

ENERGY OPERATIONS

WATERFORD 3

CORE OPERATING LIMITS REPORT

FOR CYCLE 9

REVISION 1

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WATERFORD 3
CORE OPERATING LIMITS REPORT
CYCLE 9, REVISION 1

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CORE OPERATING LIMITS REPORT CYCLE 9, REVISION 1

I. INTRODUCTION

This CORE OPERATING LIMITS REPORT (COLR) has been prepared in accordance with the requirements of Waterford 3 Technical Specification 6.9.5 for Waterford 3 Cycle 9. The core operating limits have been developed using the NRC approved methodologies specified in Section III. This is Revision 1 of the Cycle 9 COLR.

NOTE: Due to extensive format changes, revision bars are only used here and to identify the technical information which has changed from Revision 0.

Format changes included in this revision are:

- 1) Reformatting of the entire COLR so that each page is now uniquely identified by page number. This will allow the individual COLR pages to be inserted behind the applicable Technical Specification pages.
- 2) Moving the COLR figures and tables behind the applicable pages for easier reference. As a result, former Figure 9 is now COLR Figure 2. The succeeding figures were renumbered as a result.
- 3) COLR Figure 4 was reworked to make it easier to read; however, no technical changes were made to the information.
- 4) The Index was reformatted to list the COLR Figures and COLR Tables by page number.
- 5) Added prepared by, reviewed by, and approved by signature blocks

II. AFFECTED TECHNICAL SPECIFICATIONS

CORE OPERATING LIMITS REPORT

SHUTDOWN MARGIN - ANY FULL LENGTH CEA WITHDRAWN

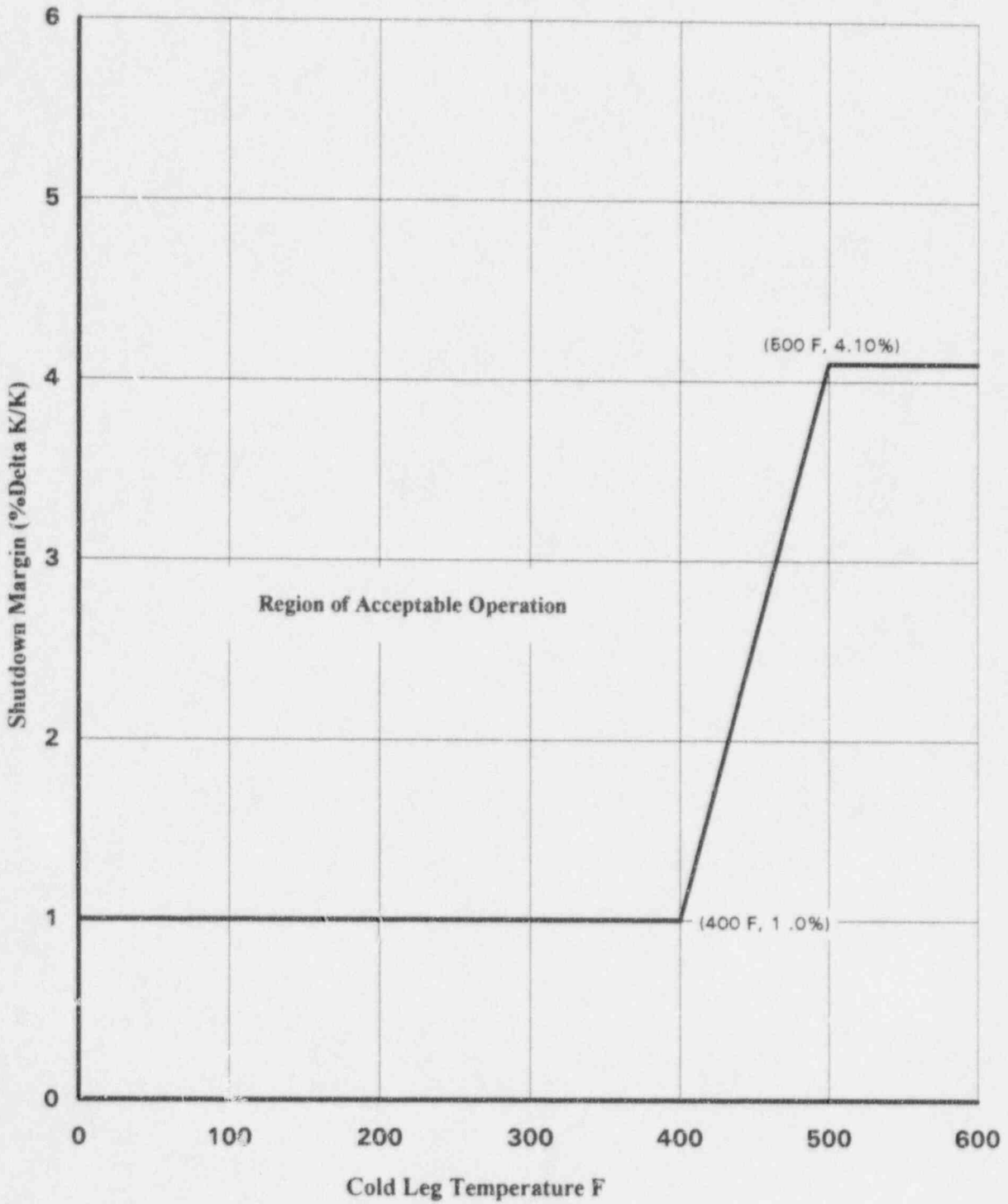
3.1.1.1 The SHUTDOWN MARGIN shall be greater than or equal to 5.15% $\Delta k/k$ when T_{avg} is greater than 200 °F or 2.0% $\Delta k/k$ when T_{avg} is less than or equal to 200 °F.

