Core Operating Limits Report
PVNGS Unit 2, Revision 1

9809020026 980821
PDR ADOCK 05000528
P PDR

CORE OPERATING LIMITS REPORT

PALO VERDE NUCLEAR GENERATING STATION (PVNGS)

UNIT 2

Revision 1

PVNGS UNIT 2 CORE OPERATING LIMITS REPORT

Table of Contents

Description	Revision #	Page
Cover Page	1	1
Table of Contents	1	2
Affected Technical Specifications	1	4
CORE Operating Limits		
3.1.1 Shutdown Margin (SDM) - Reactor Trip Breakers Open	1	4
3.1.2 Shutdown Margin (SDM) - Reactor Trip Breakers Closed	1	4
3.1.4 Moderator Temperature Coefficient (MTC)	1	5
3.1.5 Control Element Assembly (CEA) Alignment	1	5
3.1.7 Regulating CEA Insertion Limits	1	5
3.1.8 Part Length CEA Insertion Limits	1	5
3.2.1 Linear Heat Rate (LHR)	1	6
3.2.3 Azimuthal Power Tilt (Tq)	1	6
3.2.4 Departure From Nucleate Boiling Ratio (DNBR)	1	6
3.2.5 Axial Shape Index (ASI)	1	7
3.3.12 Boron Dilution Alarm System (BDAS)	1	7
3.9.1 Boron Concentration	1	7
List of Figures	1	8
Figure 3.1.1-1 Shutdown Margin Versus Cold Leg Temperature Reactor Trip Breakers Open	1	9
Figure 3.1.2-1 Shutdown Margin Versus Cold Leg Temperature Reactor Trip Breakers Closed	1	10
Figure 3.1.4-1 MTC Acceptable Operation, Modes 1 and 2	1	11
Figure 3.1.5-1 Core Power Limit After CEA Deviation	1	12
Figure 3.1.7-1 CEA Insertion Limits Versus Thermal Power (COLSS in Service)	1	13
Figure 3.1.7-2 CEA Insertion Limits Versus Thermal Power (COLSS Out of Service)	1	14
Figure 3.1.8-1 Part Length CEA Insertion Limits Versus Thermal Power	1	15

PVNGS UNIT 2 CORE OPERATING LIMITS REPORT
Table of Contents (Continued)

Description	Revision #	Page
Figure 3.2.3-1 Azimuthal Power Tilt Versus Thermal Power (COLSS in Service)	1	16
Figure 3.2.4-1 COLSS DNBR Operating Limit Allowance for Both CEACs Inoperable	1	17
Figure 3.2.4-2 DNBR Margin Operating Limit Based on the Core Protection Calculators (COLSS Out of Service, CEACs Operable)	1	18
Figure 3.2.4-3 DNBR Margin Operating Limit Based on the Core Protection Calculators (COLSS Out of Service, CEACs Inoperable)	1	19
List of Tables	1	20
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 Keff> 0.98	1	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 ≥ Keff > 0.97	1	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 ≥ Keff > 0.96	1	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 ≥ Keff > 0.95	1	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 Keff ≤ 0.95	1	25

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 2 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

CORE OPERATING LIMITS

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.

CORE OPERATING LIMITS - CONTINUED

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[1] shown in Figure 3.1.7-1; with COLSS OUT OF SERVICE, regulation CEA groups shall be limited to the withdrawal sequence and to the insertion limits[1] shown in Figure 3.1.7-2.

[1] 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.

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.

CORE OPERATING LIMITS - CONTINUED

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 the limit in Figure 3.2.3-1 with COLSS IN SERVICE.

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.

CORE OPERATING LIMITS - CONTINUED

3.2.5 - Axial Shape Index (ASI)

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

COLSS OPERABLE
$-0.186 \leq ASI \leq 0.164$

COLSS OUT OF SERVICE (CPC)
$-0.10 \leq ASI \leq 0.10$

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 ≥ 3000 ppm.

LIST OF FIGURES

3.1.1-1. Shutdown Margin Versus Cold Leg Temperature, Reactor Trip Breakers Open

3.1.2-1. Shutdown Margin Versus Cold Leg Temperature, Reactor Trip Breakers Closed

3.1.4-1. MTC Acceptable Operation, Modes 1 and 2.

3.1.5-1. Core Power Limit After CEA Deviation.

3.1.7-1. CEA Insertion Limits Versus Thermal Power (COLSS In Service).

3.1.7-2. CEA Insertion Limits Versus Thermal Power (COLSS Out of Service)

3.1.8-1. Part Length CEA Insertion Limit Versus Thermal Power.

3.2.3-1. Azimuthal Power Tilt Limit Versus Thermal Power (COLSS In Service).

3.2.4-1. COLSS DNBR Power Operating Limit Allowance for Both CEACs Inoperable.

3.2.4-2. DNBR Margin Operating Limit Based on Core Protection Calculators (COLSS Out of Service, CEACs Operable)

3.2.4-3. DNBR Margin Operating Limit Based on Core Protection Calculators (COLSS Out of Service, CEACs Inoperable)

