# **ENTERGY OPERATIONS**

# WATERFORD 3

# CORE OPERATING LIMITS REPORT

# FOR CYCLE 10

## **REVISION 1**

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#### CORE OPERATING LIMITS REPORT CYCLE 10, REVISION 1

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#### CORE OPERATING LIMITS REPORT CYCLE 10, 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 10. The core operating limits have been developed using the NRC approved methodologies specified in Section III. This is Revision 1 of the Cycle 10 COLR.

Changes between Cycle 10, Revision 0, and Cycle 10, Revision 1, included in this revision are:

1. Figures 8 and 9 have been revised to address new DNBR limits with COLSS Outof-Service when the CEACs are Operable or Inoperable.

# **II. AFFECTED TECHNICAL SPECIFICATIONS**

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#### SHUTDOWN MARGIN - ANY FULL LENGTH CEA WITHDRAWN

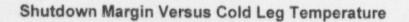
3.1.1.1 The SHUTDOWN MARGIN shall be greater than or equal to 5.15% Δk/k when Tavg is greater than 200 °F or 2.0% Ak/k when Tavg is less than or equal to 200 °F.

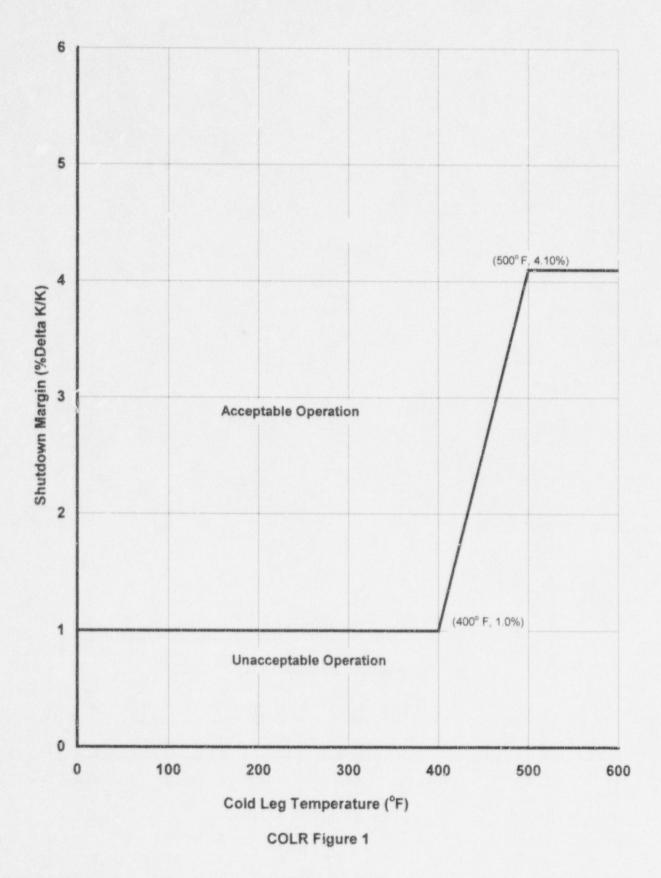
#### SHUTDOWN MARGIN - ALL FULL LENGTH CEAS FULLY INSERTED

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

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COLR 3/4 1-3 CYCLE 10 REVISION 1





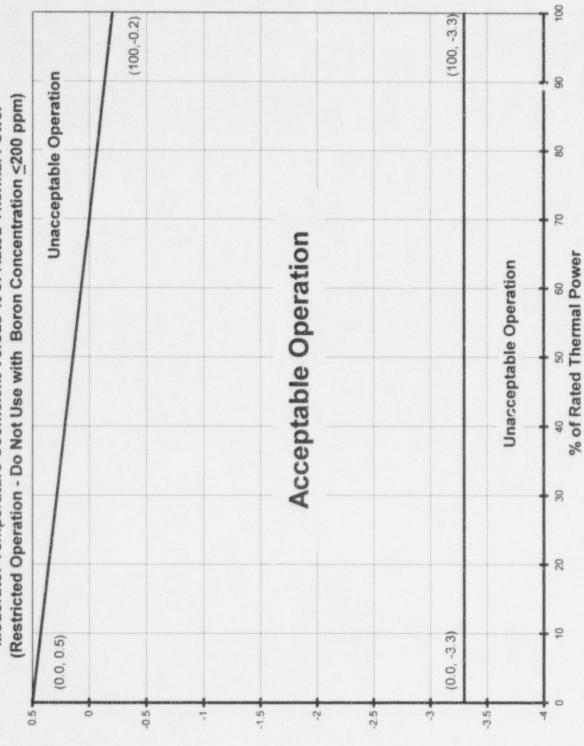
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COLR 3/4 1-3A

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#### 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.
- Restriction: The reactor shall not be operated with a critical boron concentration less than or equal to 200 ppm to ensure MTC is maintained within COLR Figure 2.



MTC (x10<sup>-4</sup> delta rho/<sup>o</sup>F)

Moderator Temperature Coefficient Versus % of Rated Thermal Power

**COLR Figure 2** 

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COLR 3/4 1-4A

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#### 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 ≥ 10 hours but < 25 hours.</p>
- d. At least once per 24 hours if the reactor has been shut down ≥ 25 hours but < 21 days.</p>
- e. At least once per 7 days if the reactor has been shut down ≥ 21 days.

#### REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON DILUTION DETECTION AS A FUNCTION OF OPERATING CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR Keff GREATER THAN 0.98

Keff >0.98

Numbe	Number of Operating Charging Pumps*				
0	1	2	3		
12 hours	0.75 hours	Opera	tion not allowed **		
12 hours	Operat	tion not a	allowed **		
8 hours	Operation not allowed **				
8 hours ained	Operat	tion not a	allowed **		
Op	Operation not allowed **				
	0 12 hours 12 hours 8 hours 8 hours	0 1 12 hours 0.75 hours 12 hours Operat 8 hours Operat 8 hours Operat	0 1 2 12 hours 0.75 hours Operation 12 hours Operation not a 8 hours Operation not a 8 hours Operation not a ained	12 hours 0.75 hours Operation not allowed **   12 hours Operation not allowed **   8 hours Operation not allowed **   8 hours Operation not allowed **   8 hours Operation not allowed **	

for the entire monitoring frequency.

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

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

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

0.98 ≥ Keff >0.97

\* 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.

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

PERATIONAL	Number of Operating Charging Pumps*				
MODE	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 CS filled	8 hours	1.5 hours	Operation	not allowed*'	
5 S partially drain	8 hours ned	0.75 hours	Operation	not allowed**	
6		Operation not allowed**			

0.97 ≥ Keff >0.96

\* 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.

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

OPERATIONAL	Number of Operating Charging Pumps*				
MODE	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 drain	8 hours ed	2.0 hours	0.5 hours	Operation not allowed**	
6		Operation not allowed**			

 $0.96 \ge K_{eff} > 0.95$ 

\* 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.

#### REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON DILUTION DETECTION AS A FUNCTION OF OPERATING CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR Keff LESS THAN OR EQUAL TO 0.95

#### Keff ≤0.95

OPERATIONAL	Number of Operating Charging Pumps*				
MODE	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 drain	8 hours red	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.

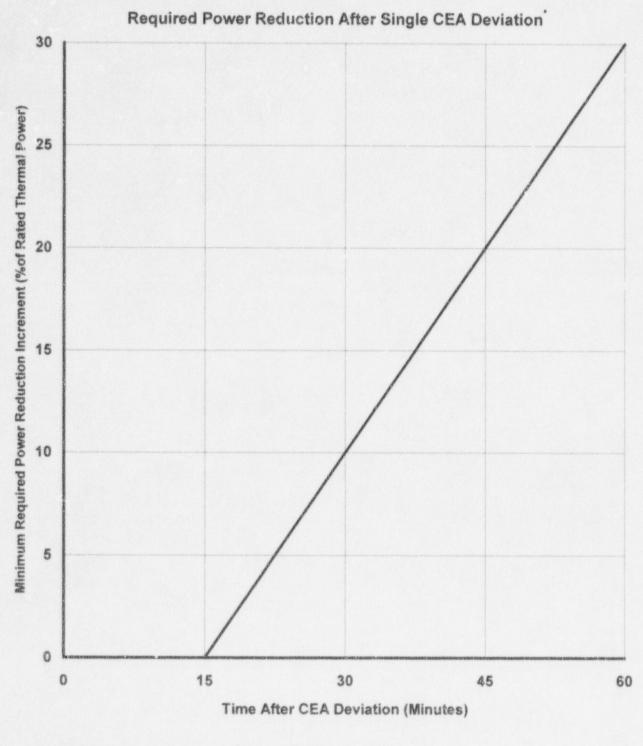
\*\* The precluded number of charging pumps shall be verified to be inoperable by racking out their motor circuit breakers.

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COLR 3/4 1-15E CYCLE 10 REVISION 1

#### **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.



**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.

#### **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.

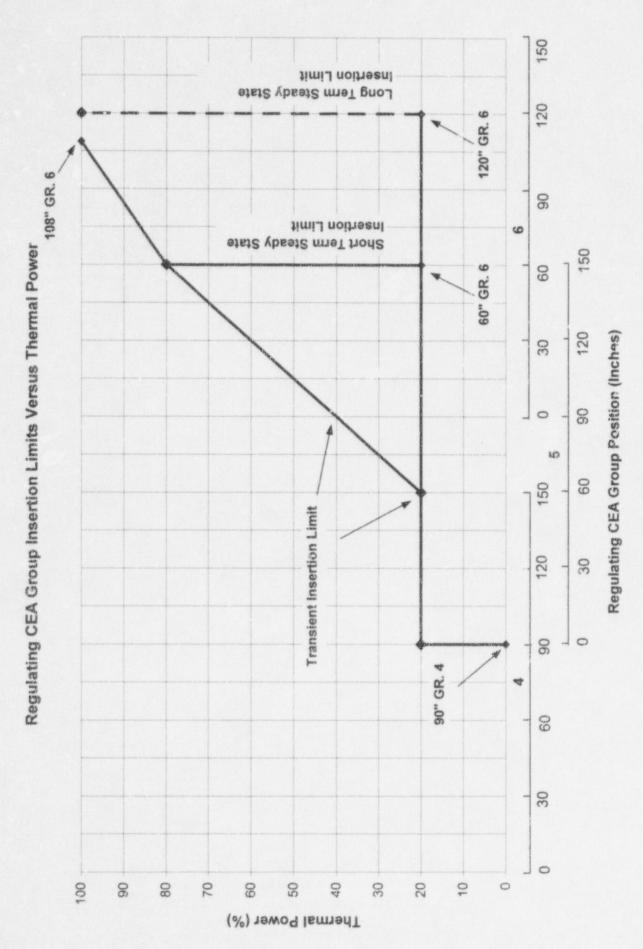
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COLR 3/4 1-25A

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# COLR Figure 4



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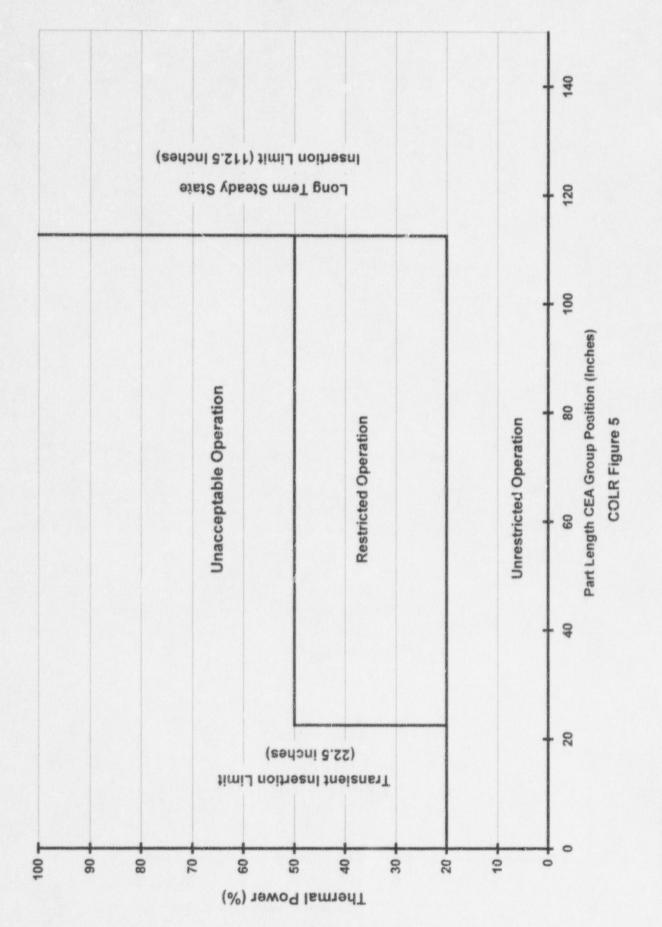
#### PART LENGTH CEA GROUP INSERTION LIMITS

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

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COLR 3/4 1-28 CYCLE 10 REVISION 1

Part Length CEA Group Insertion Limits Versus Thermal Power



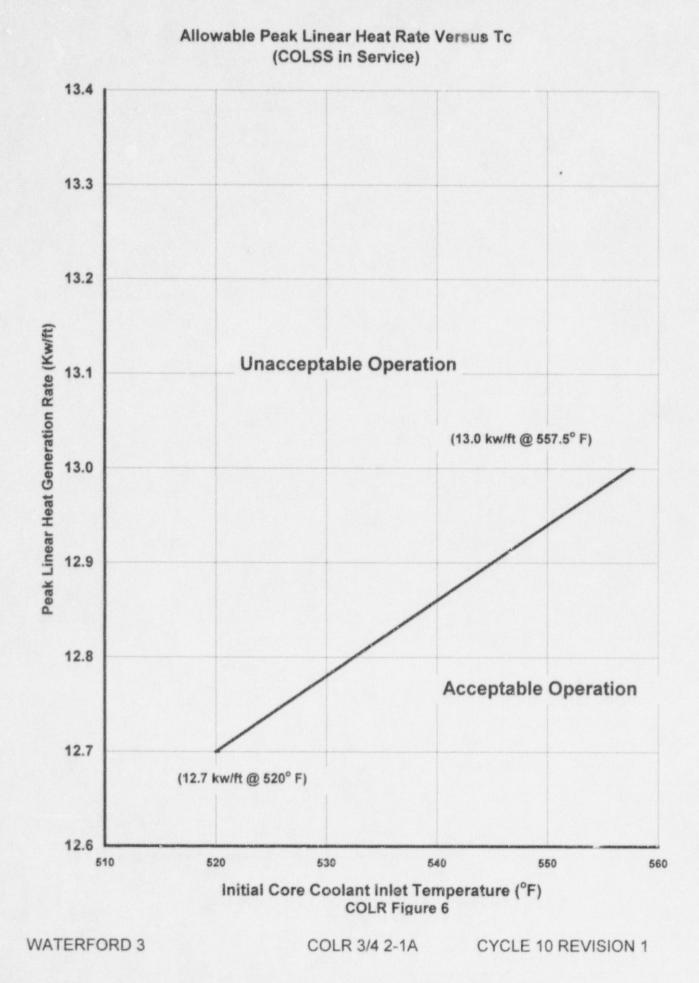
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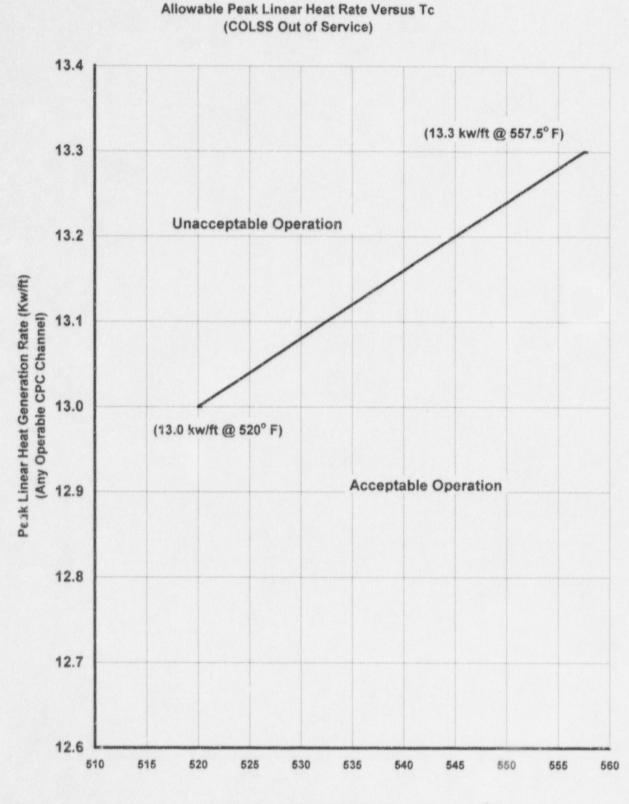
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COLR 3/4 1-28A

### CORE OPERATING LIMITS REPORT LINEAR HEAT RATE

- The linear heat rate shall be maintained: 3.2.1
  - Within the region of acceptable operation of COLR Figure 6, a. when COLSS is in service.
  - Within the region of acceptable operation of COLR Figure 7, b. when COLSS is out of service.





Initial Core Coolant Inlet Temperature (°F) COLR Figure 7

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COLR 3/4 2-1B CYCLE 10 REVISION 1

## CORE OPERATING LIMITS REPORT AZIMUTHAL POWER TILT- Tq

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

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COLR 3/4 2-4 CYCLE 10 REVISION 1

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#### **DNBR MARGIN**

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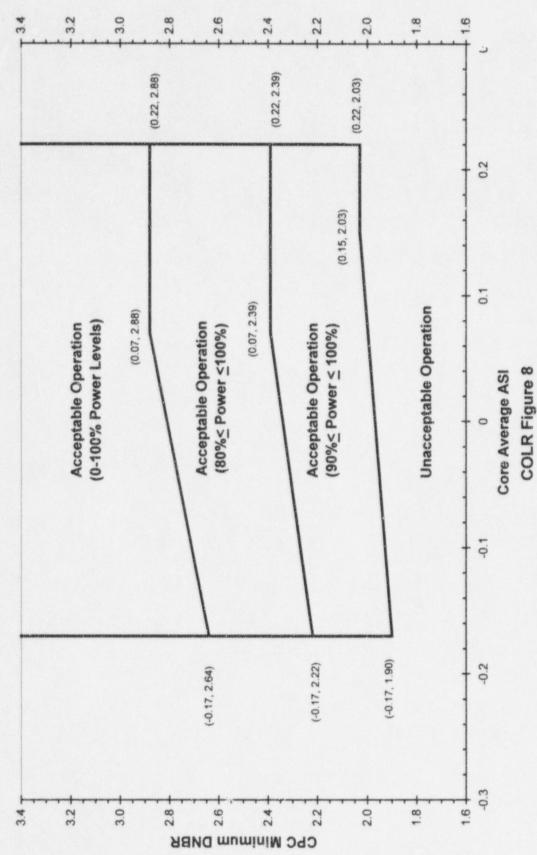
- 3.2.4 The DNBR margin shall be maintained by one of the following methods:
  - a) When COLSS is in service and neither CEAC is operable: maintain COL3S calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR decreased by 13% RATED THERMAL POWER.
  - b) 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.

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COLR 3/4 2-6A

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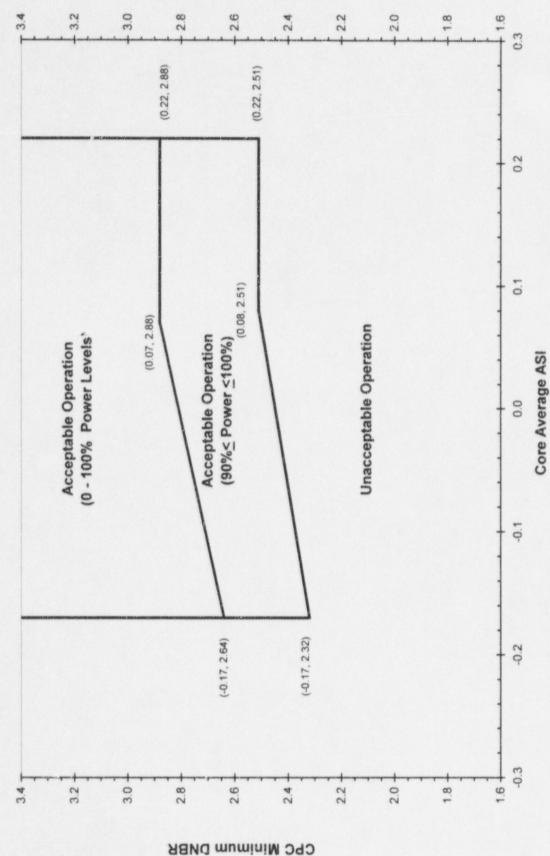
# Allowable DNBR with Any CEAC Operable (COLSS Out of Service)

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COLR 3/4 2-6B

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# **COLR Figure 9**



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

#### AXIAL SHAPE INDEX

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

#### **COLSS** Operable

-0.224 ≤ ASI ≤ +0.263 for THERMAL POWERS ≥ 70% of RATED THERMAL POWER

-0.26 ≤ ASI ≤ +0.26 for THERMAL POWERS < 70% of RATED THERMAL POWER

#### **COLSS Out of Service**

 $-0.17 \le ASI \le +0.22$  for THERMAL POWERS from 0% 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 Keff 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:

- "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.
- "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.
- "Modified Statistical Combination of Uncertainties" CEN-356(V)-P-A, May 1988, Methodology for the limits on the DNBR Margin and the ASI.
- "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.
- "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.
- "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.