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Subject: Comanche Peak Nuclear Power Plant (CPNPP)
Docket No. 50-446
Core Operating Limits Report (COLR), Unit 2 Cycle 20, (ERX-21-001, Revision 1)

Dear Sir of Madam:

Enclosed is Revision 1 of the Core Operating Limits Report (COLR) for Comanche Peak Nuclear Power Plant (CPNPP) Unit 2, Cycle 20, (ERX-21-001, Rev. 1). 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 Garry W Struble at (254) 897-6628 or garry.struble@luminant.com.

Sincerely,

Jack C. Hicks

Jack C. Hicks

Enclosure: Unit 2 Cycle 20 Core Operating Limits Report, (ERX-21-001, Rev. 1)

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ERX-21-001, Rev. 1

CPNPP UNIT 2 CYCLE 20

CORE OPERATING LIMITS REPORT

March 2022

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1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for CPNPP UNIT 2 CYCLE 20 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
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LCO 3.3.1	REACTOR TRIP SYSTEM (RTS) INSTRUMENTATION
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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% $\Delta k/k$ in MODE 1, MODE 2 with keff $\geq$ 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% $\Delta k/k$ in MODE 2 during PHYSICS TESTS.

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

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

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

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 BORON CONCENTRATION (LCO 3.9.1)

2.13.1 The required refueling boron concentration is ≥ 1894 ppm.

3.0 REFERENCES

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)
796	2.00
1011	2.50
1226	2.89
1442	2.44
1657	2.18
1872	2.17
2087	2.12
2303	2.04
2518	2.00
8545	2.00
8760	2.02
8975	2.15
9191	2.25
9406	2.33
9621	2.14
9836	2.09
10052	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

