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Waterford 3

W3F1-2014-0047

July 29, 2014

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Core Operating Limits Report – Cycle 20 Revision 1
Waterford Steam Electric Station, Unit 3
Docket No. 50-382
License No. NPF-38

Dear Sir or Madam:

Waterford 3 Core Operating Limits Report for Cycle 20 was revised to change the Azimuthal Power Tilt limit from less than or equal 0.03 to less than or equal to 0.05. Azimuthal Power Tilt values have been slightly higher than anticipated following restart from refueling outage 19. The increased limit allows for additional operating margin for the duration of Cycle 20.

If you have any questions concerning this submittal, please contact John P. Jarrell, Regulatory Assurance Manager, at (504) 739-6685.

There are no new commitments contained in this submittal.

Sincerely,

JPJ/jrm

Attachment: Waterford 3 Core Operating Limits Report Cycle 20 Revision 1

A001
NRR

cc: Mr. Marc L. Dapas
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
1600 E. Lamar Blvd.
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Attachment to

W3F1-2014-0047

Waterford 3 Core Operating Limits Report
Cycle 20 Revision 1

(Attachment contains 45 pages)

Entergy

ENTERGY NUCLEAR

Engineering Report Cover Sheet

Engineering Report Title:

WSES-3 Cycle 20 Core Operating Limits Report

Engineering Report Type:

New ☐ Revision ☒ Cancelled ☐ Superseded ☐
Superseded by: _____

Applicable Site(s)

IP1	☐	IP2	☐	IP3	☐	JAF	☐	PNPS	☐	VY	☐	WPO	☐
ANO1	☐	ANO2	☐	ECH	☐	GGNS	☐	RBS	☐	WF3	☒	PLP	☐

EC No. 51582

Report Origin: ☒ Entergy ☐ Vendor
Vendor Document No.: _____

Quality-Related: ☒ Yes ☐ No

Prepared by: C. G. Eastus / Christopher G. Eastus Date: 6/30/14
Responsible Engineer (Print Name/Sign)

Design Verified: N. Pazooki / Nima Pazooki Date: 7/1/14
Design Verifier (if required) (Print Name/Sign)

Reviewed by: L. E. Milster / Lee Milster Date: 07/01/14
Reviewer (Print Name/Sign)

Approved by: F. H. Smith / Fred Smith Date: 7-1-14
Supervisor / Manager (Print Name/Sign)

Revision Summary

Revision 0	Initial issue of the report
Revision 1	Revision to change the Azimuthal Power Tilt limit of Section 3.2.3

Table of Contents

1.0 Scope and Objectives

This report describes the development of the Waterford-3 Cycle 20 (W3C20) Rev. 1Core Operating Limits Report (COLR). The report is developed by updating the Cycle 20 Rev. 0 COLR (Input Document (ID) 2.1) with information from ID 2.2.

2.0 Input Documents

The input documents used to develop the W3C20 COLR include the following:

2.1. "Entergy Operations Waterford-3 Core Operating Limits Report for Cycle 20 Revision 0," April 29, 2014

2.2. Letter, R. A. Loretz to C. Eastus, "Increase in Core Operating Limits Report (COLR) Azimuthal Tilt Value for Waterford-3 Cycle 20," NF-WTFD-14-26, June 27, 2014.

3.0 Assumptions

None

4.0 Detailed Discussion

The information presented in ID 2.2 was used to update Section 3.2.3 in the COLR. The Azimuthal Power Tilt Limit has been changed from 0.03 to 0.05. The resulting W3C20 Rev. 1 COLR is found in Attachment 9.1.

5.0 Operating Experience

A PCRS search was performed looking for issues related to the development of a COLR as described here. The search revealed CR-WF3-2013-01755 which documented a typographical error in during the preparation of the Waterford 3 Cycle 19 COLR.

6.0 Summary of Results

Using vendor provided justification; the W3C20 Rev. 0 COLR was updated to Revision 1.

7.0 Conclusions and Recommendations

The W3C20 Revision 1 COLR has been developed and is acceptable to use.

8.0 References

None

9.0 Attachments

9.1 W3C20 Revision 1 COLR (using formatting and numbering appropriate for the COLR).

Attachment 9.1

Waterford-3 Cycle 20 COLR Revision 1

ENTERGY OPERATIONS

WATERFORD 3

CORE OPERATING LIMITS REPORT

FOR CYCLE 20

REVISION 1

WATERFORD 3

CORE OPERATING LIMITS REPORT
CYCLE 20, REVISION 1

LIST OF EFFECTIVE PAGES	
Revision 0	Pages 1-6, COLR 3/4 1-1, 1-3, 1-4, 1-15, 1-18, 1-25, 2-1, 2-4, 2-6, 2-12, 9-1, and Pages 38 – 40
Revision 1	Page 5, COLR 3/4 2-4

LIST OF EFFECTIVE FIGURE PAGES	
Revision 0	COLR 3/4 1-3A, 1-4A, 1-18A, 1-25A, 1-25B, 2-1A, 2-1B, 2-6A, 2-6B, 2-6C, 2-6D, 2-6E, 2-6F, 2-6G, 2-6H

LIST OF TABLES PAGE

LIST OF EFFECTIVE TABLE PAGES	
Revision 0	COLR 3/4 1-15A through COLR 3/4 1-15E

WATERFORD 3

CORE OPERATING LIMITS REPORT
CYCLE 20, REVISION 1

I. INTRODUCTION

This CORE OPERATING LIMITS REPORT (COLR) has been prepared in accordance with the requirements of Waterford 3 Technical Specification 6.9.1.11 for Waterford 3 Cycle 20. The core operating limits have been developed using the NRC approved methodologies specified in Section III. This is Revision 1 of the Cycle 20 COLR.

The major changes between the Cycle 20, Revision 1, COLR and the Cycle 20, Revision 0, COLR are listed below:

Section 3.2.3 was revised to change the Azimuthal Power Tilt limit from 0.03 to 0.05.

