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W3F1-2022-0030

May 3, 2022

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

Subject: Core Operating Limits Report (COLR) – Cycle 25, Revision 0

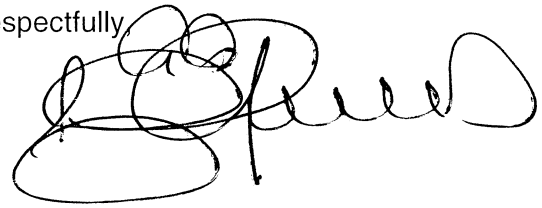
Waterford Steam Electric Station, Unit 3
Docket No. 50-382
Renewed Facility Operating License No. NPF-38

Waterford Steam Electric Station, Unit 3 (Waterford 3) Technical Specification 6.9.1.11.3 requires the submittal of the Core Operating Limits Report COLR) for each reload cycle including any mid-cycle revisions or supplements thereto. Enclosed is Revision 0 of the Waterford 3 COLR for reload Cycle 25.

There are no new commitments contained in this submittal.

Should you have any questions concerning this issue, please contact John D. Lewis, Manager, Regulatory Assurance, at 504-739-6028.

Respectfully,



John Lewis

JDL/llb

Enclosure: Waterford 3 Core Operating Limits Report Cycle 25, Revision 0

cc: NRC Region IV Regional Administrator
NRC Senior Resident Inspector – Waterford Steam Electric Station, Unit 3
NRC Project Manager – Waterford Steam Electric Station, Unit 3

Enclosure

W3F1-2022-0030

Waterford 3 Core Operating Limits Report
Cycle 25 Revision 0

(40 pages to follow)

# ENTERGY OPERATIONS

# WATERFORD 3

# CORE OPERATING LIMITS REPORT

# FOR CYCLE 25

# REVISION 0

# WATERFORD 3

# CORE OPERATING LIMITS REPORT
# CYCLE 25, REVISION 0

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# WATERFORD 3

# CORE OPERATING LIMITS REPORT
# CYCLE 25, REVISION 0

## 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 25. The core operating limits have been developed using the NRC approved methodologies specified in Section III. This is Revision 0 of the Cycle 25 COLR.

The major changes between the Cycle 25, Revision 0, COLR and the Cycle 24, Revision 2, COLR are listed below:

Renumbered COLR item 3.1.3.1 and eliminated the associated notes for that item for consistency with Technical Specifications Limiting Condition for Operation 3.1.3.1. There were no changes to any limits from the latest revision of the Cycle 24 COLR.

The wording and figure titles for DNBR Margin 3.2.4, 3.2.4 Note 1, Figure 8, Figure 8A, Figure 9, and Figure 9A were modified to match the changes to the Technical Specifications for the Common Q Core Protection Calculator System implementation. There were no changes to any limits from the latest revision of the Cycle 24 COLR.

Section III was also modified so that the DNBR Margin 3.2.4 numbering would be in accordance with the License Amendment to modify Technical Specification 6.9.1.11.1 in support of the Common Q CPCS implementation. There were no changes to any of the methodologies from the latest revision of the Cycle 24 COLR.