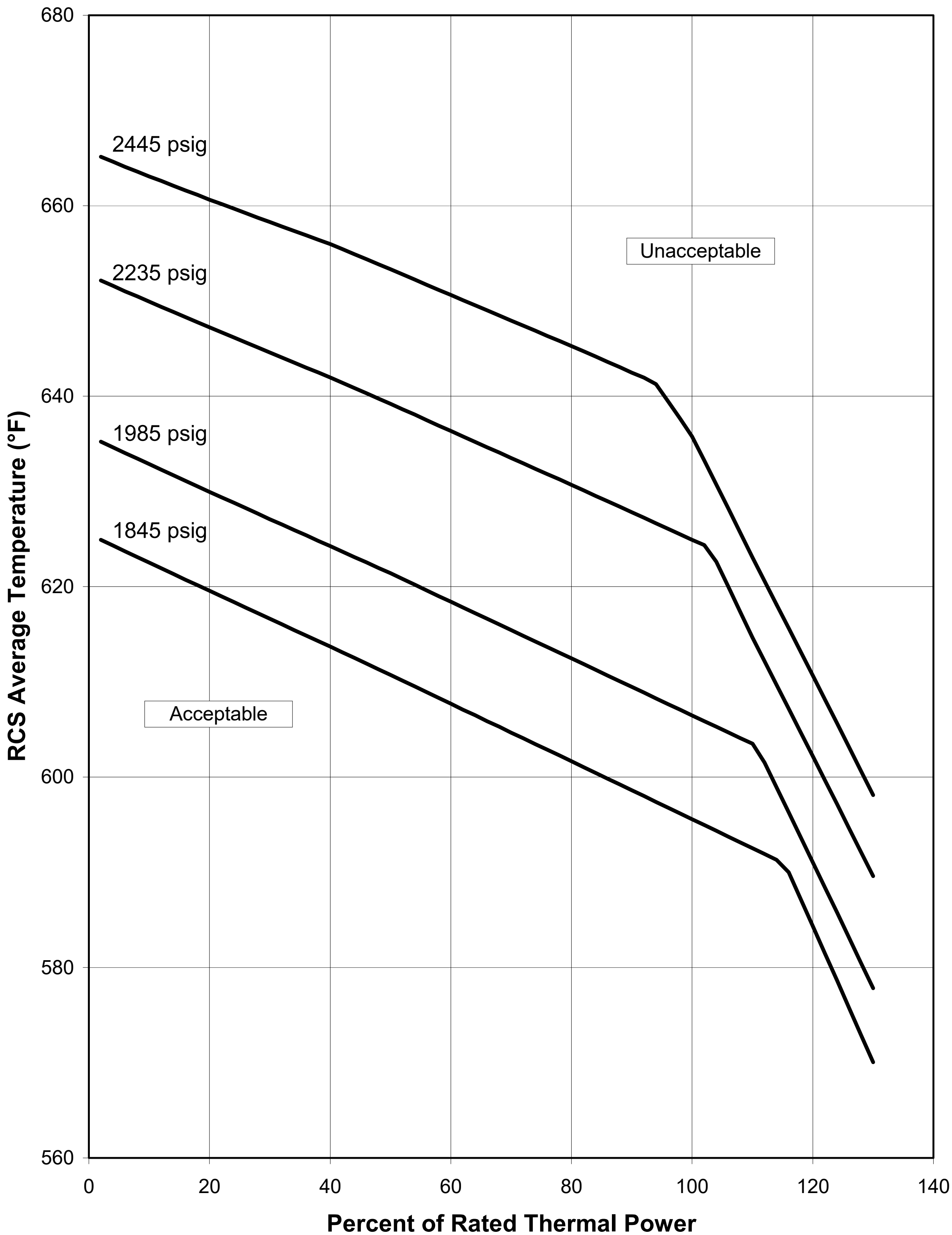