II. AFFECTED TECHNICAL SPECIFICATIONS

CORE OPERATING LIMITS REPORT

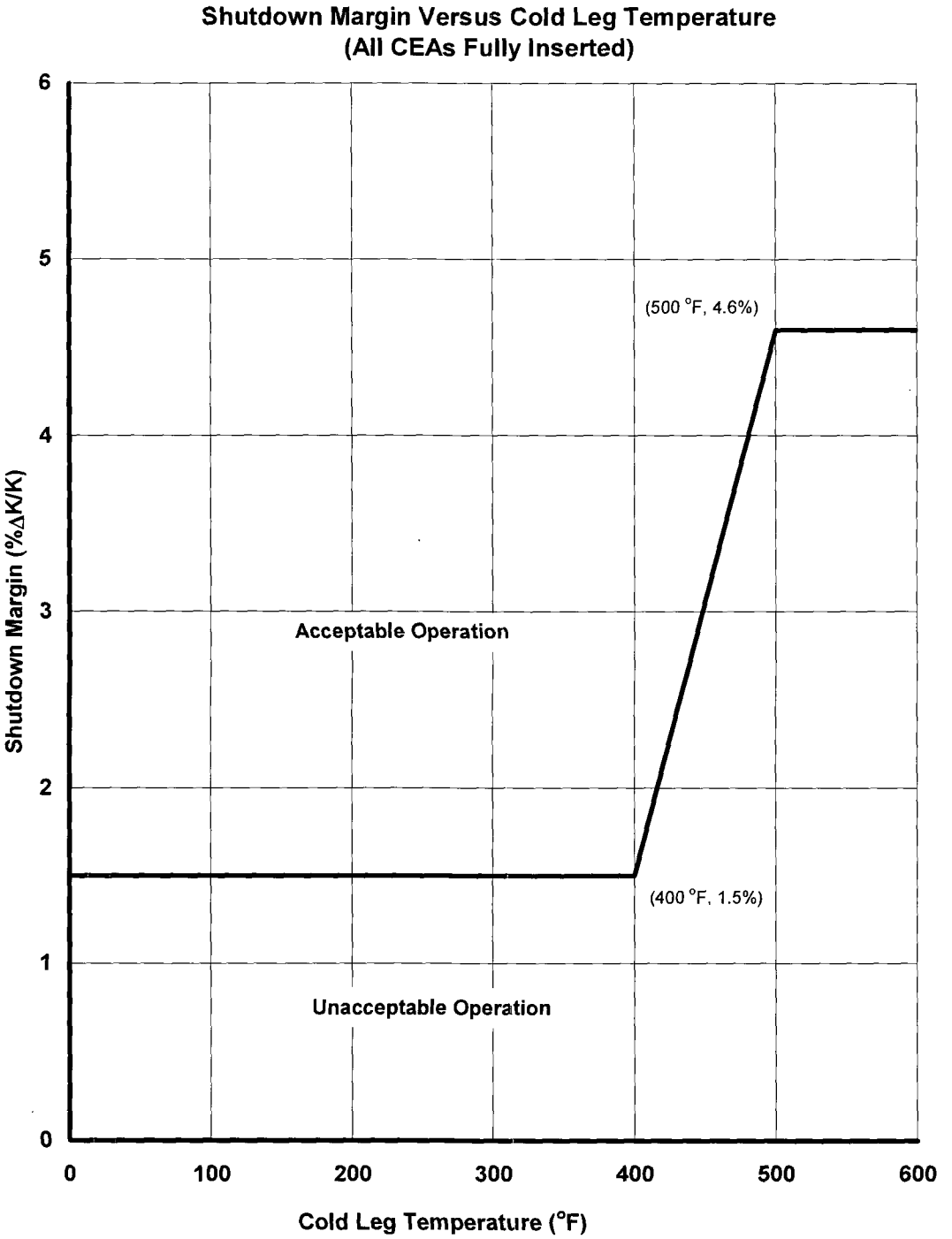
SHUTDOWN MARGIN - ANY CEA WITHDRAWN

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 CEAs FULLY INSERTED

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

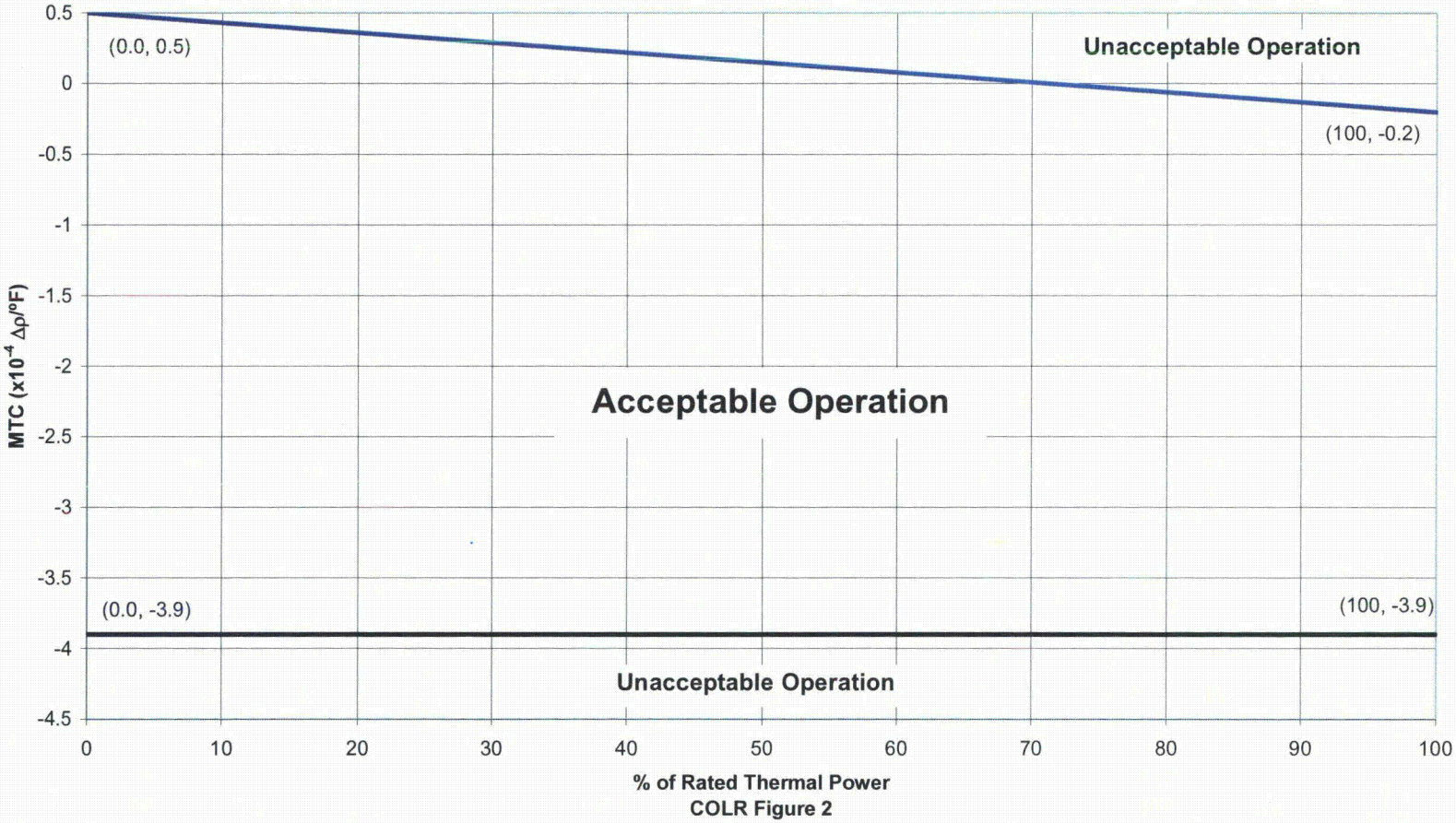


COLR Figure 1

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.

