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SUBJECT: COMANCHE PEAK NUCLEAR POWER PLANT
DOCKET NO. 50-445
CORE OPERATING LIMITS REPORT (COLR)

Dear Sir or Madam:

Enclosed is Comanche Peak Nuclear Power Plant (CPNPP), the Unit 1, Cycle 21, Core Operating Limits Report, ERX-19-001, Rev. 0. This report is prepared and submitted pursuant to Technical Specification 5.6.5, CORE OPERATING LIMITS REPORT (COLR).

This letter contains no new regulatory commitments.

If you have any questions regarding this submittal, please contact Garry Struble at (254) 897-6628 or garry.struble@luminant.com.

A001
NRR

Sincerely,

Jack C. Hicks

Jack C. Hicks

Enclosure – CPNPP Unit 1, Cycle 21, Core Operating Limits Report, ERX-19-001, Revision 0

c - Scott Morris, Region IV
Natreon Jordan, NRR
Resident Inspectors, Comanche Peak

ERX-19-001, Rev. 0

CPNPP UNIT 1 CYCLE 21

CORE OPERATING LIMITS REPORT

April 2019

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1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for CPNPP UNIT 1 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
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% 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 $$F_Q(Z) \leq \frac{F_Q^{RTP}}{P} [K(Z)] \text{ for } P > 0.5$$

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

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

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	≤	588 °F (4 channels)
	≤	588 °F (3 channels)

The RCS average temperature limits correspond to the analytical limit of 591.9 °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 ≥ 403,700 gpm.

2.12.5 SR 3.4.1.4

The RCS total flow rate based on precision heat balance shall be ≥ 403,700 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 ≥ 1775 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	4.80
150	4.80
365	5.18
580	5.26
795	5.08
1010	4.62
1225	3.90
1440	3.07
1655	2.23
1870	2.00
5740	2.00
5955	2.13
6169	2.21
6384	2.08
6599	2.00
7459	2.00
7674	2.04
7889	2.23
8104	2.41
8319	2.56
8534	2.63
8749	2.44
8964	2.55
9179	2.30
9394	2.01
9609	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.

The Power Distribution Measurement System model uses a conservative condensed set of penalty factors due to input restrictions.

