



Palo Verde Nuclear
Generating Station

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April 27, 2011

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

Dear Sirs:

**Subject: Palo Verde Nuclear Generating Station (PVNGS) Unit 2
Docket No. STN 50-529
Unit 2 Core Operating Limits Report (COLR), Revision 17**

Pursuant to PVNGS Technical Specifications, Section 5.6.5.d, enclosed is the Unit 2 Core Operating Limits Report (COLR), Revision 17, which was made effective April 15, 2011. The following changes have been implemented in this COLR revision:

- Changed the format of the analytical methods table (pages 6 and 7 of 26)
- Enhanced the internal document numbers shown in the titles of several methods (pages 6 and 7 of 26)
- Added a revision number to Report No. CENPD-132 (page 6 of 26)
- Updated the date and revision number for Report No. NFM-005 (page 6 of 26)
- Added a Revision Number for Report No. CEN-160(S)-P (page 7 of 26)
- Revised Figure 3.1.4-1 to change the negative moderator temperature coefficient (MTC) lower limit (page 13 of 26)

No commitments are being made to the NRC by this letter. Should you need further information regarding this submittal, please contact Russell A. Stroud, Licensing Section Leader, at (623) 393-5111.

Sincerely,

TNW/RAS/GAM/gat

Enclosure: PVNGS Unit 2 Core Operating Limits Report (COLR), Revision 17

ADD
NRR

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U.S. Nuclear Regulatory Commission
Unit 2 Core Operating Limits Report (COLR), Revision 17
Page 2

cc: E. E. Collins Jr. NRC Region IV Regional Administrator
L. K. Gibson NRC NRR Project Manager for PVNGS
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M. A. Brown NRC Senior Resident Inspector for PVNGS

Enclosure

**PVNGS Unit 2 Core Operating Limits Report (COLR)
Revision 17**

PALO VERDE NUCLEAR GENERATING STATION (PVNGS)

UNIT 2

CORE OPERATING LIMITS REPORT

Revision 17

Effective Date: April 15, 2011

Responsible Engineer Date	Wenzel, Richard R(Z99534)	Digitally signed by Wenzel, Richard R(Z99534) DN: cn=Wenzel, Richard R(Z99534) Reason: I am the author of this document Date: 2011.03.01 09:09:34 -07'00'
Independent Reviewer Date	Bodnar, Walter S(Z06432)	Digitally signed by Bodnar, Walter S(Z06432) DN: cn=Bodnar, Walter S(Z06432) Reason: I have reviewed this document Date: 2011.03.01 09:14:32 -07'00'
Responsible Section Leader Date	Rowland, James W(Z80533)	Digitally signed by Rowland, James W(Z80533) DN: cn=Rowland, James W(Z80533) Reason: I am approving this document as the Reload Analysis section leader Date: 2011.03.01 09:43:51 -07'00'

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This Report has been prepared in accordance with the requirements of Technical Specification 5.6.5. The Core Operating Limits have been developed using the NRC approved methodologies specified in Section 5.6.5 b of the Palo Verde Unit 2 Technical Specifications.

AFFECTED PVNGS TECHNICAL SPECIFICATIONS

- 3.1.1 Shutdown Margin (SDM) - Reactor Trip Breakers Open
- 3.1.2 Shutdown Margin (SDM) - Reactor Trip Breakers Closed
- 3.1.4 Moderator Temperature Coefficient (MTC)
- 3.1.5 Control Element Assembly (CEA) Alignment
- 3.1.7 Regulating CEA Insertion Limits
- 3.1.8 Part Strength CEA Insertion Limits
- 3.2.1 Linear Heat Rate (LHR)
- 3.2.3 Azimuthal Power Tilt (T_q)
- 3.2.4 Departure From Nucleate Boiling Ratio (DNBR)
- 3.2.5 Axial Shape Index (ASI)
- 3.3.12 Boron Dilution Alarm System (BDAS)
- 3.9.1 Boron Concentration

ANALYTICAL METHODS

The COLR contains the complete identification for each of the Technical Specification referenced topical reports (i.e., report number, title, revision, date, and any supplements) that provide the NRC-approved analytical methods used to determine the core operating limits, described in the following documents:

<u>Title</u>	<u>Report No.</u>	<u>Rev</u>	<u>Date</u>	<u>Suppl</u>
CE Method for Control Element Assembly Ejection Analysis (13-N001-1301-01204-1)	CENPD-0190-A	N.A.	January 1976	N.A.
The ROCS and DIT Computer Codes for Nuclear Design (13-N001-1900-01412-0)	CENPD-266-P-A	N.A.	April 1983	N.A.
Modified Statistical Combination of Uncertainties (13-N001-1303-01747-2)	CEN-356(V)-P-A	01-P-A	May 1988	N.A.
System 80 TM Inlet Flow Distribution (13-N001-1301-01228-0)	Enclosure 1-P to LD-82-054	N.A.	February 1993	1-P
Calculative Methods for the CE Large Break LOCA Evaluation Model for the Analysis of CE and W Designed NSSS (13-N001-1900-01192-3)	CENPD-132	N.A.	March 2001	4-P-A Rev. 1
Calculative Methods for the CE Small Break LOCA Evaluation Model (13-N001-1900-01185-3)	CENPD-137-P	N.A.	April 1998	2-P-A
Fuel Rod Maximum Allowable Pressure (13-N001-0201-00026-1)	CEN-372-P-A	N.A.	May 1990	N.A.
Arizona Public Service Company PWR Reactor Physics Methodology Using CASMO-4/SIMULATE-3 (NFM-005)	NFM-005	1	August 2007	N.A.
Technical Description Manual for the CENTS Code Volume 1 (CENTS-TD MANUAL-VOL 1)	CE-NPD 282-P-A Vols. 1	2	March 2005	N.A.
Technical Description Manual for the CENTS Code Volume 2 (CENTS-TD MANUAL-VOL 2)	CE-NPD 282-P-A Vols. 2	2	March 2005	N.A.

<u>Title</u>	<u>Report No.</u>	<u>Rev</u>	<u>Date</u>	<u>Suppl</u>
Technical Description Manual for the CENTS Code Volume 3 (CENTS-TD MANUAL-VOL 3)	CE-NPD 282-P-A Vols. 3	2	March 2005	N.A.
Implementation of ZIRLO™ Cladding Material in CE Nuclear Power Fuel Assembly Designs (13-N001-1900-01329-0)	CENPD-404-P-A	0	November 2001	N.A.
HERMITE, A Multi-Dimensional Space-Time Kinetics Code for PWR Transients (HERMITE-TOPICAL)	CENPD-188-A		July 1976	
TORC Code, A Computer Code for Determining the Thermal Margin of a Reactor Core (N001-1301-01202)	CENPD-161-P-A		April 1986	
CETOP-D Code Structures and Modeling Methods for San Onofre Nuclear Generating Station Units 2 and 3, (N001-1301-01185)	CEN-160(S)-P	1-P	September 1981	
CPC Methodology Changes for the CPC Improvement Program, (N001-1303-02283)	CEN-310-P-A	0	April 1986	
Loss of Flow, C-E Methods for Loss of Flow Analysis, (N001-1301-01203)	CENPD-183-A	0	June 1984	
Methodology for Core Designs Containing Erbium Burnable Absorbers (N001-0201-00035)	CENPD-382-P-A	0	August 1993	
Verification of the Acceptability of a 1-Pin Burnup Limit of 60 MWD/kgU for Combustion Engineering 16 x 16 PWR Fuel (N001-0201-00042)	CEN-386-P-A	0	August 1992	

The cycle-specific operating limits for the specifications listed are presented below.

