



Crystal River Nuclear Plant
Docket No. 50-302
Operating License No. DPR-72

Ref: ITS 5.6.2.18(d)

September 8, 2005
3F0905-01

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

Subject: Crystal River Unit 3 – Core Operating Limits Report, Cycle 14, Revision 3

Dear Sir:

Progress Energy Florida, Inc. (PEF) hereby submits the Crystal River - Unit 3 (CR-3) Core Operating Limits Report (COLR), Cycle 14, Revision 3, as required by Improved Technical Specifications (ITS) 5.6.2.18(d).

Revision 3 removes the requirement for CR-3 to withdraw the Axial Power Shaping Rods (APSRs) at the end of Cycle 14. Additionally, an end of Cycle 14 Refueling Boron Concentration is added to support Cycle 14 shutdown.

No new regulatory commitments are made in this letter.

If you have any questions regarding this submittal, please contact Mr. Sid Powell, Supervisor, Licensing and Regulatory Programs at (352) 563-4883.

Sincerely,

A handwritten signature in black ink, appearing to read 'Michael J. Annacone'.

Michael J. Annacone
Engineering Manager

MJA/rmb

Attachment: Core Operating Limits Report (COLR), Cycle 14, Revision 3

xc: NRR Project Manager
Regional Administrator, Region II
Senior Resident Inspector

Progress Energy Florida, Inc.
Crystal River Nuclear Plant
15760 W. Powerline Street
Crystal River, FL 34428

2001

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ATTACHMENT

**Core Operating Limits Report (COLR)
Cycle 14, Revision 3**

SYSTEM#	<u>RC</u>
CALC SUB-TYPE	<u>N/A</u>
PRIORITY CODE	<u>0</u>
QUALITY CLASS	<u>Safety Related</u>

NUCLEAR GENERATION GROUP

F03-0012

(Calculation #)

FOR

Cycle 14 Core Operating Limits Report

(Title including structures, systems, components)

☐ BNP UNIT ____ ☒ CR3 ☐ HNP ☐ RNP ☐ NES ☐ ALL

APPROVAL

☒ Electronically Approved

REV	PREPARED BY	REVIEWED BY	SUPERVISOR
2	Signature	Signature	Signature
	Name V.M. Esquillo	Name M.W. Culver	Name P.R. Allen
	Date Signed on 6/6/05	Date Signed on 6/8/05	Date Signed on 6/8/05
3	Signature	Signature	Signature
	Name S.M. Leengran	Name Ryan Maas	Name M.J. DeVoe
	Date 8/22/2005	Date 8/22/2005	Date 8/22/2005

LIST OF EFFECTIVE PAGES

Page	Rev	Attachment	Rev
1-9	3	1	3 (pages 1 – 22)
		2	3 (page 1)
		3	3 (pages 1-3)
		4	3 (pages 1-3)
		5	3 (pages 1-6)

REVISION HISTORY

Revision	Description of changes made
0	Original Document per EC 48755 Rev 1
1	Implementation of EC 48755 Rev 3 and NRC approval of License Condition 2.C.(12). Modified Attachment 1 (COLR) to remove Modes 1 & 2 restriction.
2	Permits the use of specific volt meter models (EC/ED 61264) for the Technical Specification Surveillance Requirement 3.1.7.1 comparison of the Control Rod Absolute Position Indication (API) to the Relative Position Indication (RPI).
3	Revision 3 is performed in order to remove requirement to withdraw Axial Power Shaping Rods (APSRs), in support of EC 59637. Additionally, an end of Cycle 14 Refueling Boron Concentration is added to the COLR to support Cycle 14 shutdown.

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LIST OF ATTACHMENTS

Attachment		Total Pages
1	Cycle 14 Core Operating Limits Report	22
2	Document Indexing Table	1
3	Record of Lead Review	2
4	Cross Discipline Reviews	4
5	NFP-NGGC-0018 COLR Update Checklist	6

1.0 PURPOSE

Revision 0

The purpose of this calculation is to establish the CR-3 Cycle 14 Core Operating Limits Report (COLR).

Revision 1

The purpose of revision 1 is to implement EC 48755 Rev 3 which includes the approval of License Condition 2.C.(12) per Reference 10. This activity allows for the unrestricted implementation of the Cycle 14 COLR (in Attachment 1).

Revision 2

The purpose of revision 2 is to permit the use of specific volt meter models for the Technical Specification Surveillance Requirement 3.1.7.1 comparison of the Absolute Position Indication (API) to the Relative Position Indication (RPI). The use of the volt meters supplement the plant computer and main control board panel meters. The volt meters, Keithley 2001, Keithley 197, or Keithley 197A voltmeter on the 20 VDC scale, were evaluated and determined to be acceptable by Engineering Change/Engineering Disposition 61264.

Revision 3

The purpose of revision 3 is to remove the requirement to withdraw Axial Power Shaping Rods (APSRs), in support of EC 59637 as justified in Reference 12. Additionally, an end of Cycle 14 Refueling Boron Concentration is added to the COLR to support Cycle 14 shutdown.

2.0 REFERENCES

1. "Preparation and Control of Design Analyses and Calculations," EGR-NGGC-0017, Rev 2.
2. "Design Review Requirements," EGR-NGGC-0003, Rev 10.
3. Framatome ANP Report BAW-2448, "Crystal River Unit 3 Cycle 14 Reload Report," Revision 1, November 2003 (Doc ID. 103-2448-01).
4. "Core Operating Limits Report Generation for HNP, RNP, and CR3", NFP-NGGC-0018, Rev. 6.
5. Crystal River Unit 3 – Issuance of Amendment Re: "Dual Channel Control Rod Position Indication (TAC No. M82990)", Licensing Amendment No. 144, Letter from H.S. Silver to P.M. Beard, June 25, 1992.
6. Crystal River Unit 3 – Supplemental Information and Proposed License Condition for License Amendment Request #277, Revision 0, "BHTP Departure From Nucleate Boiling Correlation" (TAC No. MB7035), letter from D.L. Roderick (PEF) to NRC, dated October 1, 2003.
7. BAW-10179PA Revision 4, "Safety Criteria and Methodology for Acceptable Cycle Reload Analysis."
8. BAW-10164PA Revision 4, "RELAP/MOD2-B&W – An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis."
9. BAW-10241P Revision 0, "BHTP DNB Correlation Applied with LYNXT."
10. Crystal River Unit 3 – Issuance of Amendment [211] Regarding Technical Specification Change Request for New Departure From Nucleate Boiling Correlation (TAC NO. MB7035), Letter from B.L. Mozafari (NRC) to D.E. Young (PEF).
11. Framatome ANP Report BAW-2492, "Crystal River Unit 3 Cycle 15 Reload Report," Revision 0, August 2005 (Doc ID. 103-2492-00).
12. FANP Document 51-5071007-00, "CR-3 Cycle 14 Verification Report for APSR Insertion Through EOC," August 2005.

