Wolf Creek Generating Station

Cycle 7
CORE OPERATING LIMITS REPORT

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1.0 CORE OPERATING LIMITS REPORT

The CORE OPERATING LIMITS REPORT (COLR) for Wolf Creek Generating Station Cycle 7 has been prepared in accordance with the requirements of Technical Specification 6.9.1.9.

The core operating limits that are included in the COLR affect the following Technical Specifications:

2.1.1	Safety Limits - Reactor Core
3.1.1.3	Moderator Temperature Coefficient (MTC) BOL and EOL limits
3.1.3.5	Shutdown Rod Insertion Limit
3.1.3.6	Control Rod Insertion Limits
3.2.1	Axial Flux Difference (AFD)
3.2.2	Heat Flux Hot Channel Factor - $F_Q(X,Y,Z)$
3.2.3	Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}(X,Y)$
3.2.5.c	Reactor Coolant System (RCS) Flow Rate
3.9.1.b	Refueling Boron Concentration

2.0 OPERATING LIMITS

The cycle-specific parameter limits for the specifications listed in Section 1.0 are presented in the subsections below:

2.1 Safety Limits - Reactor Core

(Tech Spec 2.1.1)

The combination of THERMAL POWER, pressurizer pressure, and the highest operating loop coolant temperature (T_{avg}) shall not exceed the limits shown in Figure 1* for four loop operation.

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* The curves on Figure 1 are based on

DNB Correlation	: WRB-2
DNBR design limit	: 1.17
Safety Analysis limit DNBR	: 1.80
Design $F_{\Delta H}$	: 1.65