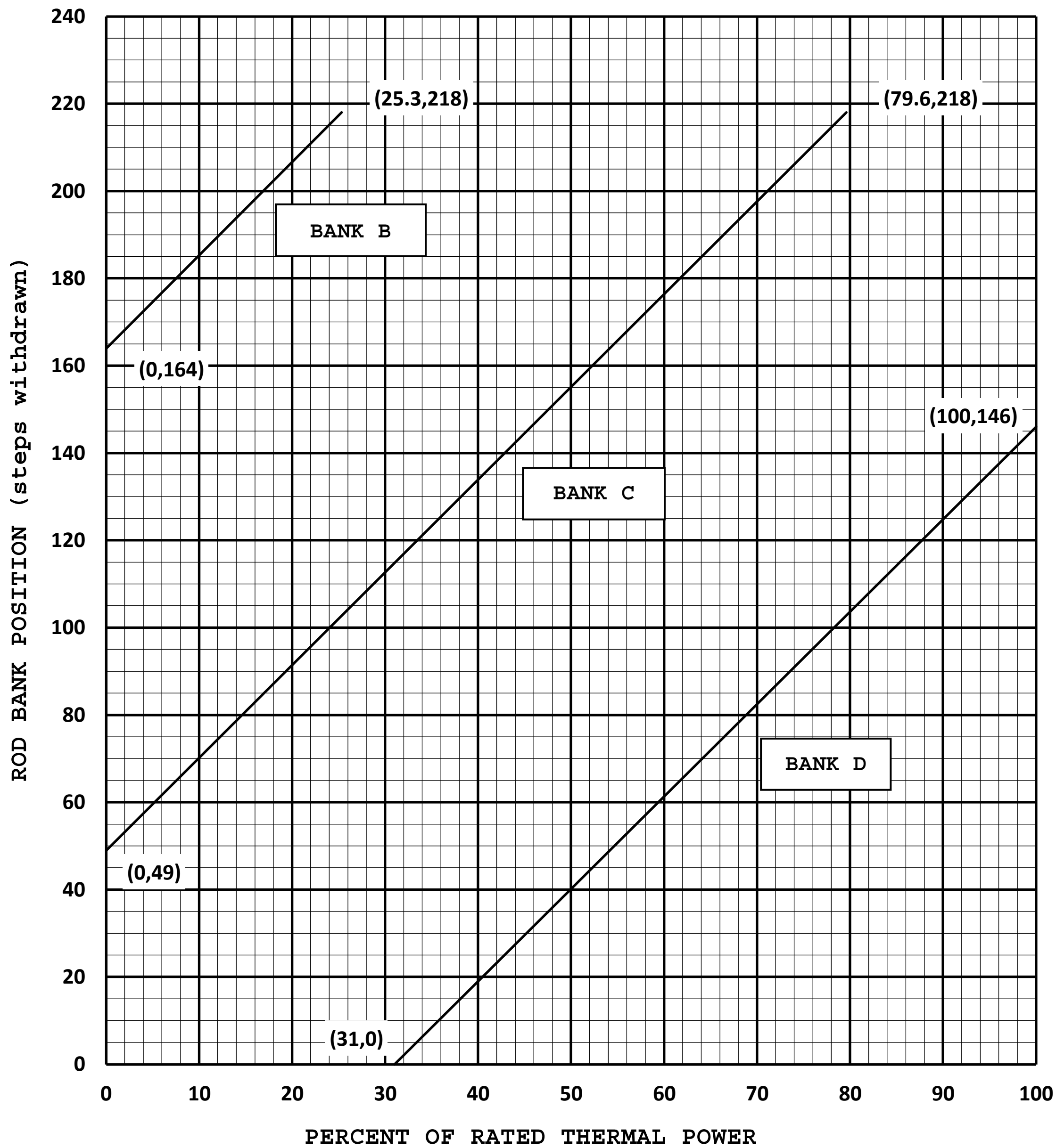