3.1.1 - Shutdown Margin (SDM) - Reactor Trip Breakers Open

The Shutdown Margin shall be greater than or equal to that shown in Figure 3.1.1-1.

3.1.2 - Shutdown Margin (SDM) - Reactor Trip Breakers Closed

The Shutdown Margin shall be greater than or equal to that shown in Figure 3.1.2-1.

3.1.4 - Moderator Temperature Coefficient (MTC)

The moderator temperature coefficient (MTC) shall be within the area of Acceptable Operation shown in Figure 3.1.4-1.

3.1.5 - Control Element Assembly (CEA) Alignment

With one or more full-strength or part-strength CEAs misaligned from any other CEAs in its group by more than 6.6 inches, the minimum required MODES 1 and 2 core power reduction is specified in Figure 3.1.5-1. The required power reduction is based on the initial power before reducing power.

3.1.7 - Regulating CEA Insertion Limits

With COLSS IN SERVICE, regulating CEA groups shall be limited to the withdrawal sequence and to the insertion limits¹ shown in Figure 3.1.7-1²; with COLSS OUT OF SERVICE, regulating CEA groups shall be limited to the withdrawal sequence and to the insertion limits¹ shown in Figure 3.1.7-2.² Regulating Groups 1 and 2 CEAs shall be maintained fully withdrawn³ while in Modes 1 and 2 (except while performing SR 3.1.5.3).

¹ A reactor power cutback will cause either (Case 1) Regulating Group 5 or Regulating Group 4 and 5 to be dropped with no sequential insertion of additional Regulating Groups (Groups 1, 2, 3, and 4) or (Case 2) Regulating Group 5 or Regulating Group 4 and 5 to be dropped with all or part of the remaining Regulating Groups (Groups 1, 2, 3, and 4) being sequentially inserted. In either case, the Transient Insertion Limit and withdrawal sequence specified in the CORE OPERATING LIMITS REPORT can be exceeded for up to 2 hours.

² The Separation between Regulating Groups 4 and 5 may be reduced from the 90 inch value specified in Figures 3.1.7-1 and 3.1.7-2 provided that each of the following conditions are satisfied:

- a) Regulating Group 4 position is between 60 and 150 inches withdrawn.
- b) Regulating Group 5 position is maintained at least 10 inches lower than Regulating Group 4 position.

- c) Both Regulating Group 4 and Regulating Group 5 positions are maintained above the Transient Insertion Limit specified in Figure 3.1.7-1 (COLSS In Service) or Figure 3.1.7-2 (COLSS Out of Service).

³ Fully withdrawn - $\geq 147.75''$ (Pulse Counter indication) and $\geq 145.25''$ (RSPT indication)

3.1.8 - Part Strength CEA Insertion Limits

The part strength CEA groups shall be limited to the insertion limits shown in Figure 3.1.8-1.

3.2.1 - Linear Heat Rate (LHR)

The linear heat rate limit of 13.1 kW/ft shall be maintained.

3.2.3 - Azimuthal Power Tilt (T_q)

The AZIMUTHAL POWER TILT (T_q) shall be less than or equal to 10% with COLSS IN SERVICE when power is greater than 20% and less than or equal to 50%. Additionally, the AZIMUTHAL POWER TILT (T_q) shall be less than or equal to 5% with COLSS IN SERVICE when power is greater than 50%. See Figure 3.2.3-1.

3.2.4 - Departure From Nucleate Boiling Ratio (DNBR)

COLSS IN SERVICE and Both CEACs INOPERABLE in Any OPERABLE CPC Channel - Maintain COLSS calculated core power less than or equal to COLSS calculated core power operation limit based on DNBR decreased by the allowance shown in Figure 3.2.4-1.

COLSS OUT OF SERVICE and CEAC(s) OPERABLE - Operate within the region of acceptable operation of Figure 3.2.4-2 using any operable CPC channel.

COLSS OUT OF SERVICE and Both CEACs INOPERABLE in Any OPERABLE CPC Channel - Operate within the region of acceptable operation of Figure 3.2.4-3 using any operable CPC channel with both CEACs INOPERABLE.

3.2.5 - Axial Shape Index (ASI)

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

COLSS OPERABLE

$-0.18 \leq \text{ASI} \leq 0.17$ for power $\geq 50\%$

$-0.28 \leq \text{ASI} \leq 0.17$ for power $>20\%$ and $< 50\%$

COLSS OUT OF SERVICE (CPC)

$-0.10 \leq \text{ASI} \leq 0.10$ for power $>20\%$

3.3.12 - Boron Dilution Alarm System (BDAS)

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 Tables 3.3.12-1 through 3.3.12-5.

3.9.1 - Boron Concentration

The boron concentration of all filled portions of the Reactor Coolant System and the refueling canal shall be maintained at a uniform concentration ≥ 3000 ppm.

FIGURE 3.1.1-1
 SHUTDOWN MARGIN VERSUS COLD LEG TEMPERATURE
 REACTOR TRIP BREAKERS OPEN

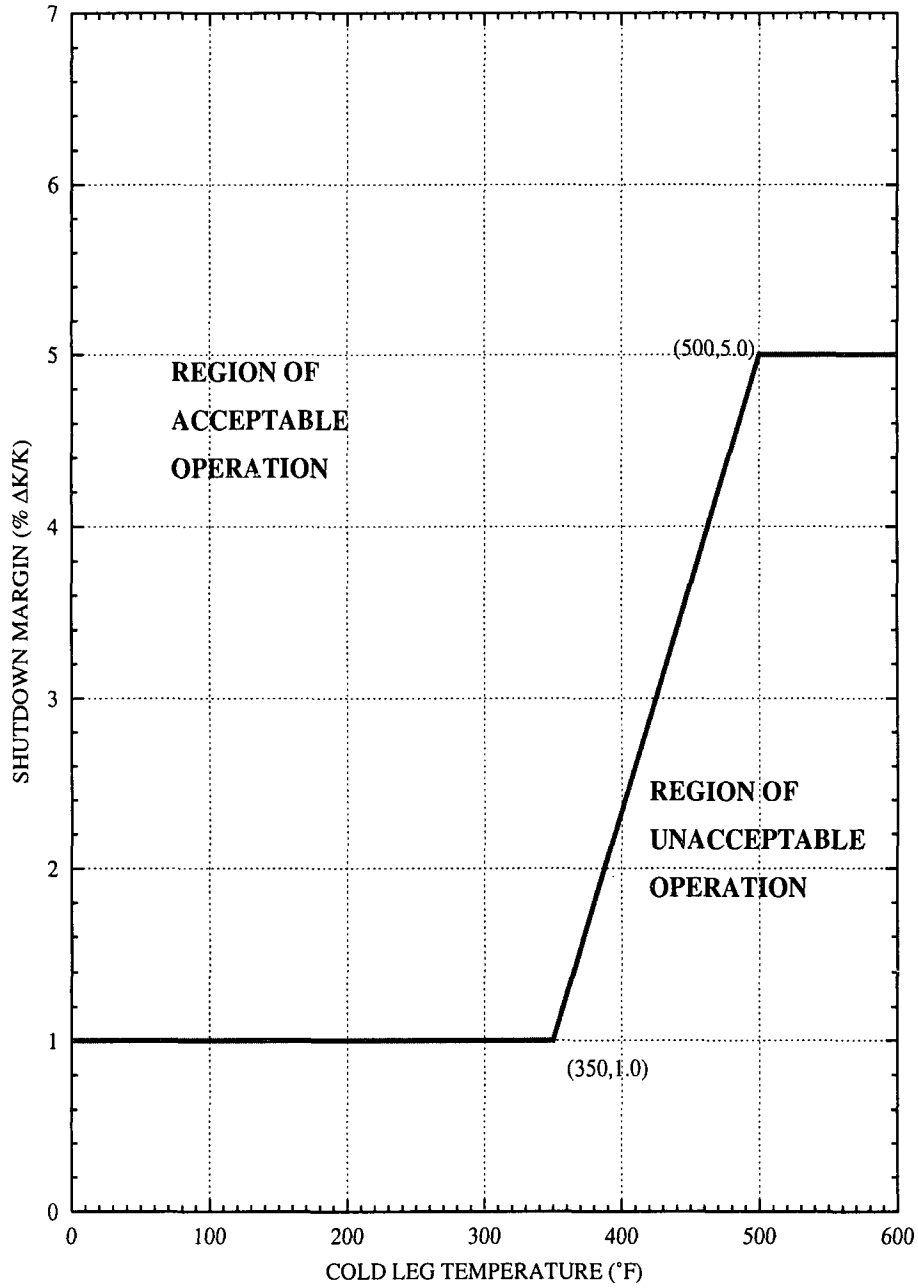
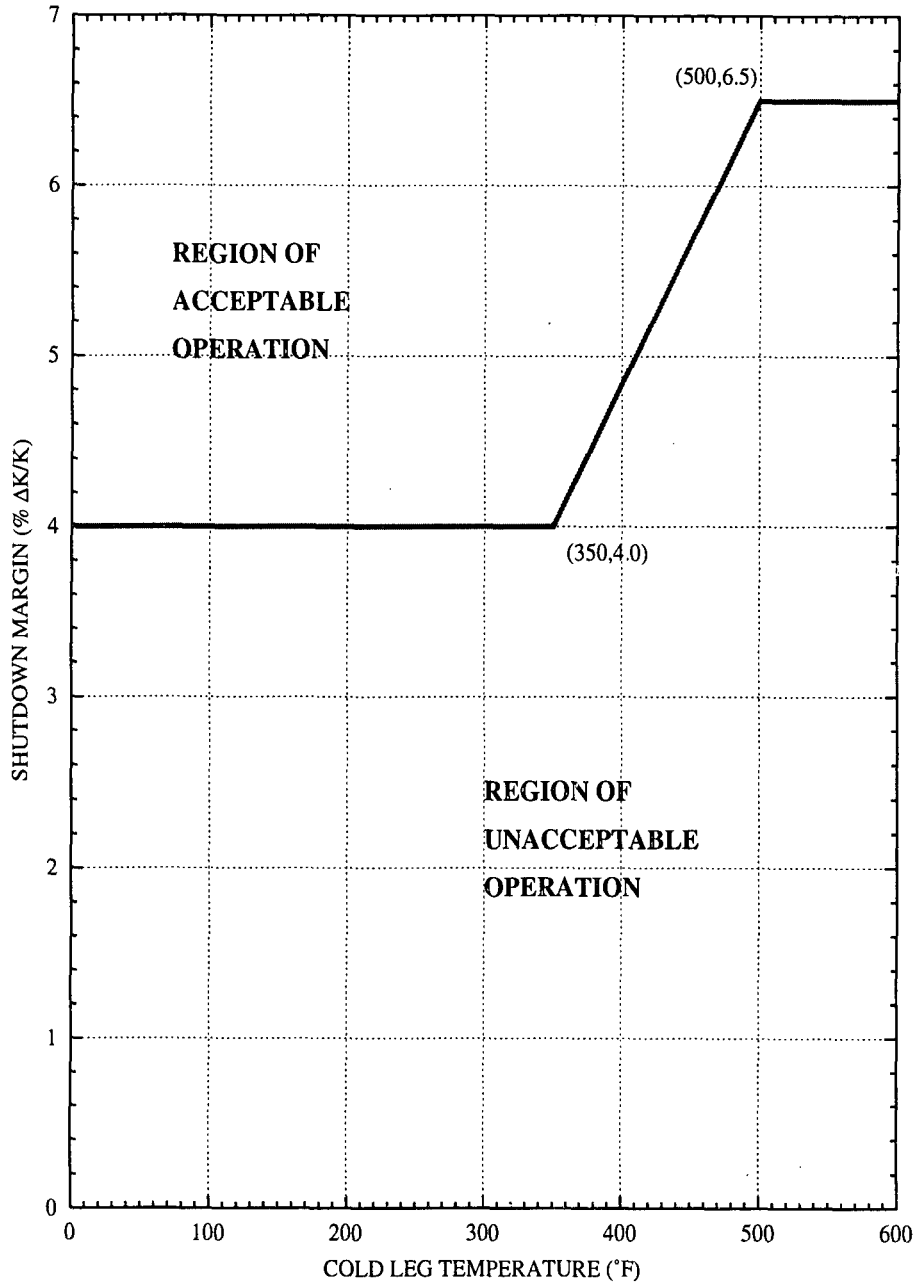


FIGURE 3.1.2-1
 SHUTDOWN MARGIN VERSUS COLD LEG TEMPERATURE
 REACTOR TRIP BREAKERS CLOSED



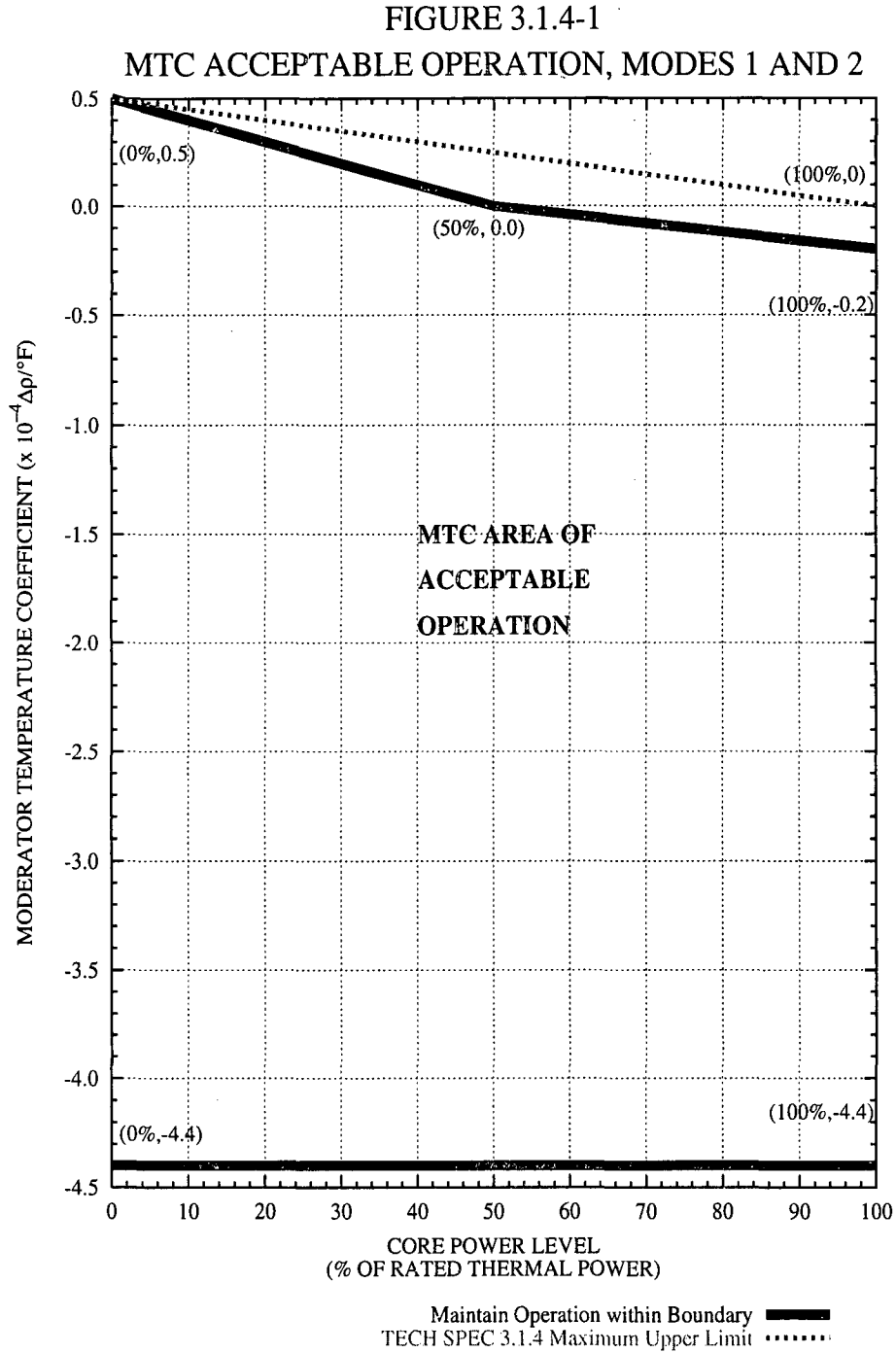
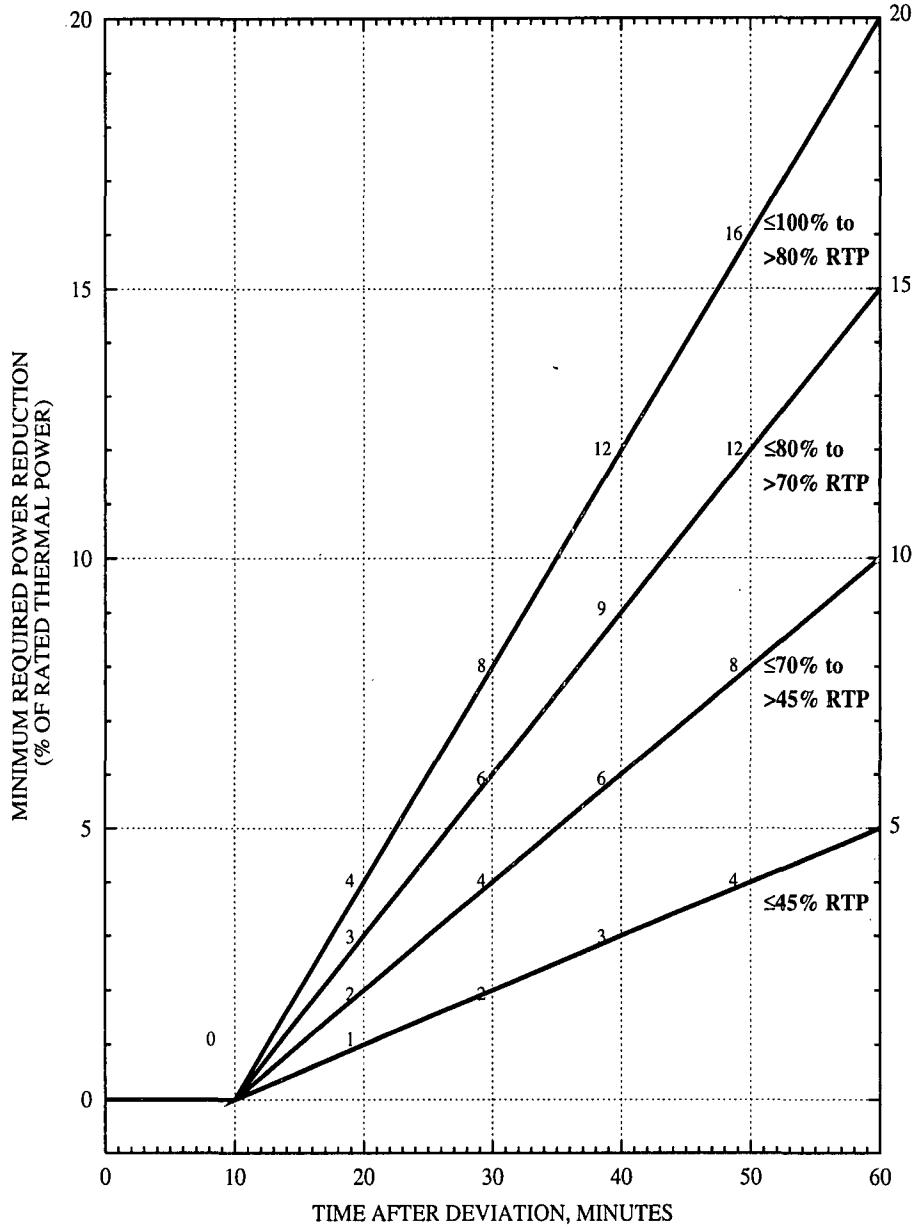
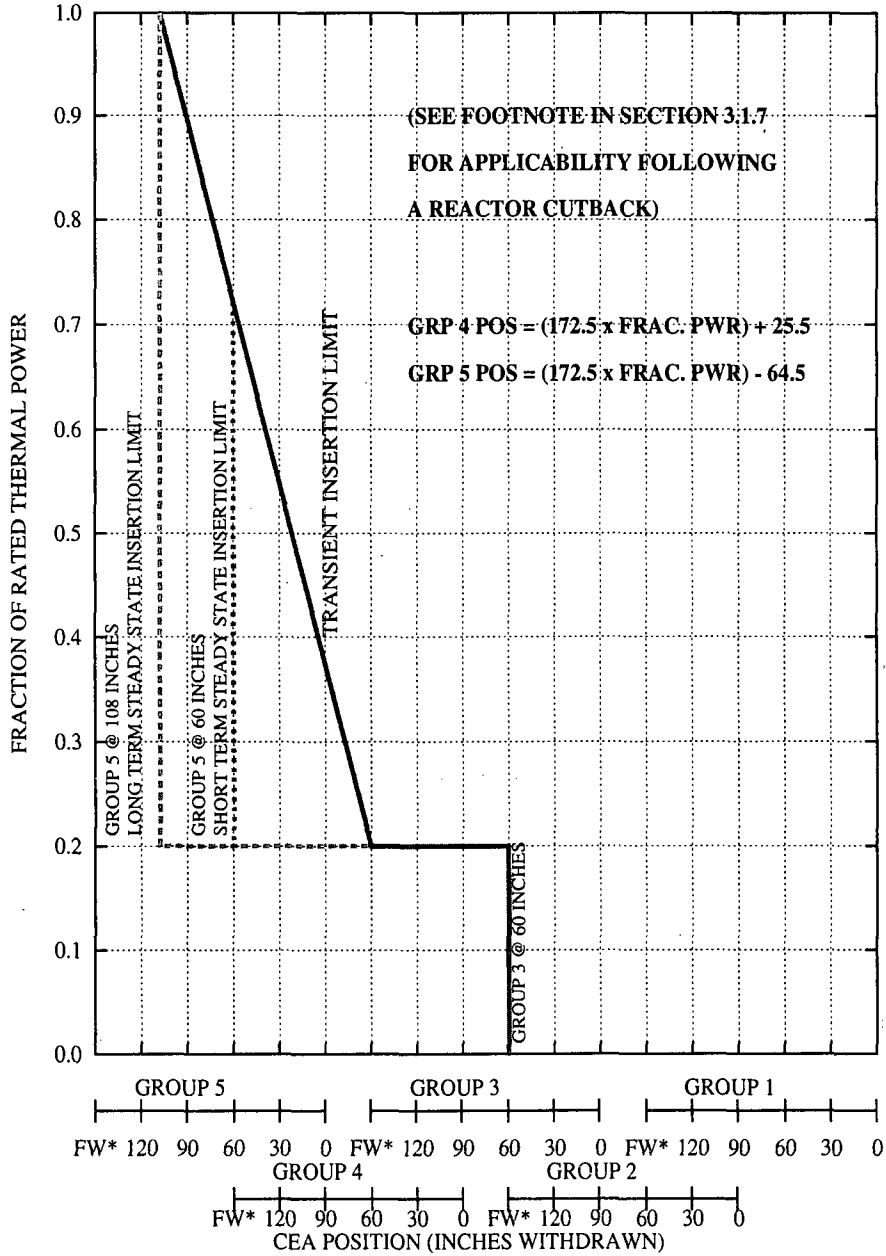


FIGURE 3.1.5-1
CORE POWER REDUCTION AFTER CEA DEVIATION*



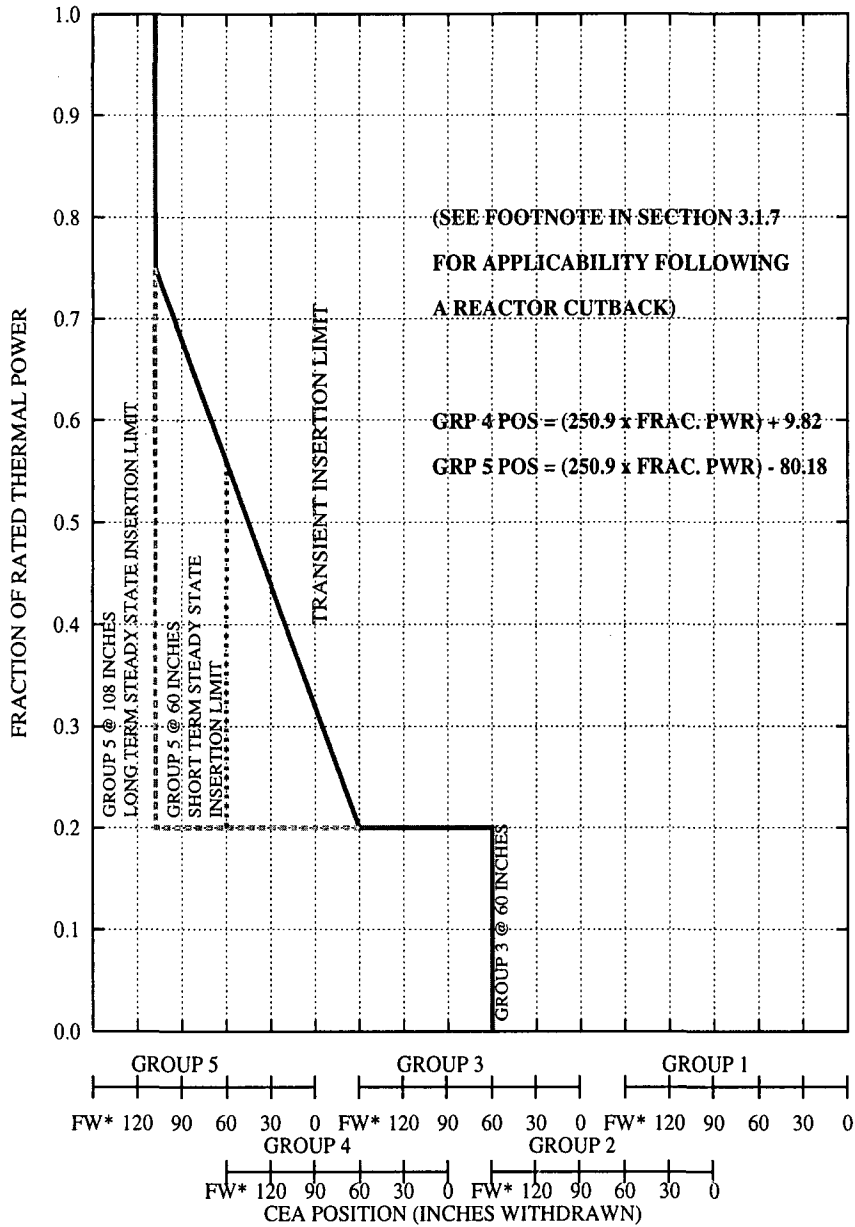
* WHEN CORE POWER IS REDUCED TO 35% OF RATED THERMAL POWER PER THIS LIMIT CURVE, FURTHER REDUCTION IS NOT REQUIRED.

FIGURE 3.1.7-1
CEA INSERTION LIMITS VERSUS THERMAL POWER
(COLSS IN SERVICE)



*Fully Withdrawn (FW) is defined as $\geq 147.75''$ (Pulse Counter) and $\geq 145.25''$ (RSPT).

FIGURE 3.1.7-2
CEA INSERTION LIMITS VERSUS THERMAL POWER
(COLSS OUT OF SERVICE)



*Fully Withdrawn (FW) is defined as $\geq 147.75''$ (Pulse Counter) and $\geq 145.25''$ (RSPT).

FIGURE 3.1.8-1
PART STRENGTH CEA INSERTION LIMITS
VERSUS THERMAL POWER

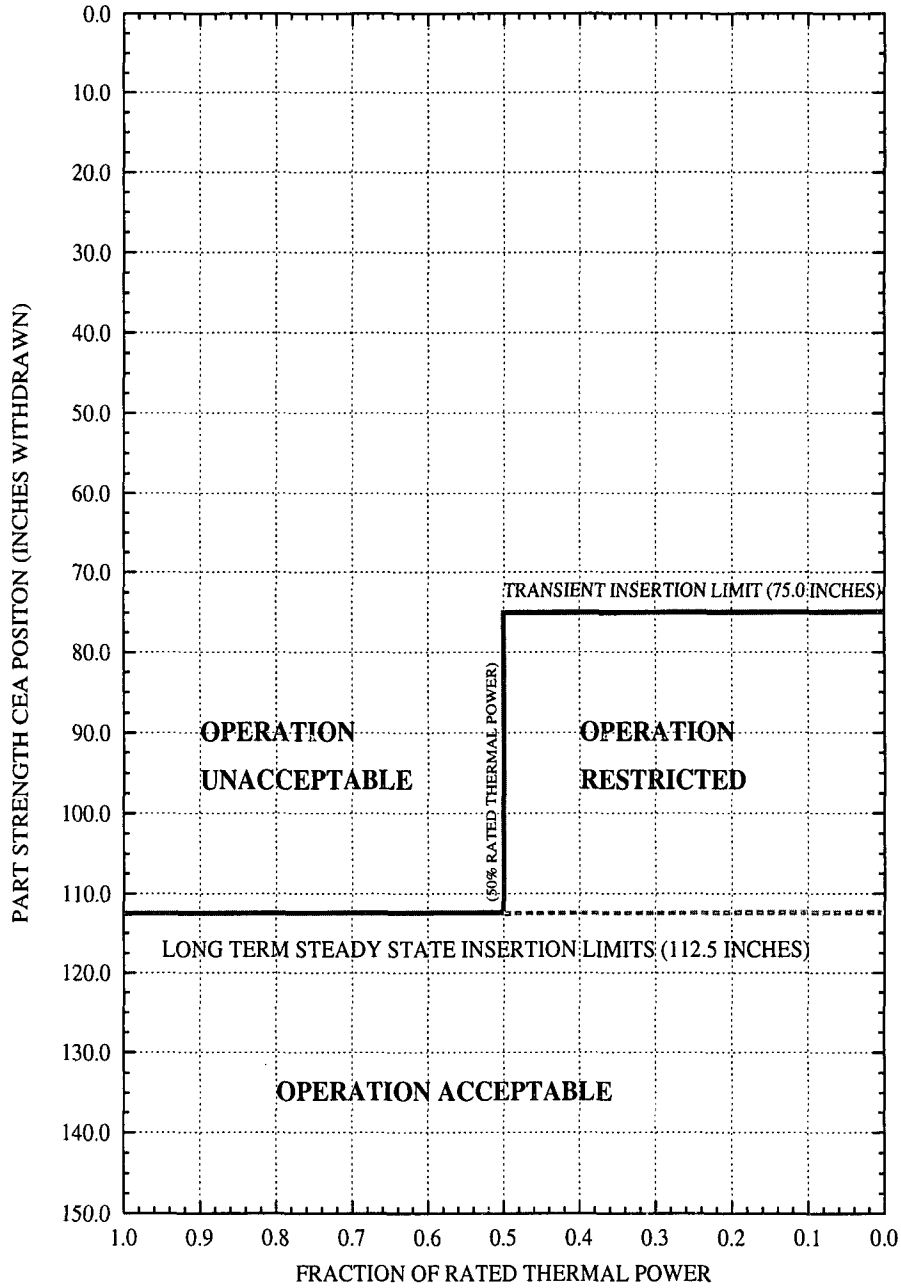


FIGURE 3.2.3-1
AZIMUTHAL POWER TILT VERSUS THERMAL POWER
(COLSS IN SERVICE)

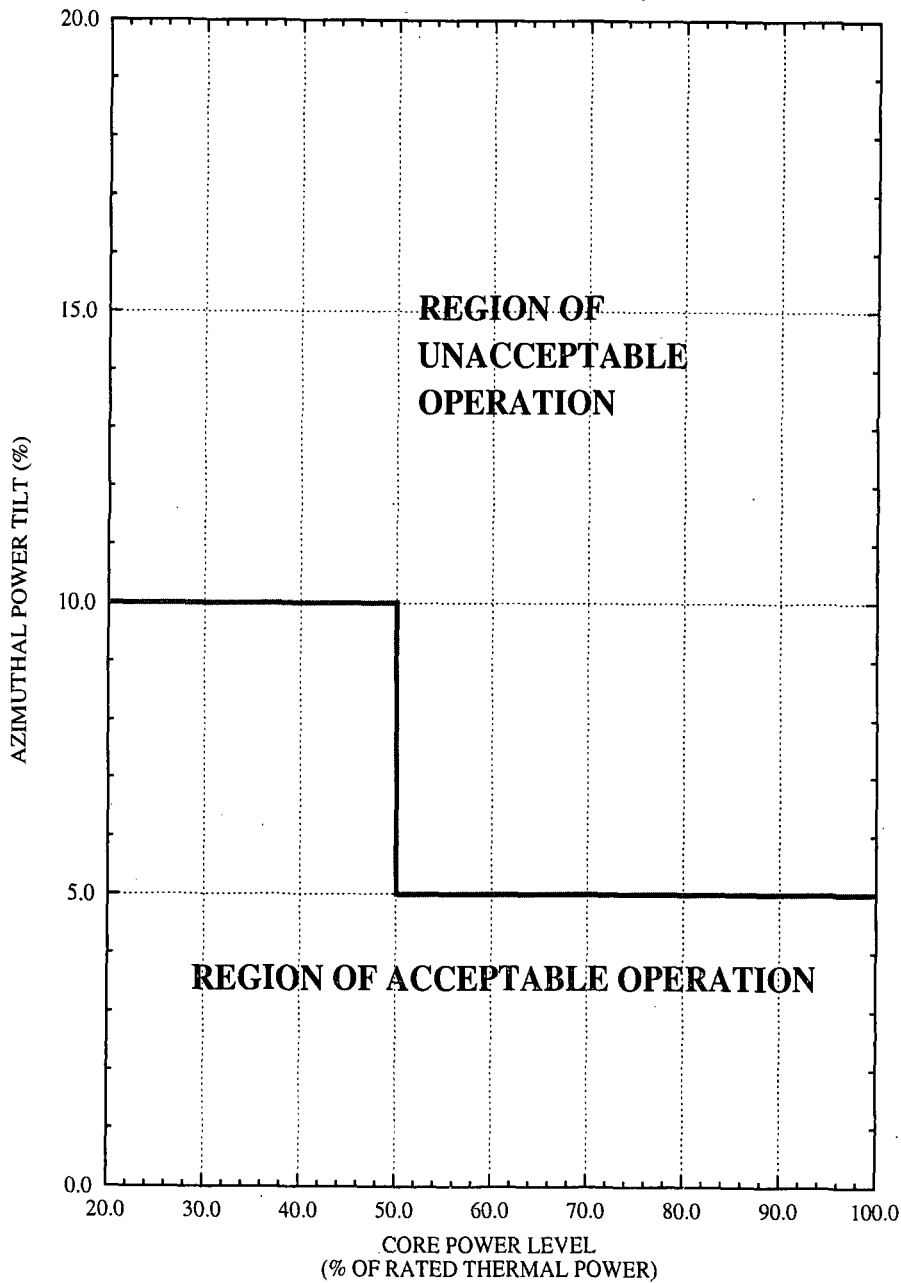


FIGURE 3.2.4-1
 COLSS DNBR OPERATING LIMIT
 ALLOWANCE FOR BOTH CEACs INOPERABLE
 IN ANY OPERABLE CPC CHANNEL

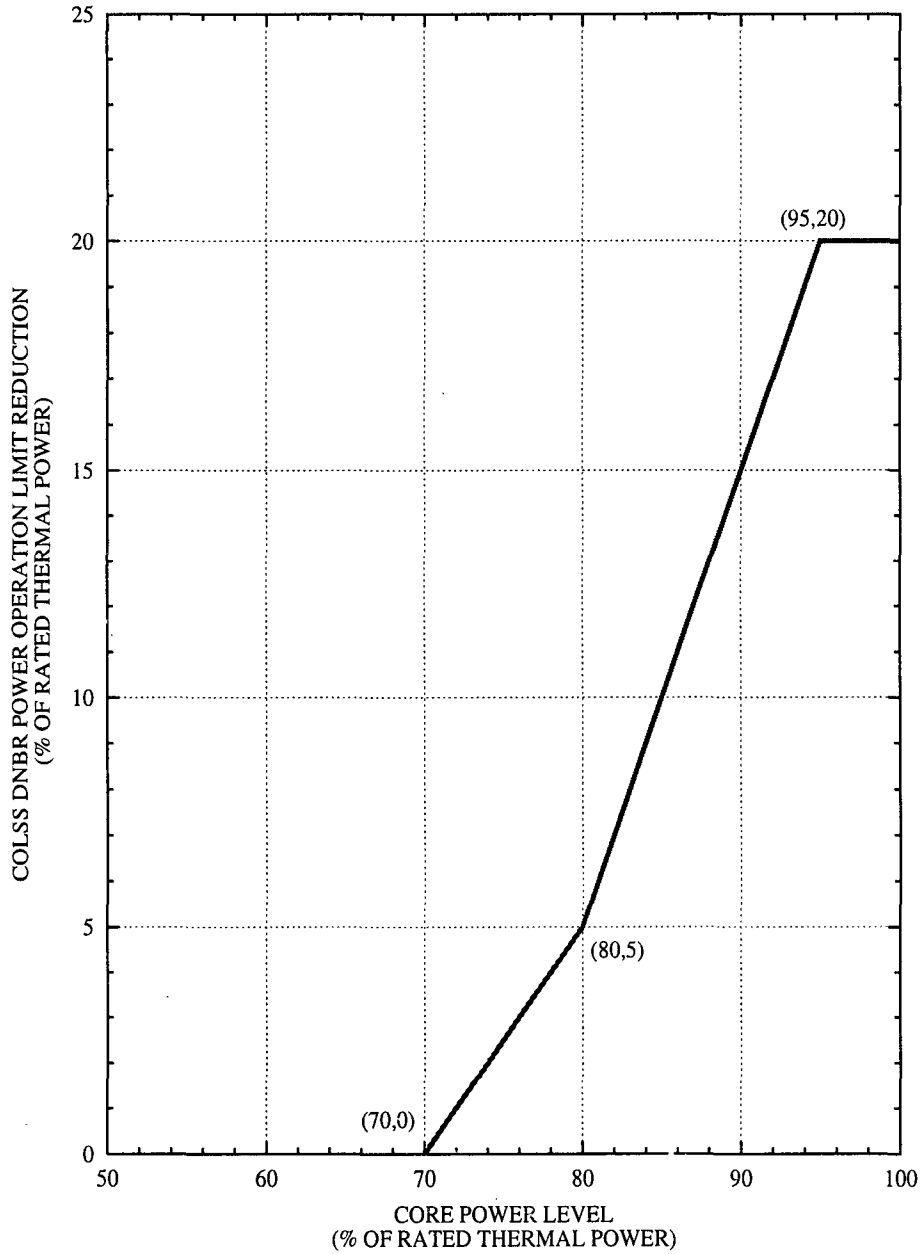


FIGURE 3.2.4-2
 DNBR MARGIN OPERATING LIMIT BASED ON
 THE CORE PROTECTION CALCULATORS
 (COLSS OUT OF SERVICE, CEAC(s) OPERABLE)

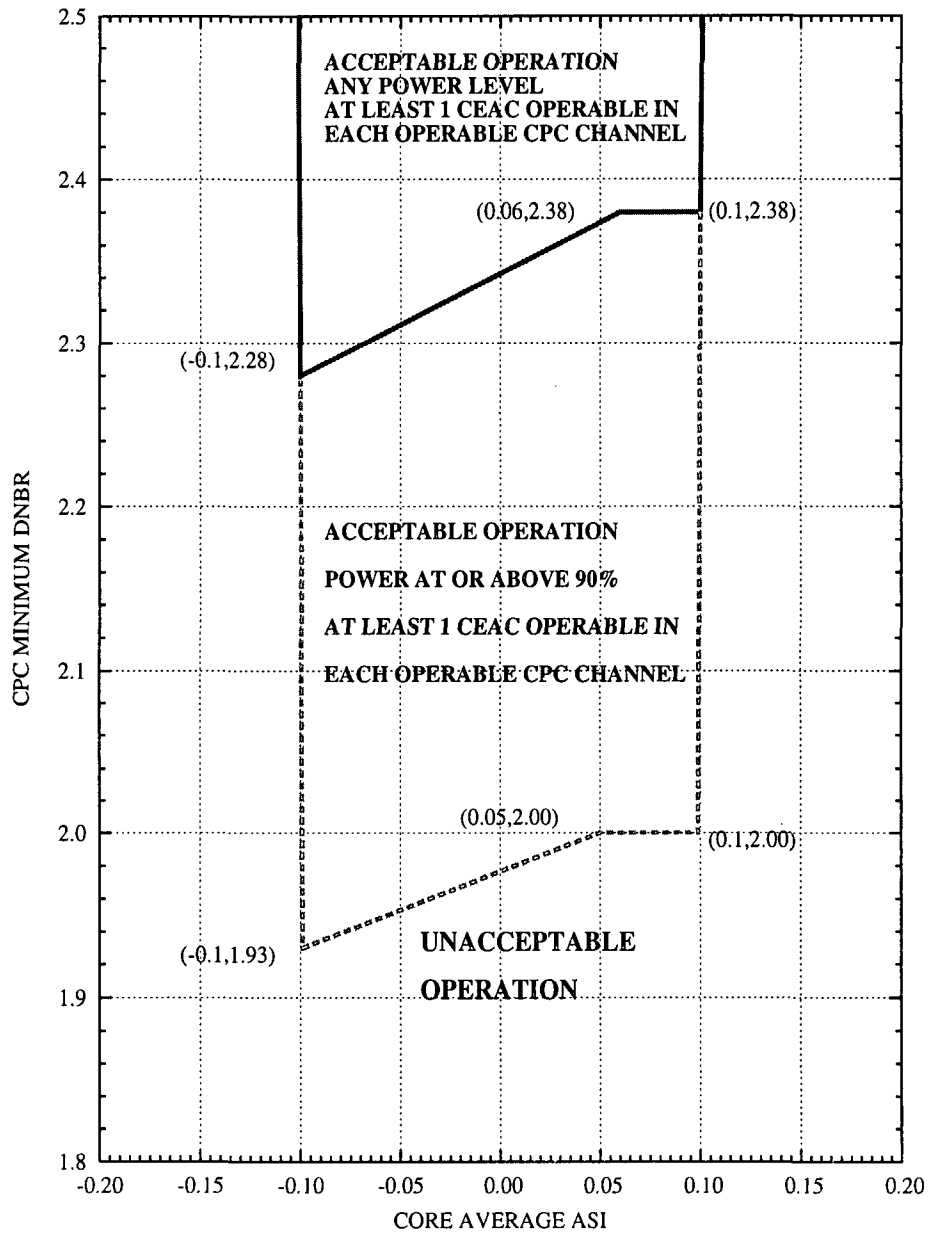


FIGURE 3.2.4-3
 DNBR MARGIN OPERATING LIMIT BASED ON
 THE CORE PROTECTION CALCULATORS
 (COLSS OUT OF SERVICE, BOTH CEACs INOPERABLE
 IN ANY OPERABLE CPC CHANNEL)

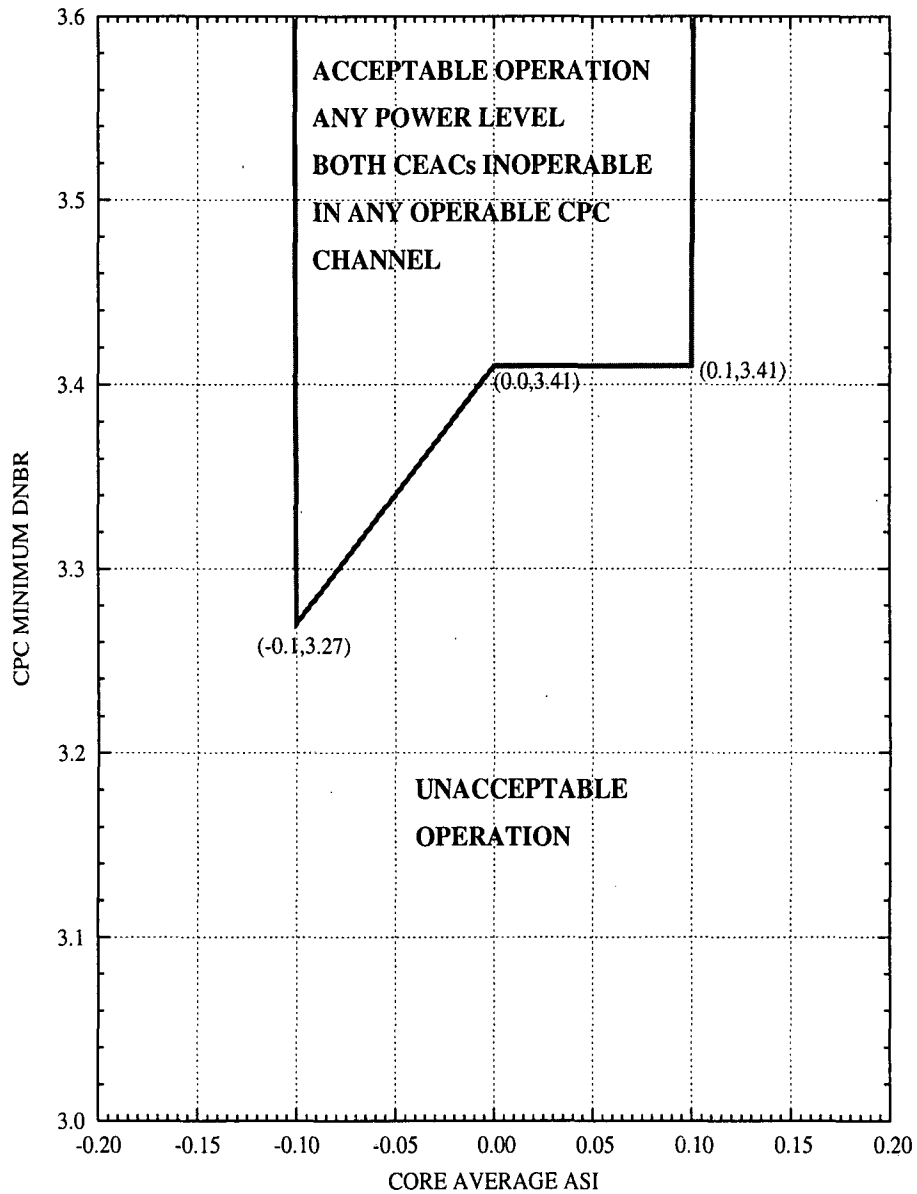


Table 3.3.12-1

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

OPERATIONAL MODE	Number of Operating Charging Pumps			
	0	1	2	3
3	12 hours	0.5 hours	ONA	ONA
4 not on SCS	12 hours	0.5 hours	ONA	ONA
5 not on SCS	8 hours	0.5 hours	ONA	ONA
4 & 5 on SCS	ONA	ONA	ONA	ONA

Notes: SCS = Shutdown Cooling System
ONA = Operation Not Allowed

Table 3.3.12-2

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON
DILUTION DETECTION AS A FUNCTION OF OPERATING
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR $0.98 \geq K_{eff} > 0.97$

OPERATIONAL MODE	Number of Operating Charging Pumps			
	0	1	2	3
3	12 hours	1 hour	0.5 hours	ONA
4 not on SCS	12 hours	1.5 hours	0.5 hours	ONA
5 not on SCS	8 hours	1.5 hours	0.5 hours	ONA
4 & 5 on SCS	8 hours	0.5 hours	ONA	ONA

Notes: SCS = Shutdown Cooling System
ONA = Operation Not Allowed

Table 3.3.12-3

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON
 DILUTION DETECTION AS A FUNCTION OF OPERATING
 CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR $0.97 \geq K_{eff} > 0.96$

OPERATIONAL MODE	Number of Operating Charging Pumps			
	0	1	2	3
3	12 hours	2.5 hours	1 hour	ONA
4 not on SCS	12 hours	2.5 hours	1 hour	0.5 hours
5 not on SCS	8 hours	2.5 hours	1 hour	0.5 hours
4 & 5 on SCS	8 hours	1 hour	ONA	ONA

Notes: SCS = Shutdown Cooling System
 ONA = Operation Not Allowed

Table 3.3.12-4

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON
 DILUTION DETECTION AS A FUNCTION OF OPERATING
 CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR $0.96 \geq K_{eff} > 0.95$

OPERATIONAL MODE	Number of Operating Charging Pumps			
	0	1	2	3
3	12 hours	3 hours	1 hour	0.5 hours
4 not on SCS	12 hours	3.5 hours	1.5 hours	0.75 hours
5 not on SCS	8 hours	3.5 hours	1.5 hours	0.75 hours
4 & 5 on SCS	8 hours	1.5 hours	0.5 hours	ONA

Notes: SCS = Shutdown Cooling System
 ONA = Operation Not Allowed

Table 3.3.12-5

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON
DILUTION DETECTION AS A FUNCTION OF OPERATING
CHARGING PUMPS AND PLANT OPERATIONAL MODES FOR $K_{\text{eff}} \leq 0.95$

OPERATIONAL MODE	Number of Operating Charging Pumps			
	0	1	2	3
3	12 hours	4 hours	1.5 hours	1 hour
4 not on SCS	12 hours	4.5 hours	2 hours	1 hour
5 not on SCS	8 hours	4.5 hours	2 hours	1 hour
4 & 5 on SCS	8 hours	2 hours	0.75 hours	ONA
6	24 hours	1.5 hours	ONA	ONA

Notes: SCS = Shutdown Cooling System
ONA = Operation Not Allowed