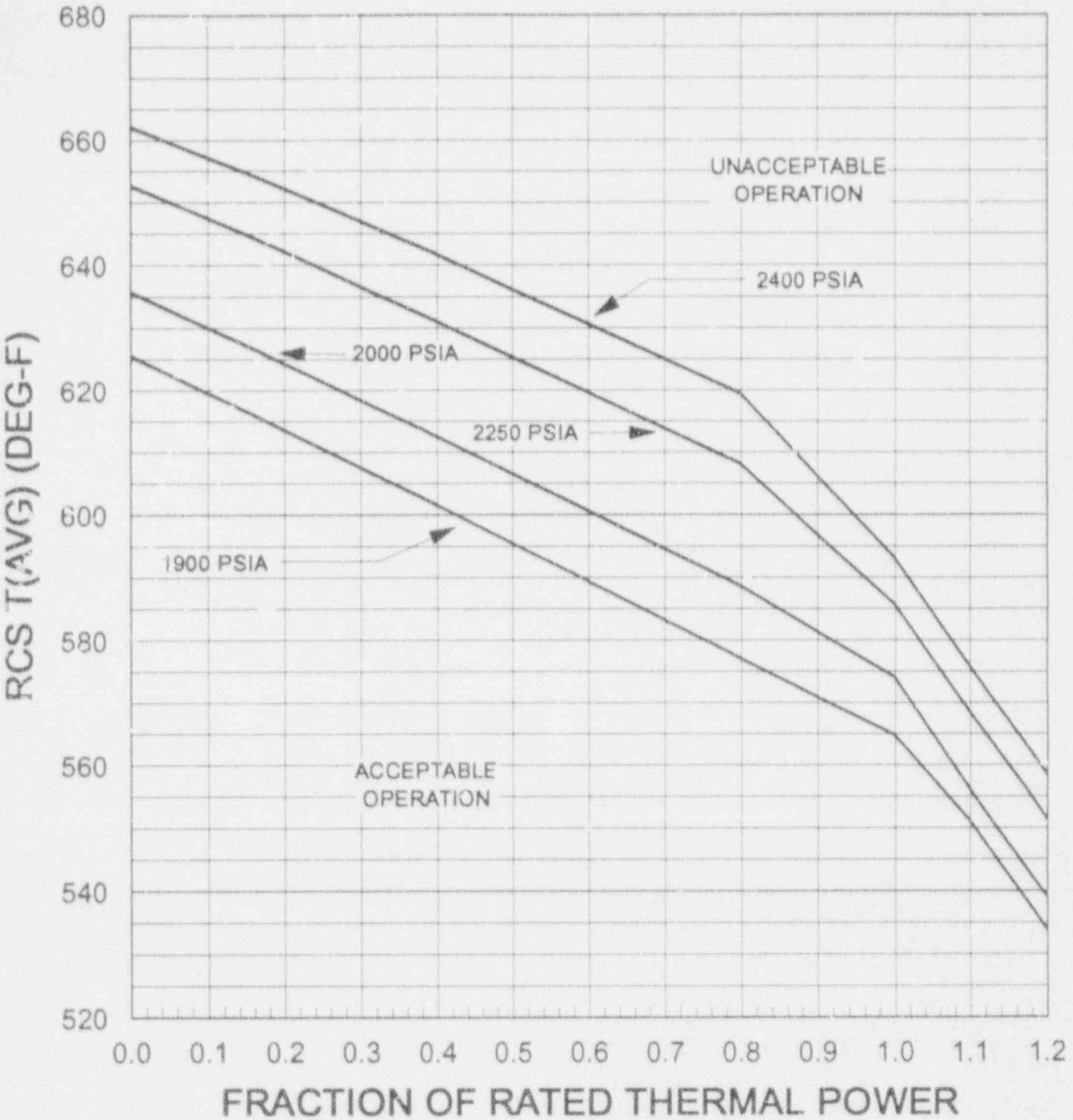


Figure 1

REACTOR CORE SAFETY LIMIT - FOUR LOOPS IN OPERATION

2.2 Moderator Temperature Coefficient (MTC)