FIGURE 2

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

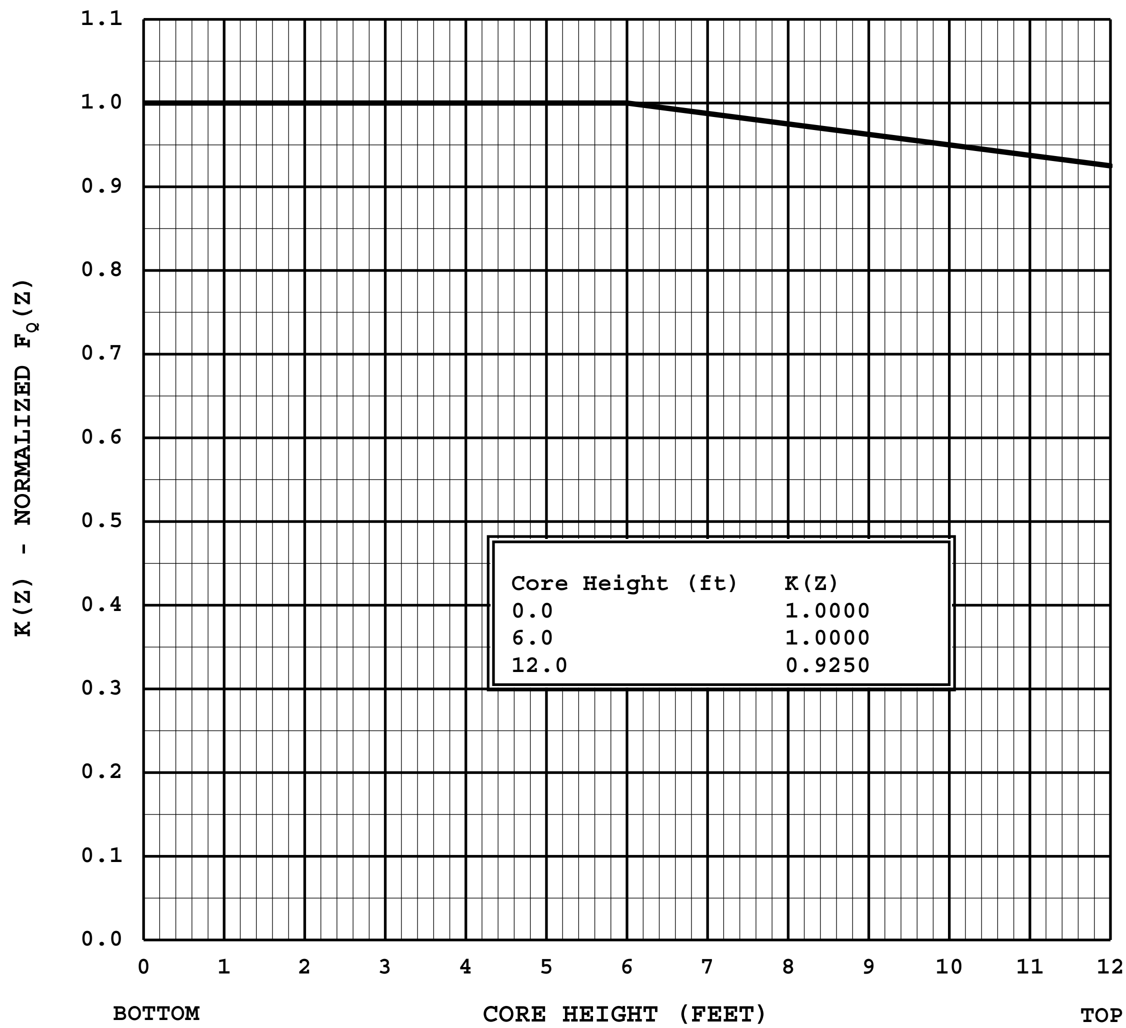
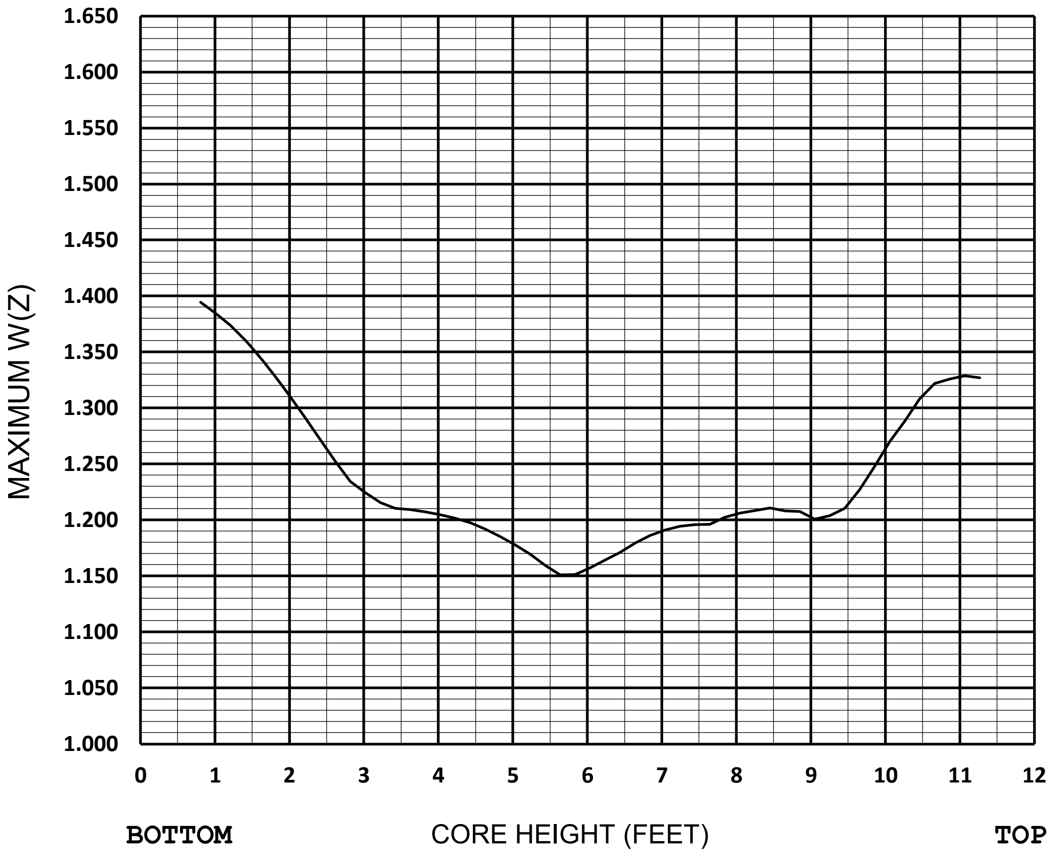


FIGURE 4

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

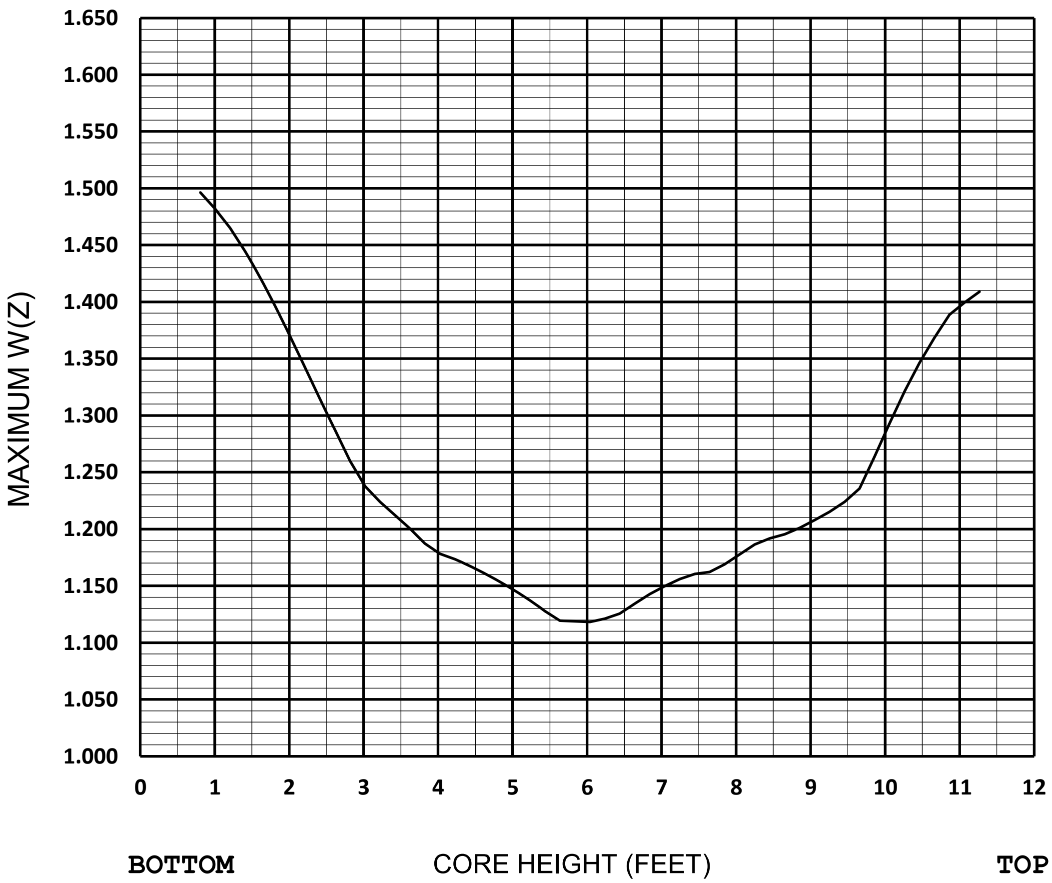


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2082	30	1.1511	16	1.2244
57	1.3269	43	1.2106	29	1.1510	15	1.2343
56	1.3288	42	1.2084	28	1.1594	14	1.2524
55	1.3257	41	1.2062	27	1.1695	13	1.2719
54	1.3218	40	1.2024	26	1.1779	12	1.2911
53	1.3081	39	1.1961	25	1.1853	11	1.3100
52	1.2883	38	1.1959	24	1.1918	10	1.3282
51	1.2700	37	1.1943	23	1.1974	9	1.3449
50	1.2482	36	1.1910	22	1.2016	8	1.3603
49	1.2272	35	1.1862	21	1.2047	7	1.3737
48	1.2105	34	1.1792	20	1.2073	6	1.3846
47	1.2038	33	1.1710	19	1.2093	5	1.3946
46	1.2006	32	1.1642	18	1.2103	1 - 4	---
45	1.2076	31	1.1573	17	1.2155		

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

FIGURE 5

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

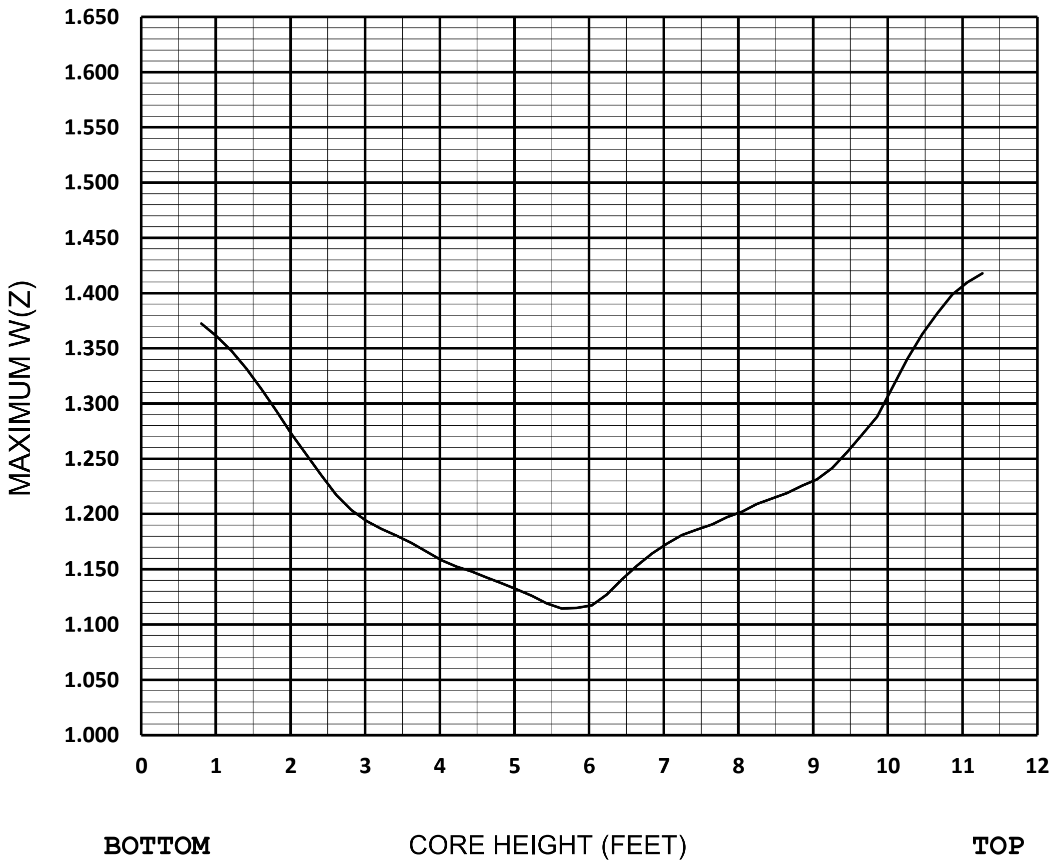


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1953	30	1.1187	16	1.2376
57	1.4090	43	1.1918	29	1.1195	15	1.2600
56	1.3994	42	1.1865	28	1.1279	14	1.2873
55	1.3886	41	1.1778	27	1.1373	13	1.3146
54	1.3683	40	1.1689	26	1.1458	12	1.3425
53	1.3460	39	1.1622	25	1.1536	11	1.3699
52	1.3214	38	1.1605	24	1.1609	10	1.3966
51	1.2933	37	1.1559	23	1.1676	9	1.4215
50	1.2638	36	1.1498	22	1.1736	8	1.4445
49	1.2357	35	1.1428	21	1.1782	7	1.4649
48	1.2238	34	1.1342	20	1.1873	6	1.4820
47	1.2152	33	1.1256	19	1.2006	5	1.4964
46	1.2077	32	1.1211	18	1.2123	1 - 4	---
45	1.2012	31	1.1184	17	1.2239		

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

FIGURE 6

W(Z) AS A FUNCTION OF CORE HEIGHT
(8,000 MWD/MTU)

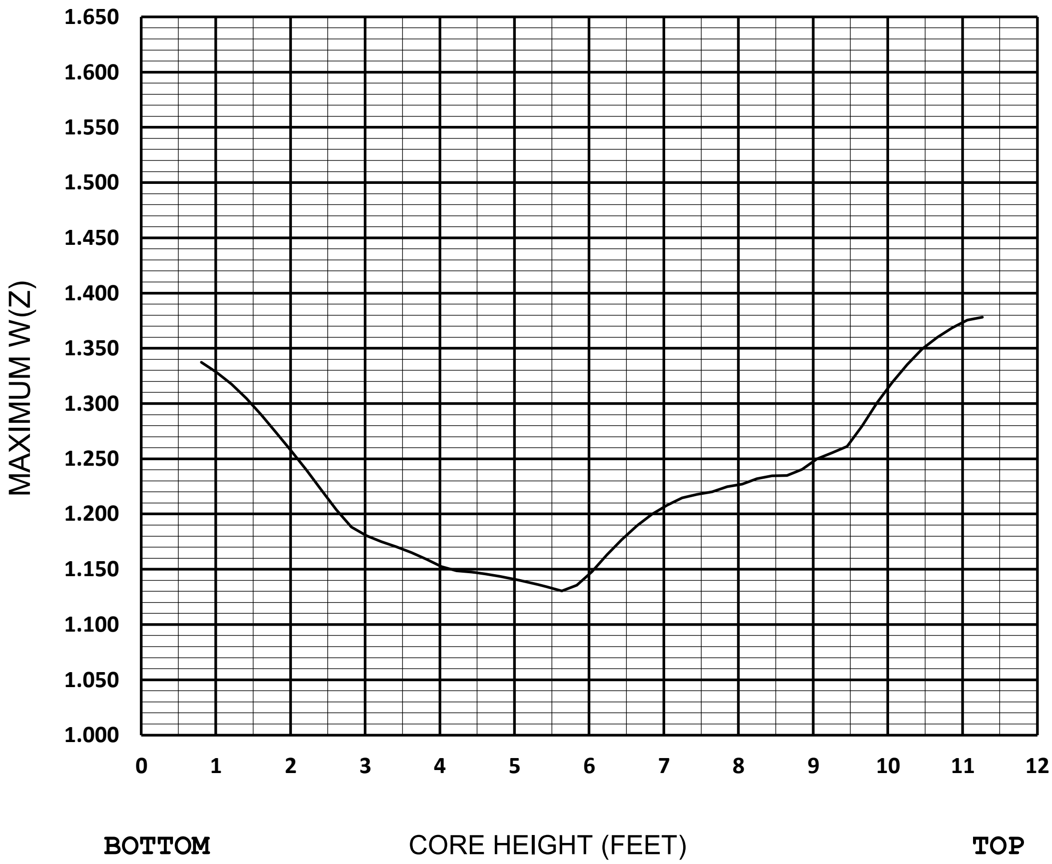


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2190	30	1.1150	16	1.1938
57	1.4179	43	1.2141	29	1.1145	15	1.2036
56	1.4097	42	1.2092	28	1.1192	14	1.2173
55	1.3987	41	1.2022	27	1.1261	13	1.2351
54	1.3816	40	1.1973	26	1.1319	12	1.2540
53	1.3627	39	1.1905	25	1.1373	11	1.2727
52	1.3403	38	1.1859	24	1.1426	10	1.2935
51	1.3142	37	1.1810	23	1.1480	9	1.3131
50	1.2881	36	1.1732	22	1.1525	8	1.3315
49	1.2718	35	1.1642	21	1.1582	7	1.3477
48	1.2561	34	1.1533	20	1.1661	6	1.3612
47	1.2414	33	1.1409	19	1.1737	5	1.3723
46	1.2315	32	1.1272	18	1.1805	1 - 4	---
45	1.2256	31	1.1173	17	1.1866		

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

FIGURE 7

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

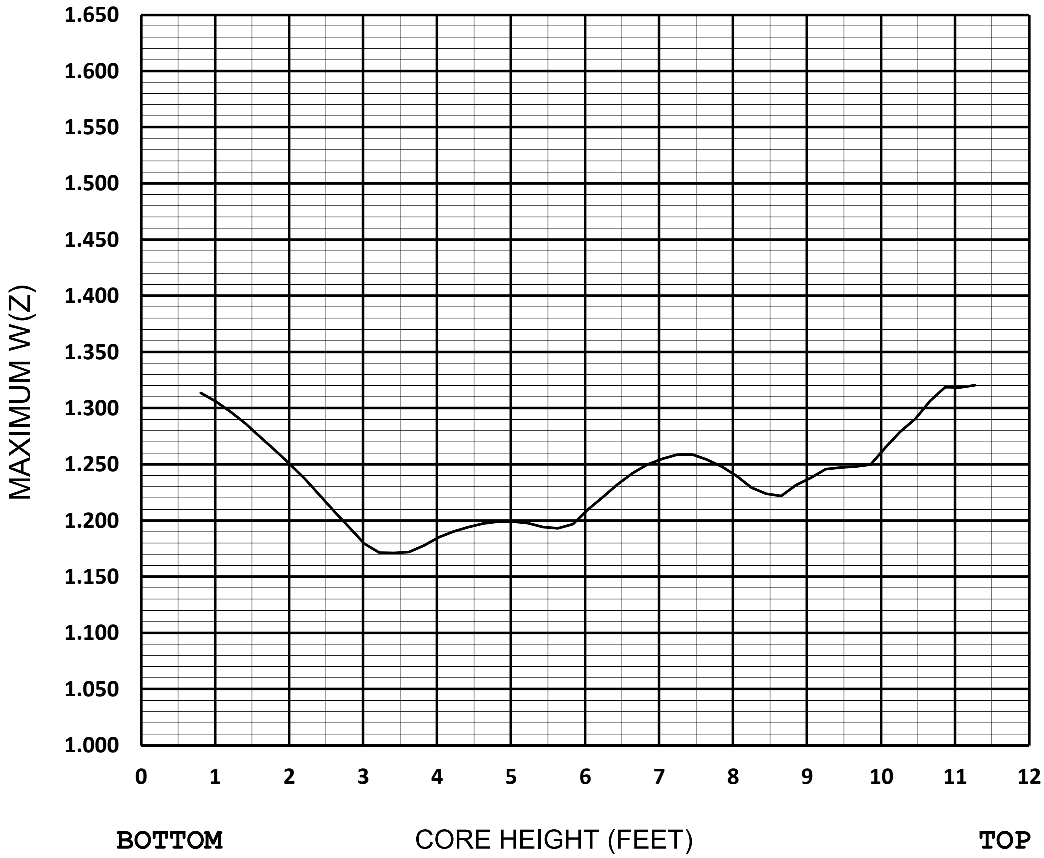


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2350	30	1.1355	16	1.1804
57	1.3784	43	1.2345	29	1.1304	15	1.1882
56	1.3756	42	1.2319	28	1.1341	14	1.2039
55	1.3685	41	1.2271	27	1.1377	13	1.2219
54	1.3599	40	1.2246	26	1.1405	12	1.2400
53	1.3496	39	1.2200	25	1.1431	11	1.2572
52	1.3353	38	1.2177	24	1.1456	10	1.2738
51	1.3192	37	1.2145	23	1.1474	9	1.2896
50	1.3009	36	1.2079	22	1.1485	8	1.3045
49	1.2796	35	1.1997	21	1.1523	7	1.3177
48	1.2613	34	1.1893	20	1.1591	6	1.3285
47	1.2553	33	1.1771	19	1.1650	5	1.3373
46	1.2499	32	1.1631	18	1.1704	1 - 4	---
45	1.2404	31	1.1478	17	1.1749		

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

FIGURE 8

W(Z) AS A FUNCTION OF CORE HEIGHT
(18,000 MWD/MTU)



Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2217	30	1.1969	16	1.1794
57	1.3206	43	1.2237	29	1.1932	15	1.1935
56	1.3184	42	1.2291	28	1.1943	14	1.2078
55	1.3186	41	1.2399	27	1.1975	13	1.2224
54	1.3063	40	1.2481	26	1.1991	12	1.2371
53	1.2904	39	1.2543	25	1.1991	11	1.2501
52	1.2791	38	1.2587	24	1.1974	10	1.2624
51	1.2651	37	1.2585	23	1.1943	9	1.2746
50	1.2496	36	1.2549	22	1.1901	8	1.2864
49	1.2481	35	1.2497	21	1.1852	7	1.2971
48	1.2471	34	1.2421	20	1.1777	6	1.3060
47	1.2456	33	1.2321	19	1.1719	5	1.3134
46	1.2380	32	1.2207	18	1.1712	1 - 4	---
45	1.2315	31	1.2096	17	1.1714		

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

FIGURE 9

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF
RATED THERMAL POWER