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## Technical Specification 5.6.5.d

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November 1, 2002

U. S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
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Washington, DC 20555-0001

Dear Sirs:

**Subject: Palo Verde Nuclear Generating Station (PVNGS)  
Unit 1  
Docket No. STN 50-528  
Core Operating Limits Report: Unit 1 - Revision 9**

Pursuant to Technical Specification 5.6.5.d, enclosed is Revision 9 of the PVNGS Unit 1 Core Operating Limits Report (COLR), issued October 31, 2002.

No commitments are being made to the NRC by this letter. Should you have any questions, please contact Thomas N. Weber at (623) 393-5764.

Sincerely,

SAB/TNW/GAM/kg

Enclosure

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**Enclosure**

**Core Operating Limits Report for  
Palo Verde Nuclear Generating Station  
Unit 1 - Revision 9**

PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

**CORE OPERATING LIMITS REPORT**

**PALO VERDE NUCLEAR GENERATING STATION (PVNGS)**

**UNIT 1**

**Revision 9**

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# PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

## Table of Contents

| <u>Description</u>   | <u>Revision #</u> | <u>Page</u> |
|--|-------------------|-------------|
| Cover Page   | 9                 | 1           |
| Table of Contents  | 9                 | 2           |
| List of Figures  | 9                 | 3           |
| List of Tables   | 9                 | 4           |
| Affected Technical Specifications                          | 8                 | 5           |
| Analytical Methods   | 8                 | 6           |
|  | 8                 | 7           |
| <b>CORE Operating Limits</b>                               |                   |             |
| 3.1.1 Shutdown Margin (SDM) - Reactor Trip Breakers Open   | 8                 | 8           |
| 3.1.2 Shutdown Margin (SDM) - Reactor Trip Breakers Closed | 8                 | 8           |
| 3.1.4 Moderator Temperature Coefficient (MTC)              | 8                 | 8           |
| 3.1.5 Control Element Assembly (CEA) Alignment             | 8                 | 8           |
| 3.1.7 Regulating CEA Insertion Limits                      | 8                 | 8           |
| 3.1.8 Part Length CEA Insertion Limits                     | 8                 | 9           |
| 3.2.1 Linear Heat Rate (LHR)                               | 8                 | 9           |
| 3.2.3 Azimuthal Power Tilt (Tq)                            | 8                 | 9           |
| 3.2.4 Departure From Nucleate Boiling Ratio (DNBR)         | 8                 | 9           |
| 3.2.5 Axial Shape Index (ASI)                              | 8                 | 10          |
| 3.3.12 Boron Dilution Alarm System (BDAS)                  | 8                 | 10          |
| 3.9.1 Boron Concentration                                  | 8                 | 10          |

## PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

### List of Figures

| <u>Description</u>   | <u>Revision #</u> | <u>Page</u> |
|--|-------------------|-------------|
| Figure 3.1.1-1 Shutdown Margin Versus Cold Leg Temperature<br>Reactor Trip Breakers Open   | 8                 | 11          |
| Figure 3.1.2-1 Shutdown Margin Versus Cold Leg Temperature<br>Reactor Trip Breakers Closed   | 8                 | 12          |
| Figure 3.1.4-1 MTC Acceptable Operation, Modes 1 and 2   | 8                 | 13          |
| Figure 3.1.5-1 Core Power Limit After CEA Deviation  | 8                 | 14          |
| Figure 3.1.7-1 CEA Insertion Limits Versus Thermal Power<br>(COLSS in Service)   | 9                 | 15          |
| Figure 3.1.7-2 CEA Insertion Limits Versus Thermal Power<br>(COLSS Out of Service)   | 9                 | 16          |
| Figure 3.1.8-1 Part Length CEA Insertion Limits Versus Thermal Power   | 8                 | 17          |
| Figure 3.2.4-1 COLSS DNBR Operating Limit Allowance for Both<br>CEACs Inoperable   | 8                 | 18          |
| Figure 3.2.4-2 DNBR Margin Operating Limit Based on the Core<br>Protection Calculators (COLSS Out of Service, CEACs<br>Operable)   | 8                 | 19          |
| Figure 3.2.4-3 DNBR Margin Operating Limit Based on the Core<br>Protection Calculators (COLSS Out of Service, CEACs<br>Inoperable) | 8                 | 20          |

## PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

### List of Tables

| <u>Description</u>  | <u>Revision #</u> | <u>Page</u> |
|---|-------------------|-------------|
| Table 3.3.12-1 Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $K_{eff} > 0.98$           | 8                 | 21          |
| Table 3.3.12-2 Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $0.98 \geq K_{eff} > 0.97$ | 8                 | 22          |
| Table 3.3.12-3 Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $0.97 \geq K_{eff} > 0.96$ | 8                 | 23          |
| Table 3.3.12-4 Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $0.96 \geq K_{eff} > 0.95$ | 8                 | 24          |
| Table 3.3.12-5 Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $K_{eff} \leq 0.95$        | 8                 | 25          |

**PVNGS UNIT 1 CORE OPERATING LIMITS REPORT**

This Report has been prepared in accordance with the requirements of Technical Specification 5.6.5. The Core Operating Limits have been developed using the NRC approved methodologies specified in Section 5.6.5 b of the Palo Verde Unit 1 Technical Specifications.

**AFFECTED PVNGS TECHNICAL SPECIFICATIONS**

- 3.1.1 Shutdown Margin (SDM) - Reactor Trip Breakers Open
- 3.1.2 Shutdown Margin (SDM) - Reactor Trip Breakers Closed
- 3.1.4 Moderator Temperature Coefficient (MTC)
- 3.1.5 Control Element Assembly (CEA) Alignment
- 3.1.7 Regulating CEA Insertion Limits
- 3.1.8 Part Length CEA Insertion Limits
- 3.2.1 Linear Heat Rate (LHR)
- 3.2.3 Azimuthal Power Tilt ( $T_q$ )
- 3.2.4 Departure From Nucleate Boiling Ratio (DNBR)
- 3.2.5 Axial Shape Index (ASI)
- 3.3.12 Boron Dilution Alarm System (BDAS)
- 3.9.1 Boron Concentration

## PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

### ANALYTICAL METHODS

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

| <u>Title</u>   | <u>Report No.</u>          | <u>Rev</u> | <u>Date</u>    | <u>Supplement</u> |
|--|----------------------------|------------|----------------|-------------------|
| 1) CE Method for Control Element Assembly Ejection Analysis  | CENPD-0190-A               | N.A.       | January 1976   | N.A.              |
| 2) The ROCS and DIT Computer Codes for Nuclear Design  | CENPD-266-P-A              | N.A.       | April 1983     | N.A.              |
| 3) Modified Statistical Combination of Uncertainties   | CEN-356(V)-P-A             | 01-P-A     | May 1988       | N.A.              |
| 4) System 80 <sup>TM</sup> Inlet Flow Distribution   | Enclosure 1-P to LD-82-054 | N.A.       | February 1993  | 1-P               |
| 5) Calculative Methods for the CE Large Break LOCA Evaluation Model for the Analysis of CE and W Designed NSSS | CENPD-132                  | N.A.       | March 2001     | 4-P-A             |
| 6) Calculative Methods for the CE Small Break LOCA Evaluation Model  | CENPD-137-P                | N.A.       | April 1998     | 2-P-A             |
| 7) Fuel Rod Maximum Allowable Pressure   | CEN-372-P-A                | N.A.       | May 1990       | N.A.              |
| 8) Arizona Public Service Company PWR Reactor Physics Methodology Using CASMO-4/SIMULATE-3                     | NFM002                     | 0          | September 1999 | N.A.              |



## PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

| <u>Title</u>  | <u>Report No.</u>              | <u>Rev</u> | <u>Date</u>      | <u>Supplement</u> |
|---|--------------------------------|------------|------------------|-------------------|
| 9) Technical Manual for the CENTS<br>Code   | CE-NPD<br>282-P-A<br>Vols. 1-3 | N.A.       | June 1993        | 1-P               |
| 10) Implementation of ZIRLO™<br>Cladding Material in CE<br>Nuclear Power Fuel Assembly<br>Designs | CENPD-<br>404-P-A              | 0          | November<br>2001 | N.A.              |

**PVNGS UNIT 1 CORE OPERATING LIMITS REPORT**

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

**3.1.1 - Shutdown Margin (SDM) - Reactor Trip Breakers Open**

The Shutdown Margin shall be greater than or equal to that shown in Figure 3.1.1-1.

**3.1.2 - Shutdown Margin (SDM) - Reactor Trip Breakers Closed**

The Shutdown Margin shall be greater than or equal to that shown in Figure 3.1.2-1.

**3.1.4 - Moderator Temperature Coefficient (MTC)**

The moderator temperature coefficient (MTC) shall be within the area of Acceptable Operation shown in Figure 3.1.4-1.

**3.1.5 - Control Element Assembly (CEA) Alignment**

With one or more full-length or part-length CEAs misaligned from any other CEAs in its group by more than 6.6 inches, the minimum required MODES 1 and 2 core power reduction is specified in Figure 3.1.5-1.

**3.1.7 - Regulating CEA Insertion Limits**

One or more CEACs OPERABLE: With COLSS IN SERVICE, regulating CEA groups shall be limited to the withdrawal sequence and to the insertion limits<sup>1</sup> shown in Figure 3.1.7-1<sup>2</sup>; with COLSS OUT OF SERVICE, regulation CEA groups shall be limited to the withdrawal sequence and to the insertion limits<sup>1</sup> shown in Figure 3.1.7-2.<sup>2</sup>

<sup>1</sup> A reactor power cutback will cause either (Case 1) Regulating Group 5 or Regulating Group 4 and 5 to be dropped with no sequential insertion of additional Regulating Groups (Groups 1, 2, 3, and 4) or (Case 2) Regulating Group 5 or Regulating Group 4 and 5 to be dropped with all or part of the remaining Regulating Groups (Groups 1, 2, 3, and 4) being sequentially inserted. In either case, the Transient Insertion Limit and withdrawal sequence specified in the CORE OPERATING LIMITS REPORT can be exceeded for up to 2 hours.

<sup>2</sup> The Separation between Regulating Groups 4 and 5 may be reduced from the 90 inch value specified in Figures 3.1.7-1 and 3.1.7-2 provided that each of the following conditions are satisfied:

**PVNGS UNIT 1 CORE OPERATING LIMITS REPORT**

- a) Regulating Group 4 position is between 60 and 150 inches withdrawn.
- b) Regulating Group 5 position is maintained at least 10 inches lower than Regulating Group 4 position.
- c) Both Regulating Group 4 and Regulating Group 5 positions are maintained above the Transient Insertion Limit specified in Figure 3.1.7-1 (COLSS In Service) or Figure 3.1.7-2 (COLSS Out of Service).

**3.1.8 - Part Length CEA Insertion Limits**

One or more CEACs OPERABLE: The part length CEA groups shall be limited to the insertion limits shown in Figure 3.1.8-1.

**3.2.1 - Linear Heat Rate (LHR)**

The linear heat rate limit of 13.1 kW/ft shall be maintained.

**3.2.3 - Azimuthal Power Tilt ( $T_q$ )**

The AZIMUTHAL POWER TILT ( $T_q$ ) shall be less than or equal to 5% with COLSS IN SERVICE when power is greater than or equal to 20%.

**3.2.4 - Departure From Nucleate Boiling Ratio (DNBR)**

COLSS IN SERVICE and Both CEACs INOPERABLE - Maintaining COLSS calculated core power less than or equal to COLSS calculated core power operation limit based on DNBR decreased by the allowance shown in Figure 3.2.4-1.

COLSS OUT OF SERVICE and Either One or Both CEACs are OPERABLE - Operating within the region of acceptable operation of Figure 3.2.4-2 using any operable CPC channel.

COLSS OUT OF SERVICE and CEACs INOPERABLE - Operating within the region of acceptable operation of Figure 3.2.4-3 using any operable CPC channel.

## PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

### 3.2.5 - Axial Shape Index (ASI)

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

COLSS OPERABLE

$-0.18 \leq \text{ASI} \leq 0.18$  for power  $\geq 50\%$

$-0.28 \leq \text{ASI} \leq 0.18$  for power  $< 50\%$

COLSS OUT OF SERVICE (CPC)