Moderator Temperature Coefficient Versus % of Rated Thermal Power



COLR Figure 2

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 1.75 times (1.75x) the existing neutron flux (cps) at the following frequencies:

a. No sooner than one half hour after shutdown and no later than 1 hour after shutdown.

b. At least once per one-half (1/2) hour if the reactor has been shut down $\geq$ 0.5 hour but < 2 hours

c. At least once per hour if the reactor has been shutdown $\geq$ 2 hours but < 10 hours.

d. At least once per 5 hours if the reactor has been shut down $\geq$ 10 hours but < 25 hours.

e. At least once per 24 hours if the reactor has been shut down $\geq$ 25 hours but < 21 days.

f. At least once per 7 days, if the reactor has been shutdown ≥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

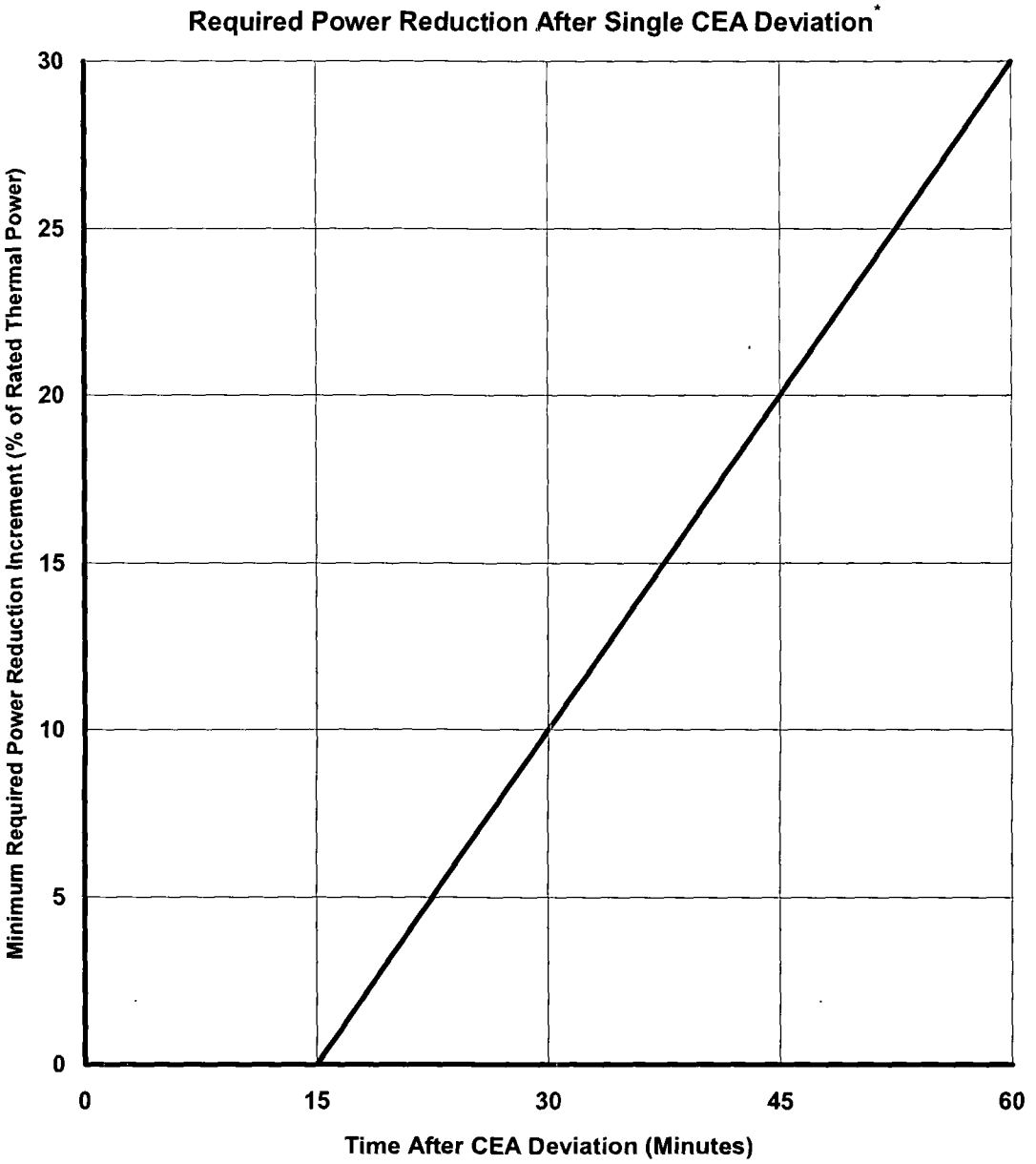
MOVABLE CONTROL ASSEMBLIES - CEA POSITION

3.1.3.1.a With one 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 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.

NOTES

1. Item 3.1.3.1.a corresponds with ACTION "c" of Technical Specification 3.1.3.1.
2. Item 3.1.3.1.b corresponds with ACTION "d" of Technical Specification 3.1.3.1.



COLR Figure 3

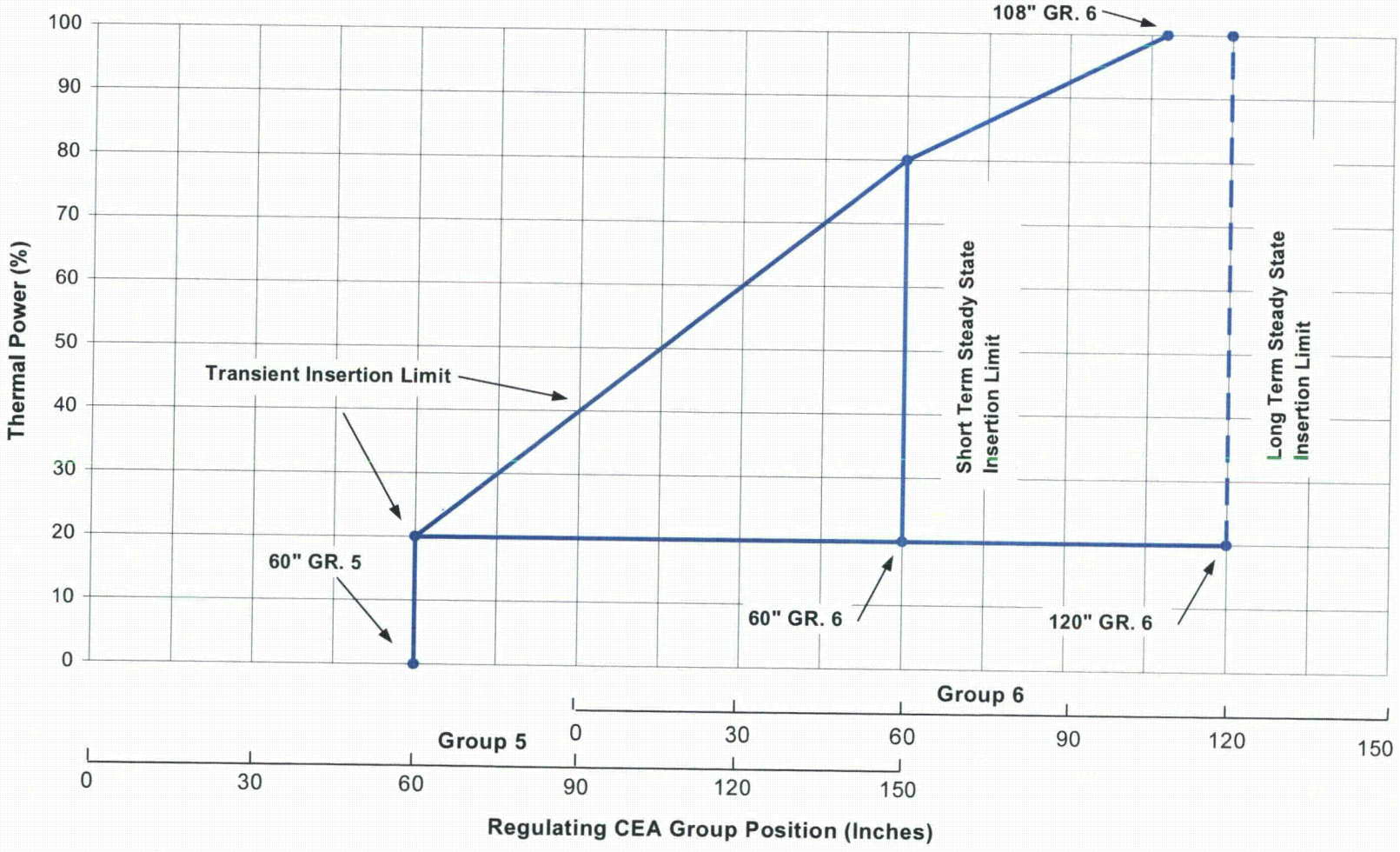
*** When thermal power is reduced to 60% of rated thermal power per this limit curve, further reduction is not required by this Technical Specification.**

CORE OPERATING LIMITS REPORT

REGULATING AND GROUP P CEA INSERTION LIMITS

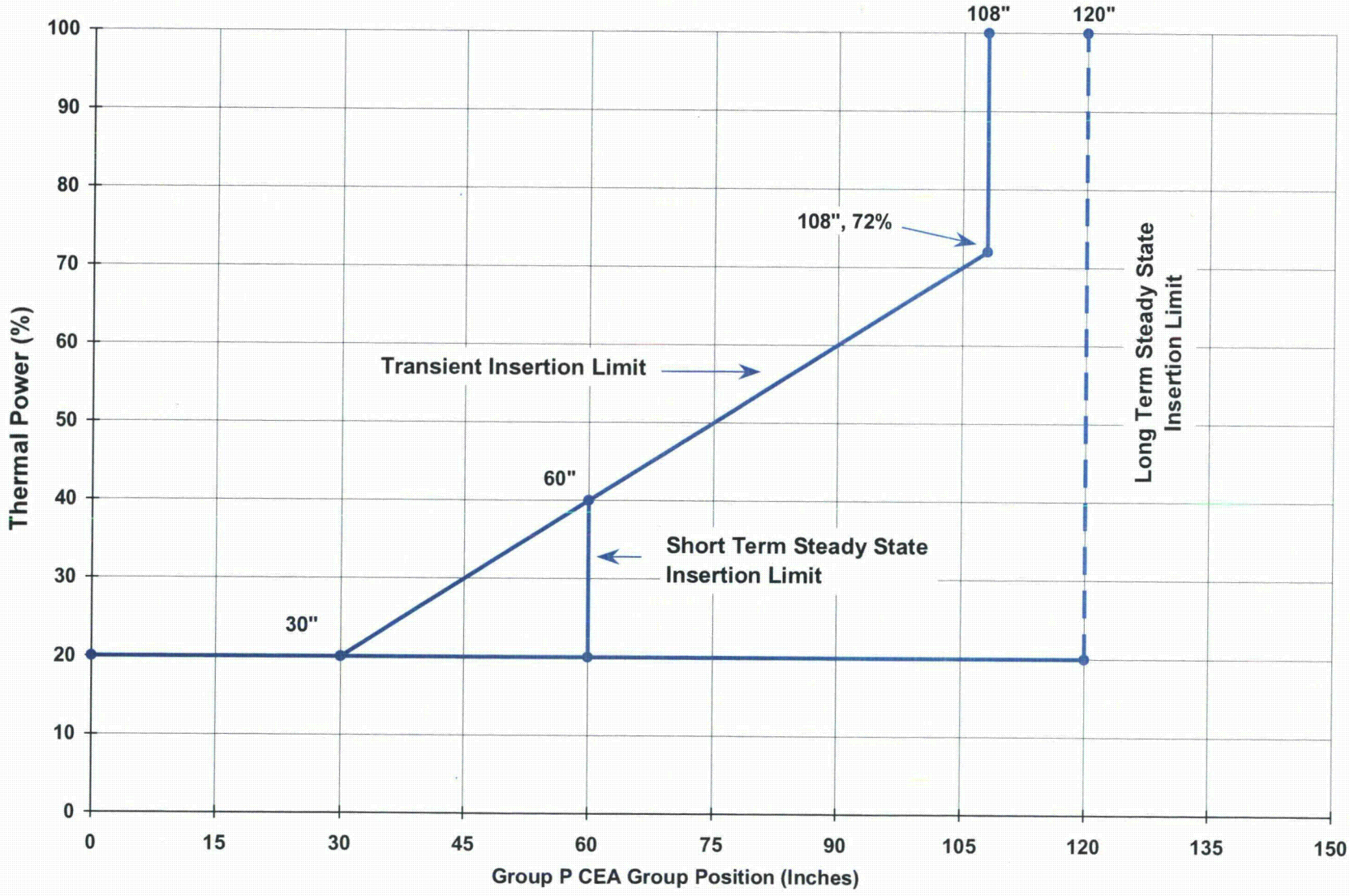
3.1.3.6 The regulating CEA groups and Group P CEAs shall be limited to the withdrawal sequence and to the insertion limits shown on COLR Figure 4 (regulating groups) and Figure 5 (Group P).

Regulating CEA Group Insertion Limits Versus Thermal Power



COLR Figure 4

Group P 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. ≤ 12.9 kW/ft when COLSS is in service

b. ≤ 13.2 kW/ft when COLSS is out of service

In accordance with Technical Specification 3.6.1.5 Action a, with the minimum containment average air temperature less than 95°F but greater than or equal to 90°F, the linear heat rate shall be maintained:

a. ≤ 12.7 kW/ft when COLSS is in service

b. ≤ 13.0 kW/ft when COLSS is out of service

COLR Figure 6

(Not Used)

COLR Figure 7

(Not Used)

CORE OPERATING LIMITS REPORT

AZIMUTHAL POWER TILT- T_q

3.2.3 The measured AZIMUTHAL POWER TILT shall be maintained ≤ 0.05.

CORE OPERATING LIMITS REPORT

DNBR MARGIN

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

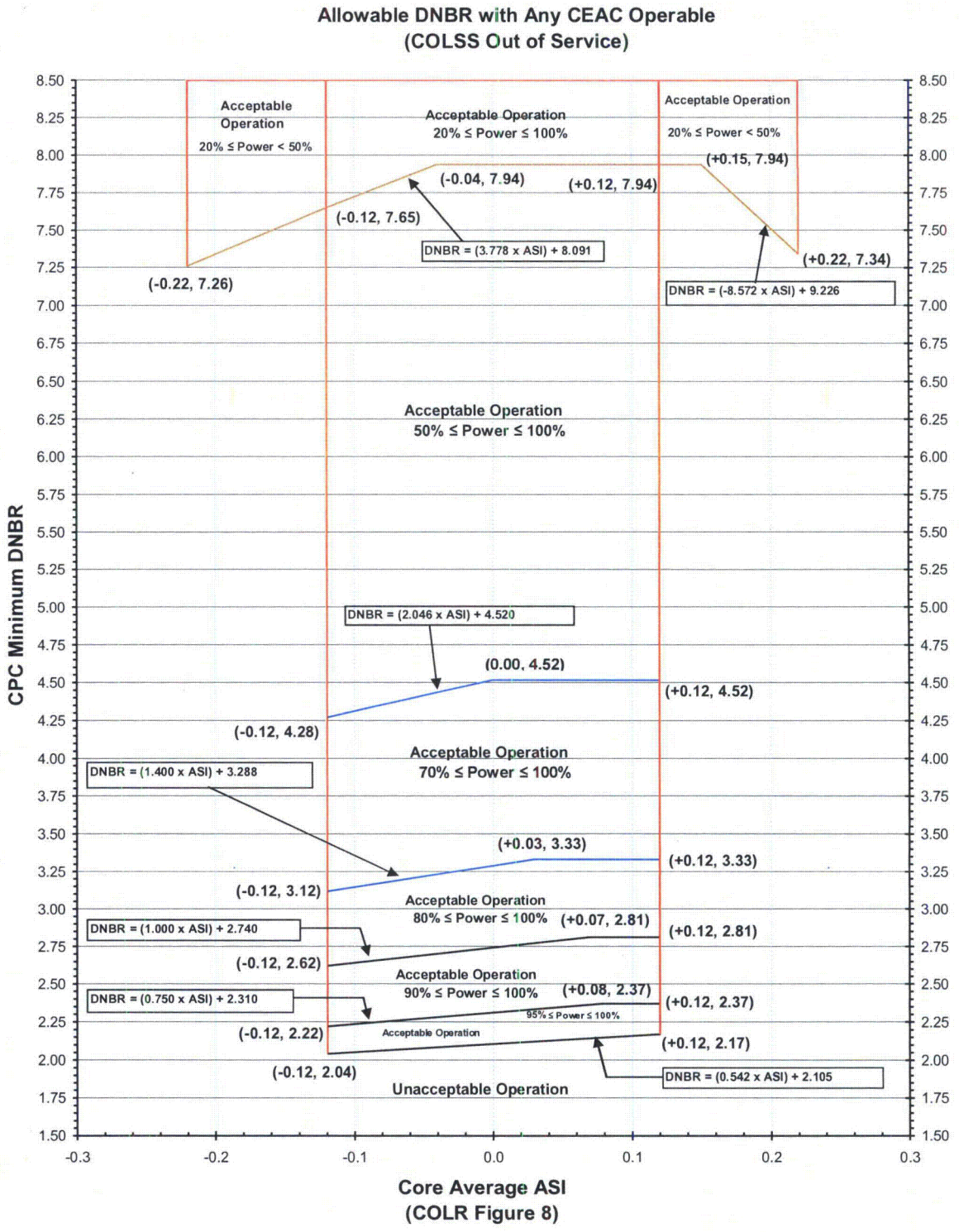
a) When COLSS is in service and neither CEAC is operable: maintain COLSS calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR decreased by 13% RATED THERMAL POWER.

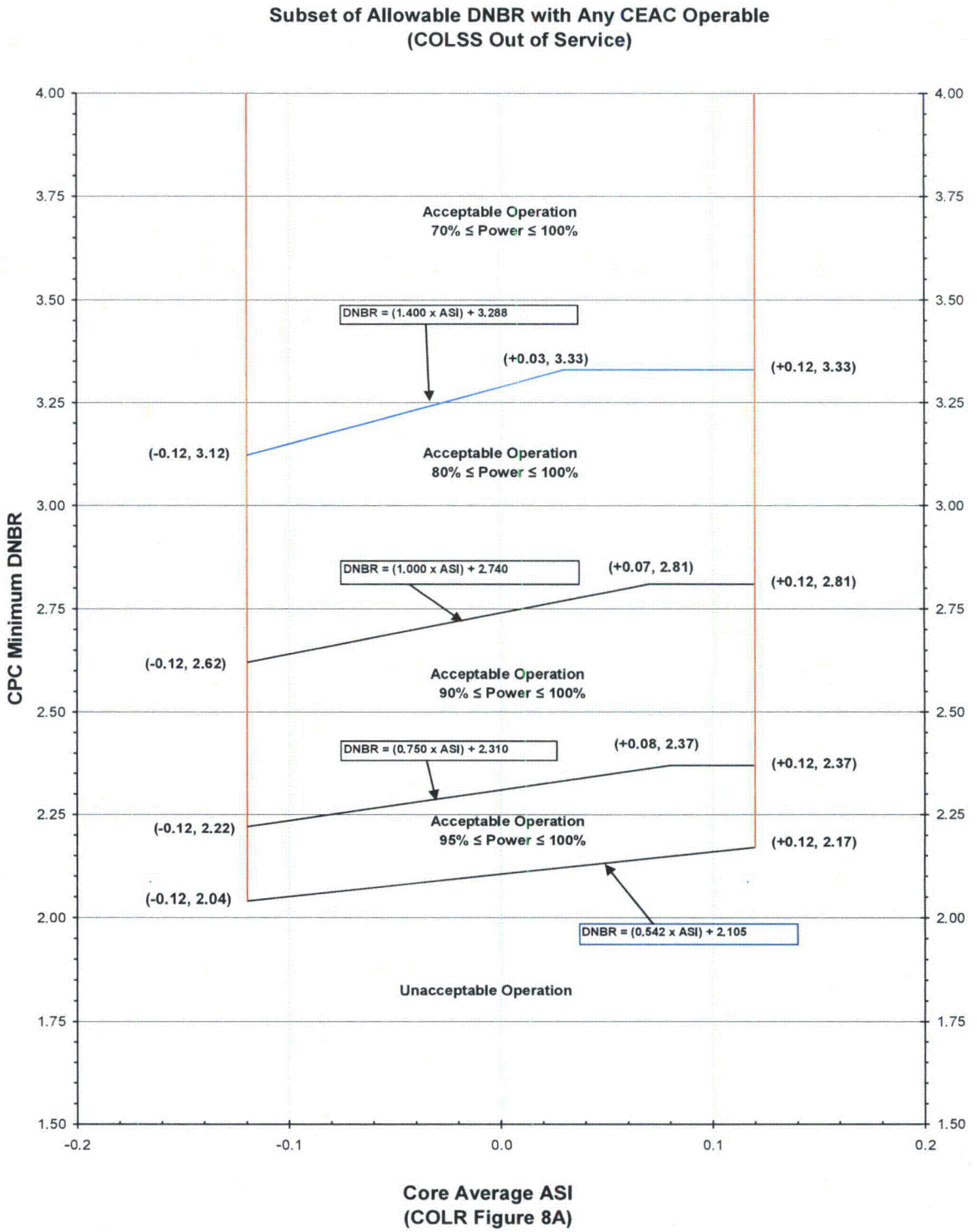
b) When COLSS is out of service and at least one CEAC is operable: operate within the region of acceptable operation shown on COLR Figure 8 (or 8A as appropriate), using any operable CPC channel.

c) When COLSS is out of service and neither CEAC is operable: operate within the region of acceptable operation shown on COLR Figure 9 (or 9A as appropriate), using any operable CPC channel.

NOTES

1. The various DNBR limit lines shown between the vertical ASI limit lines at ±0.12 and ±0.22 on Figures 8, 8A, 9, and 9A represent the minimum CPC-calculated DNBR value required for operation in the power range displayed in the area above each line. Operation at lower power levels requires that a larger DNBR value be maintained. For example, with ASI equal to -0.12 and a core power of 85%, CPC calculated DNBR must be a minimum of 2.62 with any CEAC Operable. At 79% power and the same ASI value with any CEAC Operable, the calculated DNBR must be at least 3.12. At 65% power and the same ASI value, DNBR must be a minimum of 4.28. At 90% power and an ASI value of +0.08, DNBR must be no less than 2.37.
2. The vertical ASI limit lines shown at ±0.12 and ±0.22 on Figures 8, 8A, 9, and 9A may be considered as extending beyond the maximum DNBR value on the Y-axis of the charts. Therefore, when monitoring DNBR with these figures, compliance is achieved at all power levels shown on a given figure when DNBR is greater than the largest DNBR value on the vertical scale.
3. Figure 8A is provided to offer better resolution for the four power ranges in the lower portion of Figure 8. Figure 9A is provided to offer better resolution for the four power ranges in the lower portion of Figure 9.
4. Equations are provided on Figures 8, 8A, 9, and 9A to assist in determining DNBR limits in the sloped portions of the plots.


Allowable DNBR with Any CEAC Operable
(COLSS Out of Service)
CPC Minimum DNBR
Core Average ASI
(COLR Figure 8)
Acceptable Operation
20% ≤ Power < 50%
Acceptable Operation
20% ≤ Power ≤ 100%
Acceptable Operation
20% ≤ Power < 50%
(-0.22, 7.26)
(-0.12, 7.65)
(-0.04, 7.94)
(+0.12, 7.94)
(+0.15, 7.94)
(+0.22, 7.34)
DNBR = (3.778 x ASI) + 8.091
DNBR = (-8.572 x ASI) + 9.226
Acceptable Operation
50% ≤ Power ≤ 100%
DNBR = (2.046 x ASI) + 4.520
(0.00, 4.52)
(+0.12, 4.52)
(-0.12, 4.28)
Acceptable Operation
70% ≤ Power ≤ 100%
DNBR = (1.400 x ASI) + 3.288
(+0.03, 3.33)
(+0.12, 3.33)
(-0.12, 3.12)
Acceptable Operation
80% ≤ Power ≤ 100%
(+0.07, 2.81)
(+0.12, 2.81)
DNBR = (1.000 x ASI) + 2.740
(-0.12, 2.62)
Acceptable Operation
90% ≤ Power ≤ 100%
(+0.08, 2.37)
(+0.12, 2.37)
DNBR = (0.750 x ASI) + 2.310
95% ≤ Power ≤ 100%
Acceptable Operation
(-0.12, 2.22)
(+0.12, 2.17)
(-0.12, 2.04)
DNBR = (0.542 x ASI) + 2.105
Unacceptable Operation

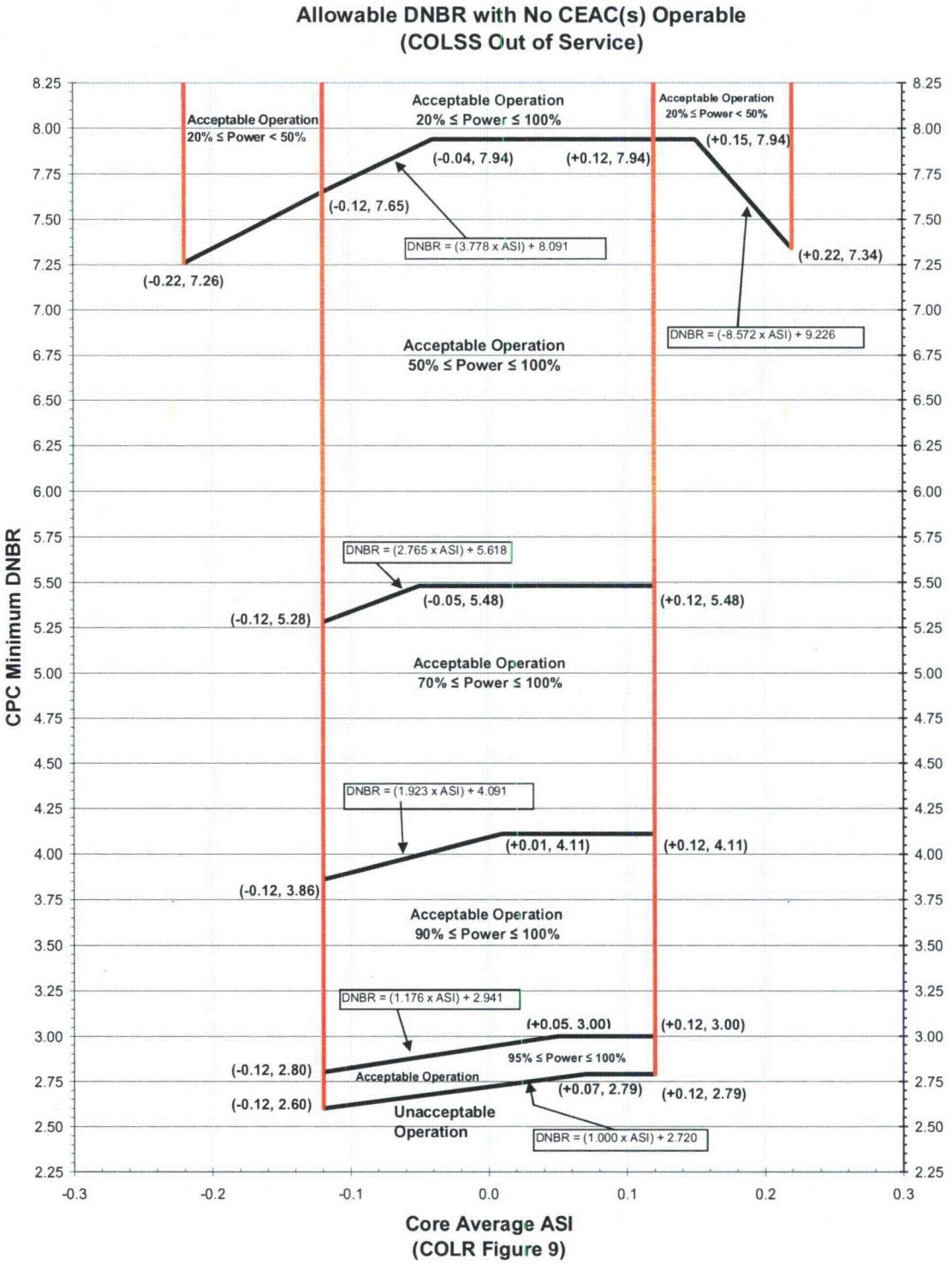

Subset of Allowable DNBR with Any CEAC Operable
(COLSS Out of Service)
CPC Minimum DNBR
Core Average ASI
(COLR Figure 8A)
Acceptable Operation
70% ≤ Power ≤ 100%
DNBR = (1.400 x ASI) + 3.288
(+0.03, 3.33)
(+0.12, 3.33)
(-0.12, 3.12)
Acceptable Operation
80% ≤ Power ≤ 100%
DNBR = (1.000 x ASI) + 2.740
(+0.07, 2.81)
(+0.12, 2.81)
(-0.12, 2.62)
Acceptable Operation
90% ≤ Power ≤ 100%
DNBR = (0.750 x ASI) + 2.310
(+0.08, 2.37)
(+0.12, 2.37)
(-0.12, 2.22)
Acceptable Operation
95% ≤ Power ≤ 100%
(+0.12, 2.17)
(-0.12, 2.04)
DNBR = (0.542 x ASI) + 2.105
Unacceptable Operation
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
-0.2
-0.1
0.0
0.1
0.2

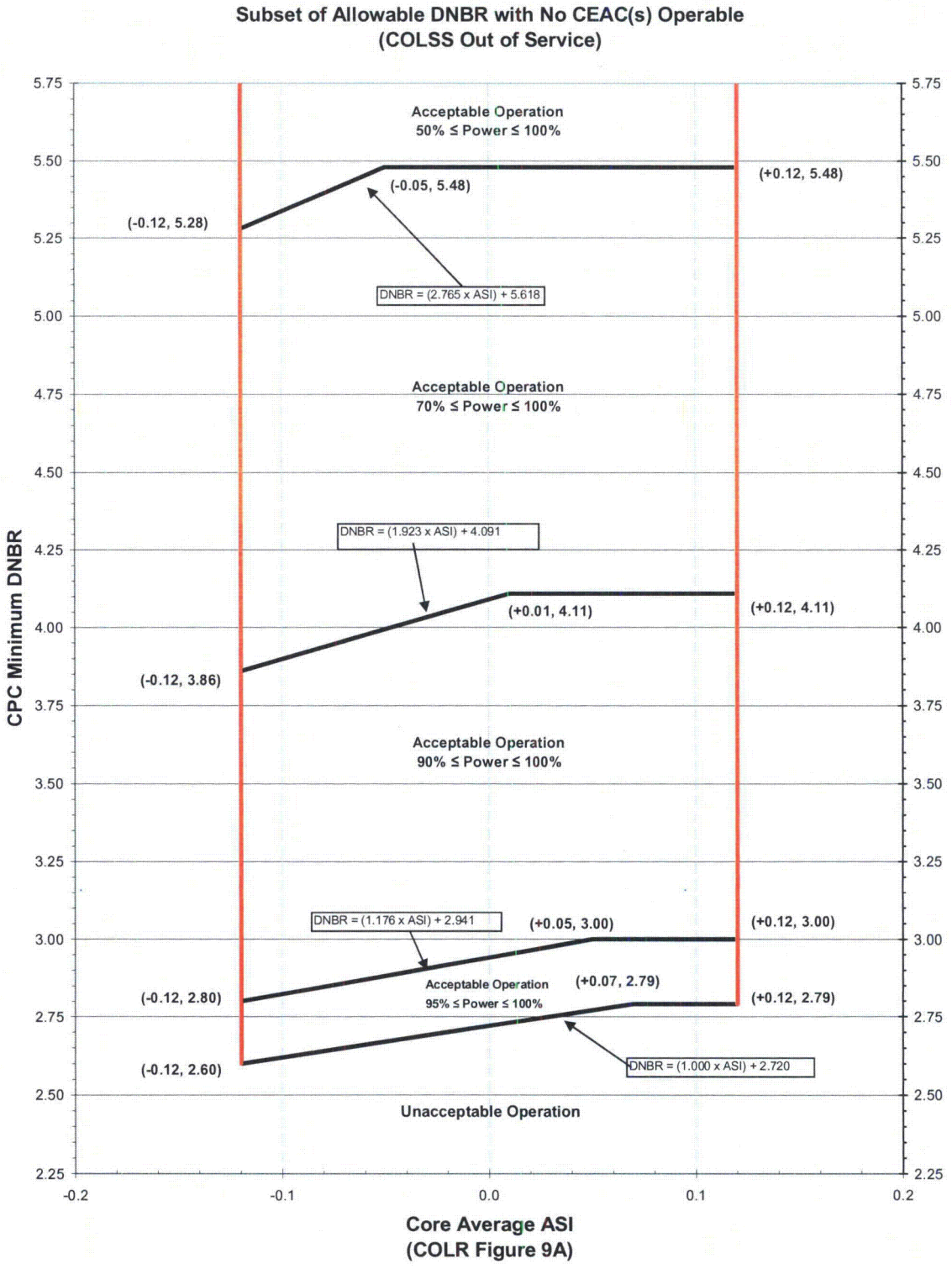
COLR Figure 8.1

(Not Used)

COLR Figure 8.1A

(Not Used)


Allowable DNBR with No CEAC(s) Operable
(COLSS Out of Service)
CPC Minimum DNBR
Core Average ASI
(COLR Figure 9)
Acceptable Operation
20% ≤ Power < 50%
Acceptable Operation
20% ≤ Power ≤ 100%
Acceptable Operation
20% ≤ Power < 50%
(-0.22, 7.26)
(-0.12, 7.65)
(-0.04, 7.94)
(+0.12, 7.94)
(+0.15, 7.94)
(+0.22, 7.34)
DNBR = (3.778 x ASI) + 8.091
DNBR = (-8.572 x ASI) + 9.226
Acceptable Operation
50% ≤ Power ≤ 100%
DNBR = (2.765 x ASI) + 5.618
(-0.12, 5.28)
(-0.05, 5.48)
(+0.12, 5.48)
Acceptable Operation
70% ≤ Power ≤ 100%
DNBR = (1.923 x ASI) + 4.091
(+0.01, 4.11)
(+0.12, 4.11)
(-0.12, 3.86)
Acceptable Operation
90% ≤ Power ≤ 100%
DNBR = (1.176 x ASI) + 2.941
(+0.05, 3.00)
(+0.12, 3.00)
95% ≤ Power ≤ 100%
Acceptable Operation
(-0.12, 2.80)
(+0.07, 2.79)
(+0.12, 2.79)
(-0.12, 2.60)
Unacceptable
Operation
DNBR = (1.000 x ASI) + 2.720


Subset of Allowable DNBR with No CEAC(s) Operable
(COLSS Out of Service)
Acceptable Operation
50% ≤ Power ≤ 100%
(-0.05, 5.48)
(+0.12, 5.48)
(-0.12, 5.28)
DNBR = (2.765 x ASI) + 5.618
Acceptable Operation
70% ≤ Power ≤ 100%
DNBR = (1.923 x ASI) + 4.091
(+0.01, 4.11)
(+0.12, 4.11)
(-0.12, 3.86)
Acceptable Operation
90% ≤ Power ≤ 100%
DNBR = (1.176 x ASI) + 2.941
(+0.05, 3.00)
(+0.12, 3.00)
Acceptable Operation
95% ≤ Power ≤ 100%
(+0.07, 2.79)
(-0.12, 2.80)
(+0.12, 2.79)
(-0.12, 2.60)
DNBR = (1.000 x ASI) + 2.720
Unacceptable Operation
CPC Minimum DNBR
Core Average ASI
(COLR Figure 9A)
5.75
5.50
5.25
5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
-0.2
-0.1
0.0
0.1
0.2

COLR Figure 9.1

(Not Used)

COLR Figure 9.1A

(Not Used)

CORE OPERATING LIMITS REPORT

AXIAL SHAPE INDEX

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

COLSS Operable

$-0.16 \leq ASI \leq +0.16$	for THERMAL POWERS ≥ 50% of RATED THERMAL POWER
$-0.26 \leq ASI \leq +0.26$	for THERMAL POWERS from 20% to <50% of RATED THERMAL POWER

COLSS Out of Service

$-0.12 \leq ASI \leq +0.12$	for THERMAL POWERS ≥ 50% of RATED THERMAL POWER
$-0.22 \leq ASI \leq +0.22$	for THERMAL POWERS from 20% to <50% of RATED THERMAL POWER

CORE OPERATING LIMITS REPORT
BORON CONCENTRATION

3.9.1 While in Mode 6, the RCS boron concentration shall be maintained sufficiently 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. "Qualification of the PHOENIX-P/ANC Nuclear Design System for Pressurized Water Reactor Cores," WCAP-11596-P-A, June 1988; "ANC: A Westinghouse Advanced Nodal Computer Code," WCAP-10965-P-A, September 1986; and "ANC: A Westinghouse Advanced Nodal Computer Code: Enhancements to ANC Rod Power Recovery," WCAP-10965-P-A Addendum 1, April 1989. (Methodology for Specifications 3.1.1.1 and 3.1.1.2 for Shutdown Margins, 3.1.1.3 for MTC, 3.1.3.6 for Regulating and Group P CEA Insertion Limits, 3.1.2.9 Boron Dilution (Calculation of CBC and IBW), and 3.9.1 Boron Concentration).

2. "C-E Method for Control Element Assembly Ejection Analysis," CENPD-190-A, Revision 0, January 1976. (Methodology for Specification 3.1.3.6 for Regulating and Group P CEA Insertion Limits and 3.2.3 for Azimuthal Power Tilt.)

3. "Modified Statistical Combination of Uncertainties" CEN-356(V)-P-A, Revision 1-P-A, May 1988. (Methodology for Specification 3.2.4.c and 3.2.4.d for DNBR Margin and 3.2.7 for ASI.)

4. "Calculative Methods for the CE Large Break LOCA Evaluation Model For the Analysis of C-E and W Designed NSSS," CENPD-132, Supplement 3-P-A, June 1985. (Methodology for Specification 3.1.1.3 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt and 3.2.7 for ASI.)

5. "Calculative Methods for the ABB CE Small Break LOCA Evaluation Model," CENPD-137-P, August 1974; Supplement 2-P-A, April 1998. (Methodology for Specification 3.1.1.3 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt and 3.2.7 for ASI.)

6. "Technical Description Manual for the CENTS Code," WCAP-15996-P-A, Revision 1, March 2005. (Methodology for Specification 3.1.1.1 and 3.1.1.2 for Shutdown Margins, 3.1.1.3 for MTC, 3.1.3.1 for Movable Control Assemblies – CEA Position, 3.1.3.6 for Regulating and Group P CEA Insertion Limits, and 3.2.4.b for DNBR Margin)

7. "Implementation of ZIRLO Material Cladding in CE Nuclear Power Fuel Assembly Designs," CENPD-404-P-A, November 2001. (Methodology for Specification 3.1.1.3 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt, and 3.2.7 for ASI).

8. "Qualification of the Two-Dimensional Transport Code PARAGON," WCAP-16045-P-A, August 2004. (Methodology for Specifications 3.1.1.1 and 3.1.1.2 for Shutdown Margins, 3.1.1.3 for MTC, 3.1.3.6 for Regulating and Group P CEA Insertion Limits, 3.1.2.9 Boron Dilution (Calculation of CBC & IBW), 3.2.4.b for DNBR Margin and 3.9.1 Boron Concentration).

9. "Implementation of Zirconium Diboride Burnable Absorber Coatings in CE Nuclear Power Fuel Assembly Designs," WCAP-16072-P-A, Revision 0, August 2004 (Methodology for Specification 3.1.1.3 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt, and 3.2.7 for ASI).

10. "CE 16 x 16 Next Generation Fuel Core Reference Report," WCAP-16500-P and Final Safety Evaluation for Westinghouse Electric Company (Westinghouse) Topical Report (TR) WCAP-16500-P, Revision 0, "CE [Combustion Engineering] 16x16 Next Generation Fuel [(NGF)] Core Reference Report," (Methodology for Specification 3.1.1.3 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt, 3.2.4.b, 3.2.4.c, and 3.2.4.d for DNBR Margin, and 3.2.7 for ASI).

11. "Optimized ZIRLO™," WCAP-12610-P-A and CENPD-404-P-A Addendum 1-A, July 2006. (Methodology for Specification 3.1.1.3 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt, and 3.2.7 for ASI.)

12. "Westinghouse Correlations WSSV and WSSV-T for Predicting Critical Heat Flux in Rod Bundles with Side-Supported Mixing Vanes," WCAP-16523-P-A Revision 0, August 2007; and Final Safety Evaluation for Westinghouse Electric Company (Westinghouse) Topical Report (TR), WCAP-16523-P, "Westinghouse Correlations WSSV and WSSV-T for Predicting Critical Heat Flux in Rod Bundles with Side-Supported Mixing Vanes," (Methodology for Specification 3.2.4.b, 3.2.4.c, and 3.2.4.d for DNBR Margin.)

13. "ABB Critical Heat Flux Correlations for PWR Fuel," CENPD-387-P-A Revision 0, May 2000. (Methodology for Specification 3.2.4.b, 3.2.4.c, and 3.2.4.d for DNBR Margin and 3.2.7 for ASI.)

14. "Calculative Methods for the CE Nuclear Power Large Break LOCA Evaluation Model -Improvement to 1999 Large Break LOCA EM Steam Cooling Model for Less Than 1 in/sec Core Reflood" CENPD-132, Supplement 4-P-A, Addendum 1-P and Final Safety Evaluation for Westinghouse Electric Company (Westinghouse) Topical Report (TR) CENPD-132 Supplement 4-P-A, Addendum 1-P, "Calculative Methods for the CE [Combustion Engineering] Nuclear Power Large Break LOCA Evaluation Model - Improvement to 1999 Large Break LOCA EM Steam Cooling Model for Less Than 1 in/sec Core Reflood," (Methodology for Specification 3.1.1.3 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt, and 3.2.7 for ASI).

15. "Application of CE Setpoint Methodology for CE 16x16 Next Generation Fuel (NGF)," WCAP 16500 P-A, Supplement 1, Revision 1, December 2010. (Methodology for Specification 3.2.4.b, 3.2.4.c, and 3.2.4.d for DNBR Margin.)