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

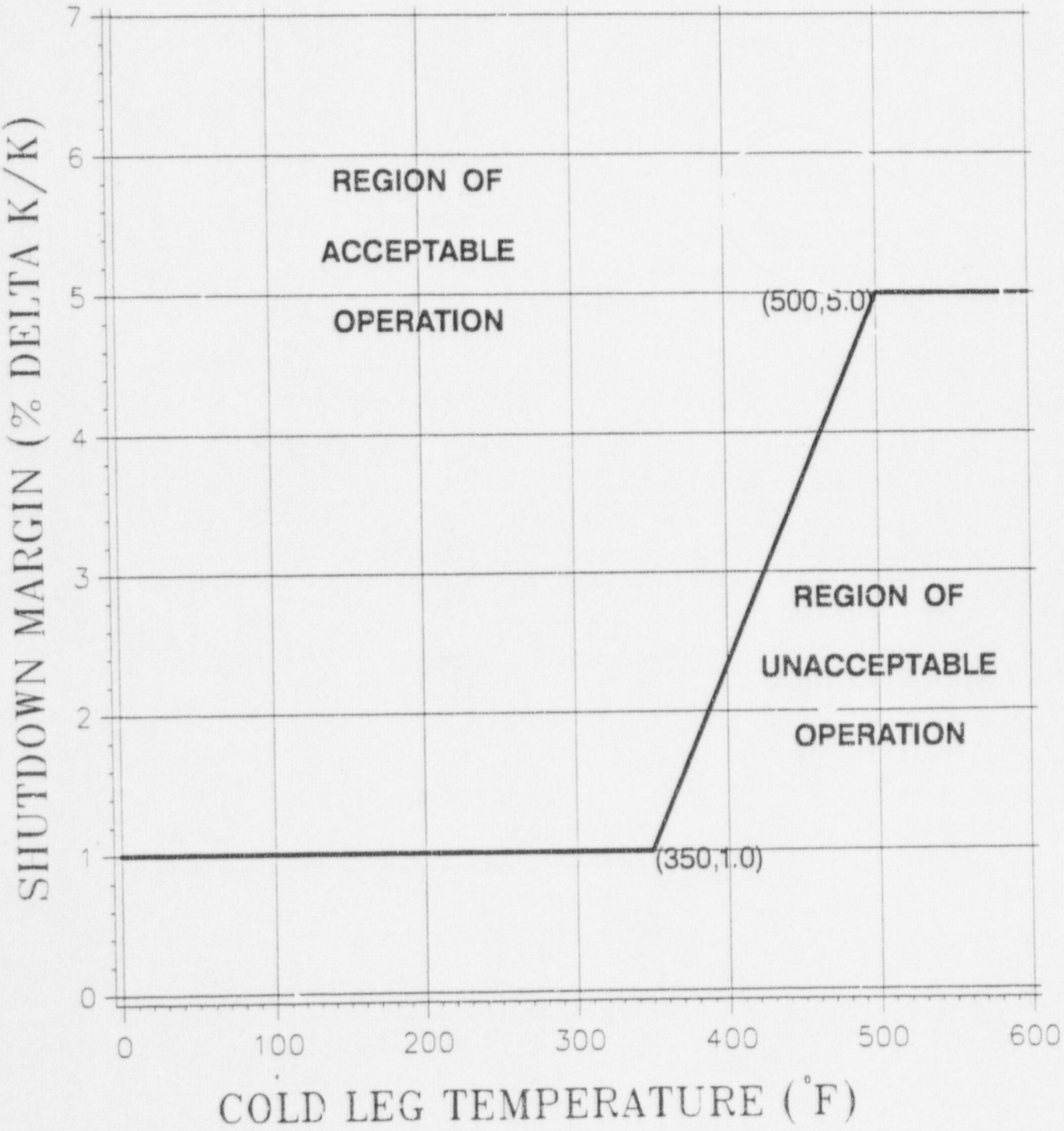
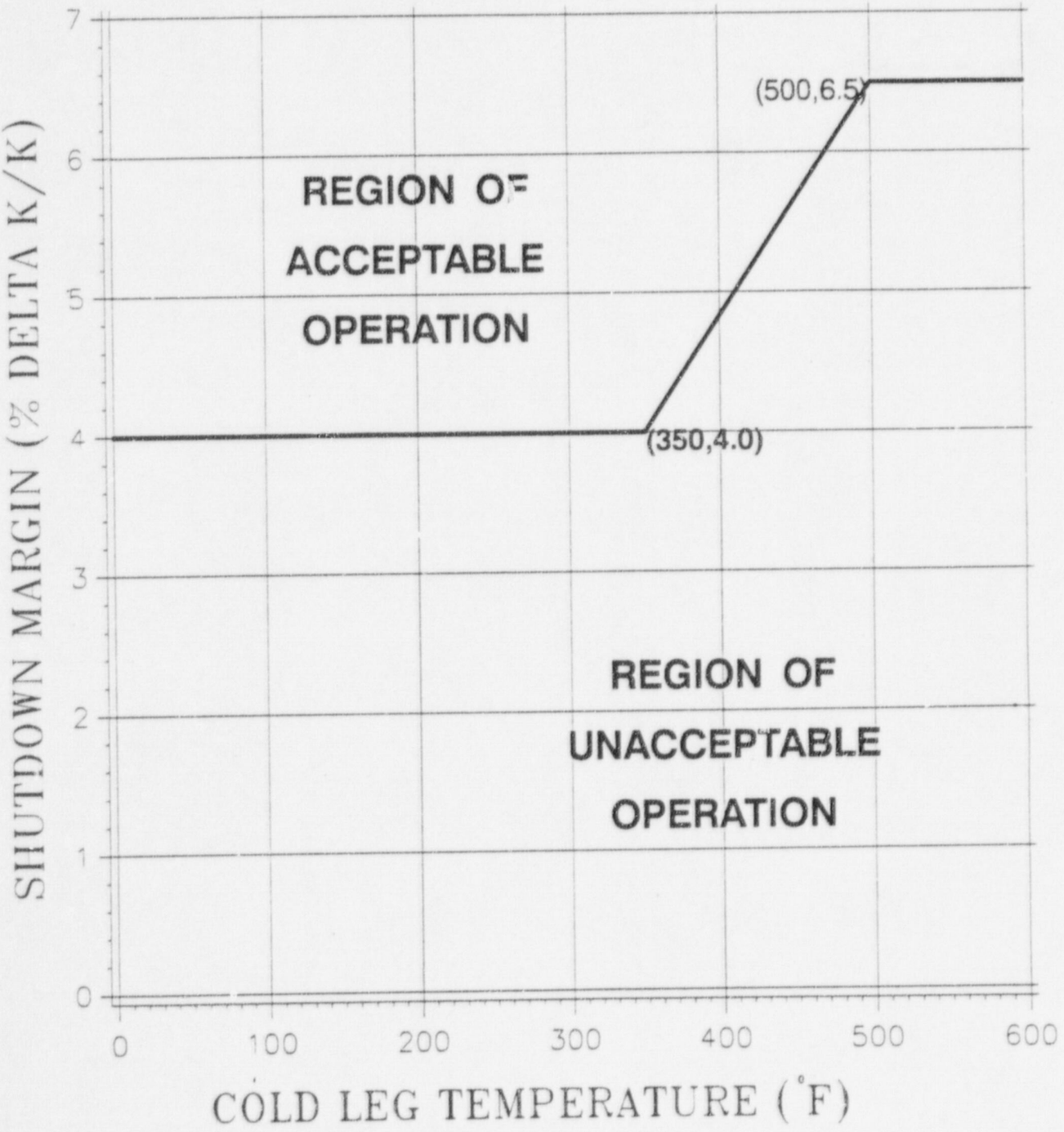


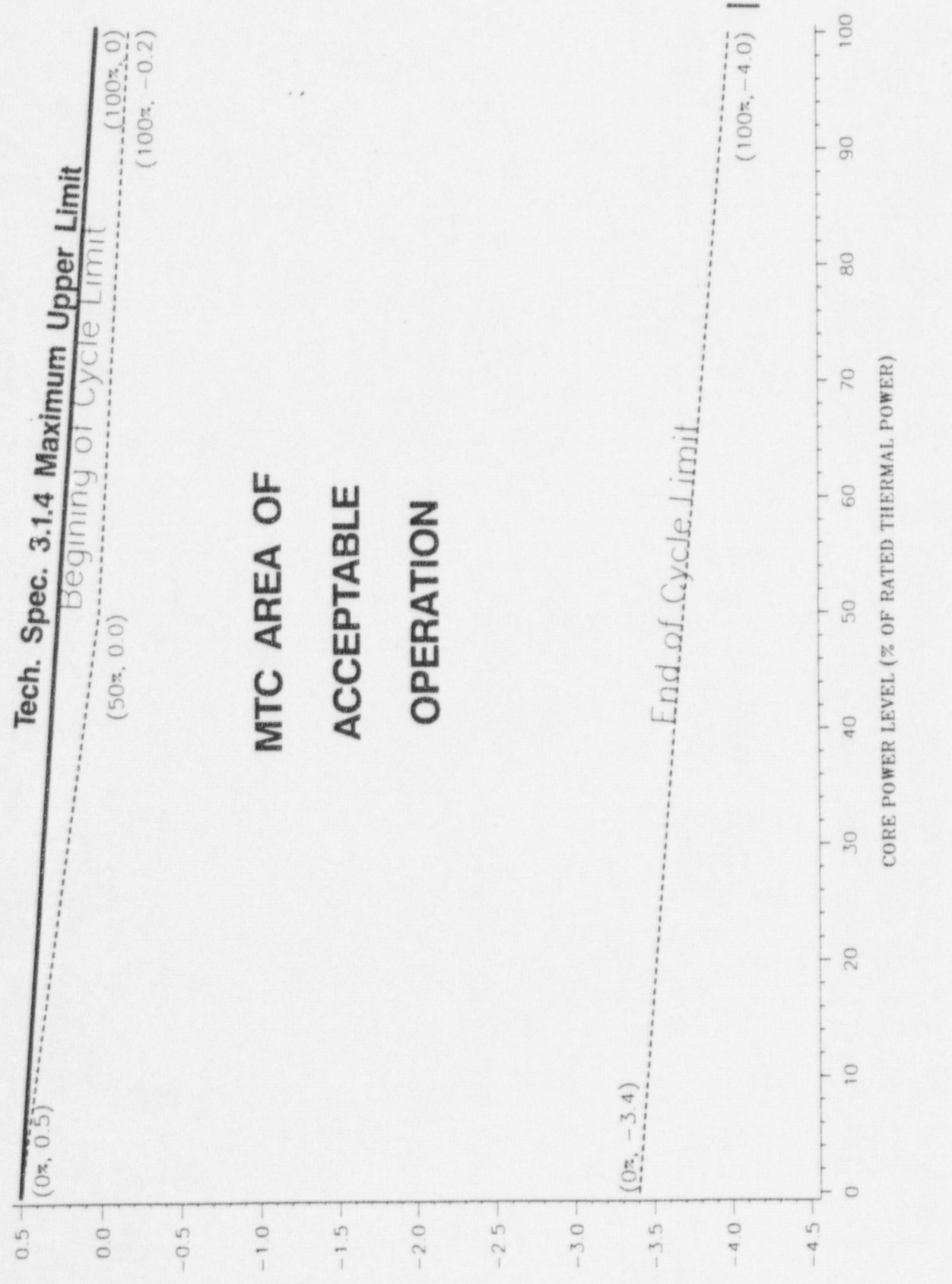
FIGURE 3.1.2-1
SHUTDOWN MARGIN VERSUS COLD LEG TEMPERATURE
REACTOR TRIP BREAKERS CLOSED



PVNGS UNIT 2 CORE OPERATING LIMITS REPORT

FIGURE 3.1.4-1

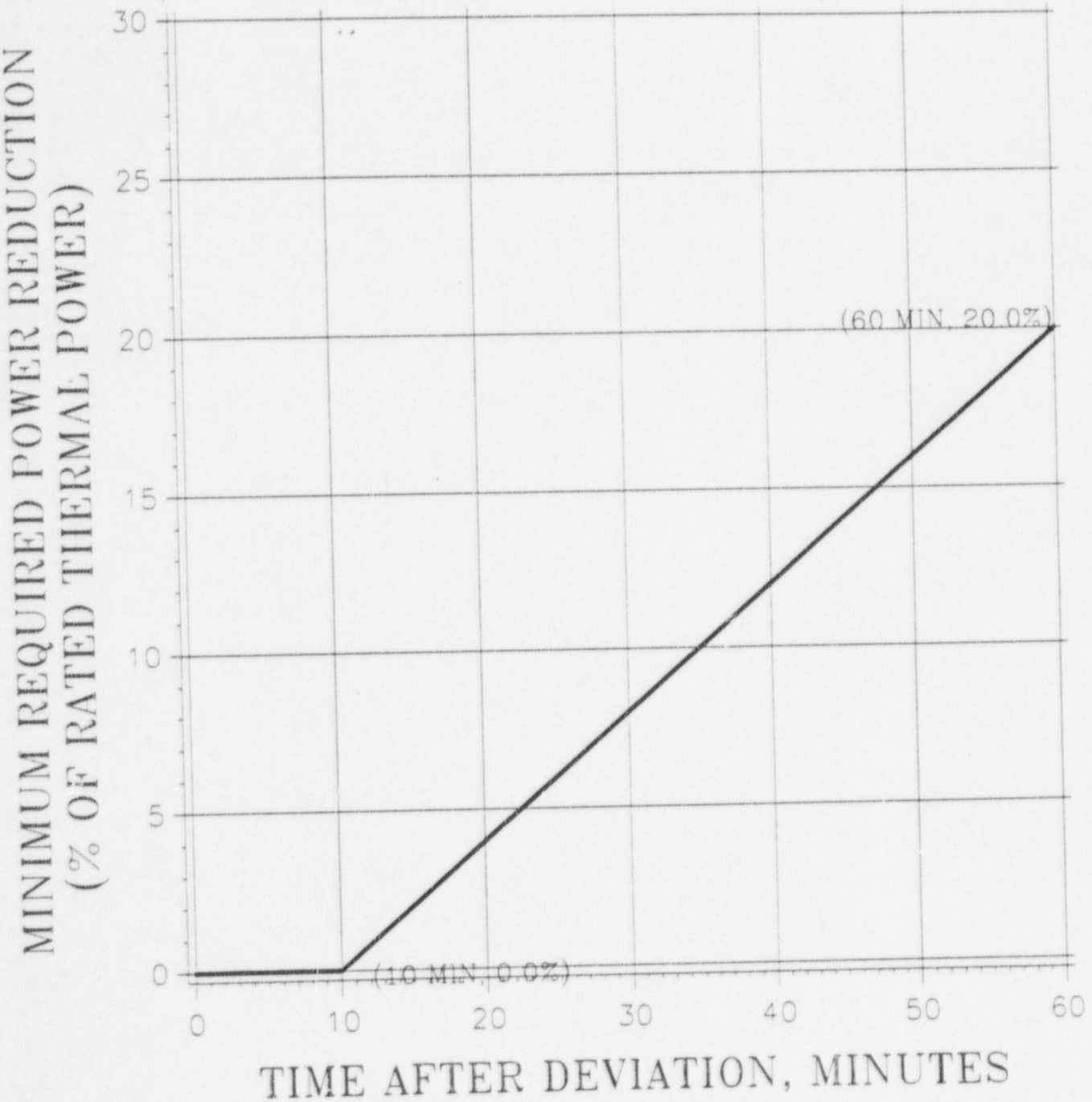
MTC ACCEPTABLE OPERATION, MODES 1 AND 2



PVNGS UNIT 2 CORE OPERATING LIMITS REPORT

FIGURE 3.1.5-1

CORE POWER LIMIT AFTER CEA DEVIATION *



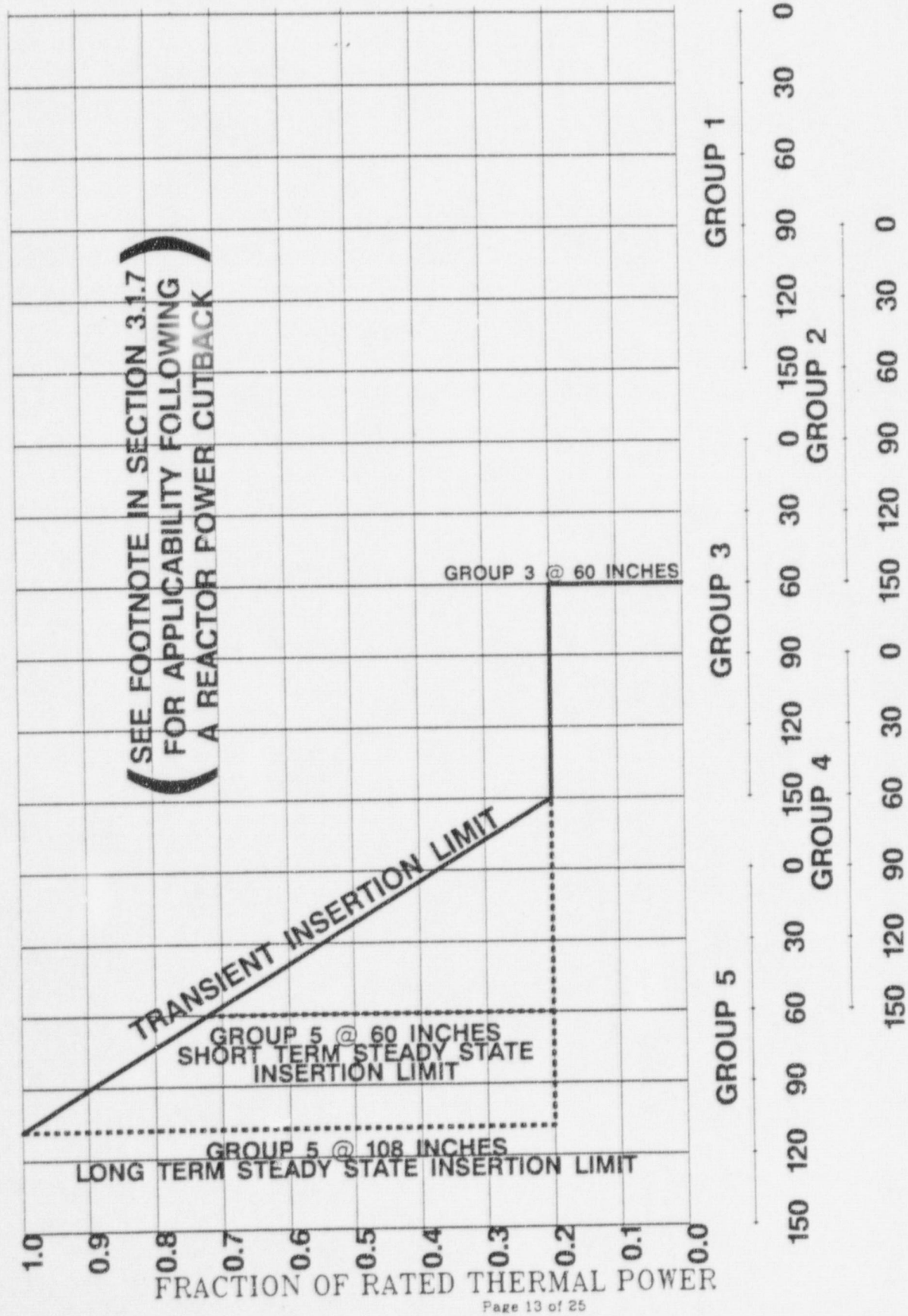
* WHEN CORE POWER IS REDUCED TO 55% OF RATED THERMAL POWER PER THIS LIMIT CURVE, FURTHER REDUCTION IS NOT REQUIRED

PVNGS UNIT 2 CORE OPERATING LIMITS REPORT

FIGURE 3.1.7-1

CEA INSERTION LIMITS VERSUS THERMAL POWER

(COLSS IN SERVICE)

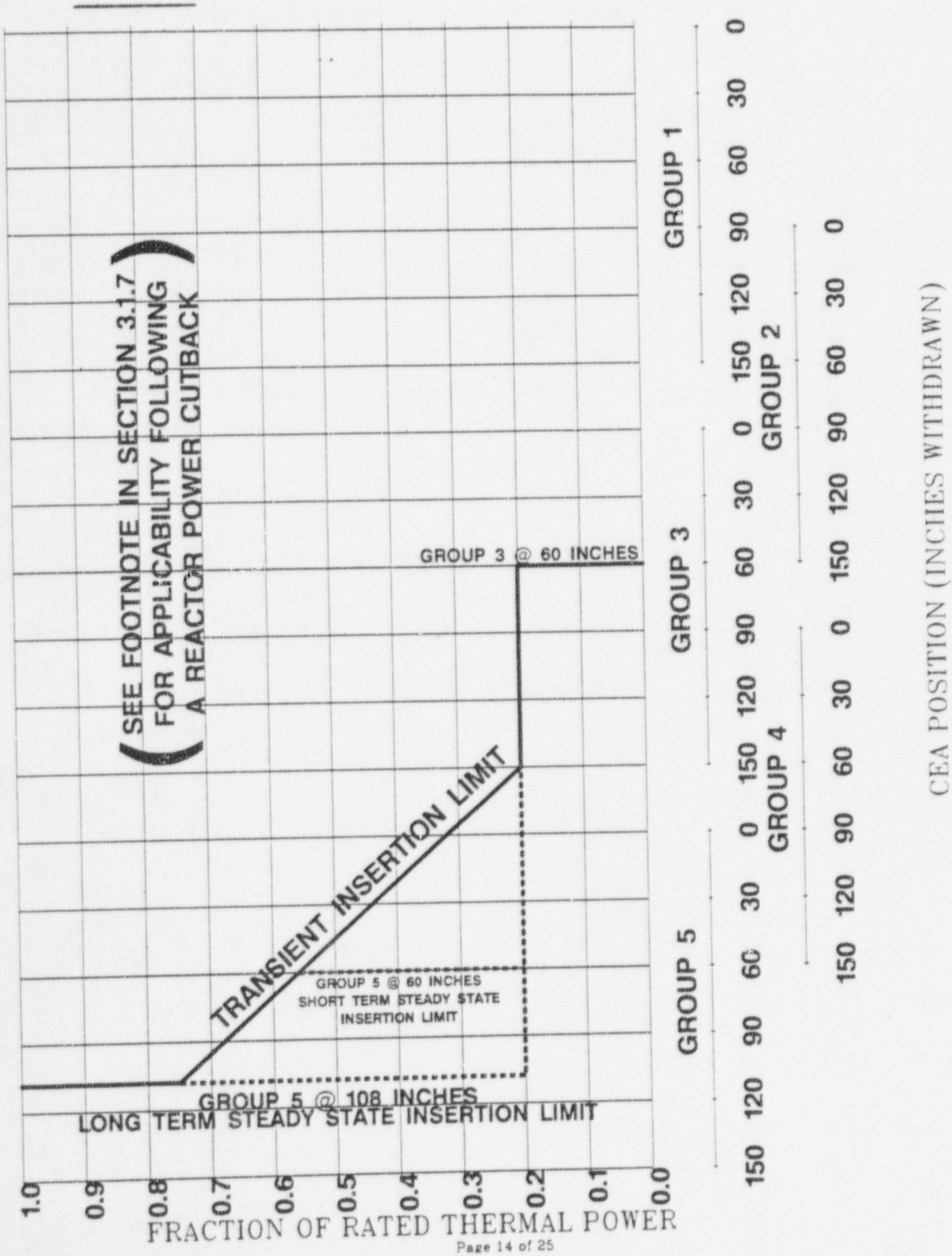


PVNGS UNIT 2 CORE OPERATING LIMITS REPORT

FIGURE 3.1.7-2

CEA INSERTION LIMITS VERSUS THERMAL POWER

(COLSS OUT OF SERVICE)



PVNGS UNIT 2 CORE OPERATING LIMITS REPORT

FIGURE 3.1.8-1

PART LENGTH CEA INSERTION LIMITS VERSUS THERMAL POWER

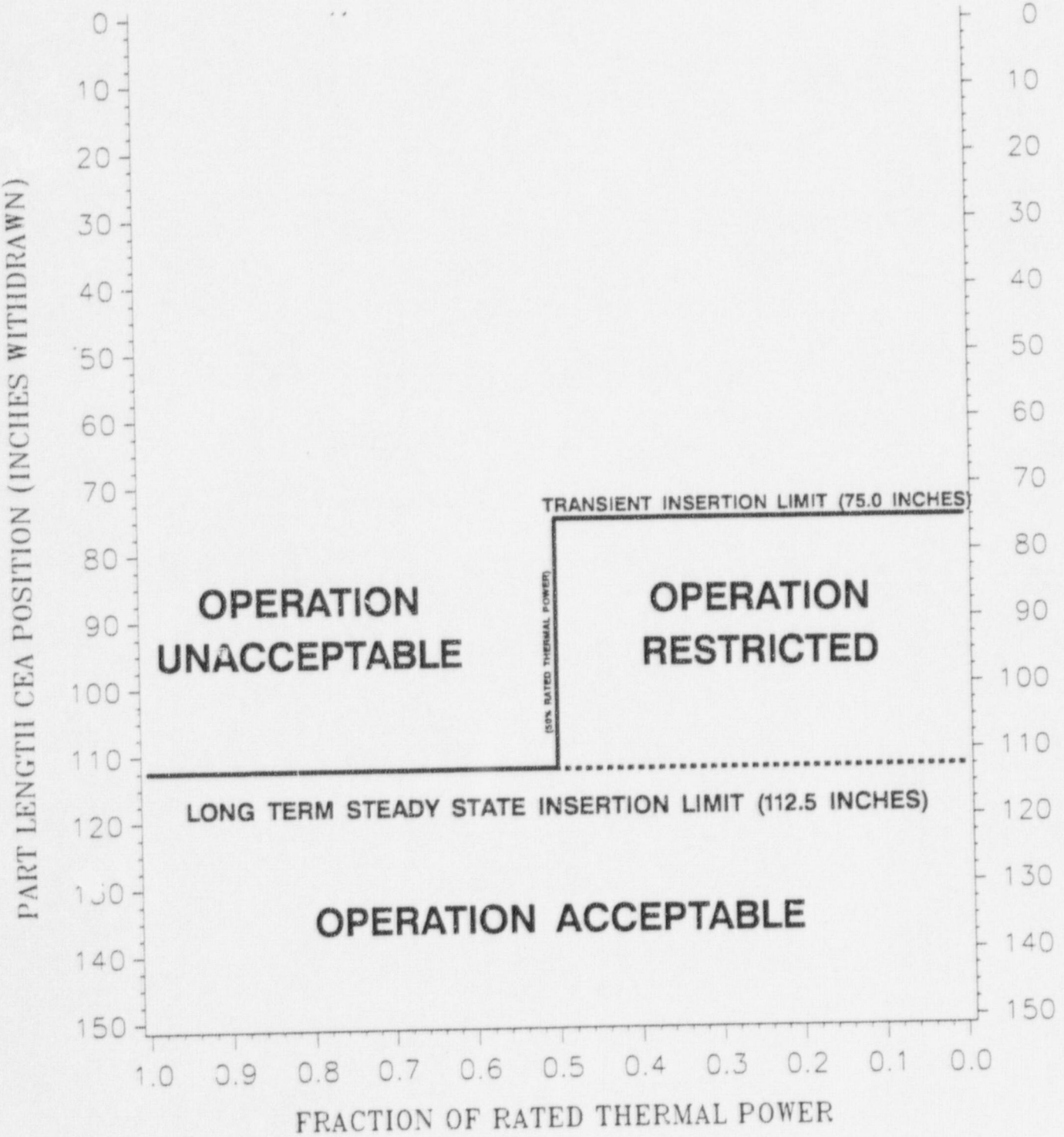
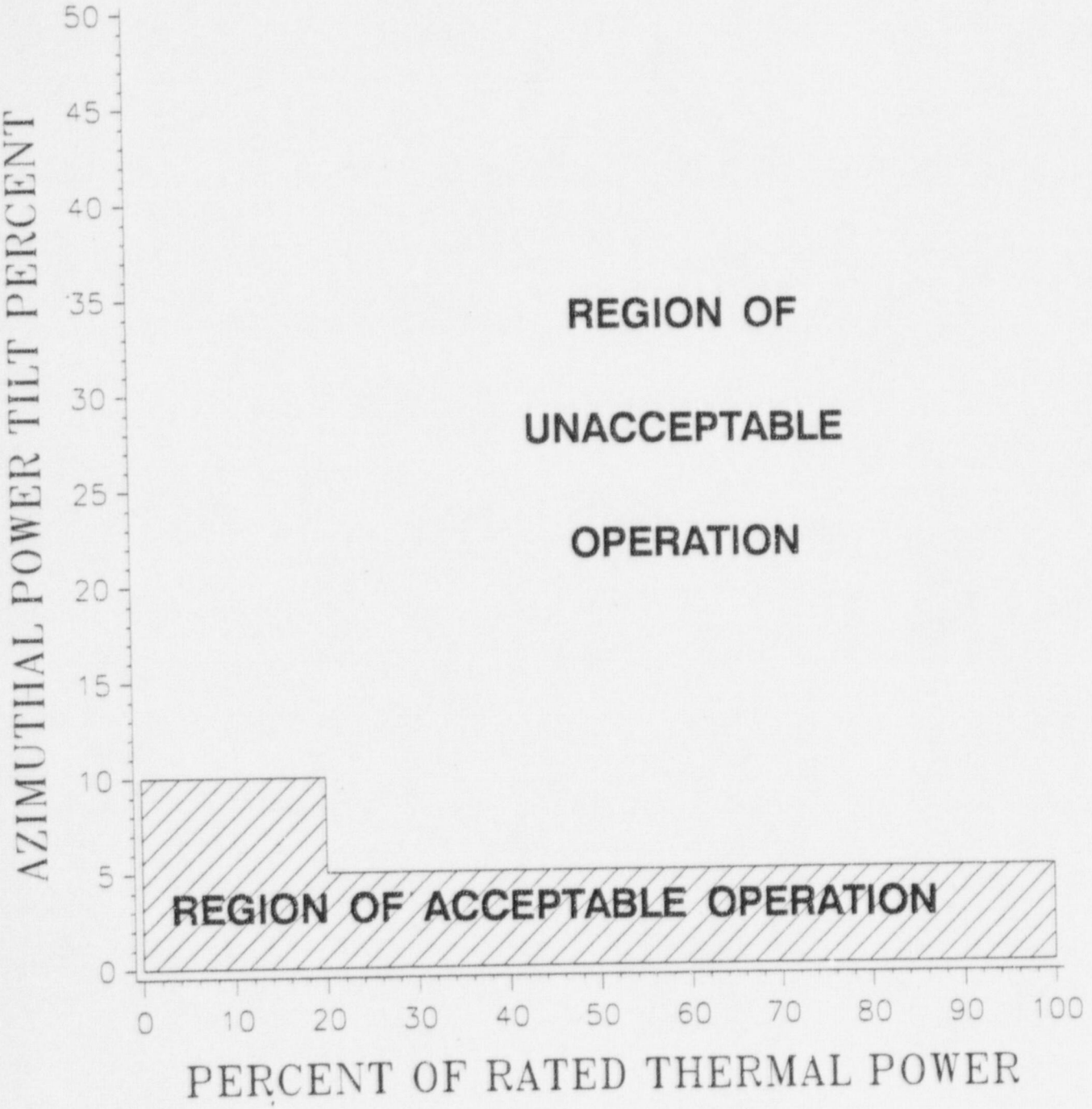


FIGURE 3.2.3-1
AZIMUTHAL POWER TILT VERSUS THERMAL POWER
(COLSS IN SERVICE)



PVNGS UNIT 2 CORE OPERATING LIMITS REPORT

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

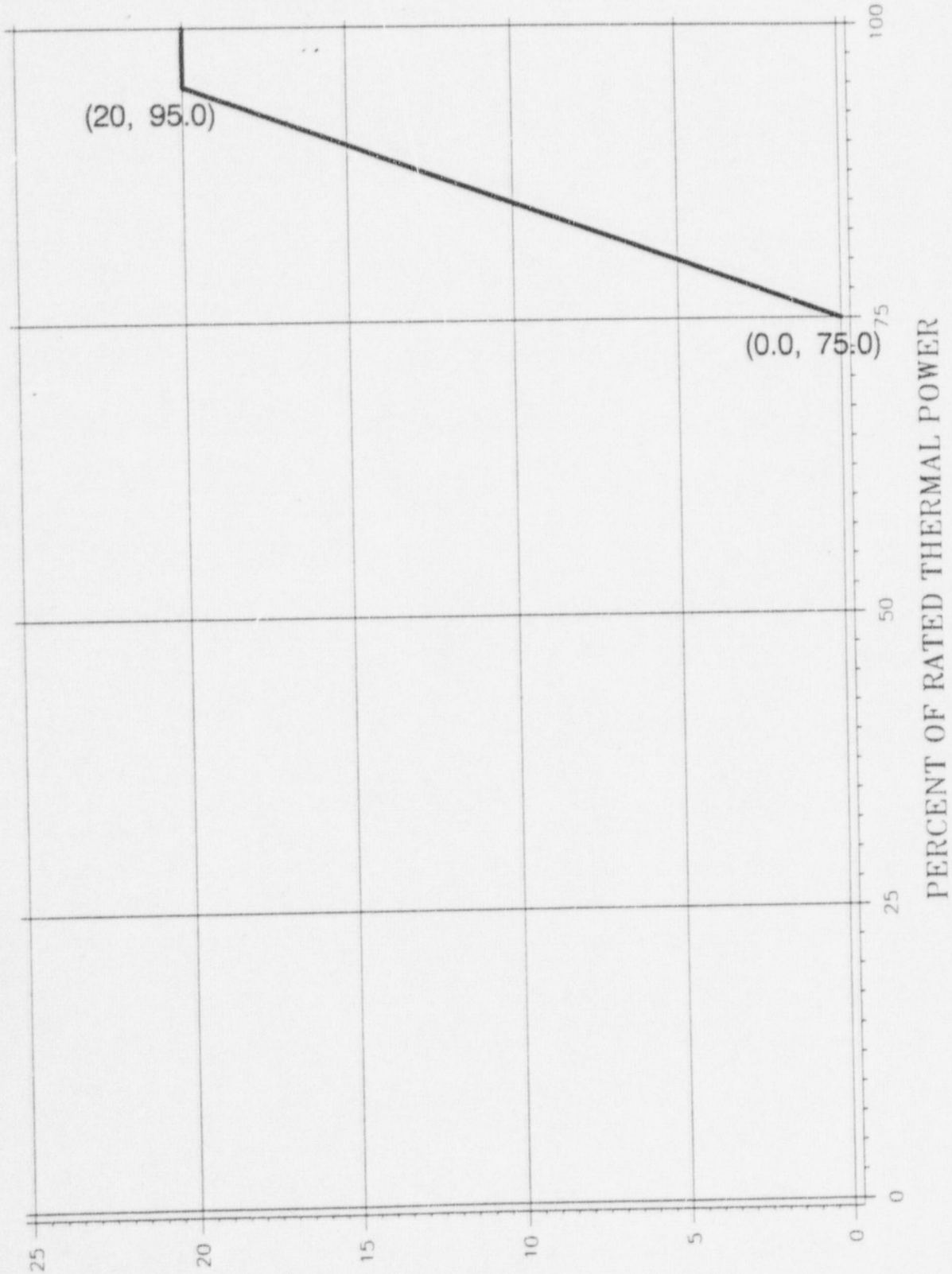


FIGURE 3.2.4-2
DNBR MARGIN OPERATING LIMIT BASED ON THE CORE PROTECTION CALCULATORS (COLSS OUT OF SERVICE, CEAC's OPERABLE)

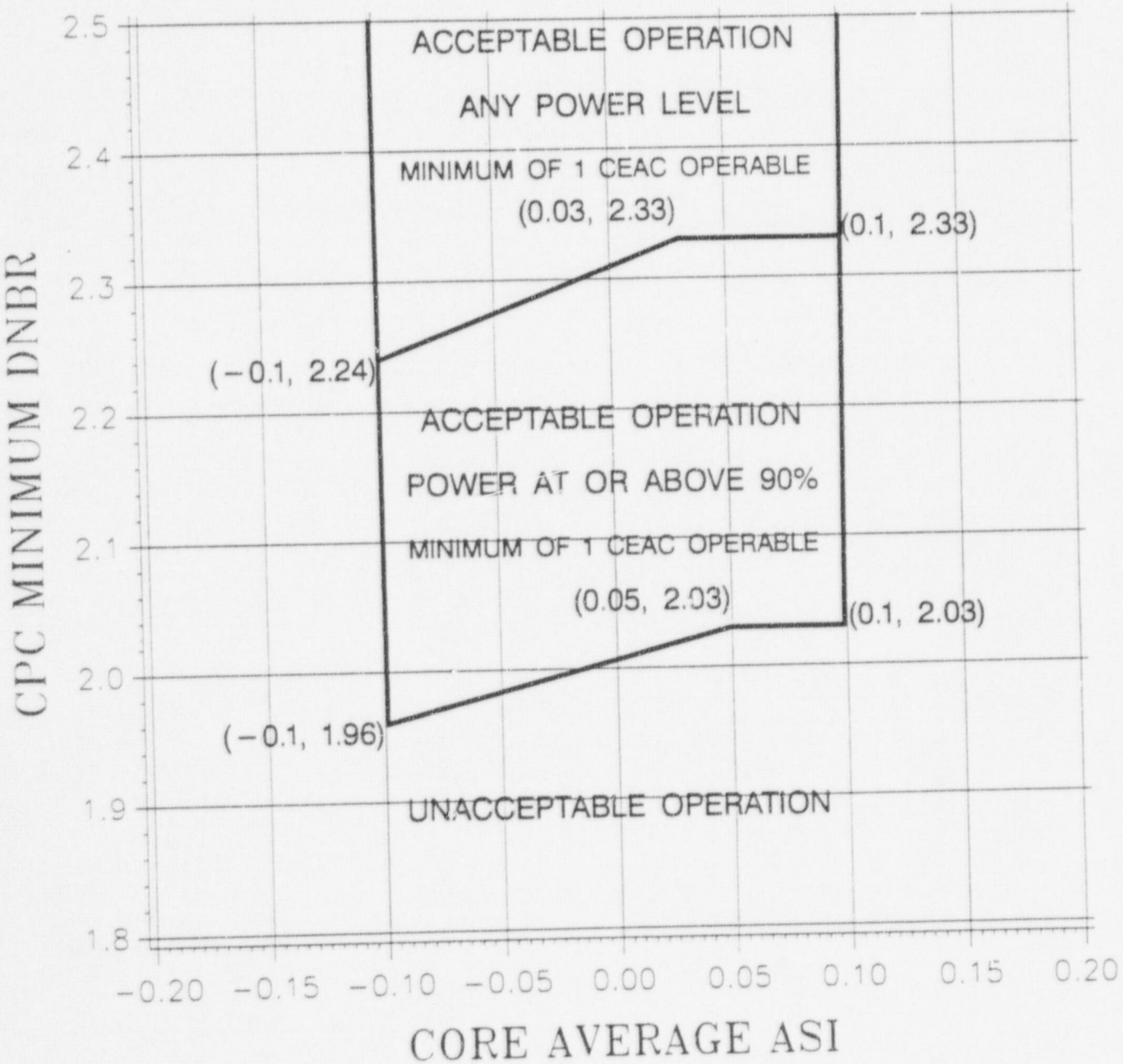
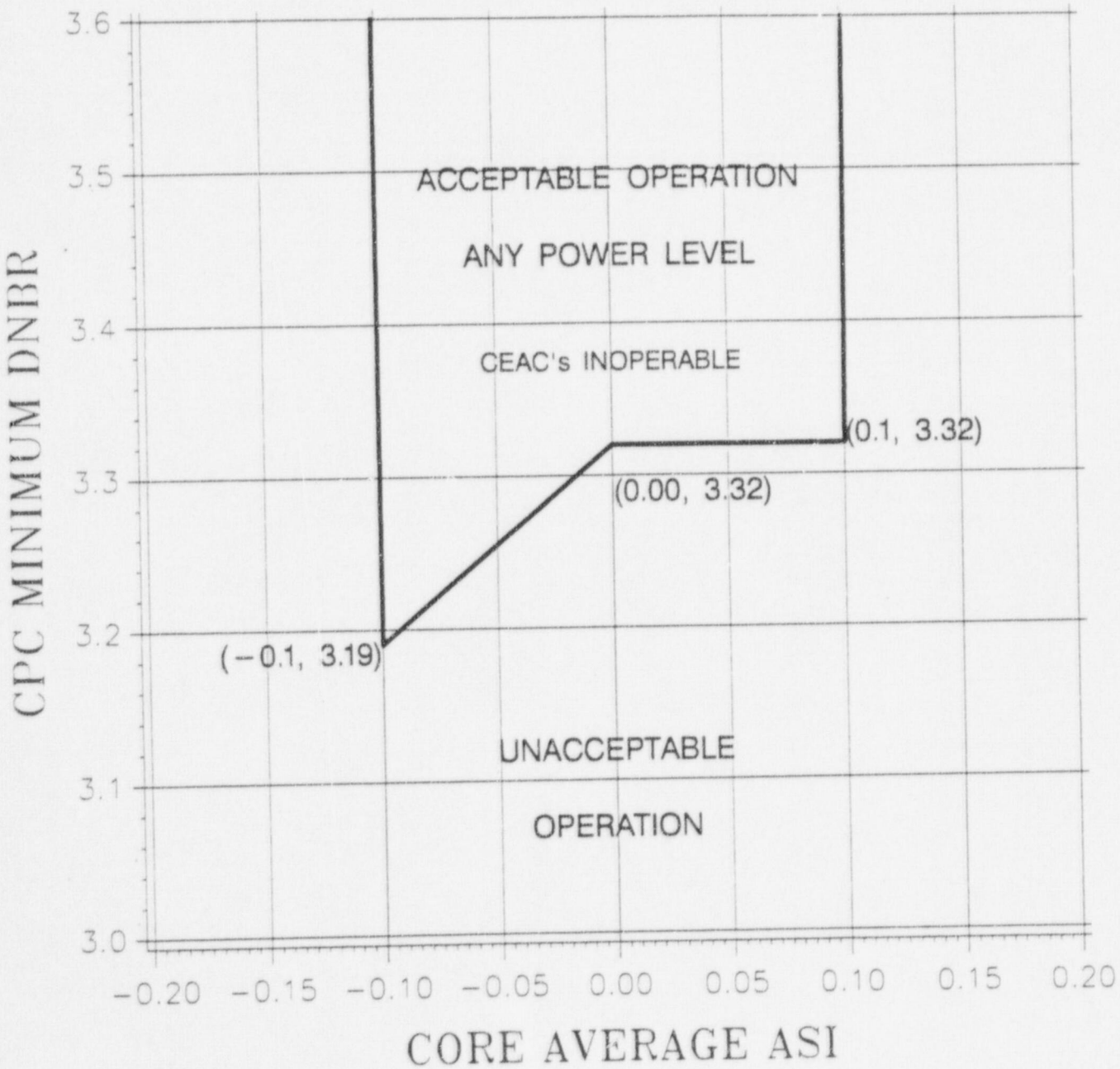


FIGURE 3.2.4-3
DNBR MARGIN OPERATING LIMIT BASED ON THE CORE PROTECTION CALCULATORS (COLSS OUT OF SERVICE, CEAC's INOPERABLE)



LIST OF TABLES

3.3.12-1. Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $K_{eff} > 0.98$.

3.3.12-2. Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $0.98 \geq K_{eff} > 0.97$.

3.3.12-3. Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $0.97 \geq K_{eff} > 0.96$.

3.3.12-4. Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $0.96 \geq K_{eff} > 0.95$.

3.3.12-5. Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $K_{eff} \leq 0.95$.

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 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

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 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

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 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

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 $0.96 \geq K_{eff} > 0.95$

OPERATIONAL 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

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 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