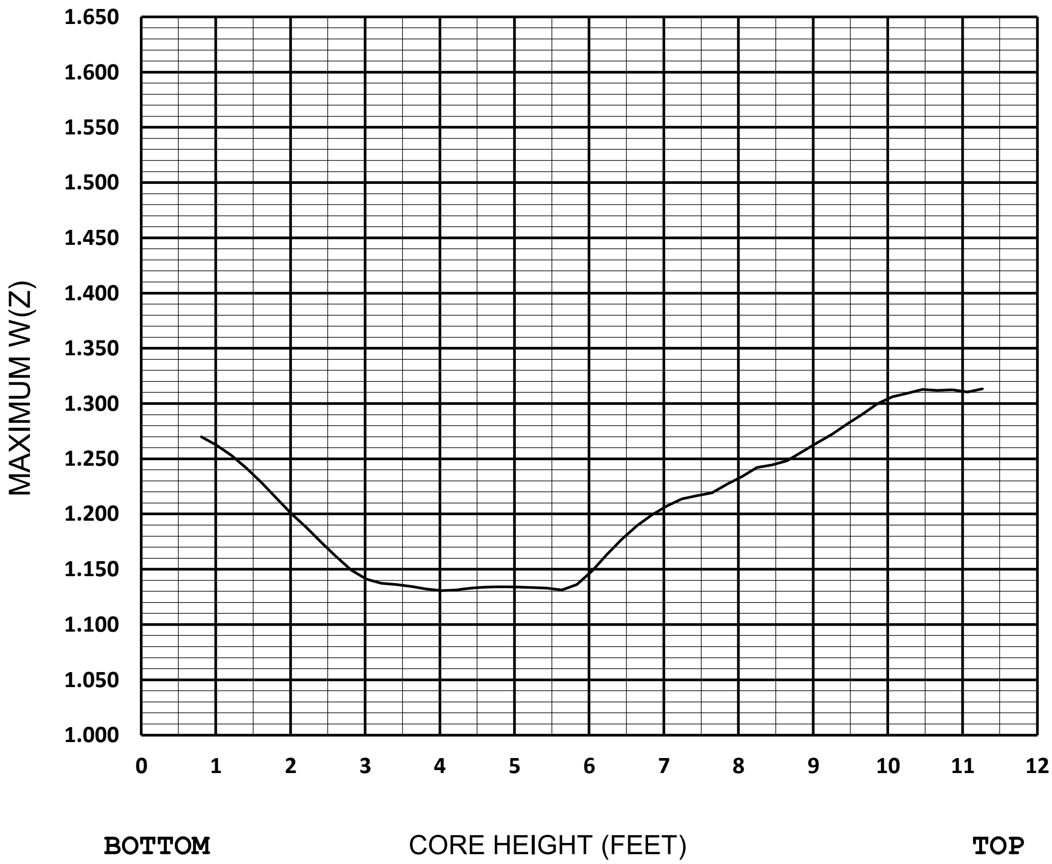


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1529	30	1.1156	16	1.2041
57	1.2355	43	1.1547	29	1.1172	15	1.2148
56	1.2320	42	1.1558	28	1.1207	14	1.2380
55	1.2276	41	1.1548	27	1.1280	13	1.2640
54	1.2205	40	1.1534	26	1.1347	12	1.2902
53	1.2124	39	1.1487	25	1.1408	11	1.3160
52	1.2071	38	1.1451	24	1.1464	10	1.3412
51	1.1993	37	1.1397	23	1.1515	9	1.3647
50	1.1916	36	1.1330	22	1.1560	8	1.3865
49	1.1852	35	1.1267	21	1.1638	7	1.4059
48	1.1763	34	1.1226	20	1.1740	6	1.4220
47	1.1684	33	1.1198	19	1.1827	5	1.4355
46	1.1598	32	1.1185	18	1.1907	1 - 4	---
45	1.1533	31	1.1166	17	1.1980		

Core Height (ft) = (Node - 1) * 0.2012

FIGURE 6

W(Z) AS A FUNCTION OF CORE HEIGHT
(11,000 MWD/MTU)

