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February 4, 2000

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D.C. 20555

Subject: Waterford 3 SES  
Docket No. 50-382  
License No. NPF-38  
Waterford 3 Cycle 10 Core Operating Limits Report

Gentlemen:

Waterford 3 Technical Specification 6.9.1.11.3 requires submittal of the Core Operating Limits Report (COLR) for each reload cycle, including any mid-cycle revisions or supplements. Revision 1 of the Cycle 10 COLR was previously submitted by letter W3F1-99-0054 on March 19, 1999.

Please find attached Revision 2 of the COLR for Waterford 3 Cycle 10. In Revision 2, the restriction in Section 3.1.1.3 was modified to allow continued operation for the entire cycle; Figures 2A, 2B, and 2C were added; and Section 3.2.7, COLSS Out of Service power range, was modified to be consistent with the Technical Specifications.

There are no commitments associated with this submittal.

A001

Waterford 3 Cycle 10 Core Operating Limits Report  
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Should you have any questions concerning this subject, please contact Edward Lemke at (504) 739-6349.

Very truly yours,

A handwritten signature in black ink, appearing to read "Edward P. Perkins". The signature is fluid and includes a long, sweeping underline that extends to the right.

E.P. Perkins  
Acting - Director  
Nuclear Safety Assurance

EPP/ELL/ssf  
Attachment: COLR, Cycle 10, Revision 2

cc: (w/Attachment)  
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NRC Resident Inspectors Office

# ENERGY OPERATIONS

## WATERFORD 3

### CORE OPERATING LIMITS REPORT

#### FOR CYCLE 10

#### REVISION 2

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Safety & Engineering Analysis

Approved by: A. E. Wemett *CEA Wemett for AEW 2/2/00*  
Licensing

**WATERFORD 3**  
**CORE OPERATING LIMITS REPORT**  
**CYCLE 10, REVISION 2**

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## **WATERFORD 3**

### **CORE OPERATING LIMITS REPORT CYCLE 10, REVISION 2**

#### **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 10. The core operating limits have been developed using the NRC approved methodologies specified in Section III. This is Revision 2 of the Cycle 10 COLR.

Changes between Cycle 10, Revision 1, and Cycle 10, Revision 2, included in this revision are:

1. Modified Section 3.1.1.3 restriction to allow continued operation for the entire cycle.
2. Added Figure 2A, Figure 2B, and Figure 2C.
3. Modified Section 3.2.7 COLSS Out of Service power range to be consistent with the Technical Specifications.

## **II. AFFECTED TECHNICAL SPECIFICATIONS**



## **CORE OPERATING LIMITS REPORT**

### **SHUTDOWN MARGIN - ANY FULL LENGTH CEA WITHDRAWN**

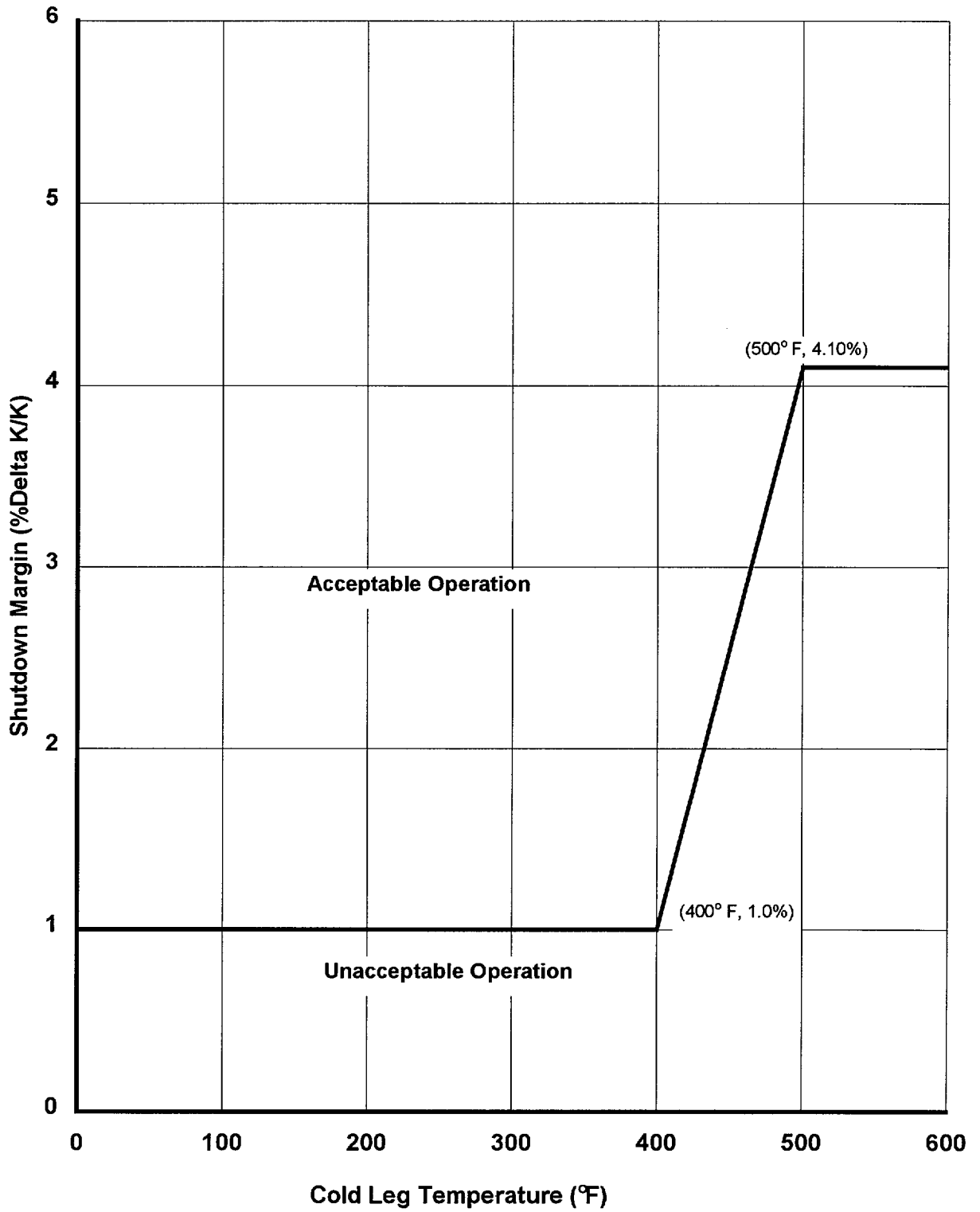
3.1.1.1 The SHUTDOWN MARGIN shall be greater than or equal to 5.15%  $\Delta k/k$  when  $T_{avg}$  is greater than 200 °F or 2.0%  $\Delta k/k$  when  $T_{avg}$  is less than or equal to 200 °F.

## **CORE OPERATING LIMITS REPORT**

### **SHUTDOWN MARGIN - ALL FULL LENGTH CEAs FULLY INSERTED**

3.1.1.2 The SHUTDOWN MARGIN shall be maintained within the region of acceptable operation of COLR Figure 1.

# Shutdown Margin Versus Cold Leg Temperature



COLR Figure 1

## **CORE OPERATING LIMITS REPORT**

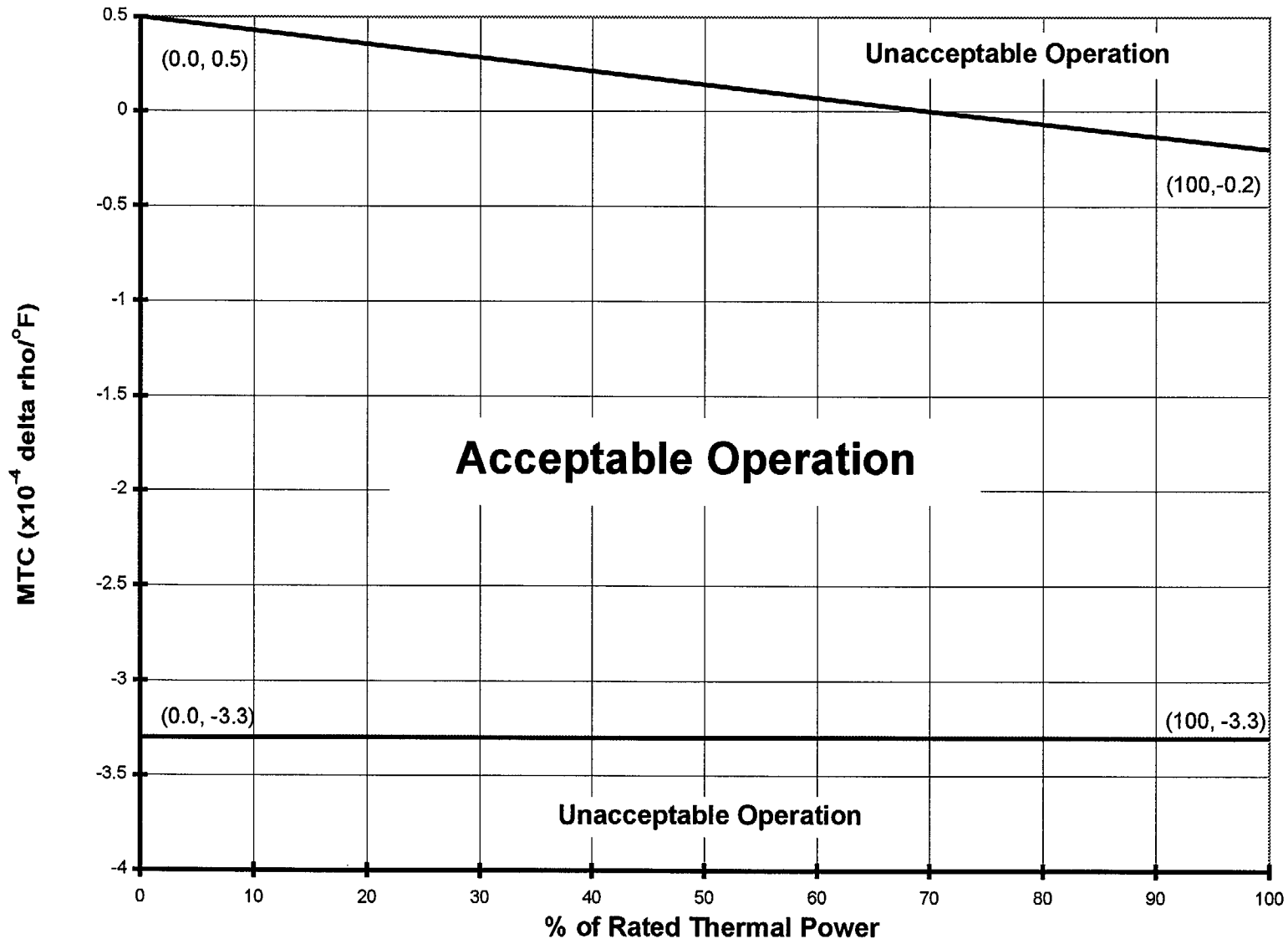
### **MODERATOR TEMPERATURE COEFFICIENT**

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

Restrictions: To maintain the Cycle 10 MTC limits within COLR Figure 2 at a power level greater than 70% rated thermal power, the plant operation shall meet the following restrictions:

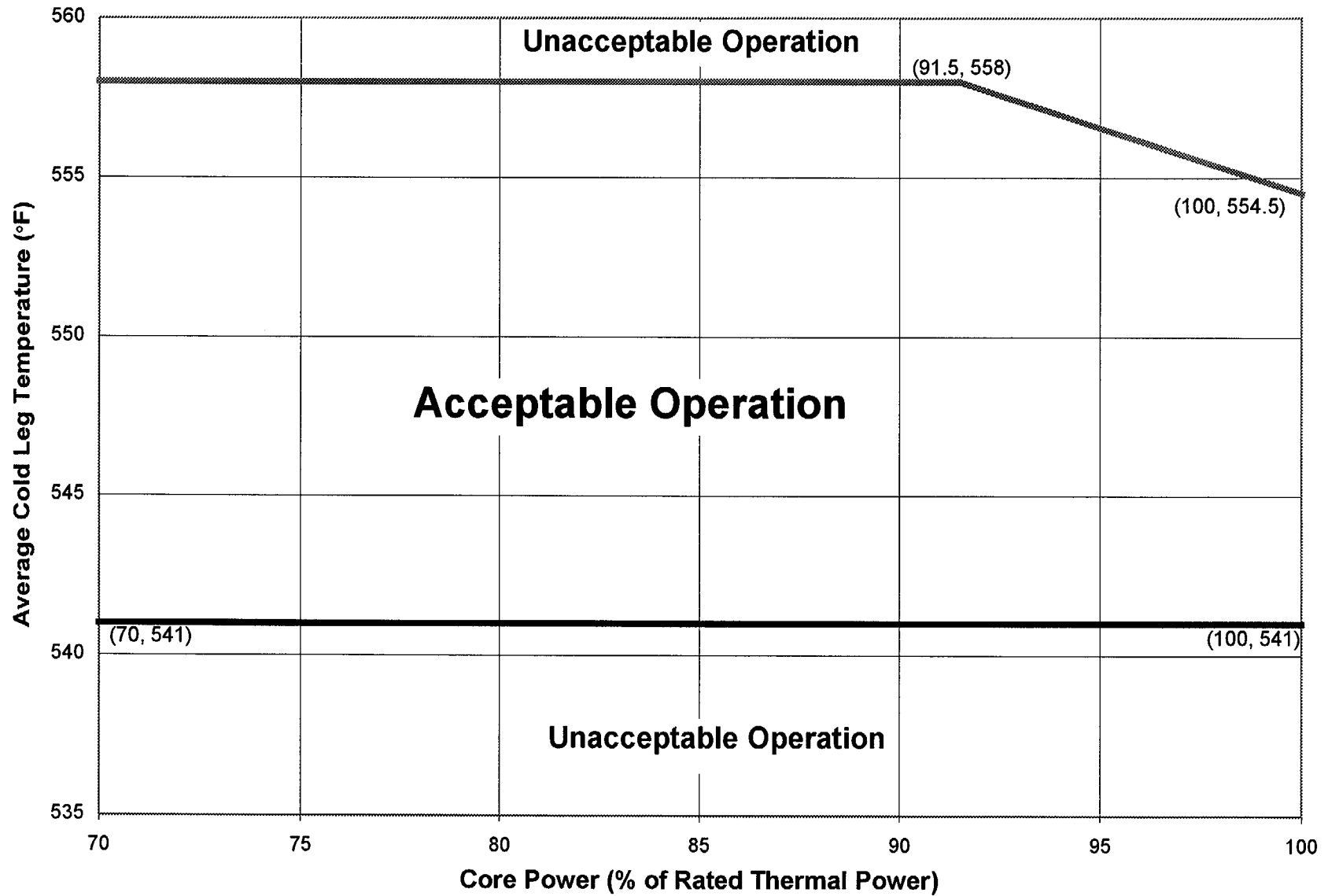
- With the Critical Boron Concentration (CBC) less than or equal to 153 ppm and greater than 100 ppm, the COLR Figure 2A cold leg temperature and power restrictions shall be maintained within the region of acceptable operation.
- With the CBC less than or equal to 100 ppm and greater than 50 ppm, the COLR Figure 2B cold leg temperature and power restrictions shall be maintained within the region of acceptable operation.
- With the CBC less than or equal to 50 ppm, the COLR Figure 2C cold leg temperature and power restrictions shall be maintained within the region of acceptable operation.

### Moderator Temperature Coefficient Versus % of Rated Thermal Power



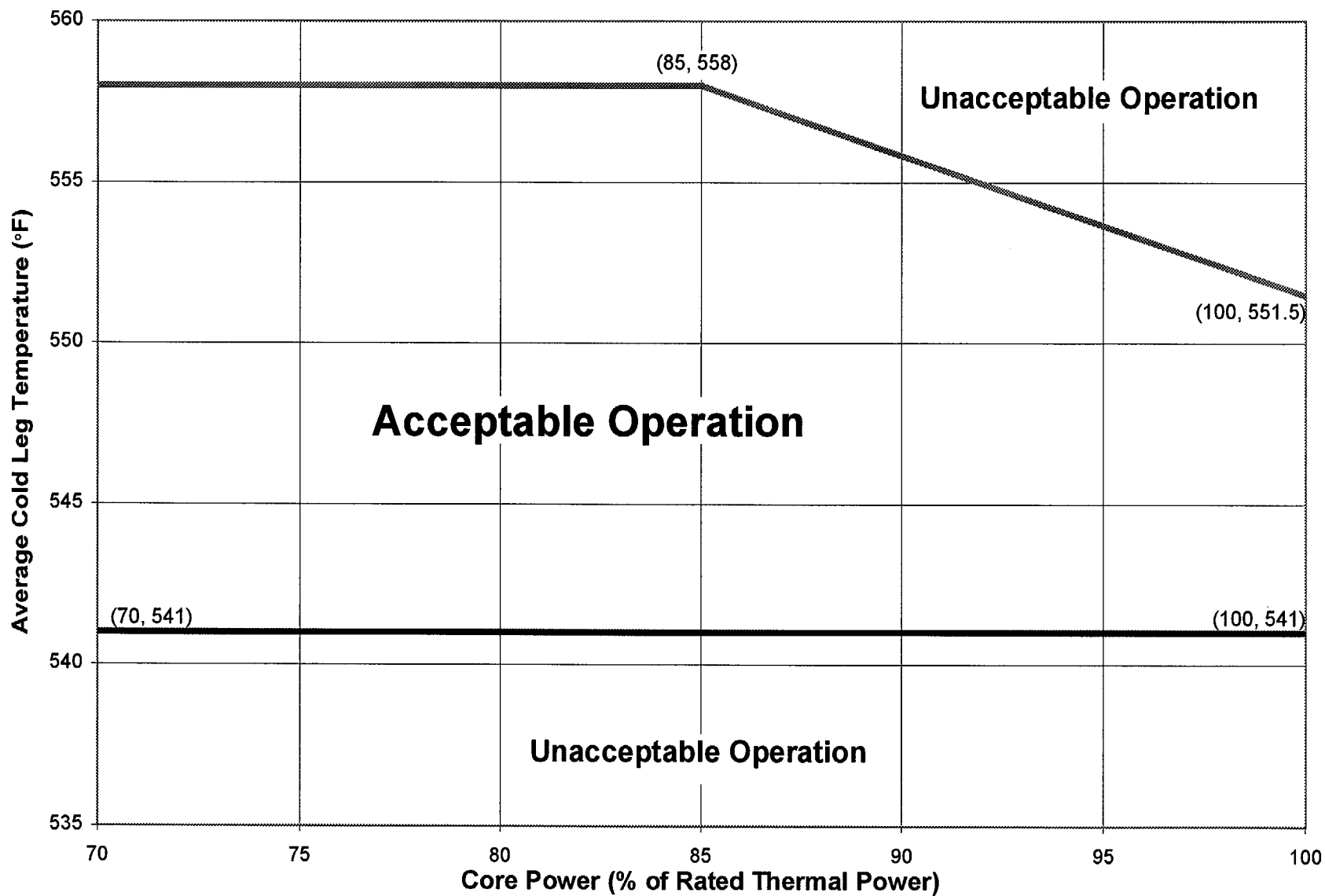
COLR Figure 2

**Cold Leg Temperature versus % of Rated Thermal Power**  
**Critical Boron Concentration (CBC) Less than or Equal to 153 ppm and Greater than 100 ppm**  
 (153 ppm ≥ CBC > 100 ppm)



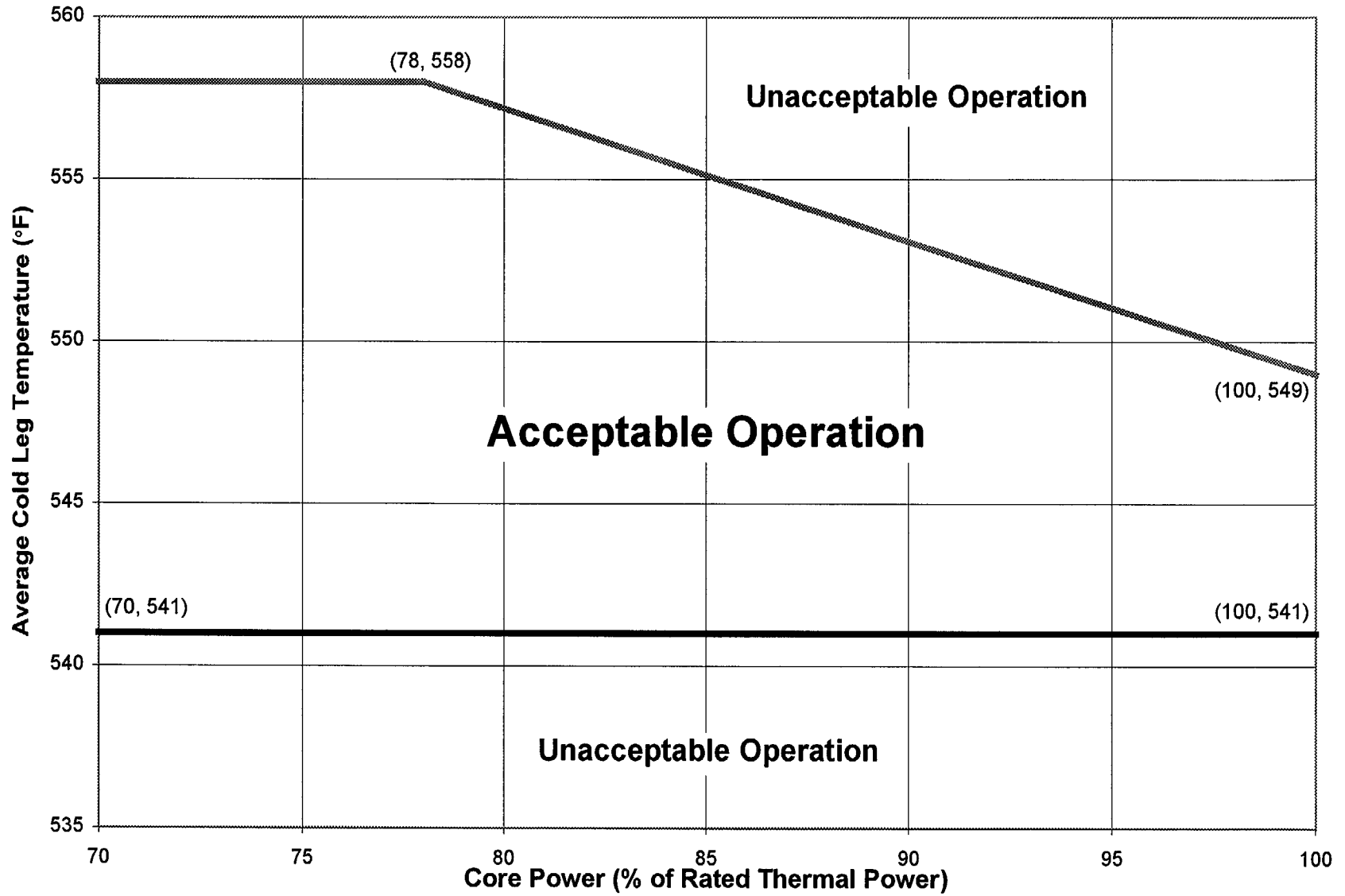
**COLR Figure 2A**

**Cold Leg Temperature versus % of Rated Thermal Power**  
**Critical Boron Concentration (CBC) Less than or Equal to 100 ppm and Greater than 50 ppm**  
(100 ppm ≥ CBC > 50 ppm)



**COLR Figure 2B**

**Cold Leg Temperature versus % of Rated Thermal Power  
Critical Boron Concentration (CBC) Less than or Equal to 50 ppm  
(CBC ≤ 50 ppm)**



**COLR Figure 2C**



## CORE OPERATING LIMITS REPORT

### BORON DILUTION

3.1.2.9 See COLR Tables 1 through 5 for required RCS boron concentration monitoring frequencies and Charging Pump operation limits.

#### 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 < 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 <sup>*</sup>			
	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 <sup>**</sup>
5 RCS filled	8 hours	2.0 hours	0.75 hours	Operation not allowed <sup>**</sup>
5 RCS partially drained	8 hours	2.0 hours	0.5 hours	Operation not allowed <sup>**</sup>
6	Operation not allowed <sup>**</sup>			

<sup>\*</sup> Charging pump OPERABILITY for any period of time shall constitute OPERABILITY for the entire monitoring frequency.

<sup>\*\*</sup> 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.

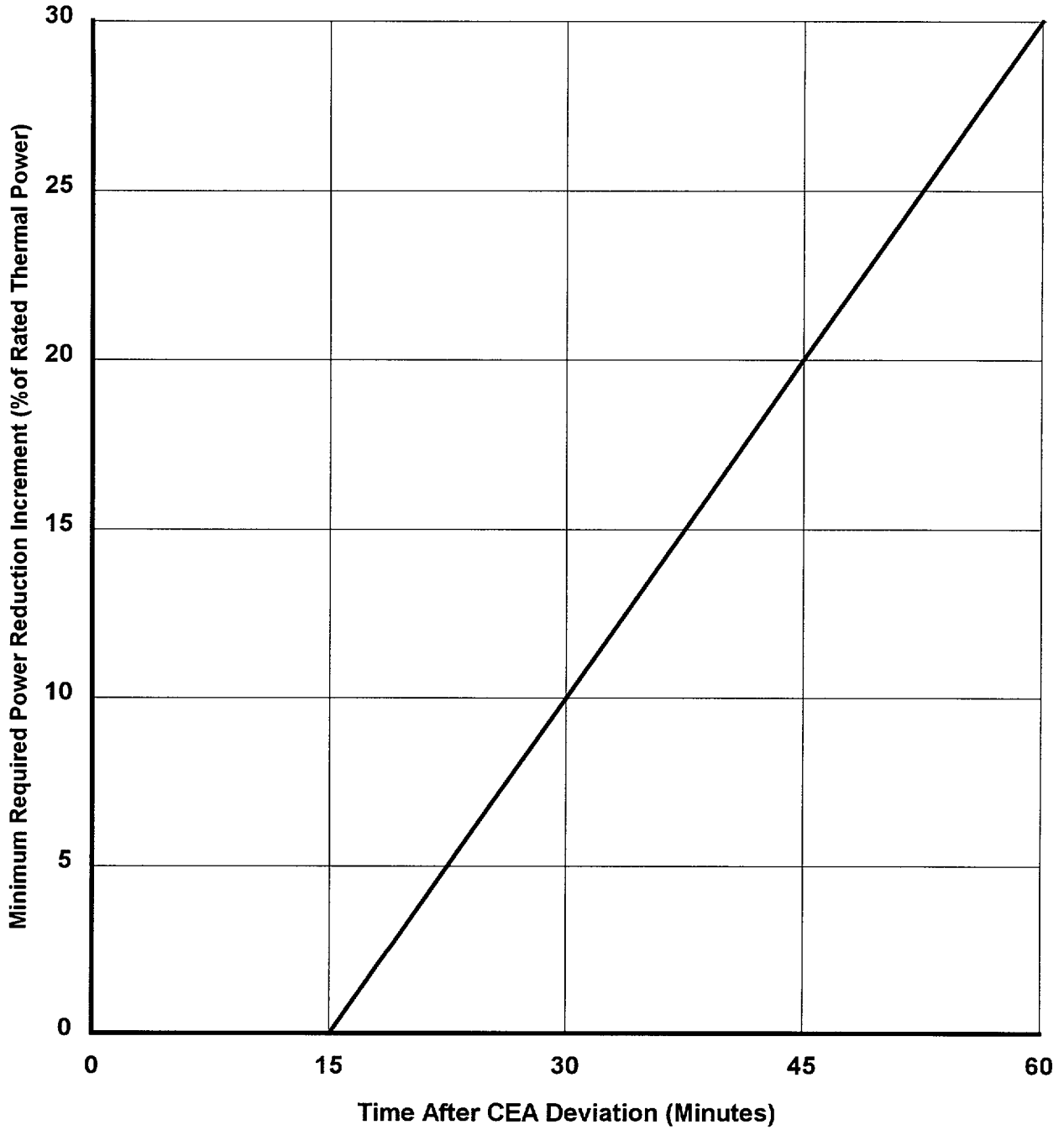
\*\* The precluded number of charging pumps shall be verified to be inoperable by racking out their motor circuit breakers.

## **CORE OPERATING LIMITS REPORT**

### **MOVABLE CONTROL ASSEMBLIES - CEA POSITION**

- 3.1.3.1.a With one full-length or part-length CEA trippable but misaligned from any other CEA in its group by more than 19 inches, operation in MODES 1 and 2 may continue, provided that core power is reduced in accordance with COLR Figure 3.
- 3.1.3.1.b With one or more full-length or part-length CEAs trippable but misaligned from any other CEAs in its group by more than 7 inches but less than or equal to 19 inches, 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

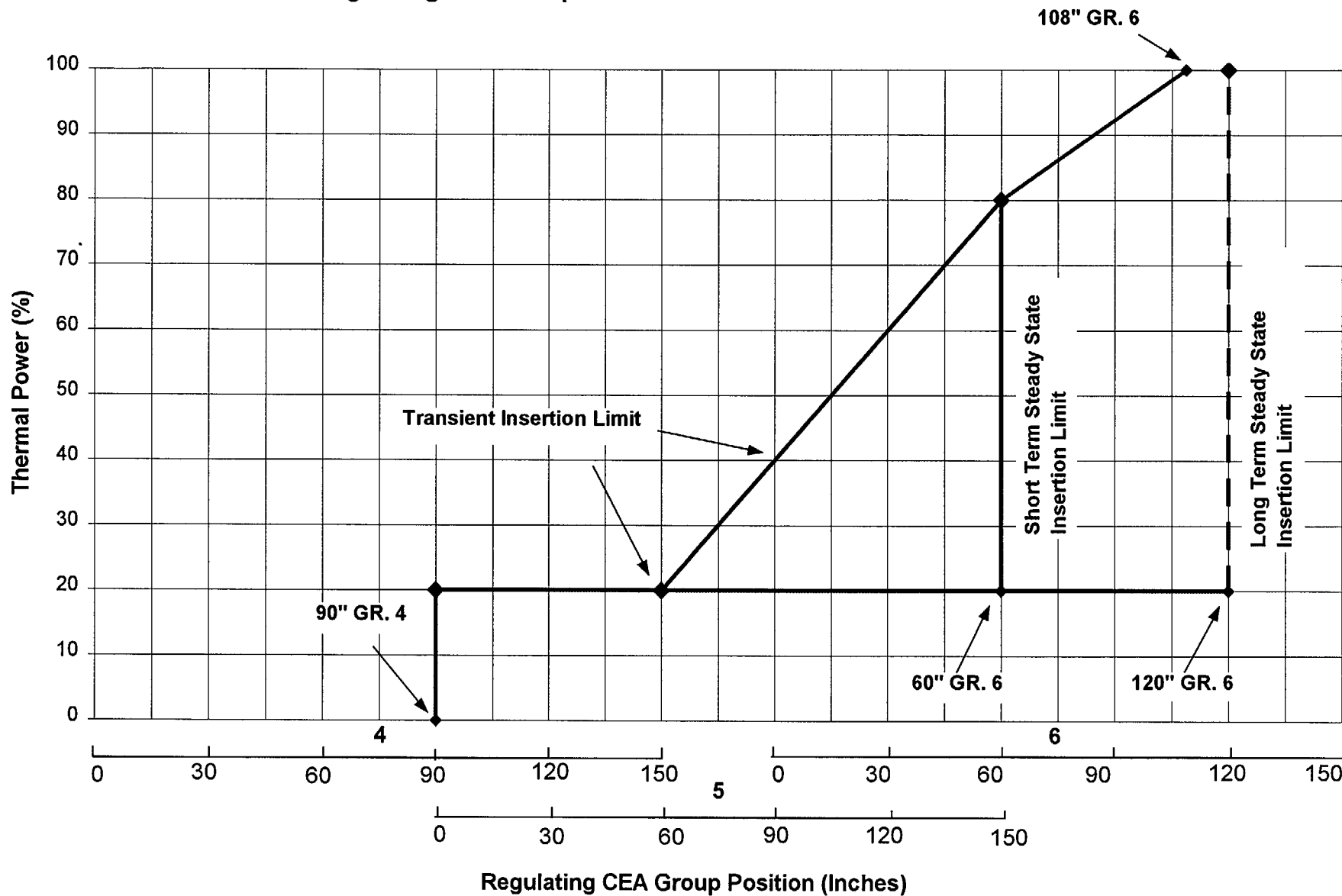
\* When thermal power is reduced to 60% of rated thermal power per this limit curve, further reduction is not required by this technical specification.



**CORE OPERATING LIMITS REPORT**  
**REGULATING CEA GROUP 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.

### Regulating CEA Group Insertion Limits Versus Thermal Power

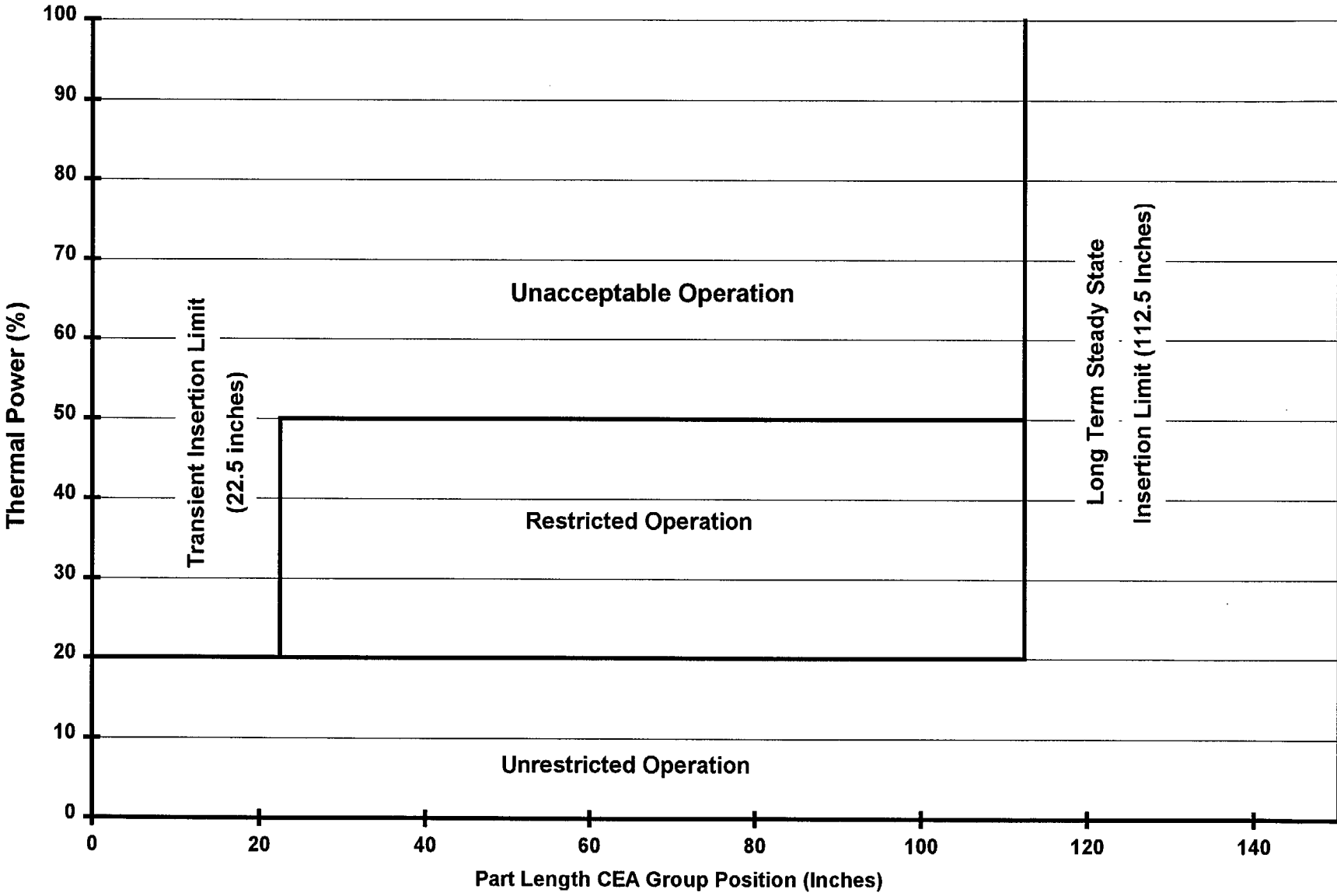


COLR Figure 4

**CORE OPERATING LIMITS REPORT**  
**PART LENGTH CEA GROUP 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 Group Insertion Limits Versus Thermal Power



COLR Figure 5

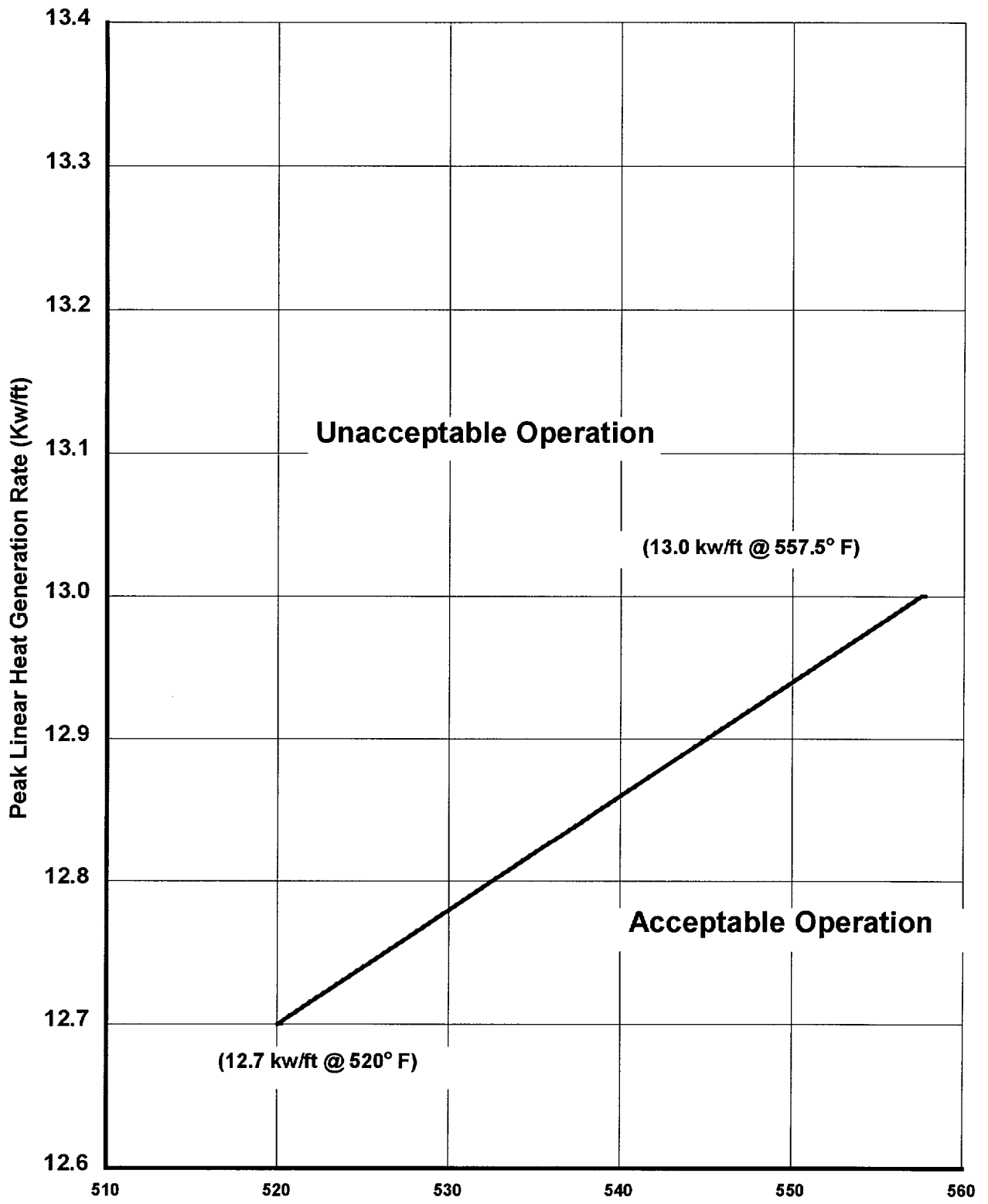
## **CORE OPERATING LIMITS REPORT**

### **LINEAR HEAT RATE**

3.2.1 The linear heat rate shall be maintained:

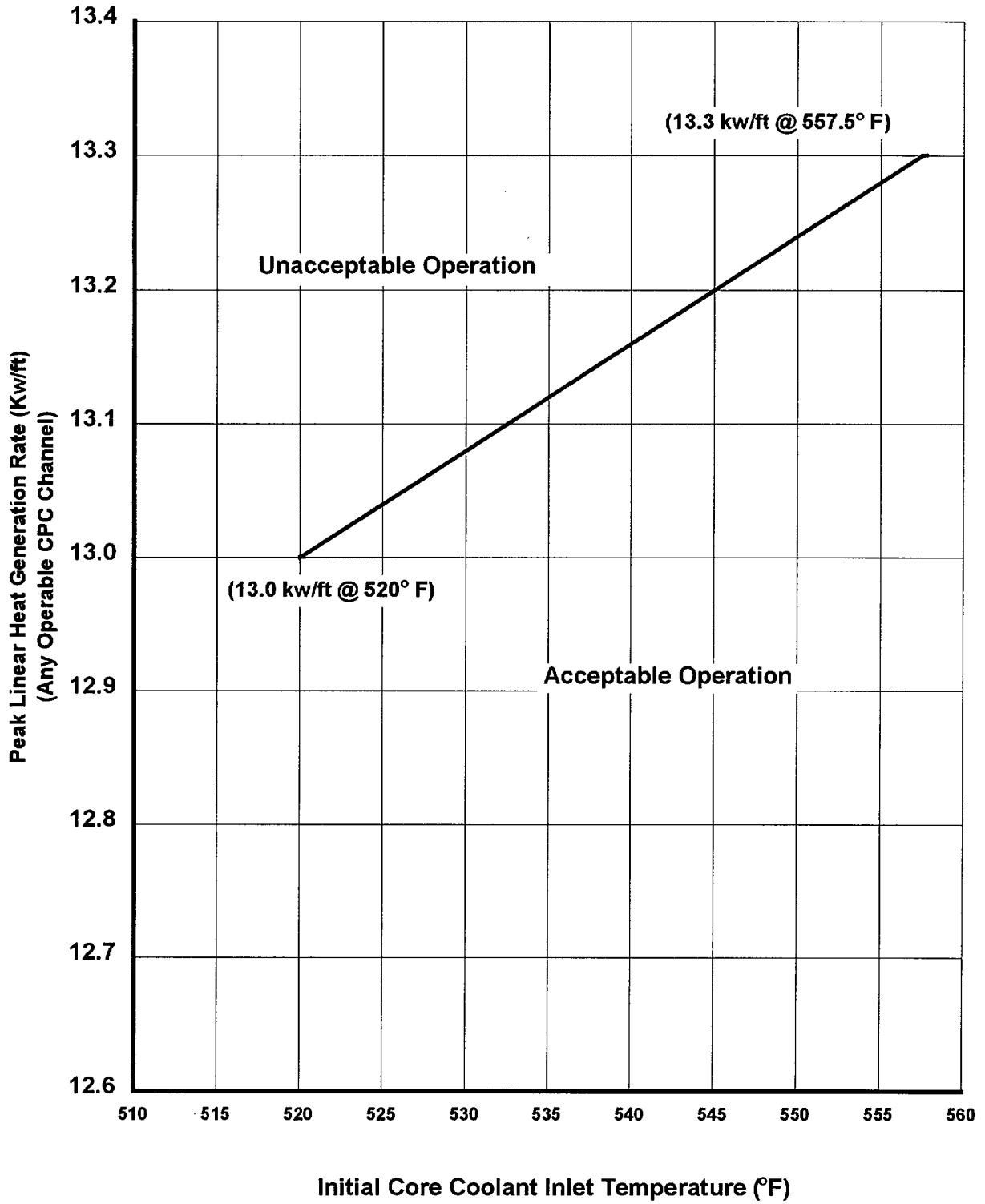
- a. Within the region of acceptable operation of COLR Figure 6, when COLSS is in service.
- b. Within the region of acceptable operation of COLR Figure 7, when COLSS is out of service.

**Allowable Peak Linear Heat Rate Versus Tc  
(COLSS in Service)**



**Initial Core Coolant Inlet Temperature (°F)**  
COLR Figure 6

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  $\leq 0.03$ .



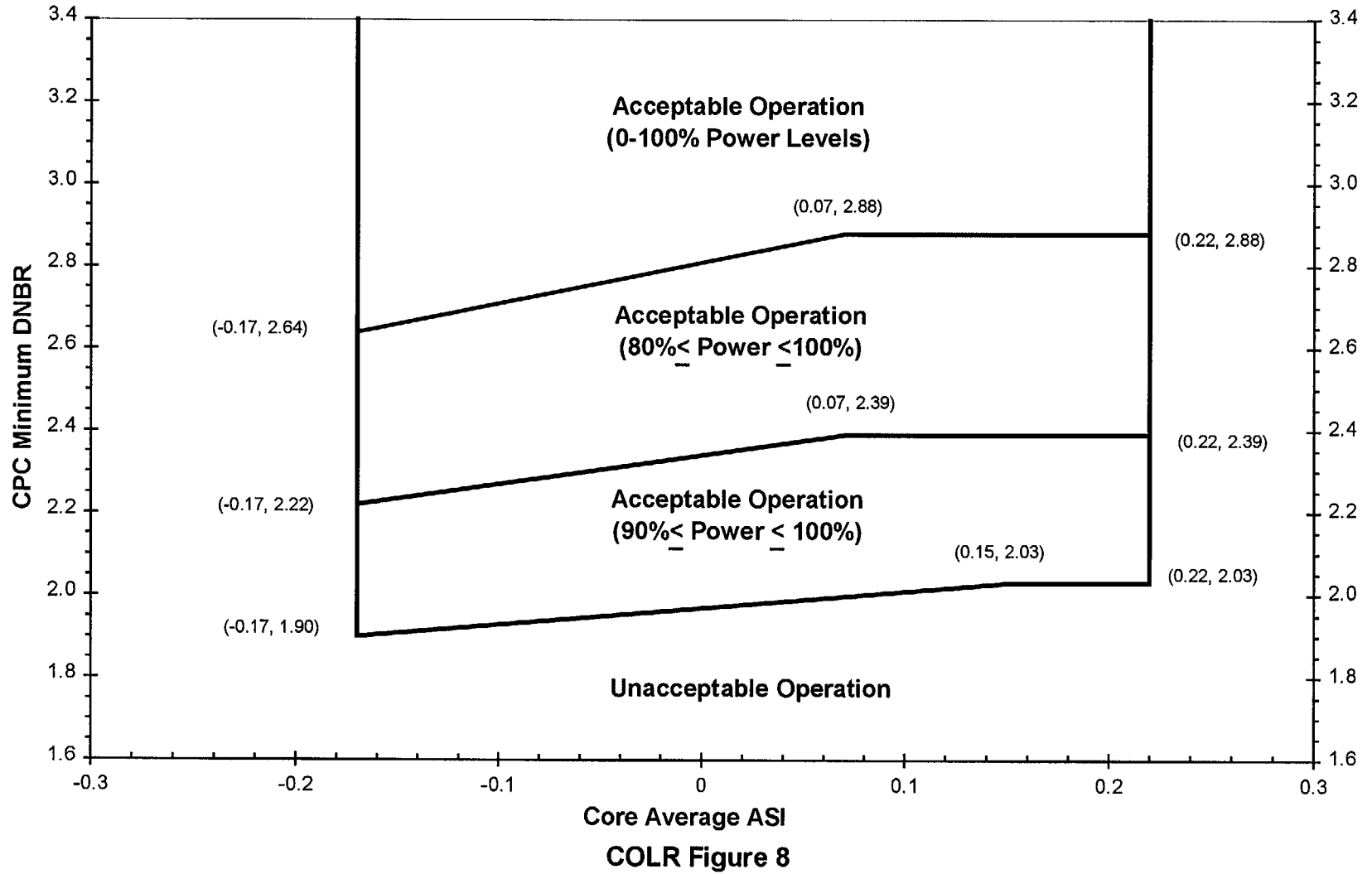
## CORE OPERATING LIMITS REPORT

### DNBR MARGIN

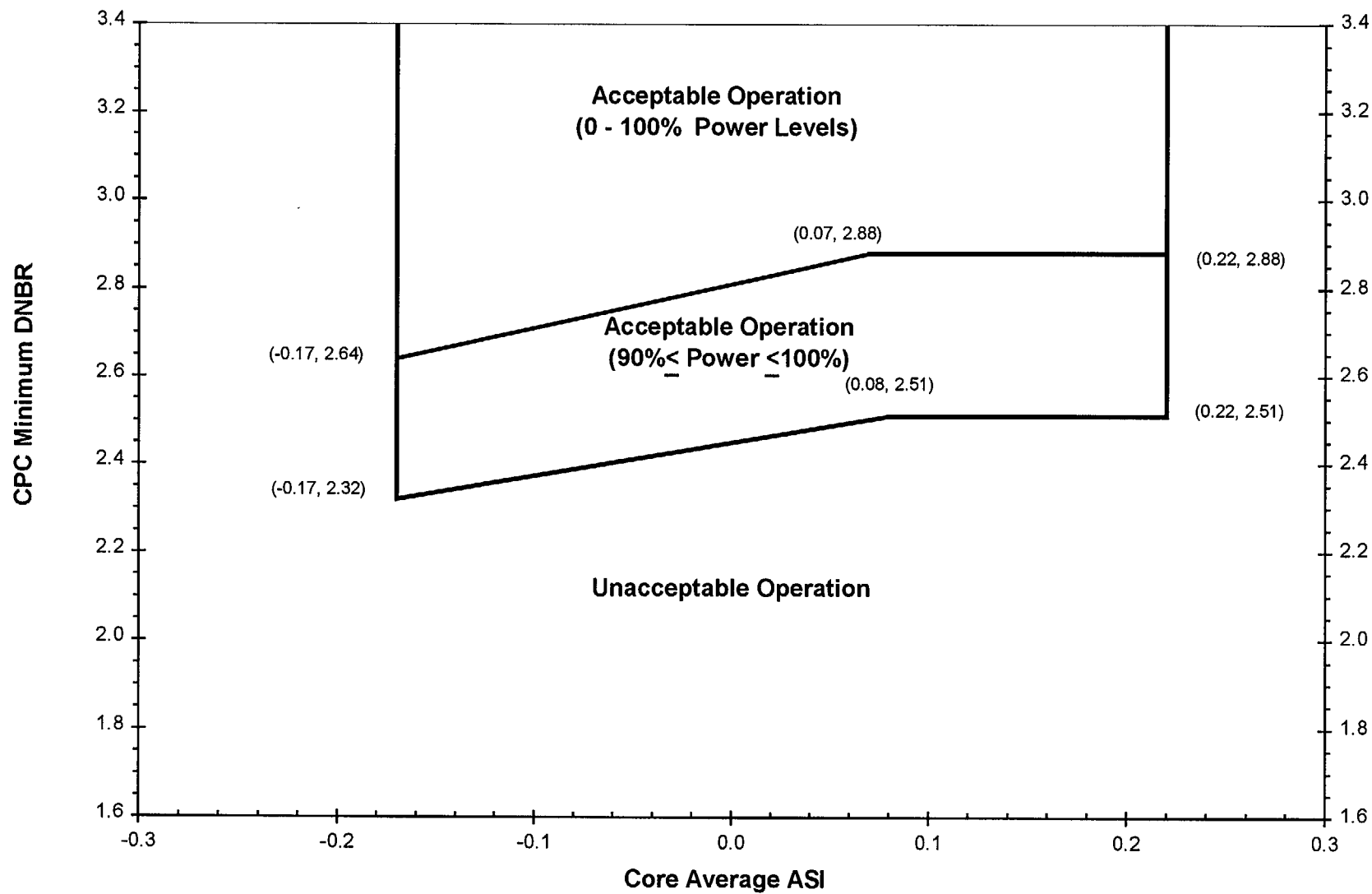
3.2.4 The DNBR margin shall be maintained by one of the following methods:

- 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.

**Allowable DNBR with Any CEAC Operable  
(COLSS Out of Service)**



Allowable DNBR With No CEAC(s) Operable  
(COLSS Out of Service)



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 from 20% to 100% 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  $K_{\text{eff}}$  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.