(Tech Spec 3.1.1.3)

(a) The BOL MTC limit is shown in Figure 2.

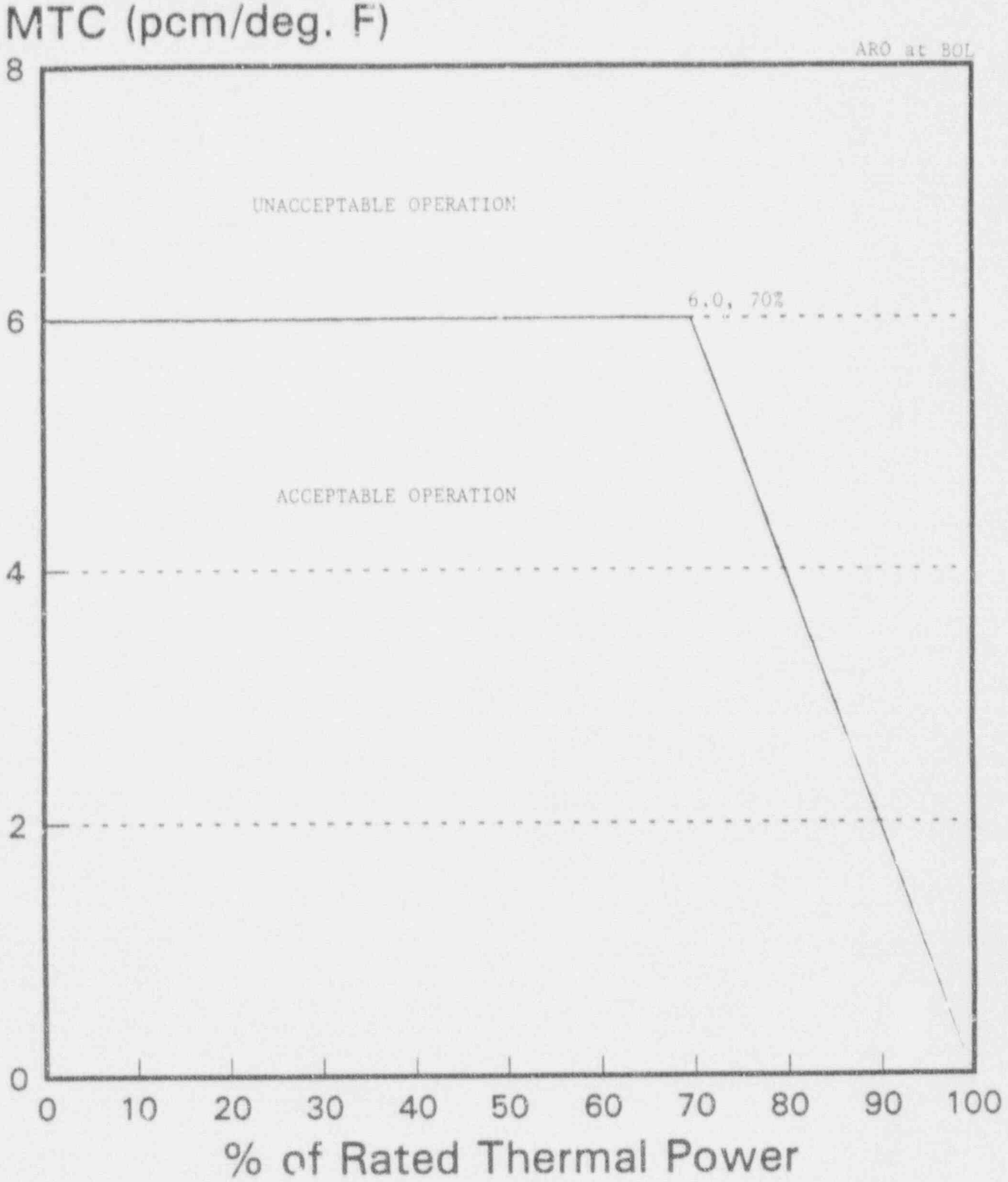
(b) The EOL MTC limit is -4[illegible] pcm/deg F.

(Tech Spec 4.1.1.3)

The 300 PPM MTC Surveillance Limit is -32 pcm/deg F.

FIGURE 2

Moderator Temperature Coefficient vs Power Level



2.3 Shutdown Rod Insertion Limit

(Tech Spec 3.1.3.5)

The shutdown rods shall be fully withdrawn, as defined in Figure 3.

2.4 Control Rod Insertion Limits

(Tech Spec 3.1.3.6)

The Control Bank Insertion Limits are specified in Figure 3.

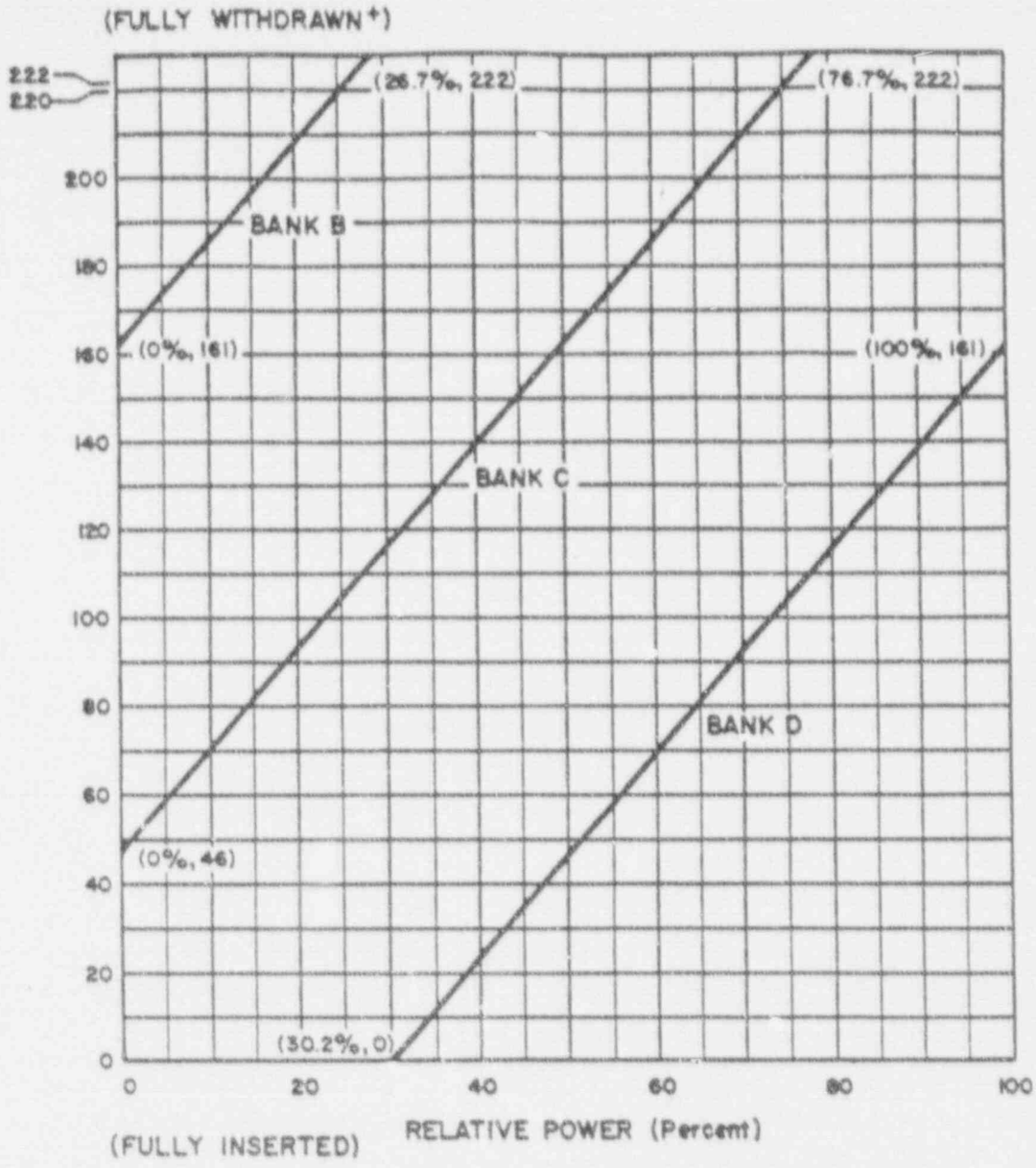


FIGURE 3

ROD BANK INSERTION LIMIT VERSUS
THERMAL POWER-FOUR LOOP OPERATION

+Fully Withdrawn shall be the condition where control rods are at a position within the interval of $\geq$ 222 and $\leq$ 231 steps withdrawn.

2.5 Axial Flux Difference (AFD)

(Tech Spec 3.2.1)

The indicated Axial Flux Difference (AFD) allowed operational space is defined by Figure 4.

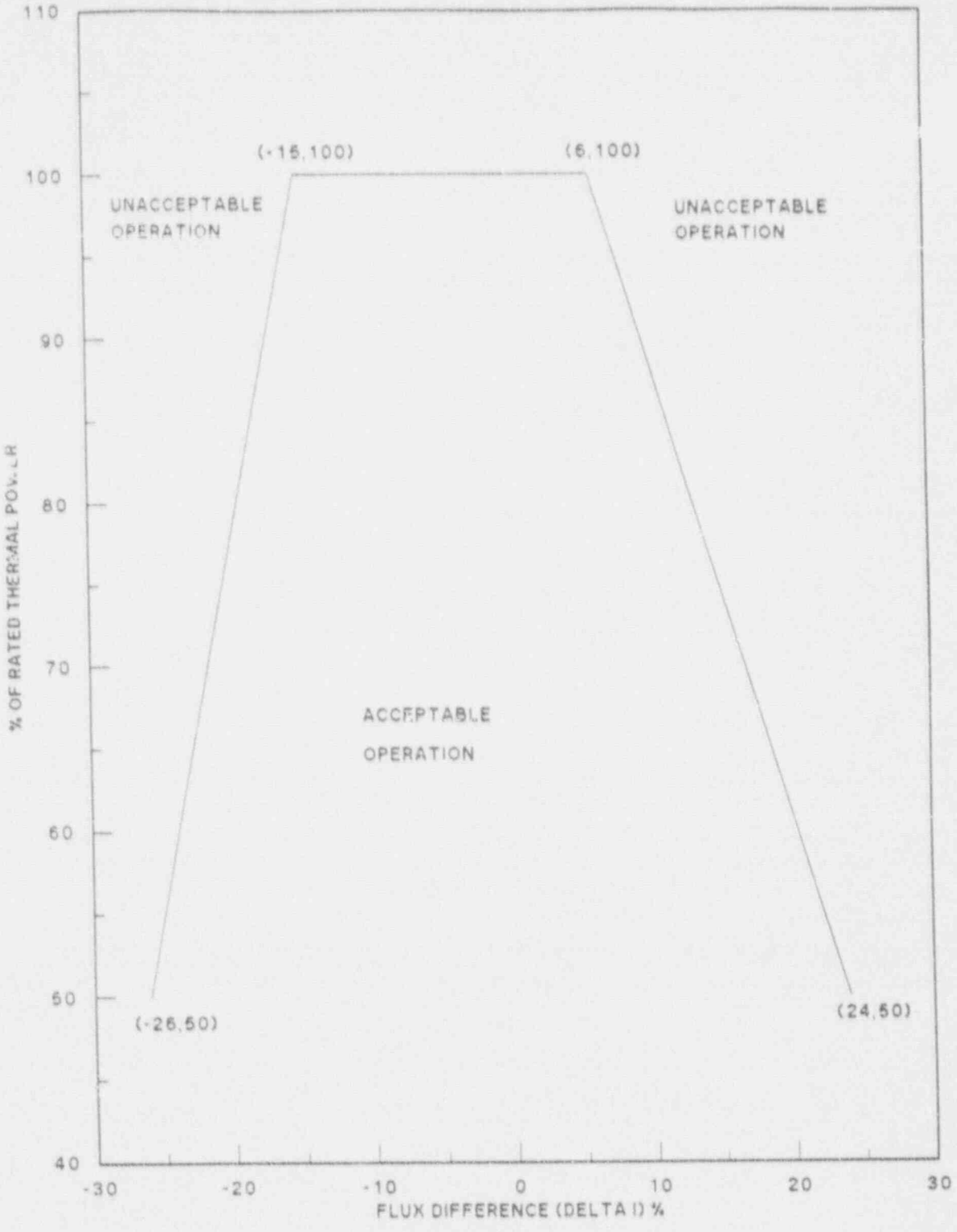


Figure 4
WOLF CREEK UNIT 1
AXIAL FLUX DIFFERENCE AS A FUNCTION OF RATED THERMAL POWER

2.6 Heat Flux Hot Channel Factor - $F_Q(X,Y,Z)$

(Tech Spec 3.2.2)

$$F_Q^{MA}(X,Y,Z) \leq \frac{F_Q^{RTP}}{P} * K(Z) \qquad \text{for } P > 0.5$$

$$F_Q^{MA}(X,Y,Z) \leq \frac{F_Q^{RTP}}{0.5} * K(Z) \qquad \text{for } \leq 0.5$$

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

F_Q^{RTP} = the F_Q at RATED THERMAL POWER
= 2.50, and

K(Z) is defined in Figure 5.

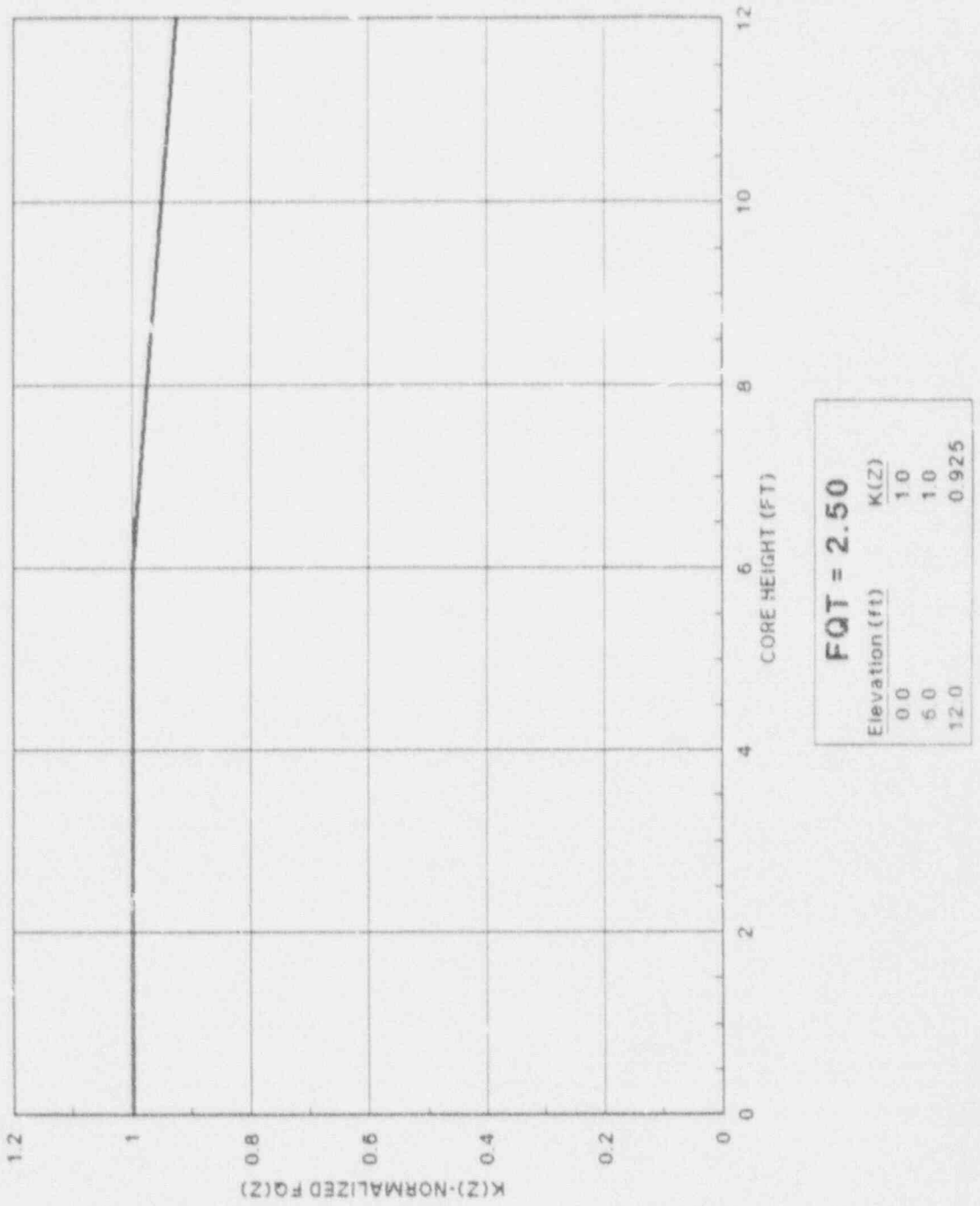
(Tech Spec 4.2.2...d)

See Appendix A for:

1. $[F_Q(X,Y,Z)]^{NOM}$
   $[F_Q^L(X,Y,Z)]^{OP}$ and $[F_Q^L(X,Y,Z)]^{RPS}$
2. Op Mar NSLOPE and Op Mar PSLOPE
3. RPS Mar NSLOPE and RPS Mar PSLOPE.

Figure 5

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



FQT = 2.50

Elevation (ft)	K(Z)
0.0	1.0
6.0	1.0
12.0	0.925

2.7 Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}(X,Y)$

(Tech Spec 3.2.3)

$F_{\Delta H}(X,Y)$ shall be limited by the relationship

$$F_{\Delta H}R^{M}(X,Y) \leq F_{\Delta H}R^{L}(X,Y).$$

See Appendix A for array $F_{\Delta H}R^{L}(X,Y)$.

(ACTION a, b)

See Appendix A for RRH.

(ACTION c)

See Appendix A for TRH.

(Tech Spec 4.2.3.2.b)

See Appendix A for array $F_{\Delta H}R^{NOM}(X,Y)$.

Definition of FΔHR

Limit:

$$F\Delta HR^{L}(X,Y) = \frac{F_{\Delta H}^{D}(X,Y)}{MAP^{D}[h^{D}(X,Y),\ AX^{D}(X,Y)]\ /\ AX^{D}(X,Y)} * \frac{1}{MH(X,Y)}$$

where,

$F_{\Delta H}^{D}(X,Y)$ = Design $F_{\Delta H}$ for the assembly at location (X,Y),

MAP^{D} = The design Maximum Allowable Peak at $h^{D}(X,Y)$ and $AX^{D}(X,Y)$,

$h^{D}(X,Y)$ = Axial location of the design axial power peak at (X,Y),

$AX^{D}(X,Y)$ = The ratio of the peak to average axial power at (X,Y) for the design power distribution, and

$MH(X,Y)$ = Minimum available margin ratio at (X,Y).

Measurement:

$$F\Delta HR^{M}(X,Y) = \frac{F_{\Delta H}^{M}(X,Y)}{MAP^{M}[h^{M}(X,Y),\ AX^{M}(X,Y)]\ /\ AX^{M}(X,Y)}$$

where,

$F_{\Delta H}^{M}(X,Y)$ = Measured $F_{\Delta H}$ for the assembly at location (X,Y),

MAP^{M} = The Maximum Allowable Peak at $h^{M}(X,Y)$ and $AX^{M}(X,Y)$,

$h^{M}(X,Y)$ = Axial location of the measured axial power peak, and

$AX^{M}(X,Y)$ = The ratio of the peak to average axial power at (X,Y) for the measured power distribution.

2.8 Reactor Coolant System (RCS) Flow Rate

(Tech Spec 3.2.5.c)

The measured Reactor Coolant System (RCS) total flow rate shall be maintained greater than or equal to 38.4×10^4 GPM for four loop operation. The indicated flow shall be used for the measured flow without adjustment for measurement uncertainty. The limit includes the 2.5% measurement uncertainty for flow.

2.9 Refueling Boron Concentration

(Tech Spec 3.9.1.b)

The refueling boron concentration shall be greater than or equal to 2300 PPM.

APPENDIX A
(Reference 1)

A. Input relating to Specification 4.2.2.2.d:

1. $[F_Q(X,Y,Z)]^{NOM}$: Nominal design peakin·

   $[F_Q^L(X,Y,Z)]^{OP}$: Operational design peaking limit, and

   $[F_Q^L(X,Y,Z)]^{RPS}$: Reactor Protection Setpoint (RPS) design peaking limit.

   These are a large number of large arrays. They are issued in a controlled report which will be submitted to the NRC on request.

   The design peaking limits include all uncertainties.

2. Op Mar NSLOPE = 1.5% / % margin

   Op Mar PSLOPE = 2.0% / % margin

3. RPS Mar NSLOPE = 1.32% / % margin

   RPS Mar PSLOPE = 2.82% / % margin

Ref. 1: Core Operating Limit Methodology for Westinghouse-Designed PWRs, BAW-10163P-A, June 1989.

APPENDIX A
(Cont'd)

B. Input relating to Specification 3.2.3:

1. $F\Delta HR^{T}(X,Y)$: The maximum allowable radial peak ratio

   These are a large number of large arrays. They are issued in a controlled report which will be submitted to the NRC on request.

   The design peaking limits include all uncertainties.

2. RRH = 3.33

3. TRH = 0.038

C. Input relating to Specification 4.2.3.2.b:

1. $F\Delta HR^{NOM}(X,Y)$: Nominal design radial peak ratio

   These are a large number of large arrays. They are issued in a controlled report which will be submitted to the NRC on request.