VISTRA ENERGY

TXU energy | Luminant

Steven K. Sewell
Senior Director, Engineering & Regulatory Affairs
Luminant
P.O. Box 1002
6322 North FM 56
Glen Rose, TX 76043
o 254.897.6113
m 817.776.0798

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TXX-17099

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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 1 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,

Steven K. Sewell

Enclosure – Unit 2 Cycle 17 Core Operating Limits Report, Revision 1

c - Kriss Kennedy, Region IV
Margaret Watford O'Banion, NRR
Resident Inspectors, Comanche Peak

ERX-17-001, Rev. 1

CPNPP UNIT 2 CYCLE 17

CORE OPERATING LIMITS REPORT

December 2017

Prepared: ______________________ Date: 12-5-2017
Jonathan M. Ralston
Principal Engineer, Westinghouse Electric Company, LLC.

Reviewed: ______________________ Date: 12/6/2017
Christopher M. Briggs
Principal Engineer, Westinghouse Electric Company, LLC.

Reviewed: ______________________ Date: 12-6-2017
Brian L. Guthrie
Principal Engineer, Westinghouse Electric Company, LLC.

Approved: ______________________* Date: 12-6-2017
Kevin N. Roland, Manager
Westinghouse Integrated Site Engineering - TX/KS

*BRIAN GUTHRIE TELESIGN FOR KEVIN ROLAND

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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
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LCO 3.2.2	NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR ($F^N_{\Delta H}$)
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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 <u>ROD GROUP ALIGNMENT LIMITS</u> (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 <u>SHUTDOWN BANK INSERTION LIMITS</u> (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: $P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$

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

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 $(q_t - q_b) \le -18\%$ RTP

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

$= 2.34 \cdot \{(q_t - q_b) - 10.0\%\}$ when $(q_t - q_b) \ge +10.0\%$ 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 ≥ 1938 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)
365	2.00
580	2.38
796	3.30
1011	4.01
1226	4.18
1441	3.71
1657	3.21
1872	2.71
2087	2.30
2302	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

