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U. S. Nuclear Regulatory Commission
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SUBJECT: COMANCHE PEAK NUCLEAR POWER PLANT (CPNPP)
DOCKET NO. 50-445
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 19. 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.

Should you have any questions, please contact Mr. J. D. Seawright at (254) 897-0140.

Sincerely,

Luminant Generation Company LLC

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A001
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Enclosure to TXX-16071

Unit 1 Cycle 19
Core Operating Limits Report

ERX-16-001, Rev. 0

CPNPP UNIT 1 CYCLE 19

CORE OPERATING LIMITS REPORT

April 2016

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1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for CPNPP UNIT 1 CYCLE 19 has been prepared in accordance with the requirements of Technical Specification 5.6.5.

The Technical Specifications affected by this report are listed below:

SLs 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) (SLs 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% $\Delta k/k$ 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 <u>NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR ($F^N_{\Delta H}$)</u> (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 <u>AXIAL FLUX DIFFERENCE (AFD)</u> (LCO 3.2.3)

2.10.1 The AFD Acceptable Operation Limits are provided in Figure 9.

2.11 <u>REACTOR TRIP SYSTEM (RTS) INSTRUMENTATION</u> (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 <u>RCS PRESSURE, TEMPERATURE, AND FLOW DEPARTURE FROM NUCLEATE BOILING (DNB) LIMITS</u> (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 BORON CONCENTRATION (LCO 3.9.1)

2.13.1 The required refueling boron concentration is ≥ 1779 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)
795	2.00
1010	2.15
1225	2.18
1440	2.02
1655	2.00
3160	2.00
3375	2.01
3589	2.27
3804	2.18
4019	2.06
4234	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

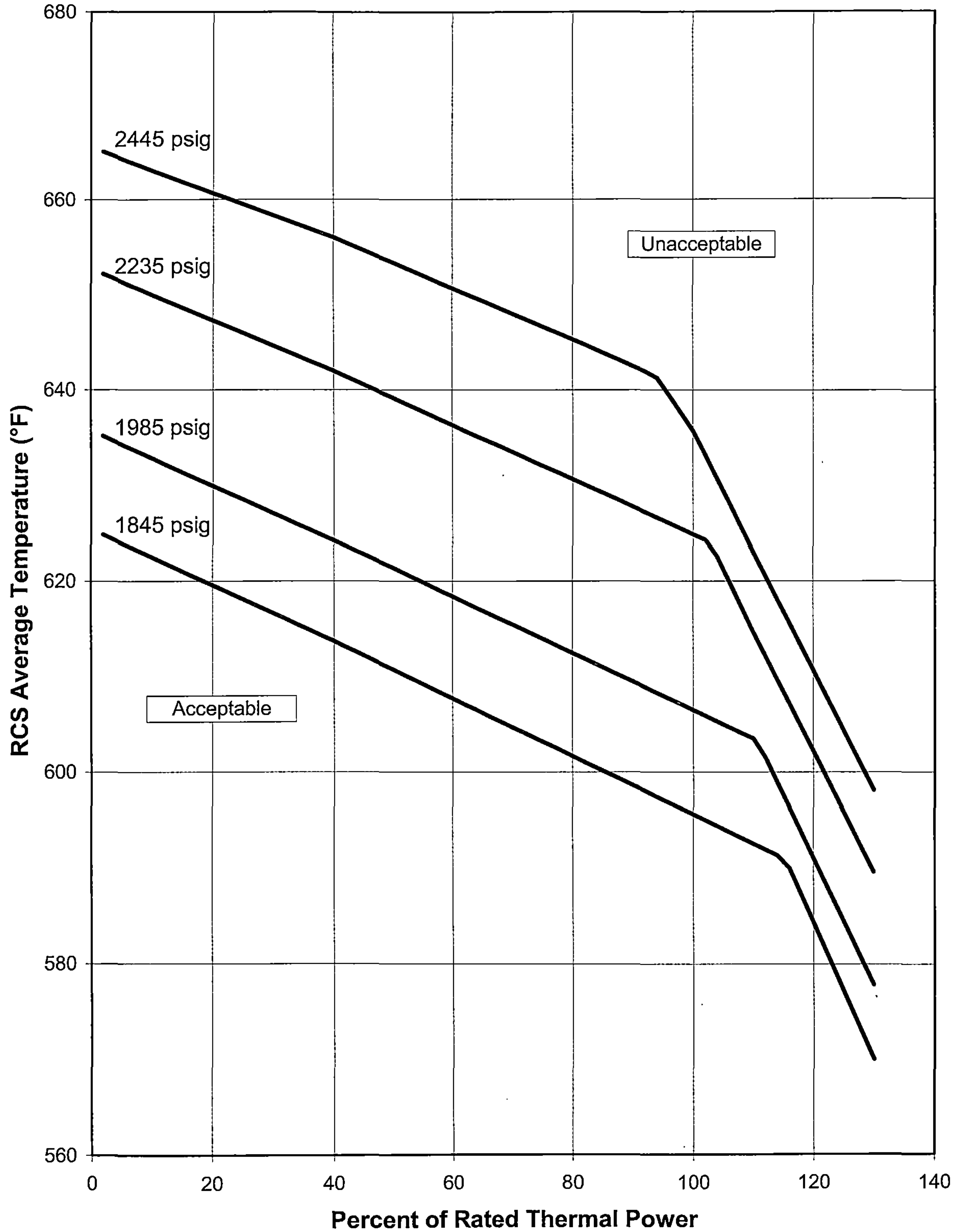
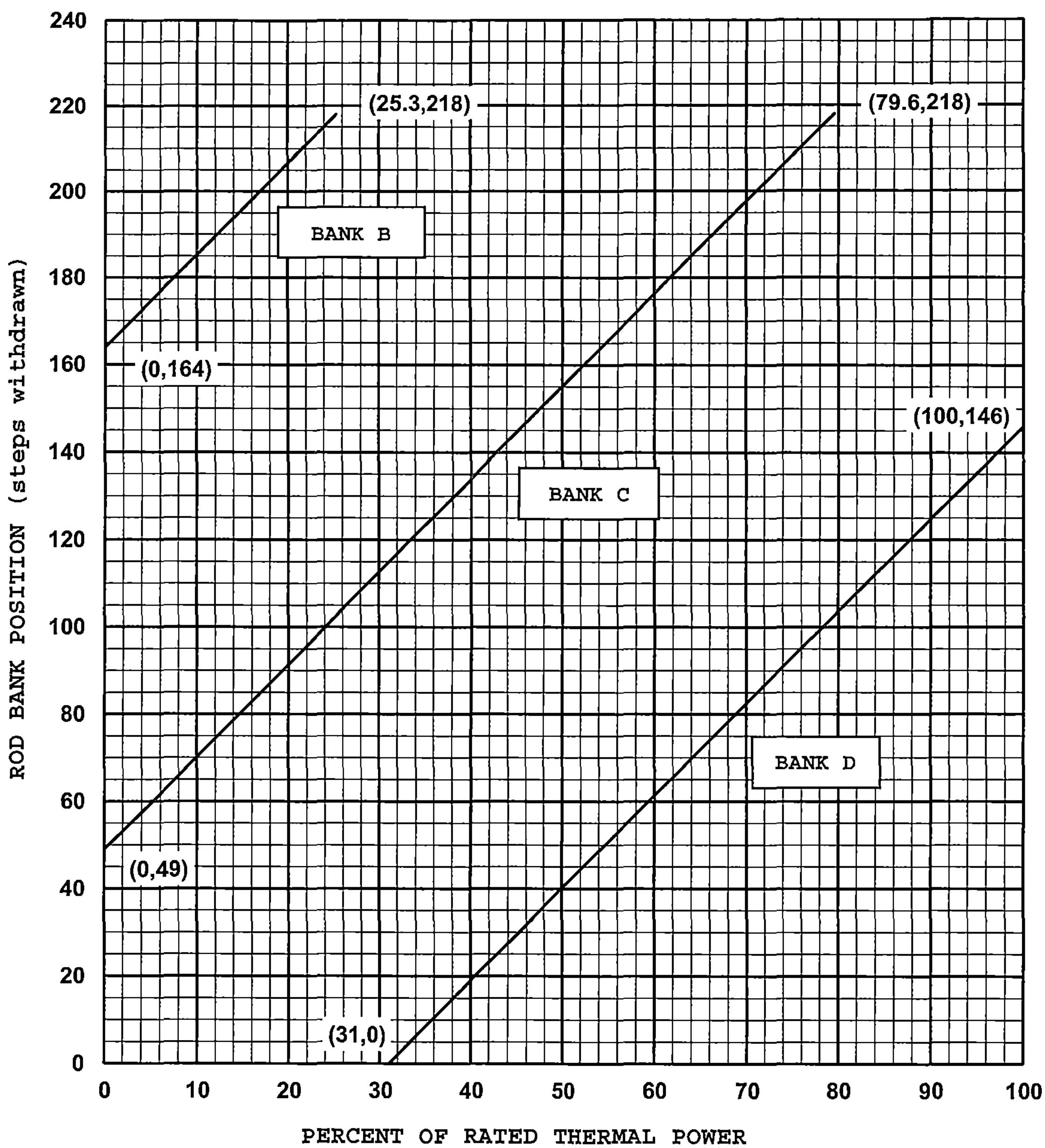


FIGURE 2

ROD BANK INSERTION LIMITS VERSUS THERMAL POWER



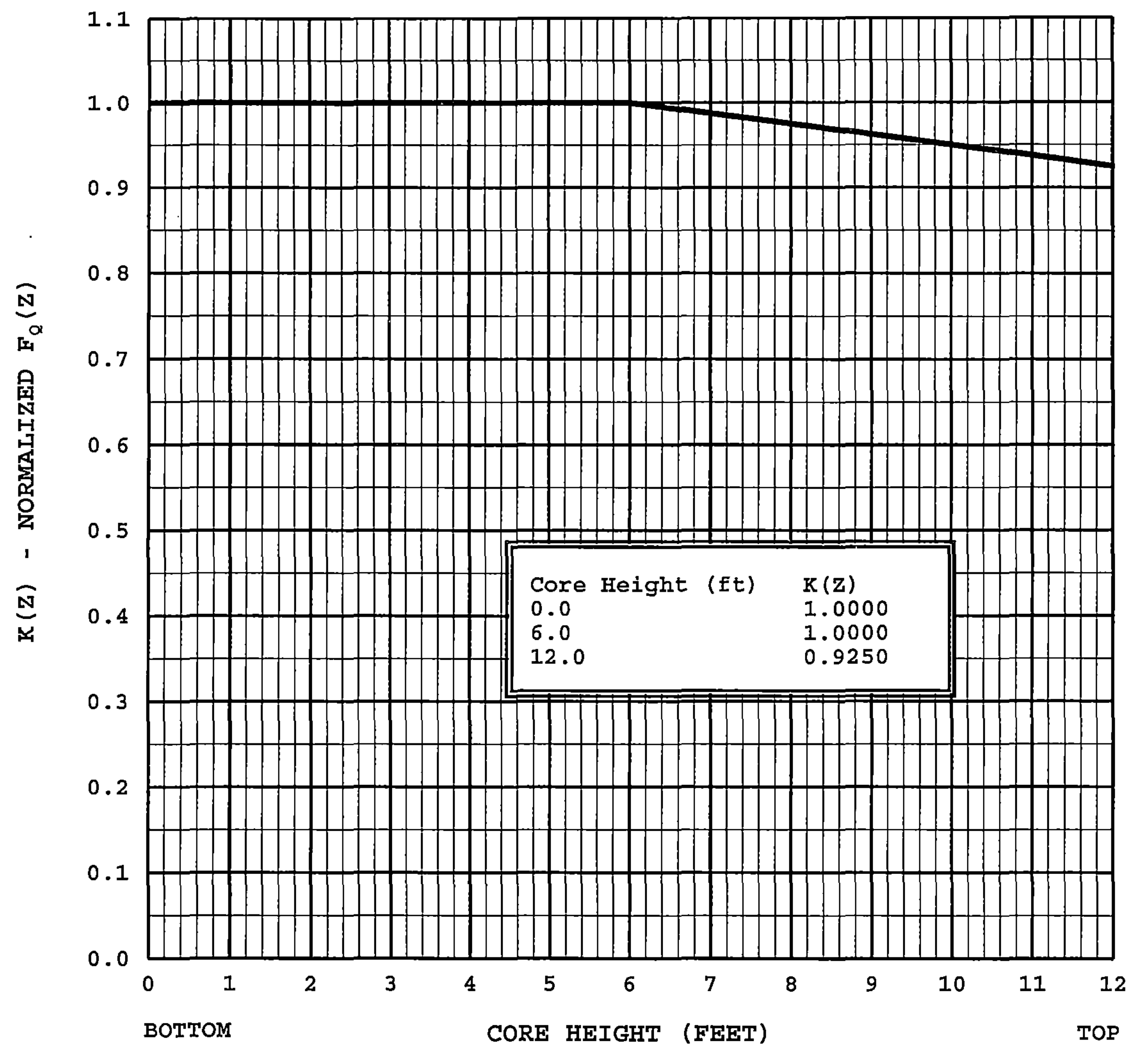
NOTES:

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

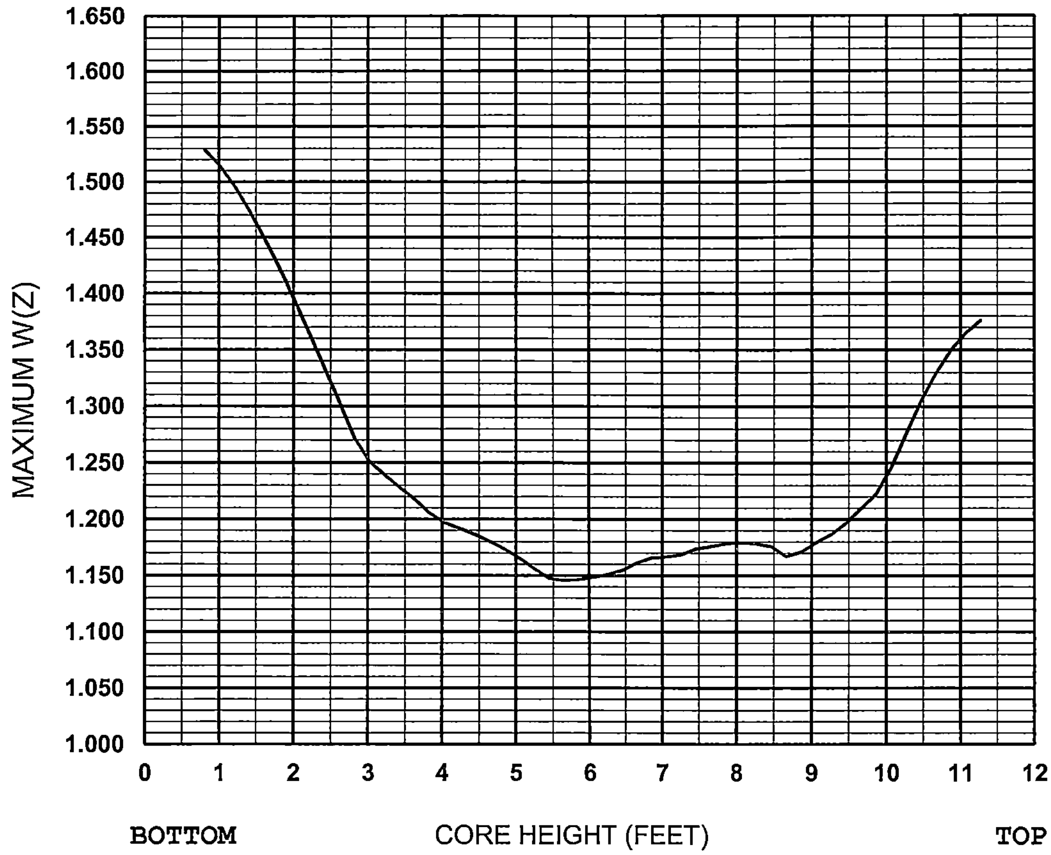
K(Z) - NORMALIZED $F_Q(Z)$ AS A FUNCTION OF CORE HEIGHT



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)

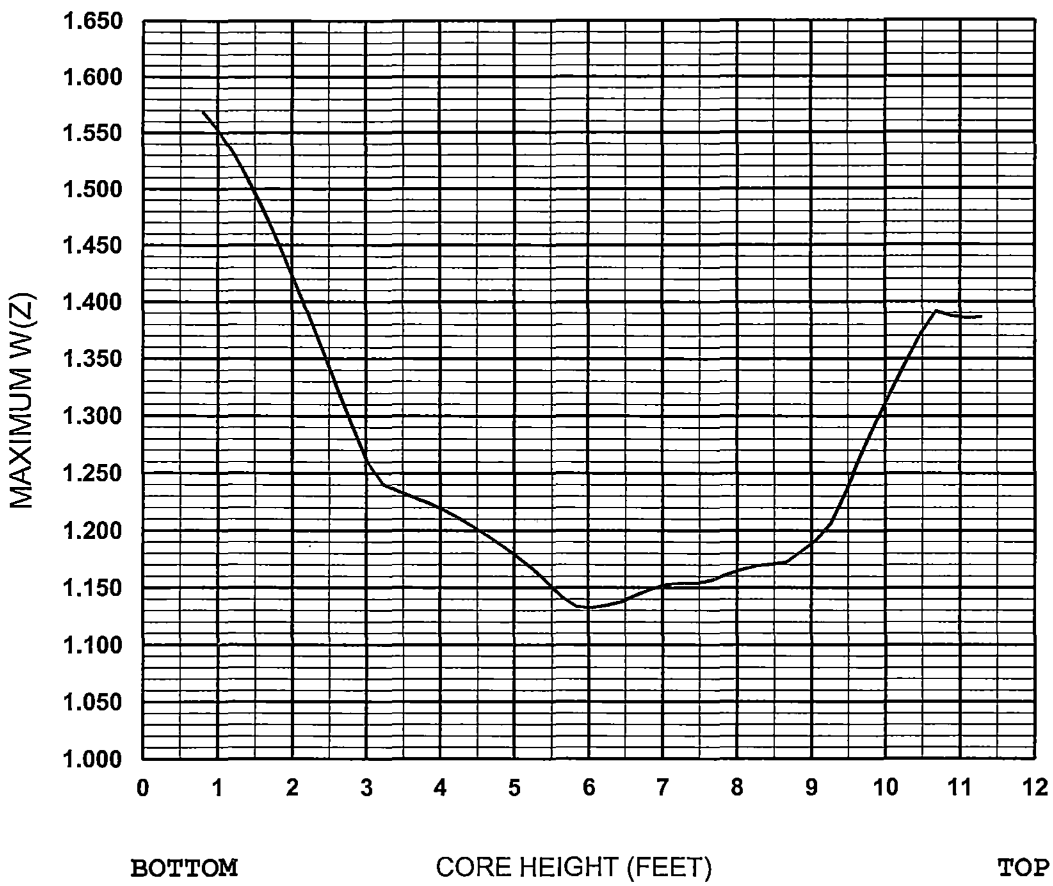


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1674	30	1.1467	16	1.2512
57	1.3763	43	1.1760	29	1.1459	15	1.2720
56	1.3656	42	1.1786	28	1.1478	14	1.3039
55	1.3503	41	1.1795	27	1.1566	13	1.3342
54	1.3302	40	1.1787	26	1.1660	12	1.3644
53	1.3055	39	1.1761	25	1.1737	11	1.3941
52	1.2767	38	1.1737	24	1.1808	10	1.4225
51	1.2464	37	1.1687	23	1.1869	9	1.4494
50	1.2229	36	1.1669	22	1.1921	8	1.4741
49	1.2101	35	1.1658	21	1.1973	7	1.4963
48	1.1969	34	1.1612	20	1.2059	6	1.5151
47	1.1869	33	1.1547	19	1.2180	5	1.5291
46	1.1795	32	1.1508	18	1.2285	1 - 4	---
45	1.1712	31	1.1486	17	1.2395		

Core Height (ft) = (Node - 1) * 0.2013217

FIGURE 5

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

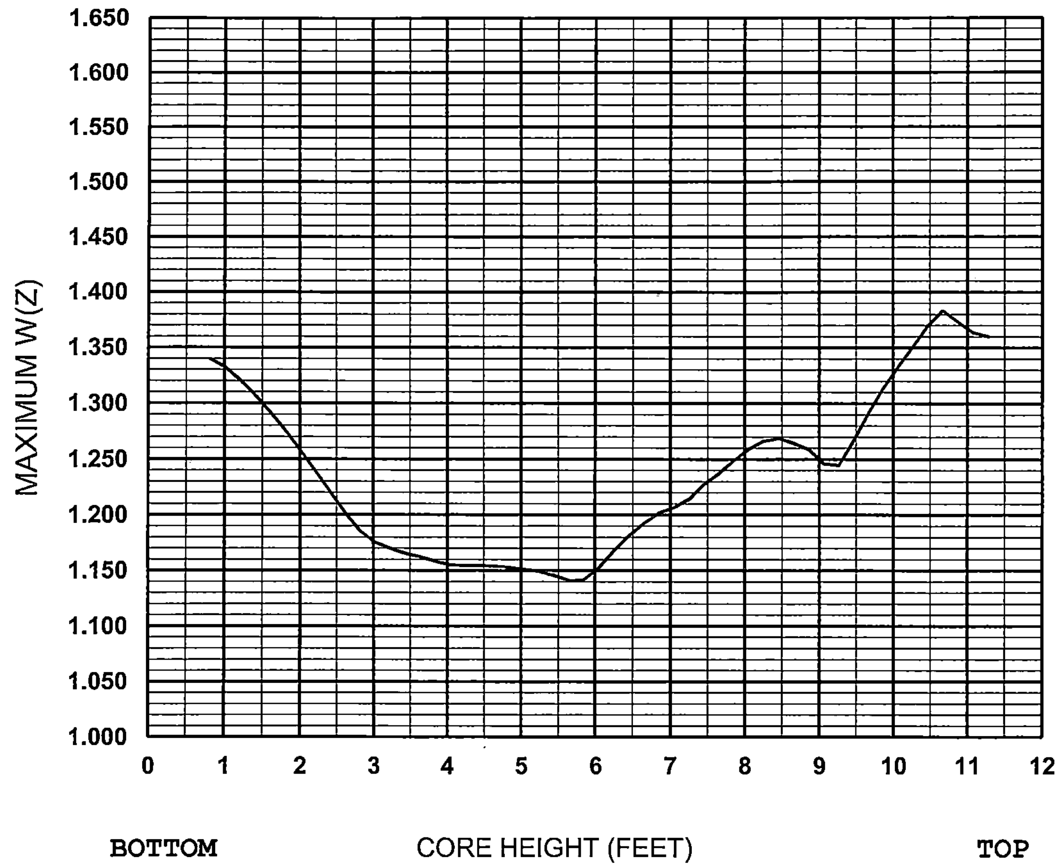


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.1723	30	1.1334	16	1.2598
57	1.3868	43	1.1706	29	1.1416	15	1.2906
56	1.3858	42	1.1692	28	1.1548	14	1.3234
55	1.3878	41	1.1659	27	1.1669	13	1.3563
54	1.3914	40	1.1613	26	1.1776	12	1.3890
53	1.3718	39	1.1567	25	1.1874	11	1.4212
52	1.3465	38	1.1541	24	1.1961	10	1.4521
51	1.3203	37	1.1540	23	1.2039	9	1.4812
50	1.2934	36	1.1527	22	1.2116	8	1.5080
49	1.2648	35	1.1490	21	1.2186	7	1.5320
48	1.2336	34	1.1436	20	1.2244	6	1.5527
47	1.2066	33	1.1376	19	1.2295	5	1.5686
46	1.1917	32	1.1347	18	1.2345	1 - 4	---
45	1.1819	31	1.1324	17	1.2404		

Core Height (ft) = (Node - 1) * 0.2013217

FIGURE 6

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

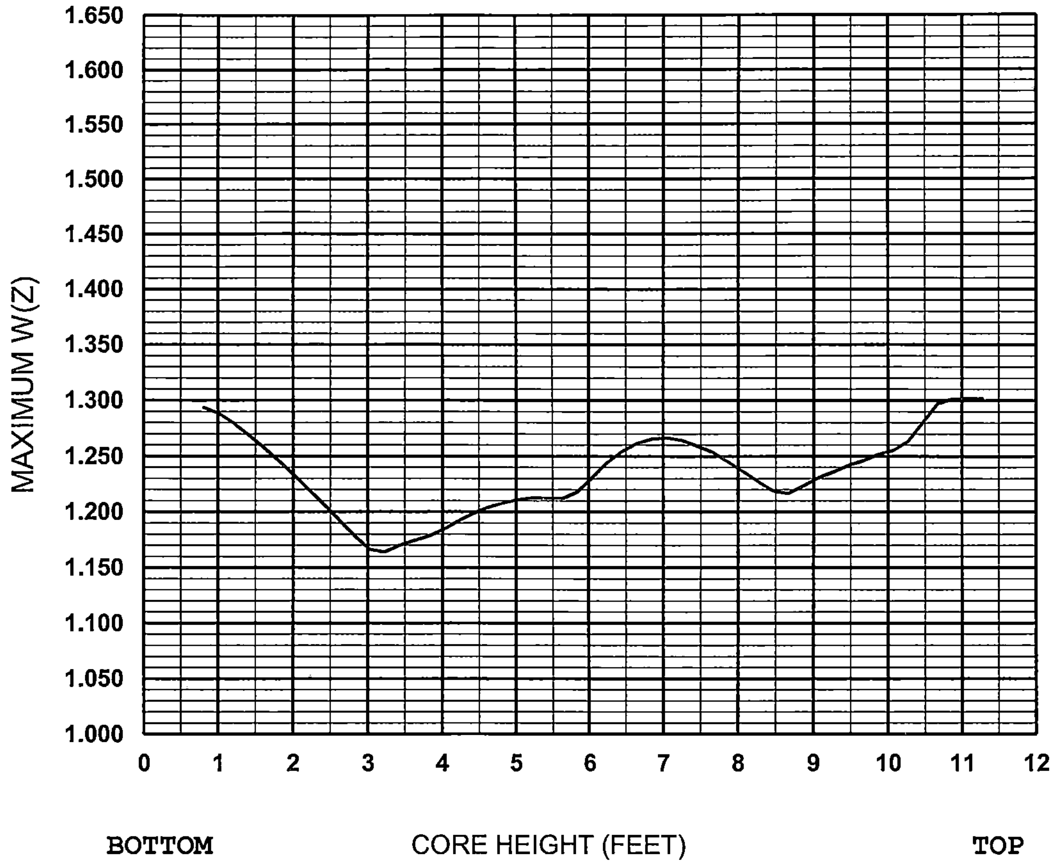


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2645	30	1.1417	16	1.1755
57	1.3601	43	1.2689	29	1.1410	15	1.1854
56	1.3638	42	1.2663	28	1.1458	14	1.2012
55	1.3731	41	1.2592	27	1.1494	13	1.2200
54	1.3835	40	1.2490	26	1.1513	12	1.2388
53	1.3701	39	1.2375	25	1.1528	11	1.2570
52	1.3513	38	1.2275	24	1.1541	10	1.2747
51	1.3334	37	1.2144	23	1.1547	9	1.2914
50	1.3142	36	1.2069	22	1.1543	8	1.3067
49	1.2918	35	1.2019	21	1.1553	7	1.3205
48	1.2668	34	1.1926	20	1.1588	6	1.3321
47	1.2448	33	1.1812	19	1.1626	5	1.3398
46	1.2462	32	1.1676	18	1.1656	1 - 4	---
45	1.2588	31	1.1522	17	1.1699		

Core Height (ft) = (Node - 1) * 0.2013217

FIGURE 7

W(Z) AS A FUNCTION OF CORE HEIGHT
(16,000 MWD/MTU)

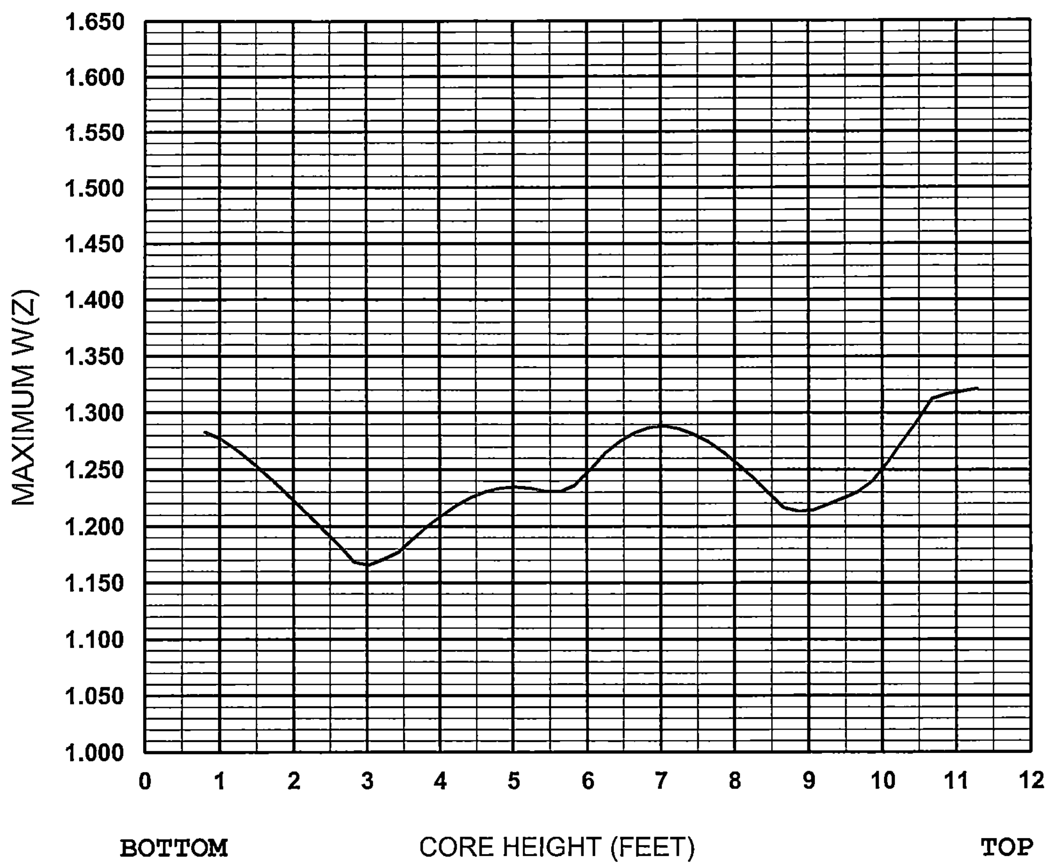


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
58 - 61	---	44	1.2166	30	1.2181	16	1.1666
57	1.3016	43	1.2191	29	1.2123	15	1.1787
56	1.3021	42	1.2280	28	1.2123	14	1.1928
55	1.3014	41	1.2370	27	1.2129	13	1.2064
54	1.2975	40	1.2457	26	1.2112	12	1.2198
53	1.2804	39	1.2540	25	1.2082	11	1.2329
52	1.2635	38	1.2594	24	1.2045	10	1.2457
51	1.2555	37	1.2644	23	1.1993	9	1.2578
50	1.2516	36	1.2668	22	1.1924	8	1.2691
49	1.2463	35	1.2656	21	1.1849	7	1.2796
48	1.2419	34	1.2614	20	1.1787	6	1.2883
47	1.2359	33	1.2542	19	1.1744	5	1.2936
46	1.2307	32	1.2444	18	1.1701	1 - 4	---
45	1.2234	31	1.2309	17	1.1639		

Core Height (ft) = (Node - 1) * 0.2013217

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	1.2165	30	1.2363	16	1.1656
57	1.3214	43	1.2292	29	1.2306	15	1.1686
56	1.3191	42	1.2426	28	1.2307	14	1.1837
55	1.3168	41	1.2542	27	1.2335	13	1.1966
54	1.3126	40	1.2650	26	1.2350	12	1.2094
53	1.2928	39	1.2746	25	1.2339	11	1.2222
52	1.2745	38	1.2810	24	1.2307	10	1.2346
51	1.2560	37	1.2862	23	1.2255	9	1.2465
50	1.2399	36	1.2886	22	1.2184	8	1.2579
49	1.2304	35	1.2872	21	1.2097	7	1.2684
48	1.2246	34	1.2826	20	1.1999	6	1.2774
47	1.2196	33	1.2748	19	1.1886	5	1.2829
46	1.2145	32	1.2642	18	1.1767	1 - 4	---
45	1.2132	31	1.2496	17	1.1709		

Core Height (ft) = (Node - 1) * 0.2013217

FIGURE 9

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF
RATED THERMAL POWER