# II. AFFECTED TECHNICAL SPECIFICATIONS

**CORE OPERATING LIMITS REPORT**

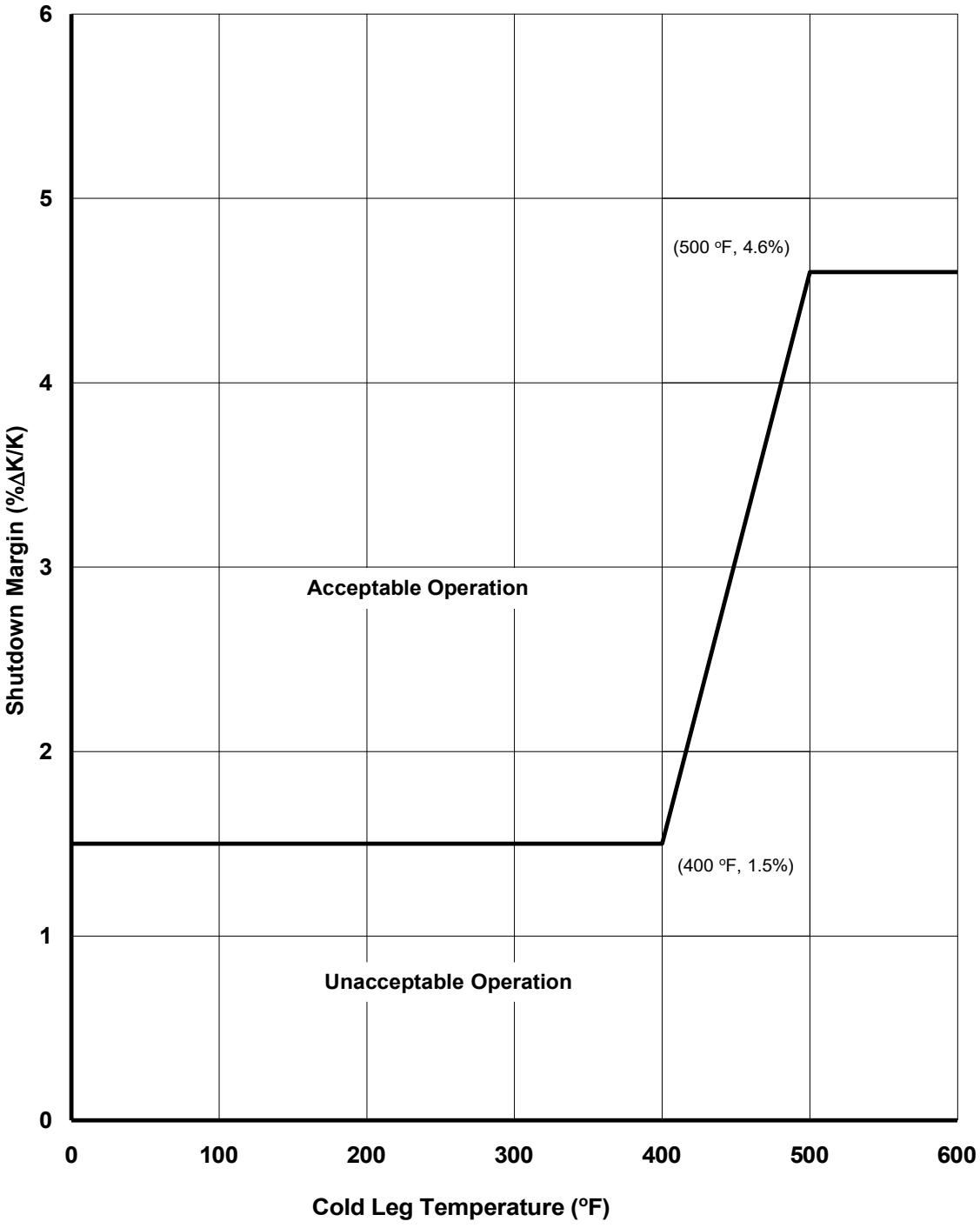
**SHUTDOWN MARGIN - ANY CEA WITHDRAWN**

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.

## 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.

**Shutdown Margin Versus Cold Leg Temperature**
**(All CEAs Fully Inserted)**

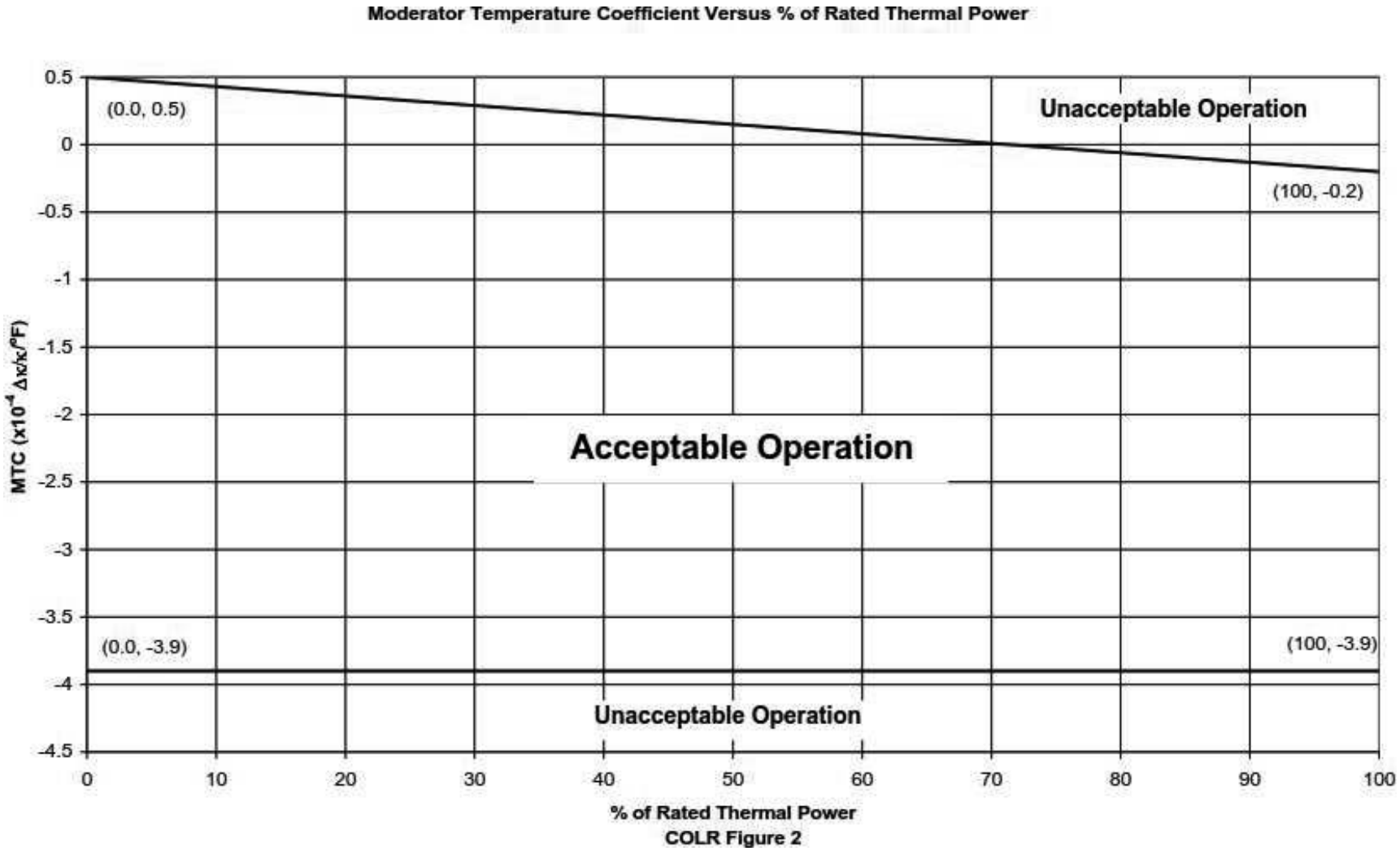



**COLR Figure 1**

**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
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
MTC (x10⁻⁴ Δk/k/°F)
(0.0, 0.5)
Unacceptable Operation
(100, -0.2)
Acceptable Operation
(0.0, -3.9)
(100, -3.9)
Unacceptable Operation
0
10
20
30
40
50
60
70
80
90
100
% 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.

** Charging pumps shall be verified to be inoperable by removing power to the required number.

**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.

** Charging pumps shall be verified to be inoperable by removing power to the required number.

## 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.

** Charging pumps shall be verified to be inoperable by removing power to the required number.

## 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.

** Charging pumps shall be verified to be inoperable by removing power to the required number.

**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

$K_{eff} \leq 0.95$

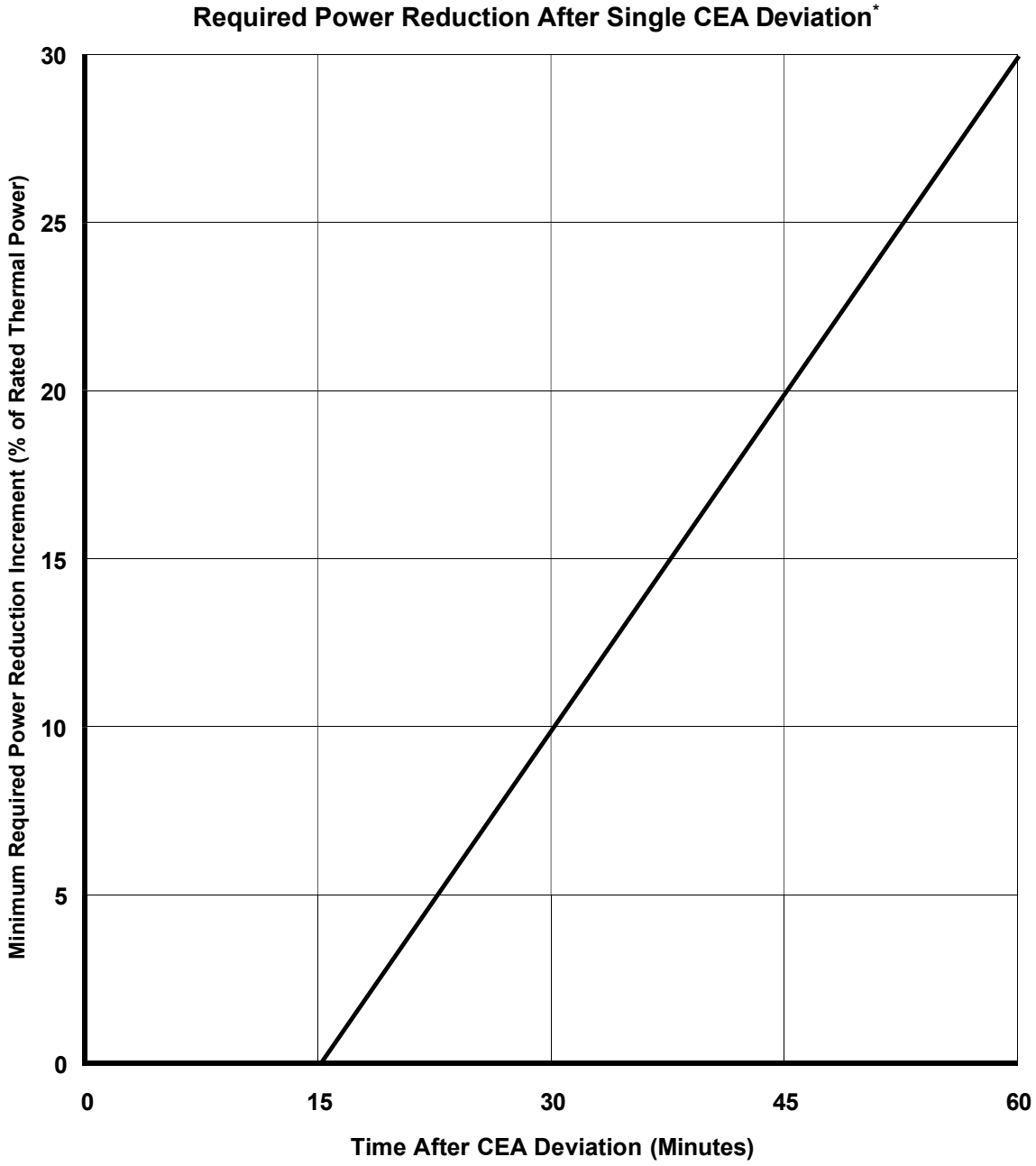
| OPERATIONAL MODE | Number of Operating Charging Pumps* 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| 3 | 12 hours | 5.0 hours | 2.0 hours | 1.0 hours |
| 4 | 12 hours | 2.75 hours | 1.0 hours | Operation not allowed** |
| 5 RCS filled | 8 hours | 3.0 hours | 1.0 hours | 0.5 hours |
| 5 RCS partially drained | 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.

** Charging pumps shall be verified to be inoperable by removing power to the required number.

3.1.3.1.c 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.d 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.




**COLR Figure 3**

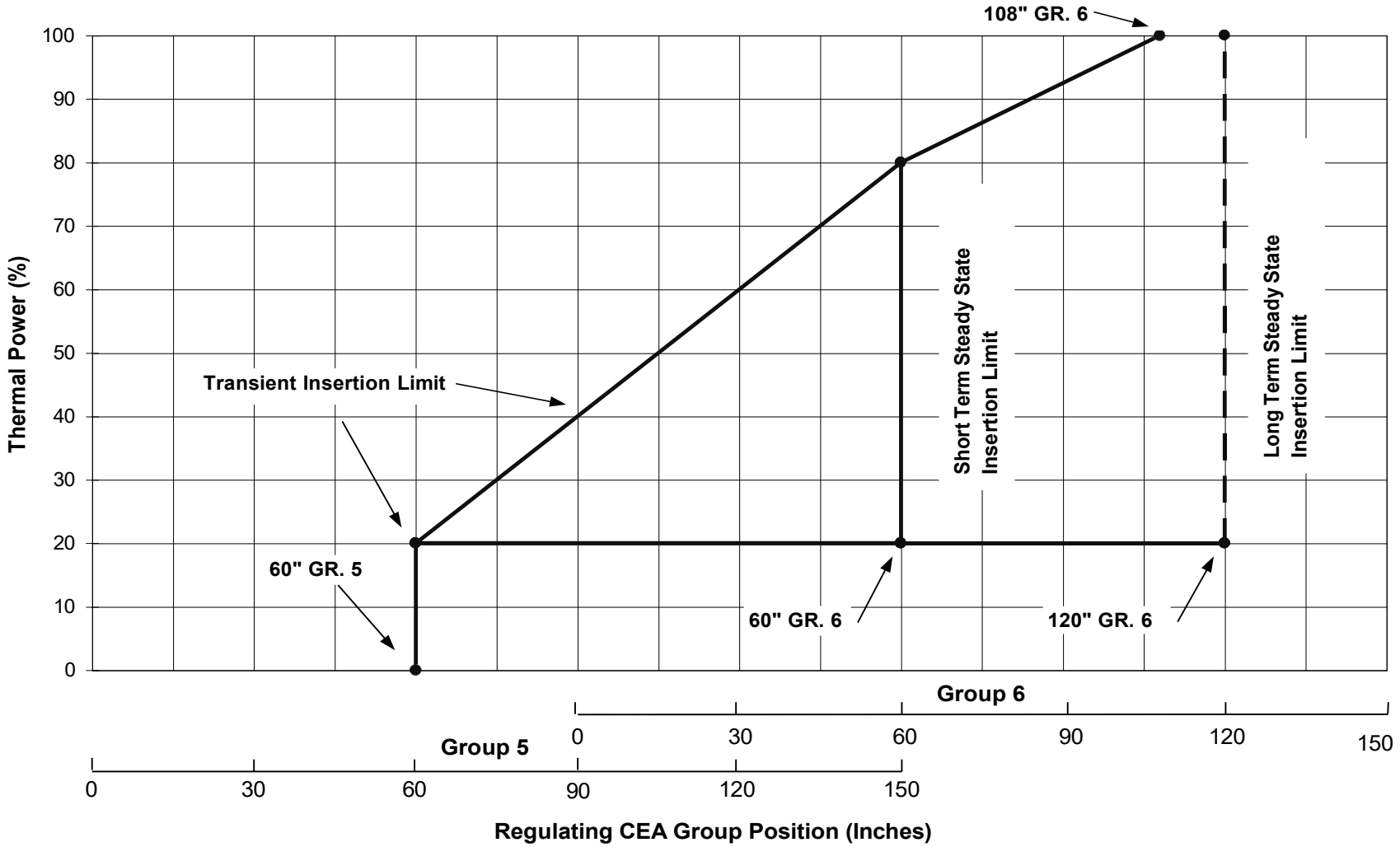
*** When thermal power is reduced to 60% of rated thermal power per this limit curve, further reduction is not required by this Technical Specification.**

**CORE OPERATING LIMITS REPORT**

**REGULATING AND GROUP P CEA INSERTION LIMITS**

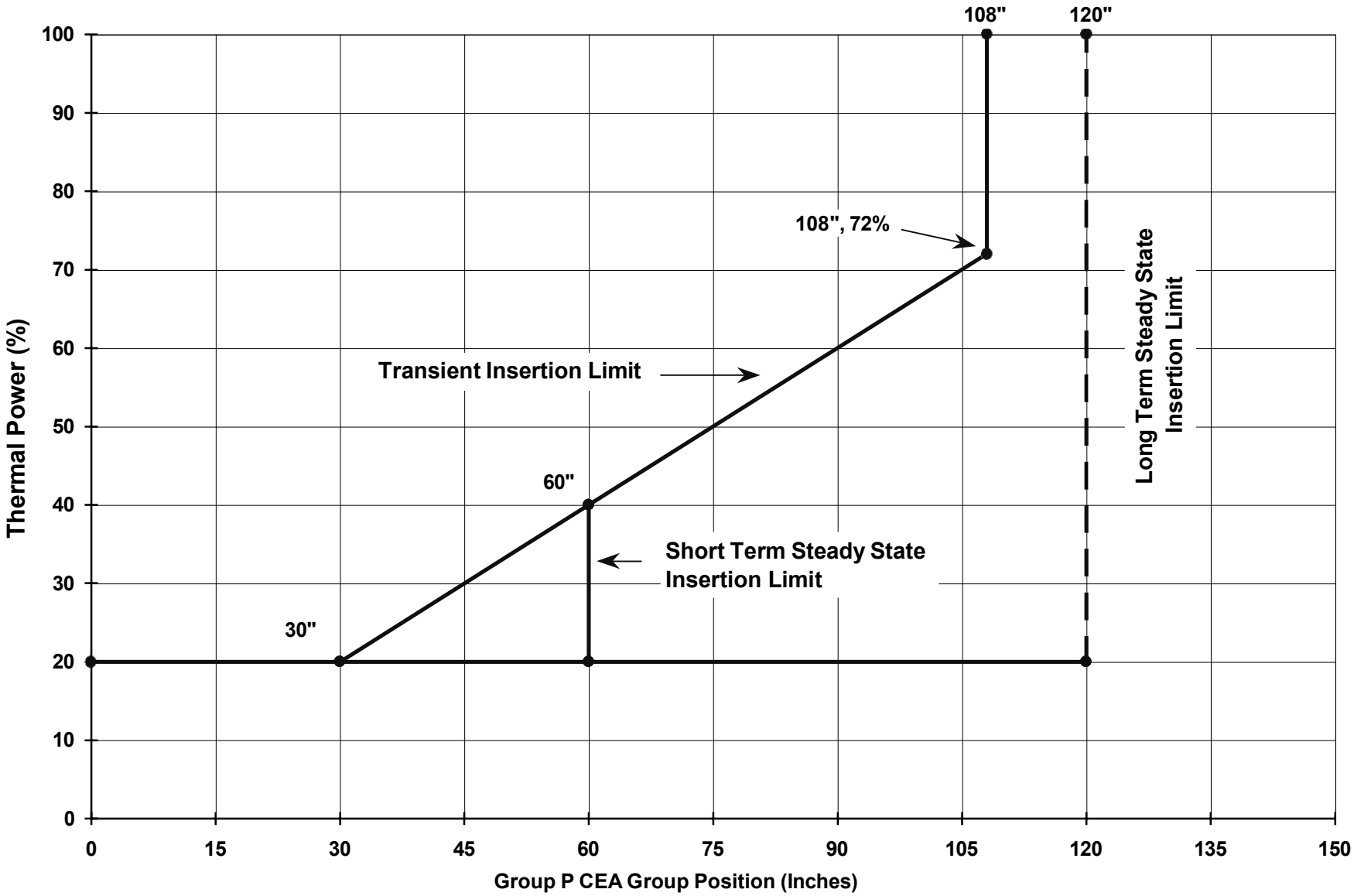
3.1.3.6 The regulating CEA groups and Group P CEAs shall be limited to the withdrawal sequence and to the insertion limits shown on COLR Figure 4 (regulating groups) and Figure 5 (Group P).

## 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 $\leq 0.03$.

## CORE OPERATING LIMITS REPORT

### DNBR MARGIN

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

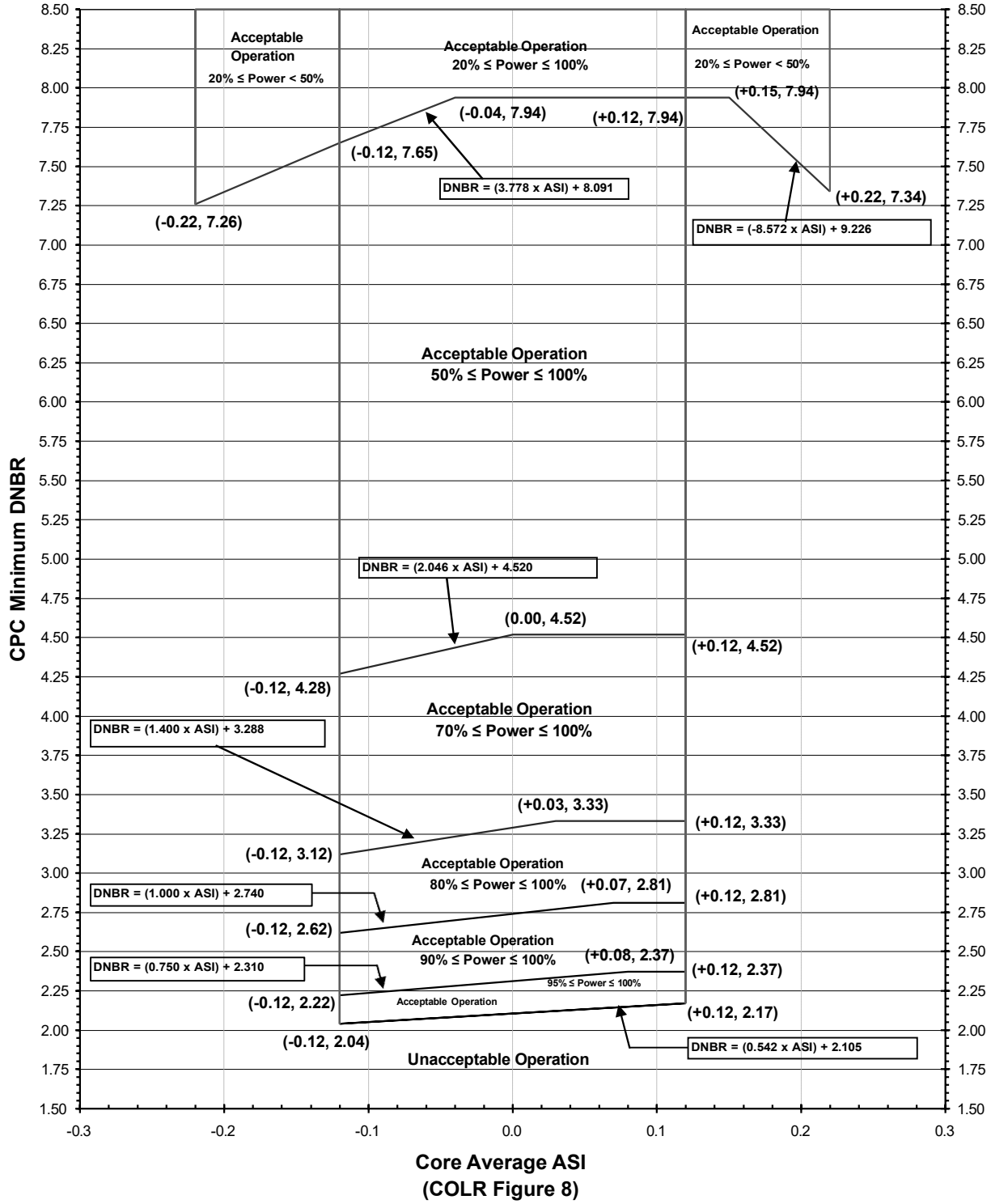
a) Core Operating Limit Supervisory System (COLSS) in Service:
   1. When COLSS is in service maintain COLSS calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR when at least one Control Element Assembly Calculator (CEAC) is operable in each operable Core Protection Calculator (CPC) channel.
   2. When COLSS is in service and the CEAC requirements in TS LCO 3.2.4.a.1 are not met 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) COLSS Out of Service:
   1. When COLSS is out of service and at least one CEAC is operable in each operable CPC channel operate within the region of acceptable operation shown on COLR Figure 8 (or 8A as appropriate), using any operable CPC channel.
   2. When COLSS is out of service and the CEAC requirements in TS LCO 3.2.4.b.1 are not met operate within the region of acceptable operation shown on COLR Figure 9 (or 9A as appropriate), using any operable CPC channel (with both CEACs inoperable).

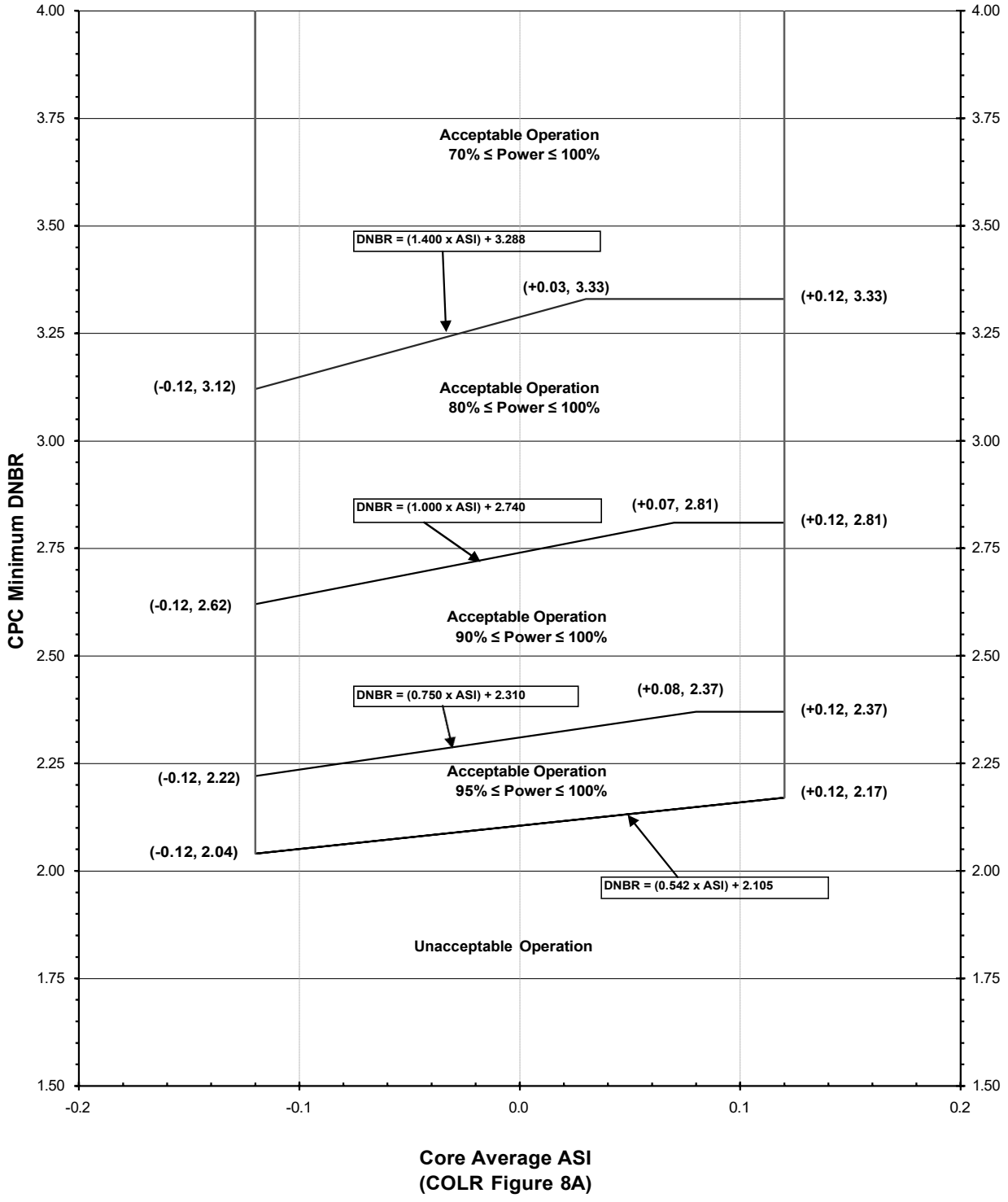
NOTES

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 at least one CEAC Operable in each Operable CPC channel. At 79% power and the same ASI value with at least one CEAC Operable in each Operable CPC channel, 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 at least One CEAC Operable in Each Operable CPC Channel (COLSS Out of Service)**



**Subset of Allowable DNBR with at least One CEAC Operable in Each Operable CPC Channel (COLSS Out of Service)**



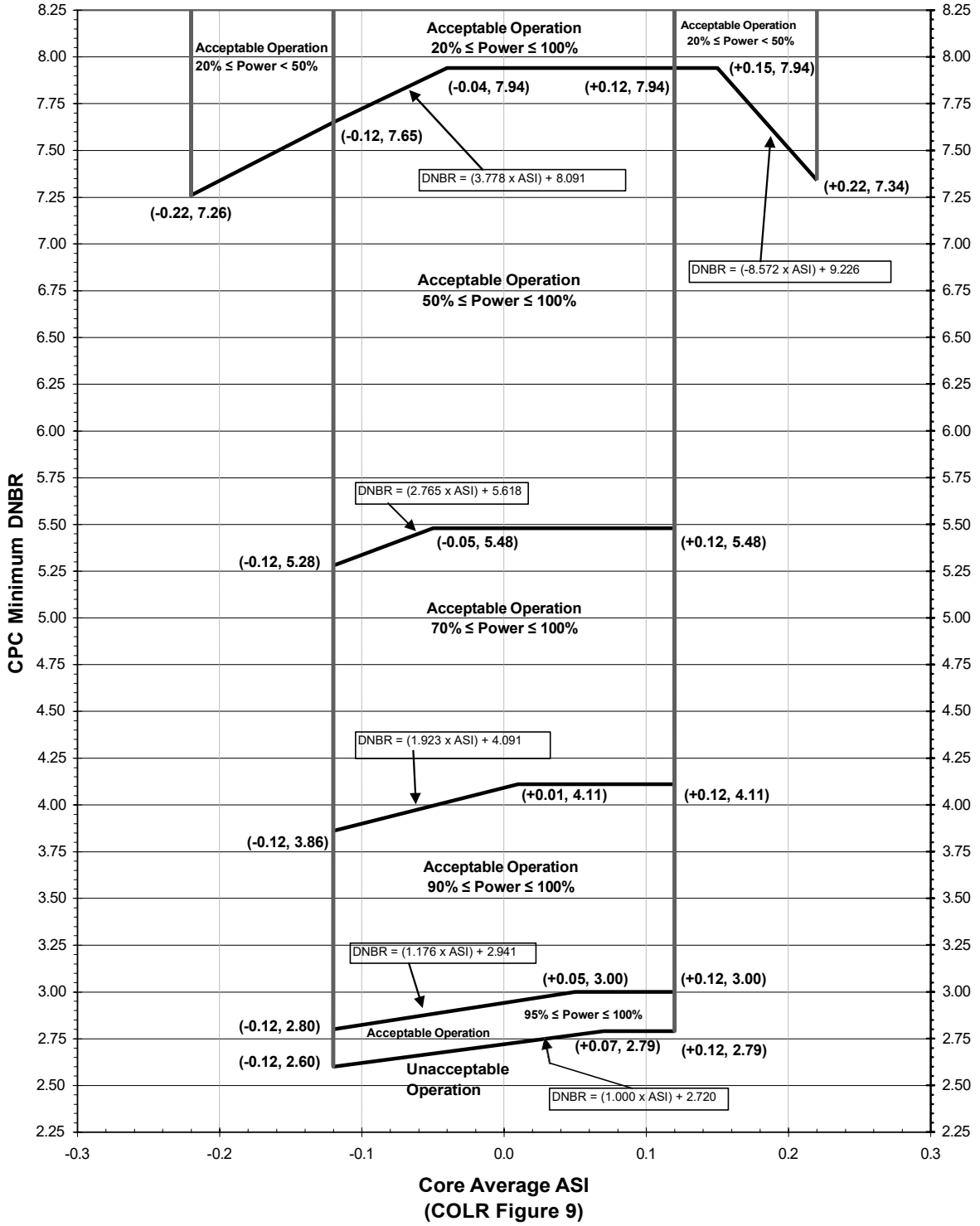
**COLR Figure 8.1**

(Not Used)

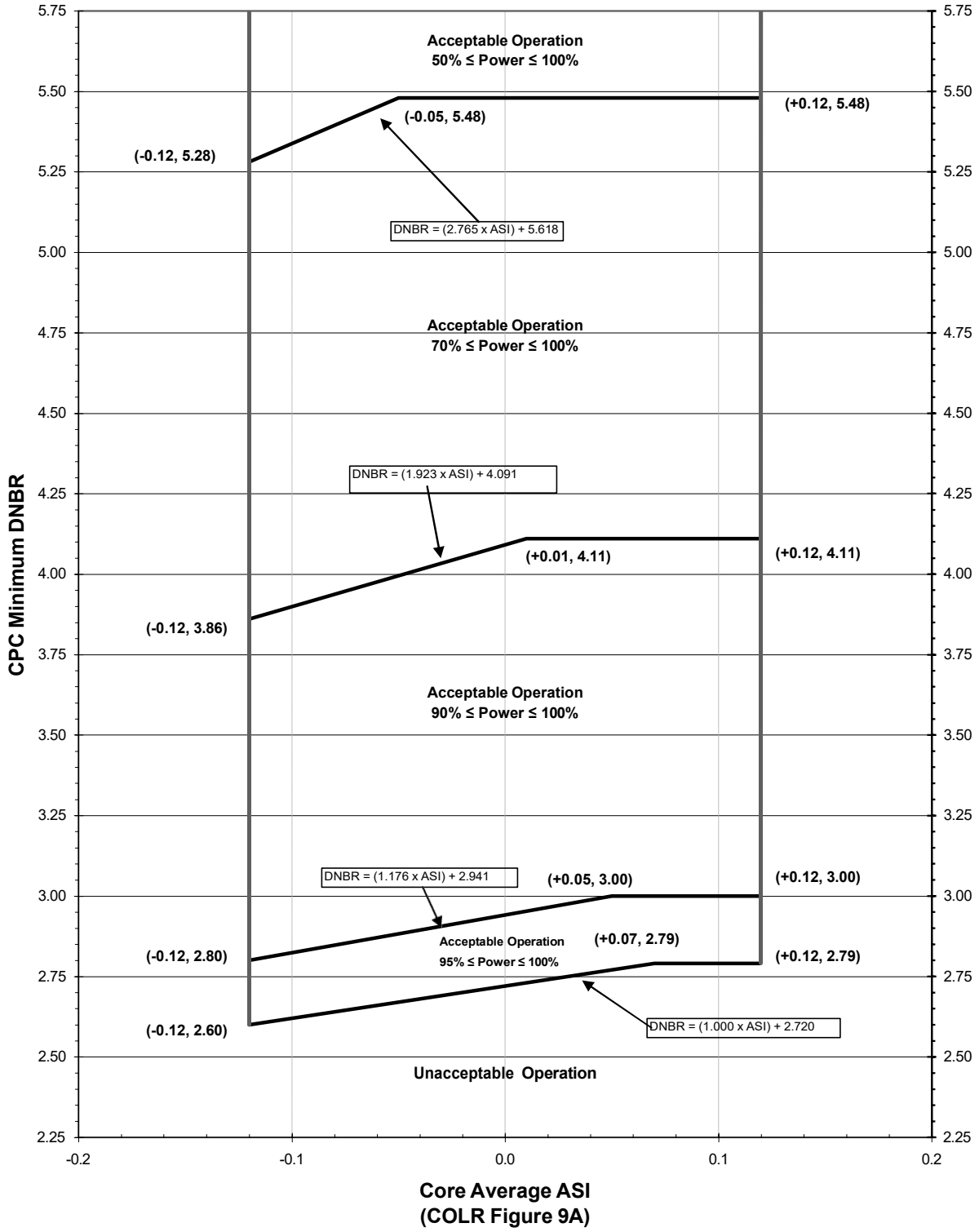
**COLR Figure 8.1A**

(Not Used)

**Allowable DNBR with No CEAC(s) Operable using Any Operable CPC Channel (with both CEACs inoperable) (COLSS Out of Service)**



**Subset of Allowable DNBR with No CEAC(s) Operable using Any Operable CPC Channel (with both CEACs inoperable)**
**(COLSS Out of Service)**



**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 ≤ ASI ≤ +0.16 | for THERMAL POWERS ≥ 50% of RATED THERMAL POWER |
| −0.26 ≤ ASI ≤ +0.26 | for THERMAL POWERS from 20% to <50% of RATED THERMAL POWER |

**COLSS Out of Service**

| | |
|---|---|
| −0.12 ≤ ASI ≤ +0.12 | for THERMAL POWERS ≥ 50% of RATED THERMAL POWER |
| −0.22 ≤ ASI ≤ +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, 3.2.4.a.2 for DNBR Margin, 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.b.1 and 3.2.4.b.2 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.a.2 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.a.2 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.a.2, 3.2.4.b.1, and 3.2.4.b.2 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.a.2, 3.2.4.b.1, and 3.2.4.b.2 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.a.2, 3.2.4.b.1, and 3.2.4.b.2 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.a.2, 3.2.4.b.1, and 3.2.4.b.2 for DNBR Margin.)