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Ref: 10CFR50.36

CPSES-200203517
Log # TXX-02183
File # 10010, 916(COLR), RN-48

October 10, 2002

U. S. Nuclear Regulatory Commission
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Washington, DC 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)
DOCKET NO. 50-445
THE UNIT 1, CYCLE 10 CORE OPERATING LIMITS REPORT

Gentlemen:

Enclosed is the Core Operating Limits Report for Unit 1, Cycle 10 prepared and submitted pursuant to Technical Specification 5.6.5.

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

Sincerely,

TXU Generation Company LP
By: TXU Generation Management Company LLC,
Its General Partner

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ERX-02-004, Revision 0

# CPSES UNIT 1 CYCLE 10

# CORE OPERATING LIMITS REPORT

October 2002

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## 1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for CPSES UNIT 1 CYCLE 10 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 |
| LCO 3.1.8 | PHYSICS TESTS EXCEPTIONS - MODE 2 |
| LCO 3.2.1 | HEAT FLUX HOT CHANNEL FACTOR |
| LCO 3.2.2 | NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR |
| LCO 3.2.3 | AXIAL FLUX DIFFERENCE |
| LCO 3.3.1 | REACTOR TRIP SYSTEM INSTRUMENTATION |
| LCO 3.4.1 | RCS PRESSURE, TEMPERATURE, AND FLOW DEPARTURE FROM NUCLEATE BOILING 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 5, 9 through 19, and 21, as supplemented by Item 20. 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 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: $$P = \frac{\text{THERMAL POWER}}{\text{RATED THERMAL POWER}}$$

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

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.a. A constant factor of 2% shall be used at 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 $F^{RTP}_{\Delta H} = 1.55$

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;

$K_1$ = 1.138

$K_2$ = 0.0139 /°F

$K_3$ = 0.00071 /psig

$T_c^o$ = 559.7 °F

$P^1$ ≥ 2235 psig

$T_1$ ≥ 10 sec

$T_2$ ≤ 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 $< (q_t-q_b) < +7.4\%$ RTP

= $2.335 \cdot \{(q_t-q_b) - 7.4\%\}$ when $(q_t-q_b) \geq +7.4\%$ 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 instrument 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 2055 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) |
|---|---|
| 8460 | 2.00 |
| 8670 | 2.06 |
| 8870 | 2.17 |
| 9080 | 2.26 |
| 9290 | 2.30 |
| 9500 | 2.29 |
| 9700 | 2.24 |
| 9910 | 2.24 |
| 10120 | 2.28 |
| 10330 | 2.24 |
| 10540 | 2.10 |
| 10740 | 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 the 3.2.1.2.a Surveillance Requirements. 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