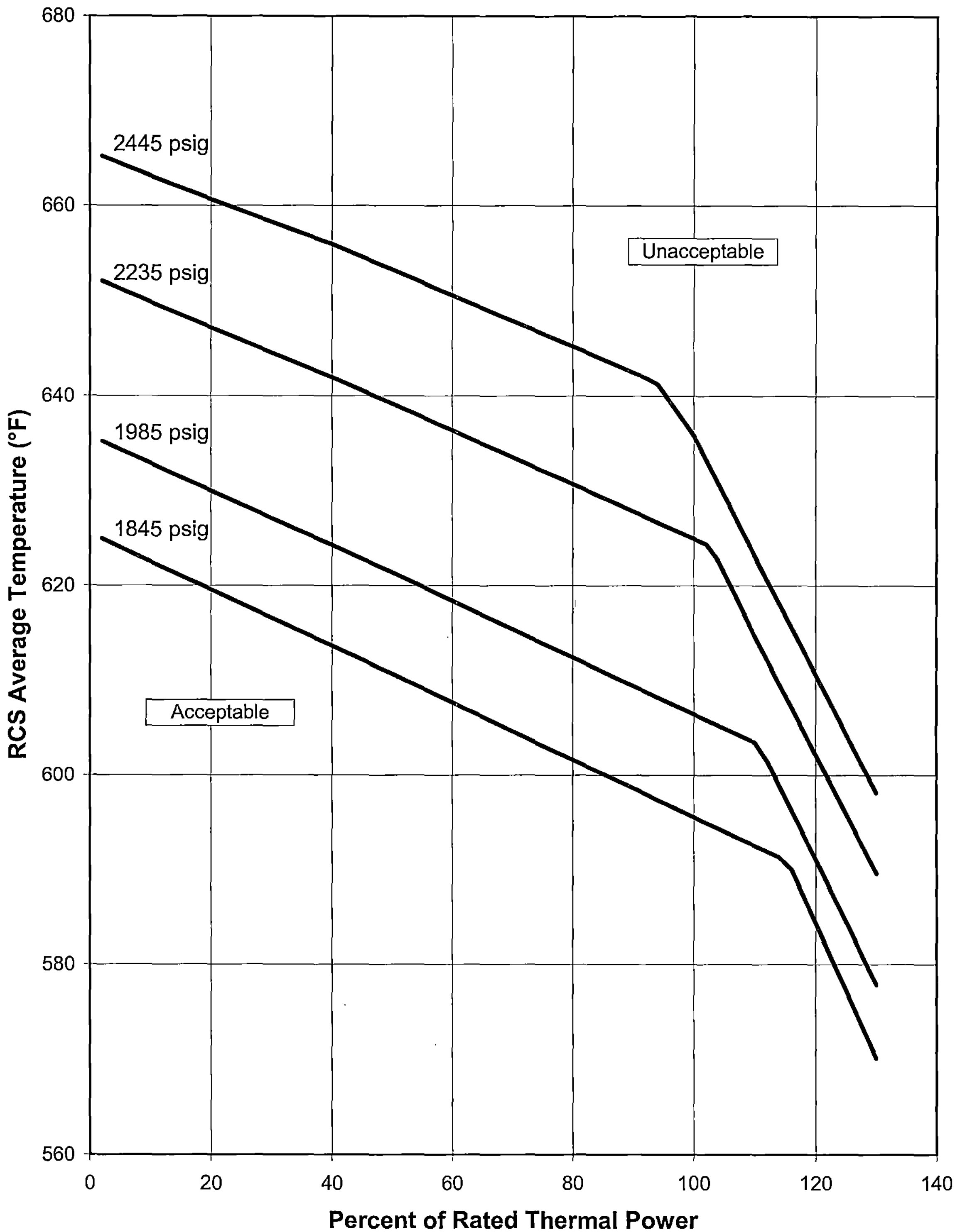
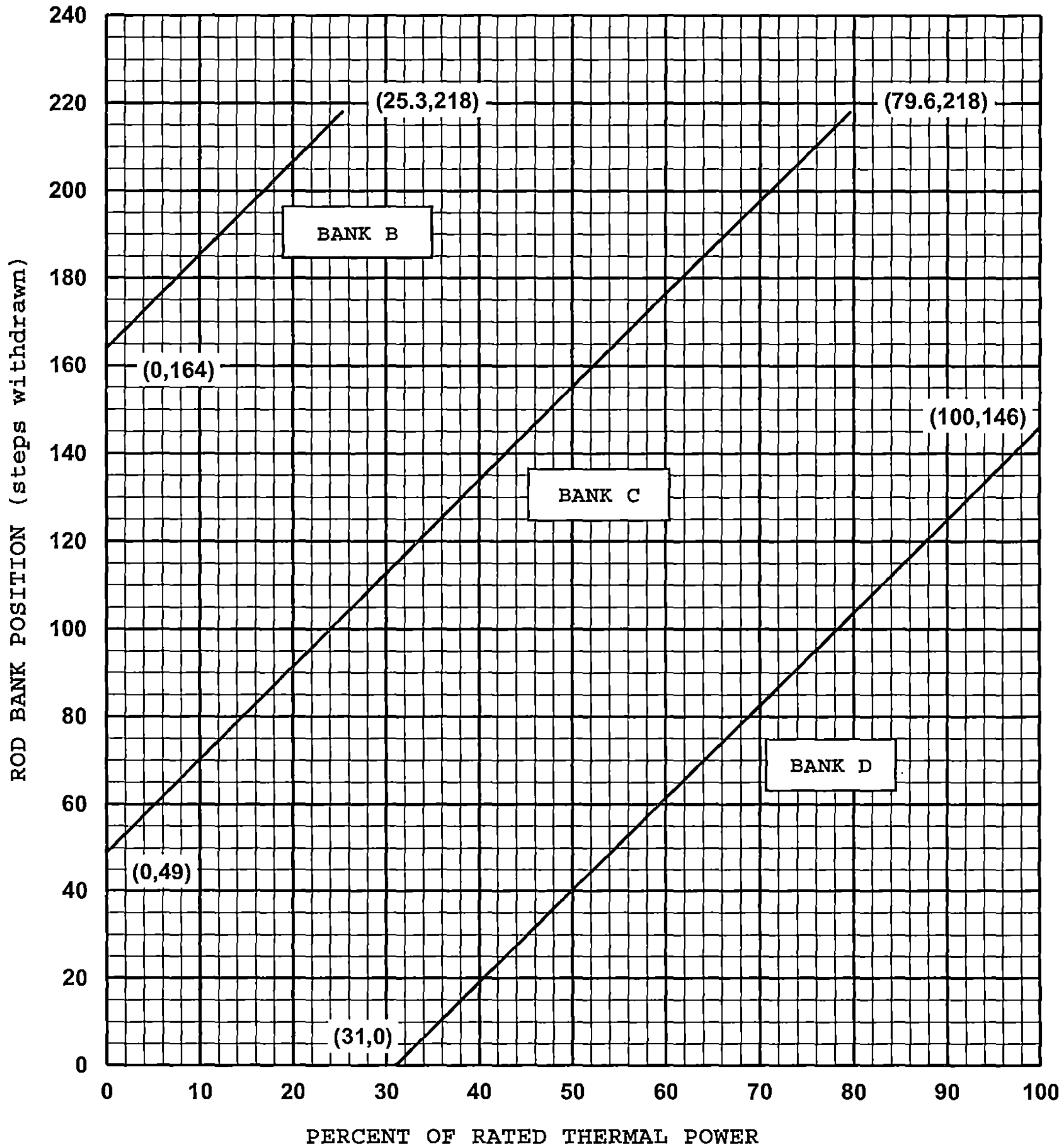


