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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)
DOCKET NO. 50-446
THE UNIT 1, CYCLE 9 CORE OPERATING LIMITS REPORT

Gentlemen:

Enclosed is the Core Operating Limits Report for Unit 1, Cycle 9 prepared and submitted pursuant to Technical Specification 5.6.5.

D029

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This communication contains no new licensing basis commitments regarding CPSES Units 1 and 2.

Sincerely,

C. L. Terry

By: Roger D. Walker
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Enclosure

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ERX-2001-003, R0

CPSES UNIT 1 CYCLE 9

CORE OPERATING LIMITS REPORT

March 2001

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This Core Operating Limits Report (COLR) for CPSES UNIT 1 CYCLE 9 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
LCO 3.1.1	SHUTDOWN MARGIN
LCO 3.1.3	MODERATOR TEMPERATURE COEFFICIENT
LCO 3.1.4	ROD GROUP ALIGNMENT LIMITS
LCO 3.1.5	SHUTDOWN BANK INSERTION LIMITS
LCO 3.1.6	CONTROL BANK INSERTION LIMITS
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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 5 and 9 through 19. These limits have been determined such that all applicable limits of the safety analysis are met.

2.1 SAFETY LIMITS (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 222 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 $F_Q(Z) \leq \frac{F_Q^{RTP}}{P} [K(Z)]$ for $P > 0.5$

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

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

2.8.2 $F_Q^{RTP} = 2.42$

2.8.3 K(Z) is provided in Figure 3.

2.8.4 Maximum elevation dependent W(Z) values are given in Figure 4. Figures 5, 6, and 7 give burnup dependent values for W(Z). Figures 5, 6, and 7 can be used in place of Figure 4 to interpolate or extrapolate (via a three point fit) the W(Z) at a particular burnup.

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 $[\ F_Q^C(Z)\ /\ K(Z)\ ]$

$F_Q^W(Z)$ shall be increased by a factor of 1.02. This requirement is for all cycle burnups.

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 $F^{RTP}_{\Delta H} = 1.55$

2.9.3 $PF_{\Delta H} = 0.3$

2.10 AXIAL FLUX DIFFERENCE (AFD) (LCO 3.2.3)

2.10.1 The AFD target band is +5%, -12% at 100% RTP linearly expanding to +20%, -17% at 50% RTP. Below 50% RTP, the AFD target band remains constant at +20%, -17%.

2.10.2 The AFD Acceptable Operation Limits are provided in Figure 8.

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 = 1.150

K_2 = 0.0139 /°F

K_3 = 0.00071 /psig

T_c^o = 559.8 °F

$P^1 \geq$ 2235 psig

$T_1 \geq$ 10 sec

$T_2 \leq$ 3 sec

$f_1(\Delta q) = 0.00 \cdot \{(q_t-q_b) + 65\%\}$ when $(q_t-q_b) \leq -65\%$ RTP

$= 0\%$ when -65% RTP $< (q_t-q_b) < +6.5\%$ RTP

$= 1.95 \cdot \{(q_t-q_b) - 6.5\%\}$ when $(q_t-q_b) \geq +6.5\%$ 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)
	≤	592 °F	(3 channels)

The RCS average temperature limits correspond to the analytical limit of 595.7 °F 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 based on precision heat balance shall be ≥ 397,200 gpm

2.12.5 SR 3.4.1.4

The RCS total flow rate based on precision heat balance shall be ≥ 397,200 gpm

The required RCS flow, based on an elbow tap differential pressure measurement prior to MODE 1 after the refueling outage, shall be greater than 317,000 gpm.

2.13 BORON CONCENTRATION (LCO 3.9.1)

2.13.1 The required refueling boron concentration is 2208 ppm.

FIGURE 1

REACTOR CORE SAFETY LIMITS

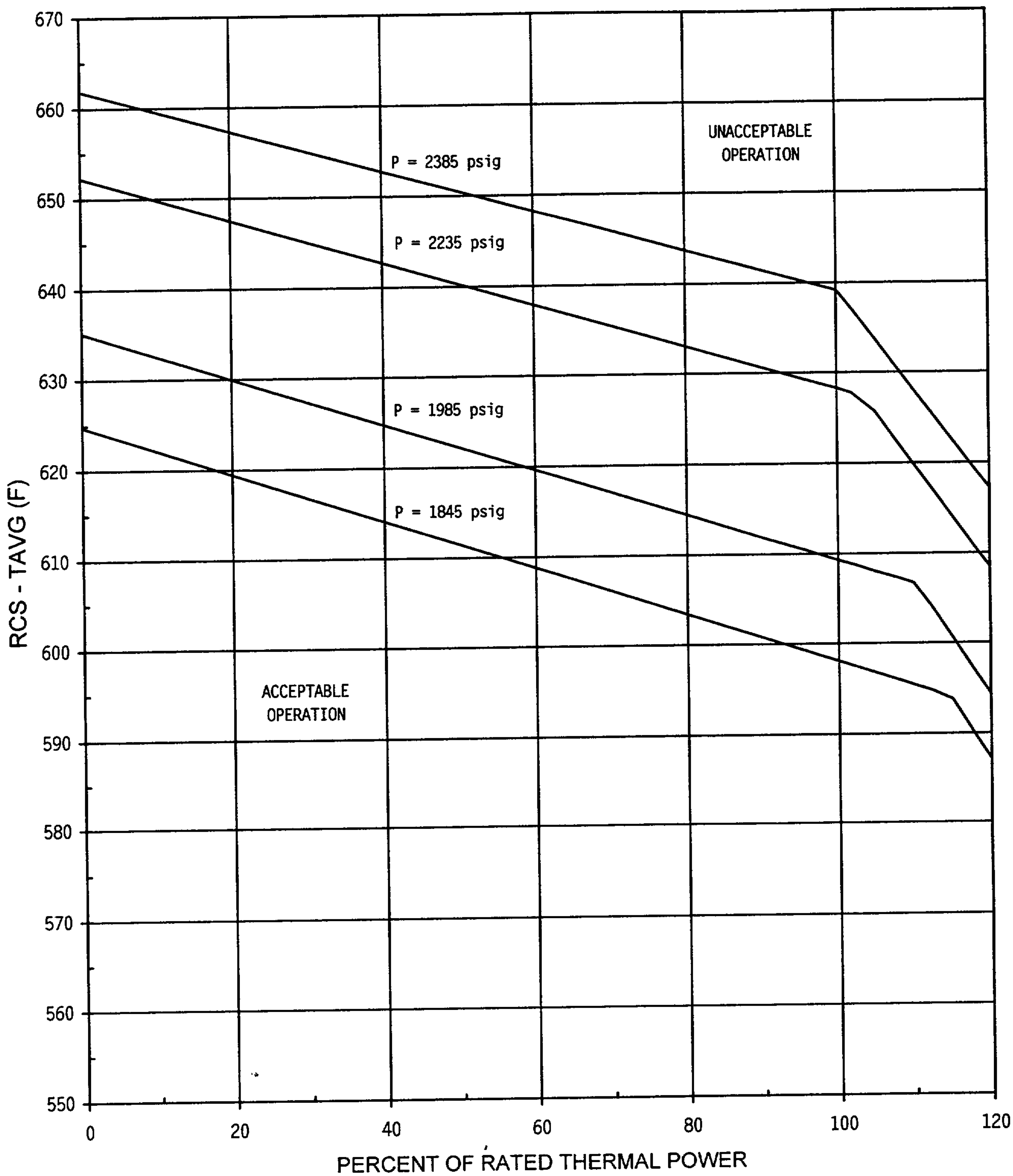
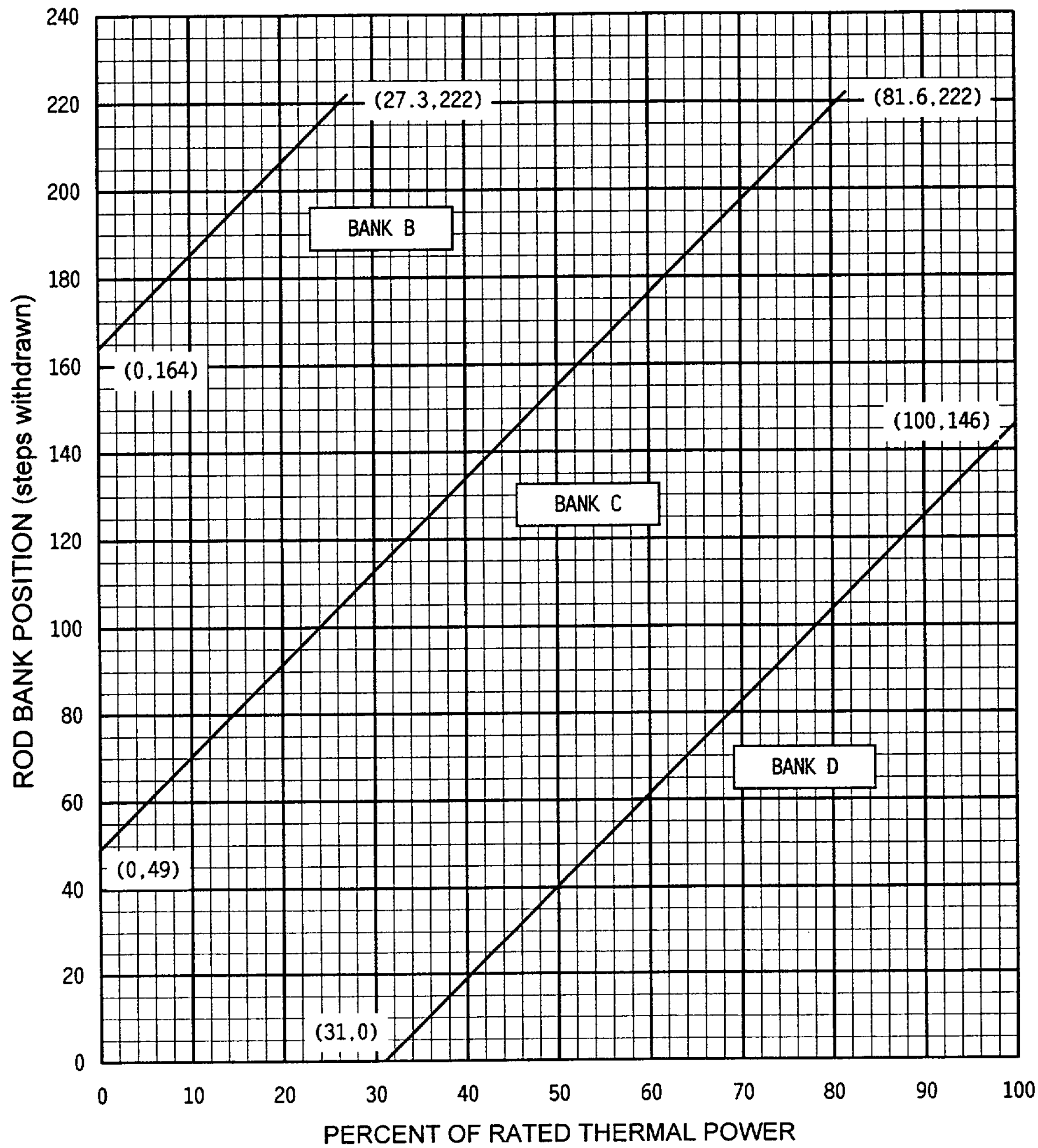


FIGURE 2

ROD BANK INSERTION LIMITS VERSUS THERMAL POWER



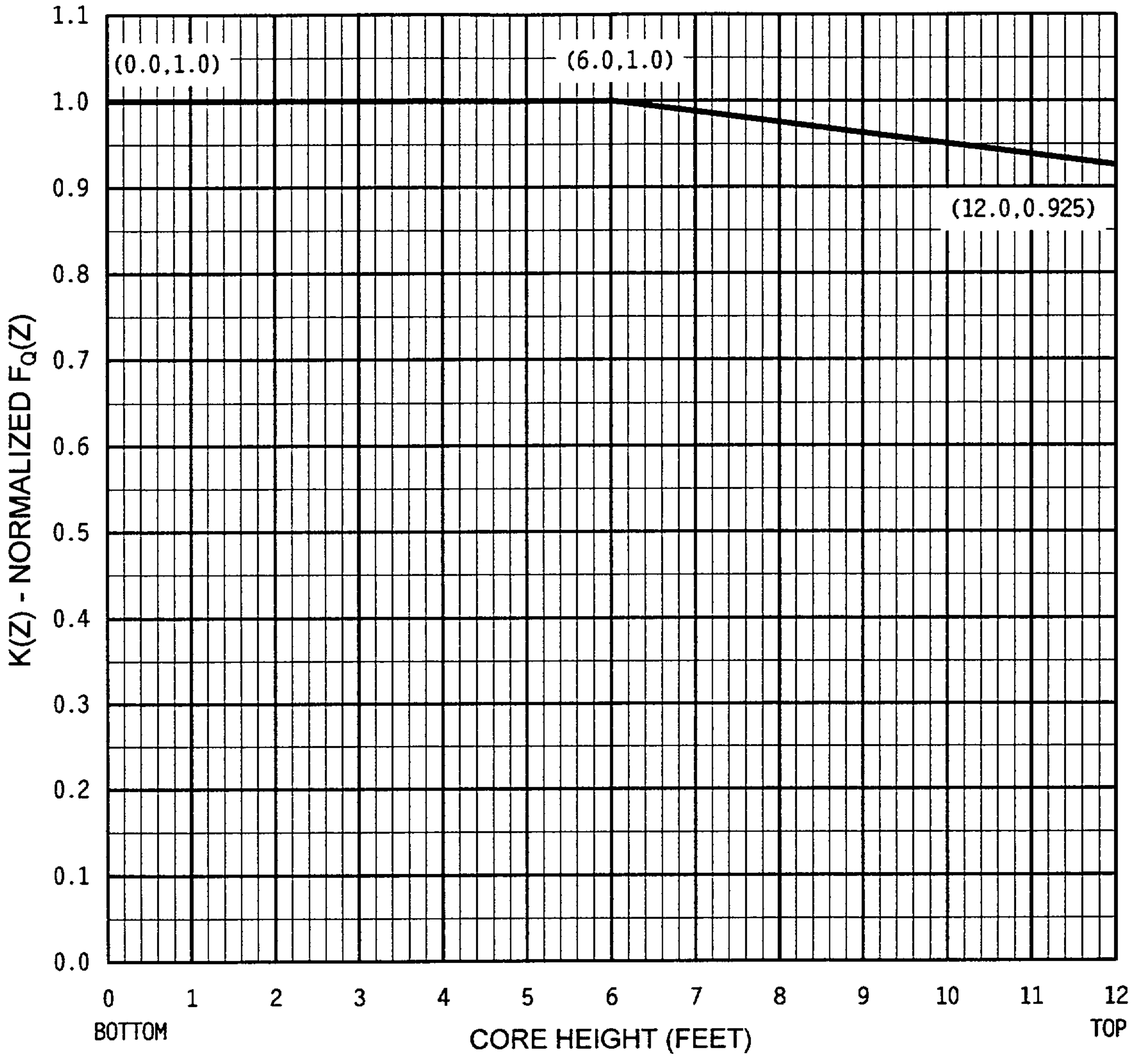
NOTES:

1. Fully withdrawn shall be the condition where control rods are at a position within the interval of 222 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

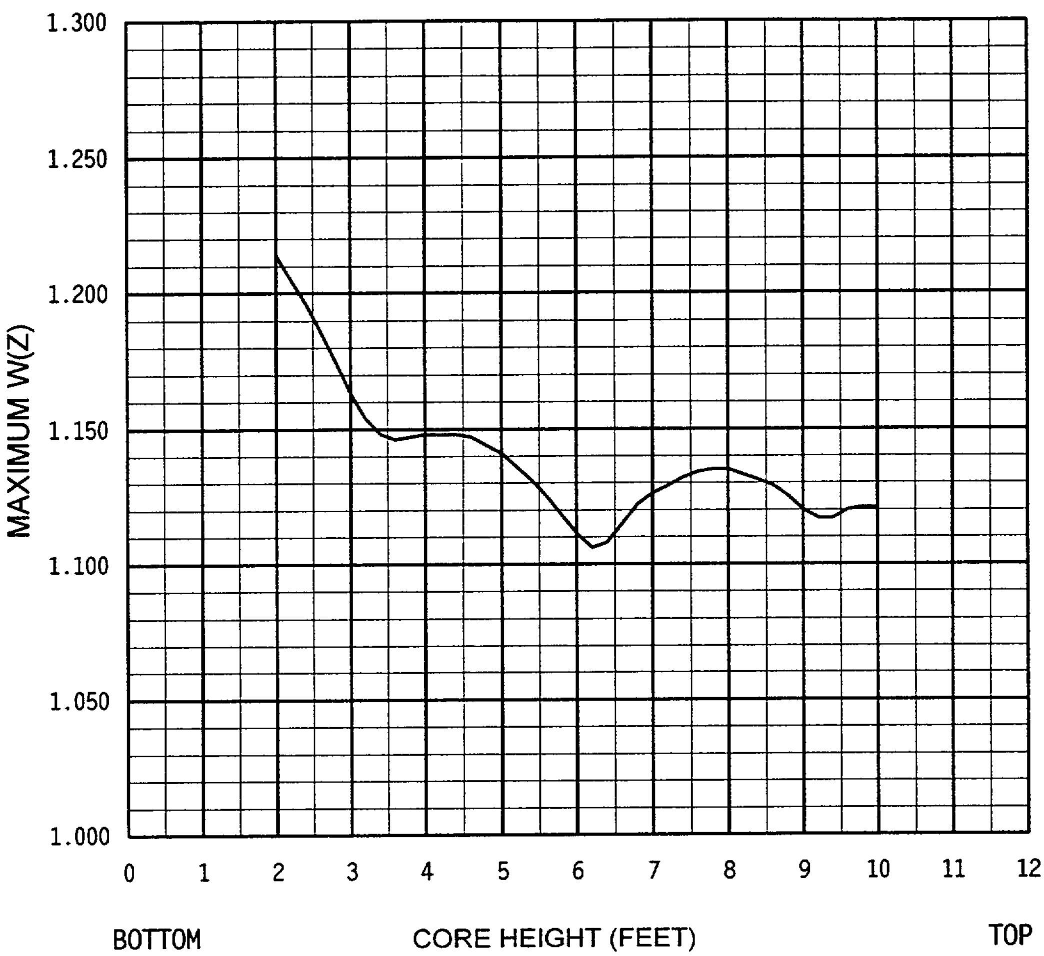


Axial Node	K(Z)	Axial Node	K(Z)	Axial Node	K(Z)	Axial Node	K(Z)
61	0.9250	53	0.9450	45	0.9650	37	0.9850
60	0.9275	52	0.9475	44	0.9675	36	0.9875
59	0.9300	51	0.9500	43	0.9700	35	0.9900
58	0.9325	50	0.9525	42	0.9725	34	0.9925
57	0.9350	49	0.9550	41	0.9750	33	0.9950
56	0.9375	48	0.9575	40	0.9775	32	0.9975
55	0.9400	47	0.9600	39	0.9800	1 - 31	1.0000
54	0.9425	46	0.9625	38	0.9825		

Core Height (ft) = (Node - 1) * 0.2

FIGURE 4

W(Z) AS A FUNCTION OF CORE HEIGHT
(MAXIMUM)

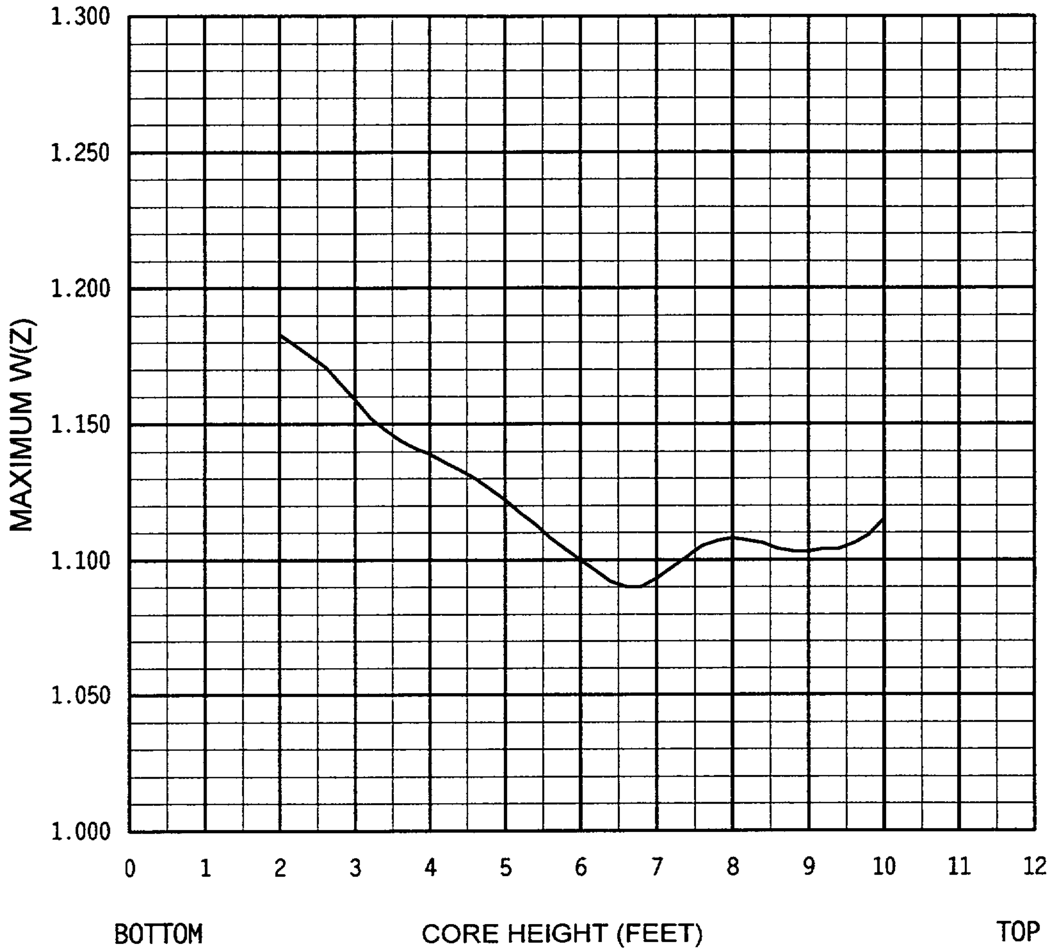


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
52 - 61	---	41	1.135	30	1.118	19	1.146
51	1.121	40	1.135	29	1.125	18	1.148
50	1.121	39	1.134	28	1.131	17	1.154
49	1.120	38	1.132	27	1.136	16	1.163
48	1.117	37	1.129	26	1.141	15	1.175
47	1.117	36	1.126	25	1.144	14	1.186
46	1.120	35	1.122	24	1.147	13	1.196
45	1.125	34	1.115	23	1.148	12	1.205
44	1.129	33	1.108	22	1.148	11	1.214
43	1.131	32	1.106	21	1.148	1 - 10	---
42	1.133	31	1.111	20	1.147		

Core Height (ft) = (Node - 1) * 0.2

FIGURE 5

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

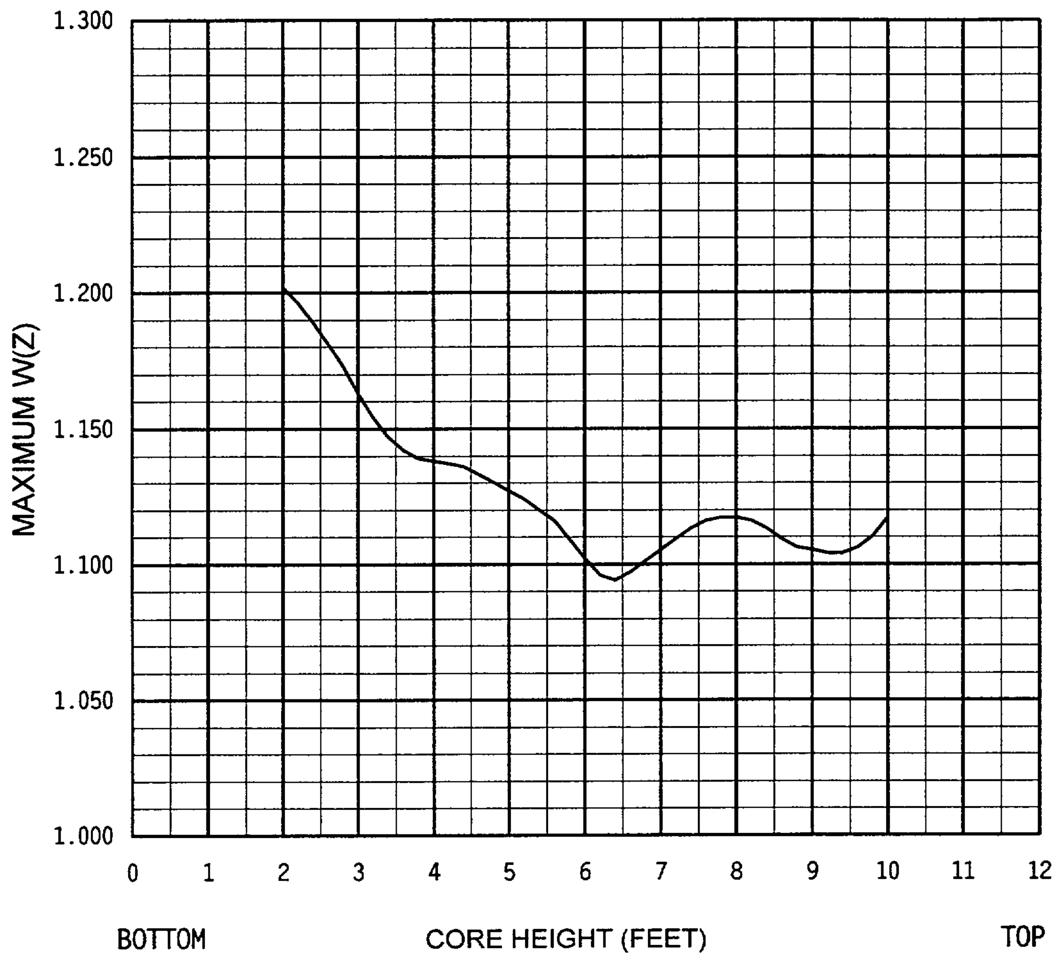


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
52 - 61	---	41	1.108	30	1.104	19	1.144
51	1.115	40	1.107	29	1.108	18	1.148
50	1.109	39	1.105	28	1.113	17	1.152
49	1.106	38	1.101	27	1.117	16	1.159
48	1.104	37	1.097	26	1.122	15	1.165
47	1.104	36	1.093	25	1.126	14	1.171
46	1.103	35	1.090	24	1.130	13	1.175
45	1.103	34	1.090	23	1.133	12	1.179
44	1.104	33	1.092	22	1.136	11	1.183
43	1.106	32	1.096	21	1.139	1 - 10	---
42	1.107	31	1.100	20	1.141		

Core Height (ft) = (Node - 1) * 0.2

FIGURE 6

W(Z) AS A FUNCTION OF CORE HEIGHT
(10,000 MWD/MTU)

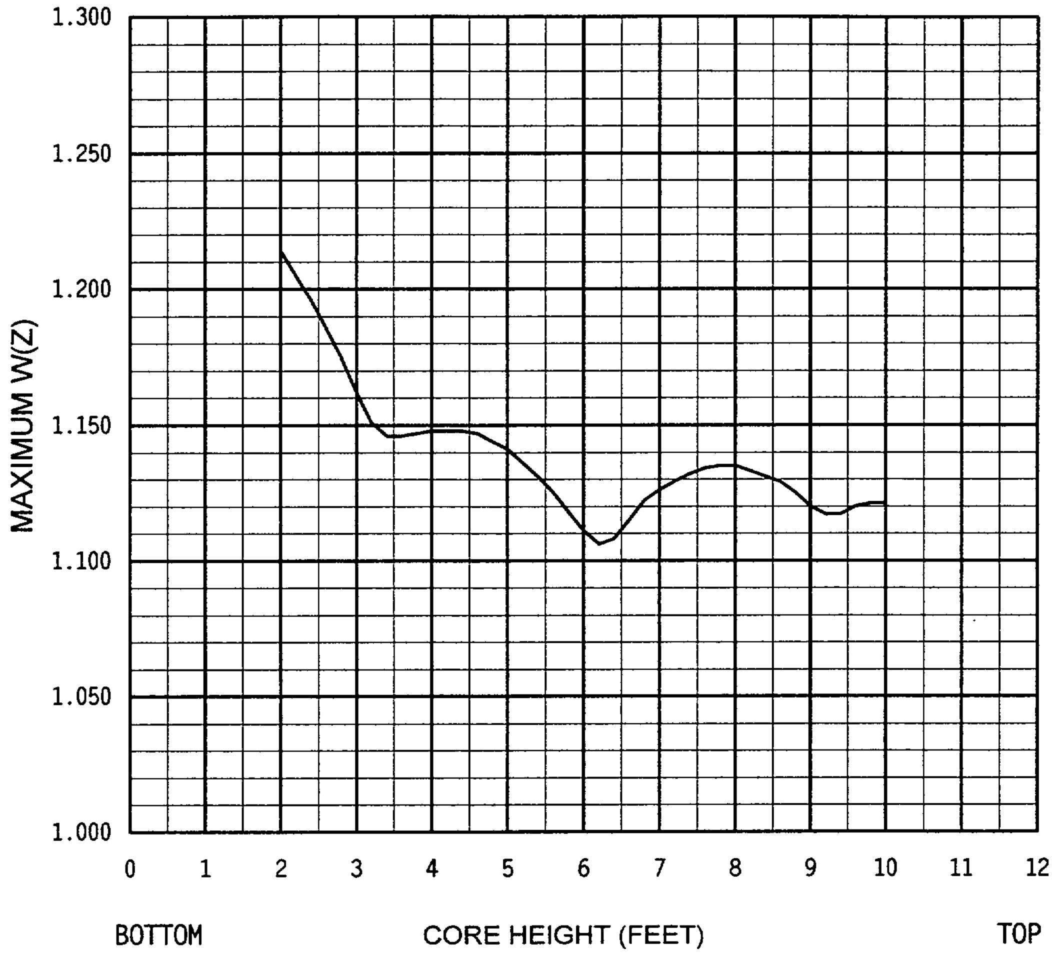


Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)	Axial Node	W(Z)
52 - 61	---	41	1.117	30	1.109	19	1.142
51	1.117	40	1.117	29	1.116	18	1.147
50	1.110	39	1.116	28	1.120	17	1.154
49	1.106	38	1.113	27	1.124	16	1.163
48	1.104	37	1.109	26	1.127	15	1.173
47	1.104	36	1.105	25	1.130	14	1.181
46	1.105	35	1.101	24	1.133	13	1.189
45	1.106	34	1.097	23	1.136	12	1.196
44	1.109	33	1.094	22	1.137	11	1.202
43	1.113	32	1.096	21	1.138	1 - 10	---
42	1.116	31	1.102	20	1.139		

Core Height (ft) = (Node - 1) * 0.2

FIGURE 7

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)
52 - 61	---	41	1.135	30	1.118	19	1.146
51	1.121	40	1.135	29	1.125	18	1.146
50	1.121	39	1.134	28	1.131	17	1.151
49	1.120	38	1.132	27	1.136	16	1.162
48	1.117	37	1.129	26	1.141	15	1.175
47	1.117	36	1.126	25	1.144	14	1.186
46	1.120	35	1.122	24	1.147	13	1.196
45	1.125	34	1.115	23	1.148	12	1.205
44	1.129	33	1.108	22	1.148	11	1.214
43	1.131	32	1.106	21	1.148	1 - 10	---
42	1.133	31	1.111	20	1.147		

Core Height (ft) = (Node - 1) * 0.2

FIGURE 8

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF
RATED THERMAL POWER