CORE OPERATING LIMITS REPORT

SHUTDOWN MARGIN - ALL FULL LENGTH CEA FULLY INSERTED

3.1.1.2 The SHUTDOWN MARGIN shall be greater than or equal to that shown in COLR Figure 1.

Shutdown Margin As a Function of Cold Leg Temperature

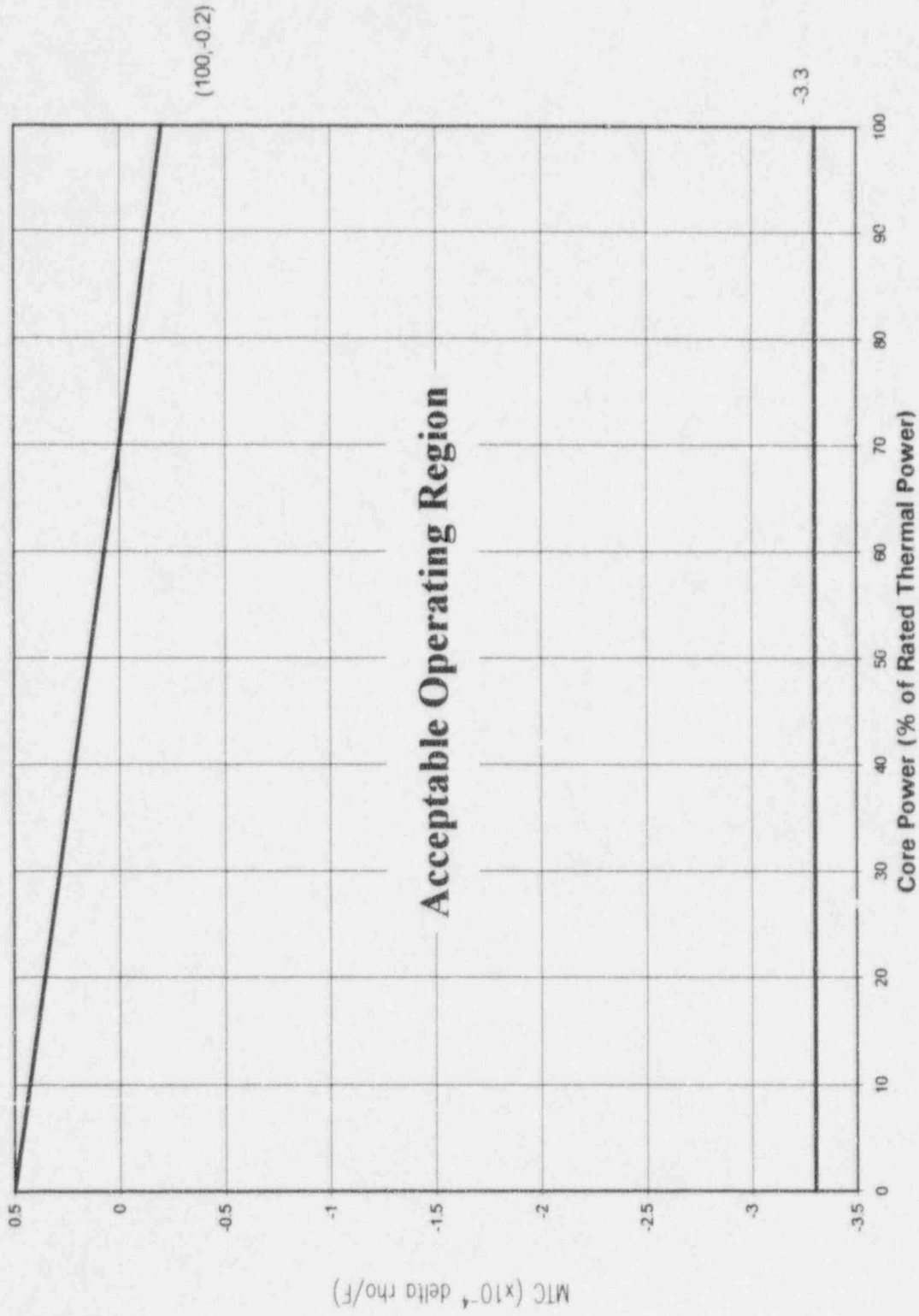


COLR Figure 1

CORE OPERATING LIMITS REPORT
MODERATOR TEMPERATURE COEFFICIENT

3.1.1.3 The Moderator Temperature Coefficient (MTC) shall be within the region of acceptable operation of COLR Figure 2.

MTC as a Function of Core Power



COLR Figure 2

CORE OPERATING LIMITS REPORT

BORON DILUTION

LIMITING CONDITION FOR OPERATION

3.1.2.9 With one or both start-up channel high neutron flux alarms inoperable, do not operate the plant in the configurations prohibited by COLR Tables 1 through 5 for the current Mode.

ACTION

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 COLR Tables 1 through 5.

SURVEILLANCE REQUIREMENTS

Each required boron dilution alarm shall be adjusted to less than or equal to twice (2x) the existing neutron flux (cps) at the following frequencies:

- a. No sooner than one half hour after shutdown.
- b. At least once per hour if the reactor has been shutdown < than 10 hours.
- c. At least once per 5 hours if the reactor has been shut down \geq 10 hours but < 25 hours.
- d. At least once per 24 hours if the reactor has been shut down \geq 25 hours but < 21 days.
- e. At least once per 7 days if the reactor has been shut down \geq 21 days.

COLR TABLE 1

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

$K_{eff} > 0.98$

OPERATIONAL MODE	Number of Operating Charging Pumps*			
	0	1	2	3
3	12 hours	0.75 hours	Operation not allowed **	
4	12 hours	Operation not allowed **		
5 RCS filled	8 hours	Operation not allowed **		
5 RCS partially drained	8 hours	Operation not allowed **		
6	Operation not allowed **			

* Charging pump OPERABILITY for any period of time shall constitute OPERABILITY for the entire monitoring frequency.

** The precluded number of charging pumps shall be verified to be inoperable by racking out their motor circuit breakers.

COLR TABLE 2

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON
DILUTION DETECTION AS A FUNCTION OF OPERATING
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR
 K_{eff} GREATER THAN 0.97 AND LESS THAN OR EQUAL TO 0.98

$$0.98 \geq K_{eff} > 0.97$$

OPERATIONAL MODE	Number of Operating Charging Pumps*			
	0	1	2	3
3	12 hours	2.0 hours	0.5 hours	Operation not allowed**
4	12 hours	0.75 hours	Operation not allowed**	
5 RCS filled	8 hours	0.75 hours	Operation not allowed**	
5 RCS partially drained	8 hours	0.5 hours	Operation not allowed**	
6	Operation not allowed**			

* Charging pump OPERABILITY for any period of time shall constitute OPERABILITY for the entire monitoring frequency.

** The precluded number of charging pumps shall be verified to be inoperable by racking out their motor circuit breakers.

COLR TABLE 3

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON
DILUTION DETECTION AS A FUNCTION OF OPERATING
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR
 K_{eff} GREATER THAN 0.96 AND LESS THAN OR EQUAL TO 0.97

$$0.97 \geq K_{eff} > 0.96$$

OPERATIONAL MODE	Number of Operating Charging Pumps*			
	0	1	2	3
3	12 hours	3.0 hours	1.25 hours	0.5 hours
4	12 hours	1.5 hours	Operation not allowed**	
5 RCS filled	8 hours	1.5 hours	Operation not allowed**	
5 RCS partially drained	8 hours	0.75 hours	Operation not allowed**	
6	Operation not allowed**			

* Charging pump OPERABILITY for any period of time shall constitute OPERABILITY for the entire monitoring frequency.

** The precluded number of charging pumps shall be verified to be inoperable by racking out their motor circuit breakers.

COLR TABLE 4

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON
DILUTION DETECTION AS A FUNCTION OF OPERATING
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR
 K_{eff} GREATER THAN 0.95 AND LESS THAN OR EQUAL TO 0.96

$$0.96 \geq K_{eff} > 0.95$$

OPERATIONAL MODE	Number of Operating Charging Pumps*			
	0	1	2	3
3	12 hours	4.0 hours	2.0 hours	1.0 hours
4	12 hours	2.25 hours	0.75 hours	Operation not allowed**
5 RCS filled	8 hours	2.0 hours	0.75 hours	Operation not allowed**
5 RCS partially drained	8 hours	2.0 hours	0.5 hours	Operation not allowed**
6	Operation not allowed**			

* Charging pump OPERABILITY for any period of time shall constitute OPERABILITY for the entire monitoring frequency.

** The precluded number of charging pumps shall be verified to be inoperable by racking out their motor circuit breakers.

COLR TABLE 5

**REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON
DILUTION DETECTION AS A FUNCTION OF OPERATING
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR
 K_{eff} LESS THAN OR EQUAL TO 0.95**

$K_{eff} \leq 0.95$

OPERATIONAL MODE	Number of Operating Charging Pumps*			
	0	1	2	3
3	12 hours	5.0 hours	2.0 hours	1.0 hours
4	12 hours	2.75 hours	1.0 hours	Operation not allowed**
5 RCS filled	8 hours	3.0 hours	1.0 hours	0.5 hours
5 RCS partially drained	8 hours	2.5 hours	0.75 hours	Operation not allowed**
6	24 hours	2.25 hours	0.5 hours	Operation not allowed**

* Charging pump OPERABILITY for any period of time shall constitute OPERABILITY for the entire monitoring frequency.

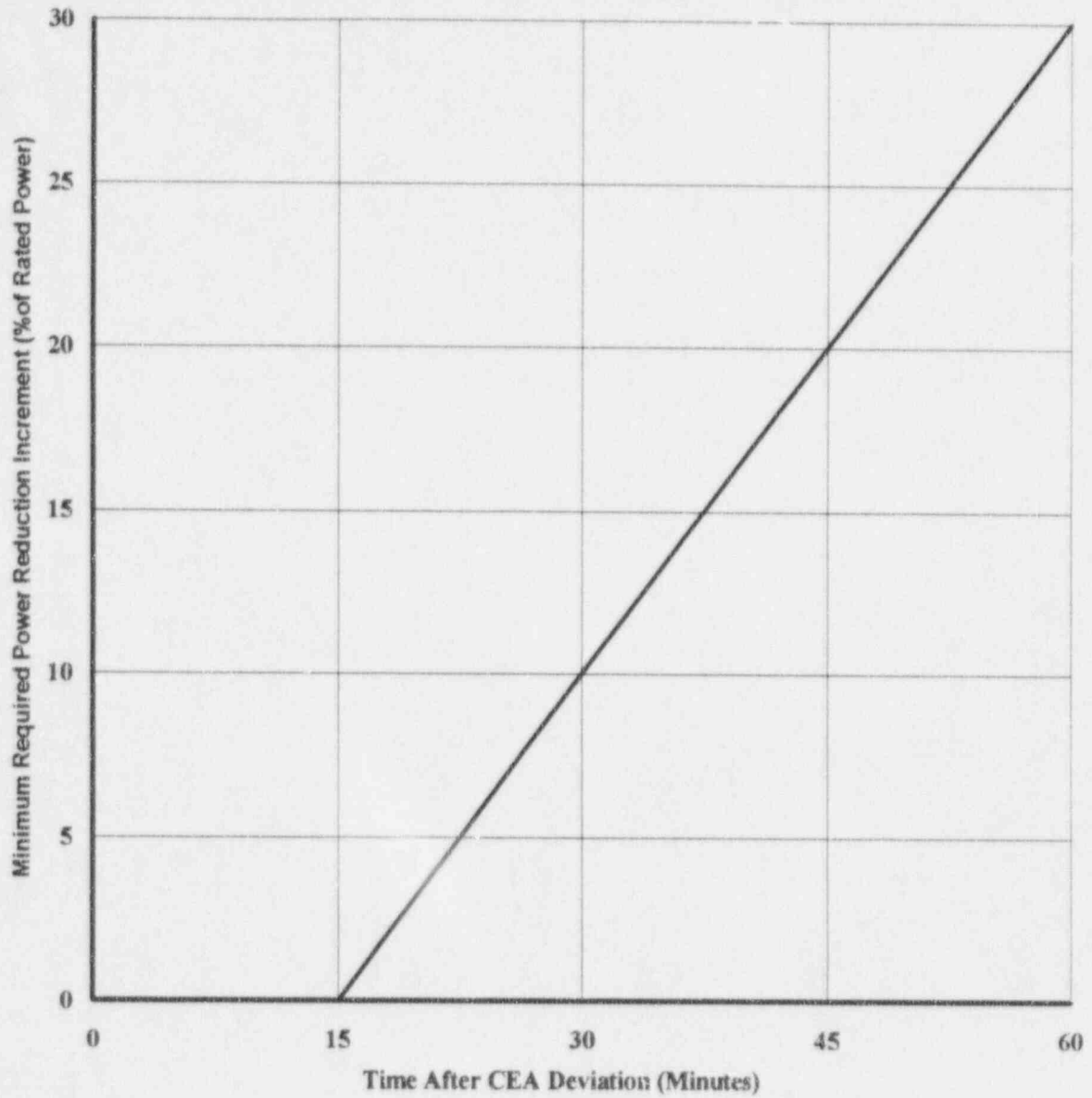
** The precluded number of charging pumps shall be verified to be inoperable by racking out their motor circuit breakers.

CORE OPERATING LIMITS REPORT

MOVABLE CONTROL ASSEMBLIES - CEA POSITION

- 3.1.3.1 With one or more full-length or part-length CEAs trippable but misaligned from any other CEAs in its group by more than the Technical Specification 3.1.3.1 allowed value, operation in Modes 1 and 2 may continue, provided that core power is reduced in accordance with COLR Figure 3.

Required Power Reduction After Single CEA Deviation*



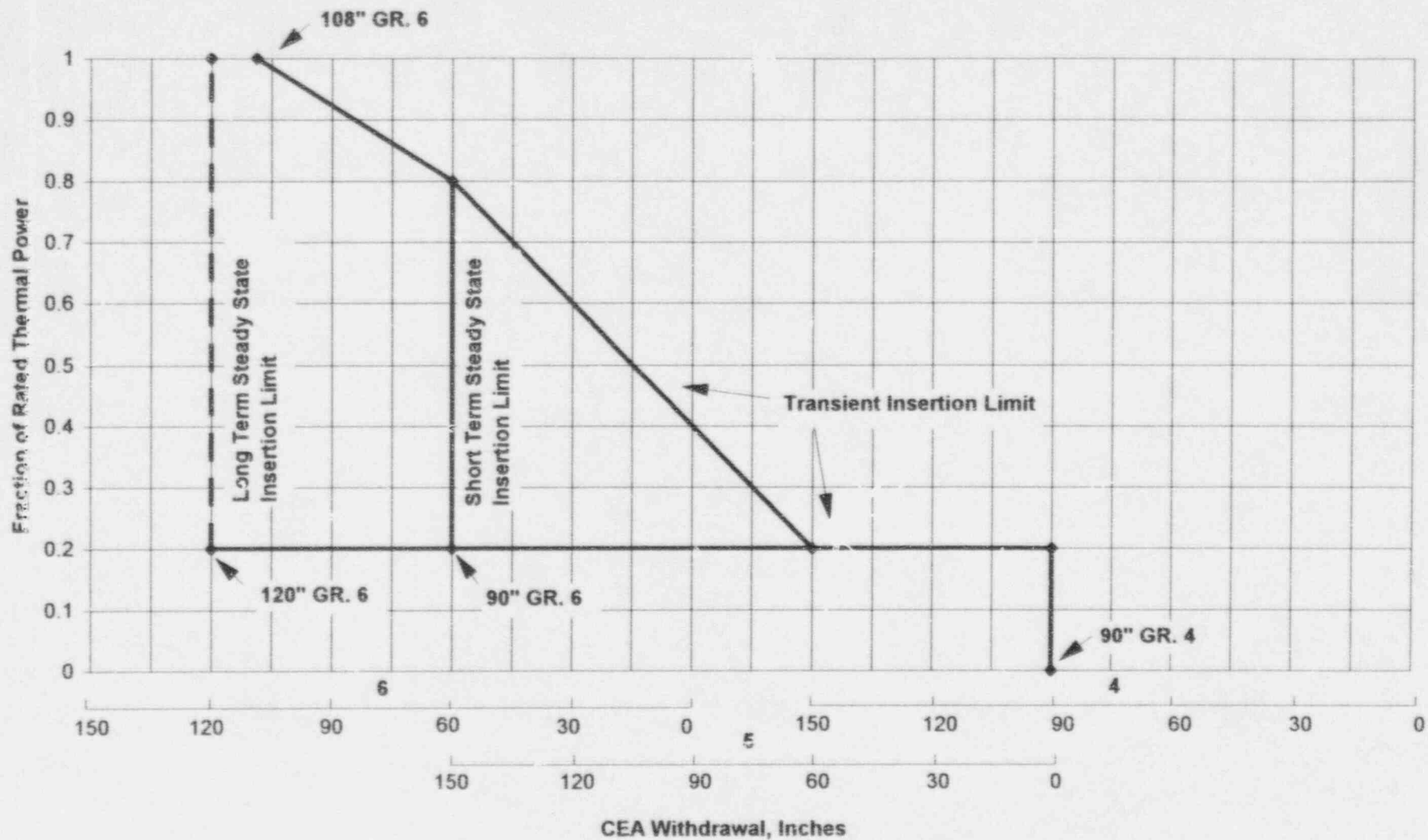
COLR Figure 3

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

CORE OPERATING LIMITS REPORT
REGULATING CEA INSERTION LIMITS

3.1.3.6 The regulating CEA groups shall be limited to the withdrawal sequence and to the insertion limits shown on COLR Figure 4.

CEA Insertion Limits Versus Thermal Power



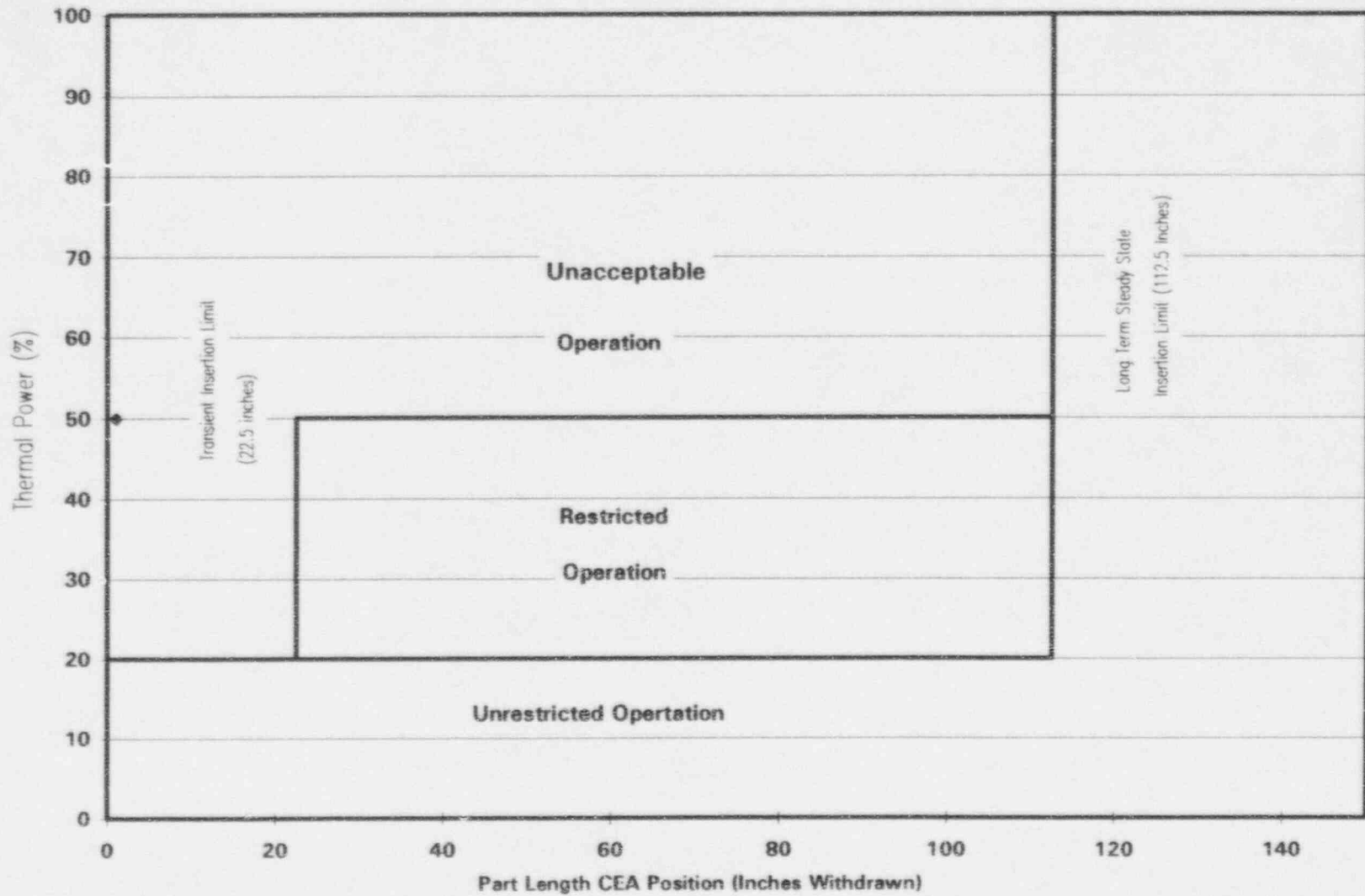
COLR Figure 4

CORE OPERATING LIMITS REPORT

PART LENGTH CEA INSERTION LIMITS

3.1.3.7 The part length CEA group shall be limited to the insertion limits shown on COLR Figure 5.

Part Length CEA Insertion Limit Versus Thermal Power



COLR Figure 5

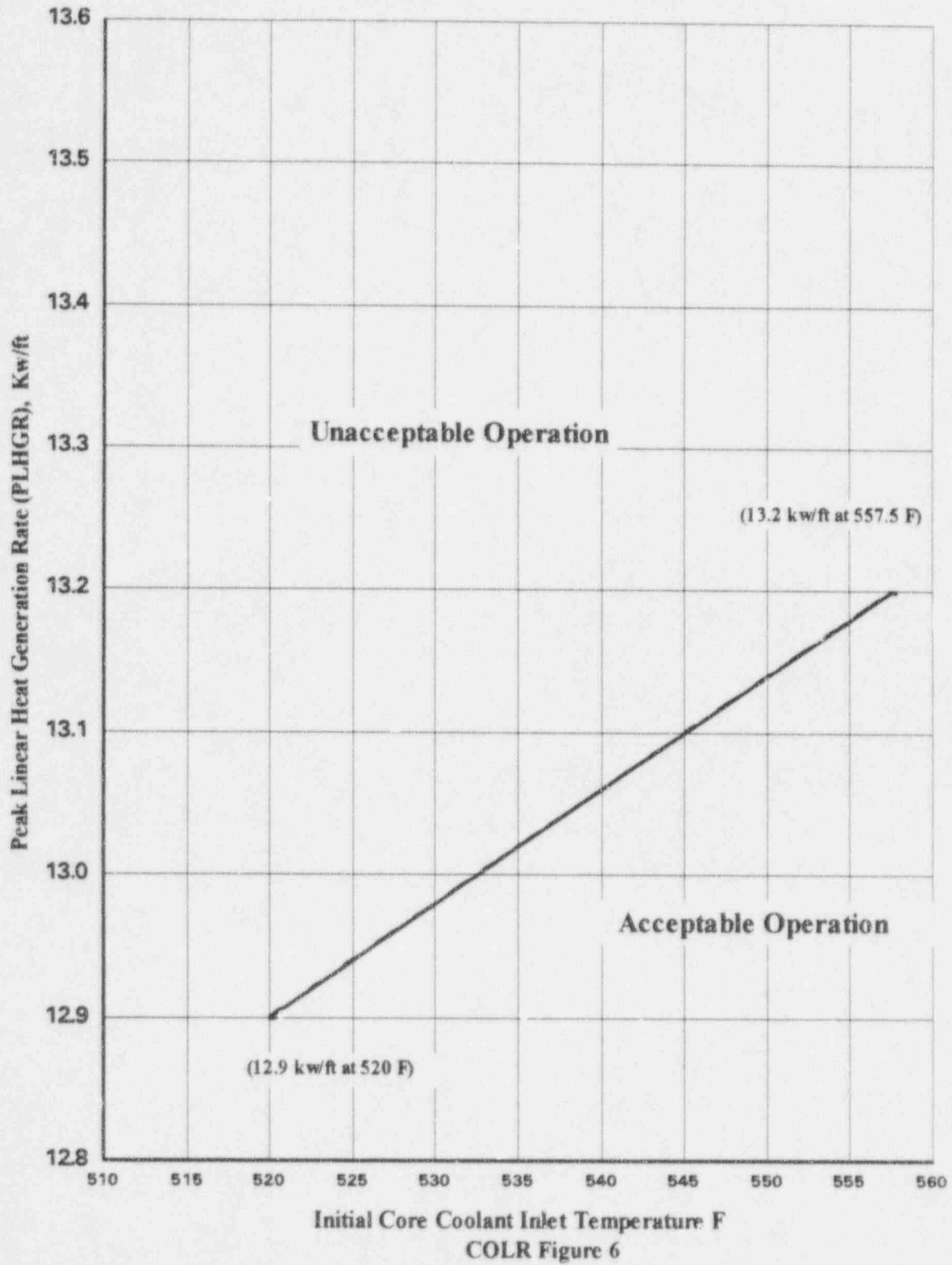
CORE OPERATING LIMITS REPORT

LINEAR HEAT RATE

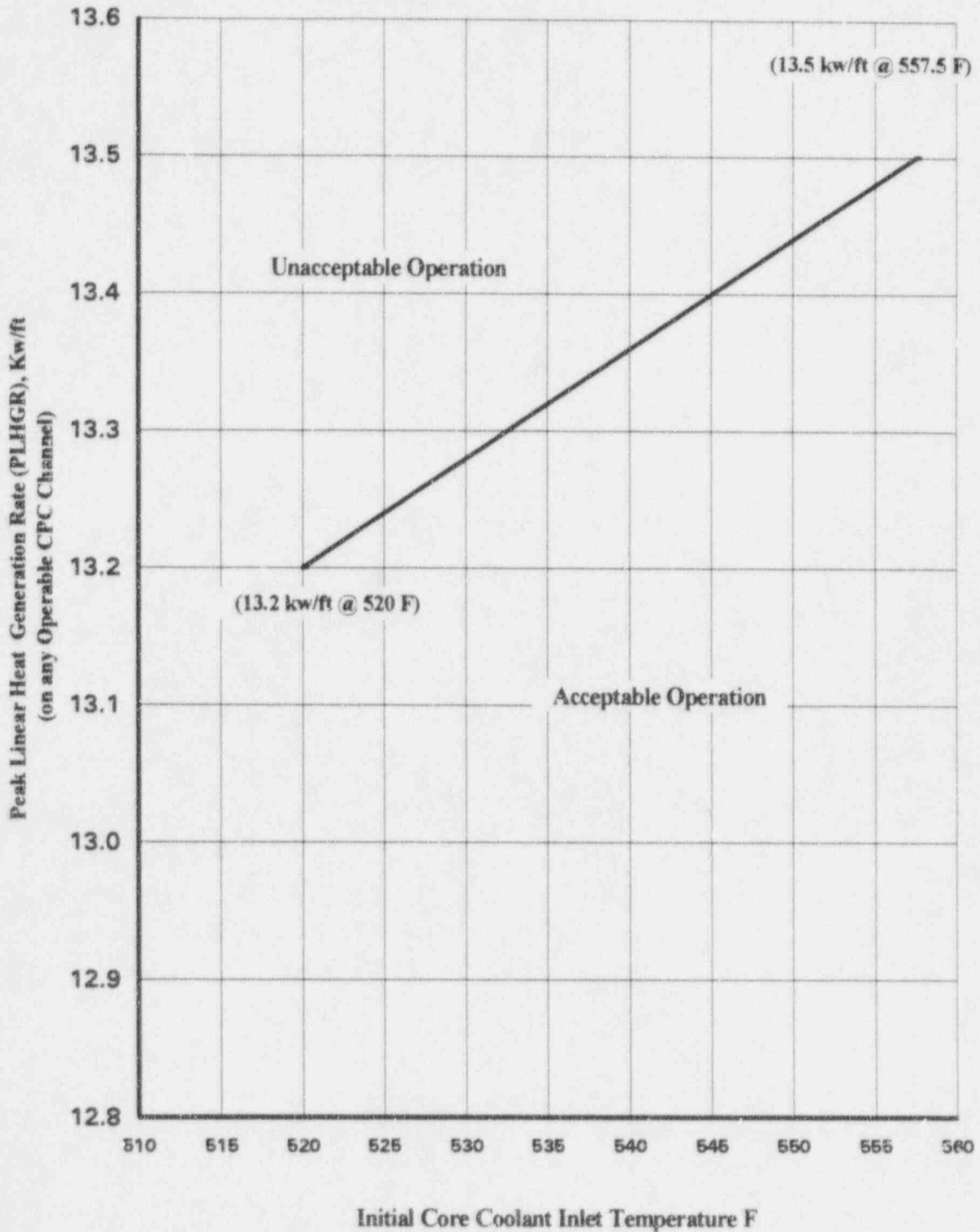
3.2.1 The linear heat rate shall be maintained:

- a. Within the region of acceptable operation of COLR Figure 6.
- b. Within the region of acceptable operation of COLR Figure 7, when COLSS is out of service.

Allowable Peak Linear Heat Rate Versus Tc



Allowable Peak Linear Heat Rate Versus Tc
(COLSS Out of Service)



COLR Figure 7

CORE OPERATING LIMITS REPORT
AZIMUTHAL POWER TILT- T_q

3.2.3 The measured AZIMUTHAL POWER TILT shall be maintained ≤ 0.03 .

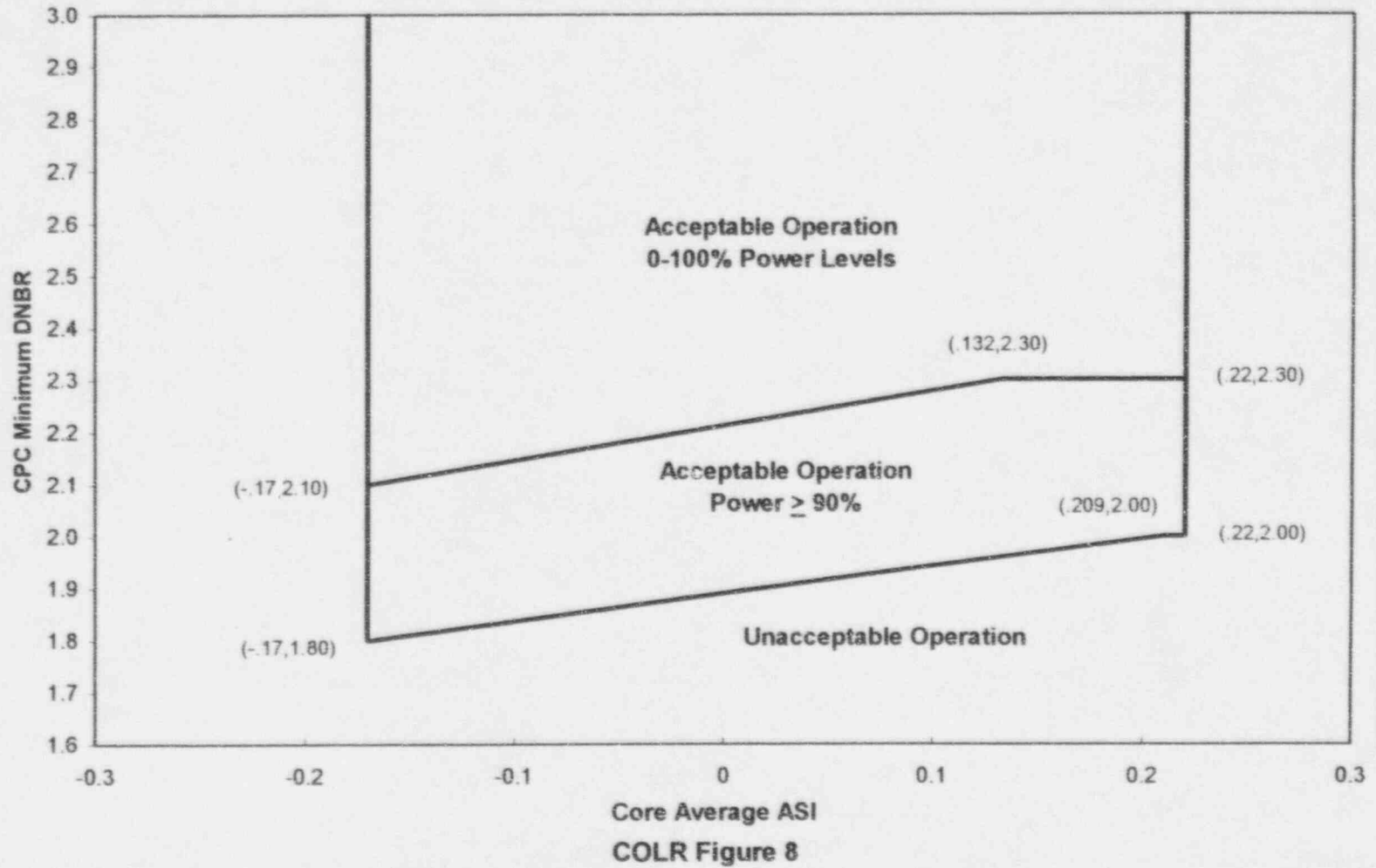
CORE OPERATING LIMITS REPORT

DNBR MARGIN

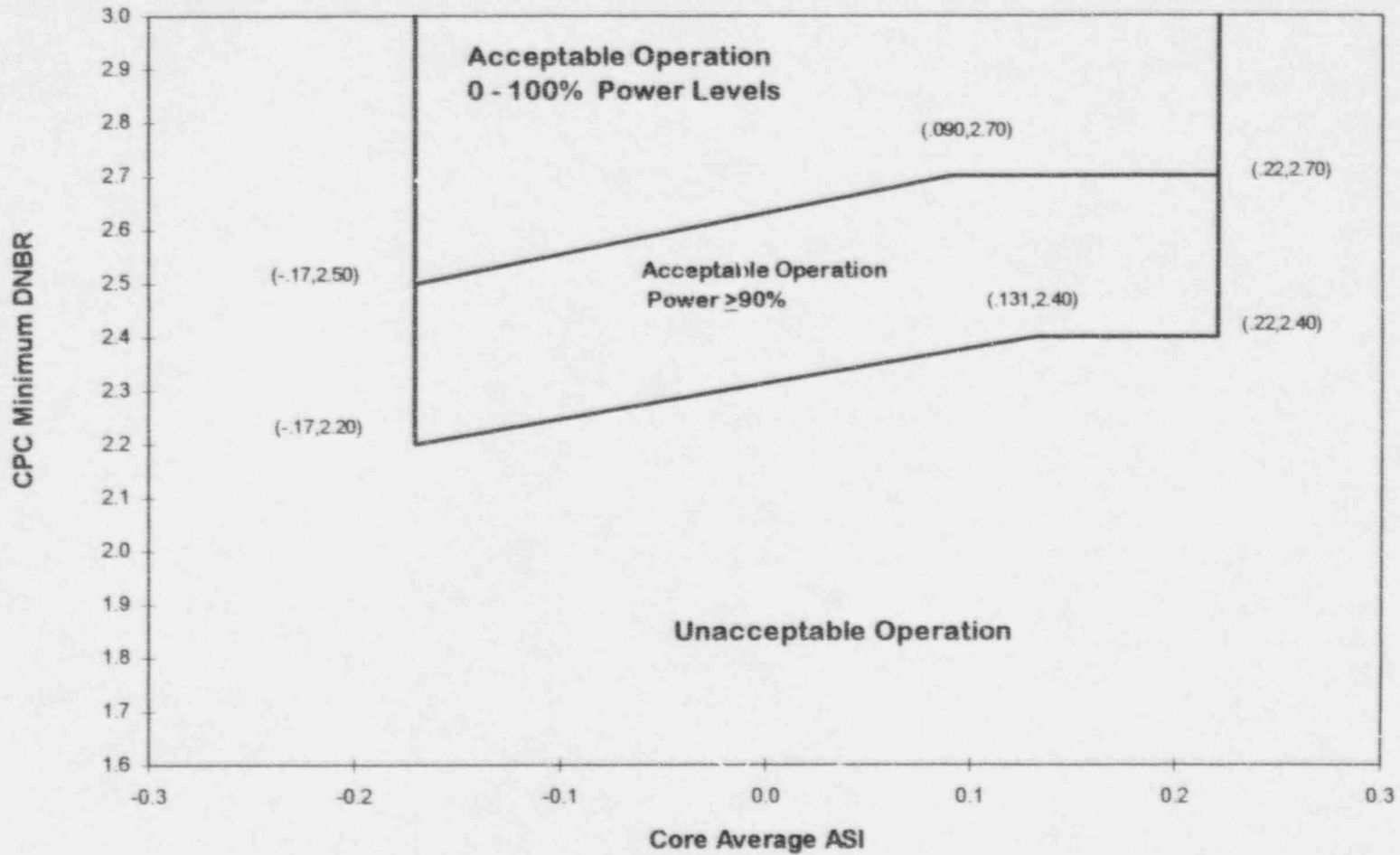
3.2.4 The DNBR limit shall be maintained by one of the following methods:

- a) When COLSS is in service and neither CEAC is operable: maintain COLSS calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR decreased by 13% RATED THERMAL POWER.
- b) When COLSS is out of service and at least one CEAC is operable: operate within the Region of Acceptable Operation shown on COLR Figure 8, using any operable CPC channel.
- c) When COLSS is out of service and neither CEAC is operable: operate within the Region of Acceptable Operation shown on COLR Figure 9, using any operable CPC channel.

Waterford 3 Cycle 9 COOS
CEAC Operable Limit Lines



Waterford 3 Cycle 9 COOS
CEAC Inoperable Limit Lines



COLR Figure 9

CORE OPERATING LIMITS REPORT

AXIAL SHAPE INDEX

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

COLSS Operable

$-0.224 \leq \text{ASI} \leq +0.263$ for THERMAL POWERS $\geq 70\%$ of RATED THERMAL POWER |

$-0.26 \leq \text{ASI} \leq +0.26$ for THERMAL POWERS $< 70\%$ of RATED THERMAL POWER |

COLSS Out of Service

$-0.17 \leq \text{ASI} \leq +0.22$ for THERMAL POWERS $\geq 70\%$ of RATED THERMAL POWER

$-0.22 \leq \text{ASI} \leq +0.22$ for THERMAL POWERS $< 70\%$ of RATED THERMAL POWER

CORE OPERATING LIMITS REPORT

BORON CONCENTRATION

- 3.9.1 While in Mode 6, the RCS boron concentration shall be maintained sufficient to ensure that the more restrictive of the following reactivity conditions is met:
- a. Either K_{eff} of 0.95 or less, or
 - b. A boron concentration of greater than or equal to 2050 ppm.

III. 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; and "C-E Methodology for Core Designs Containing Gadolinia-Urania Burnable Absorber," CENPD-275-P-A, May 1988. Methodology for the limit on Shutdown Margins, MTC, and the Regulating CEA Insertion Limits.
2. "C-E Method for Control Element Assembly Ejection Analysis," CENPD-0190-A, January 1976. Methodology for the Regulating CEA Insertion Limits and Azimuthal Power Tilt.
3. "Modified Statistical Combination of Uncertainties" CEN-356(V)-P-A, May 1988, Methodology for the limits on the DNBR Margin and the ASI.
4. "Calculative Methods for the C-E Large Break LOCA Calculation Model For The Analysis of C-E and W Designed NSSS," CENPD-132, Supplement 3-P-A, June 1985. Methodology for the limits on the MTC, Linear Heat Rate, Azimuthal Power Tilt and ASI.
5. "Calculative Methods for the C-E Small Break LOCA Evaluation Model," CENPD-137-P, August 1974; Supplement 1, January 1977. Methodology for the limits on the MTC, Linear Heat Rate, Azimuthal Power Tilt and ASI.
6. "CESEC - Digital Simulation of a Combustion Engineering Nuclear Steam Supply System", CENPD-107, December 1981. Methodology for the limits on the Shutdown Margins, MTC, Movable Control Assemblies - CEA Position, Regulating CEA Insertion Limits, Part Length CEA Insertion Limits and Azimuthal Power Tilt.