FIGURE 2

ROD BANK INSERTION LIMITS VERSUS THERMAL POWER



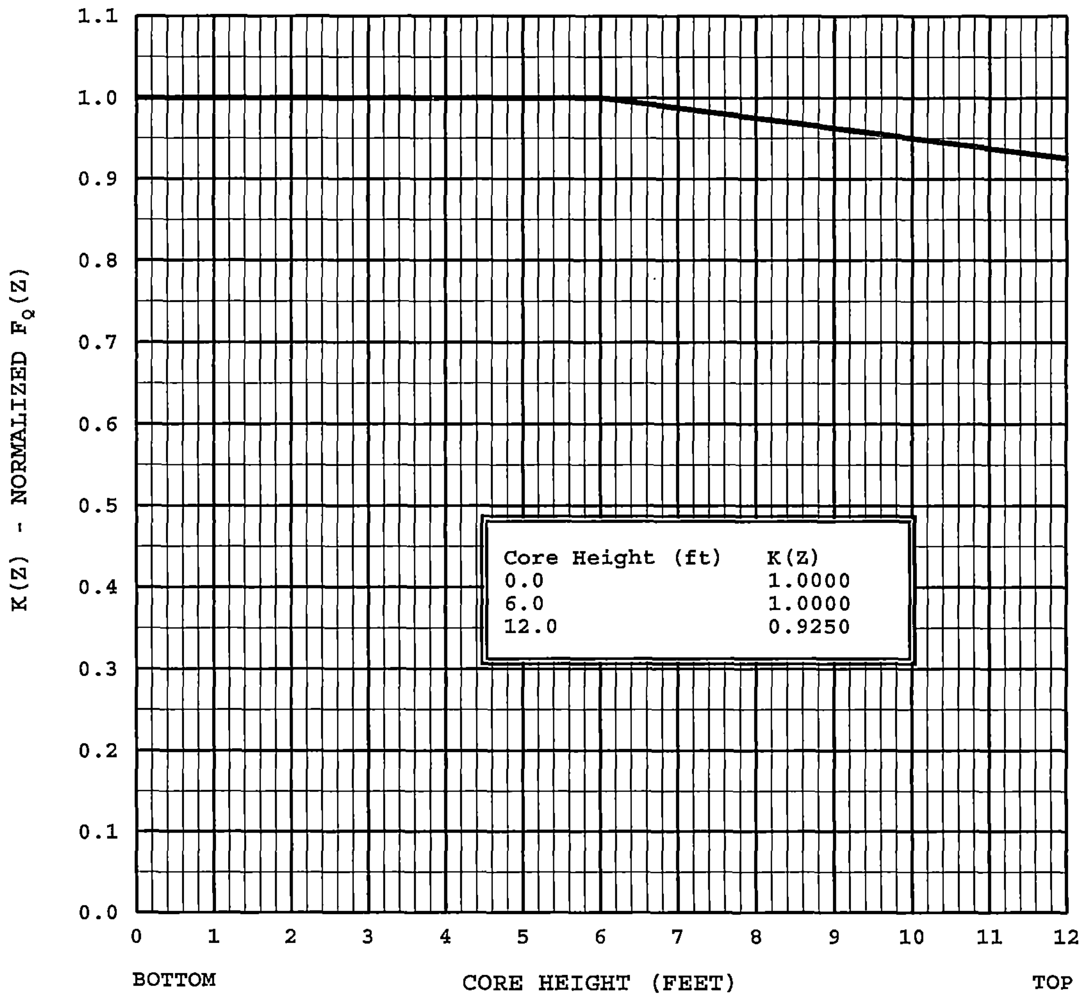
NOTES:

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

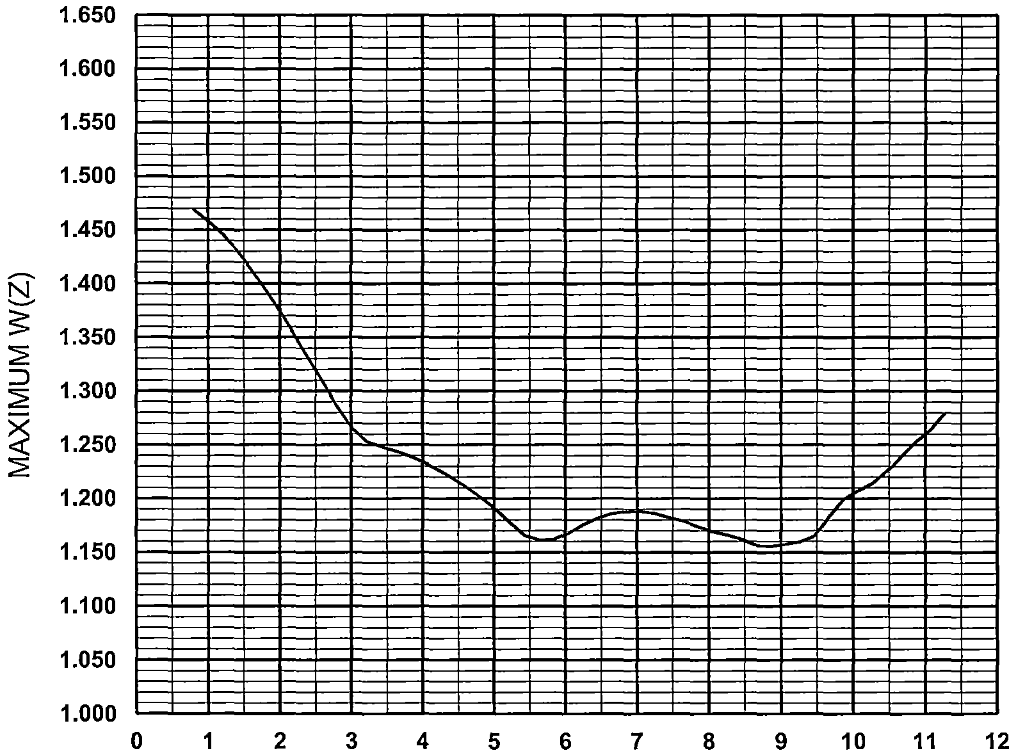
K(Z) - NORMALIZED $F_Q(Z)$ AS A FUNCTION OF CORE HEIGHT



Core Height (ft)	K(Z)
0.0	1.0000
6.0	1.0000
12.0	0.9250

FIGURE 4

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

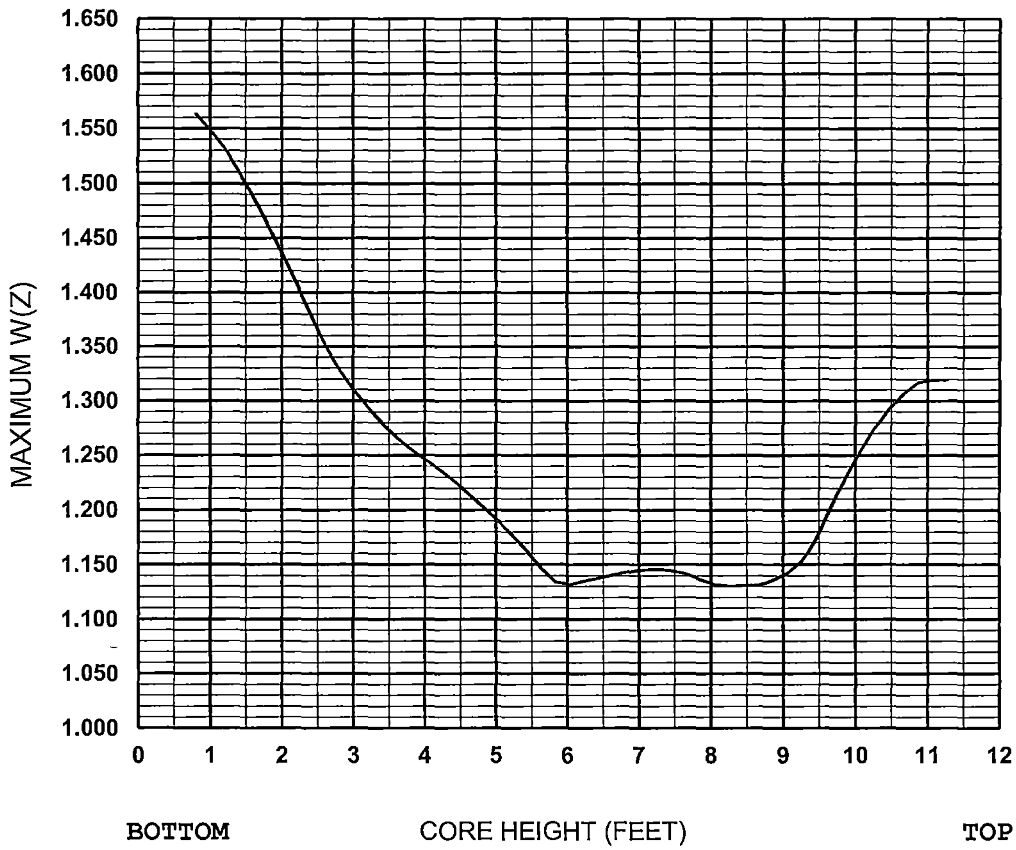


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1563	30	1.1618	16	1.2646
57	1.2792	43	1.1620	29	1.1612	15	1.2840
56	1.2638	42	1.1660	28	1.1654	14	1.3064
55	1.2529	41	1.1692	27	1.1769	13	1.3292
54	1.2394	40	1.1739	26	1.1894	12	1.3514
53	1.2253	39	1.1789	25	1.2000	11	1.3729
52	1.2139	38	1.1821	24	1.2099	10	1.3934
51	1.2073	37	1.1860	23	1.2188	9	1.4127
50	1.1991	36	1.1883	22	1.2266	8	1.4304
49	1.1829	35	1.1879	21	1.2334	7	1.4458
48	1.1645	34	1.1857	20	1.2393	6	1.4581
47	1.1594	33	1.1814	19	1.2442	5	1.4689
46	1.1575	32	1.1754	18	1.2484	1 - 4	---
45	1.1556	31	1.1676	17	1.2528		