Figure 1
Reactor Core Safety Limits

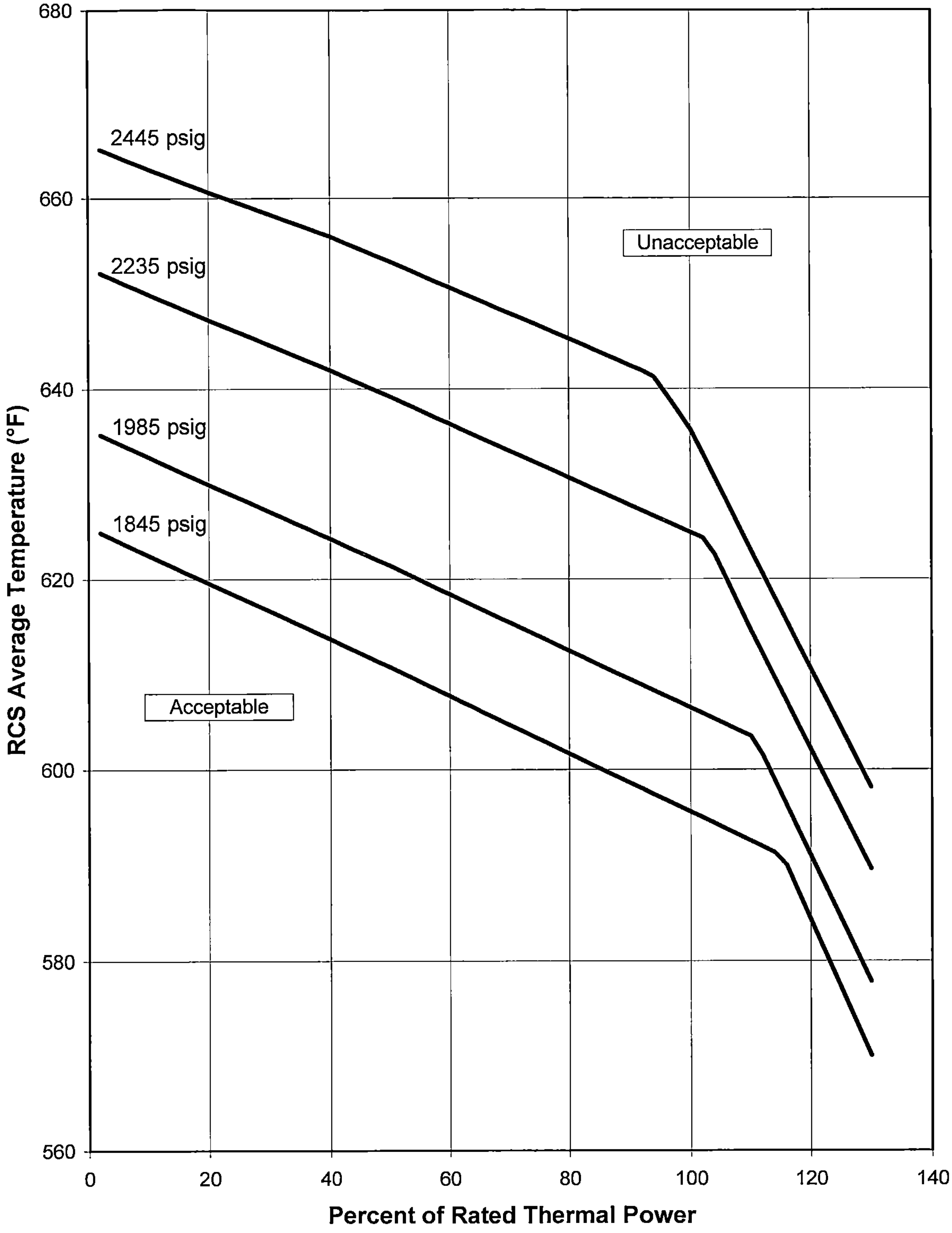