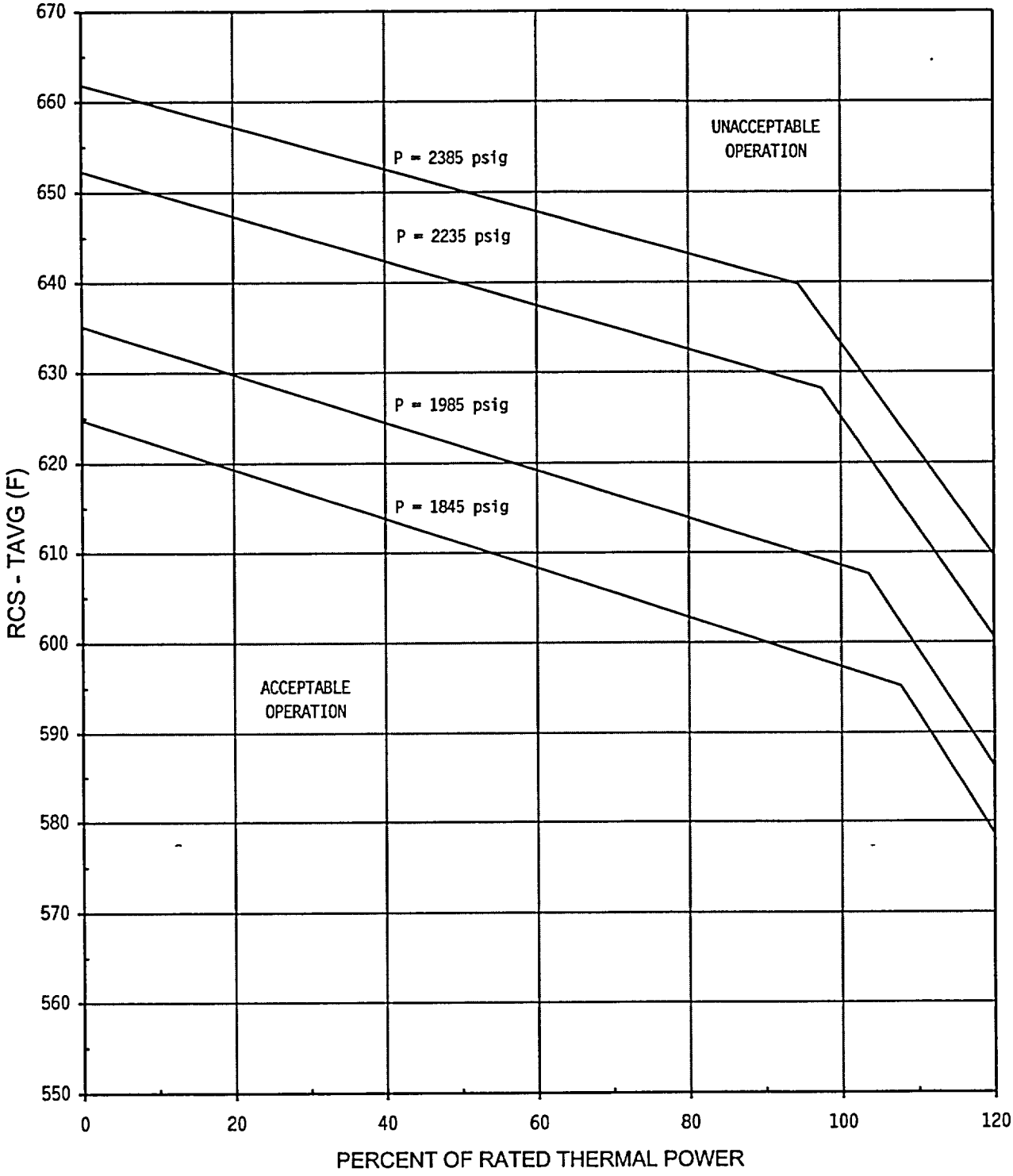
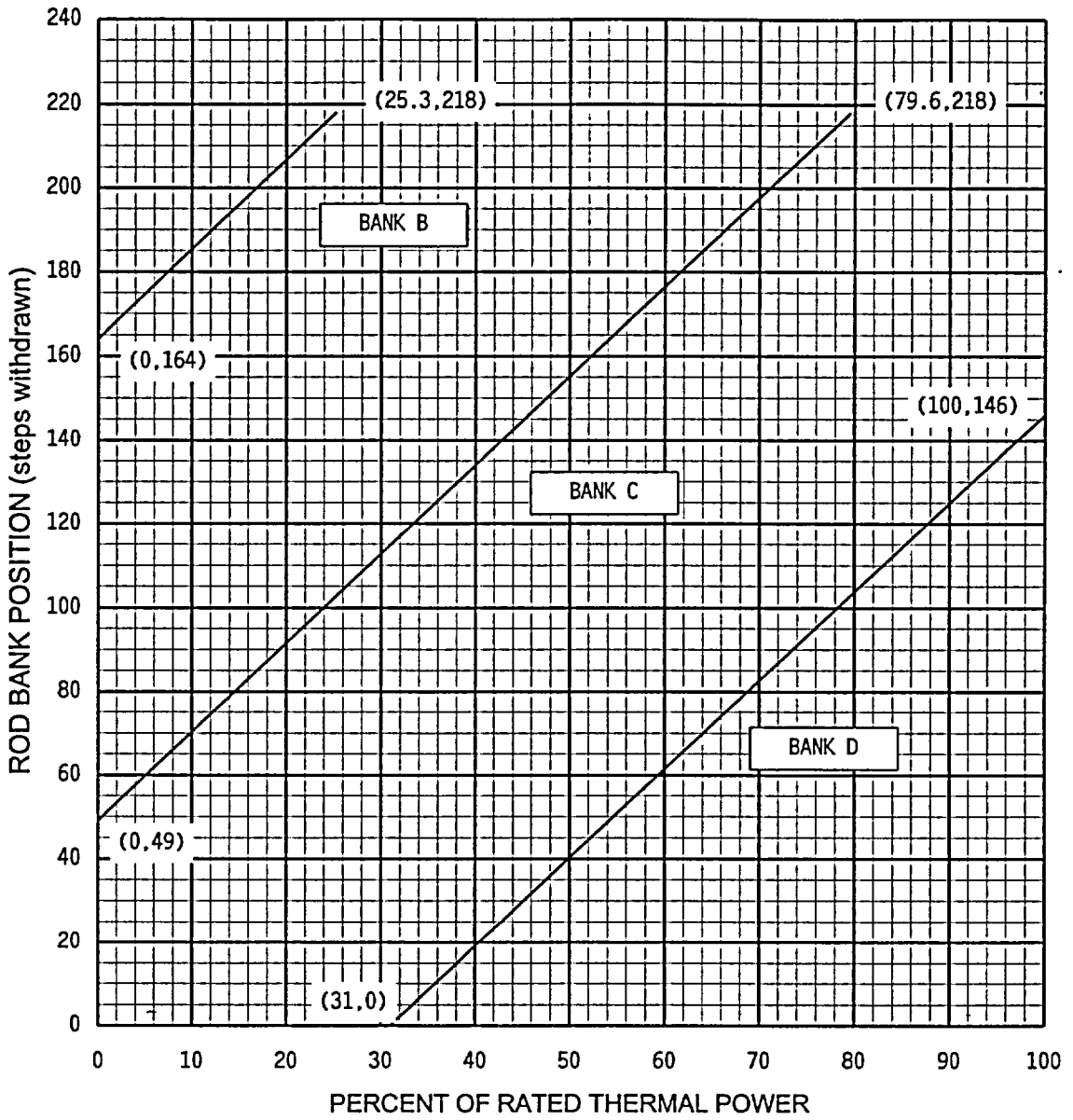


FIGURE 2

ROD BANK INSERTION LIMITS VERSUS THERMAL POWER



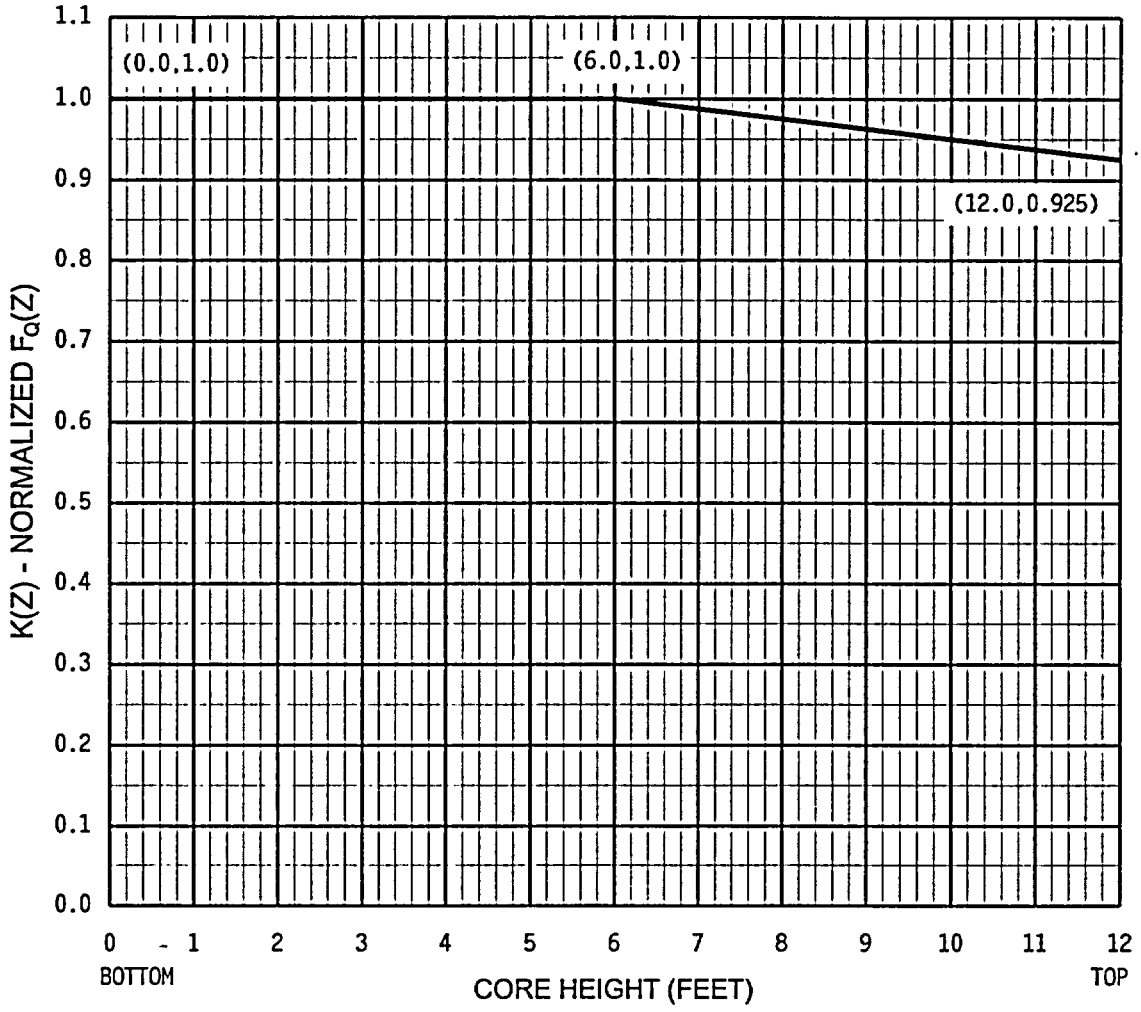

NOTES:

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

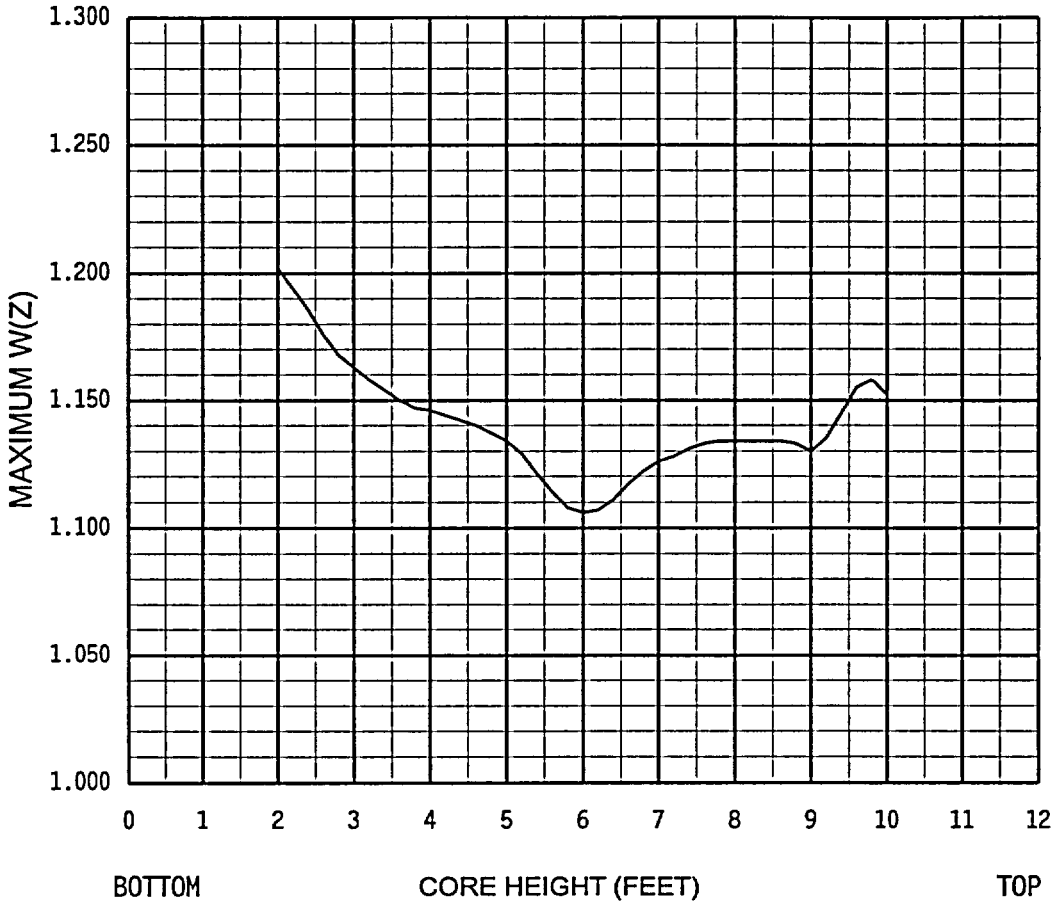



| Axial Node | K(Z) | Axial Node | K(Z) | Axial Node | K(Z) | Axial Node | K(Z) |
|---|---|---|---|---|---|---|---|
| 61 | 0.9250 | 53 | 0.9450 | 45 | 0.9650 | 37 | 0.9850 |
| 60 | 0.9275 | 52 | 0.9475 | 44 | 0.9675 | 36 | 0.9875 |
| 59 | 0.9300 | 51 | 0.9500 | 43 | 0.9700 | 35 | 0.9900 |
| 58 | 0.9325 | 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)



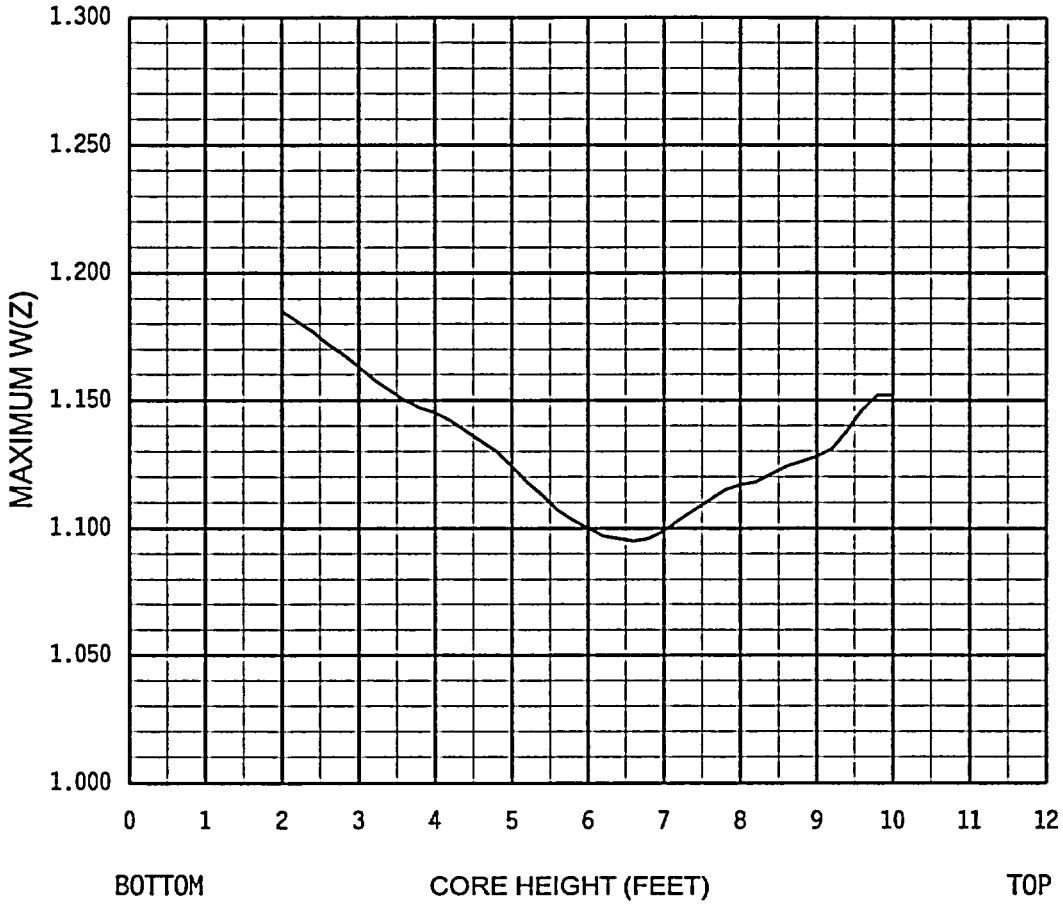

| Axial Node | W(Z) | Axial Node | W(Z) | Axial Node | W(Z) | Axial Node | W(Z) |
|---|---|---|---|---|---|---|---|
| 52 - 61 | --- | 41 | 1.134 | 30 | 1.108 | 19 | 1.150 |
| 51 | 1.152 | 40 | 1.134 | 29 | 1.114 | 18 | 1.154 |
| 50 | 1.158 | 39 | 1.133 | 28 | 1.121 | 17 | 1.158 |
| 49 | 1.155 | 38 | 1.131 | 27 | 1.129 | 16 | 1.163 |
| 48 | 1.145 | 37 | 1.128 | 26 | 1.134 | 15 | 1.168 |
| 47 | 1.135 | 36 | 1.126 | 25 | 1.137 | 14 | 1.176 |
| 46 | 1.130 | 35 | 1.122 | 24 | 1.140 | 13 | 1.186 |
| 45 | 1.133 | 34 | 1.117 | 23 | 1.142 | 12 | 1.194 |
| 44 | 1.134 | 33 | 1.111 | 22 | 1.144 | 11 | 1.202 |
| 43 | 1.134 | 32 | 1.107 | 21 | 1.146 | 1 - 10 | --- |
| 42 | 1.134 | 31 | 1.106 | 20 | 1.147 | | |

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

COLR for CPSES Unit 1 Cycle 10

FIGURE 5

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

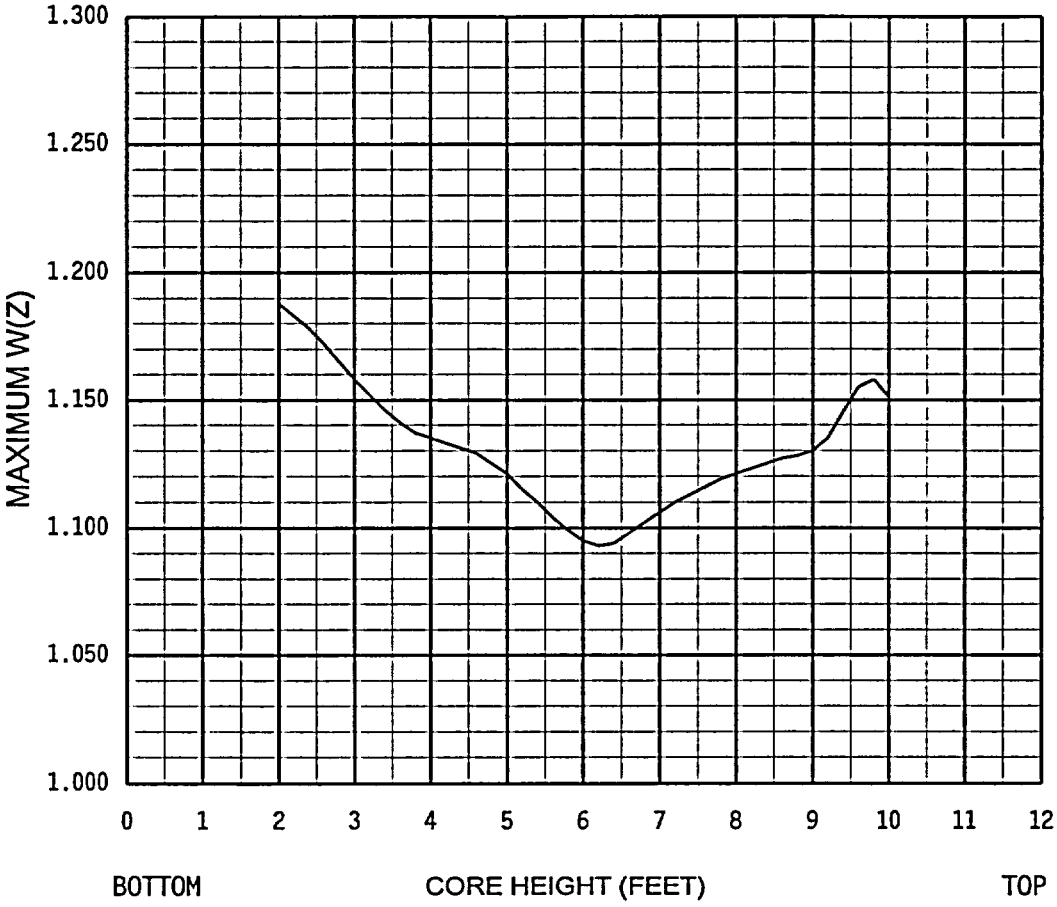



| Axial Node | W(Z) | Axial Node | W(Z) | Axial Node | W(Z) | Axial Node | W(Z) |
|---|---|---|---|---|---|---|---|
| 52 - 61 | --- | 41 | 1.117 | 30 | 1.103 | 19 | 1.150 |
| 51 | 1.152 | 40 | 1.115 | 29 | 1.107 | 18 | 1.154 |
| 50 | 1.152 | 39 | 1.111 | 28 | 1.113 | 17 | 1.158 |
| 49 | 1.146 | 38 | 1.107 | 27 | 1.118 | 16 | 1.163 |
| 48 | 1.138 | 37 | 1.103 | 26 | 1.124 | 15 | 1.168 |
| 47 | 1.131 | 36 | 1.099 | 25 | 1.130 | 14 | 1.172 |
| 46 | 1.128 | 35 | 1.096 | 24 | 1.134 | 13 | 1.177 |
| 45 | 1.126 | 34 | 1.095 | 23 | 1.138 | 12 | 1.181 |
| 44 | 1.124 | 33 | 1.096 | 22 | 1.142 | 11 | 1.185 |
| 43 | 1.121 | 32 | 1.097 | 21 | 1.145 | 1 - 10 | --- |
| 42 | 1.118 | 31 | 1.100 | 20 | 1.147 | | |

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

FIGURE 6

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

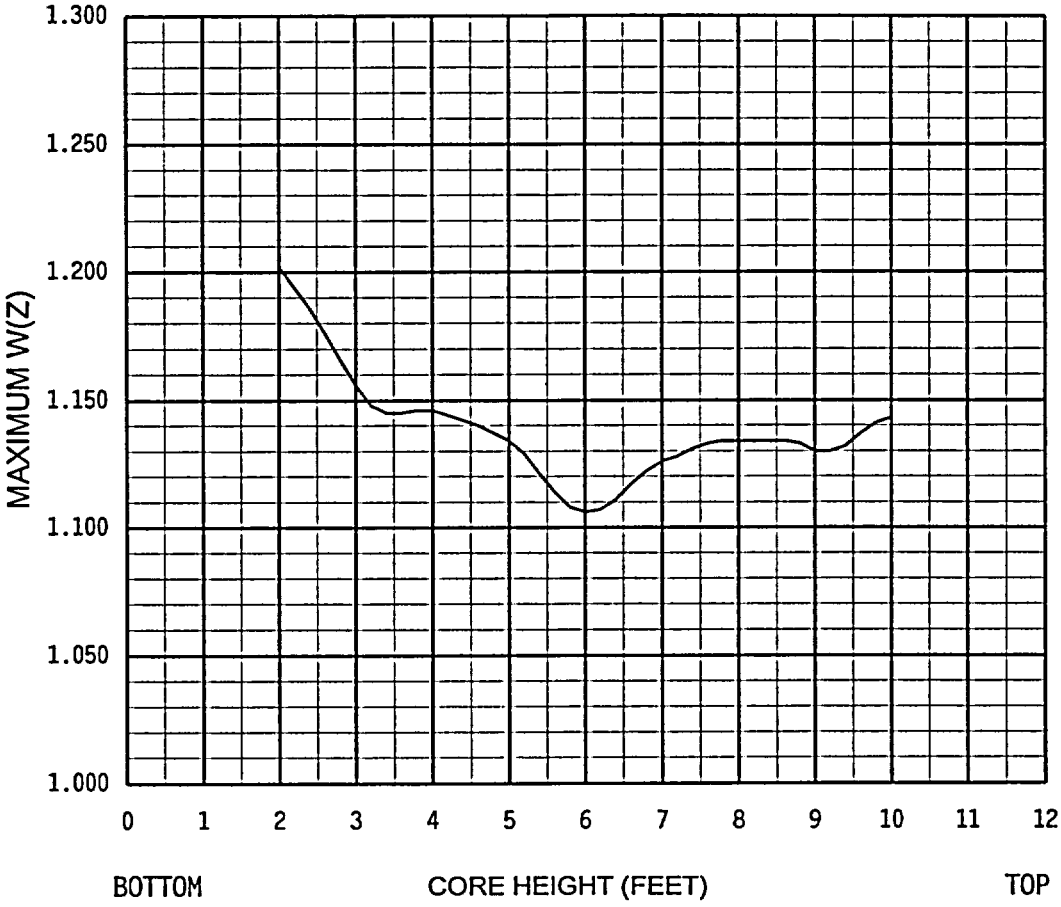



| Axial Node | W(Z) | Axial Node | W(Z) | Axial Node | W(Z) | Axial Node | W(Z) |
|---|---|---|---|---|---|---|---|
| 52 - 61 | --- | 41 | 1.121 | 30 | 1.099 | 19 | 1.141 |
| 51 | 1.151 | 40 | 1.119 | 29 | 1.104 | 18 | 1.146 |
| 50 | 1.158 | 39 | 1.116 | 28 | 1.110 | 17 | 1.152 |
| 49 | 1.155 | 38 | 1.113 | 27 | 1.115 | 16 | 1.158 |
| 48 | 1.145 | 37 | 1.110 | 26 | 1.121 | 15 | 1.165 |
| 47 | 1.135 | 36 | 1.106 | 25 | 1.125 | 14 | 1.172 |
| 46 | 1.130 | 35 | 1.102 | 24 | 1.129 | 13 | 1.178 |
| 45 | 1.128 | 34 | 1.098 | 23 | 1.131 | 12 | 1.183 |
| 44 | 1.127 | 33 | 1.094 | 22 | 1.133 | 11 | 1.188 |
| 43 | 1.125 | 32 | 1.093 | 21 | 1.135 | 1 - 10 | --- |
| 42 | 1.123 | 31 | 1.095 | 20 | 1.137 | | |

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 | 1.134 | 30 | 1.108 | 19 | 1.145 |
| 51 | 1.143 | 40 | 1.134 | 29 | 1.114 | 18 | 1.145 |
| 50 | 1.141 | 39 | 1.133 | 28 | 1.121 | 17 | 1.148 |
| 49 | 1.137 | 38 | 1.131 | 27 | 1.129 | 16 | 1.156 |
| 48 | 1.132 | 37 | 1.128 | 26 | 1.134 | 15 | 1.166 |
| 47 | 1.130 | 36 | 1.126 | 25 | 1.137 | 14 | 1.176 |
| 46 | 1.130 | 35 | 1.122 | 24 | 1.140 | 13 | 1.186 |
| 45 | 1.133 | 34 | 1.117 | 23 | 1.142 | 12 | 1.194 |
| 44 | 1.134 | 33 | 1.111 | 22 | 1.144 | 11 | 1.202 |
| 43 | 1.134 | 32 | 1.107 | 21 | 1.146 | 1 - 10 | --- |
| 42 | 1.134 | 31 | 1.106 | 20 | 1.146 | | |

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

FIGURE 8

AXIAL FLUX DIFFERENCE LIMITS AS A FUNCTION OF
RATED THERMAL POWER