3.0 BODY OF CALCULATION

Revision 0

Procedure NFP-NGGC-0018 (Reference 4) was used to produce the Cycle 14 COLR given in Attachment 1. The completed Reference 4 checklist is included in Attachment 5. The primary input to this calculation is the CR3 Cycle 14 Reload Report (Reference 3). Cross discipline reviews were performed and are documented in Section 5.1 and Attachment 4. A list of changes from the Cycle 13 COLR is given below:

Change Number	Description of Change From Cycle 13	Applicable TS Number
1	Revised cycle-specific axial Power imbalance protective limits for Cycle 14 (see Page 8-6 of Reference 2)	2.1.1.1, 2.1.1.2
2	Revised 4 pump regulating rod group insertion error adjusted limits figure for Cycle 14, 0 EFPD to EOC (see Page 8-8 of Reference 2)	3.2.1
3	Revised 3 pump regulating rod group insertion error adjusted limits figure for Cycle 14, 0 EFPD to EOC (see Page 8-9 of Reference 2)	3.2.1
4	Revised allowable EFPD range during which APSRs are inserted for Cycle 14 to 643 to 663 EFPD	3.2.2
5	Revised 4 pump axial power imbalance error adjusted operating limit figure for Cycle 14, 0 EFPD to EOC (including RPS axial power imbalance trip setpoint envelopes) (see Page 8-11 of Reference 2)	3.2.3, 3.3.1
6	Revised 3 pump axial power imbalance error adjusted operating limit figure for Cycle 14, 0 EFPD to EOC (including RPS axial power imbalance trip setpoint envelopes) (see Page 8-12 of Reference 2)	3.2.3, 3.3.1
7	Revised quadrant power tilt limit table for Cycle 14, 0 EFPD to EOC (see Page 8-13 of Reference 2)	3.2.4
8	Revised the nuclear heat flux hot channel factor (F_Q) limits by revision to $LHR^{allow}(Bu)$ and LHR^{avg} for NAS (see Pages 8-14, 8-15 and 8-16 of Reference 2)	3.2.5
9	Revised the nuclear enthalpy rise hot channel factor (F_{AH}^N) limits by revision to table of maximum allowable radial peaking (ARP) limits (see Page 8-20 of Reference 2)	3.2.5
10	Revised cycle-specific allowable nuclear overpower and axial power imbalance setpoint envelope for Cycle 14 (see Page 8-21 of Reference 2)	3.3.1
11	Revised RCS DNB Temperature Limit for Cycle 14 to $\leq 605.8^\circ F$	3.4.1.2
12	Revised RCS DNB Flow Rate Limits for Cycle 14 to ≥ 133.5 E6 lb/hr with 4 RCPs operating and to ≥ 77.7 E6 lb/hr with 3 RCPs operating	3.4.1.3
13	Revised Cycle 14 refueling boron concentration to 2860 ppm.	3.9.1
14	Revised approved methodology reference BAW-10179 to use Revision 4 supplemented by License Condition 2.C.12 (Reference 6).	5.6.2.18
15	Modified MTC plot to make units of MTC consistent with units used for the Lower Limit (e.g. pcm/F was converted to $\times 10^{-4}$ $\Delta k/k/\text{degree F}$, values on y-axis were modified to correctly reflect the limit in these units).	3.1.3
16	Administrative changes to make page headers consistent with the limits list on page 1 of the COLR.	N/A
17	Changed occurrences of defined terms to all capital letters in figures and plots.	N/A
18	Added CAUTION to Introduction of COLR (page 2). See PRECAUTIONS & LIMITATION section of this calculation.	5.6.2.18

Moderator Temperature Coefficient Limit (MTC)

For the upper limit less than 80% thermal power, four power levels were analyzed to determine an appropriate MTC curve for four RC pump operation. The MTC curves used for each analysis were 0, +1, +2, and +5 pcm/F for 95, 75, 65, and 50 percent full power, respectively. The results of the study demonstrated that the calculated PCT for the 100 percent full-power case would bound the partial-power operation with the specified MTC curves. The figure for < 80% Thermal Power in LCO 3.1.3 in the COLR shows the allowable MTC as a function of percent full power with the key assumption of preserving the full power LHR.

Revision 1

Revised COLR to remove CAUTION on page 2 of 22, due to NRC approval of License Condition 2.C.(12).

Revision 3

COLR revised to remove Note regarding APSR withdrawal from Regulating Rod Insertion Limits curves, as found on pages 7 and 8 of 22. The Axial Power Shaping Rod (APSR) Insertion Limits (page 9 of 22) was rewritten to remove the requirement to withdraw the APSRs. These changes are shown acceptable in Reference 12. Additionally a refueling boron concentration was added to support Cycle 14 Mode 6 shutdown and offload conditions to page 21 of 22.

4.0 PRECAUTIONS & LIMITATIONS

Revision 0

The purpose of this calculation is to establish the Cycle 14 COLR as a reference for plant affected documents and to document the refueling boron concentration for LCO 3.9.1. The License Condition (Reference 6) allowing for the use of an unapproved methodology (Reference 9) has not been approved by the NRC, therefore, a caution statement was added to the introduction in the COLR as follows:

CAUTION

Since Licensing Condition 2.C.(12) has not yet been issued by the NRC, COLR Limits based on the above combination of methodologies are not approved for Revision 0 of the Cycle 14 COLR. Therefore, the only applicable COLR limit values for Revision 0 are SHUTDOWN MARGIN (SDM) and Refueling Boron Concentration which were performed using BAW-10179PA Rev. 4, which has been previously approved by the NRC. Specification of these two limits in the COLR allow for entry into Modes 6, 5, 4 or 3.

A revision to this calculation is required to issue the Cycle 14 COLR Licensing document to permit entry into Mode 2.

4.0 PRECAUTIONS & LIMITATIONS (continued)

Revision 1

CLOSED: Revision 1 closes this Precaution & Limitation by removing the above CAUTION from the Cycle 14 COLR in Attachment 1. NRC approval of Licensing Condition was received in Reference 10.

5.0 CONCLUSIONS

Based on the successful application of the governing procedures and on the resolution of comments of cross discipline reviews, the CR3 Cycle 14 COLR (Attachment 1) is suitable for use in Cycle 14.

5.1 CROSS DISCIPLINE IMPACT

Revision 0

Cross discipline reviews were performed. Reactor Engineering, Licensing, Operations, Electrical I&C (Design), NFM&SA (Safety), NFM&SA (Radiological), Mechanical/Civil Design, and Configuration Management have reviewed the Cycle 14 COLR. These reviews are given in Attachment 3.

Revision 1

Cross discipline reviews of Revision 1 were performed by Reactor Engineering, Licensing, Operations and Configuration Management. A reduced number of reviews are justified due to the nature of the change from Revision 0 to Revision 1 (i.e. removal of CAUTION from COLR Introduction (page2)).

Revision 2

Lead and Cross discipline reviews of Revision 2 were performed by Reactor Engineering, Nuclear Fuels Management and Safety Analysis, Design Engineering, System Engineering, Licensing, and Operations.

Revision 3

Cross discipline reviews of Revision 3 were performed by Reactor Engineering, Licensing, and Configuration Management. These reviews are provided in Attachment 4.

Progress Energy - Florida
Crystal River Unit 3

Cycle 14
Core Operating Limits Report
Revision 3

Referencing
Improved Technical Specifications

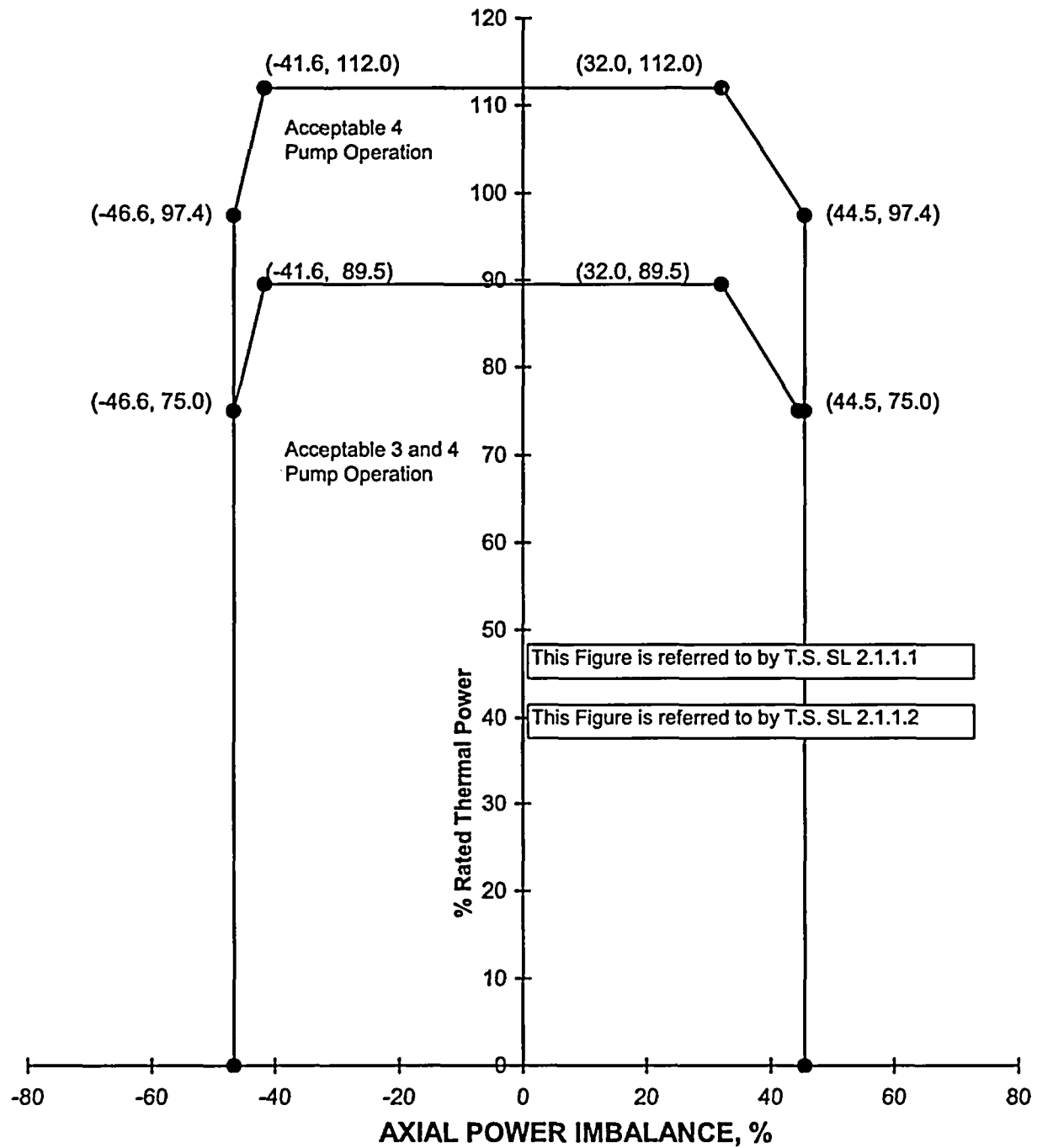
1.0 Core Operating Limits

This Core Operating Limits Report for CR3 Cycle 14 has been prepared in accordance with the requirements of Technical Specification Section 1.1 and 5.6.2.18. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC. Per ITS 5.6.2.18, the approved COLR methodology is BAW-10179PA Rev. 4, "Safety Criteria and Methodology for Acceptable Cycle Reload Analysis" which is supplemented by Licensing Condition 2.C.(12) and License Amendment 144, dated June 25, 1992. The Licensing Condition 2.C.(12) includes BAW-10164PA Rev. 4, "RELAP/MOD2-B&W – An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis" and BAW-10241P Rev. 0, "BHTP DNB Correlation Applied with LYNXT." License Amendment 144 SER methodology is used to specify the API/RPI Agreement Limits for SR 3.1.7.1. The Cycle 14 limits generated using the methodologies above are documented in BAW-2448 Revision 0, "Crystal River Unit 3 Cycle 14 Reload Report", dated August 2003.

The following limits are included in this report.

SL 2.1.1.1	AXIAL POWER IMBALANCE Protective Limits
SL 2.1.1.2	AXIAL POWER IMBALANCE Protective Limits
LCO 3.1.1	SHUTDOWN MARGIN (SDM)
LCO 3.1.3	Moderator Temperature Coefficient (MTC)
SR 3.1.7.1	API/RPI Position Indication Agreement
LCO 3.2.1	Regulating Rod Insertion Limits
LCO 3.2.2	AXIAL POWER SHAPING ROD (APSR) Insertion Limits
LCO 3.2.3	AXIAL POWER IMBALANCE Operating Limits
LCO 3.2.4	QUADRANT POWER TILT
LCO 3.2.5	Power Peaking Factors
LCO 3.3.1	Reactor Protection System (RPS) Instrumentation
SR 3.4.1.1	RCS Pressure DNB Limits
SR 3.4.1.2	RCS Temperature DNB Limits
SR 3.4.1.3	RCS Flow Rate DNB Limits
LCO 3.9.1	Refueling Boron Concentration

AXIAL POWER IMBALANCE Protective Limits



SHUTDOWN MARGIN (SDM)

Normal operating procedures require RCS boration to 1.0% $\Delta k/k$ Subcritical at 73°F prior to bypassing EFIC actuation on low steam generator pressure, or when high steam generator levels exist during secondary system chemistry control and steam generator cleaning in MODES 3, 4, and 5, therefore

Mode 3,4,5 $SDM \geq 1.0\% \Delta k/k$

These limits are referred to by Technical Specification LCO 3.1.1

Reference: Improved Technical Specification Bases B3.1.1.

Moderator Temperature Coefficient Limit (MTC)

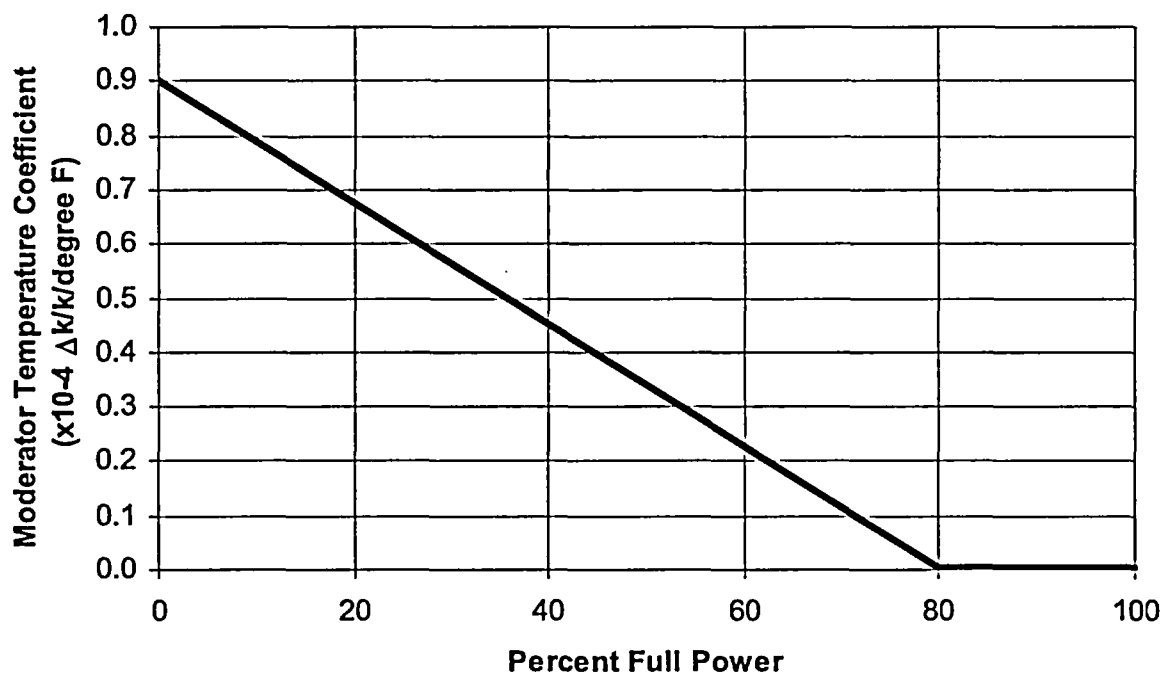
Lower Limit

MTC at HFP > $-3.58 \times 10^{-4} \Delta k/k/^{\circ}F$

Upper Limit

MTC \leq The curve below:

The following Upper Limits may not be exceeded (Limits ensure the validity of the ECCS analysis is preserved) for operation in MODES 1 and 2:



These limits are
referred to by
Technical
Specification
LCO 3.1.3

Absolute Position Indicator (API)/ Relative Position Indicator (RPI) Agreement Limits

2.7% when the comparison is performed using the plant computer (Note 1), or

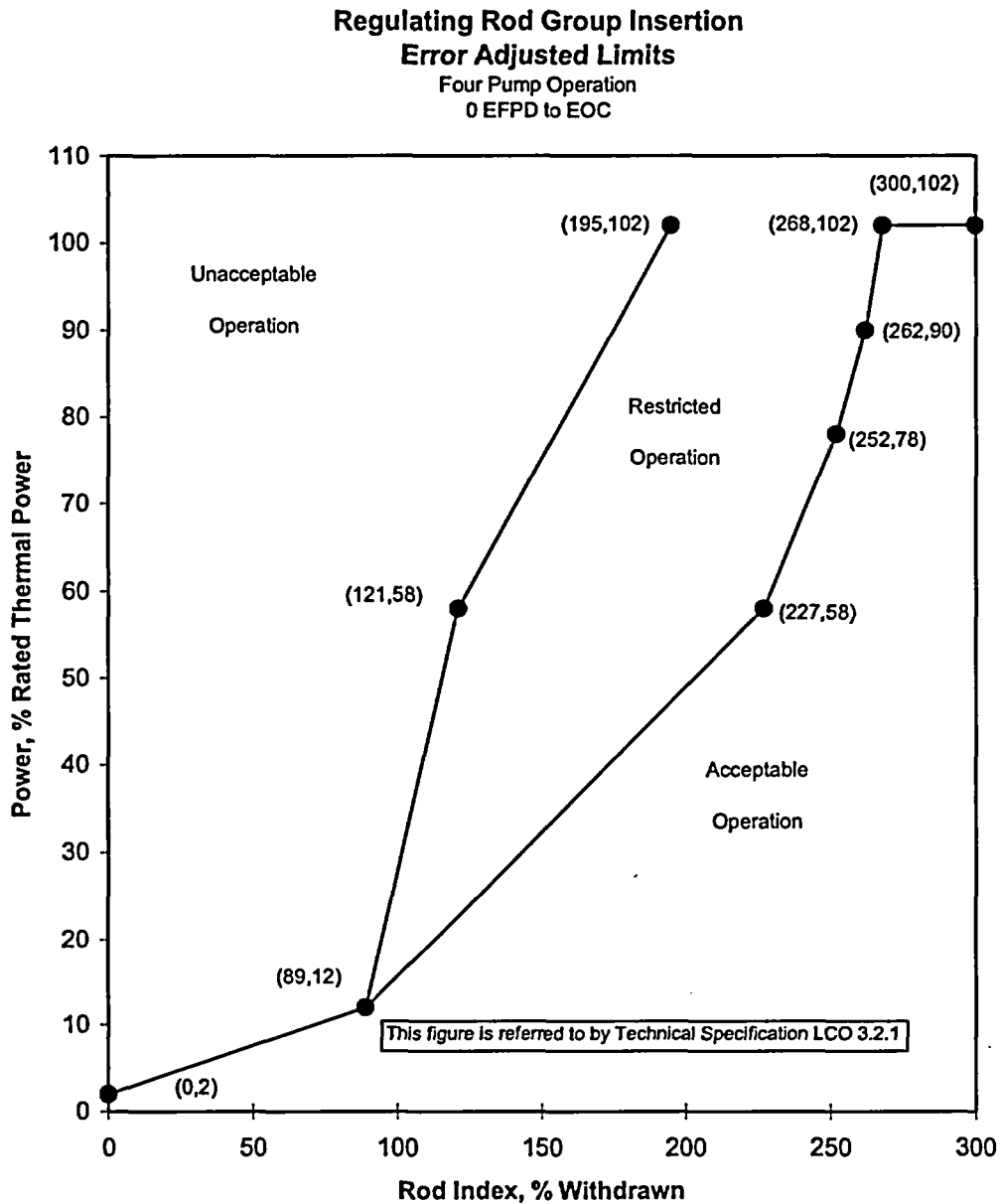
3.5% when the comparison is performed using the panel meters on the main control board, or

These limits are referred to by Technical Specification SR 3.1.7.1
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Reference: "Crystal River Unit 3 – Issuance of Amendment Re: Dual Channel Control Rod Position Indication (TAC No. M82990)", Licensing Amendment No. 144, Letter from H.S. Silver to P.M. Beard, June 25, 1992.

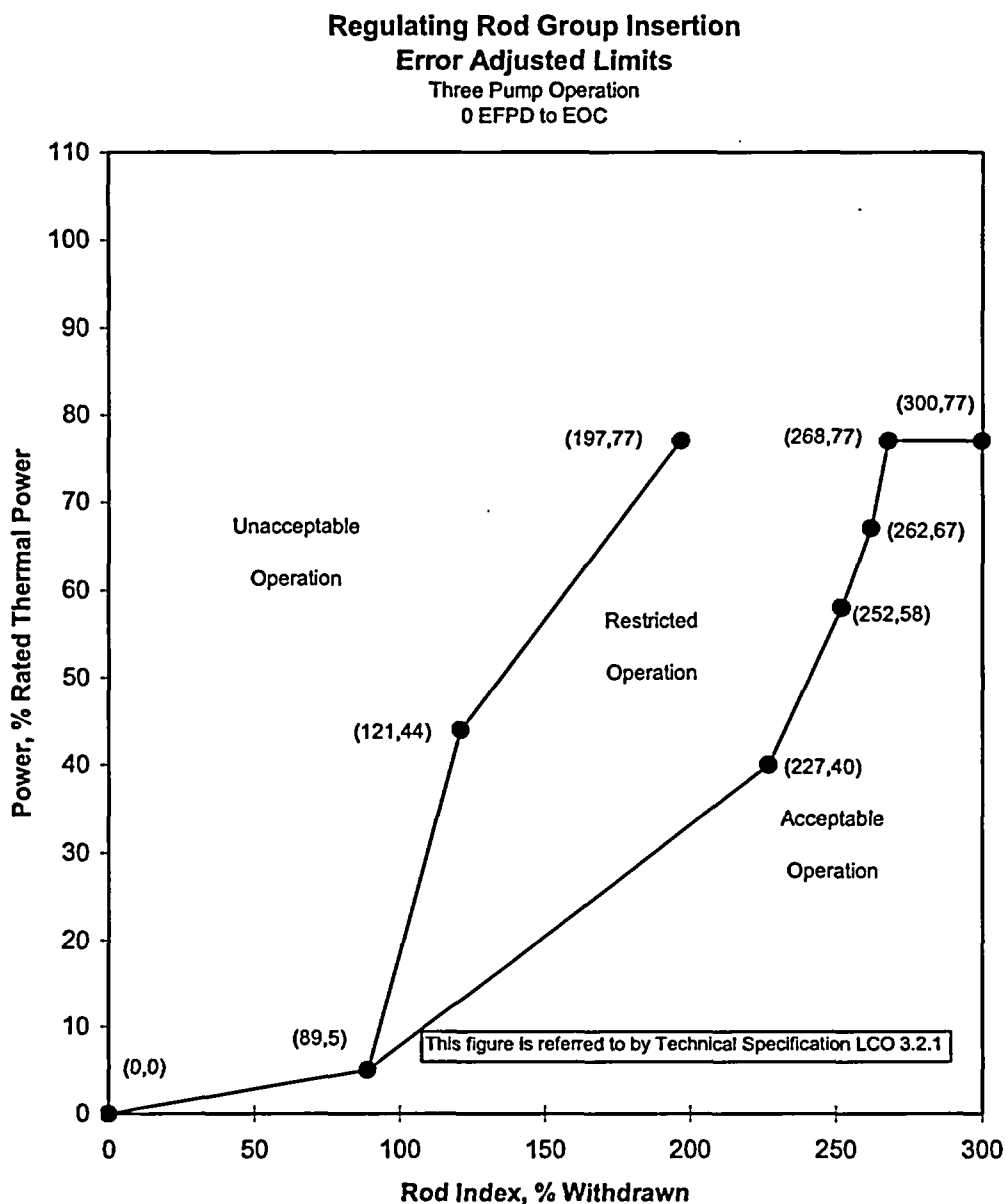
Note 1 If the plant computer is not available, then the following meter models are approved for use: Keithley 2001, Keithley 197, Keithley 197A (Ref. EC 61264)

Regulating Rod Insertion Limits



Note 1: A Rod group overlap of $25 \pm 5\%$ between sequential groups 5 and 6, and 6 and 7 shall be maintained

Regulating Rod Insertion Limits (Continued)



Note 1: A Rod group overlap of $25 \pm 5\%$ between sequential groups 5 and 6, and 6 and 7 shall be maintained

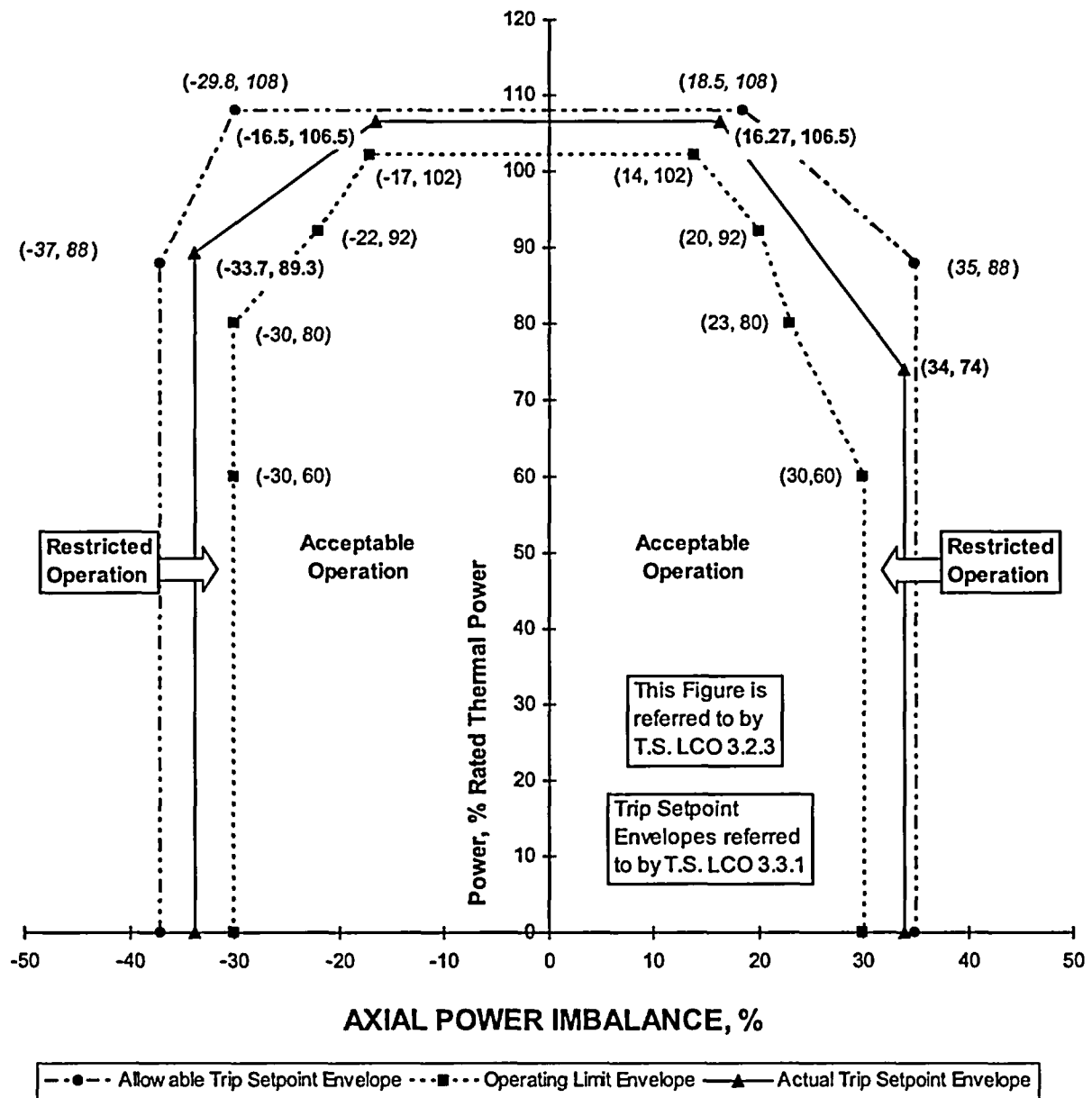
AXIAL POWER SHAPING ROD (APSR) Insertion Limits

From BOC to EOC, the APSRs may be positioned as necessary.

These limits are
referred to by
Technical
Specification
LCO 3.2.2

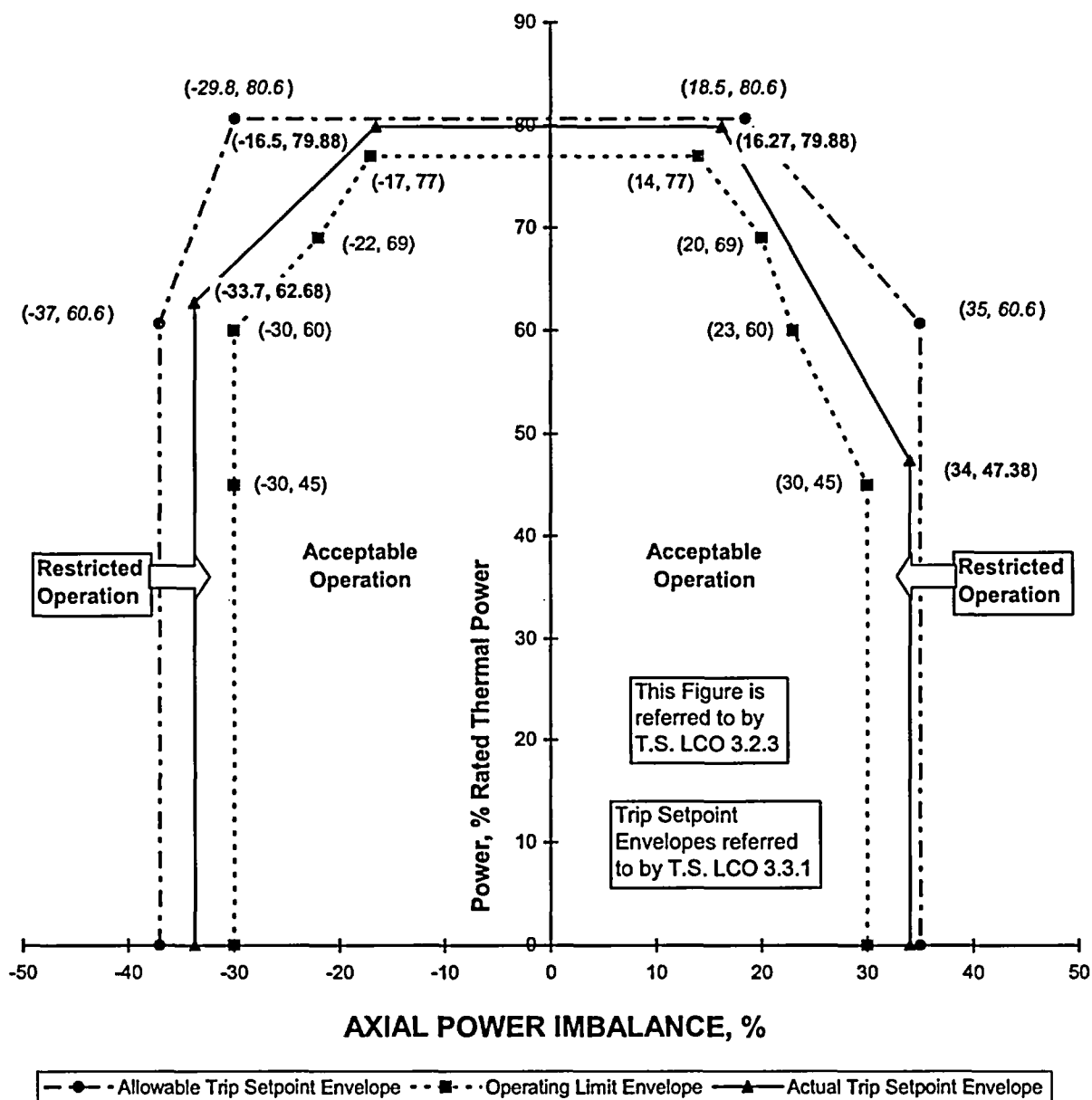
AXIAL POWER IMBALANCE Operating Limits

**AXIAL POWER IMBALANCE Error Adjusted
Operating Limit and Trip Setpoint Envelopes
Four Pump Operation
0 EFPD to EOC**



AXIAL POWER IMBALANCE Operating Limits (Continued)