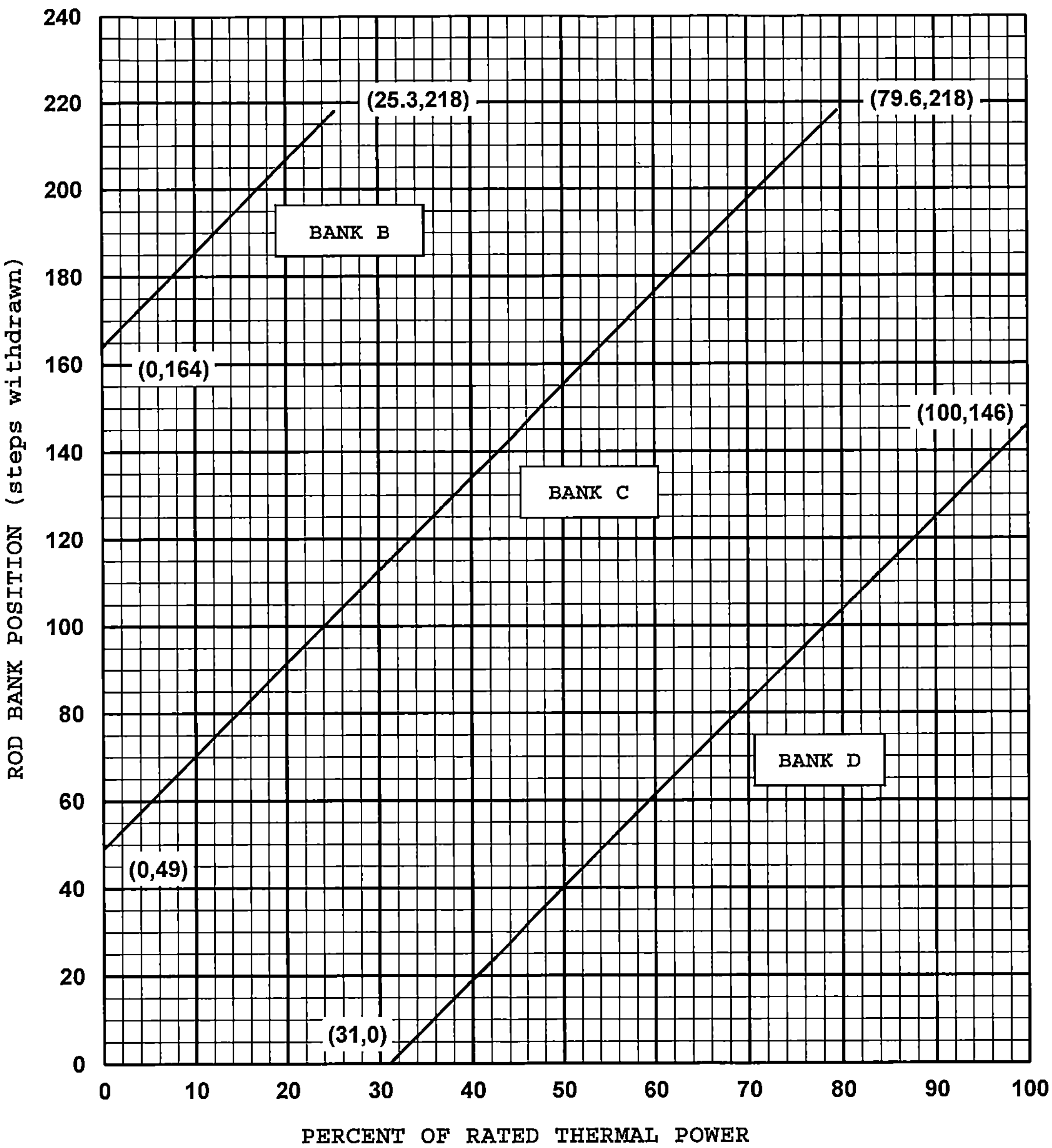


FIGURE 2

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

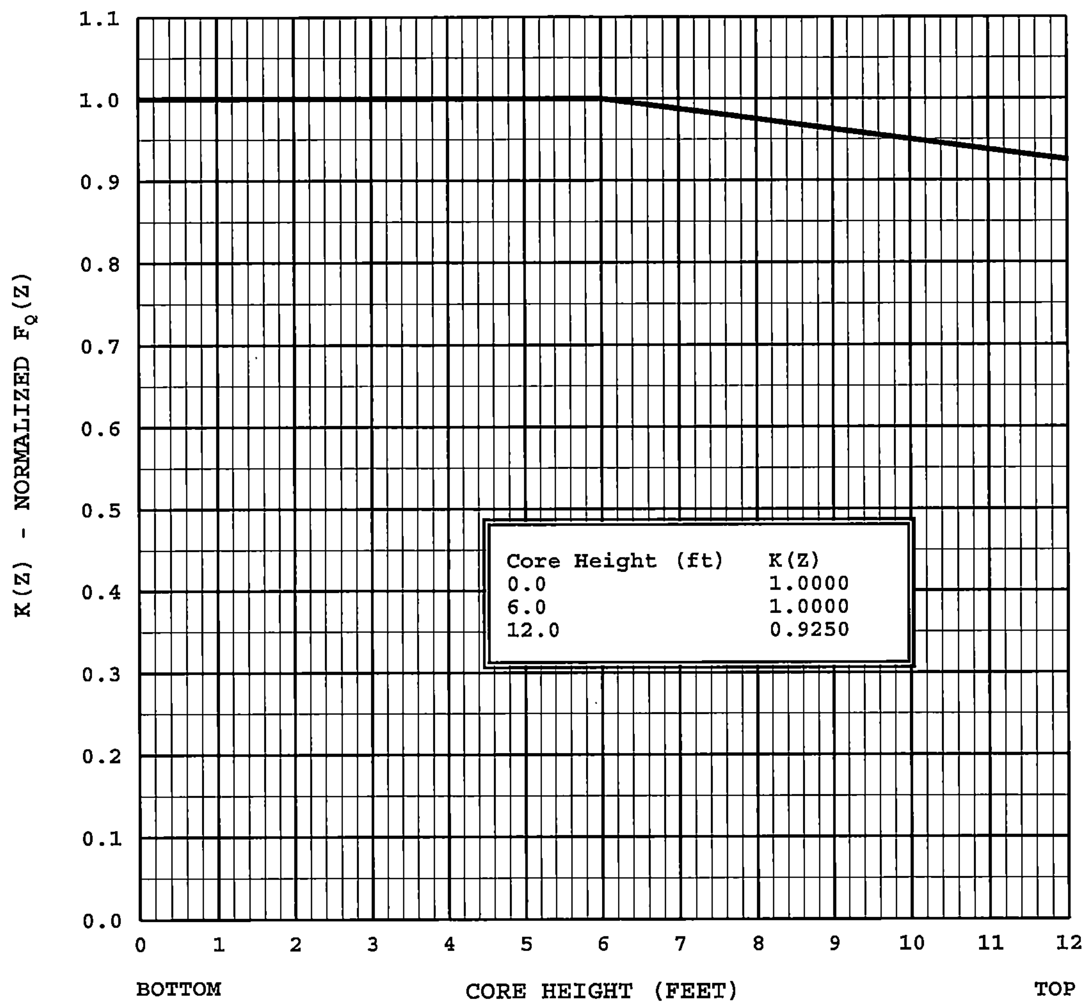
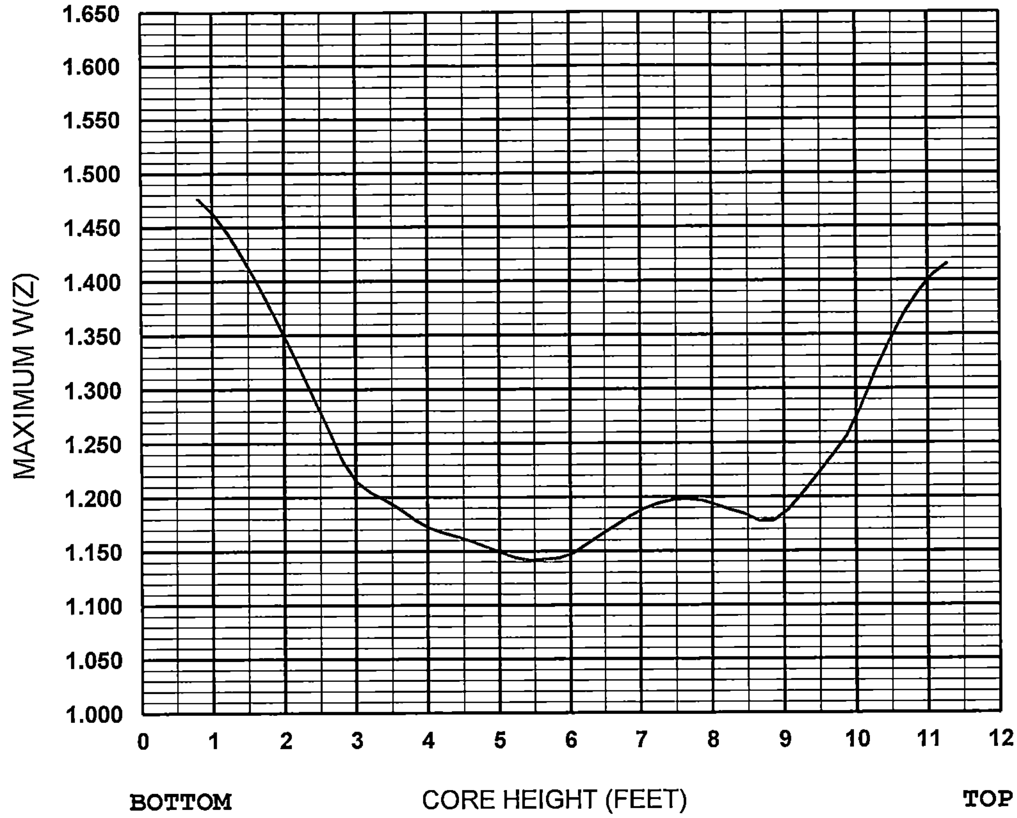


FIGURE 4

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

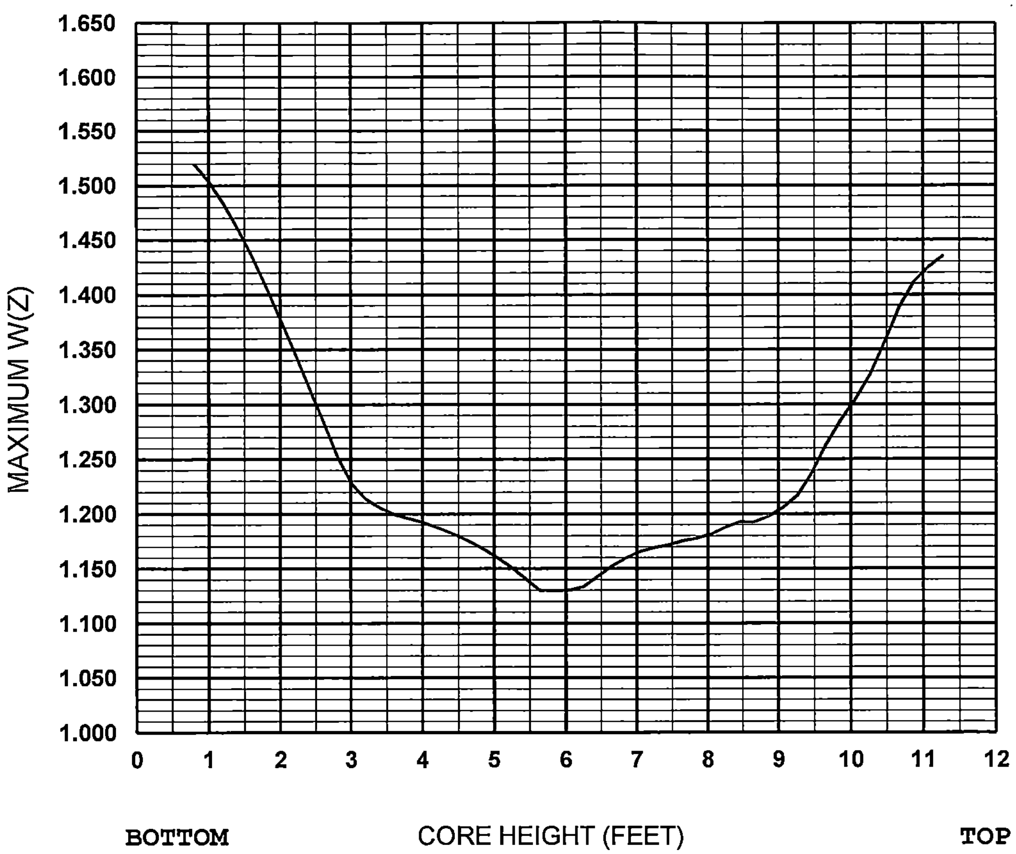


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1774	30	1.1434	16	1.2138
57	1.4149	43	1.1840	29	1.1424	15	1.2336
56	1.4054	42	1.1881	28	1.1412	14	1.2630
55	1.3894	41	1.1925	27	1.1438	13	1.2913
54	1.3690	40	1.1970	26	1.1486	12	1.3196
53	1.3434	39	1.1983	25	1.1536	11	1.3476
52	1.3155	38	1.1974	24	1.1587	10	1.3745
51	1.2829	37	1.1942	23	1.1633	9	1.4000
50	1.2551	36	1.1891	22	1.1669	8	1.4236
49	1.2375	35	1.1819	21	1.1715	7	1.4449
48	1.2202	34	1.1733	20	1.1790	6	1.4629
47	1.2034	33	1.1648	19	1.1886	5	1.4762
46	1.1881	32	1.1565	18	1.1969	1 - 4	---
45	1.1782	31	1.1482	17	1.2041		

Core Height (ft) = (Node - 1) * 0.2013222

FIGURE 5

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

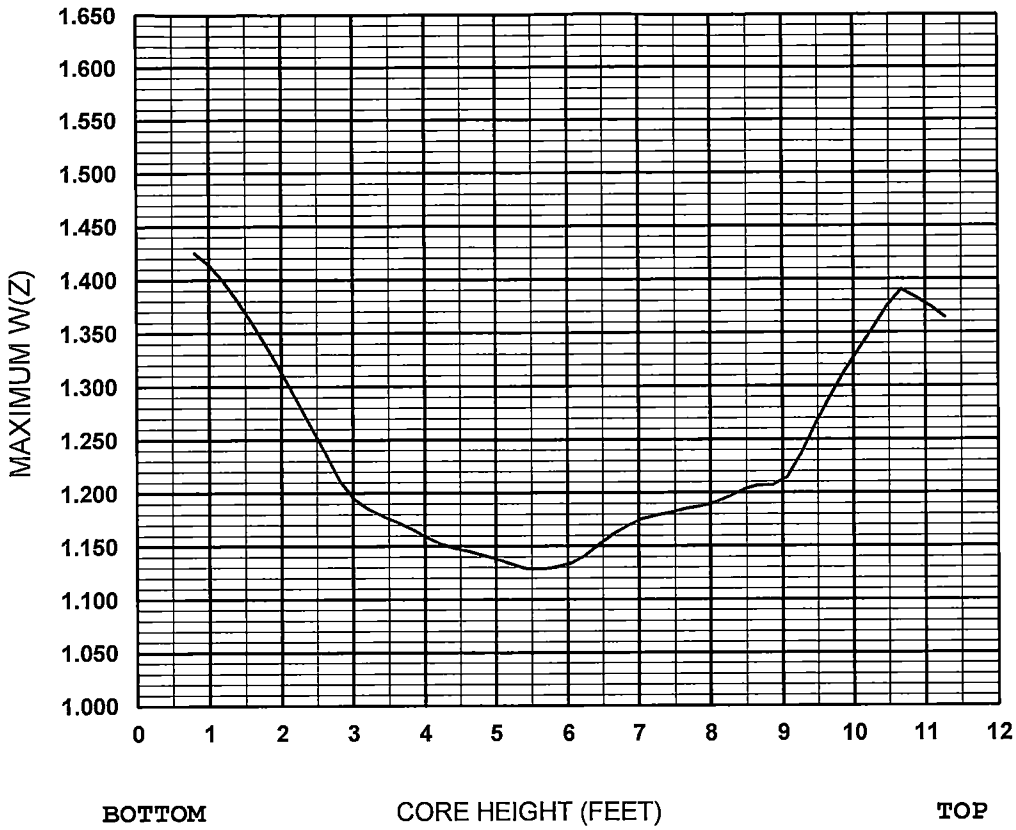


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1923	30	1.1298	16	1.2271
57	1.4348	43	1.1925	29	1.1301	15	1.2510
56	1.4251	42	1.1879	28	1.1411	14	1.2829
55	1.4113	41	1.1815	27	1.1515	13	1.3140
54	1.3885	40	1.1777	26	1.1603	12	1.3452
53	1.3565	39	1.1753	25	1.1685	11	1.3761
52	1.3269	38	1.1714	24	1.1757	10	1.4059
51	1.3048	37	1.1692	23	1.1820	9	1.4340
50	1.2859	36	1.1656	22	1.1874	8	1.4600
49	1.2635	35	1.1596	21	1.1919	7	1.4834
48	1.2370	34	1.1518	20	1.1955	6	1.5037
47	1.2168	33	1.1423	19	1.1991	5	1.5192
46	1.2056	32	1.1333	18	1.2051	1 - 4	---
45	1.1977	31	1.1302	17	1.2133		

Core Height (ft) = (Node - 1) * 0.2013222

FIGURE 6

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

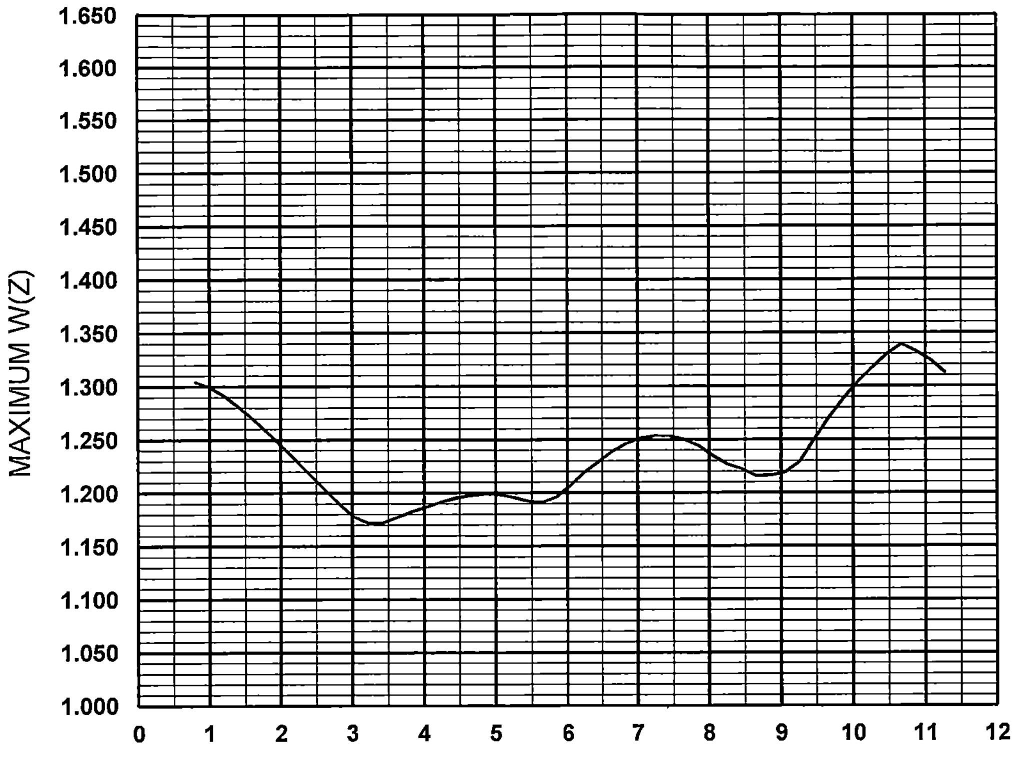


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2069	30	1.1303	16	1.1941
57	1.3639	43	1.2027	29	1.1284	15	1.2115
56	1.3740	42	1.1964	28	1.1285	14	1.2373
55	1.3826	41	1.1907	27	1.1328	13	1.2622
54	1.3900	40	1.1873	26	1.1377	12	1.2871
53	1.3740	39	1.1851	25	1.1412	11	1.3117
52	1.3529	38	1.1812	24	1.1447	10	1.3355
51	1.3332	37	1.1790	23	1.1481	9	1.3580
50	1.3127	36	1.1754	22	1.1518	8	1.3788
49	1.2897	35	1.1692	21	1.1584	7	1.3975
48	1.2644	34	1.1612	20	1.1661	6	1.4134
47	1.2365	33	1.1514	19	1.1724	5	1.4250
46	1.2142	32	1.1408	18	1.1781	1 - 4	---
45	1.2070	31	1.1337	17	1.1849		

Core Height (ft) = (Node - 1) * 0.2013222

FIGURE 7

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

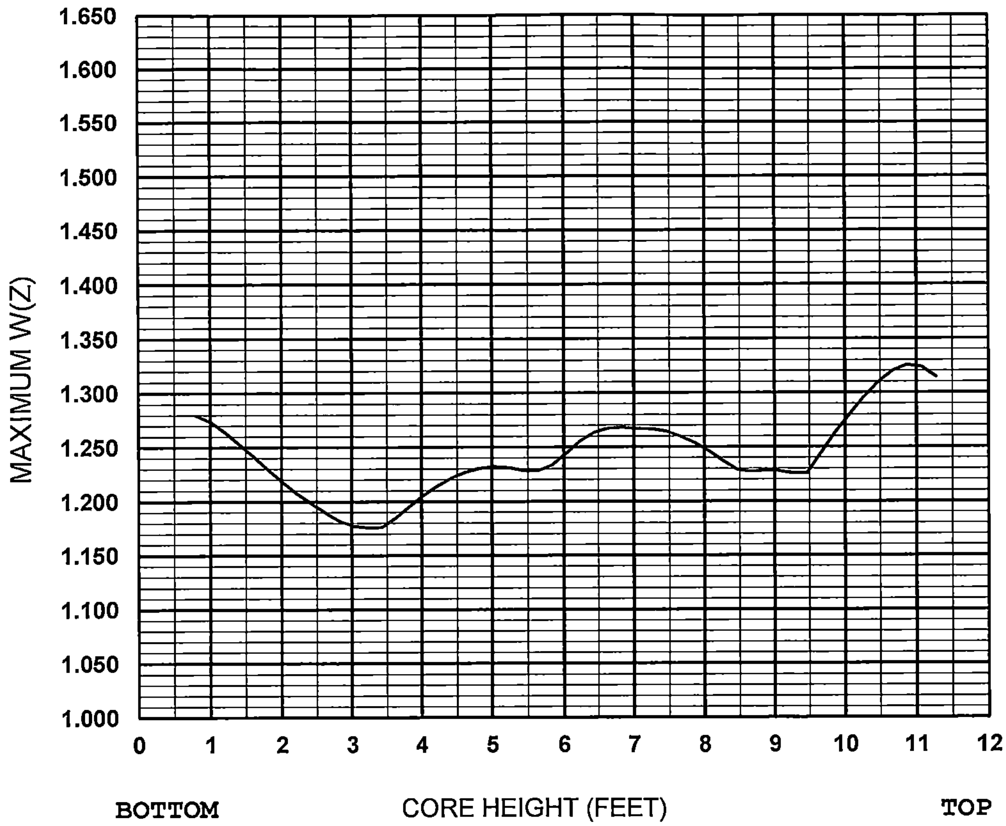


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2157	30	1.1961	16	1.1777
57	1.3125	43	1.2222	29	1.1910	15	1.1897
56	1.3239	42	1.2267	28	1.1923	14	1.2026
55	1.3322	41	1.2347	27	1.1961	13	1.2168
54	1.3390	40	1.2442	26	1.1984	12	1.2308
53	1.3294	39	1.2498	25	1.1988	11	1.2442
52	1.3171	38	1.2530	24	1.1977	10	1.2572
51	1.3037	37	1.2535	23	1.1951	9	1.2694
50	1.2882	36	1.2513	22	1.1910	8	1.2807
49	1.2703	35	1.2465	21	1.1866	7	1.2909
48	1.2499	34	1.2389	20	1.1822	6	1.2992
47	1.2292	33	1.2289	19	1.1772	5	1.3040
46	1.2192	32	1.2189	18	1.1718	1 - 4	---
45	1.2164	31	1.2072	17	1.1719		

Core Height (ft) = (Node - 1) * 0.2013222

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	1.2273	30	1.2335	16	1.1774
57	1.3143	43	1.2292	29	1.2282	15	1.1820
56	1.3234	42	1.2376	28	1.2283	14	1.1899
55	1.3253	41	1.2466	27	1.2311	13	1.1986
54	1.3201	40	1.2539	26	1.2322	12	1.2077
53	1.3095	39	1.2600	25	1.2307	11	1.2181
52	1.2956	38	1.2646	24	1.2272	10	1.2297
51	1.2799	37	1.2664	23	1.2217	9	1.2415
50	1.2632	36	1.2670	22	1.2144	8	1.2528
49	1.2444	35	1.2679	21	1.2055	7	1.2639
48	1.2255	34	1.2675	20	1.1953	6	1.2735
47	1.2254	33	1.2633	19	1.1844	5	1.2796
46	1.2278	32	1.2560	18	1.1761	1 - 4	---
45	1.2281	31	1.2447	17	1.1758		

Core Height (ft) = (Node - 1) * 0.2013222

FIGURE 9

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER