

CORE OPERATING LIMITS REPORT

PALO VERDE NUCLEAR GENERATING STATION (PVNGS)

UNIT 2 CYCLE 7

Revision 0

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P PDR

PVNGS UNIT 2 CYCLE 7 CORE OPERATING LIMITS REPORT

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This Report has been prepared in accordance with the requirements of Technical Specification 6.9.1. The Core Operating Limits have been developed using the NRC approved methodologies specified in Section 6.9.1.10 of the Palo Verde Unit 2 Technical Specifications.

AFFECTED PVNGS TECHNICAL SPECIFICATIONS

- 3.1.1.2 Shutdown Margin - Reactor Trip Breakers Closed
- 3.1.1.3 Moderator Temperature Coefficient
- 3.1.2.7 Boron Dilution Alarms
- 3.1.3.1 Movable Control Assemblies - CEA Position
- 3.1.3.6 Regulating CEA Insertion Limits
- 3.1.3.7 Part Length CEA Insertion Limits
- 3.2.1 Linear Heat Rate
- 3.2.3 Azimuthal Power Tilt - T_q
- 3.2.4 DNBR Margin
- 3.2.7 Axial Shape Index
- 3.9.1 Boron Concentration (Mode 6)

CORE OPERATING LIMITS

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

3.1.1.2 - Shutdown Margin - Reactor Trip Breakers Closed

The Shutdown Margin shall be greater than or equal to that shown in Figure 3.1.1.2-1.

3.1.1.3 - Moderator Temperature Coefficient

The moderator temperature coefficient (MTC) shall be within the area of Acceptable Operation shown in Figure 3.1.1.3-1.



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CORE OPERATING LIMITS - CONTINUED

3.1.2.7 - Boron Dilution Alarms

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 3.1.2.7-1 through 3.1.2.7-5.

3.1.3.1 - Movable Control Assemblies - CEA Position

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 3.1.3.1-1.

3.1.3.6 - Regulating CEA Insertion Limits

One or more CEAC's OPERABLE: With COLSS IN SERVICE, regulation CEA groups shall be limited to the withdrawal sequence and to the insertion limits shown in Figure 3.1.3.6-1; with COLSS OUT OF SERVICE, regulation CEA groups shall be limited to the withdrawal sequence and to the insertion limits shown in Figure 3.1.3.6-2.

3.1.3.7 - Part Length CEA Insertion Limits

One or more CEAC's OPERABLE: The part length CEA groups shall be limited to the insertion limits shown in Figure 3.1.3.7-1.

3.2.1 - Linear Heat Rate

The linear heat rate limit of 13.5 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.

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CORE OPERATING LIMITS - CONTINUED

3.2.4 - DNBR Margin

COLSS IN SERVICE and Both CEAC's 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 CEAC's 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 CEAC's INOPERABLE - Operating within the region of acceptable operation of Figure 3.2.4-3 using any operable CPC channel.

3.2.7 - Axial Shape Index

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

COLSS OPERABLE
 $-0.188 \leq \text{ASI} \leq 0.169$

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

3.9.1 - Boron Concentration (Mode 6)

The boron concentration of all filled portions of the Reactor Coolant System and the refueling canal shall be maintained at a uniform concentration ≥ 2500 ppm.

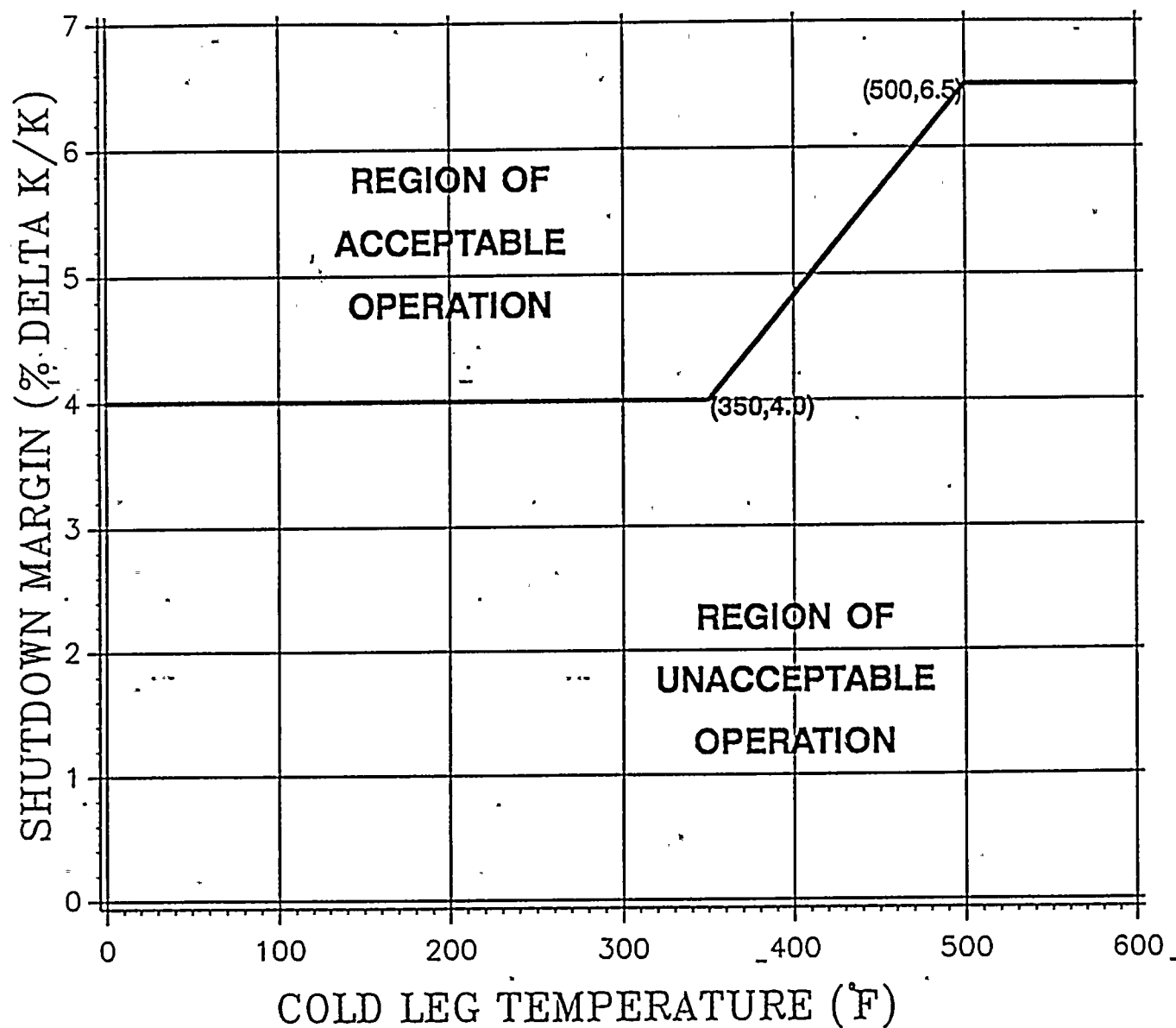
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- 3.1.1.3-1. MTC Acceptable Operation, Modes 1 and 2.
- 3.1.3.1-1. Core Power Limit After CEA Deviation.
- 3.1.3.6-1. CEA Insertion Limits Versus Thermal Power (COLSS In Service).
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- 3.1.3.7-1. Part Length CEA Insertion Limit Versus Thermal Power.
- 3.2.3-1. Azimuthal Power Tilt Limit Versus Thermal Power (COLSS In Service).
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- 3.2.4-2. DNBR Margin Operating Limit Based on Core Protection Calculators (COLSS Out of Service, CEACs Operable)
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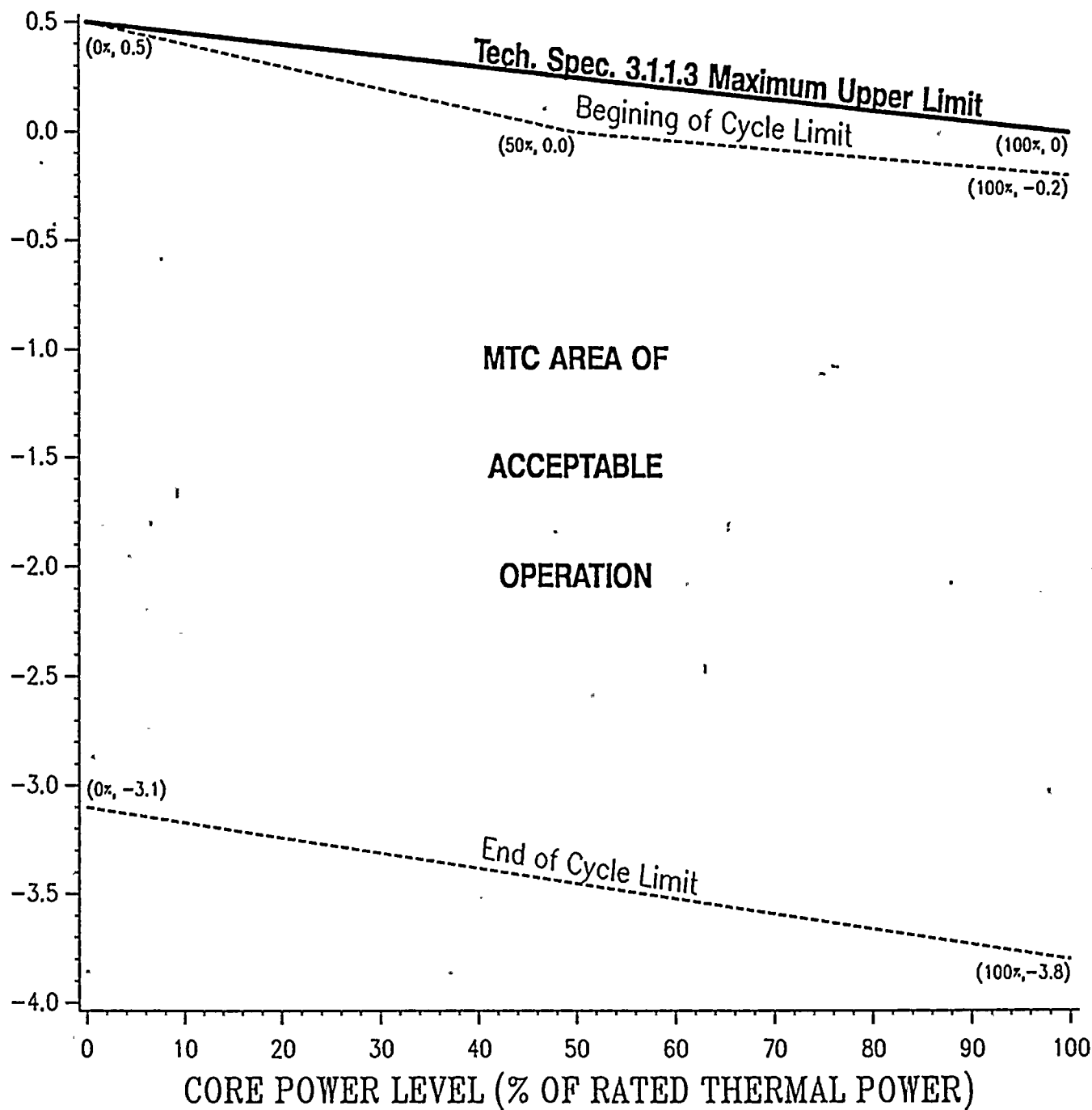
FIGURE 3.1.1.2-1
SHUTDOWN MARGIN VERSUS COLD LEG TEMPERATURE
REACTOR TRIP BREAKERS CLOSED



PVNGS UNIT 2 CYCLE 7 CORE OPERATING LIMITS REPORT

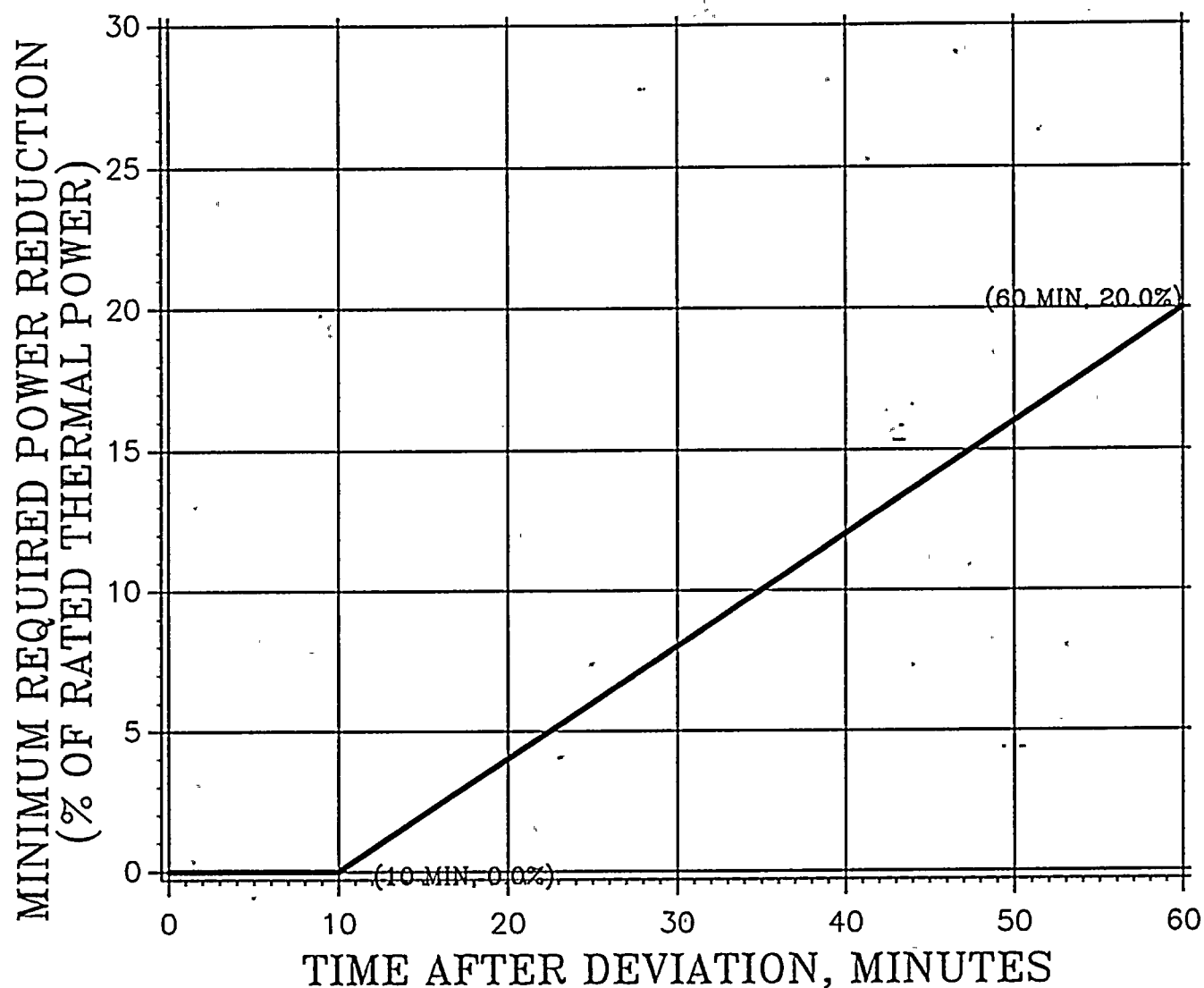
FIGURE 3.1.1.3-1

MTC ACCEPTABLE OPERATION, MODES 1 AND 2

MODERATOR TEMPERATURE COEFFICIENT ($\times 10^{-4} \Delta \rho / ^\circ F$)

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FIGURE 3.1.3.1-1
CORE POWER LIMIT AFTER CEA DEVIATION *

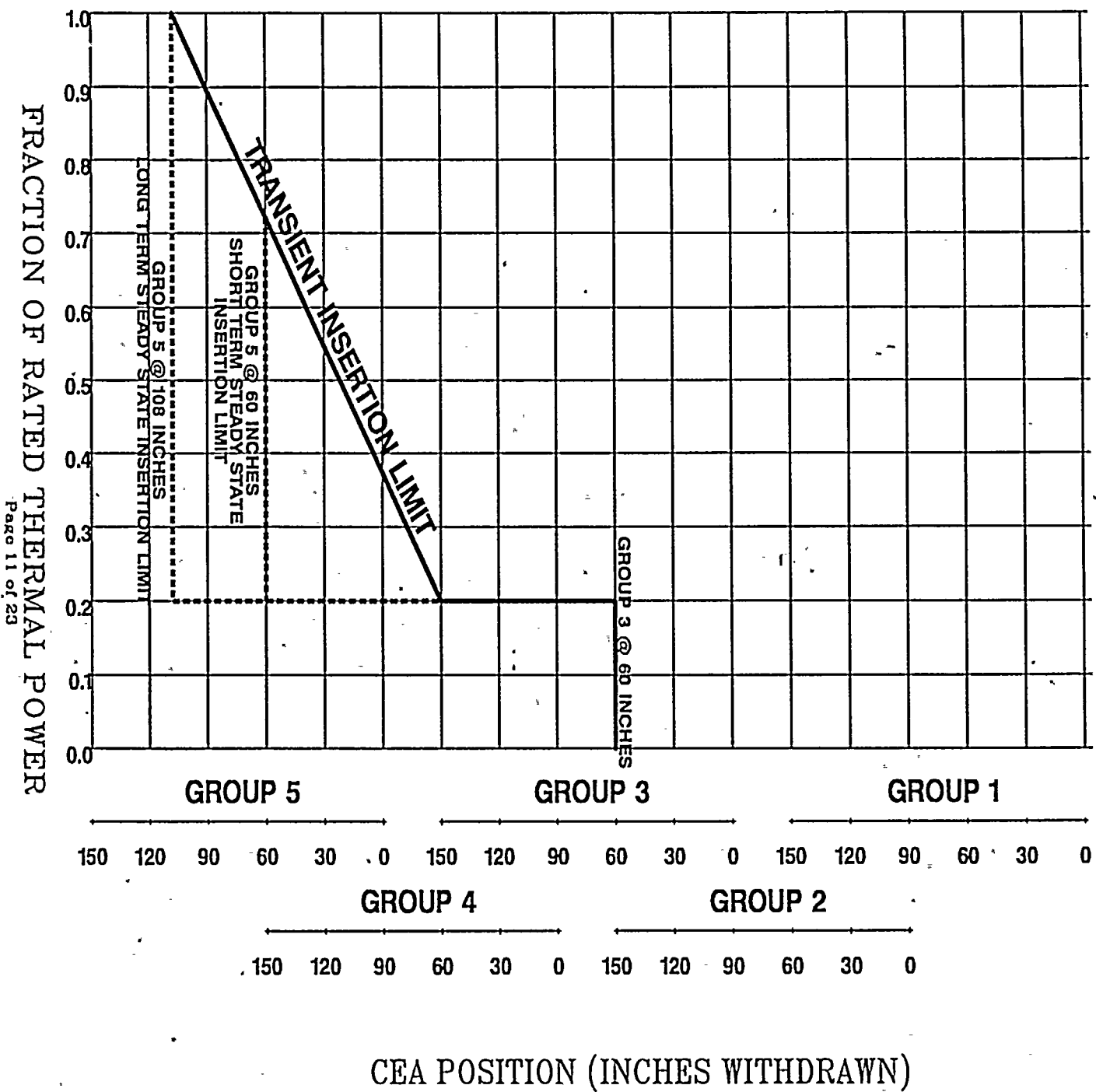


* WHEN CORE POWER IS REDUCED TO 55% OF RATED THERMAL POWER PER THIS LIMIT CURVE, FURTHER REDUCTION IS NOT REQUIRED



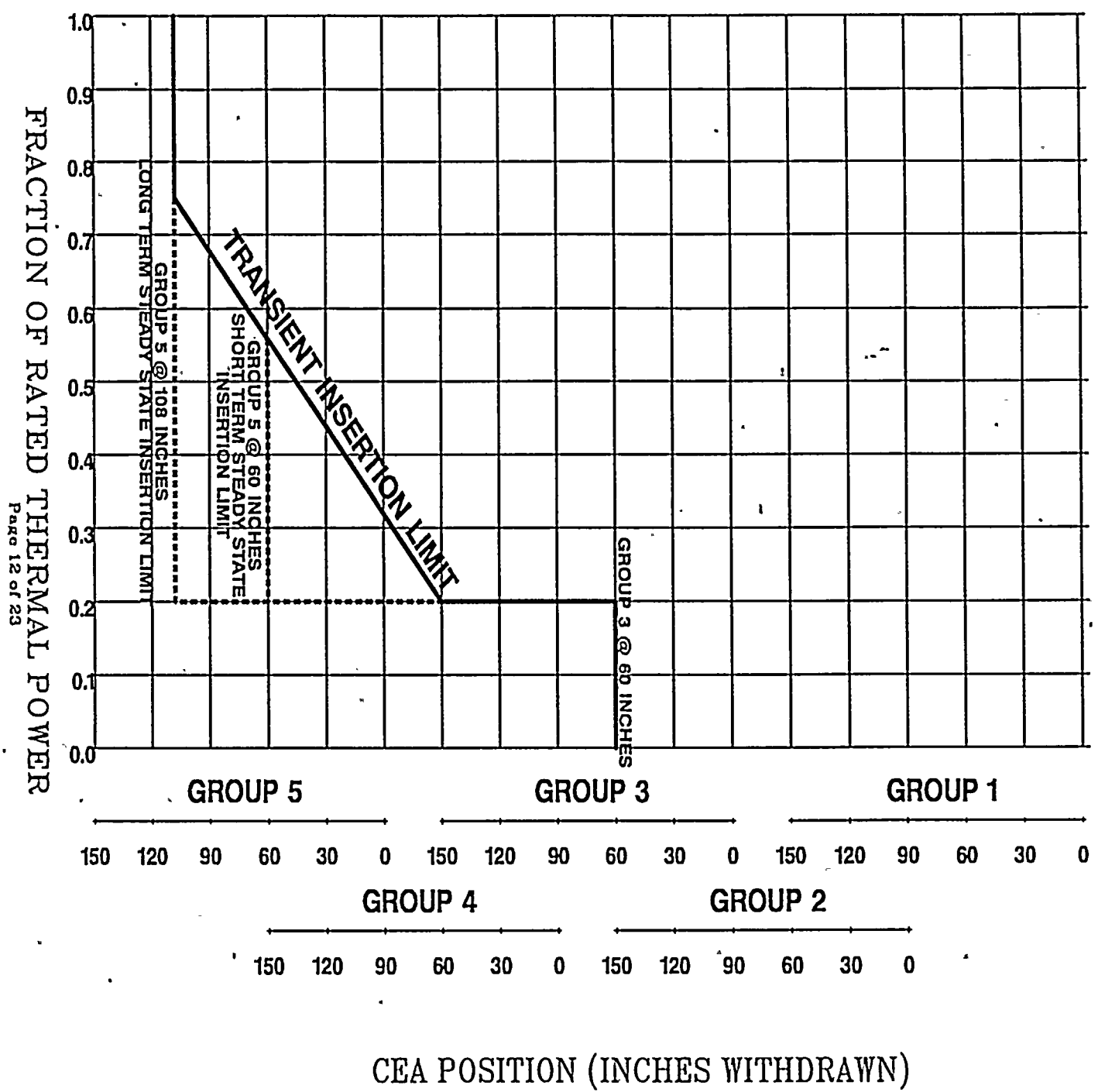
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 FIGURE 3.1.3.6-1
 CEA INSERTION LIMITS VERSUS THERMAL POWER
 (COLSS IN SERVICE)



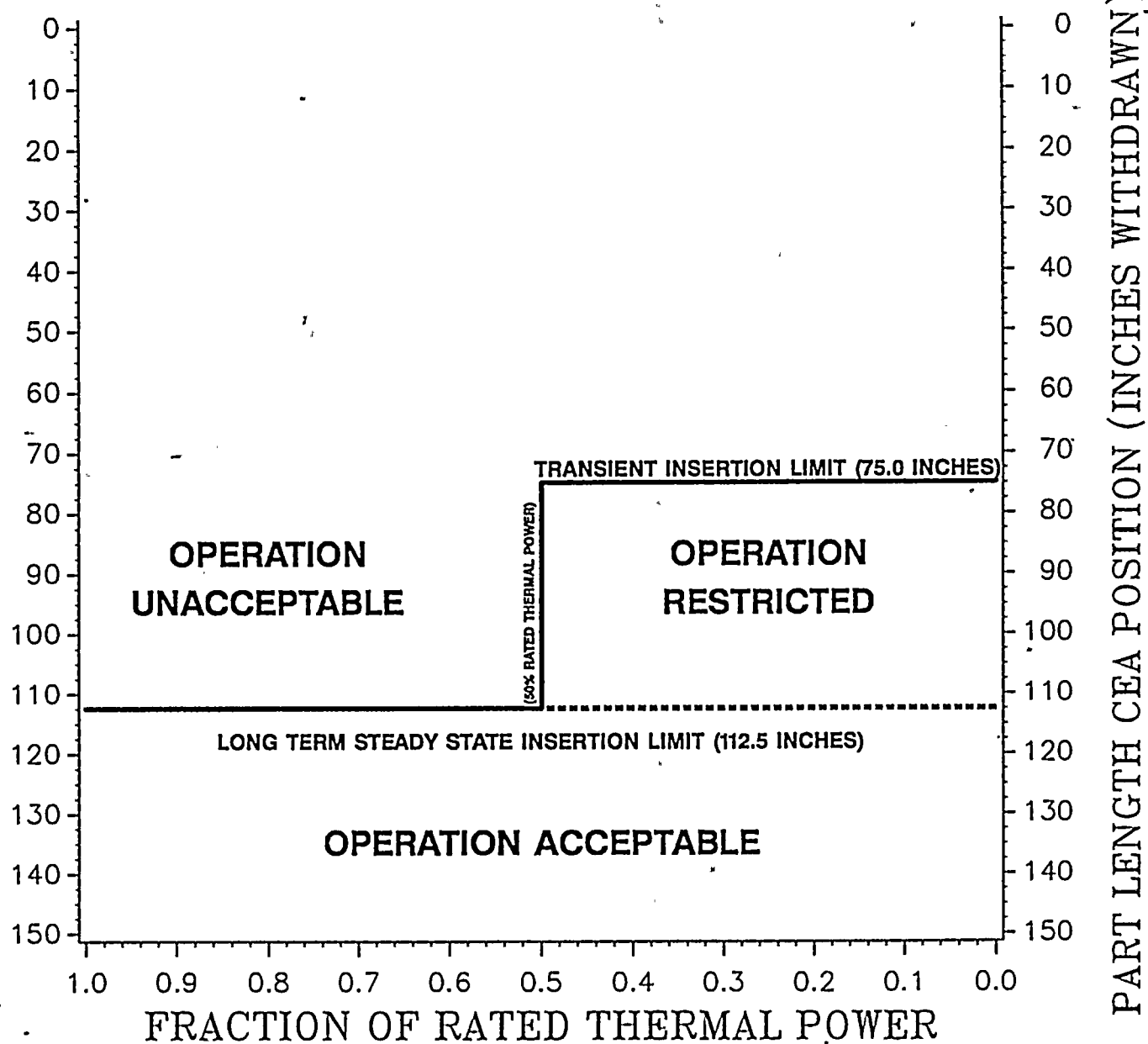


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 FIGURE 3.1.3.6-2
 CEA INSERTION LIMITS VERSUS THERMAL POWER
 (COLS OUT OF SERVICE)



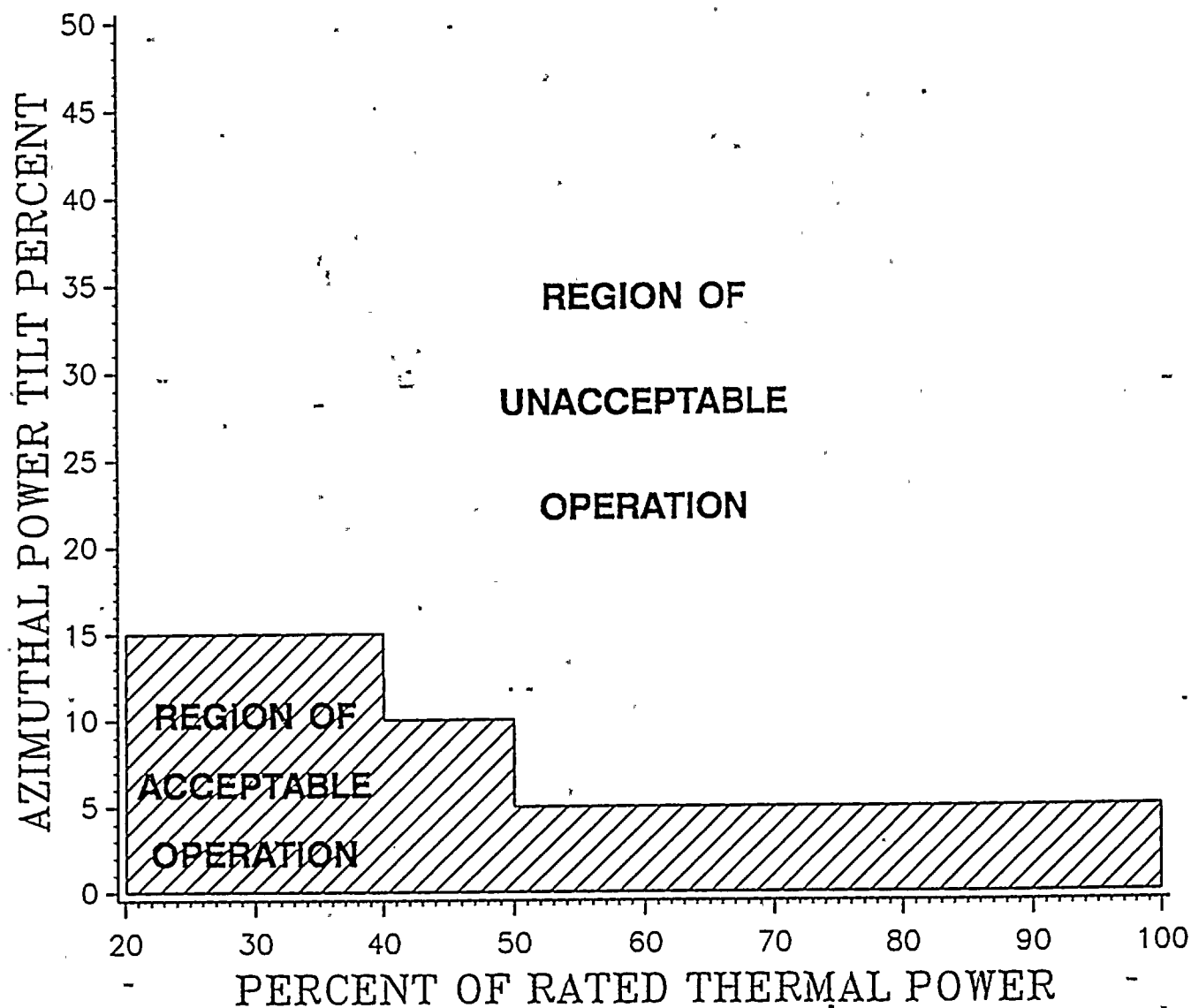
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FIGURE 3.1.3.7-1
PART LENGTH CEA INSERTION LIMITS VERSUS THERMAL POWER

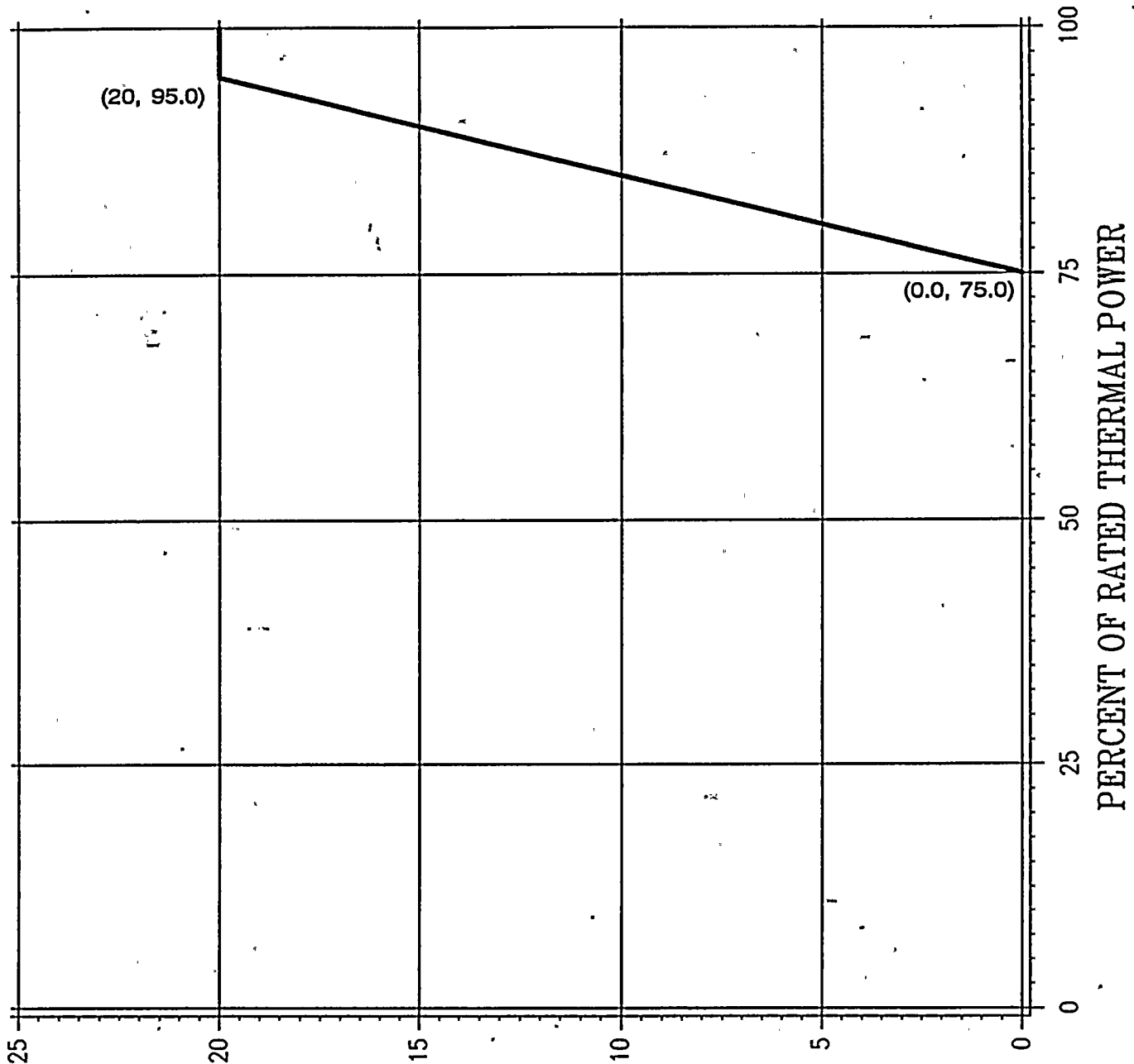


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FIGURE 3.2.3-1
AZIMUTHAL POWER TILT VERSUS THERMAL POWER
(COLSS IN SERVICE)



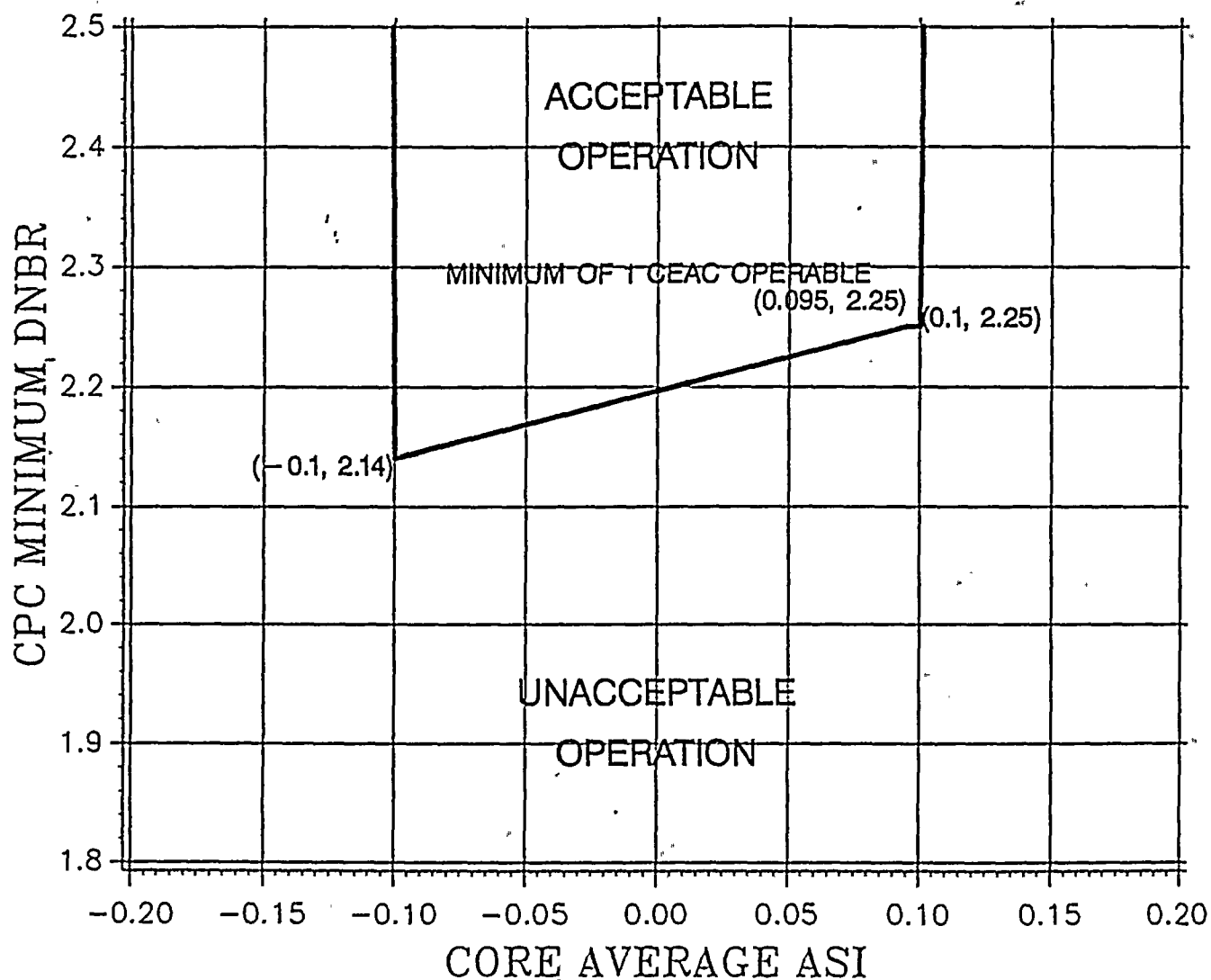
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FIGURE 3.2.4-1
COLSS DNBR OPERATING LIMIT
ALLOWANCE FOR BOTH CEAC's INOPERABLE



COLSS DNBR POWER OPERATING LIMIT REDUCTION
(% OF RATED THERMAL POWER)

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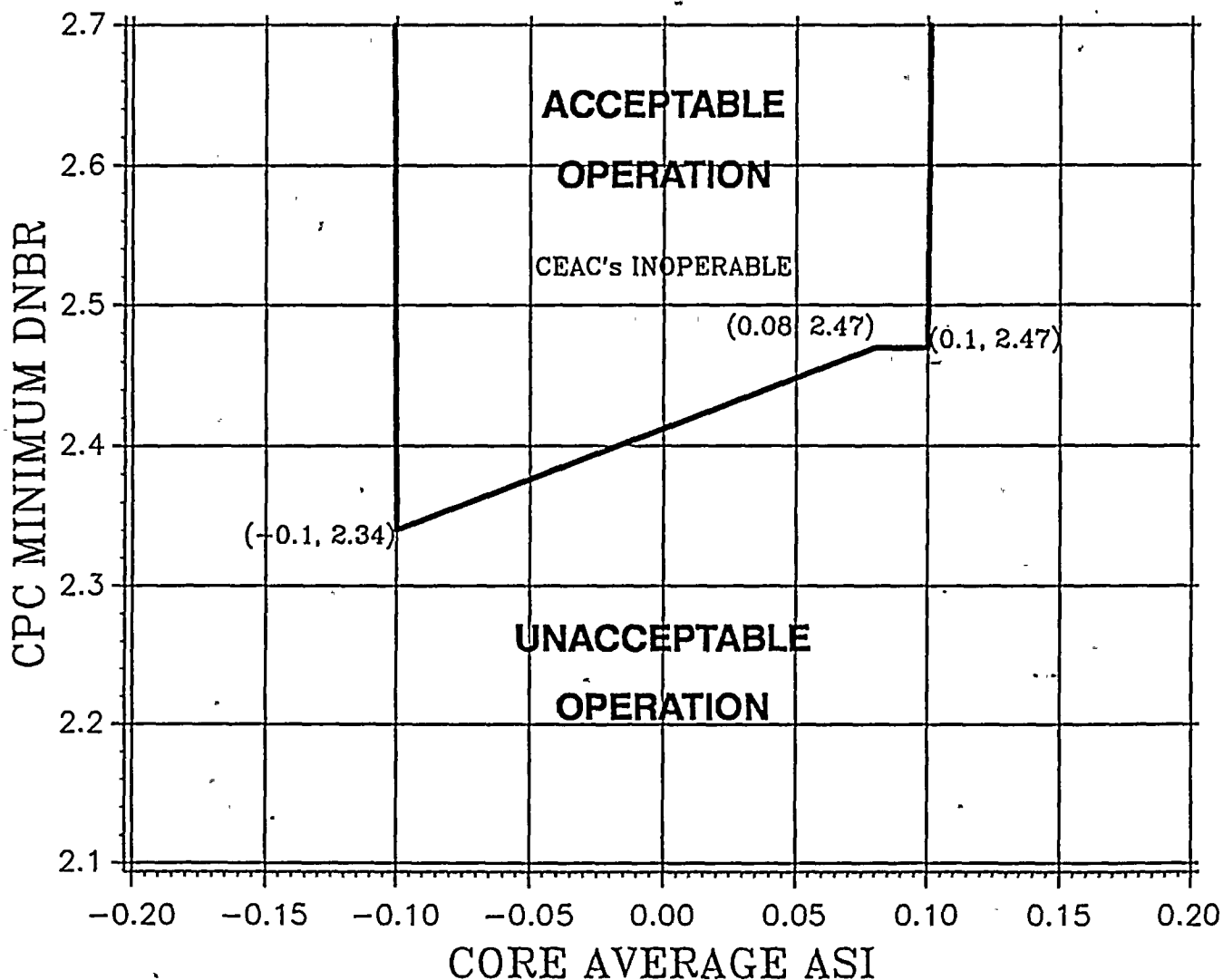
FIGURE 3.2.4-2
DNBR MARGIN OPERATING LIMIT BASED ON
THE CORE PROTECTION CALCULATORS
(COLSS OUT OF SERVICE, CEAC's OPERABLE)





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



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- 3.1.2.7-2. Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $0.98 \geq K_{eff} > 0.97$.
- 3.1.2.7-3. Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $0.97 \geq K_{eff} > 0.96$.
- 3.1.2.7-4. Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $0.96 \geq K_{eff} > 0.95$.
- 3.1.2.7-5. Required Monitoring Frequencies for Backup Boron Dilution Detection as a Function of Operating Charging Pumps and Plant Operational Modes for $K_{eff} \leq 0.95$.

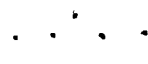
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TABLE 3.1.2.7-1

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	1 hour	ONA	ONA
4 not on SCS	12 hours	1 hour	ONA	ONA
5 not on SCS	8 hours	1 hour	ONA	ONA
4 & 5 on SCS	ONA	ONA	ONA	ONA

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



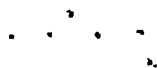
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TABLE 3.1.2.7-2

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

OPERATIONAL MODE	Number of Operating Charging Pumps			
	0	1	2	3
3	12 hours	2 hours	0.5 hours	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	0.5 hours	ONA	ONA

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



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TABLE 3.1.2.7-3

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	3.5 hours	1.5 hours	0.5 hours
4 not on SCS	12 hours	3.5 hours	1.5 hours	1 hour
5 not on SCS	8 hours	3.5 hours	1.5 hours	1 hour
4 & 5 on SCS	8 hours	1 hour	0.5 hours	ONA

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

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TABLE 3.1.2.7-4

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 MODE	Number of Operating Charging Pumps			
	0	1	2	3
3	12 hours	5 hours	2 hours	1 hour
4 not on SCS	12 hours	5 hours	2 hours	1 hour
5 not on SCS	8 hours	5 hours	2 hours	1 hour
4 & 5 on SCS	8 hours	2 hours	0.5 hours	ONA

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

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TABLE 3.1.2.7-5

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	6 hours	2.5 hours	1.5 hours
4 not on SCS	12 hours	6 hours	3 hours	1.5 hours
5 not on SCS	8 hours	6 hours	3 hours	1.5 hours
4 & 5 on SCS	8 hours	2 hours	1 hour	0.5 hours
6 (≥ 4000 ppm)	24 hours	8 hours	4 hours	2 hours
6 (< 4000 ppm)	24 hours	2 hours	0.5 hours	ONA

Notes: SCS = Shutdown Cooling System
ONA = Operation not allowed



11-11-61

1. The first part of the report is a general description of the project. It includes the title, the purpose of the study, and the scope of the work. The title is "The Effect of Temperature on the Rate of Reaction of Hydrogen Peroxide with Potassium Iodate." The purpose of the study is to determine the effect of temperature on the rate of reaction. The scope of the work is to determine the effect of temperature on the rate of reaction of hydrogen peroxide with potassium iodate.

2. The second part of the report is a description of the experimental procedure. It includes the materials used, the apparatus used, and the method of carrying out the experiment. The materials used are hydrogen peroxide, potassium iodate, and sulfuric acid. The apparatus used is a conical flask, a stopper, a thermometer, and a water bath. The method of carrying out the experiment is to mix a known volume of hydrogen peroxide with a known volume of potassium iodate in a conical flask, stopper the flask, and immerse it in a water bath at a known temperature. The time taken for the reaction to complete is measured by the time taken for the solution to turn blue.

3. The third part of the report is a description of the results of the experiment. It includes a table of the data obtained, a graph of the rate of reaction against temperature, and a discussion of the results. The data obtained is as follows:

Temperature (°C)	Time taken for reaction to complete (s)
10	120
20	60
30	30
40	15
50	8

The graph of the rate of reaction against temperature shows that the rate of reaction increases with temperature. The discussion of the results shows that the rate of reaction is affected by temperature, and that the rate of reaction increases with temperature.