$-0.10 \leq \text{ASI} \leq 0.10$

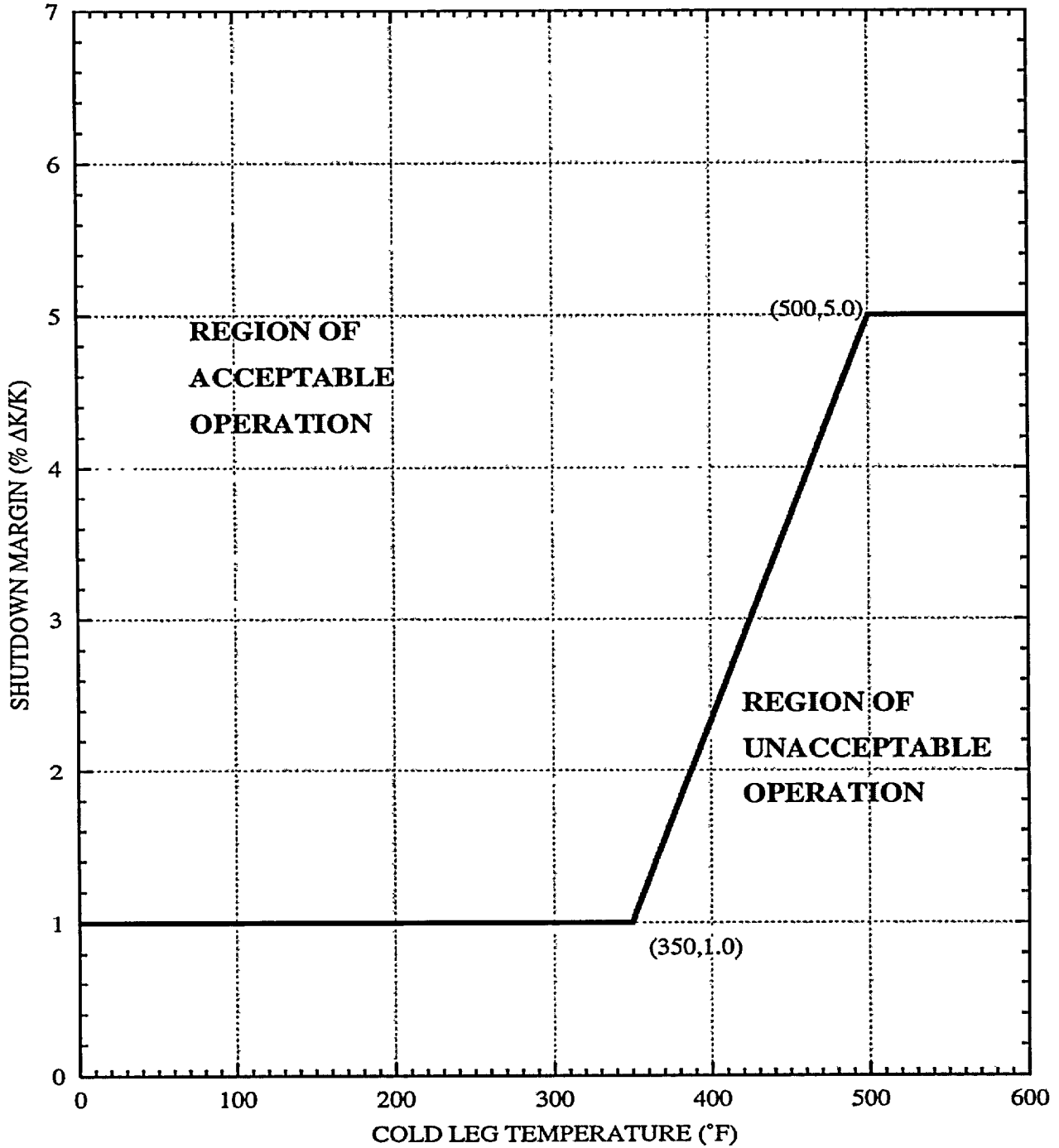
### 3.3.12 - Boron Dilution Alarm System (BDAS)

With one or both start-up channel high neutron flux alarms inoperable, the RCS boron concentration shall be determined at the applicable monitoring frequency specified in Tables 3.3.12-1 through 3.3.12-5.

### 3.9.1 - Boron Concentration

The boron concentration of all filled portions of the Reactor Coolant System and the refueling canal shall be maintained at a uniform concentration  $\geq 3000$  ppm.

**FIGURE 3.1.1-1  
SHUTDOWN MARGIN VERSUS COLD LEG TEMPERATURE  
REACTOR TRIP BREAKERS OPEN**



**FIGURE 3.1.2-1  
SHUTDOWN MARGIN VERSUS COLD LEG TEMPERATURE  
REACTOR TRIP BREAKERS CLOSED**

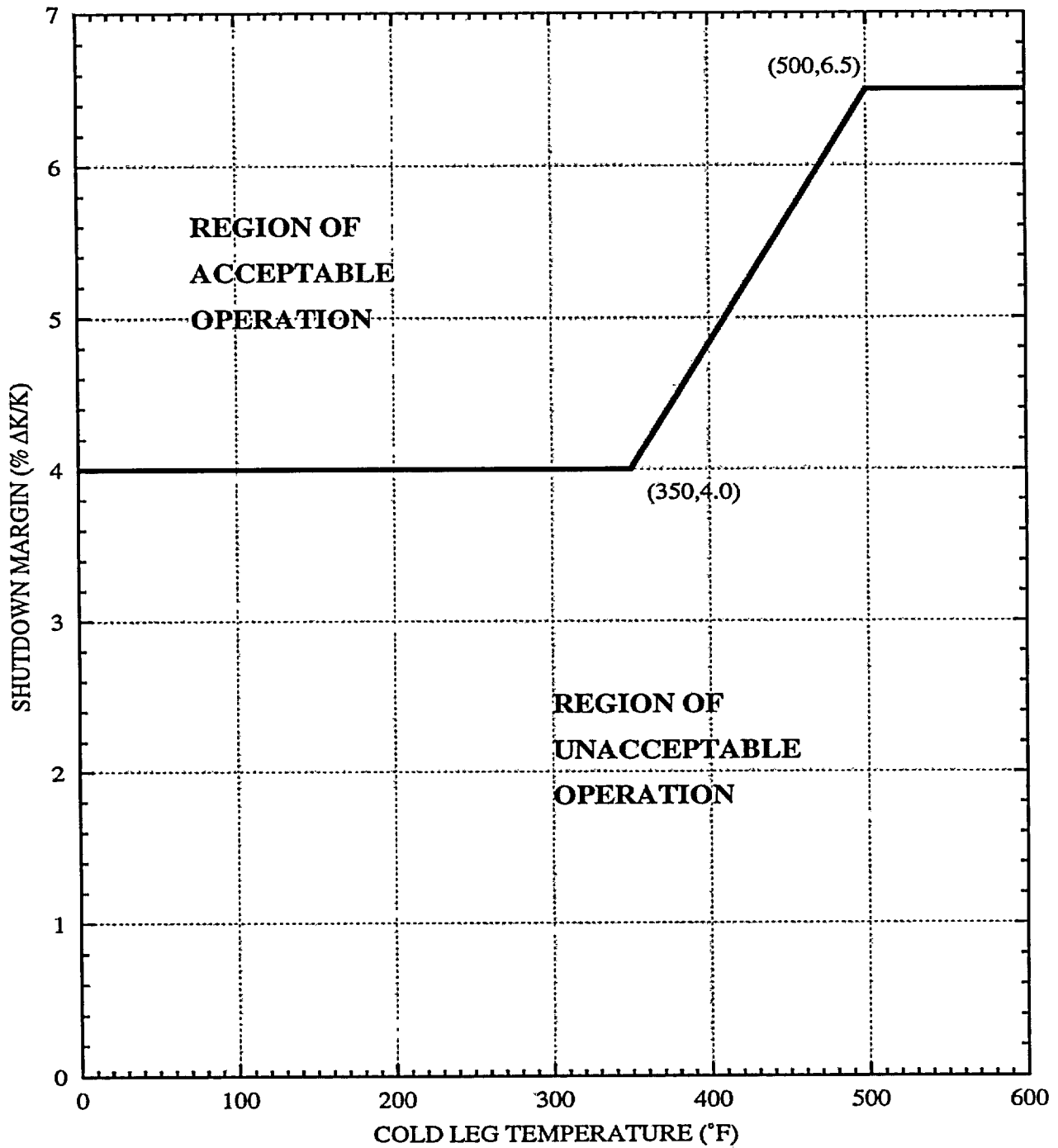
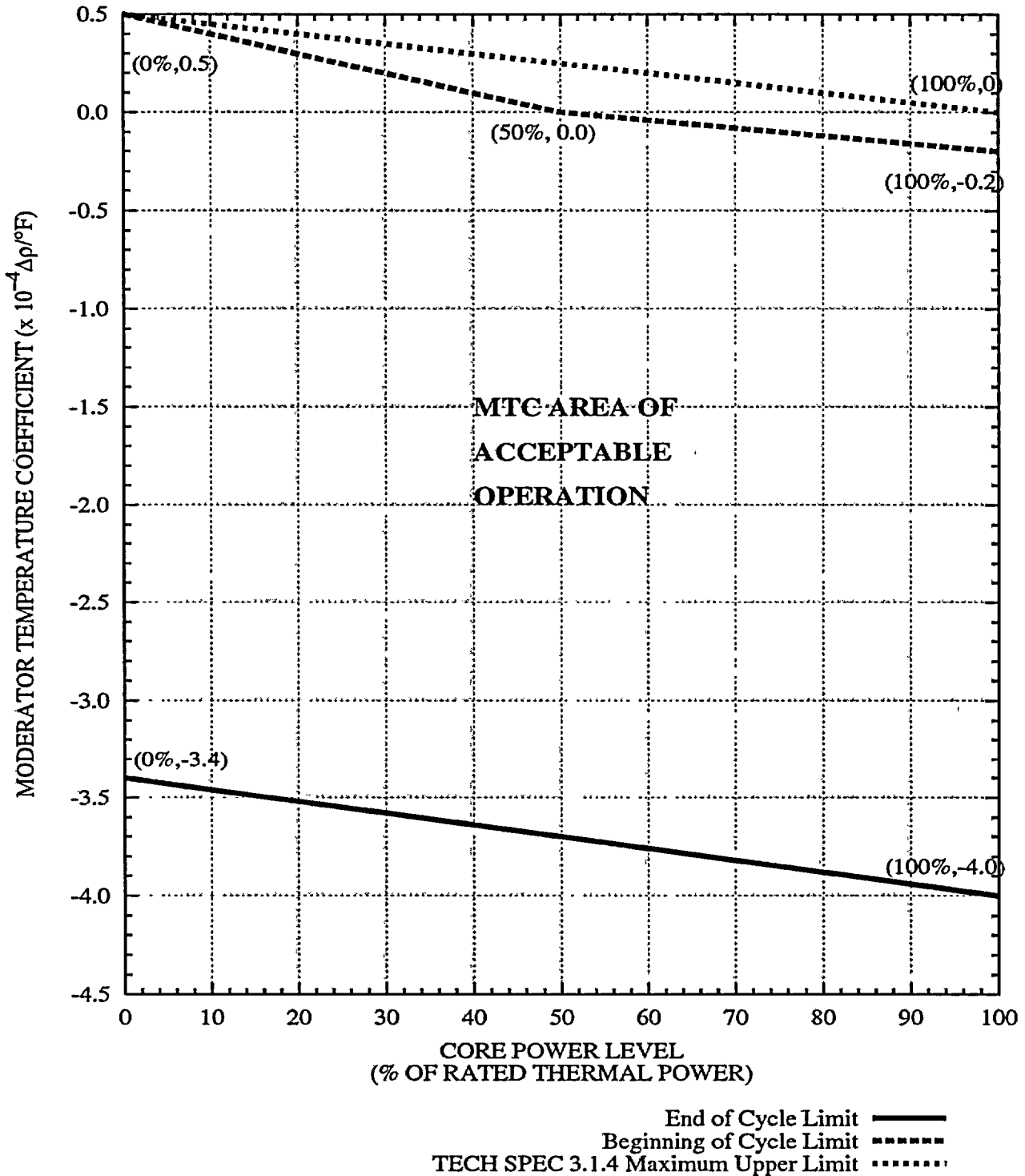


FIGURE 3.1.4-1  
MTC ACCEPTABLE OPERATION, MODES 1 AND 2



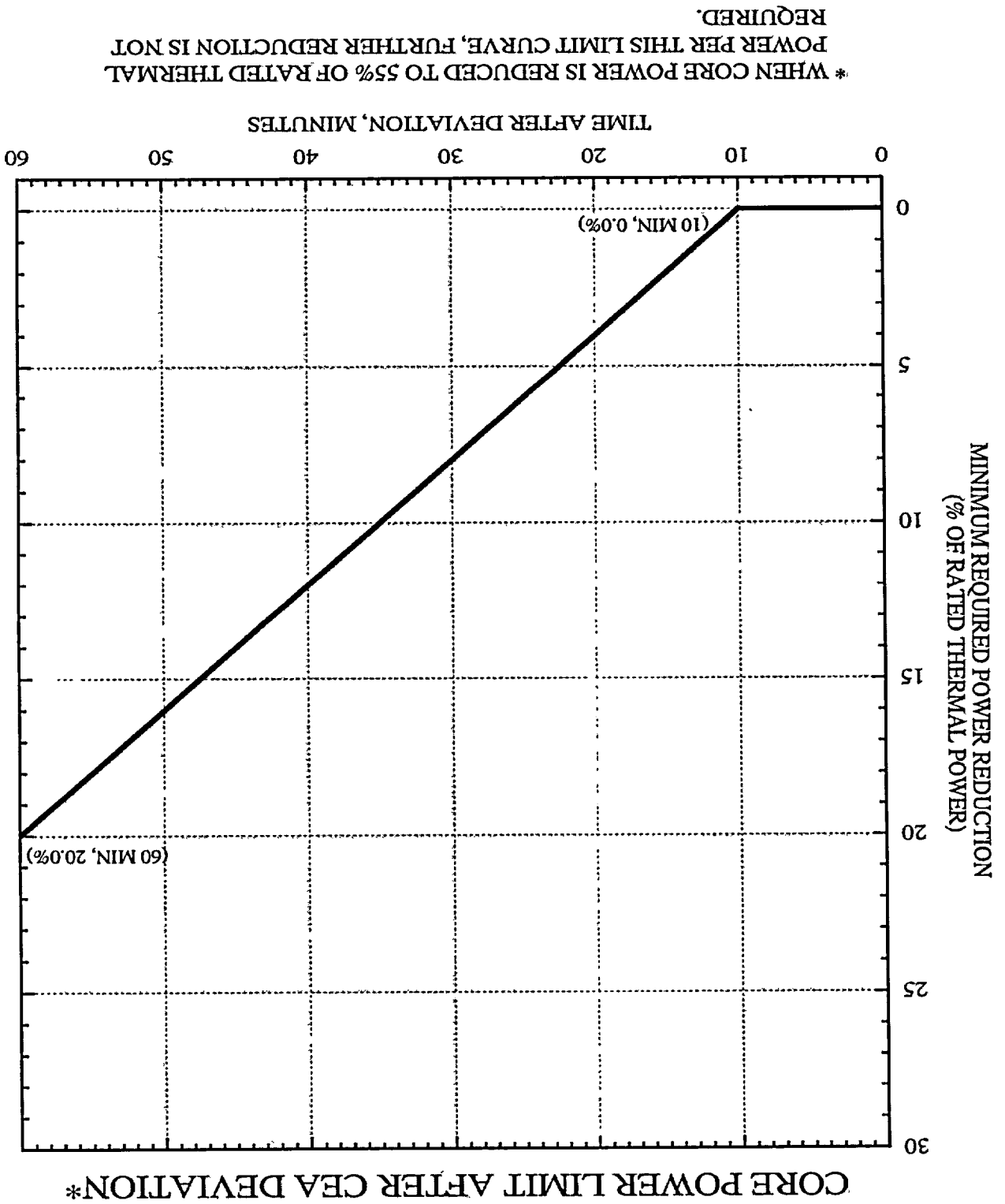


FIGURE 3.1.5-1

CORE POWER LIMIT AFTER CEA DEVIATION\*



**FIGURE 3.1.7-1**  
**CEA INSERTION LIMITS VERSUS THERMAL POWER**  
**(COLSS IN SERVICE)**

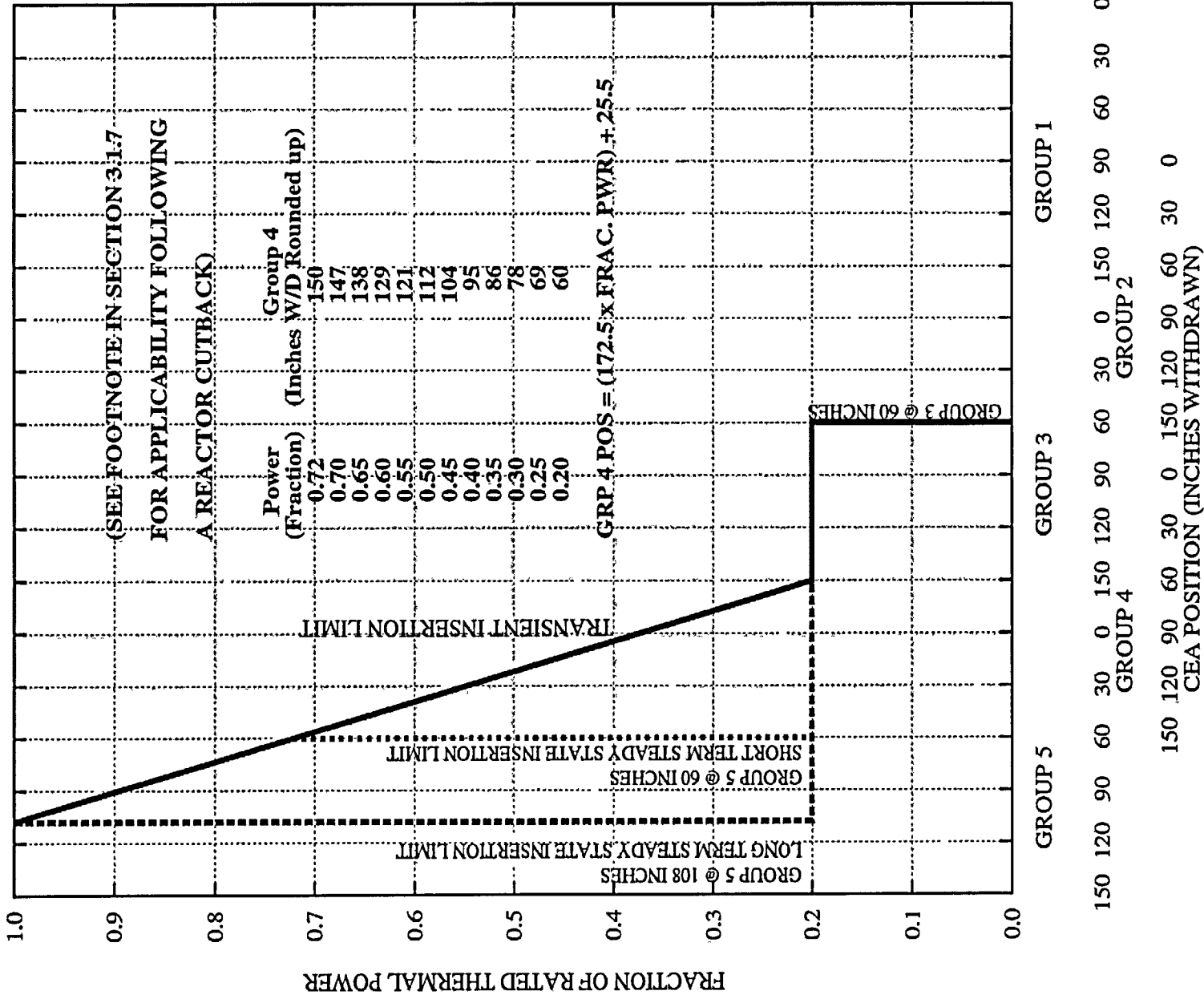


FIGURE 3.1.7-2

CEA INSERTION LIMITS VERSUS THERMAL POWER  
(COLSS OUT OF SERVICE)

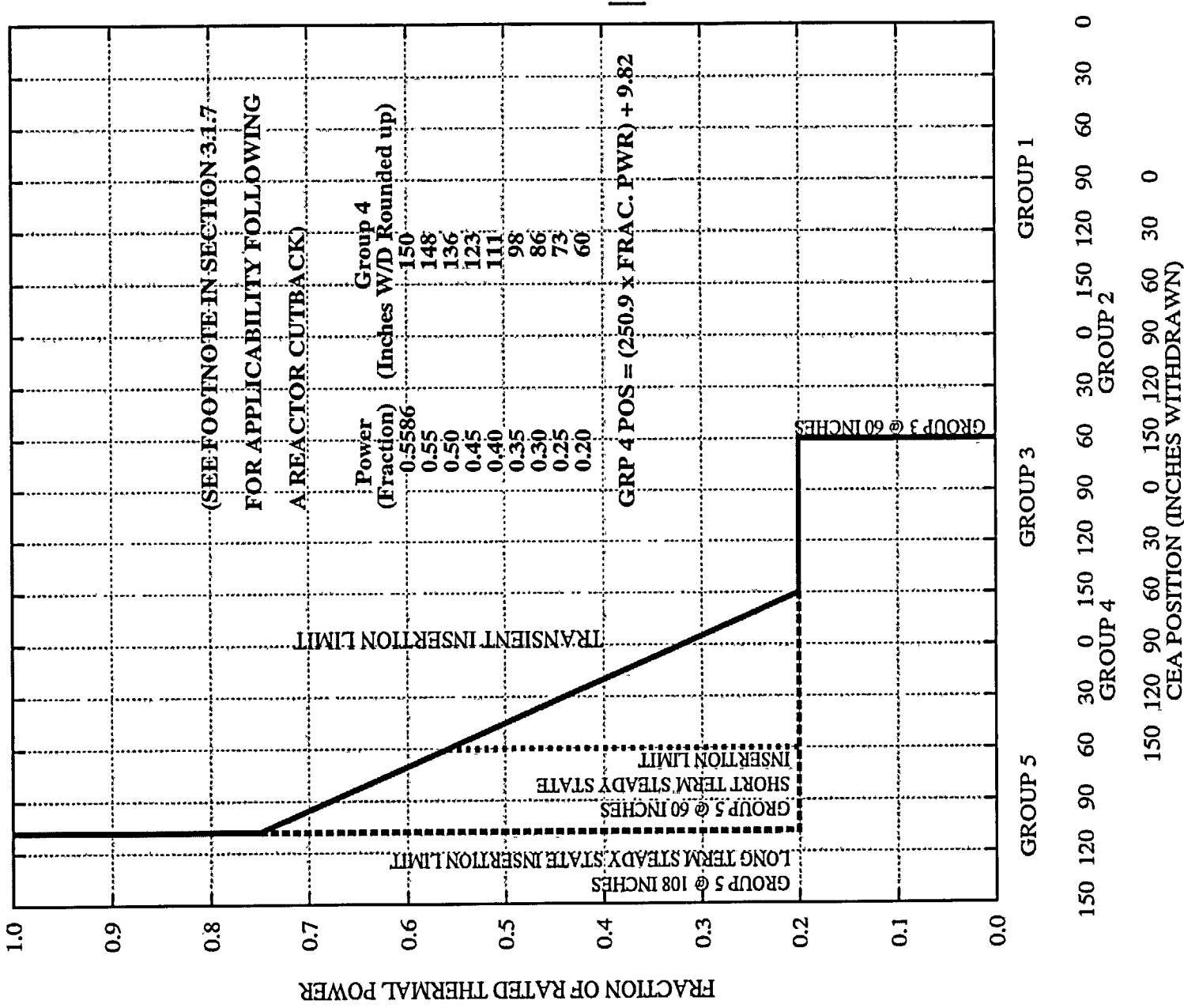


FIGURE 3.1.8-1  
PART LENGTH CEA INSERTION LIMITS  
VERSUS THERMAL POWER

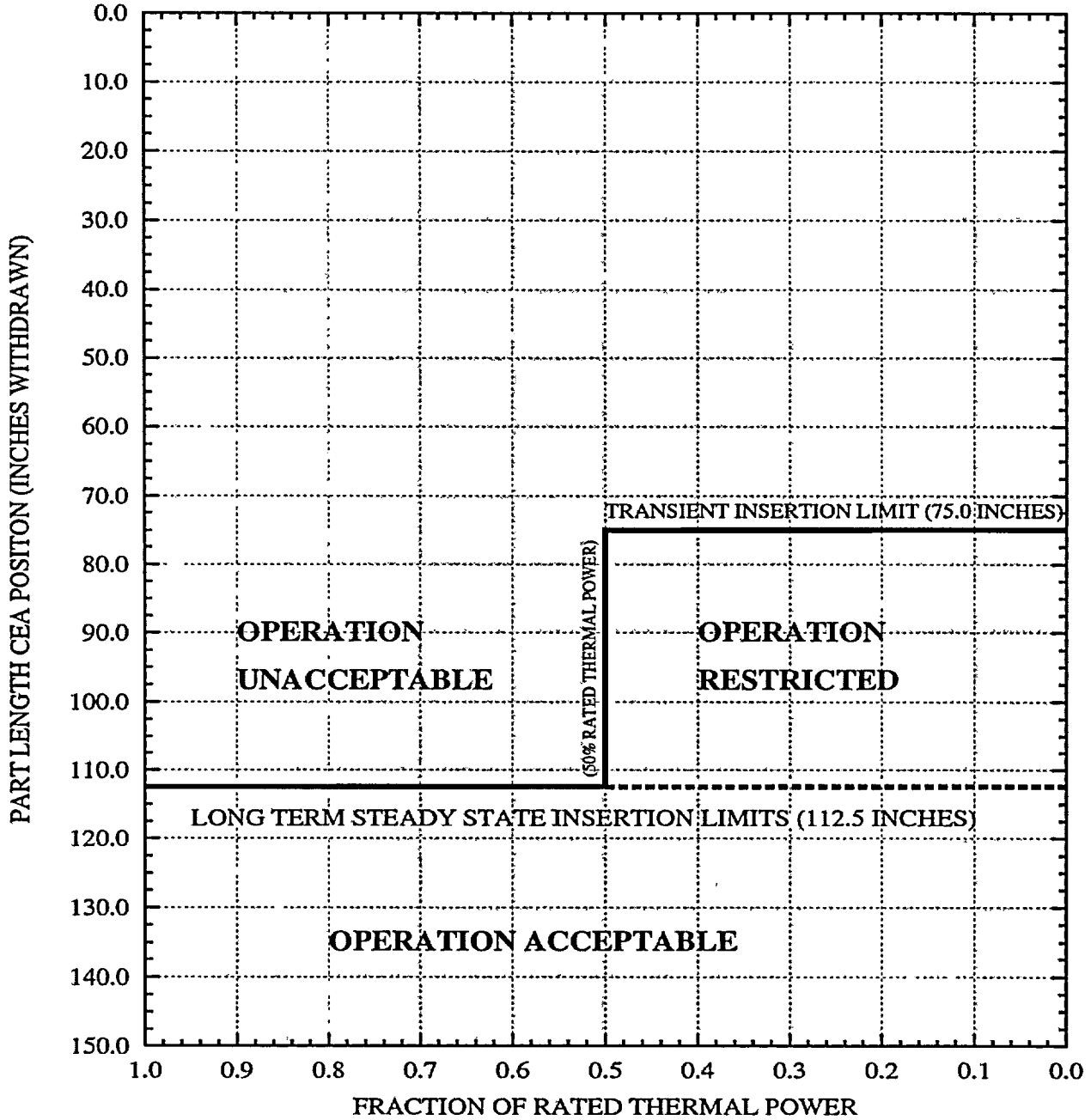
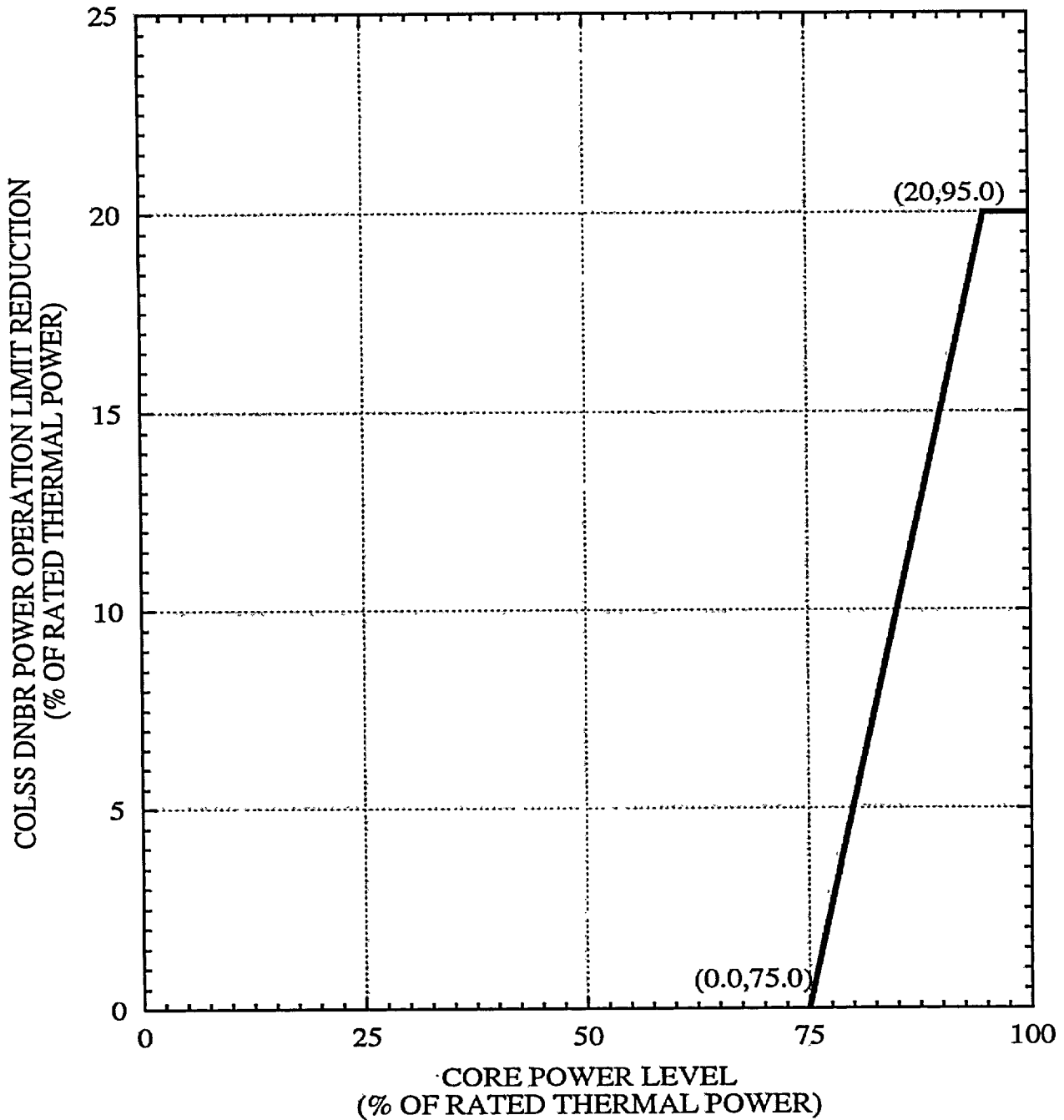
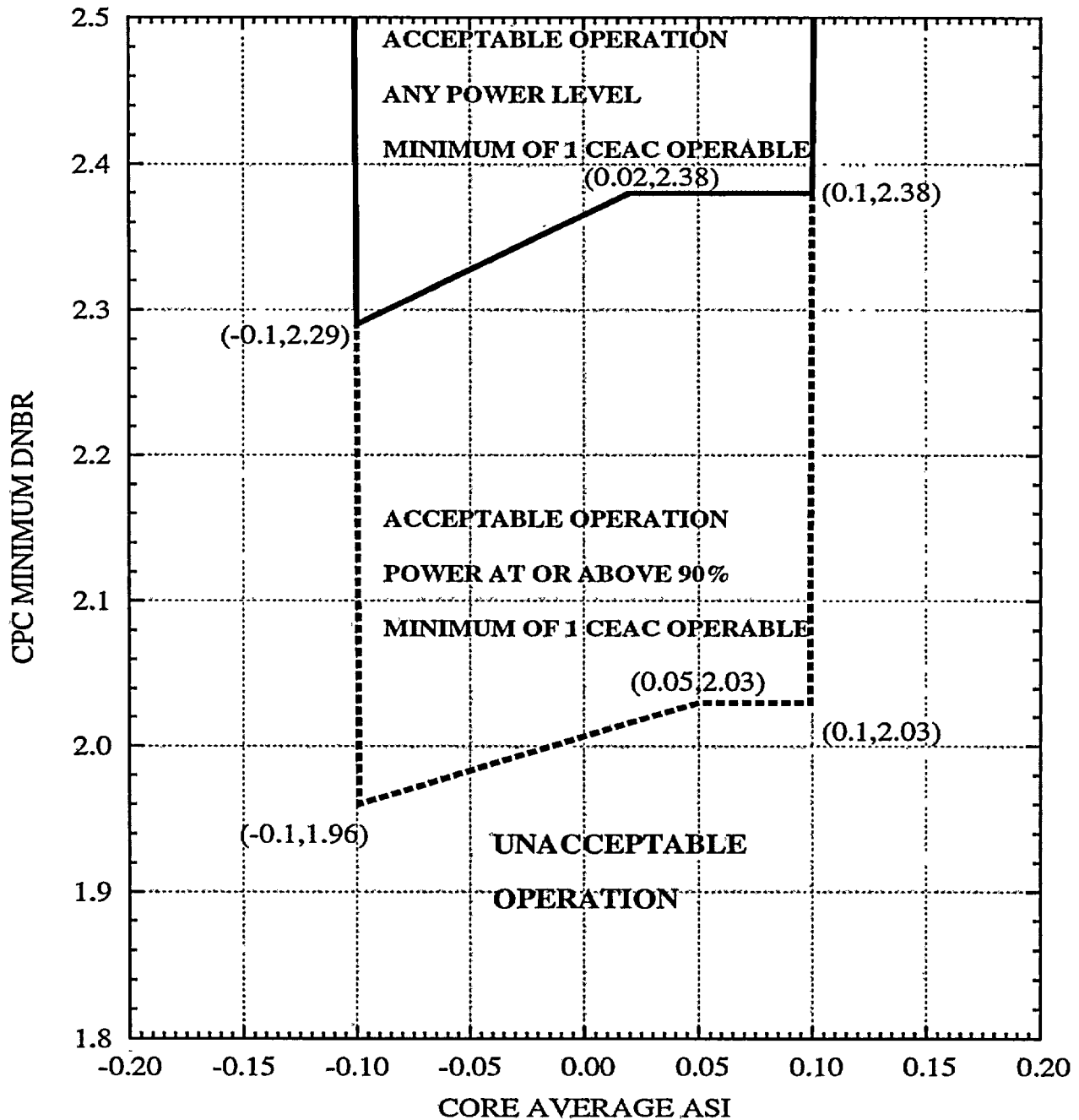


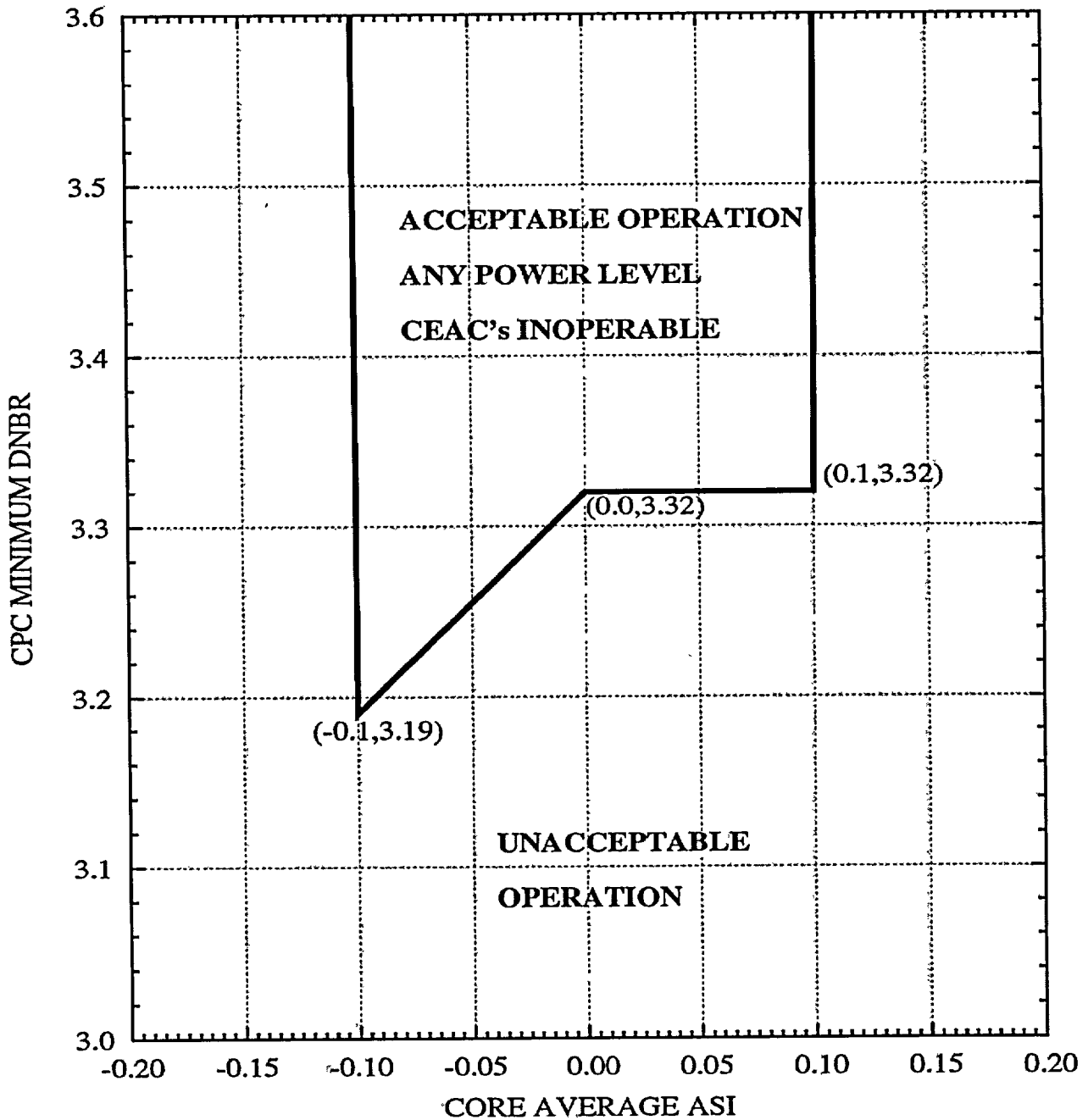
FIGURE 3.2.4-1  
 COLSS DNBR OPERATING LIMIT  
 ALLOWANCE FOR BOTH CEAC'S INOPERABLE



**FIGURE 3.2.4-2  
DNBR MARGIN OPERATING LIMIT BASED ON  
THE CORE PROTECTION CALCULATORS  
(COLSS OUT OF SERVICE, CEAC's OPERABLE)**



**FIGURE 3.2.4-3  
DNBR MARGIN OPERATING LIMIT BASED ON  
THE CORE PROTECTION CALCULATORS  
(COLSS OUT OF SERVICE, CEAC's INOPERABLE)**



## PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

Table 3.3.12-1

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON  
DILUTION DETECTION AS A FUNCTION OF OPERATING  
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR  $K_{eff} > 0.98$

| OPERATIONAL<br>MODE | Number of Operating Charging Pumps |           |     |     |
|---------------------|------------------------------------|-----------|-----|-----|
|                     | 0                                  | 1         | 2   | 3   |
| 3                   | 12 hours                           | 0.5 hours | ONA | ONA |
| 4 not on SCS        | 12 hours                           | 0.5 hours | ONA | ONA |
| 5 not on SCS        | 8 hours                            | 0.5 hours | ONA | ONA |
| 4 & 5 on SCS        | ONA                                | ONA       | ONA | ONA |

Notes: SCS = Shutdown Cooling System  
ONA = Operation Not Allowed

## PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

Table 3.3.12-2

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON  
DILUTION DETECTION AS A FUNCTION OF OPERATING  
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR  $0.98 \geq K_{eff} > 0.97$

| OPERATIONAL<br>MODE | Number of Operating Charging Pumps |           |           |     |
|---------------------|------------------------------------|-----------|-----------|-----|
|                     | 0                                  | 1         | 2         | 3   |
| 3                   | 12 hours                           | 1 hour    | 0.5 hours | ONA |
| 4 not on SCS        | 12 hours                           | 1.5 hours | 0.5 hours | ONA |
| 5 not on SCS        | 8 hours                            | 1.5 hours | 0.5 hours | ONA |
| 4 & 5 on SCS        | 8 hours                            | 0.5 hours | ONA       | ONA |

Notes: SCS = Shutdown Cooling System  
ONA = Operation Not Allowed



## PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

Table 3.3.12-3

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON  
DILUTION DETECTION AS A FUNCTION OF OPERATING  
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR  $0.97 \geq K_{eff} > 0.96$

| OPERATIONAL<br>MODE | Number of Operating Charging Pumps |           |        |           |
|---------------------|------------------------------------|-----------|--------|-----------|
|                     | 0                                  | 1         | 2      | 3         |
| 3                   | 12 hours                           | 2.5 hours | 1 hour | ONA       |
| 4 not on SCS        | 12 hours                           | 2.5 hours | 1 hour | 0.5 hours |
| 5 not on SCS        | 8 hours                            | 2.5 hours | 1 hour | 0.5 hours |
| 4 & 5 on SCS        | 8 hours                            | 1 hour    | ONA    | ONA       |

Notes: SCS = Shutdown Cooling System  
ONA = Operation Not Allowed

## PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

Table 3.3.12-4

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON  
DILUTION DETECTION AS A FUNCTION OF OPERATING  
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR  $0.96 \geq K_{\text{eff}} > 0.95$

| OPERATIONAL<br>MODE | Number of Operating Charging Pumps |           |           |            |
|---------------------|------------------------------------|-----------|-----------|------------|
|                     | 0                                  | 1         | 2         | 3          |
| 3                   | 12 hours                           | 3 hours   | 1 hour    | 0.5 hours  |
| 4 not on SCS        | 12 hours                           | 3.5 hours | 1.5 hours | 0.75 hours |
| 5 not on SCS        | 8 hours                            | 3.5 hours | 1.5 hours | 0.75 hours |
| 4 & 5 on SCS        | 8 hours                            | 1.5 hours | 0.5 hours | ONA        |

Notes: SCS = Shutdown Cooling System  
ONA = Operation Not Allowed

## PVNGS UNIT 1 CORE OPERATING LIMITS REPORT

Table 3.3.12-5

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON  
DILUTION DETECTION AS A FUNCTION OF OPERATING  
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR  $K_{eff} \leq 0.95$

| OPERATIONAL<br>MODE | Number of Operating Charging Pumps |           |            |        |
|---------------------|------------------------------------|-----------|------------|--------|
|                     | 0                                  | 1         | 2          | 3      |
| 3                   | 12 hours                           | 4 hours   | 1.5 hours  | 1 hour |
| 4 not on SCS        | 12 hours                           | 4.5 hours | 2 hours    | 1 hour |
| 5 not on SCS        | 8 hours                            | 4.5 hours | 2 hours    | 1 hour |
| 4 & 5 on SCS        | 8 hours                            | 2 hours   | 0.75 hours | ONA    |
| 6                   | 24 hours                           | 1.5 hours | ONA        | ONA    |

Notes: SCS = Shutdown Cooling System  
ONA = Operation Not Allowed