

ENERGY OPERATIONS
ARKANSAS NUCLEAR ONE - UNIT 2

CORE OPERATING LIMITS REPORT

FOR CYCLE 12

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ARKANSAS NUCLEAR ONE - UNIT 2
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I. INTRODUCTION

This CORE OPERATING LIMITS REPORT (COLR) has been prepared in accordance with the requirements of Arkansas Nuclear One - Unit 2 (ANO-2) Technical Specification 6.9.5 for ANO-2's Cycle 12. The core operating limits have been developed using the NRC approved methodologies specified in Section V. This is Revision 0 of the Cycle 12 COLR.

II. SUMMARY OF CHANGES

Listed below are the changes to the COLR from the latest revision of the Cycle 11 COLR.

- The Shutdown Margin for Modes 1, 2, 3, and 4 has changed from 5.5% to 6.5%.
- The specific values for MTC have been replaced with a curve.
- The PDIL for CEA Groups 4, 5, and 6 has been revised to delete Groups 4 and 5 from the curve. A note was added that states "Regulating Banks 1 through 5 in the Full-Out Position".
- The PDIL for the PLCEA has been deleted and a PDIL for Group P has been added. A note was added that states "Regulating Banks 1 through 5 in the Full-Out Position".
- The Linear Heat Rate with COLSS out of service has been raised from 12.8 to 13.5 kW/ft.
- A new parameter for the DNBR margin has been added to the COLR.
- The Statistical Combination of Uncertainties methodology is replaced with the Modified Statistical Combination of Uncertainties methodology.

III. AFFECTED TECHNICAL SPECIFICATIONS

- 1) 3/4.1.1.1 Shutdown Margin - $T_{avg} > 200^{\circ}\text{F}$
- 2) 3/4.1.1.2 Shutdown Margin - $T_{avg} \leq 200^{\circ}\text{F}$
- 3) 3.1.1.4 Moderator Temperature Coefficient
- 4) 3.1.3.1 Movable Control Assemblies - CEA Position
- 5) 3.1.3.6 Regulating CEA Insertion Limits
- 6) 3/4.2.1 Linear Heat Rate
- 7) 3.2.3 Azimuthal Power Tilt - T_q
- 8) 3/4.2.4 DNBR Margin
- 9) 3.2.7 Axial Shape Index

IV. CORE OPERATING LIMITS

The cycle-specific operating limits for the specifications listed are presented below.

1) 3/4.1.1.1 - SHUTDOWN MARGIN - $T_{avg} > 200^{\circ}\text{F}$

The SHUTDOWN MARGIN shall be greater than or equal to 6.5 % $\Delta k/k$ in Modes 1, 2, 3, and 4.

2) 3/4.1.1.2 - SHUTDOWN MARGIN - $T_{avg} \leq 200^{\circ}\text{F}$

The SHUTDOWN MARGIN shall be greater than or equal to 5.0% $\Delta k/k$ in Mode 5.

3) 3.1.1.4 - MODERATOR TEMPERATURE COEFFICIENT

The Moderator Temperature Coefficient (MTC) shall be:

- a) in accordance with Figure 1
- b) less negative than $-3.4 \text{ E-}4 \Delta k/k/^{\circ}\text{F}$ at RATED THERMAL POWER

4) 3.1.3.1 - MOVABLE CONTROL ASSEMBLIES - CEA POSITION

With one or more CEAs trippable but misaligned from any other CEAs in its group by more than the Technical Specification 3.1.3.1 allowed value, the minimum required core power reduction for Modes 1 and 2 is specified in Figure 2.

5) 3.1.3.6 - REGULATING CEA INSERTION LIMITS

The regulating CEA groups shall be limited to the withdrawal and insertion limits shown on Figure 3. Figure 3 assumes that Banks 1 through 5 are fully withdrawn.

Group P shall be limited to the insertion limits shown on Figure 4. Figure 4 assumes Banks 1 through 5 are fully withdrawn.

6) 3/4.2.1 - LINEAR HEAT RATE

With COLSS out of service, the linear heat rate shall be maintained ≤ 13.5 kW/ft .

7) 3.2.3 - AZIMUTHAL POWER TILT- T_q

The measured AZIMUTHAL POWER TILT shall be maintained ≤ 0.03 .

8) 3/4.2.4 - DNBR MARGIN

The DNBR limit shall be maintained by one of the following methods:

- a) With COLSS in service and neither CEAC operable - Maintain COLSS calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR decreased by 13%.
- b) With COLSS out of service and at least one CEAC operable - Operate within the Region of Acceptable Operation shown on Figure 5, using any operable CPC channel.
- c) With COLSS out of service and neither CEAC operable - Operate within the Region of Acceptable Operation shown on Figure 6, using any operable CPC channel.

9) 3.2.7 - AXIAL SHAPE INDEX

The core average AXIAL SHAPE INDEX (ASI) shall be maintained within the following limits:

- a) COLSS IN SERVICE
 $- 0.27 \leq ASI \leq + 0.27$
- b) COLSS OUT OF SERVICE (CPC)
 $- 0.20 \leq ASI \leq + 0.20$

V. METHODOLOGIES

The analytical methods used to determine the core operating limits listed above are those previously reviewed and approved by the NRC in:

- 1) "The ROCS and DIT Computer Codes for Nuclear Design," CENPD-266-P-A, April 1983. Methodology for the limit on Shutdown Margins, MTC, DNBR Margin and the CEA Insertion Limits.
- 2) "CE Method for Control Element Assembly Ejection Analysis," CENPD-0190-A, January 1976. Methodology for the CEA Insertion Limits and Azimuthal Power Tilt.
- 3) "Modified Statistical Combination of Uncertainties," CEN-356(V)-P-A, Revision 01-P-A, May 1988. Methodology for the limits on the DNBR Margin and the ASI.
- 4) "Calculative Methods for the CE Large Break LOCA Evaluation Model," CENPD-132-P, August 1974. Methodology for the limits on the Linear Heat Rate and Azimuthal Power Tilt.
- 5) "Calculational Methods for the CE Large Break LOCA Evaluation Model," CENPD-132-P, Supplement 1, February 1975. Methodology for the limits on the MTC, Linear Heat Rate, Azimuthal Power Tilt and ASI.
- 6) "Calculational Methods for the CE Large Break LOCA Evaluation Model," CENPD-132-P, Supplement 2-P, July 1975. Methodology for the limits on the MTC, Linear Heat Rate, Azimuthal Power Tilt and ASI.
- 7) "Calculative Methods for the CE Large Break LOCA Evaluation Model for the Analysis of CE and W Designed NSSS," CEN-132, Supplement 3-P-A, June 1985. Methodology for Specification 3.1.1.4 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt, and 3.2.7 for ASI.
- 8) "Calculational Methods for the CE Small Break LOCA Evaluation Model," CENPD-137-P, August 1974. Methodology for the limits on the MTC, Linear Heat Rate, Azimuthal Power Tilt and ASI.
- 9) "CESEC - Digital Simulation of a Combustion Engineering Nuclear Steam Supply System," December 1981. Methodology for the limits on the Shutdown Margins, MTC, Movable Control Assemblies - CEA Position, CEA Insertion Limits, DNBR Margin and Azimuthal Power Tilt.

VI. LIST OF FIGURES

- Figure 1. Moderator Temperature Coefficient
- Figure 2. Required Power Reduction After CEA Deviation
- Figure 3. CEA Insertion Limits Versus Thermal Power
- Figure 4. Group P Insertion Limit Versus Thermal Power
- Figure 5. DNBR Margin Operating Limit Based on Core Protection Calculators (COLSS Out of Service, CEAC Operable)
- Figure 6. DNBR Margin Operating Limit Based on Core Protection Calculators (COLSS Out of Service, Both CEACs Inoperable)

FIGURE 1

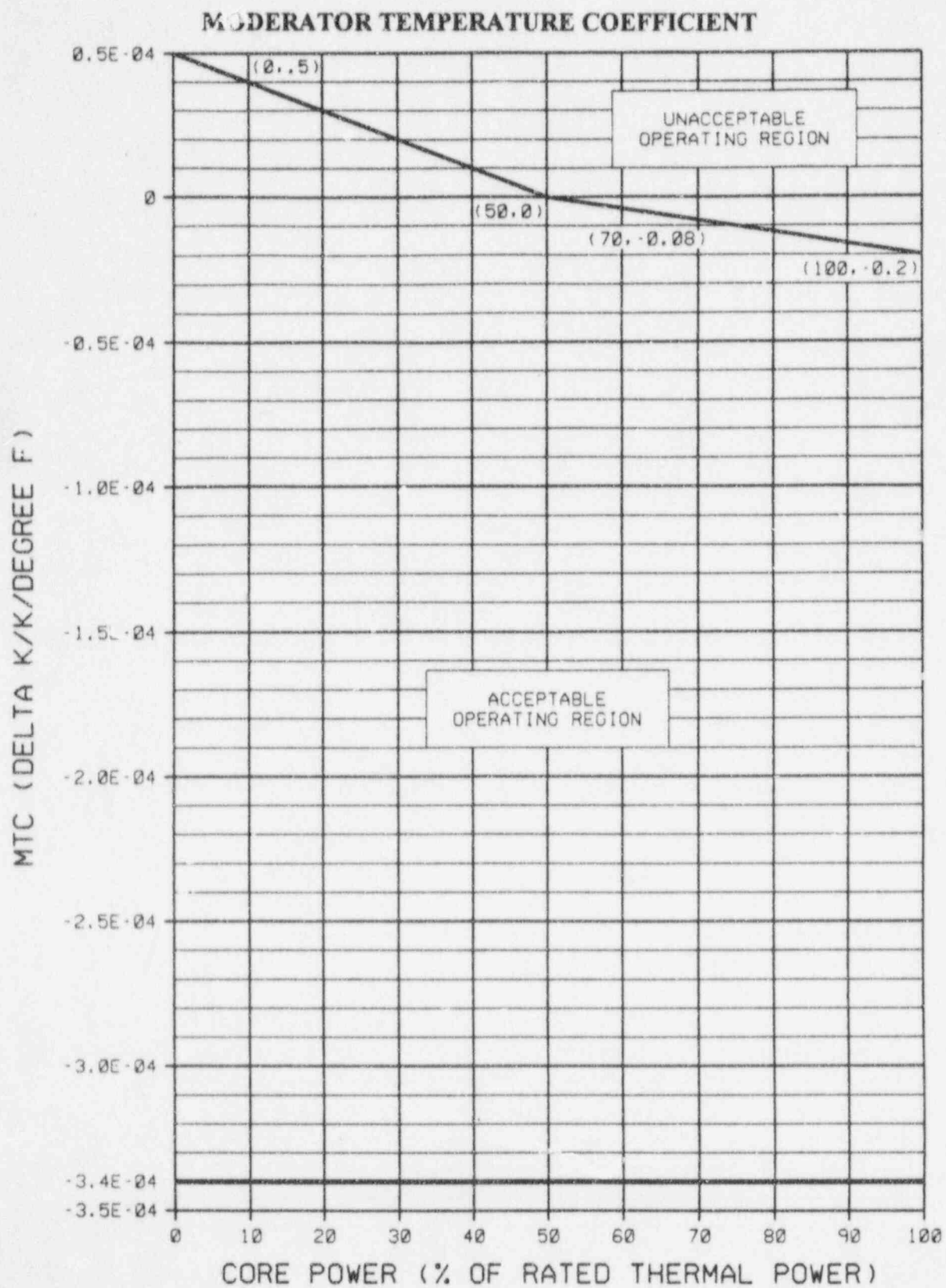


FIGURE 2

REQUIRED POWER REDUCTION AFTER CEA DEVIATION*

*When core power is reduced to 60% of rated power per this limit curve, further reduction is not required

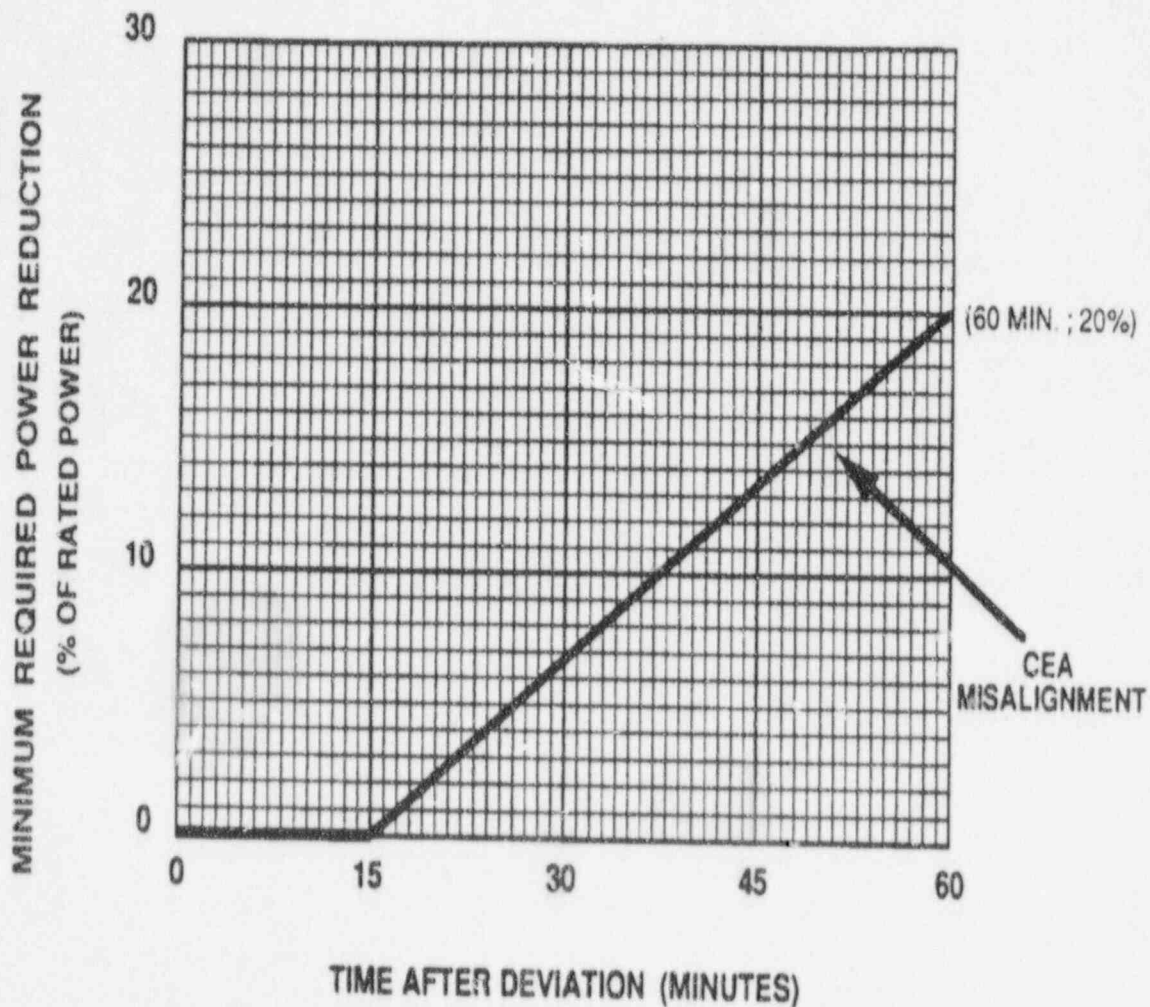
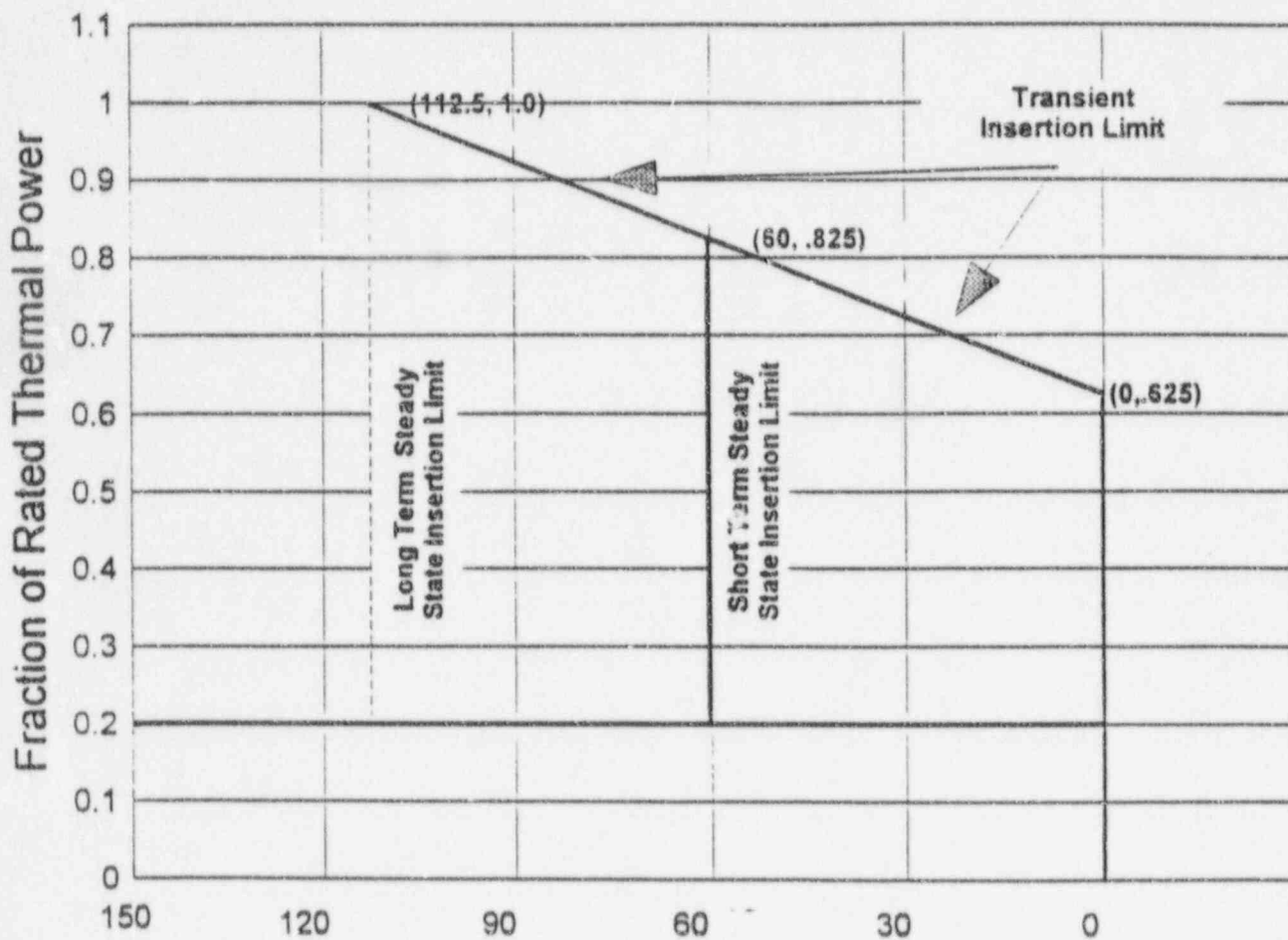


FIGURE 3

CEA INSERTION LIMITS VERSUS THERMAL POWER



CEA Bank 6 Position, inches withdrawn
(Regulating Banks 1 through 5 in Full-Out Position)

FIGURE 4

GROUP P INSERTION LIMIT VERSUS THERMAL POWER

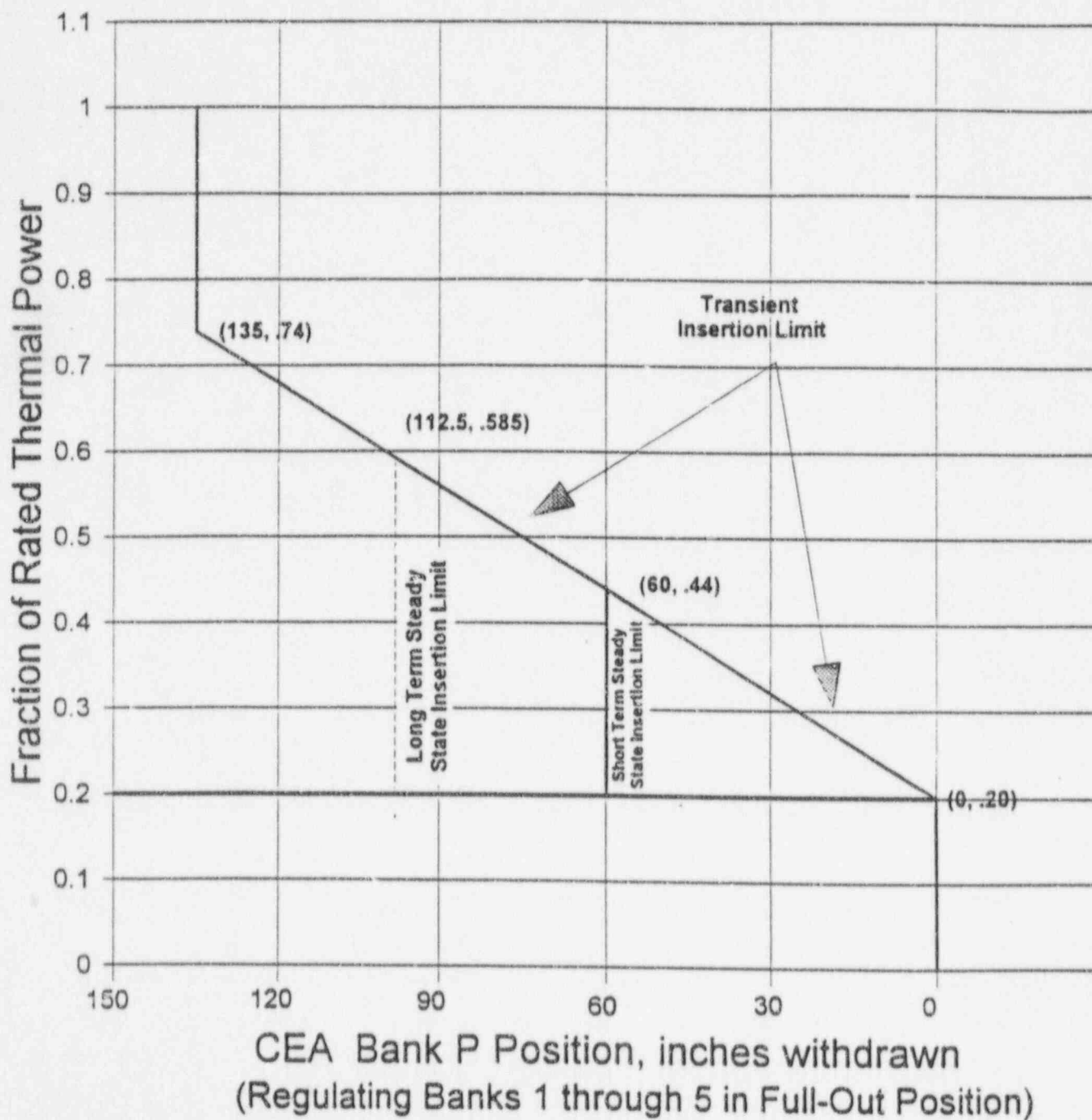


FIGURE 5

DNBR MARGIN OPERATING LIMIT BASED
ON CORE PROTECTION CALCULATORS

(COLSS OUT OF SERVICE, CEAC OPERABLE)

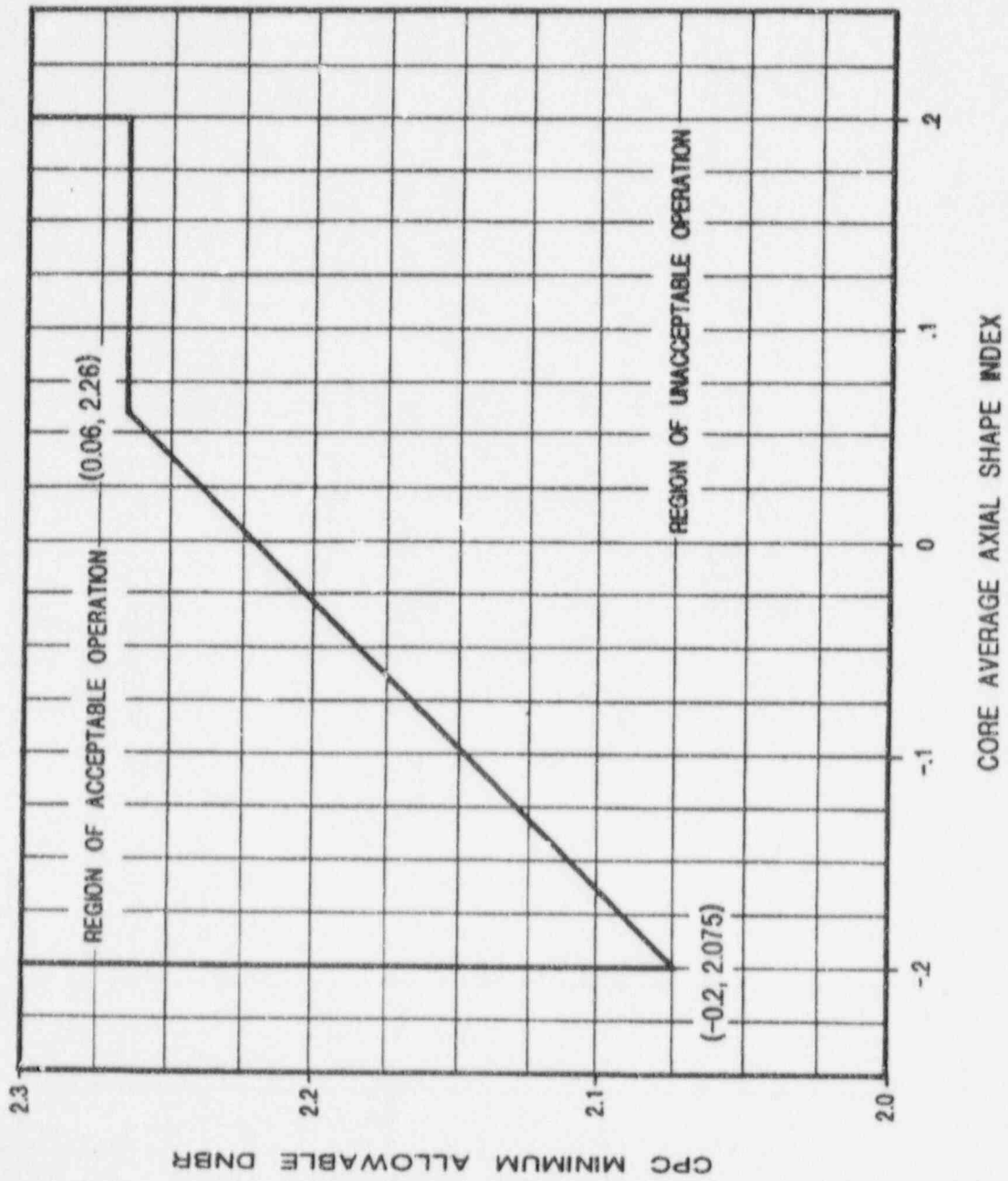


FIGURE 6

DNBR MARGIN OPERATING LIMIT BASED
ON CORE PROTECTION CALCULATORS

(COLLS OUT OF SERVICE, BOTH CEACS INOPERABLE)