**AXIAL POWER IMBALANCE Error Adjusted
Operating Limit and Trip Setpoint Envelopes
Three Pump Operation
0 EFPD to EOC**



QUADRANT POWER TILT

QUADRANT POWER TILT Limits For Thermal Power \leq 60%

For Operation from 0 EFPD to EOC

QUADRANT POWER TILT As Measured By:	STEADY-STATE <u>LIMIT(%)</u>	TRANSIENT <u>LIMIT(%)</u>	MAXIMUM <u>LIMIT(%)</u>
Symmetrical Incore Detector System	7.50	10.03	20.0
Power Range Channels	4.94	6.96	20.0
Minimum Incore Detector System	3.07	4.40	20.0
Measurement System Independent	8.58	11.07	20.0

QUADRANT POWER TILT Limits For Thermal Power $>$ 60%

For Operation from 0 EFPD to EOC

QUADRANT POWER TILT As Measured By:	STEADY-STATE <u>LIMIT(%)</u>	TRANSIENT <u>LIMIT(%)</u>	MAXIMUM <u>LIMIT(%)</u>
Symmetrical Incore Detector System	4.53	10.03	20.0
Power Range Channels	1.96	6.96	20.0
Minimum Incore Detector System	1.90	4.40	20.0
Measurement System Independent	4.92	11.07	20.0

<p>These limits are referred to by Technical Specification LCO 3.2.4</p>
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Power Peaking Factors

These Limits are referred to by Technical Specification LCO 3.2.5

Heat Flux Hot Channel Factor F_Q (for NAS)

F_Q shall be limited by the following relationships:

$$F_Q \leq LHR^{\text{allow}}(\text{Bu}) / [LHR^{\text{avg}} * P] \text{ (for } P \leq 1.0\text{)}$$

$LHR^{\text{allow}}(\text{Bu})$ = See the following table

$LHR^{\text{avg}} = 5.9535 \text{ kW/ft}$ for Mark-B10ZL fuel

$LHR^{\text{avg}} = 5.9476 \text{ kW/ft}$ for Mark-B10E and Mk-B10I fuel

$LHR^{\text{avg}} = 5.8533 \text{ kW/ft}$ for Mark-B-HTP fuel

P = ratio of THERMAL POWER / RATED THERMAL POWER

Bu = fuel burnup (MWd/mtU)

CR-3 Cycle 14 Reload Allowable LHR Limits
Batch 16 (Mark-B-HTP) LHR^{allow}
Allowable Peak LHR for Specified Burnup, kW/ft

NAS Level	0-703 EFPD 15503 – 36971 MWd/mtU
1	15.3
2	15.6
3	16.2
4	16.2
5	16.4
6	16.2
7	15.6
8	15.4

This table is referred to
by Technical Specification
LCO 3.2.5

Power Peaking Factors (Continued)

CR-3 Cycle 14 Reload Allowable LHR Limits
Batch 15B (Mark-B10E) LHR^{allow}
Allowable Peak LHR for Specified Burnup Range, kW/ft

NAS Level	0-471 EFPD 15503 – 29886 MWd/mtU	471-550 EFPD 29886 – 32299 MWd/mtU	550-600 EFPD 32299 – 33826 MWd/mtU	600-653 EFPD 33826 – 35445 MWd/mtU	653-703 EFPD 35445 – 36971 MWd/mtU
1	15.4	14.7	14.3	13.9	13.5
2	15.6	14.9	14.5	14.0	13.6
3	16.2	15.4	14.9	14.4	13.9
4	16.3	15.4	14.9	14.4	13.9
5	16.4	15.5	15.0	14.5	14.0
6	16.2	15.4	14.9	14.4	13.9
7	15.6	14.9	14.5	14.0	13.6
8	15.4	14.7	14.3	13.9	13.5

CR-3 Cycle 14 Reload Allowable LHR Limits
Batch 15 A, C, D, E (Mark-B10I) LHR^{allow}
Allowable Peak LHR for Specified Burnup Range, kW/ft

NAS Level	0-373 EFPD 15503 – 26893 MWd/mtU	373-500 EFPD 26893 – 30772 MWd/mtU	500-600 EFPD 30772 – 33826 MWd/mtU	600-653 EFPD 33826 – 35445 MWd/mtU	653-703 EFPD 35445 – 36971 MWd/mtU
1	15.4	14.3	13.5	13.0	12.6
2	15.6	14.4	13.6	13.1	12.6
3	16.2	14.8	13.8	13.3	12.8
4	16.3	14.9	13.8	13.3	12.8
5	16.4	15.0	13.9	13.4	12.9
6	16.2	14.8	13.8	13.3	12.8
7	15.6	14.4	13.6	13.1	12.6
8	15.4	14.3	13.5	13.0	12.6

These tables are referred to
by Technical Specification.
LCO 3.2.5

Power Peaking Factors (Continued)

CR-3 Cycle 14 Reload Allowable LHR Limits
Batch 14B (Mark-B10E) & Batch 14C (Mark-B10I) LHR^{allow}
Allowable Peak LHR for Specified Burnup Range, kW/ft

NAS Level	0-200 EFPD 15503 – 21610 MWd/mtU	200-400 EFPD 21610 – 27718 MWd/mtU	400-550 EFPD 27718 - 32299 MWd/mtU	550-653 EFPD 32299 – 35445 MWd/mtU	653-703 EFPD 35445 – 36971 MWd/mtU
1	13.4	13.1	12.9	12.8	12.7
2	13.5	13.2	13.0	12.8	12.7
3	13.7	13.4	13.2	13.0	12.9
4	13.7	13.4	13.2	13.0	12.9
5	13.8	13.5	13.3	13.1	13.0
6	13.7	13.5	13.2	13.0	12.9
7	13.5	13.2	13.0	12.8	12.7
8	13.4	13.1	12.9	12.8	12.7

CR-3 Cycle 14 Reload Allowable LHR Limits
Batch 12A4 (Mark-B10ZL) LHR^{allow}
Allowable Peak LHR for Specified Burnup Range, kW/ft

NAS Level	0-93 EFPD 15503 – 18343 MWd/mtU	93-300 EFPD 18343 – 24664 MWd/mtU	300-500 EFPD 24664 – 30772 MWd/mtU	500-653 EFPD 30772 – 35445 MWd/mtU	653-703 EFPD 35445 – 36971 MWd/mtU
1	15.4	14.9	14.3	13.6	13.3
2	15.6	15.1	14.4	13.7	13.4
3	16.2	15.6	14.8	14.0	13.7
4	16.3	15.7	14.9	14.0	13.7
5	16.4	15.8	15.0	14.1	13.8
6	16.2	15.6	14.8	14.0	13.7
7	15.6	15.1	14.4	13.7	13.4
8	15.4	14.9	14.3	13.6	13.3

These tables are referred to
by Technical Specification
LCO 3.2.5

Power Peaking Factors (Continued)

This Limit is referred to by Technical Specification LCO 3.2.5

Enthalpy Rise Hot Channel Factor $F_{\Delta H}^N$ (for NAS)

$$F_{\Delta H}^N \leq \text{ARP} [1 + (1/\text{RH})(1 - P/P_m)]$$

ARP = Allowable Radial Peak, See the following table

P = ratio of THERMAL POWER / RATED THERMAL POWER and $P \leq 1.0$

$P_m = 1.0$ for 4-RCP operation

$P_m = 0.75$ for 3-RCP operation

RH = 3.34

Cycle 14 Allowable Radial Peaks (ARP)

<u>Axial Peak</u>	<u>Axial Location⁽¹⁾</u> <u>(X/L)</u>	<u>ARP</u>	<u>Axial Peak</u>	<u>Axial Location⁽¹⁾</u> <u>(X/L)</u>	<u>ARP</u>
1.1	0.00	1.9281	1.5	0.00	1.9790
1.1	0.10	1.9264	1.5	0.10	1.9041
1.1	0.14	1.9262	1.5	0.14	1.8847
1.1	0.20	1.9254	1.5	0.20	1.9034
1.1	0.40	1.9240	1.5	0.40	1.9694
1.1	0.60	1.9229	1.5	0.60	1.8275
1.1	0.80	1.9224	1.5	0.80	1.6786
1.1	0.88	1.9000	1.5	0.88	1.6328
1.1	0.90	1.8798	1.5	0.90	1.6358
1.1	1.00	1.8000	1.5	1.00	1.5712
1.2	0.00	2.0085	1.7	0.00	1.7737
1.2	0.10	2.0050	1.7	0.10	1.6867
1.2	0.14	2.0046	1.7	0.14	1.6635
1.2	0.20	2.0035	1.7	0.20	1.6795
1.2	0.40	2.0008	1.7	0.40	1.7622
1.2	0.60	1.9993	1.7	0.60	1.6947
1.2	0.80	1.8783	1.7	0.80	1.5617
1.2	0.88	1.8304	1.7	0.88	1.5218
1.2	0.90	1.8185	1.7	0.90	1.5308
1.2	1.00	1.7394	1.7	1.00	1.4687
1.3	0.00	2.0936	1.9	0.00	1.6083
1.3	0.10	2.0878	1.9	0.10	1.5149
1.3	0.14	2.0874	1.9	0.14	1.4891
1.3	0.20	2.0858	1.9	0.20	1.5027
1.3	0.40	2.0827	1.9	0.40	1.5812
1.3	0.60	1.9721	1.9	0.60	1.5791
1.3	0.80	1.8095	1.9	0.80	1.4620
1.3	0.88	1.7599	1.9	0.88	1.4259
1.3	0.90	1.7547	1.9	0.90	1.4364
1.3	1.00	1.6824	1.9	1.00	1.3811

⁽¹⁾Based on an active core height of 143.0 inches. Linear interpolation is acceptable.

Reactor Protection System (RPS) Instrumentation

RCS Variable Low Pressure Setpoint Equation

$$P_{\text{Trip}} \geq (11.59 * T_{\text{HOT}} - 5037.8) \text{ psig}$$

This limit is referred to by ITS
Table 3.3.1-1, Item 5

RCS DNB Pressure Limits

RCS loop pressure \geq 2064 psig

(Assumes 20% tube plugging and bounds either four or three RCPs operating).

These limits are
referred to by
SR 3.4.1.1

RCS DNB Temperature Limit

RCS Hot Leg Temperature $\leq 605.8^{\circ}\text{F}$

(Assumes 20% OTSG tube plugging).

These limits are
referred to by
SR 3.4.1.2

RCS DNB Flow Rate Limits

RCS total flow rate ≥ 133.5 E6 lb/hr with four RCPs operating, or ≥ 99.7 E6 lb/hr with three RCPs operating.

(Assumes 20% OTSG tube plugging).

These limits are
referred to by
SR 3.4.1.3

Refueling Boron Concentration

The boron concentration must be greater than 2860 ppmB.

The value includes $1\%\Delta k/k$ for uncertainties and is based on a 685 EFPD cycle 13. The refueling boron concentration must be increased by 2 ppm for each EFPD that the cycle 13 length is less than 685 EFPD, and 1 ppm/EFPD may be deducted for each EFPD that the cycle 13 length is more than 685 EFPD.

The Mode 6 refueling boron concentration must be greater than **1419 ppmB** for the cycle 14 core configuration or during offload of the cycle 14 core, subject to the following:

- 1) allowances are included for a cycle 14 length as short as 688 EFPD;
- 2) must be corrected for the actual expected ^{10}B isotopic atom percent if less than the basis of 19.8 ^{10}B isotopic atom percent;
- 3) no allowance is included for intermediate cycle 14 core locations;
- 4) control rod assemblies and APSRs do not affect the required refueling boron concentration.

<p>This limit is referred to by Technical Specification LCO 3.9.1</p>

Revision History

Revision 0 – October 2003; Original Cycle 14 COLR.

Revision 1 – October 2003; Cycle 14 COLR update to implementation of Licensing Condition 2.C.(12) allowing entry into Mode 2.

Revision 2 – May 2005; Cycle 14 COLR Update to permit use of approved volt meter models for API/RPI comparison (Ref. EC 61264)

Revision 3 – August 2005, Cycle 14 COLR Update to remove the requirement to withdraw the APSRs (Ref. EC 59637) and add Mode 6 refueling boron concentration.