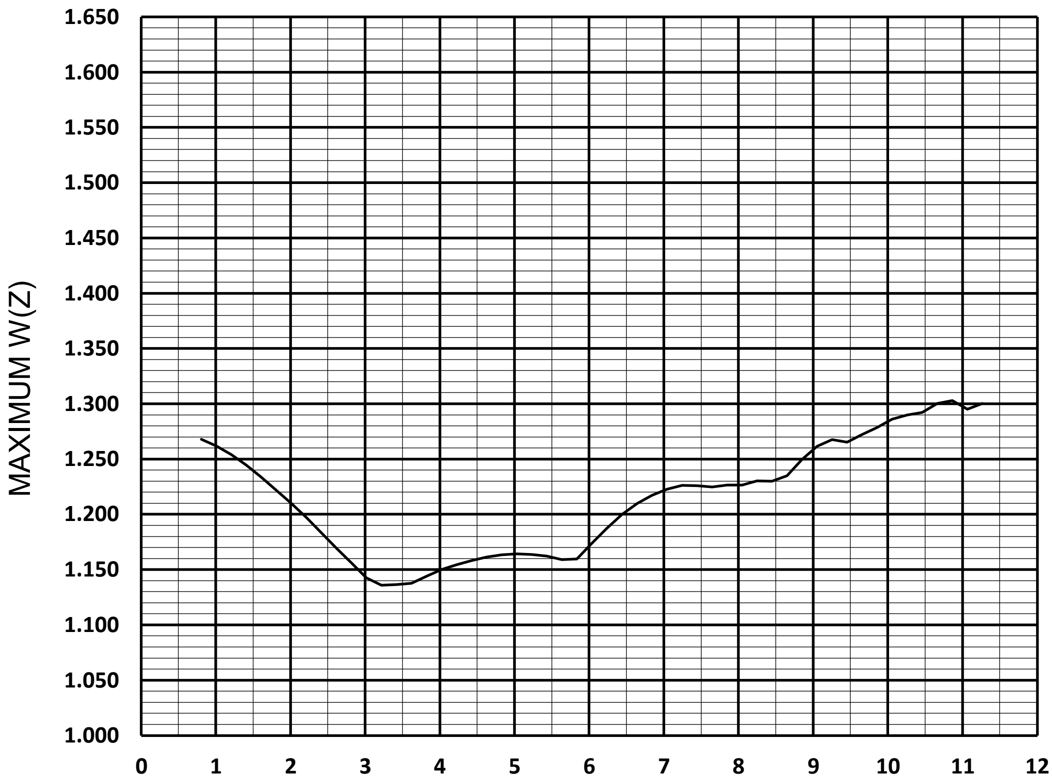


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2481	30	1.1362	16	1.1410
57	1.3135	43	1.2444	29	1.1313	15	1.1492
56	1.3104	42	1.2421	28	1.1329	14	1.1613
55	1.3125	41	1.2341	27	1.1336	13	1.1744
54	1.3119	40	1.2271	26	1.1338	12	1.1880
53	1.3127	39	1.2193	25	1.1341	11	1.2005
52	1.3092	38	1.2167	24	1.1338	10	1.2145
51	1.3061	37	1.2138	23	1.1329	9	1.2285
50	1.2998	36	1.2074	22	1.1313	8	1.2416
49	1.2901	35	1.1994	21	1.1307	7	1.2532
48	1.2816	34	1.1893	20	1.1322	6	1.2625
47	1.2721	33	1.1772	19	1.1344	5	1.2699
46	1.2645	32	1.1634	18	1.1361	1 - 4	---
45	1.2564	31	1.1483	17	1.1372		

Core Height (ft) = (Node - 1) * 0.2012

FIGURE 7

W(Z) AS A FUNCTION OF CORE HEIGHT
(14,000 MWD/MTU)



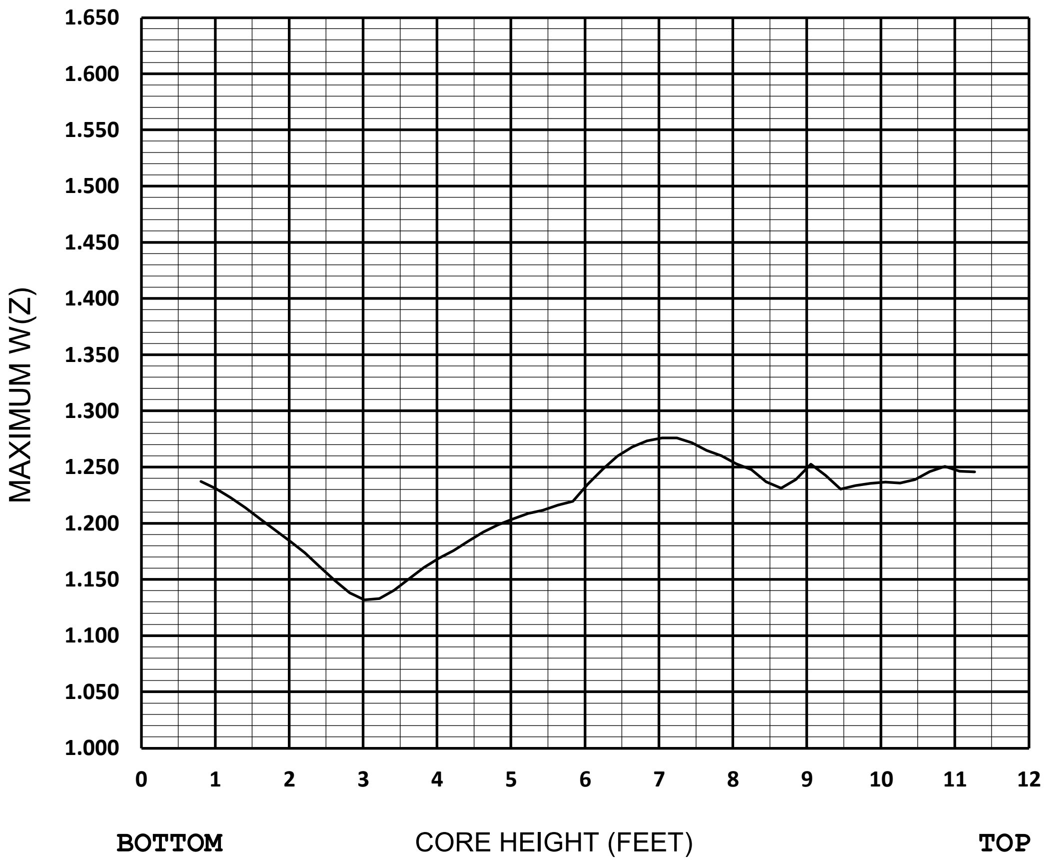
BOTTOM CORE HEIGHT (FEET) **TOP**

Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2348	30	1.1597	16	1.1426
57	1.3002	43	1.2299	29	1.1590	15	1.1560
56	1.2952	42	1.2302	28	1.1621	14	1.1695
55	1.3029	41	1.2266	27	1.1638	13	1.1833
54	1.3003	40	1.2265	26	1.1641	12	1.1973
53	1.2922	39	1.2248	25	1.1633	11	1.2099
52	1.2899	38	1.2259	24	1.1613	10	1.2218
51	1.2861	37	1.2261	23	1.1582	9	1.2334
50	1.2787	36	1.2226	22	1.1543	8	1.2444
49	1.2722	35	1.2173	21	1.1500	7	1.2541
48	1.2654	34	1.2096	20	1.1440	6	1.2618
47	1.2675	33	1.1997	19	1.1377	5	1.2679
46	1.2615	32	1.1875	18	1.1363	1 - 4	---
45	1.2495	31	1.1739	17	1.1360		

Core Height (ft) = (Node - 1) * 0.2012

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	1.2311	30	1.2194	16	1.1321
57	1.2456	43	1.2370	29	1.2161	15	1.1381
56	1.2463	42	1.2477	28	1.2116	14	1.1493
55	1.2506	41	1.2529	27	1.2086	13	1.1613
54	1.2460	40	1.2599	26	1.2038	12	1.1736
53	1.2388	39	1.2649	25	1.1988	11	1.1840
52	1.2359	38	1.2717	24	1.1922	10	1.1938
51	1.2367	37	1.2761	23	1.1841	9	1.2039
50	1.2355	36	1.2758	22	1.1758	8	1.2139
49	1.2334	35	1.2733	21	1.1688	7	1.2231
48	1.2304	34	1.2680	20	1.1606	6	1.2308
47	1.2425	33	1.2597	19	1.1506	5	1.2373
46	1.2525	32	1.2481	18	1.1403	1 - 4	---
45	1.2390	31	1.2346	17	1.1330		

Core Height (ft) = (Node - 1) * 0.2012

FIGURE 9

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER