VISTRA ENERGY

TXU energy | Luminant

Timothy A. Hope
Manager, Regulatory Affairs
Luminant
P.O. Box 1002
6322 North FM 56
Glen Rose, TX 76043
o 254.897.6370
m 817.360.6882

CP-201700932
TXX-17091

U. S. Nuclear Regulatory Commission   Ref 10CFR50.36(c)(5)

ATTN: Document Control Desk
Washington, DC 20555-0001

11/15/2017

SUBJECT: COMANCHE PEAK NUCLEAR POWER PLANT
DOCKET NO. 50-445 (UNIT 1)
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 1, Cycle 20. This report is prepared and submitted pursuant to Technical Specification 5.6.5.

This communication contains no new licensing basis commitments regarding CPNPP Unit 1.

ADD1
NRR

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

Sincerely,

Timothy A. Hope

Enclosure – Unit 1 Cycle 20 Core Operating Limits Report, Revision 0

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

ERX-17-002, Rev. 0

CPNPP UNIT 1 CYCLE 20

CORE OPERATING LIMITS REPORT

September 2017

Prepared: Date: 9-21-2017
Jonathan M. Ralston
Principal Engineer, Westinghouse Electric Company, LLC.

Reviewed: Chris Briggs Date: 9/21/2017
Christopher M. Briggs
Principal Engineer, Westinghouse Electric Company, LLC.

Reviewed: Date: 9-21-2017
Brian L. Guthrie
Principal Engineer, Westinghouse Electric Company, LLC.

Approved: Date: 9-26-2017
Kevin N. Roland, Manager
Westinghouse Integrated Site Engineering - TX/KS

DISCLAIMER

The information contained in this report was prepared for the specific requirement of Vistra Operations Company LLC and may not be appropriate for use in situations other than those for which it was specifically prepared. Vistra Operations Company LLC PROVIDES NO WARRANTY HEREUNDER, EXPRESS OR IMPLIED, OR STATUTORY, OF ANY KIND OR NATURE WHATSOEVER, REGARDING THIS REPORT OR ITS USE, INCLUDING BUT NOT LIMITED TO ANY WARRANTIES ON MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

By making this report available, Vistra Operations Company LLC does not authorize its use by others, and any such use is forbidden except with the prior written approval of Vistra Operations Company LLC. Any such written approval shall itself be deemed to incorporate the disclaimers of liability and disclaimers of warranties provided herein. In no event shall Vistra Operations Company LLC have any liability for any incidental or consequential damages of any type in connection with the use, authorized or unauthorized, of this report or of the information in it.

TABLE OF CONTENTS

DISCLAIMER ii

TABLE OF CONTENTS iii

LIST OF TABLES iv

LIST OF FIGURES v

SECTION — PAGE

1.0 CORE OPERATING LIMITS REPORT 1

2.0 OPERATING LIMITS 2

2.1 SAFETY LIMITS (SLs) 2

2.2 SHUTDOWN MARGIN (SDM) 2

2.3 MODERATOR TEMPERATURE COEFFICIENT (MTC) 2

2.4 ROD GROUP ALIGNMENT LIMITS 3

2.5 SHUTDOWN BANK INSERTION LIMITS 3

2.6 CONTROL BANK INSERTION LIMITS 4

2.7 PHYSICS TESTS EXCEPTIONS - MODE 2 4

2.8 HEAT FLUX HOT CHANNEL FACTOR ($F_Q(Z)$) 4

2.9 NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR ($F^N_{\Delta H}$) 6

2.10 AXIAL FLUX DIFFERENCE (AFD) 6

2.11 REACTOR TRIP SYSTEM (RTS) INSTRUMENTATION 6

2.12 RCS PRESSURE, TEMPERATURE, AND FLOW DEPARTURE FROM NUCLEATE BOILING (DNB) LIMITS 7

2.13 BORON CONCENTRATION 8

3.0 REFERENCES 8

LIST OF TABLES

TABLE		PAGE
1	$F_Q(Z)$ MARGIN DECREASES IN EXCESS OF 2% PER 31 EFPD	9

LIST OF FIGURES

FIGURE		PAGE
1	REACTOR CORE SAFETY LIMITS	10
2	ROD BANK INSERTION LIMITS VERSUS THERMAL POWER	11
3	K(Z) - NORMALIZED $F_Q(Z)$ AS A FUNCTION OF CORE HEIGHT	12
4	W(Z) AS A FUNCTION OF CORE HEIGHT - (150 MWD/MTU)	13
5	W(Z) AS A FUNCTION OF CORE HEIGHT - (3,000 MWD/MTU)	14
6	W(Z) AS A FUNCTION OF CORE HEIGHT - (9,000 MWD/MTU)	15
7	W(Z) AS A FUNCTION OF CORE HEIGHT - (14,000 MWD/MTU)	16
8	W(Z) AS A FUNCTION OF CORE HEIGHT - (20,000 MWD/MTU)	17
9	AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF RATED THERMAL POWER	18

1.0 CORE OPERATING LIMITS REPORT

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

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

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

$P^1 \geq$ 2235 psig

$\tau_1 \geq$ 10 sec

$\tau_2 \leq$ 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 ≥ 1820 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)
8101	2.00
8316	2.20
8531	2.50
8746	2.73
8961	3.00
9176	2.89
9391	2.72
9606	2.56
9820	2.40
10035	2.24
10250	2.13
10465	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

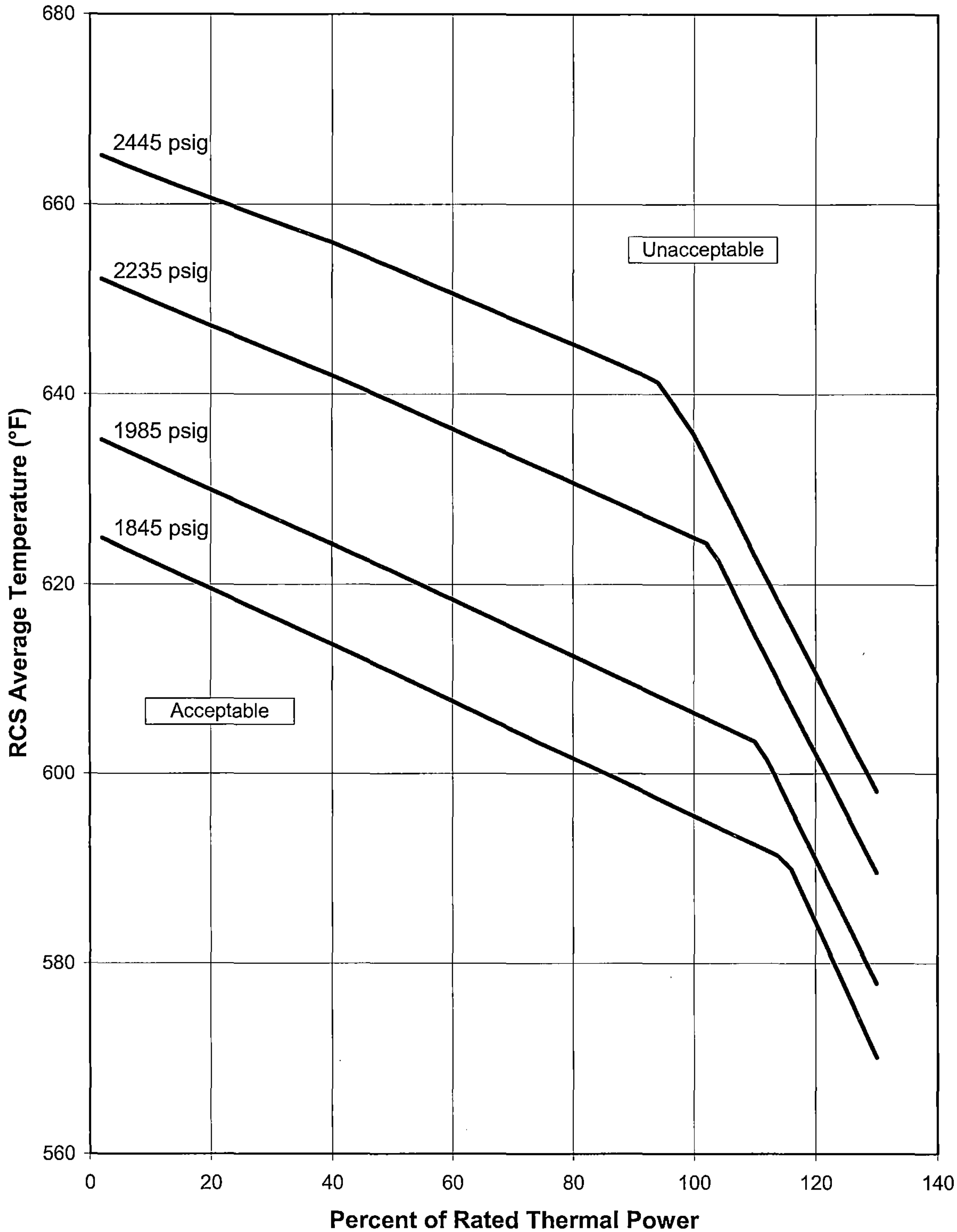
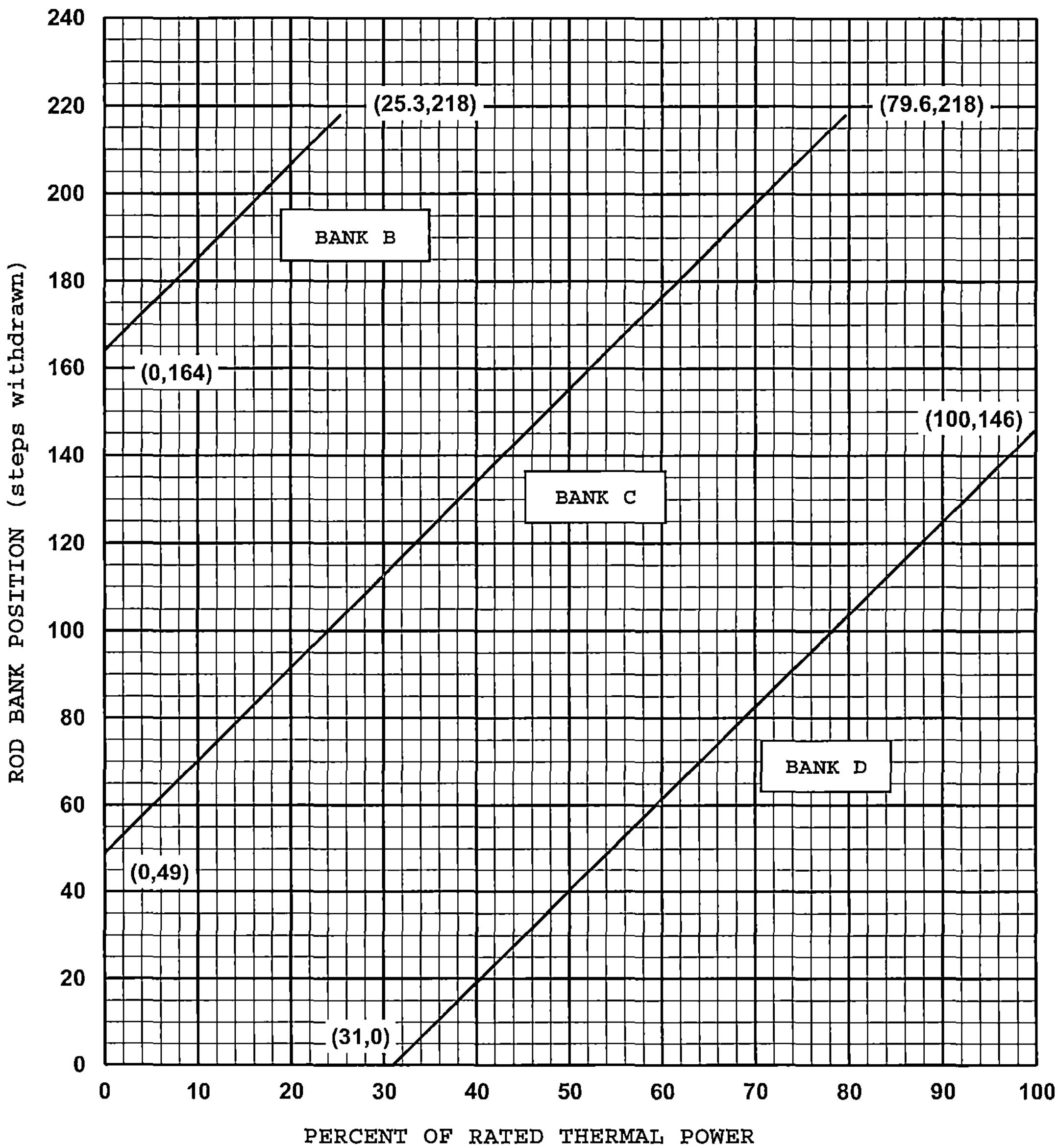


FIGURE 2

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

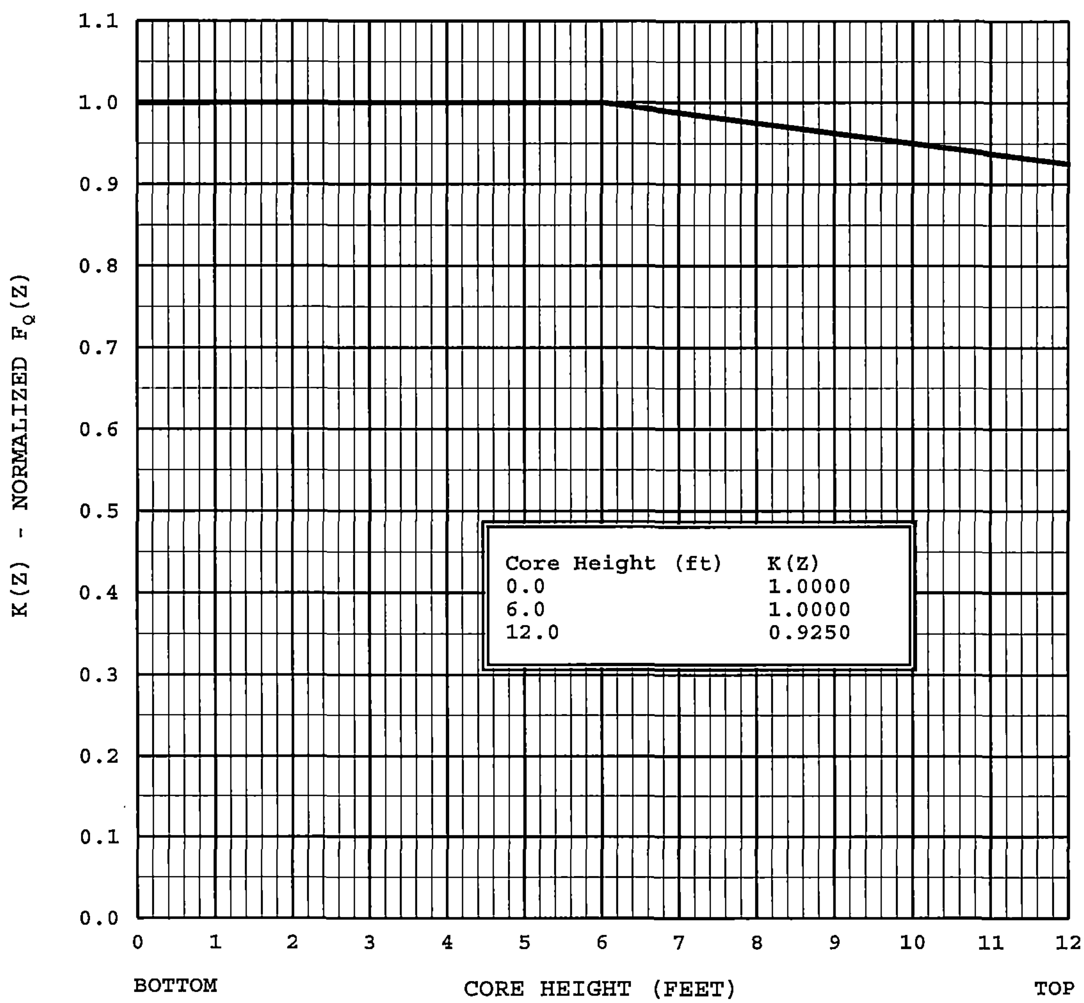
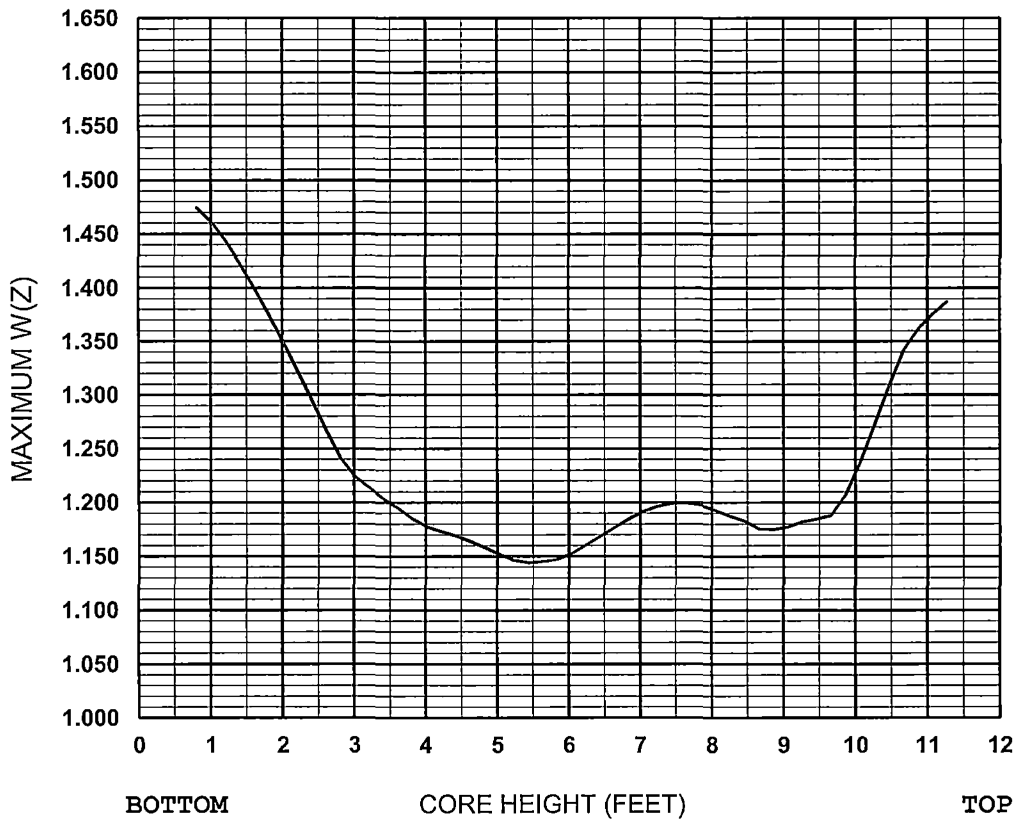


FIGURE 4

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

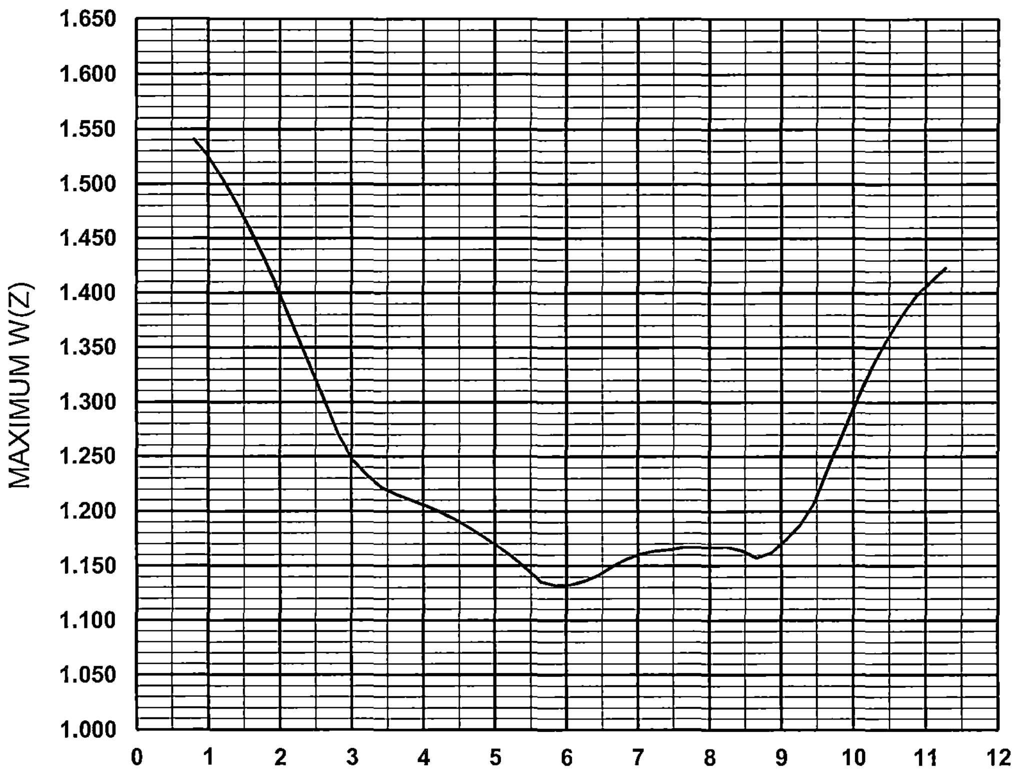


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1755	30	1.1473	16	1.2236
57	1.3873	43	1.1828	29	1.1453	15	1.2404
56	1.3758	42	1.1875	28	1.1442	14	1.2668
55	1.3619	41	1.1927	27	1.1464	13	1.2945
54	1.3417	40	1.1977	26	1.1519	12	1.3221
53	1.3088	39	1.1996	25	1.1582	11	1.3493
52	1.2725	38	1.1992	24	1.1638	10	1.3754
51	1.2371	37	1.1965	23	1.1688	9	1.4002
50	1.2071	36	1.1918	22	1.1729	8	1.4231
49	1.1880	35	1.1850	21	1.1771	7	1.4439
48	1.1845	34	1.1768	20	1.1843	6	1.4615
47	1.1821	33	1.1687	19	1.1943	5	1.4744
46	1.1775	32	1.1607	18	1.2029	1 - 4	---
45	1.1748	31	1.1527	17	1.2132		

Core Height (ft) = (Node - 1) * 0.2013236

FIGURE 5

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

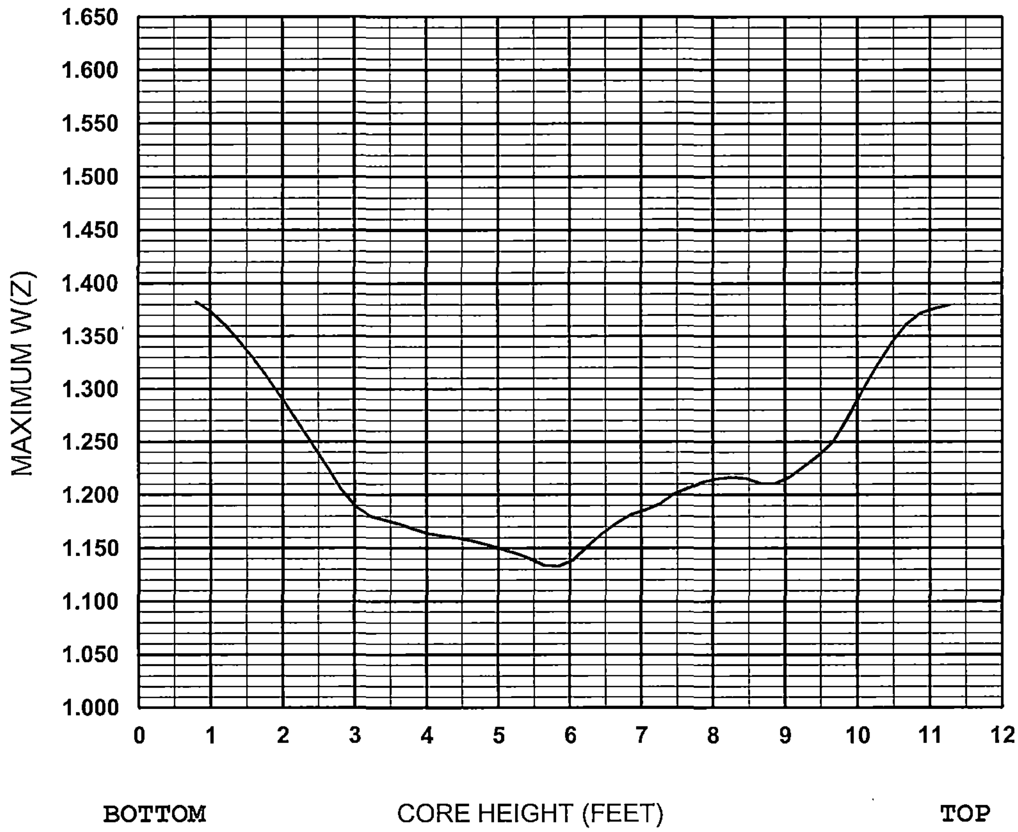


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1574	30	1.1320	16	1.2464
57	1.4231	43	1.1638	29	1.1354	15	1.2692
56	1.4105	42	1.1670	28	1.1474	14	1.3020
55	1.3970	41	1.1670	27	1.1584	13	1.3336
54	1.3792	40	1.1671	26	1.1677	12	1.3652
53	1.3576	39	1.1669	25	1.1768	11	1.3963
52	1.3330	38	1.1648	24	1.1854	10	1.4263
51	1.3044	37	1.1637	23	1.1929	9	1.4547
50	1.2732	36	1.1611	22	1.1996	8	1.4809
49	1.2402	35	1.1563	21	1.2052	7	1.5045
48	1.2075	34	1.1495	20	1.2103	6	1.5250
47	1.1873	33	1.1411	19	1.2154	5	1.5407
46	1.1735	32	1.1358	18	1.2217	1 - 4	---
45	1.1618	31	1.1324	17	1.2326		

Core Height (ft) = (Node - 1) * 0.2013236

FIGURE 6

W(Z) AS A FUNCTION OF CORE HEIGHT
(9,000 MWD/MTU)



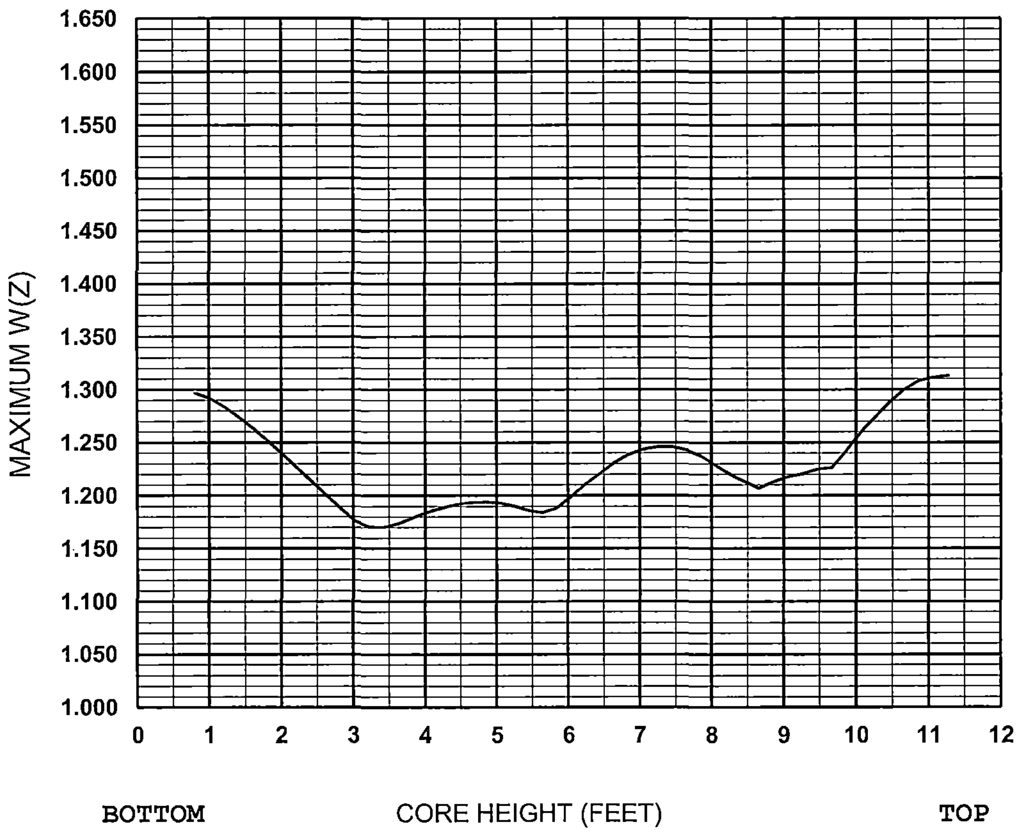
Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2108	30	1.1330	16	1.1885
57	1.3797	43	1.2155	29	1.1337	15	1.2045
56	1.3764	42	1.2163	28	1.1401	14	1.2263
55	1.3717	41	1.2151	27	1.1455	13	1.2474
54	1.3608	40	1.2119	26	1.1494	12	1.2683
53	1.3432	39	1.2062	25	1.1531	11	1.2890
52	1.3217	38	1.2003	24	1.1569	10	1.3088
51	1.2982	37	1.1913	23	1.1596	9	1.3276
50	1.2726	36	1.1857	22	1.1612	8	1.3448
49	1.2498	35	1.1813	21	1.1638	7	1.3604
48	1.2373	34	1.1733	20	1.1679	6	1.3735
47	1.2265	33	1.1634	19	1.1725	5	1.3826
46	1.2166	32	1.1514	18	1.1763	1 - 4	---
45	1.2106	31	1.1387	17	1.1803		

Core Height (ft) = (Node - 1) * 0.2013236

COLR for CPNPP Unit 1 Cycle 20

FIGURE 7

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

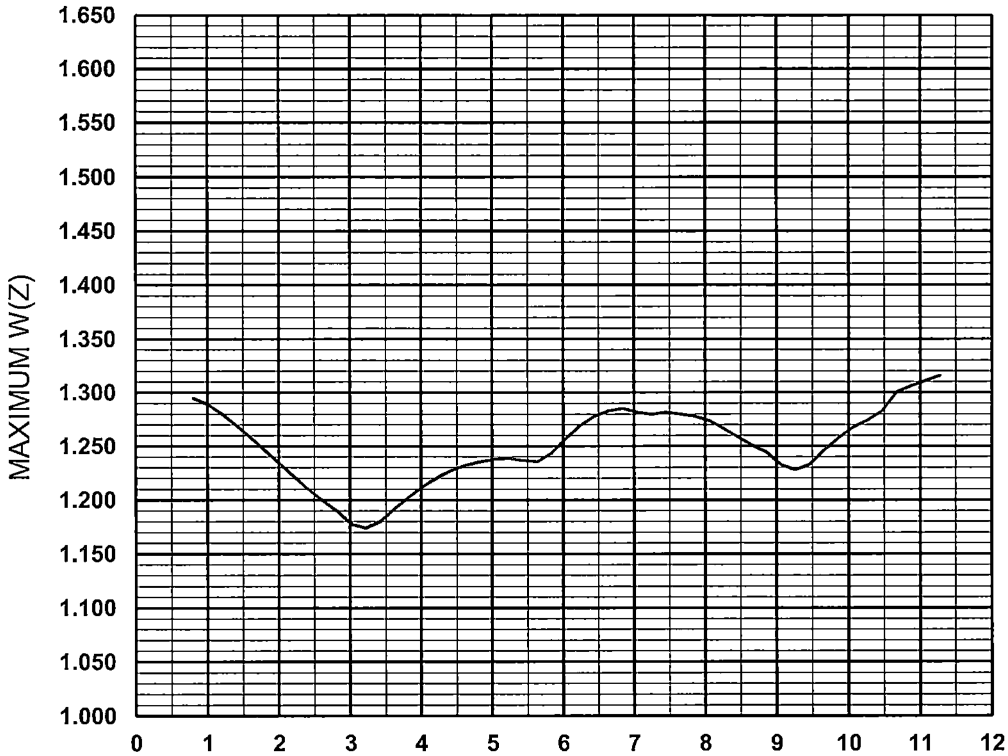


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2070	30	1.1882	16	1.1762
57	1.3130	43	1.2132	29	1.1839	15	1.1884
56	1.3115	42	1.2201	28	1.1862	14	1.2006
55	1.3083	41	1.2286	27	1.1904	13	1.2138
54	1.3003	40	1.2374	26	1.1931	12	1.2267
53	1.2883	39	1.2429	25	1.1941	11	1.2393
52	1.2742	38	1.2458	24	1.1935	10	1.2516
51	1.2599	37	1.2460	23	1.1916	9	1.2632
50	1.2420	36	1.2435	22	1.1884	8	1.2740
49	1.2261	35	1.2385	21	1.1842	7	1.2839
48	1.2246	34	1.2308	20	1.1789	6	1.2920
47	1.2205	33	1.2207	19	1.1736	5	1.2967
46	1.2179	32	1.2107	18	1.1704	1 - 4	---
45	1.2128	31	1.1991	17	1.1705		

Core Height (ft) = (Node - 1) * 0.2013236

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	1.2509	30	1.2435	16	1.1774
57	1.3159	43	1.2585	29	1.2356	15	1.1896
56	1.3109	42	1.2666	28	1.2365	14	1.1994
55	1.3062	41	1.2738	27	1.2385	13	1.2097
54	1.3005	40	1.2779	26	1.2379	12	1.2217
53	1.2827	39	1.2798	25	1.2356	11	1.2339
52	1.2742	38	1.2817	24	1.2324	10	1.2459
51	1.2676	37	1.2796	23	1.2274	9	1.2577
50	1.2577	36	1.2817	22	1.2207	8	1.2690
49	1.2462	35	1.2849	21	1.2123	7	1.2798
48	1.2330	34	1.2830	20	1.2025	6	1.2889
47	1.2278	33	1.2778	19	1.1916	5	1.2948
46	1.2325	32	1.2692	18	1.1800	1 - 4	---
45	1.2442	31	1.2571	17	1.1741		

Core Height (ft) = (Node - 1) * 0.2013236

FIGURE 9

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF
RATED THERMAL POWER