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

FIGURE 5

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



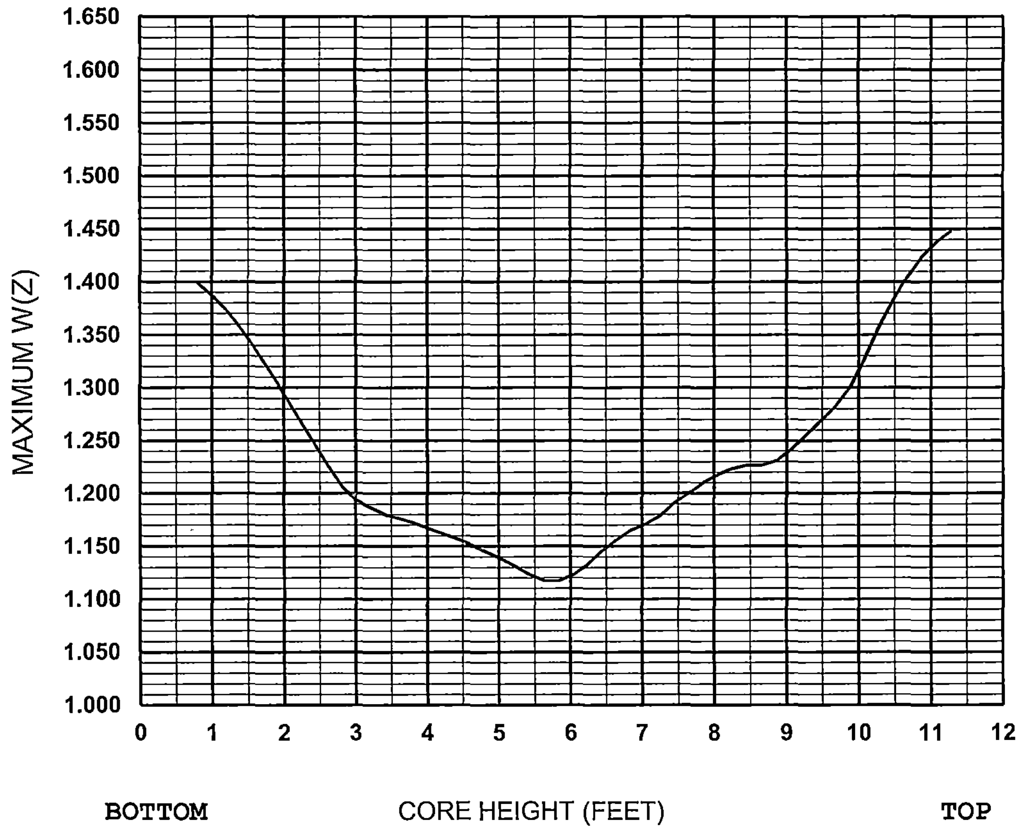
Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1310	30	1.1341	16	1.3087
57	1.3194	43	1.1308	29	1.1463	15	1.3274
56	1.3190	42	1.1303	28	1.1618	14	1.3501
55	1.3169	41	1.1318	27	1.1764	13	1.3785
54	1.3066	40	1.1367	26	1.1898	12	1.4071
53	1.2927	39	1.1416	25	1.2022	11	1.4348
52	1.2746	38	1.1445	24	1.2140	10	1.4617
51	1.2531	37	1.1457	23	1.2255	9	1.4871
50	1.2292	36	1.1454	22	1.2362	8	1.5106
49	1.2024	35	1.1434	21	1.2454	7	1.5315
48	1.1738	34	1.1404	20	1.2546	6	1.5483
47	1.1528	33	1.1380	19	1.2657	5	1.5634
46	1.1423	32	1.1353	18	1.2785	1 - 4	---
45	1.1360	31	1.1318	17	1.2926		

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

COLR for CPNPP Unit 2 Cycle 17

FIGURE 6

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

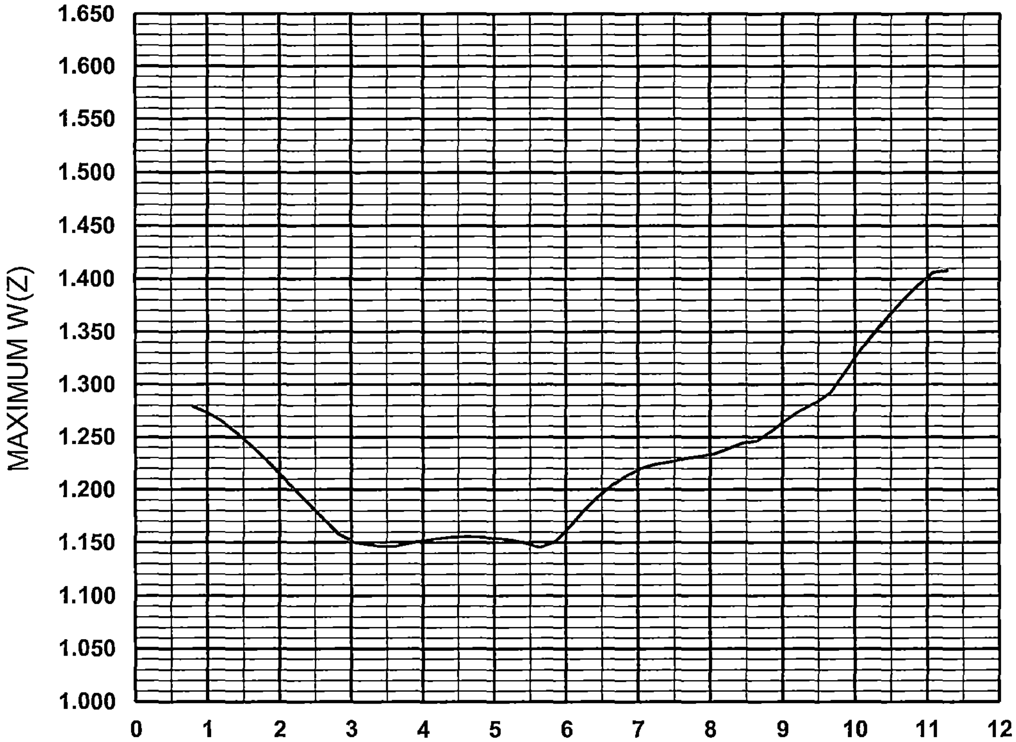


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2268	30	1.1173	16	1.1932
57	1.4478	43	1.2268	29	1.1172	15	1.2052
56	1.4376	42	1.2235	28	1.1228	14	1.2256
55	1.4236	41	1.2181	27	1.1306	13	1.2479
54	1.4042	40	1.2104	26	1.1378	12	1.2704
53	1.3813	39	1.2003	25	1.1444	11	1.2927
52	1.3556	38	1.1908	24	1.1510	10	1.3144
51	1.3257	37	1.1784	23	1.1568	9	1.3353
50	1.2989	36	1.1706	22	1.1617	8	1.3551
49	1.2813	35	1.1651	21	1.1666	7	1.3728
48	1.2679	34	1.1562	20	1.1717	6	1.3867
47	1.2547	33	1.1457	19	1.1760	5	1.3986
46	1.2413	32	1.1329	18	1.1796	1 - 4	---
45	1.2309	31	1.1227	17	1.1862		

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

FIGURE 7

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

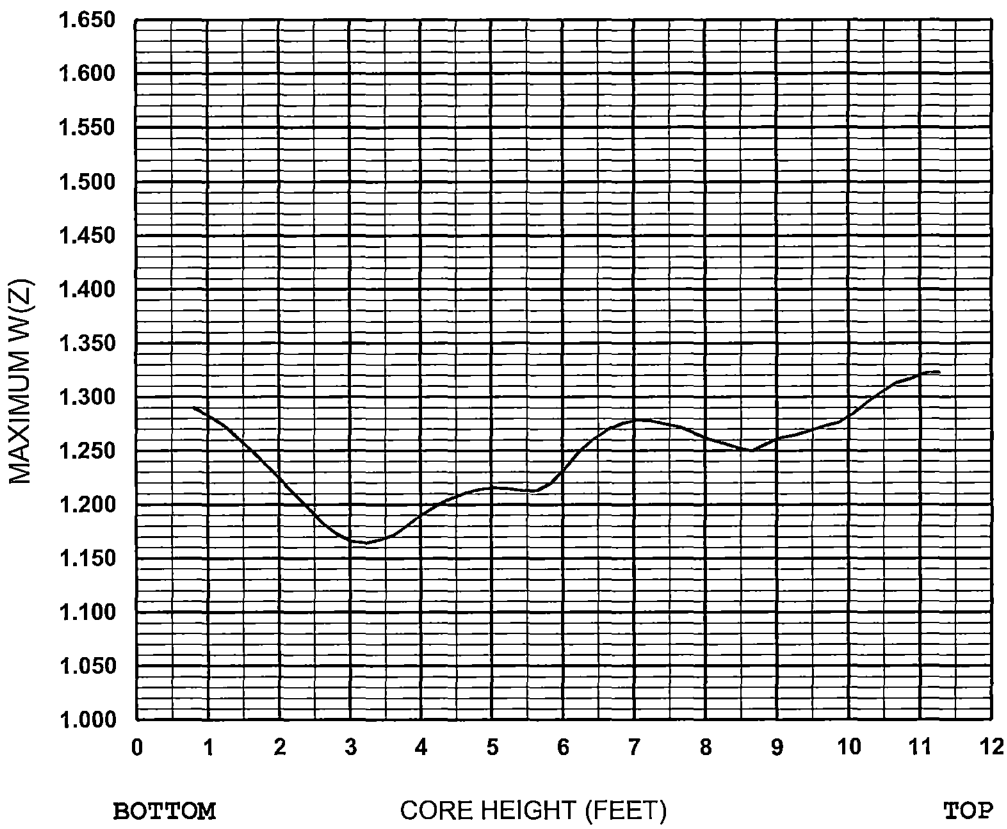


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2468	30	1.1504	16	1.1507
57	1.4081	43	1.2440	29	1.1450	15	1.1578
56	1.4058	42	1.2390	28	1.1494	14	1.1717
55	1.3934	41	1.2338	27	1.1524	13	1.1859
54	1.3804	40	1.2313	26	1.1537	12	1.2001
53	1.3655	39	1.2298	25	1.1549	11	1.2143
52	1.3490	38	1.2263	24	1.1556	10	1.2282
51	1.3319	37	1.2241	23	1.1552	9	1.2414
50	1.3119	36	1.2203	22	1.1539	8	1.2537
49	1.2924	35	1.2133	21	1.1520	7	1.2647
48	1.2828	34	1.2042	20	1.1492	6	1.2729
47	1.2753	33	1.1928	19	1.1466	5	1.2793
46	1.2664	32	1.1795	18	1.1462	1 - 4	---
45	1.2557	31	1.1641	17	1.1482		

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	1.1657
57	1.3229	43	1.2527	29	1.2130	15	1.1726
56	1.3224	42	1.2572	28	1.2126	14	1.1830
55	1.3169	41	1.2609	27	1.2146	13	1.1959
54	1.3131	40	1.2661	26	1.2155	12	1.2100
53	1.3049	39	1.2716	25	1.2141	11	1.2239
52	1.2956	38	1.2744	24	1.2108	10	1.2375
51	1.2844	37	1.2777	23	1.2057	9	1.2506
50	1.2761	36	1.2786	22	1.1989	8	1.2630
49	1.2729	35	1.2757	21	1.1909	7	1.2743
48	1.2689	34	1.2698	20	1.1810	6	1.2831
47	1.2648	33	1.2608	19	1.1717	5	1.2897
46	1.2622	32	1.2492	18	1.1674	1 - 4	---
45	1.2559	31	1.2339	17	1.1642		

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

FIGURE 9

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER