ENCLOSURE 3 CONTAINS PROPRIETARY INFORMATION WITHHOLD FROM PUBLIC DISCLOSURE IN ACCORDANCE WITH 10 CFR 2.390(b)(4)

Xcel Energy®

Monticello Nuclear Generating Plant
2807 W County Road 75
Monticello, MN 55362

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L-MT-17-051
Technical Specification 5.6.3

U. S. Nuclear Regulatory Commission
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Monticello Nuclear Generating Plant
Docket No. 50-263
Renewed Facility Operating License No. DPR-22

Submittal of Core Operating Limits Report (NAD-MN-042, Revision 2) for Cycle 29

Northern States Power Company – Minnesota (NSPM), a Minnesota corporation, doing business as Xcel Energy, is providing in accordance with Technical Specification (TS) 5.6.3, "Core Operating Limits Report (COLR)," a revised COLR for the Monticello Nuclear Generating Plant (MNGP). The COLR provides the cycle-specific values of the limits established using U.S. Nuclear Regulatory Commission (NRC) approved methodologies such that the applicable limits of the plant safety analysis are met.

Enclosure 1 provides a non-proprietary version of the MNGP COLR for Cycle 29 (NAD-MN-042NP, Revision 2). The proprietary version of the COLR contains information of the type that Global Nuclear Fuel – Americas, LLC (GNF-A) maintains in confidence and withholds from public disclosure. Enclosure 2 provides an executed affidavit from GNF-A. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the NRC and addresses with specificity the considerations listed in 10 CFR 2.390(b)(4), Enclosure 3 provides the proprietary version of the COLR for Cycle 29 (NAD-MN-042P, Revision 2).

GNF-A, as the owner of the proprietary information, executed the enclosed affidavit, which identifies that the enclosed proprietary information has been handled and classified as proprietary, is customarily held in confidence, and has been withheld from public disclosure. The proprietary information was provided to MNGP in a GNF-A transmittal that is referenced by the affidavit. The proprietary information has been faithfully reproduced in the enclosed documentation such that the affidavit remains applicable. GNF-A hereby requests that the enclosed proprietary information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 10 CFR 9.17.

Summary of Commitments

This letter proposes no new commitments and does not revise any existing commitments.

Should you have questions regarding this letter, please contact Mr. Richard Loeffler at (763) 295-1247.

Peter A. Gardner
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Enclosures (3)

cc: Administrator, Region III, USNRC
Project Manager, Monticello, USNRC
Resident Inspector, Monticello, USNRC
Minnesota Department of Commerce (without Enclosure 3)

ENCLOSURE 1

MONTICELLO NUCLEAR GENERATING PLANT

CYCLE 29

CORE OPERATING LIMITS REPORT

NON-PROPRIETARY

NAD-MN-042NP

REVISION 2

(52 pages follow)

Xcel Energy®

Monticello Nuclear Generating Plant

Cycle 29

Non-Proprietary

Core Operating Limits Report

NAD-MN-042NP

Revision 2

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Information Notice

This is a non-proprietary version of the Monticello Nuclear Generating Plant Cycle 29 COLR, NAD-MN-042, Revision 2, which has proprietary information removed. Portions of the document that have been removed are indicated by white space inside open and closed brackets as shown here [[ ]].

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1.0 Core Operating Limits Report (COLR)

This Core Operating Limits Report for Monticello Nuclear Generating Plant (MNGP) Cycle 29 is prepared in accordance with the requirements of Technical Specification 5.6.3. The core operating limits are developed using NRC-approved methodology as listed in Section 7 of this COLR and are established such that all applicable thermal limits of the plant safety analysis are met. With respect to Technical Specification 2.1.1, the analysis methods for Cycle 29 are "AREVA Methods."

A 0.03 penalty will be applied when the ratio of core power to core flow is ≥ 42 MWt / Mlbm/hr in the EFW region. The 0.03 penalty is not applied when MNGP is operating in the Maximum Extended Load Line Limit (MELLLA) region or operating in the EFW region where the ratio of core power to core flow is < 42 MWt / Mlbm/hr. The OLMCPRs in Section 5 of this COLR were selected to ensure that the MCPR SLs of Tech Spec SL 2.1 are not violated..

This report includes the Enhanced Option III (EO-III) long term stability solution, which is required to operate in the Extended Flow Window (EFW) (i.e., MELLLA+) region of the Power-flow map.

This report includes using COTRANSA2 (Reference 10.0), XCOBRA (Reference 11.0), XCOBRA-T (Reference 12.0) and CASMO-4/MICROBURN-B2 (Reference 13.0) as described in the AREVA THERMEX methodology report (Reference 11.0) and neutronics methodology report (Reference 14.0).

2.0 References

1.0 General Electric Standard Application for Reactor Fuel (GESTAR-II), NEDE-24011-P-A-20, December 2013

2.0 Monticello Reload Safety Analysis Report for Cycle 29, ANP-3563P, Revision 2, April 2017

3.0 GE14 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR II), NEDC-32868P, Revision 5, MFN 13-028, May 2013.

4.0 Deleted.

5.0 Enhanced Option III Long Term Stability Solution, ANP-10262PA, Revision 0, May 2008.

6.0 Calculation CA-08-051, Rev 0, Instrument Setpoint Calculation - Rod Block Monitor (RBM) PRNM Setpoints for CLTP and EPU Operation (EC 10856).

7.0 GE BWR Licensing Report, Average Power Range Monitor, Rod Block Monitor, and Technical Specification Improvement (ARTS) Program for Monticello Nuclear Generation Plant, NEDC-30492-P, Section 4, April 1984.

8.0 Deleted.

9.0 Letter from D. Musolf (NSP) to Director, Office of Nuclear Reactor Regulation, NRC "Revision 1 to License Amendment Request Dated September 7, 1976, Single Loop Operation" dated July 2, 1982.

10.0 ANF-913(P)(A) Volume 1 Revision 1 and Volume 1 Supplements 2, 3 and 4, *COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses*, Advanced Nuclear Fuels Corporation, August 1990.

11.0 XN-NF-80-19(P)(A) Volume 3 Revision 2, *Exxon Nuclear Methodology for Boiling Water Reactors, THERMEX: Thermal Limits Methodology Summary Description*, Exxon Nuclear Company, January 1987.

12.0 XN-NF-84-105(P)(A) Volume 1 and Volume 1 Supplements 1 and 2, *XCOBRA-T: A Computer Code for BWR Transient Thermal-Hydraulic Core Analysis,* Exxon Nuclear Company, February 1987.

13.0 EMF-2158(P)(A) Revision 0, *Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2,* Siemens Power Corporation, October 1999.

14.0 XN-NF-80-19(P)(A) Volume 1 and Supplements 1 and 2, *Exxon Nuclear Methodology for Boiling Water Reactors - Neutronic Methods for Design and Analysis*, Exxon Nuclear Company, March 1983.

15.0 Reactor Long-Term Stability Solution Option III: Licensing Basis Hot Channel Oscillation Magnitude for Monticello Nuclear Generating Plant, GHNE-0000-0073-4167-R2, December 2007.

16.0 Calculation 14-049, Revision 1, Instrument Setpoint Calculation, Average Power Rand Monitor NUMAC PRNM Setpoints – Extended Flow Window Stability (EC18508), March 9, 2017.

17.0 Monticello LOCA MAPLHGR Limits for EPU/EFW with ATRIUM 10XM Fuel and Revised ECCS Parameters, ANP-3558P Revision 0, January 2017.

18.0 Monticello Cycle 29 Fuel Cycle Design, ANP-3521 Revision 0, September 2016.

19.0 Monticello Fuel Transition Cycle 28 Reload Licensing Analysis (EPU/MELLLA), ANP-3213(P) Revision 1, June 2013.

20.0 Monticello Licensing Analysis For EFW (EPU/MELLLA+), ANP-3295P Revision 3, February 2016.

21.0 Supplemental Reload Licensing Report for Monticello Reload 27 Cycle 28, 002N3952-R0, Revision 0, March 2015.

22.0 Monticello Nuclear Generating Plant Cycle 28 Proprietary Core Operation Limits Report, NAD-MN-037P, Revision 0, May 2015.

3.0 Rod Block Monitor Operability Requirements

The Rod Withdrawal Error (RWE) analysis (Reference 2.0) validated that the following MCPR values provide the required margin for full withdrawal of any control rod during Monticello Cycle 29:

Note that the RBM is not credited below 30% power as identified below in Section 4.0.

For Power ≥ 27% and < 90%: MCPR ≥ 2.20 (for TLO)

For Power ≥ 27% and < 90%: MCPR ≥ 2.25 (for SLO)

For Power ≥ 90%: MCPR ≥ 1.83 (for TLO)

When the core power is greater than or equal to 27% and less than 90% of rated in two-loop operation and the MCPR is less than 2.20, then a limiting control rod pattern exists and the Rod Block Monitor is required to be operable.

When the core power is greater than or equal to 27% in single loop operation and the MCPR is less than 2.25, then a limiting control rod pattern exists and the Rod Block Monitor is required to be operable when in two-loop operation.

When the core power is greater than or equal to 90% and the MCPR is less than 1.83, then a limiting control rod pattern exists and the Rod Block Monitor is required to be operable.

Reference: Technical Specification Table 3.3.2.1-1 Function 1.

4.0 Rod Block Monitor Upscale Trip Setpoint

Technical Specification Trip Setpoints and Allowable Values

Function		Trip Setpoint	Allowable Values
Low Power Range – Upscale	(a)	≤ 121.2/125 of full scale	≤ 121.6/125 of full scale
Intermediate Power Range – Upscale	(b)	≤ 116.2/125 of full scale	≤ 116.6/125 of full scale
High Power Range – Upscale	(c), (d)	≤ 111.2/125 of full scale	≤ 111.6/125 of full scale

Applicable Thermal Power

(a) Thermal Power ≥ 30% and < 65% RTP and MCPR is below the limit specified in Section 3.0.
(b) Thermal Power ≥ 65% and < 85% RTP and MCPR is below the limit specified in Section 3.0.
(c) Thermal Power ≥ 85% and < 90% RTP and MCPR is below the limit specified in Section 3.0.
(d) Thermal Power ≥ 90% RTP and MCPR is below the limit specified in Section 3.0.

Reference: Technical Specification Table 3.3.2.1-1 Functions 1.a, 1.b, and 1.c. The Reference for the "**Trip Setpoints**" and "**Allowable Values**" is Reference 6.0.

5.0 Minimum Critical Power Ratio (MCPR)

5.1 Tech. Spec. Scram Speed (TSSS)

The Operating Limit Minimum Critical Power Ratio (OLMCPR) for TSSS does not account for scram speeds that are faster than those required by Technical Specifications.

5.1.1 TSSS OLMCPR for Two Recirculation Loop Operation

The TSSS OLMCPR shall be determined for two recirculation loop operation as follows:

For ATRIUM 10XM fuel:
If core thermal power (P) is ≥ 40% of rated core thermal power, then the TSSS OLMCPR for all fuel types is the greater of {MCPR(P) from Figure 3} or {MCPR(F) from Figure 7}, where 1.67 is the TSSS OLMCPR at rated (100%) core thermal power reported in Table 2.

> i.e. if P ≥ 40% rated core thermal power,
> then TSSS OLMCPR limit
> = Maximum of {MCPR(P) from Figure 3} or {MCPR(F) from Figure 7}.

For GE14 fuel:
If core thermal power (P) is ≥ 40% of rated core thermal power, then the TSSS OLMCPR for all fuel types is the greater of {MCPR(P) from Figure 3} or {MCPR(F) from Figure 7}, where 1.65 is the TSSS OLMCPR at rated (100%) core thermal power reported in Table 2.

> i.e. if P ≥ 40% rated core thermal power,
> then TSSS OLMCPR limit
> = Maximum of {MCPR(P) from Figure 3} or {MCPR(F) from Figure 7}.

If core thermal power (P) is < 40% of rated core thermal power, the TSSS OLMCPR for all fuel types is obtained from Figure 3.

Reference: Technical Specification Section 3.2.2.

5.1.2 TSSS OLMCPR for Single Recirculation Loop Operation

The TSSS OLMCPR shall be determined for single recirculation loop operation as follows:

For ATRIUM 10XM fuel:
If core thermal power (P) is ≥ 40% of rated core thermal power, then the TSSS OLMCPR for all fuel types is the greater of {MCPR(P) from Figure 13} or {MCPR(F) from Figure 7}.

> i.e. if P ≥ 40% rated core thermal power,
> then TSSS OLMCPR limit
> = Maximum of {MCPR(P) from Figure 13} or {MCPR(F) from Figure 7}.

For GE14 fuel:
If core thermal power (P) is ≥ 40% of rated core thermal power, then the TSSS OLMCPR for all fuel types is the greater of {MCPR(P) from Figure 13} or {MCPR(F) from Figure 7.

i.e. if P ≥ 40% rated core thermal power,
then TSSS OLMCPR limit
= Maximum of {MCPR(P) from Figure 13} or {MCPR(F) from Figure 7}.

If core thermal power (P) is < 40% of rated core thermal power, the TSSS OLMCPR for all fuel types is obtained from Figure 13.

Reference: Technical Specification Section 3.2.2.

5.2 Nominal Scram Speed (NSS)

The OLMCPR for NSS does take into account the measured scram speeds that are faster than the Technical Specification requirements, thus reducing the potential consequences of a limiting transient. The NSS OLMCPR value is determined in a similar manner to the TSSS OLMCPR.

5.2.1 NSS OLMCPR for Two Recirculation Loop Operation

The NSS OLMCPR shall be determined for two recirculation loop operation as follows:

For ATRIUM 10XM fuel:
If core thermal power (P) is ≥ 40% of rated core thermal power, then the NSS OLMCPR for all fuel types is the <u>greater</u> of {MCPR(P) from Figure 4 (E≤12900 MWd/MTU) or Figure 6 (E > 12900 MWd/MTU)} or {MCPR(F) from Figure 7}.

If more margin is needed and the exposure is between 12900 MWd/MTU and before EOFP, Figure 5 may be used in place of Figure 6.

i.e. if P ≥ 40% rated core thermal power
and the cycle exposure is ≤ 12900 MWd/MTU,
then the NSS OLMCPR limit
= Maximum of {MCPR(P) from Figure 4} or {MCPR(F) from Figure 7}.

and. if P ≥ 40% rated core thermal power
and the cycle exposure is > 12900 MWd/MTU,
then the NSS OLMCPR limit
= Maximum of {MCPR(P) from Figure 6} or {MCPR(F) from Figure 7}.

and. if P ≥ 40% rated core thermal power
and more MCPR margin is needed
and the cycle exposure is > 12900 MWd/MTU but before EOFP,
then the NSS OLMCPR limit
= Maximum of {MCPR(P) from Figure 5} or {MCPR(F) from Figure 7}.

For GE14 fuel:
If core thermal power (P) is ≥ 40% of rated core thermal power, then the NSS OLMCPR for all fuel types is the <u>greater</u> of {MCPR(P) from Figure 4 (E≤ 12900 MWd/MTU) or Figure 6 (E>12900)} or {MCPR(F) from Figure 7}, where the value of the NSS OLMCPR at rated (100%) core thermal power is taken from Table 2 based on the cycle exposure.

i.e. if P ≥ 40% rated core thermal power and the cycle exposure is ≤ 12900 MWd/MTU,
then the NSS OLMCPR limit
= Maximum of {MCPR(P) from Figure 4} or {MCPR(F) from Figure 7}.

and. if P $\geq$ 40% rated core thermal power and the cycle exposure is > 12900 MWd/MTU,
then the NSS OLMCPR limit
= Maximum of {MCPR(P) from Figure 6} or {MCPR(F) from Figure 7}.

If core thermal power (P) is < 40% of rated core thermal power, the NSS OLMCPR for all fuel types is obtained from Figure 3.

Reference: Technical Specification 3.2.2.

5.2.2 NSS OLMCPR for Single Recirculation Loop Operation

The NSS OLMCPR is the same as the TSSS OLMCPR defined above in Section 5.1.2.

Reference: Technical Specification 3.2.2.

5.3 Technical Specification Scram Time Dependence

Technical Specification 3.1.4 and Table 3.1.4-1 provide the scram insertion time versus position requirements for continued operations. Technical Specification Surveillance Requirements SR 3.1.4.1 – SR 3.1.4.4 provide the surveillance requirements for the CRDs. Data from testing of the CRDs, or from an unplanned scram, is summarized in Surveillance Test 0081.

Using this cycle specific information, values of τ^{P}_{ave} can be calculated in accordance with the equation below for each notch position (P = 46, 36, 26, and 06).

The Equation (1) used to calculate the average of the current scram times for the cycle is:

$$\tau^{P}_{ave} = \frac{\sum_{i=1}^{N} \tau^{P}_{i}}{N} \qquad (1)$$

where:

τ^{P}_{i} =	the scram time to notch position P for control rod i from its most recent surveillance test;
N =	The number of operable control rods (N $\leq$ 121).
P =	The notch position (P = 46, 36, 26, and 06)
$\sum_{i=1}^{N} \tau^{P}_{i}$ =	sum of the most recent scram times for all operable control rods (N) measured to notch position P to comply with the Technical Specification surveillance requirements SR 3.1.4.1, SR 3.1.4.2, SR 3.1.4.3, SR 3.1.4.4.

The average scram time for notch position (P), τ^{P}_{ave} is tested against the Nominal Scram Speed for that notch position (NSS^{P}) using the following equation:

$$\tau^{P}_{ave} \leq NSS^{P} \qquad (2)$$

where:

NSS^P is the Nominal Scram Speed for the specified CRD Notch Position (P) from Table 1.

Table 1
NSS Scram Insertion Time to CRD Notch Position

Notch Position (P)	NSS^P (sec)
46	0.304
36	0.820
26	1.355
06	2.477

If the average scram time satisfies the Equation 2 criteria for each notch position, continued plant operation under the NSS operating limit minimum critical power ratio (OLMCPR) for pressurization events is permitted. If the average scram time fails the Equation 2 criteria for any notch position, the TSSS OLMCPR must be used for pressurization events.

No interpolation between NSS and TSSS operating limits is allowed.

Note that TSSS has an OLMCPR applicable to two recirculation loop operation, and an OLMCPR applicable to single recirculation loop operation. The NSS OLMCPR value for single recirculation loop operation is the same as the TSSS OLMCPR value for single recirculation loop operation.

Table 2
Cycle OLMCPR Values

	TSSS		NSS	
Range of Applicability	**AREVA 10XM**	**GE14**	**AREVA 10XM**	**GE14**
BOC to 12900 MWd/MTU	**1.67**	**1.65**	**1.60**	**1.60**
BOC to EOFP	**1.67**	**1.65**	**1.62**	**1.60**
BOC to Coastdown	**1.67**	**1.65**	**1.63**	**1.60**

All the OLMCPR values reported in Table 2 are for two recirculation loop operation.

5.4 Pressure Regulator Out of Service (PROOS) Operation

This section provides power dependent MCPR limits when a backup pressure regulator is not operational (also called PROOS).

A Pressure Regulator Fails Down-Scale (PRFDS) event without backup pressure regulator was evaluated for Monticello (Reference 19.0). This event resulted in a more restrictive Power Dependent MCPR limit than required for normal reduced power operation with both pressure regulators operational. The off-rated flow dependent limits have been generated for Cycle 29 (Reference 2.0). Figure 9 provides the required more restrictive power dependent MCPR ARTS limits. The ARTS limits are described in Reference 7.0. The new Pressure Regulator Out of Service limits are applicable for Cycle 29 (Reference 2.0).

Note that for GE14 fuel with powers below 40% the power dependent MCPR ARTS limits provided in Figure 3 are still valid.

Figure 9 combines the unchanged limits from Figure 3 along with the more restrictive limits determined in Reference 2.0 for PROOS operation. Figure 9 should only be used for operation without a backup pressure regulator. Figure 9 is valid for both TSSS and NSS OLMCPR limits.

An interim MFLCPR Limit is provided in Figure 10. This limit should only be used if the Gardel thermal limit input has not been modified as described in Section 5.4.1 or Section 5.4.2 to account for pressure regulator out of service operation. That is, only Figure 9 or Figure 10 should be used to provide the appropriate PROOS limit. These figures should not be utilized in combination.

5.4.1 OLMCPR for Two Recirculation Loop Operation, WITHOUT A BACKUP PRESSURE REGULATOR.

The TSSS OLMCPR or NSS OLMCPR shall be determined for two recirculation loop operation as follows:

For ATRIUM 10XM fuel:
If core thermal power (P) is ≥ 40% of rated core thermal power, then the TSSS OLMCPR or NSS OLMCPR for all fuel types is the greater of {MCPR(P) from Figure 9} or {MCPR(F) from Figure 7}.

> i.e. if P ≥ 40% rated core thermal power,
> then PROOS TSSS/NSS OLMCPR limit
> = Maximum of {MCPR(P) from Figure 9} or {MCPR(F) from Figure 7}.

For GE14 fuel:
If core thermal power (P) is ≥ 40% of rated core thermal power, then the TSSS OLMCPR or NSS OLMCPR for all fuel types is the greater of {MCPR(P) from Figure 9} or {MCPR(F) from Figure 7.

> i.e. if P ≥ 40% rated core thermal power,
> then PROOS TSSS/NSS OLMCPR limit
> = Maximum of {MCPR(P) from Figure 9} or {MCPR(F) from Figure 7}.

If core thermal power (P) is < 40% of rated core thermal power, the TSSS OLMCPR for all fuel types is obtained from Figure 9.

5.4.2 OLMCPR for Single Recirculation Loop Operation, WITHOUT A BACKUP PRESSURE REGULATOR

The TSSS OLMCPR as defined previously for single recirculation loop operation in Section 5.1.2 is the same OLMCPR to be used for single recirculation loop operation for PROOS.

6.0 Power-Flow Map

The Power-Flow Operating Map based on analysis to support Cycle 29 is shown in Figure 8. The Power-Flow Operating Map is consistent with a rated power of 2004 MWt as described in Reference 20.0. The Backup Stability Protection (BSP) lines are described in Section 9.0 of this report.

Region I in Figure 8 is the Scram Region and Region II is the Controlled Entry Region. These two regions are applicable when the OPRM Upscale Trip is INOPERABLE.

7.0 Approved Analytical Methods

NEDE-24011-P-A	Rev. 20	"General Electric Standard Application for Reactor Fuel (GESTAR)"
NEDE-24011-P-A-US	Rev. 20	"General Electric Standard Application for Reactor Fuel (GESTAR) – Supplement for the United States."
XN-NF-81-58(P)(A)	Rev. 2 and Supplements 1 and 2,	"RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model," March 1984
EMF-85-74(P)	Rev. 0 Supplement 1(P)(A) and Supplement 2(P)(A),	"RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model," February 1998
ANF-89-98(P)(A)	Rev. 1 and Supplement 1,	"Generic Mechanical Design Criteria for BWR Fuel Designs," May 1995
XN-NF-80-19(P)(A)	Volume 1 and Supplements 1 and 2,	"Exxon Nuclear Methodology for Boiling Water Reactors - Neutronic Methods for Design and Analysis," March 1983
XN-NF-80-19(P)(A)	Volume 4 Rev. 1,	"Exxon Nuclear Methodology for Boiling Water Reactors: Application of the ENC Methodology to BWR Reloads," June 1986
EMF-2158(P)(A)	Rev. 0	"Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2," October 1999.
XN-NF-80-19(P)(A)	Volume 3 Rev. 2,	"Exxon Nuclear Methodology for Boiling Water Reactors, THERMEX: Thermal Limits Methodology Summary Description," January 1987
XN-NF-84-105(P)(A)	Volume 1 and Volume 1 Supplements 1 and 2,	"XCOBRA-T: A Computer Code for BWR Transient Thermal-Hydraulic Core Analysis," February 1987
ANF-913(P)(A)	Volume 1 Rev. 1 and Volume 1 Supplements 2, 3, and 4,	"COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses," August 1990
EMF-2209(P)(A)	Rev. 3	"SPCB Critical Power Correlation," September 2009
EMF-2245(P)(A)	Rev. 0	"Application of Siemens Power Corporation's Critical Power Correlations to Co-Resident Fuel," August 2000
EMF-2361(P)(A)	Rev. 0	"EXEM BWR-2000 ECCS Evaluation Model," May 2001
EMF-2292(P)(A)	Rev. 0	"ATRIUM™-10: Appendix K Spray Heat Transfer Coefficients," September 2000
EMF-CC-074(P)(A)	Volume 4 Rev. 0,	"BWR Stability Analysis: Assessment of STAIF with Input from MICROBURN-B2," August 2000
BAW-10247P-A	Rev. 0	"Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors," February 2008
ANP-10298P-A	Rev. 1	"ACE/ATRIUM 10XM Critical Power Correlation," March 2014
ANP-10307P-A	Rev. 0	"AREVA MCPR Safety Limit Methodology for Boiling Water Reactors," June 2011
BAW-10255P-A	Rev. 2	"Cycle-Specific DIVOM Methodology Using the RAMONA5-FA Code," May 2008
ANP-10262PA	Rev. 0	"Enhanced Option III Long Term Stability Analysis," May 2008

8.0 Fuel Rod Heat Generation Rate

8.1 Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) as a Function of Exposure

The MAPLHGR limits in Table 3 through Table 13 are conservative values bounding all fuel lattice types (all natural uranium lattices are excluded) in a given fuel bundle design, and are intended only for use in hand calculations as described below to establish MAPLHGR limits for Technical Specification 3.2.1. No channel bow effects are included in the bounding MAPLHGR values in these tables as there are no reused channels.

MAPLHGR limits for the ATRIUM 10XM fuel and for each individual GE14 fuel lattice for a given bundle design as a function of axial location and average planar exposure are determined based on the approved methodology referenced in Monticello Technical Specification 5.6.3.b and are loaded into the process computer for use in core monitoring calculations.

When and if hand calculations are required:

8.1.1 Two-Recirculation Loop Operation (MAPLHGR)

At rated core thermal power and core flow conditions, the MAPLHGR value for each fuel bundle design as a function of average planar exposure shall not exceed the bounding limits provided in Table 3 through Table 13.

The MAPLHGR limit for two recirculation loop operation is determined as follows:

For ATRIUM 10XM fuel:
The ATRIUM 10XM MAPLHGR limits are not adjusted for off-rated core thermal power conditions or for off-rated core flow conditions.

A10XM MAPLHGR (TS) Limit = ATRIUM 10XM MAPLHGR from Table 3.

For GE14 fuel:
The GE14 MAPLHGR limit is adjusted for off-rated core flow conditions by determining the following:

GE14 MAPLHGR(P) = MAPFAC(P) * MAPLHGR limit from Table 4 through Table 13.
GE14 MAPLHGR(F) = MAPFAC(F) * MAPLHGR limit from Table 4 through Table 13.

where MAPFAC(P) and MAPFAC(F) are determined from Figure 14 and Figure 15, respectively, and where P is the core thermal power in percent of rated and F is the core flow in percent of rated.

Note that the MAPFACs are always ≤ 1.0, so GE14 MAPLHGR is always less than or equal to the MAPLHGR limit from the table.

GE14 MAPLHGR (TS) Limit = Minimum{ GE14 MAPLHGR(P), GE14 MAPLHGR(F)}

Note that all natural uranium lattices are excluded in Table 3 through Table 13. Straight line interpolation between nearest data points is permitted only within each individual Table of Table 3 through Table 13.

8.1.2 Single Recirculation Loop Operation (MAPLHGR)

Note that Single Loop Operation is not permitted in the EFW region.

When in single recirculation loop operation, perform the following:

8.1.2.1 Perform the action specified in Section 8.1.1 above.

8.1.2.2 Separately, apply the single loop operation multiplier to the limiting values of MAPLHGR from Table 3 through Table 13 as follows:

for ATRIUM 10XM: the SLO multiplier is 0.70, and

for GE14C: the SLO multiplier is 0.83.

8.1.2.3 Select the more limiting (i.e. smaller) value from Section 8.1.2.1 or Section 8.1.2.2.

Reference: Technical Specification 3.2.1.

8.1.3 Pressure Regulator Out of Service (PROOS) Operation

MAPLHGR and LHGR limits with Pressure Regulator Out of Service are addressed in Section 8.3.

8.2 Linear Heat Generation Rate (LHGR)

For ATRIUM 10XM fuel, the LHGR limits provided in Table 14 are applicable to all ATRIUM 10XM fuel in Cycle 29. The LHGR limits are provided as a function of fuel rod peak pellet exposure. The LHGR limits are fuel rod nodal limits, and are to be applied at every node of the fuel rod including the natural uranium lattices.

For GE14 fuel, the uranium dioxide (UO_2) and gadolinia LHGR limits provided in Table 15 are applicable to all GE14 fuel lattice types in Cycle 29. The uranium dioxide (UO_2) and gadolinia LHGR limits are provided as a function of fuel rod peak pellet exposure. The gadolinia LHGR limits in Table 15 are conservative values which bound the gadolinia LHGR limits for all the gadolinia concentrations occurring in each of the bundle types used in Cycle 29. The LHGR limits are fuel rod nodal limits, and are to be applied at every node of the fuel rod including the natural uranium lattices.

The individual LHGR limits for the uranium dioxide and gadolinia fuel rods in each fuel bundle type used in Cycle 29, as a function of axial location and pellet exposure are determined based on the approved methodology referenced in Monticello Technical Specification 5.6.3.b and are loaded into the process computer for use in core monitoring calculations.

The LHGR limits are presented in this report for use when and if hand calculations are performed to demonstrate compliance with Technical Specification 3.2.3.

When and if hand calculations are performed:

8.2.1 Two-Recirculation Loop Operation (LHGR)

At rated core thermal power and core flow conditions, the LHGR limit for each fuel bundle design as a function of peak pellet exposure and fuel pin type shall not exceed the bounding limits provided in Table 14 and Table 15.

The LHGR limit is adjusted for off-rated core thermal power and core flow conditions by determining the following:

For ATRIUM 10XM fuel:
A10XM LHGR(P) = LHGRFAC(P) * LHGR limit from Table 14.
A10XM LHGR(F) = LHGRFAC(F) * LHGR limit from Table 14.

where the multipliers LHGRFAC(P) and LHGRFAC(F) are determined from Figure 1 and Figure 2, respectively, and where P is the core thermal power in percent of rated, and F is the core flow in percent of rated.

The Technical Specification (TS) LHGR limit for ATRIUM 10XM fuel is determined as follows:
A10XM LHGR TS Limit = Minimum{ A10XM LHGR(P), A10XM LHGR(F)}

For GE14 fuel:
GE14 LHGR(P) = LHGRFAC(P) * LHGR limit from Table 15.
GE14 LHGR(F) = LHGRFAC(F) * LHGR limit from Table 15.

where the multipliers LHGRFAC(P) and LHGRFAC(F) are determined from Figure 1 and Figure 2, respectively, and where P is the core thermal power in percent of rated, and F is the core flow in percent of rated.

The Technical Specification (TS) LHGR limit for GE14 fuels determined as follows:
GE14 LHGR TS Limit = Minimum{ GE14 LHGR(P), GE14 LHGR(F)}

Note that the LHGR limits are fuel rod nodal limits, and are to be applied at every node of the fuel rod, including the natural uranium lattices. Straight line interpolation between nearest data points is permitted within Table 14 or within Table 15. For Table 15, interpolation is permitted for UO2 or for Gadolinia, but not between UO2 and Gadolinia.

8.2.2 Single Recirculation Loop Operation (LHGR)

Note that Single Loop Operation is not permitted in the EFW region.

When in single recirculation loop operation, perform the following:

8.2.2.1 Perform the same action specified in Section 8.2.1 above. There are no separate single loop operation specific multipliers applicable to LHGR, i.e. the multipliers from Section 8.2.1 also apply to single recirculation loop operation.

Reference: Technical Specification Section 3.2.3.

8.2.3 Pressure Regulator Out of Service (PROOS) Operation

MAPLHGR and LHGR limits with Pressure Regulator Out of Service are addressed in Section 8.3.

8.3 Pressure Regulator Out of Service (PROOS) Operation

This section provides power dependent MAPLHGR and LHGR limits when a backup pressure regulator is not operational (also called PROOS).

The Pressure Regulator Fails Down-Scale (PRFDS) event without backup pressure regulator evaluated for Monticello in Reference 19.0 resulted in more restrictive power dependent LHGR limits than required for normal reduced power operation with both pressure regulators operational. When this event was evaluated for Cycle 29 (Reference 2.0), the results showed the LHGR limits with PROOS are more limiting than the base case.

The MAPLHGR and LHGR limits are adjusted for off-rated core thermal power and core flow conditions by determining the following:

For ATRIUM 10XM fuel
A10XM LHGR(P) = LHGRFAC(P) * LHGR limit from Table 14.
A10XM MAPLHGR (TS) Limit = MAPLHGR from Table 3 (note that there are no power-dependent MAPLHGR limits for ATRIUM 10XM fuel.)

where LHGRFAC(P) is determined from Figure 11 and where P is the core thermal power in percent of rated.

Note that the LHGRFAC(F) value for PROOS is the same as the non-PROOS value determined in Section 8.2.1.

The Technical Specification (TS) MAPLHGR and LHGR limits for ATRIUM 10XM fuel with PROOS are determined as follows:

ATRIUM 10XM MAPLHGR (TS) Limit = MAPLHGR from Table 3
ATRIUM 10XM LHGR (TS) Limit = Minimum{LHGR(P), LHGR(F)}

For GE14 Fuel:
LHGR(P) = LHGRFAC(P) * LHGR limit from Table 15.
MAPLHGR(P) = MAPFAC(P) * MAPLHGR limit from Table 4 through Table 13.

where LHGRFAC(P) is determined from Figure 11, MAPFAC(P) is determined from Figure 16 and where P is the core thermal power in percent of rated.

Note that the LHGRFAC(F) value for PROOS is the same as the non-PROOS value determined in Section 8.2.1.

The Technical Specification (TS) MAPLHGR and LHGR limits are GE14 fuel with PROOS are determined as follows:

GE14 MAPLHGR (TS) Limit = Minimum{MAPLHGR(P), MAPLHGR(F)}
GE14 LHGR (TS) Limit = Minimum{LHGR(P), LHGR(F)}

Figure 12 combines the unchanged limits from Figure 11 along with the more restrictive limits determined in Reference 2.0 for PROOS operation. Figure 12 should only be used for operation without a backup pressure regulator.

Interim MFLPD Limits are provided in Figure 12 to address the more restrictive LHGR Limits identified in the Reference 2.0 analysis. These limits should only be used if the Gardel thermal limit input has <u>not</u> been modified to account for PROOS operation. That is, only Figure 11 or Figure 12 should be used to provide the appropriate PROOS LHGR limit. Figure 11 should not be utilized in combination with Figure 12.

Interim MAPRAT Limits are provided in Figure 17 to address the more restrictive MAPLHGR Limits identified in the Reference 21.0 analysis. These limits should only be used if the Gardel thermal limit input has <u>not</u> been modified to account for PROOS operation. That is, only Figure 16 or Figure 17 should be used to provide the appropriate PROOS MAPLHGR limit. Figure 16 should not be utilized in combination with Figure 17.

Table 3
MAPLHGR Limits, ATRIUM 10XM

GE14-P10DNAB392-16GZ-100T-145-T6-2931

Average Planar Exposure GWD/MTU (GWD/STU)	**MAPLHGR Limit (kW/ft)[(1)(2)]**
0.00 (0.00)	12.5
20.00 (18.14)	12.5
67.00 (60.78)	7.6

Notes:
(1) Values in Table 3 are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) MAPLHGR Data, Reference 17.0.

Table 4
MAPLHGR Limits , GE14C EDB-3375

GE14-P10DNAB373-16GZ-100T-145-T6-3375 (2)

Average Planar Exposure GWD/MTU (GWD/STU)	MAPLHGR Limit (kW/ft)(1)(3)
0.00 (0.00)	8.31
0.22 (0.20)	8.37
1.10 (1.00)	8.44
2.20 (2.00)	8.51
3.31 (3.00)	8.58
4.41 (4.00)	8.64
5.51 (5.00)	8.71
6.61 (6.00)	8.78
7.72 (7.00)	8.85
8.82 (8.00)	8.93
9.92 (9.00)	9.03
11.02 (10.00)	9.14
12.13 (11.00)	9.25
13.23 (12.00)	9.33
14.33 (13.00)	9.41
15.43 (14.00)	9.48
16.53 (15.00)	9.54
17.64 (16.00)	9.60
18.74 (17.00)	9.64
19.84 (18.00)	9.68
20.94 (19.00)	9.64
22.05 (20.00)	9.60
23.15 (21.00)	9.56
24.25 (22.00)	9.51
25.35 (23.00)	9.46
26.46 (24.00)	9.41
27.56 (25.00)	9.36
33.07 (30.00)	9.12
38.58 (35.00)	8.90
38.85 (35.24)	8.87
44.09 (40.00)	8.38
49.60 (45.00)	7.84
55.12 (50.00)	6.89
55.50 (50.35)	6.77
60.63 (55.00)	5.22
61.77 (56.04)	4.86
61.83 (56.09)	4.86
63.07 (57.22)	4.85
63.11 (57.25)	4.84

Notes:
(1) Values in Table 4 are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) Engineering Data Bank (EDB) number, Reference 21.0.
(3) MAPLHGR Data, Reference 21.0.

Table 5
MAPLHGR Limits, GE14C EDB-3377

GE14-P10DNAB391-15GZ-100T-145-T6-3377 [2]

Average Planar Exposure GWD/MTU (GWD/STU)	MAPLHGR Limit (kW/ft)[1][3]
0.00 (0.00)	8.39
0.22 (0.20)	8.44
1.10 (1.00)	8.53
2.20 (2.00)	8.66
3.31 (3.00)	8.81
4.41 (4.00)	8.91
5.51 (5.00)	9.00
6.61 (6.00)	9.09
7.72 (7.00)	9.19
8.82 (8.00)	9.28
9.92 (9.00)	9.38
11.02 (10.00)	9.46
12.13 (11.00)	9.56
13.23 (12.00)	9.63
14.33 (13.00)	9.70
15.43 (14.00)	9.78
16.53 (15.00)	9.85
17.64 (16.00)	9.91
18.74 (17.00)	9.96
19.84 (18.00)	10.00
20.94 (19.00)	9.96
22.05 (20.00)	9.89
23.15 (21.00)	9.83
24.25 (22.00)	9.77
25.35 (23.00)	9.71
26.46 (24.00)	9.65
27.56 (25.00)	9.59
33.07 (30.00)	9.33
38.58 (35.00)	9.12
38.85 (35.24)	9.10
44.09 (40.00)	8.70
49.60 (45.00)	8.16
55.12 (50.00)	7.26
55.50 (50.35)	7.15
60.63 (55.00)	5.77
63.41 (57.53)	4.88
63.42 (57.53)	4.88
63.50 (57.61)	4.88
63.99 (58.05)	4.88
64.04 (58.09)	4.87

Notes:
(1) Values in Table 5 are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) Engineering Data Bank (EDB) number, Reference 21.0.
(3) MAPLHGR Data, Reference 21.0.

Table 6
MAPLHGR Limits, GE14C EDB-4175

GE14-P10DNAB372-17GZ-100T-145-T6-4175 [2]

Average Planar Exposure GWD/MTU (GWD/STU)	MAPLHGR Limit (kW/ft)[1][3]
0.00 (0.00)	8.34
0.22 (0.20)	8.38
1.10 (1.00)	8.45
2.20 (2.00)	8.54
3.31 (3.00)	8.65
4.41 (4.00)	8.76
5.51 (5.00)	8.87
6.61 (6.00)	8.99
7.72 (7.00)	9.12
8.82 (8.00)	9.25
9.92 (9.00)	9.39
11.02 (10.00)	9.51
12.13 (11.00)	9.63
13.23 (12.00)	9.70
14.33 (13.00)	9.75
15.43 (14.00)	9.81
16.53 (15.00)	9.88
17.64 (16.00)	9.83
18.74 (17.00)	9.78
19.84 (18.00)	9.74
20.94 (19.00)	9.71
22.05 (20.00)	9.66
23.15 (21.00)	9.61
25.35 (23.00)	9.50
26.46 (24.00)	9.45
27.56 (25.00)	9.41
33.07 (30.00)	9.19
38.58 (35.00)	9.01
38.85 (35.24)	8.99
44.09 (40.00)	8.54
49.60 (45.00)	8.04
55.12 (50.00)	7.19
55.50 (50.35)	7.09
60.63 (55.00)	5.77
63.44 (57.55)	4.88
63.50 (57.61)	4.88
63.70 (57.79)	4.87
64.88 (58.86)	4.87
65.11 (59.07)	4.87

Notes:
(1) Values in Table 6 are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) Engineering Data Bank (EDB) number, Reference 21.0.
(3) MAPLHGR Data, Reference 21.0.

Table 7
MAPLHGR Limits, GE14C EDB-4176

GE14-P10DNAB386-16GZ-100T-145-T6-4176 [(2)]

Average Planar Exposure GWD/MTU (GWD/STU)	MAPLHGR Limit (kW/ft)[(1)(3)]
0.00 (0.00)	8.48
0.22 (0.20)	8.52
1.10 (1.00)	8.58
2.20 (2.00)	8.66
3.31 (3.00)	8.74
4.41 (4.00)	8.82
5.51 (5.00)	8.90
6.61 (6.00)	8.98
7.72 (7.00)	9.06
8.82 (8.00)	9.15
9.92 (9.00)	9.24
11.02 (10.00)	9.33
12.13 (11.00)	9.43
13.23 (12.00)	9.48
14.33 (13.00)	9.54
15.43 (14.00)	9.61
16.53 (15.00)	9.68
17.64 (16.00)	9.75
18.74 (17.00)	9.81
19.84 (18.00)	9.86
20.94 (19.00)	9.89
22.05 (20.00)	9.88
23.15 (21.00)	9.84
24.25 (22.00)	9.78
25.35 (23.00)	9.73
26.46 (24.00)	9.68
27.56 (25.00)	9.63
33.07 (30.00)	9.39
38.58 (35.00)	9.14
38.85 (35.24)	9.12
44.09 (40.00)	8.69
49.60 (45.00)	8.12
55.12 (50.00)	7.22
55.50 (50.35)	7.11
60.63 (55.00)	5.62
62.89 (57.06)	4.89
63.16 (57.30)	4.89
63.50 (57.61)	4.89
64.67 (58.67)	4.89
65.28 (59.23)	4.89

Notes:
(1) Values in Table 7 are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) Engineering Data Bank (EDB) number, Reference 21.0.
(3) MAPLHGR Data, Reference 21.0.

Table 8
MAPLHGR Limits, GE14C EDB-4177

GE14-P10DNAB386-16GZ-100T-145-T6-4177 (2)

Average Planar Exposure GWD/MTU (GWD/STU)	MAPLHGR Limit (kW/ft)(1)(3)
0.00 (0.00)	8.50
0.22 (0.20)	8.54
1.10 (1.00)	8.60
2.20 (2.00)	8.68
3.31 (3.00)	8.76
4.41 (4.00)	8.84
5.51 (5.00)	8.93
6.61 (6.00)	9.02
7.72 (7.00)	9.11
8.82 (8.00)	9.20
9.92 (9.00)	9.30
11.02 (10.00)	9.39
12.13 (11.00)	9.48
13.23 (12.00)	9.54
14.33 (13.00)	9.59
15.43 (14.00)	9.64
16.53 (15.00)	9.70
17.64 (16.00)	9.76
18.74 (17.00)	9.82
19.84 (18.00)	9.86
20.94 (19.00)	9.89
22.05 (20.00)	9.84
23.15 (21.00)	9.79
24.25 (22.00)	9.75
25.35 (23.00)	9.70
26.46 (24.00)	9.66
27.56 (25.00)	9.62
33.07 (30.00)	9.39
38.58 (35.00)	9.14
38.85 (35.24)	9.12
44.09 (40.00)	8.69
49.60 (45.00)	8.12
55.12 (50.00)	7.23
55.50 (50.35)	7.12
60.63 (55.00)	5.65
63.02 (57.17)	4.88
63.12 (57.26)	4.88
63.50 (57.61)	4.88
64.64 (58.64)	4.88
65.26 (59.20)	4.88

Notes:
(1) Values in Table 8are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) Engineering Data Bank (EDB) number, Reference 21.0.
(3) MAPLHGR Data, Reference 21.0.

Table 9
MAPLHGR Limits, GE14C EDB-4178

GE14-P10DNAB389-11GZ-100T-145-T6-4178 [(2)]

Average Planar Exposure GWD/MTU (GWD/STU)	MAPLHGR Limit (kW/ft)[(1)(3)]
0.00 (0.00)	8.94
0.22 (0.20)	9.01
1.10 (1.00)	9.09
2.20 (2.00)	9.15
3.31 (3.00)	9.21
4.41 (4.00)	9.28
5.51 (5.00)	9.35
6.61 (6.00)	9.41
7.72 (7.00)	9.49
8.82 (8.00)	9.56
9.92 (9.00)	9.64
11.02 (10.00)	9.71
12.13 (11.00)	9.79
13.23 (12.00)	9.86
14.33 (13.00)	9.88
15.43 (14.00)	9.90
16.53 (15.00)	9.92
17.64 (16.00)	9.94
18.74 (17.00)	9.96
19.84 (18.00)	9.96
20.94 (19.00)	9.97
22.05 (20.00)	9.94
23.15 (21.00)	9.89
24.25 (22.00)	9.84
25.35 (23.00)	9.79
26.46 (24.00)	9.73
27.56 (25.00)	9.68
33.07 (30.00)	9.43
38.58 (35.00)	9.16
38.85 (35.24)	9.14
44.09 (40.00)	8.71
49.60 (45.00)	8.12
55.12 (50.00)	7.32
55.50 (50.35)	7.21
60.63 (55.00)	5.84
63.50 (57.61)	4.91
63.61 (57.71)	4.88
63.63 (57.72)	4.88
65.22 (59.17)	4.88
65.83 (59.72)	4.86

Notes:
(1) Values in Table 9 are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) Engineering Data Bank (EDB) number, Reference 21.0.
(3) MAPLHGR Data, Reference 21.0.

Table 10
MAPLHGR Limits, GE14C EDB-4332

GE14-P10DNAB374-16GZ-100T-145-T6-4332 (2)

Average Planar Exposure GWD/MTU (GWD/STU)	MAPLHGR Limit (kW/ft)(1)(3)
0.00 (0.00)	8.19
0.22 (0.20)	8.23
1.10 (1.00)	8.31
2.20 (2.00)	8.42
3.31 (3.00)	8.54
4.41 (4.00)	8.66
5.51 (5.00)	8.79
6.61 (6.00)	8.92
7.72 (7.00)	9.06
8.82 (8.00)	9.21
9.92 (9.00)	9.35
11.02 (10.00)	9.50
12.13 (11.00)	9.59
13.23 (12.00)	9.37
14.33 (13.00)	9.26
15.43 (14.00)	9.28
16.53 (15.00)	9.28
17.64 (16.00)	9.28
18.74 (17.00)	9.26
19.84 (18.00)	9.23
20.94 (19.00)	9.19
22.05 (20.00)	9.15
23.15 (21.00)	9.11
24.25 (22.00)	9.07
26.46 (24.00)	9.00
27.56 (25.00)	8.96
33.07 (30.00)	8.81
38.58 (35.00)	8.57
38.85 (35.24)	8.55
44.09 (40.00)	8.11
49.60 (45.00)	7.57
55.12 (50.00)	6.58
55.50 (50.35)	6.47
60.63 (55.00)	5.03
61.91 (56.16)	4.64
62.57 (56.76)	4.64
63.37 (57.49)	4.64
63.50 (57.60)	4.64

Notes:
(1) Values in Table 10 are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) Engineering Data Bank (EDB) number, Reference 21.0.
(3) MAPLHGR Data, Reference 21.0.

Table 11
MAPLHGR Limits, GE14C EDB-4333

GE14-P10DNAB384-15GZ-100T-145-T6-4333 [(2)]

Average Planar Exposure GWD/MTU (GWD/STU)	MAPLHGR Limit (kW/ft)[(1)(3)]
0.00 (0.00)	8.51
0.22 (0.20)	8.55
1.10 (1.00)	8.62
2.20 (2.00)	8.72
3.31 (3.00)	8.82
4.41 (4.00)	8.93
5.51 (5.00)	9.05
6.61 (6.00)	9.17
7.72 (7.00)	9.30
8.82 (8.00)	9.43
9.92 (9.00)	9.56
11.02 (10.00)	9.70
12.13 (11.00)	9.80
13.23 (12.00)	9.69
14.33 (13.00)	9.49
15.43 (14.00)	9.45
16.53 (15.00)	9.45
17.64 (16.00)	9.43
18.74 (17.00)	9.41
19.84 (18.00)	9.38
20.94 (19.00)	9.34
22.05 (20.00)	9.29
23.15 (21.00)	9.25
24.25 (22.00)	9.21
25.35 (23.00)	9.17
26.46 (24.00)	9.13
27.56 (25.00)	9.09
33.07 (30.00)	8.92
38.58 (35.00)	8.71
38.85 (35.24)	8.69
44.09 (40.00)	8.24
49.60 (45.00)	7.75
55.12 (50.00)	6.76
55.50 (50.35)	6.66
60.63 (55.00)	5.30
62.78 (56.95)	4.65
63.23 (57.36)	4.65
63.30 (57.43)	4.65
63.44 (57.56)	4.65

Notes:
(1) Values in Table 11 are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) Engineering Data Bank (EDB) number, Reference 21.0.
(3) MAPLHGR Data, Reference 21.0.

Table 12
MAPLHGR Limits, GE14C EDB-4337

GE14-P10DNAB387-16GZ-100T-145-T6-4337 [(2)]

Average Planar Exposure GWD/MTU (GWD/STU)	MAPLHGR Limit (kW/ft)[(1)(3)]
0.00 (0.00)	8.42
0.22 (0.20)	8.46
1.10 (1.00)	8.54
2.20 (2.00)	8.64
3.31 (3.00)	8.74
4.41 (4.00)	8.85
5.51 (5.00)	8.96
6.61 (6.00)	9.07
7.72 (7.00)	9.19
8.82 (8.00)	9.30
9.92 (9.00)	9.43
11.02 (10.00)	9.55
12.13 (11.00)	9.68
13.23 (12.00)	9.63
14.33 (13.00)	9.46
15.43 (14.00)	9.45
16.53 (15.00)	9.47
17.64 (16.00)	9.47
18.74 (17.00)	9.45
19.84 (18.00)	9.42
20.94 (19.00)	9.38
22.05 (20.00)	9.33
23.15 (21.00)	9.29
24.25 (22.00)	9.25
25.35 (23.00)	9.21
26.46 (24.00)	9.17
27.56 (25.00)	9.13
33.07 (30.00)	8.95
38.58 (35.00)	8.74
38.85 (35.24)	8.72
44.09 (40.00)	8.26
49.60 (45.00)	7.78
55.12 (50.00)	6.79
55.50 (50.35)	6.68
60.63 (55.00)	5.34
62.91 (57.07)	4.65
63.50 (57.61)	4.65
63.58 (57.68)	4.65
64.28 (58.31)	4.65
64.34 (58.37)	4.65

Notes:
(1) Values in Table 12 are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) Engineering Data Bank (EDB) number, Reference 21.0.
(3) MAPLHGR Data, Reference 21.0.

Table 13
MAPLHGR Limits, GE14C EDB-4338

GE14-P10DNAB389-11GZ-100T-145-T6-4338 [(2)]

Average Planar Exposure GWD/MTU (GWD/STU)	MAPLHGR Limit (kW/ft)[(1)(3)]
0.00 (0.00)	8.77
0.22 (0.20)	8.82
1.10 (1.00)	8.90
2.20 (2.00)	9.02
3.31 (3.00)	9.12
4.41 (4.00)	9.20
5.51 (5.00)	9.28
6.61 (6.00)	9.35
7.72 (7.00)	9.43
8.82 (8.00)	9.51
9.92 (9.00)	9.60
11.02 (10.00)	9.68
12.13 (11.00)	9.76
13.23 (12.00)	9.81
14.33 (13.00)	9.84
15.43 (14.00)	9.87
16.53 (15.00)	9.89
17.64 (16.00)	9.91
18.74 (17.00)	9.93
19.84 (18.00)	9.94
20.94 (19.00)	9.94
22.05 (20.00)	9.94
23.15 (21.00)	9.94
25.35 (23.00)	9.93
26.46 (24.00)	9.90
27.56 (25.00)	9.83
33.07 (30.00)	9.52
38.58 (35.00)	9.27
38.85 (35.24)	9.25
44.09 (40.00)	8.79
49.60 (45.00)	8.26
55.12 (50.00)	7.33
55.50 (50.35)	7.22
60.63 (55.00)	5.79
63.46 (57.57)	4.88
63.46 (57.57)	4.88
63.50 (57.61)	4.88
65.25 (59.20)	4.88
65.61 (59.52)	4.88

Notes:
(1) Values in Table 13 are for two recirculation loop operation, see Section 8.1.1. For single loop operation, see Section 8.1.2
(2) Engineering Data Bank (EDB) number, Reference 21.0.
(3) MAPLHGR Data, Reference 21.0.

Table 14
ATRIUM 10XM Steady-State LHGR Limits

Peak Pellet Exposure GWD/MTU (GWD/STU)	LHGR Limit [(a)(b)] (kW/ft)
0.0 (0.0)	14.1
18.9 (17.15)	14.1
74.4 (67.49)	7.4

Notes:

(a) Applicable multipliers per Section 8.2 will be applied to the data in this table for two recirculation loop and single recirculation loop operations.

(b) LHGR Data from Table 8.8 in Reference 2.0.

Table 15
GE14 UO2/Gd Thermal Mechanical LHGR Limits

Peak Pellet Exposure GWD/MTU (GWD/STU)	UO2 LHGR Limit [(a)(b)(c)] (kW/ft)	Peak Pellet Exposure GWD/MTU (GWD/STU)	Most Limiting Gadolinia LHGR Limit [(a)(b)(c)] (kW/ft)
[[			
			]]

Notes:
(a) Applicable multipliers per Section 8.2 will be applied to the data in this table for two recirculation loop and single recirculation loop operations.
(b) These bounding Thermal Mechanical LHGR Limits may be used with every EDB type loaded in Cycle 29.
(c) LHGR Data, Reference 22.0.

9.0 Core Stability Requirements

9.1 Stability EO-III Solution

Monticello has implemented the AREVA Enhance Option III (EO-III) Long Term Stability solution using the Oscillation Power Range Monitor (OPRM) as described in Reference 5.0. Plant-specific Hot Channel Oscillation Magnitude (HCOM) (Reference 15.0) and other cycle specific stability parameters are used in the Cycle 29 EO-III Stability Evaluation, which is documented in Reference 2.0. A Backup Stability Protection (BSP) evaluation is also documented in Reference 2.0.

The following Enhanced Option III OPRM stability setpoint determination, the implementation of the associated BSP Regions shown in Figure 8, and the Extended Flow Window Stability- High rod block and scram describe the stability licensing basis protections for Monticello Cycle 29.

Reference: Technical Specification 3.3.1.1

9.2 Enhanced Option III OPRM Setpoints

A reload Enhanced Option III evaluation has been performed in accordance with the licensing methodology described in Reference 5.0. The stability based Operating Limit Minimum Critical Power Ratio (OLMCPR) is determined for two conditions as a function of OPRM amplitude setpoint. The two conditions evaluated are: (1) a postulated oscillation at 45% rated core flow quasi steady-state operation (SS), and (2) a postulated oscillation following a two recirculation pump trip (2RPT) from the limiting rated power operating state point.

The OPRM-setpoint-dependent OLMCPR(SS) and OLMCPR(2RPT) values are calculated for Cycle 29 in accordance with the Enhanced Option III guidelines described in Reference 5.0. The Cycle 29 Enhanced Option III evaluation provides adequate protection against violation of the Safety Limit MCPR (SLMCPR) for the two postulated reactor instability events as long as the plant OLMCPR is equal to or greater than the OLMCPR(SS) and OLMCPR(2RPT) for the selected OPRM setpoint in Table 16.

The relationship between the OPRM Successive Confirmation Count Setpoint and the OPRM Amplitude Setpoint is provided in Table 17.

The OPRM setpoints for Two Loop Operation (TLO) are conservative relative to Single Loop Operation (SLO) and are, therefore, bounding.

Table 16
OPRM Setpoint Versus OLMCPR

OPRM Amplitude Setpoint	OLMCPR(SS)	OLMCPR(2PT)
1.05	1.32	1.40
1.06	1.35	1.43
1.07	1.38	1.46
1.08	1.41	1.49
1.09	1.44	1.52
1.10	1.47	1.55
1.11	1.52	1.60
1.12	1.57	1.66
1.13	1.62	1.72
1.14	1.68	1.78
1.15	1.75	1.85
OLMCPR Acceptance Criteria	**Off-Rated OLMCPR at 45% Flow**	**Rated Power OLMCPR as Described in Section 5.0**

Table 17
Relationship Between OPRM Successive Confirmation Count Setpoint and OPRM Amplitude Setpoint

Successive Confirmation Count Setpoint	OPRM Amplitude Setpoint
6	≥ 1.04
8	≥ 1.05
9	≥ 1.06
10	≥ 1.07
11	≥ 1.08
12	≥ 1.09
13	≥ 1.10
14	≥ 1.11
15	≥ 1.13
16	≥ 1.14
17	≥ 1.16
18	≥ 1.19
19	≥ 1.21
20	≥ 1.24

The OPRM Period Based Detection Algorithm (PBDA) instrumentation setpoints for use in Technical Specification LCO 3.3.1.1 Table 3.3.1.1-1 Function 2f shall not exceed the following:

Confirmation Count Setpoint: 13

Amplitude Setpoint: 1.10

Reference: Technical Specification 3.3.1.1

9.3 Extended Flow Window Stability – High Scram

Reference 5.0 describes the single channel instability exclusion and backup stability protection provided by the Extended Flow Window Stability (EFWS) scram. The EFWS APRM setpoints from Reference **Error! Reference source not found.** are confirmed for Cycle 29 and defined in Table 18.

Table 18
EFWS Nominal Setpoints for the Scram Region

Parameter	Allowable Value	NTSP
Slope of EFWS APRM flow-biased trip linear segment.	2.49	2.49
Constant Power Line for Trip from zero Drive Flow to Flow Breakpoint value.	40.6 % RTP*	38.6 % RTP*
Constant Flow Line for Trip.	48.1 % RDF**	49.1 % RDF**
Flow Breakpoint value	30.3 % RDF**	31.3 % RDF**

Notes:
* RTP – Rated Thermal Power
** RDF – Recirculation Drive Flow

Reference: Technical Specification 3.3.1.1

9.4 Backup Stability Protection Regions

The Backup Stability Protection (BSP) regions are shown in Figure 8. The BSP regions are an integral part of the Tech Spec-required alternative method to detect and suppress thermal hydraulic instability oscillations in that they identify areas of the power/flow map where there is an increased probability that the reactor core could experience a thermal hydraulic instability.

Regions are identified that are either excluded from planned entry and continued operation (Scram Region), or where planned entry is not permitted unless specific operating restrictions are met and specific actions are required to be taken to immediately leave the region following inadvertent or forced entry (Controlled Entry Region). The boundaries of these regions are established on a cycle-specific basis based upon core decay ratio calculations performed using NRC-approved methodology (Reference 2.0).

The BSP regions are only applicable when the Upscale Trip function of the OPRM is inoperable. However, immediate action is required to leave Region I even if the OPRMs are operable. The BSP region boundaries were calculated for Monticello Cycle 29 for nominal feedwater temperature conditions. The endpoints of the regions are defined in Table 19. The region boundaries shown in Figure 8 are defined using the Generic Shape Function (GSF), which is described in Reference 5.0.

Table 19
BSP Endpoints for Normal Feedwater Temperature

Endpoint	Power (%)	Flow (%)	Definition
A1	56.5	40.0	Scram Region Boundary, HFCL
B1	42.5	33.7	Scram Region Boundary, NCL
A2	64.4	50.0	Controlled Entry Region Boundary, HFCL
B2	28.5	31.2	Controlled Entry Region Boundary, NCL

Note:
BSP Endpoints, Reference 2.0.

Reference: Technical Specification 3.3.1.1

9.5 Actions For Entry Into Scram Region

Immediate manual scram upon determination that the region has been entered. If entry is unavoidable, early scram initiation is appropriate.

Reference: Technical Specification 3.3.1.1

9.6 Actions For Entry Into Controlled Entry Region

If entry is inadvertent or forced, immediate exit from region is required. The region can be exited by control rod insertion or core flow increase. Increasing the core flow by restarting an idle recirculation pump is not an acceptable method of exiting the region.

Deliberate entry into the Controlled Entry Region requires compliance with at least one of the stability controls outlined below:

1. Maintain core average boiling boundary (BB) $\geq$ 4.0 feet.
2. Maintain core decay ratio (DR) < 0.6 as calculated by an on-line stability monitor.
3. Continuous dedicated monitoring of real time control room neutron monitoring instrumentation with manual scram required upon indication of a reactor instability induced power oscillation.

Caution is required whenever operating near the Controlled Entry Region boundary (i.e., within approximately 10% of core power or core flow), and it is recommended that the amount of time spent operating near this region be minimized.

Reference: Technical Specification 3.3.1.1

10.0 Turbine Bypass System Response Time

The TURBINE BYPASS SYSTEM RESPONSE TIME shall be that time interval from when the main turbine trip solenoid is activated until 80% of the turbine bypass capacity is established. The TURBINE BYPASS SYSTEM RESPONSE TIME shall be ≤ 1.1 seconds.

Reference: Technical Specification 1.1, Surveillance Requirement 3.7.7.3.

11.0 Shutdown Margin (SDM) Confirmation

Technical Specification 3.1.1 requires that the SDM be confirmed for Monticello Cycle 29. Analytical SDM has been confirmed in the Reload Safety Analysis Report (Reference 18.0, Table 2.1).

For any mid-cycle core loading changes, the analytical SDM will be re-confirmed, formally documented, and reviewed prior to start-up.

12.0 APRM Simulated Thermal Power – High, Delta W Allowable Value

The APRM Simulated Thermal Power – High Flow Biased Scram Setpoint Allowable Value shall be:

For Two Loop Operation (TLO):

$S_{STP} \leq (0.61(W) + 67.2\%RTP)$ and $\leq 116\%RTP$

where:

S_{STP} = Scram setting in percent of rated thermal power (2004 MWt)

W = Loop recirculation flow rate in percent of rated

For Single Loop Operation (SLO):
(NOTE: SLO is not permitted in the MELLLA+ region.)

$S_{STP} \leq (0.55(W-\Delta W) + 61.5\%RTP)$

where:

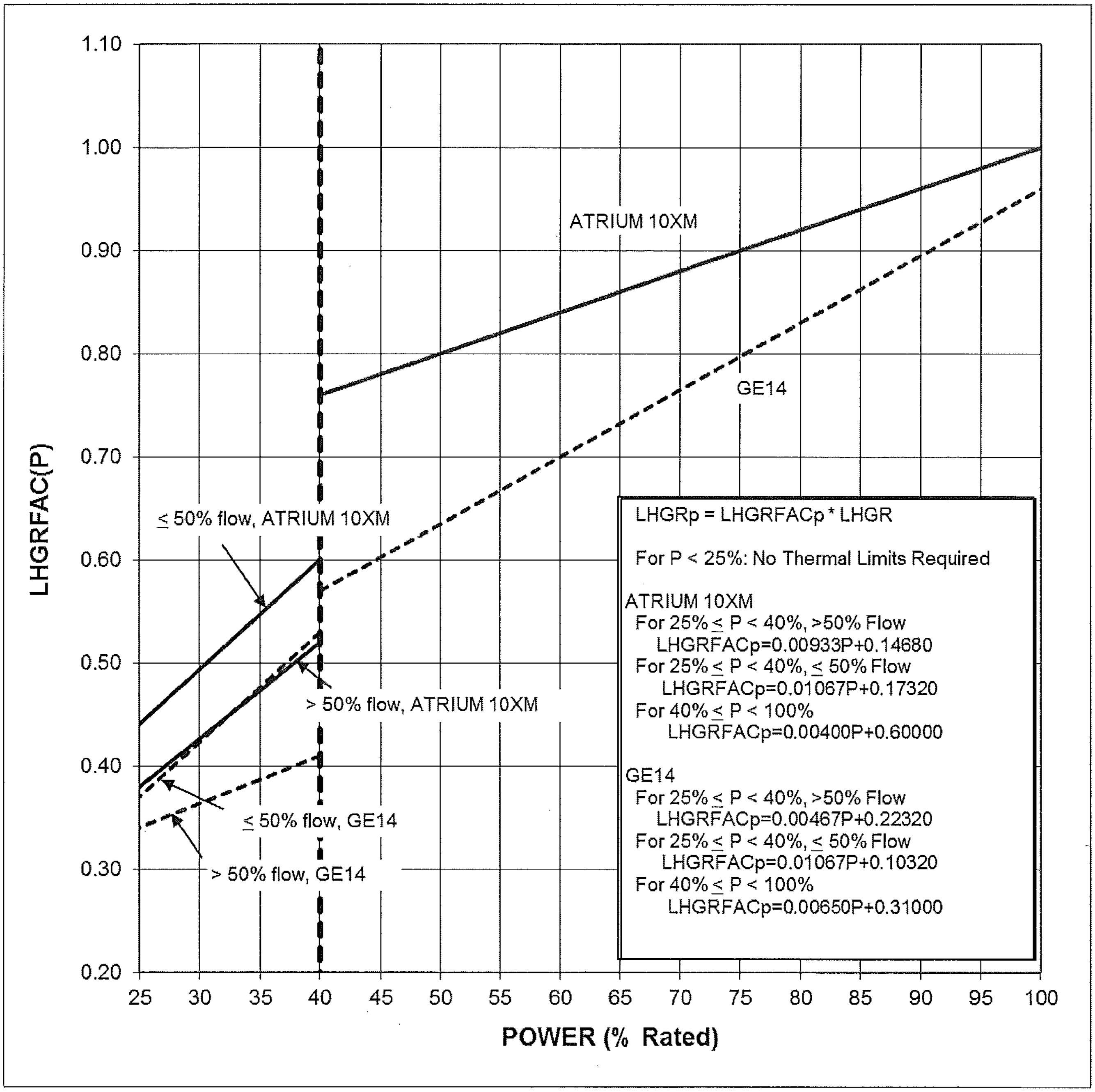
S_{STP} = Scram setting in percent of rated thermal power (2004 MWt)

W = Loop recirculation flow rate in percent of rated

ΔW = Difference between two-loop and single-loop effective recirculation flow at the same core flow (ΔW = 5.4% for single loop operation, ΔW = 0.0 for two-loop operation)

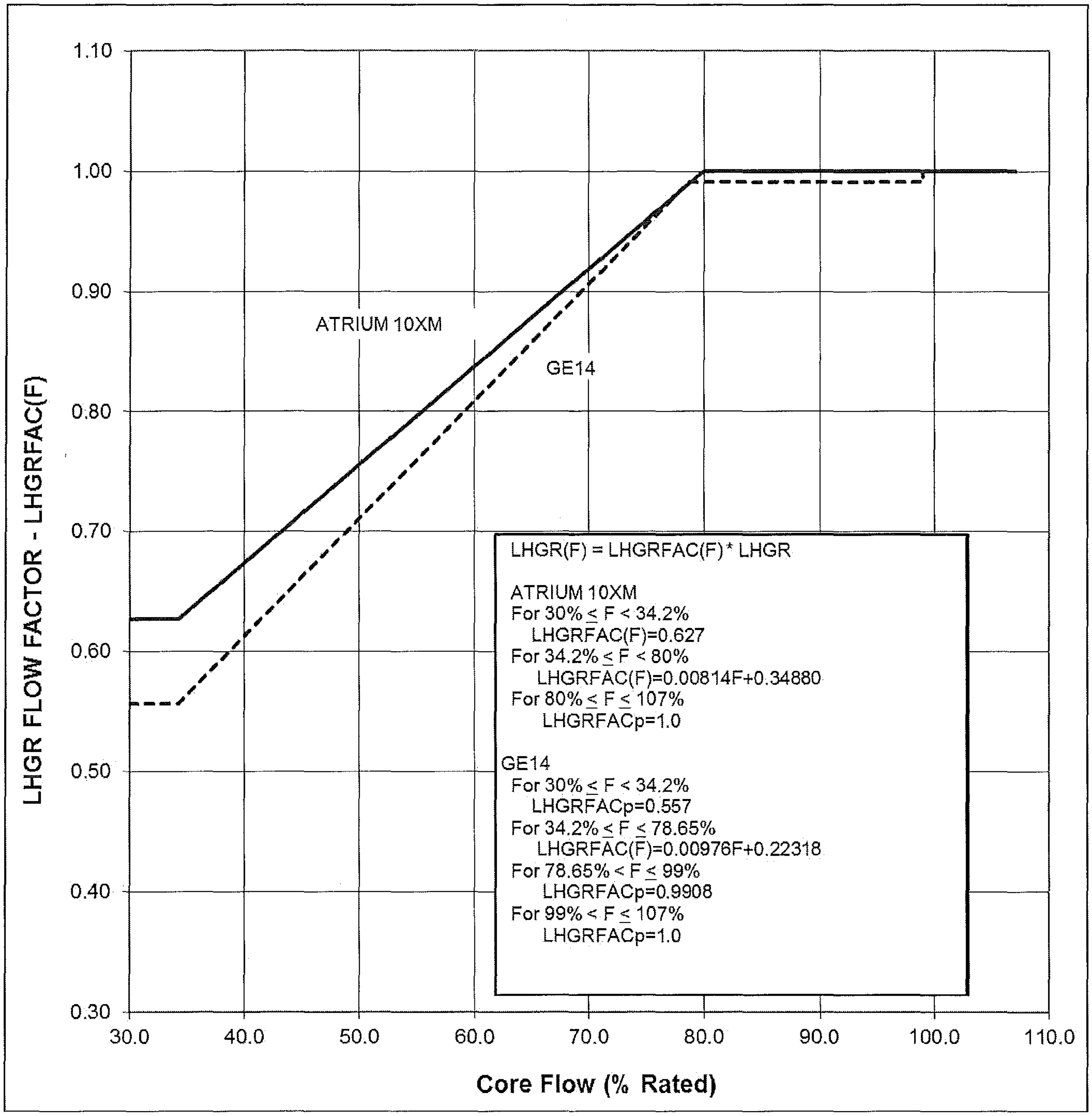
Reference: Technical Specification 5.6.3, item 5, Technical Specification Table 3.3.1.1-1, Function 2.b, footnote (b), and Reference 9.0

Figure 1
Power Dependent LHGR Multipliers



Results from the equations above are accurate to three decimal places.

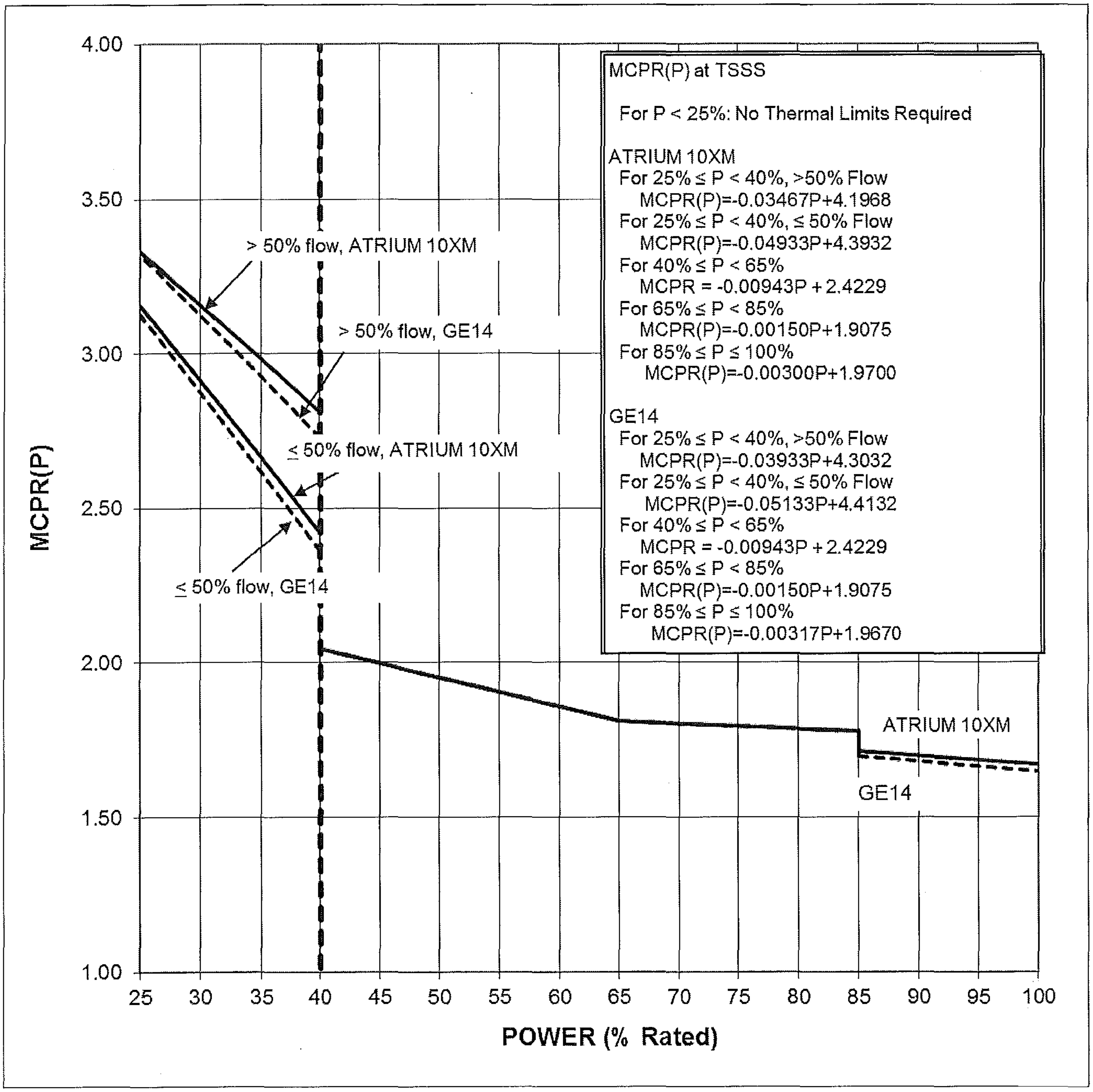
Figure 2
Flow Dependent LHGR Multipliers



In addition to the flow dependent multipliers, Monticello also requires an ECCS MAPLHGR multiplier of 0.9908 for operation at or below 99% core flow for GE14 fuel. This multiplier ensures that the off-rated limits assumed in the EPU ECCS-LOCA analyses bound the cycle-specific off-rated limits calculated for MELLLA+ (EFW) operation.

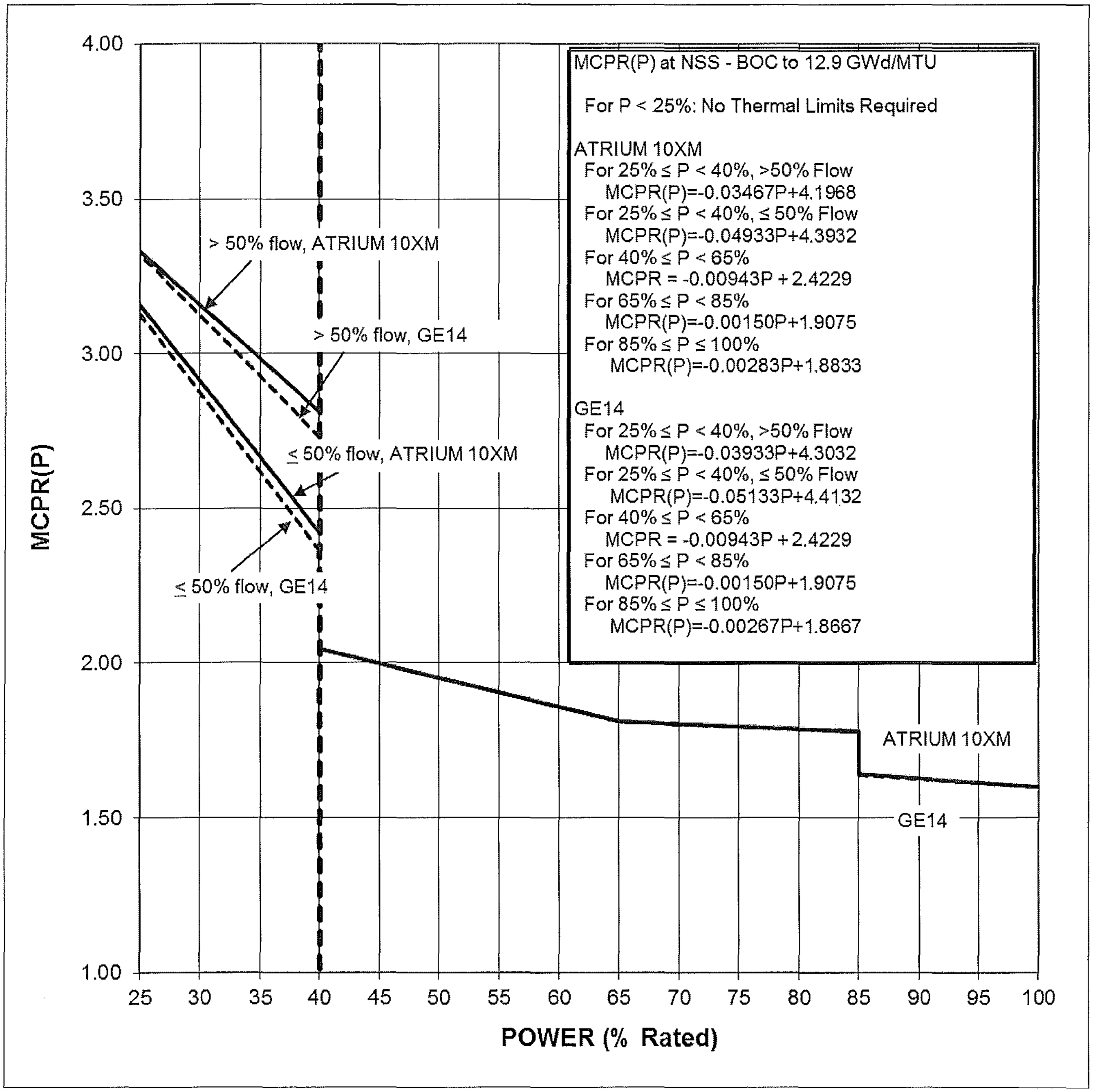
Results from the equations above are accurate to three decimal places.

Figure 3
Power Dependent MCPR(P) Limits for TSSS Insertion Rates



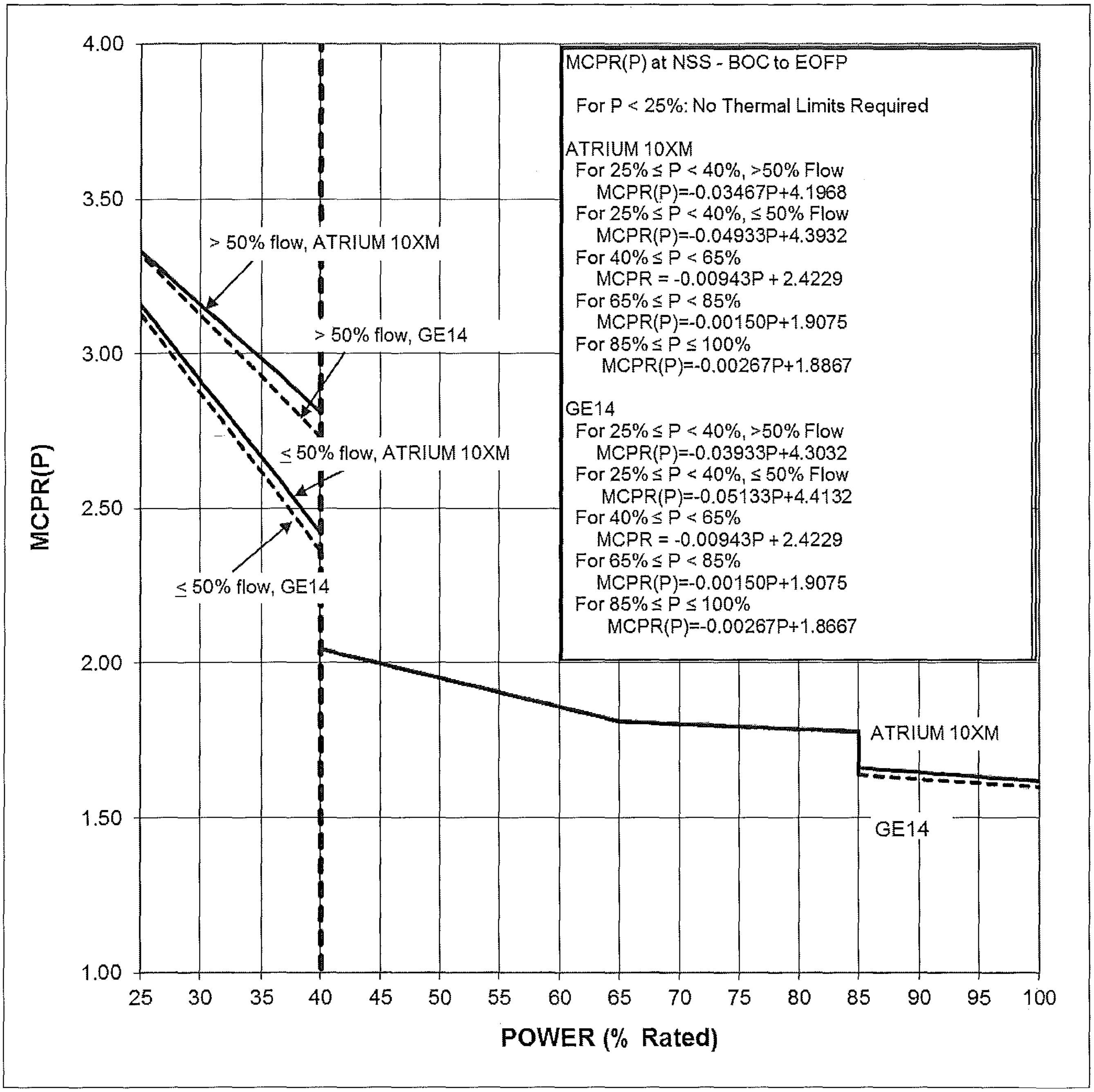
Results from the equations above are accurate to three decimal places.

Figure 4
Power Dependent MCPR(P) Limits for NSS – BOC to 12.9 GWd/MTU



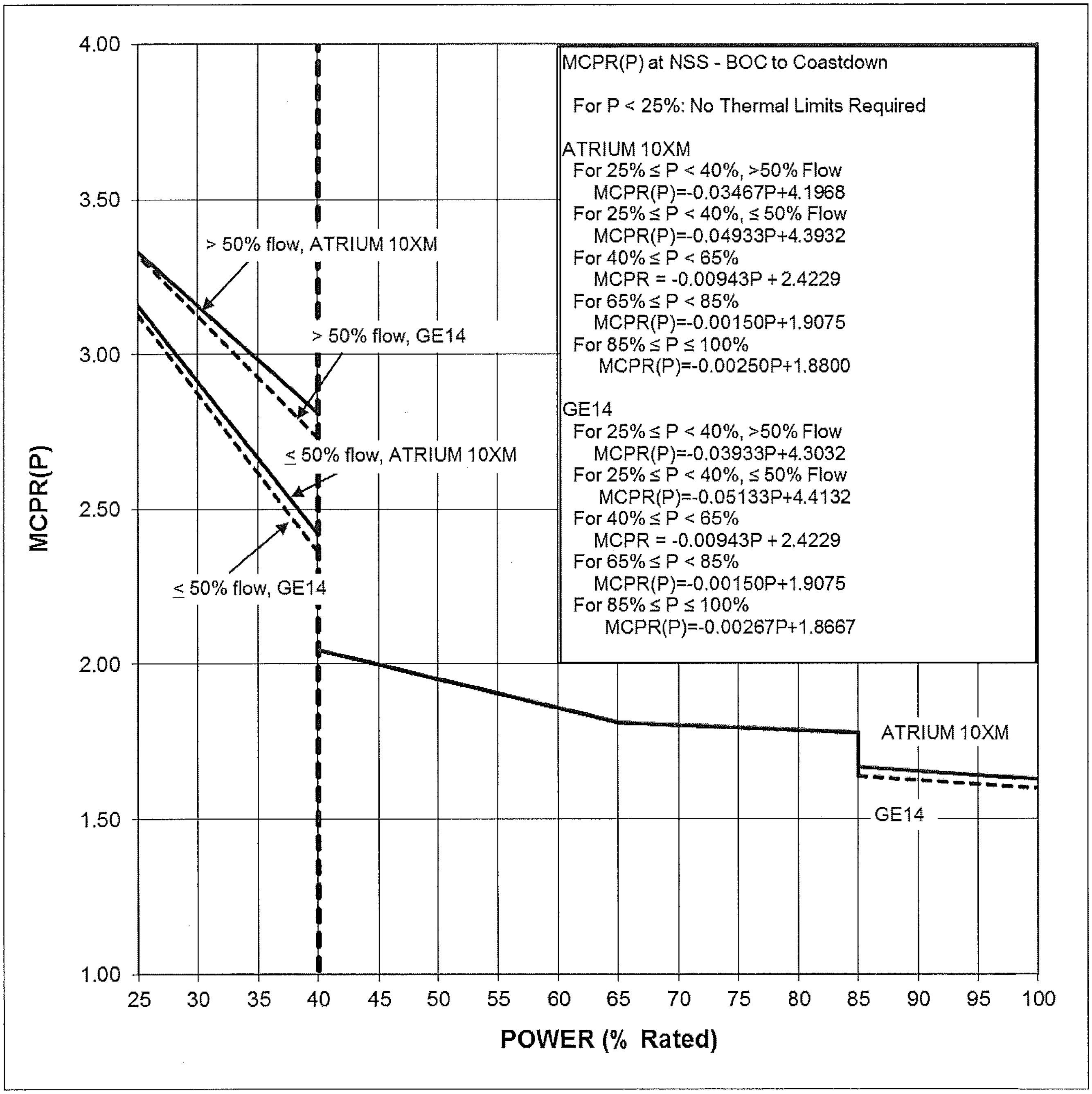
Results from the equations above are accurate to three decimal places.

Figure 5
Power Dependent MCPR(P) Limits for NSS – BOC to EOFP



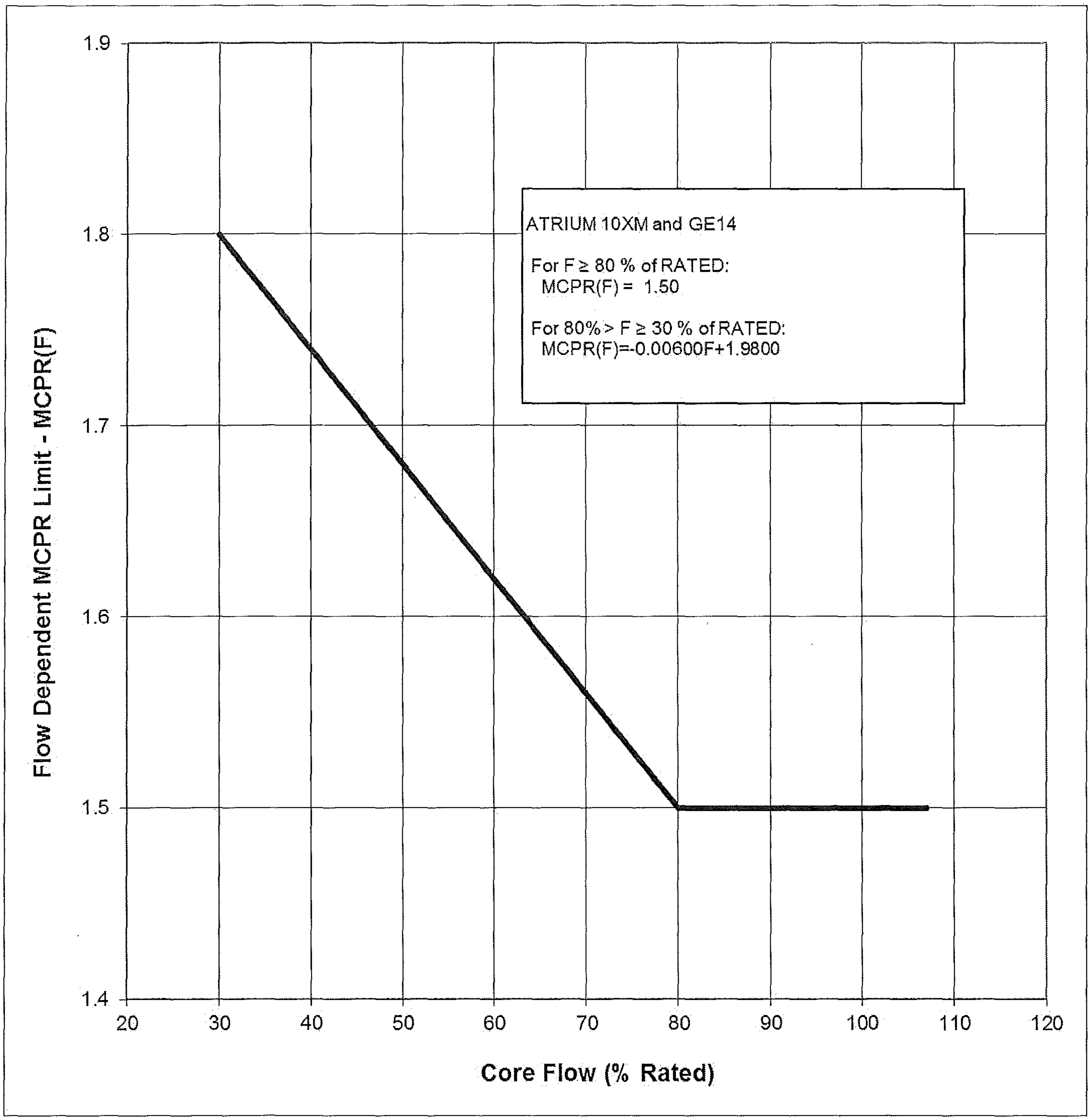
Results from the equations above are accurate to three decimal places.

Figure 6
Power Dependent MCPR(P) Limits for NSS – BOC to Coastdown



Results from the equations above are accurate to three decimal places.

Figure 7
Flow Dependent MCPR Limits



Results from the equations above are accurate to three decimal places.

The flow-dependent MCPR limits shown above apply to both GE14 fuel and ATRIUM 10XM fuel.

Figure 8
Power/Flow Map

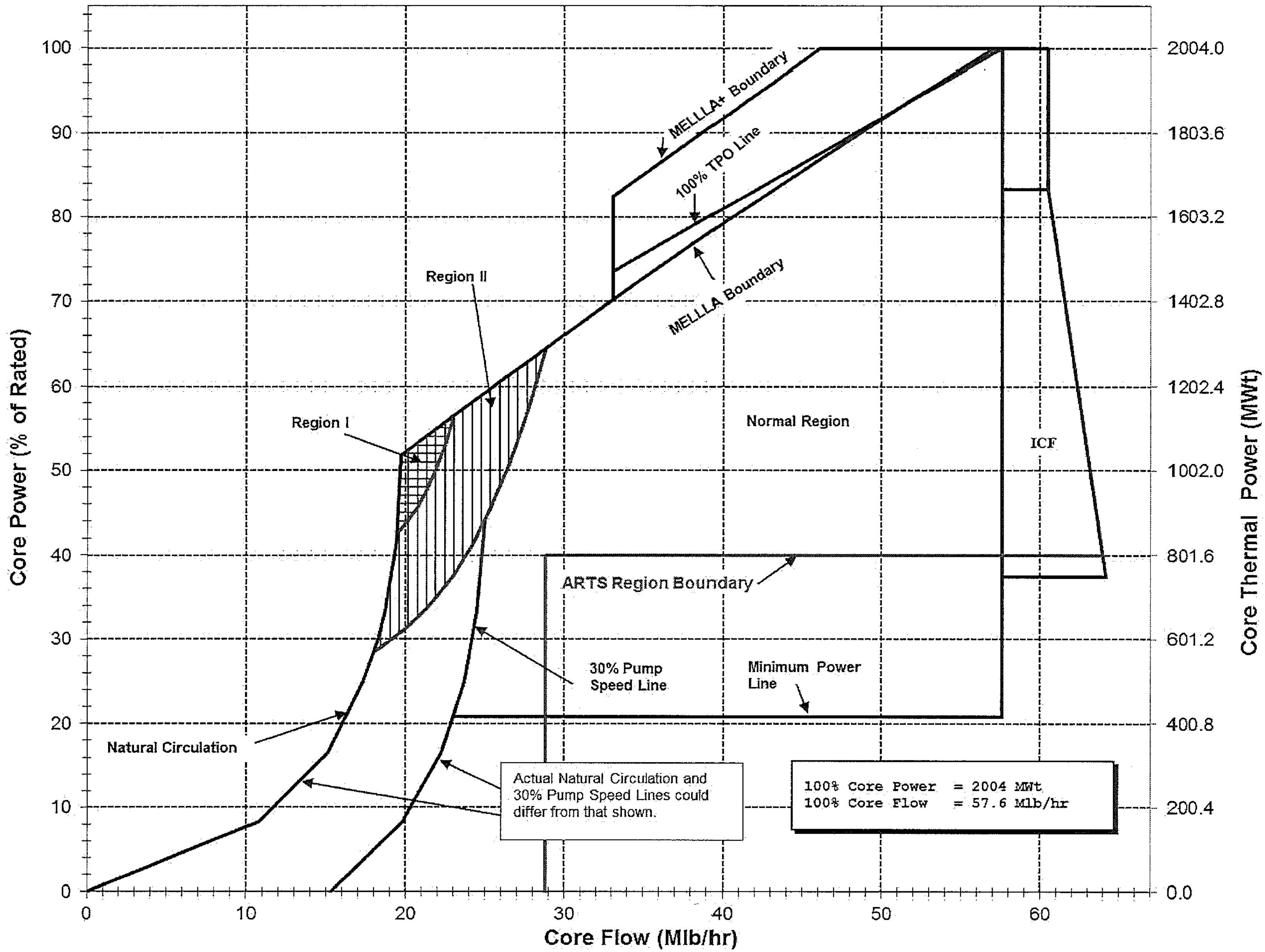
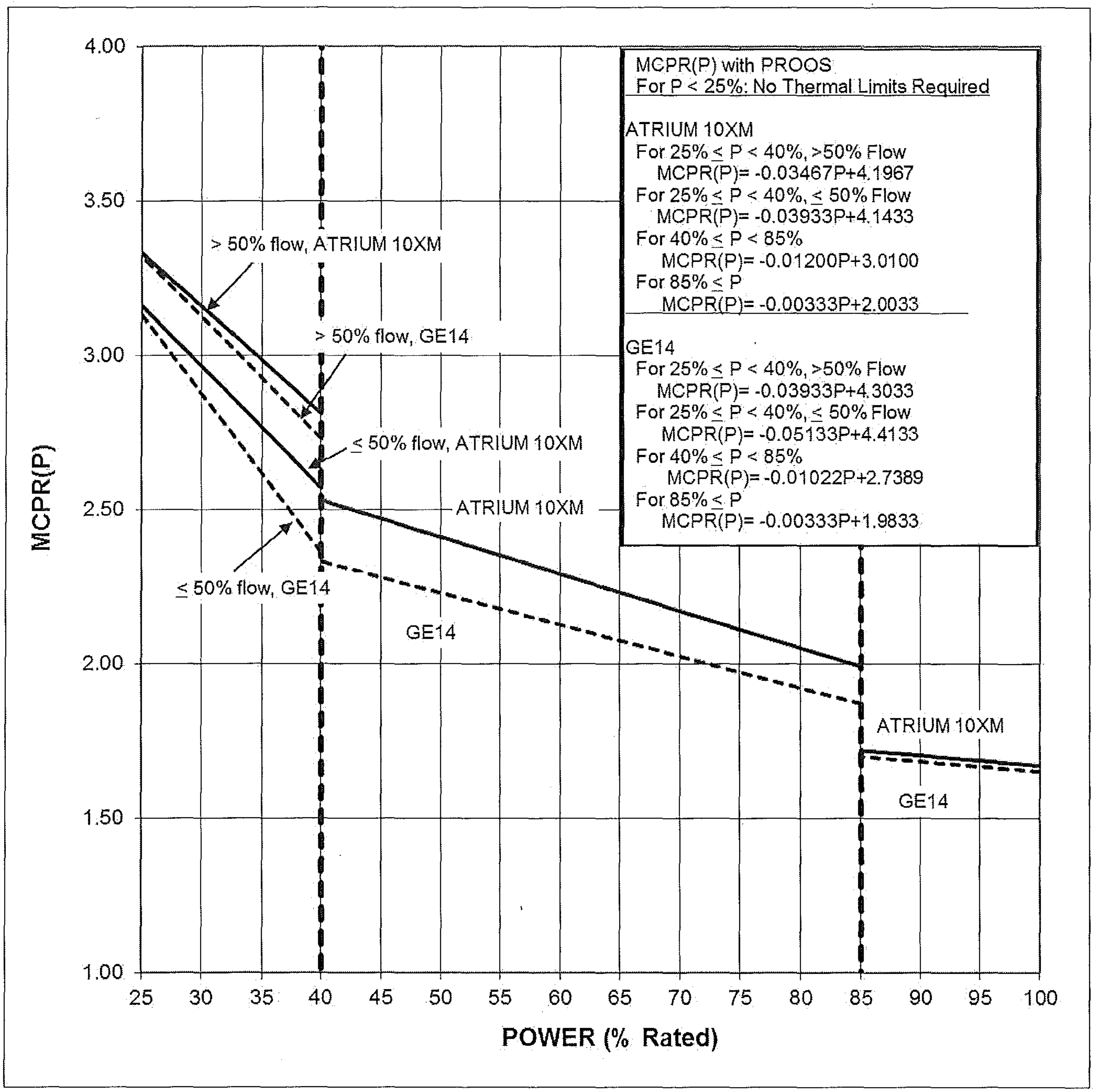
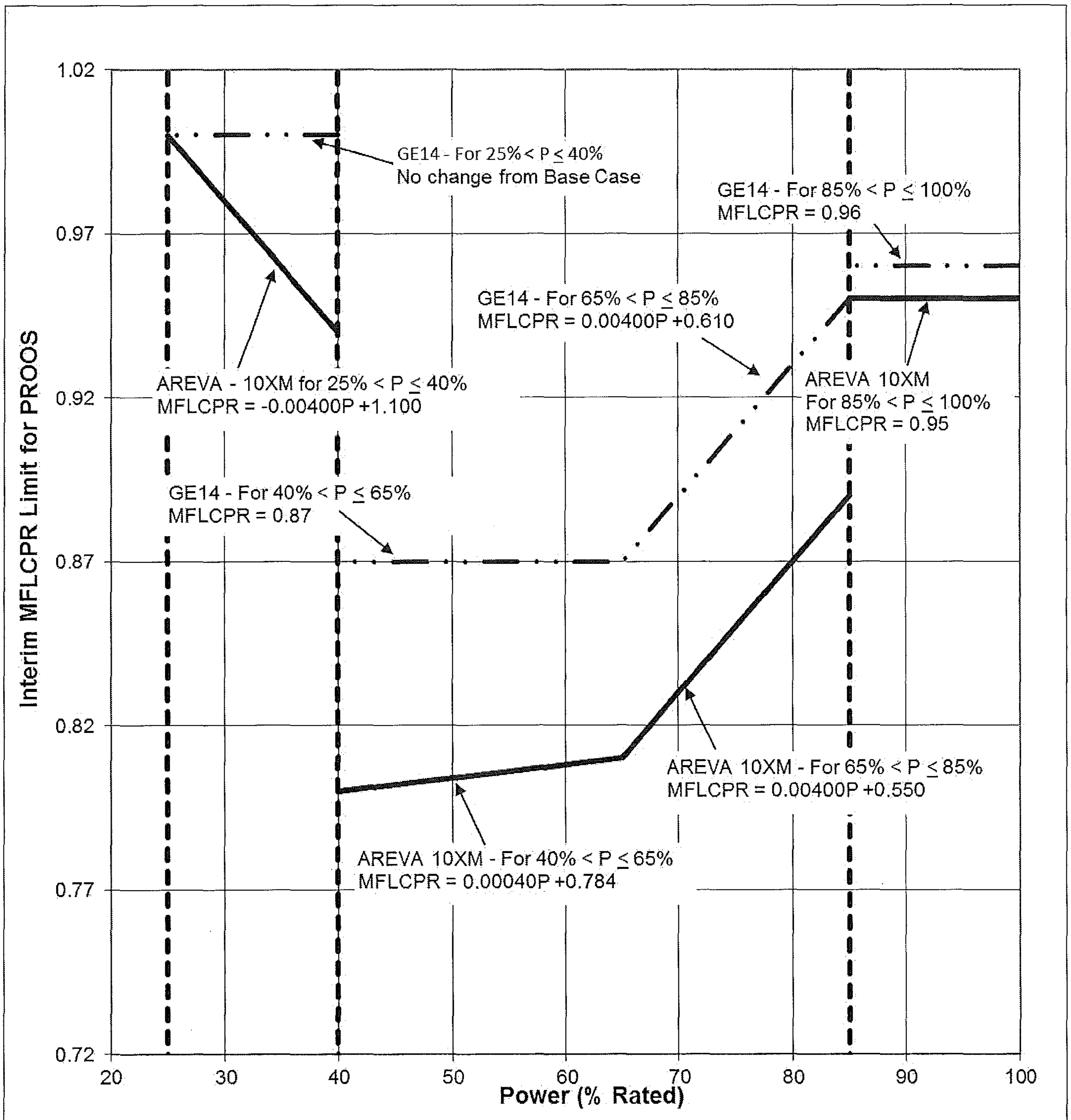


Figure 9
Power Dependent MCPR(P) Limits for
Pressure Regulator Out of Service (PROOS)



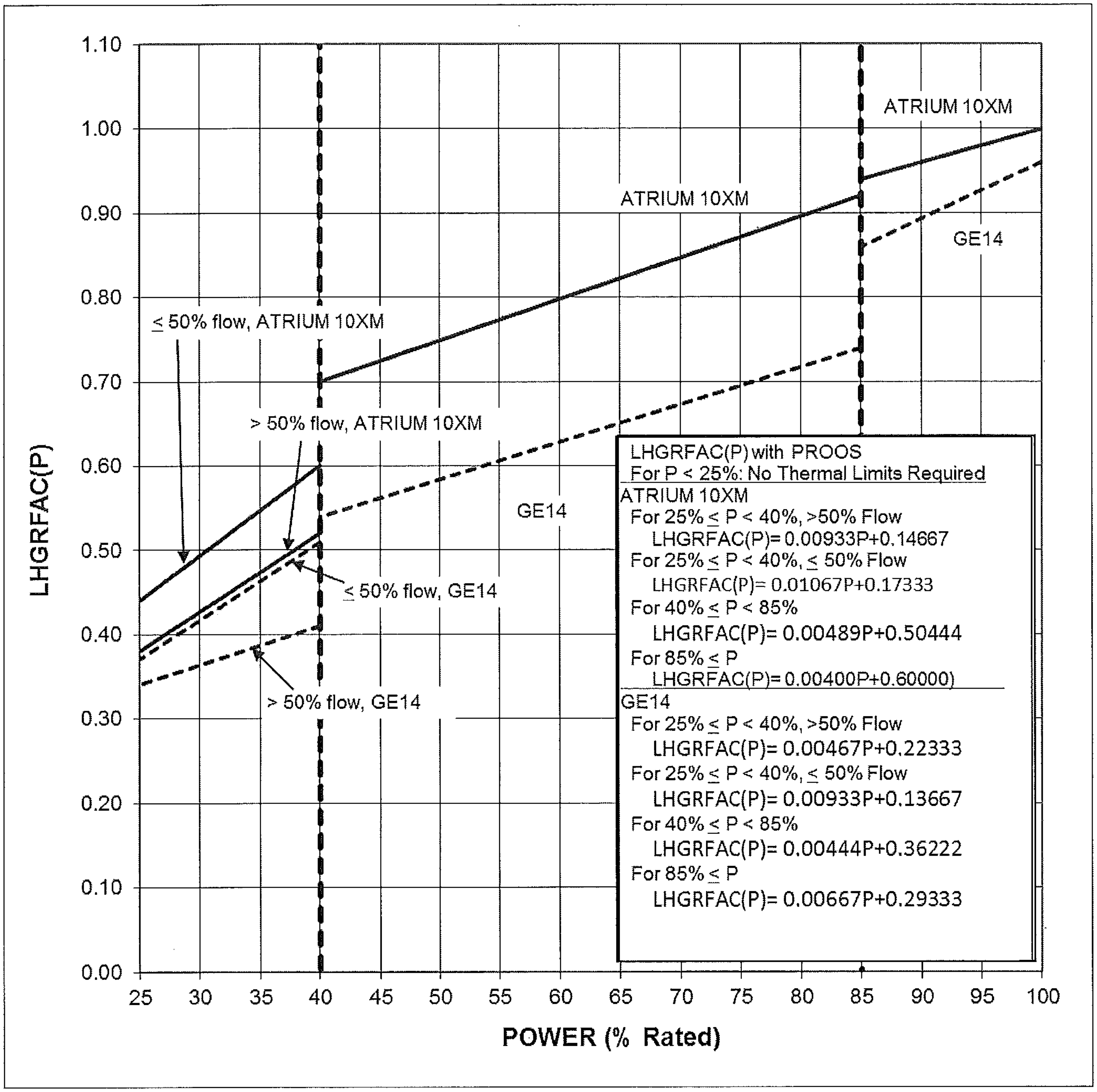
Results from the equations above are accurate to three decimal places.

Figure 10
Pressure Regulator Out Of Service
Interim MFLCPR Limit



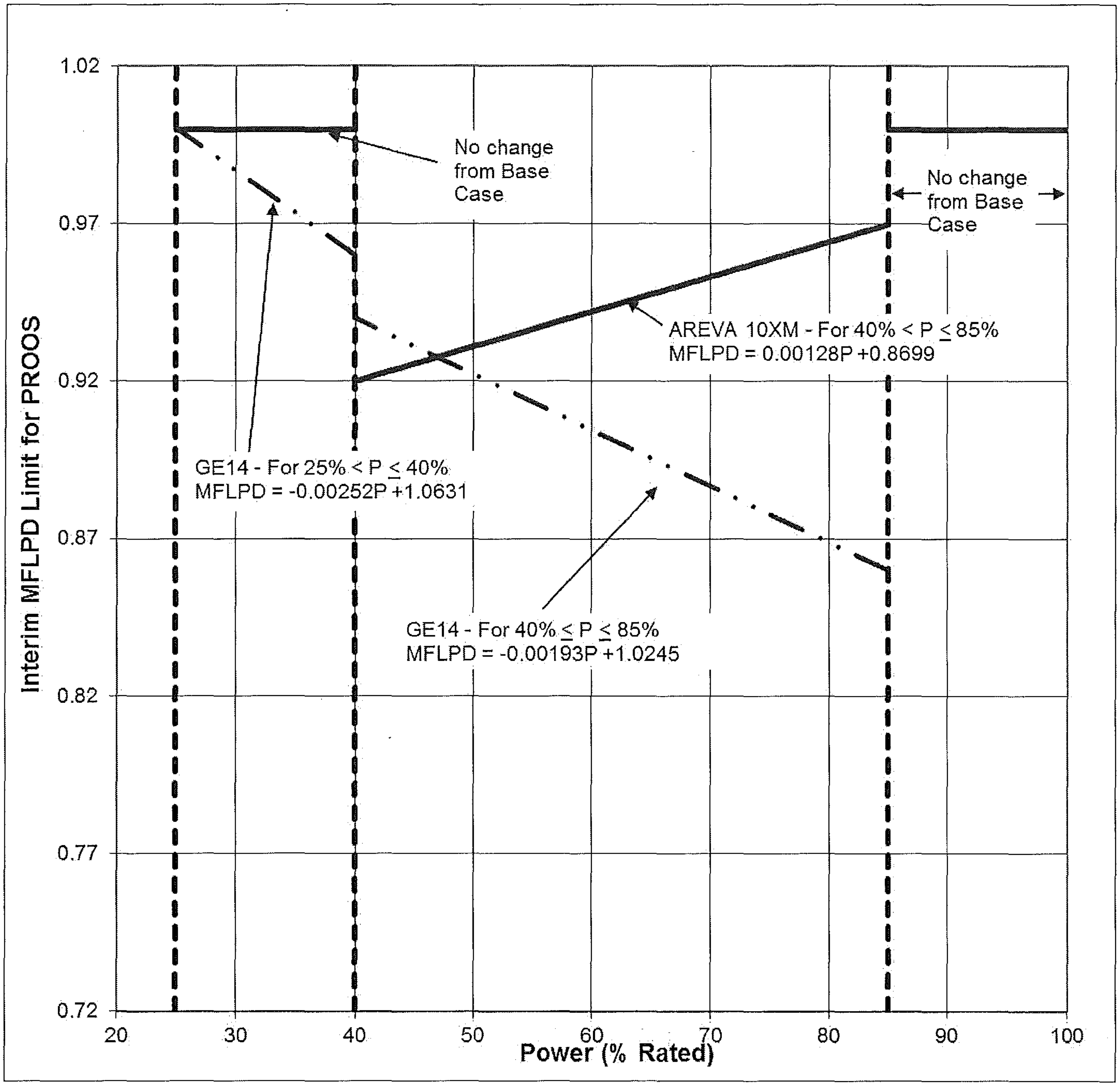
The plots are valid for NSS and TSSS times.
The limits are not dependent on core flow.
Results from the equations above are accurate to two decimal places.

Figure 11
Power Dependent LHGR Multipliers
for Pressure Regulator Out of Service (PROOS)



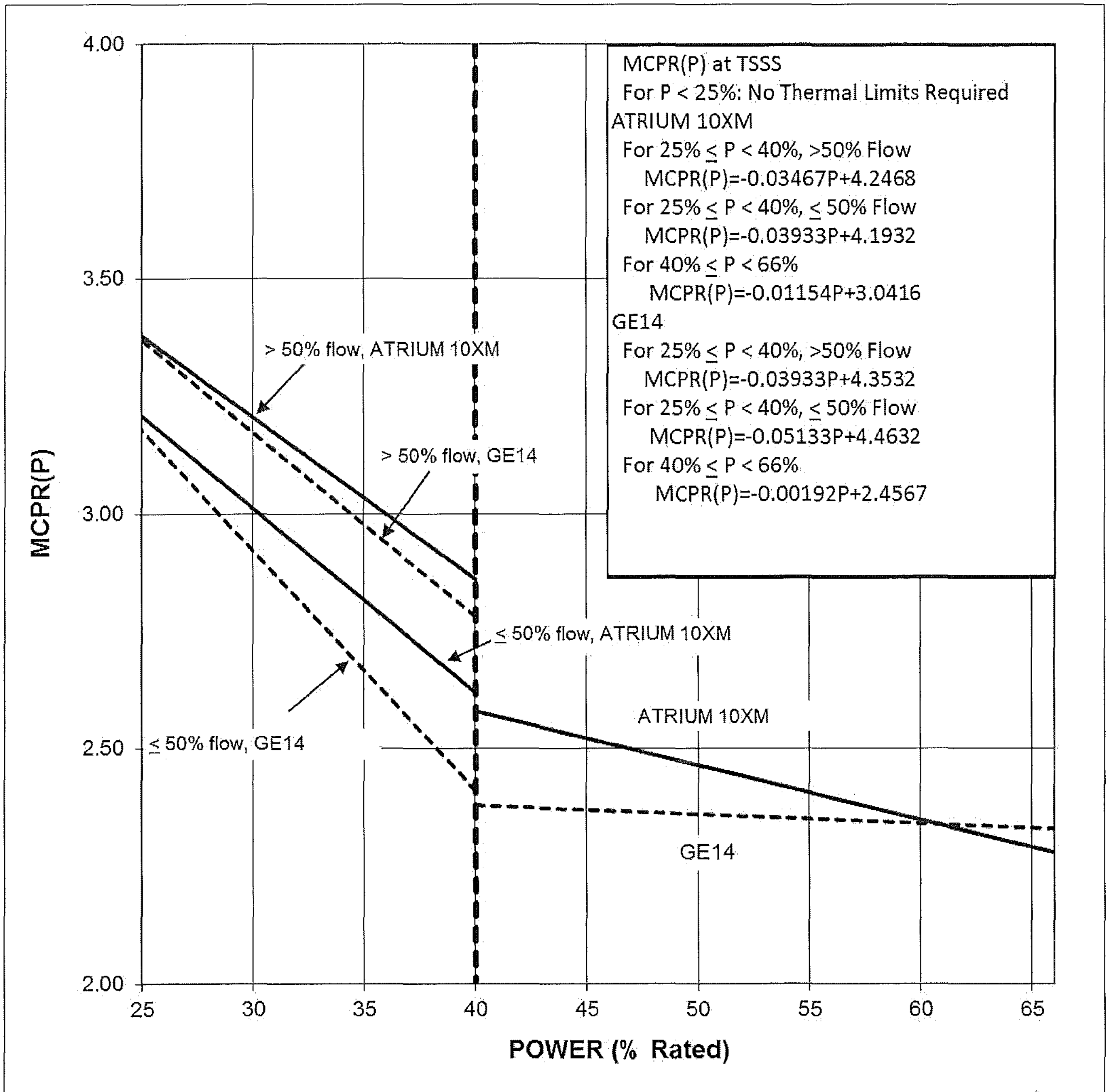
Results from the equations above are accurate to three decimal places.

Figure 12
Pressure Regulator Out of Service (PROOS)
Interim MFLPD Limit



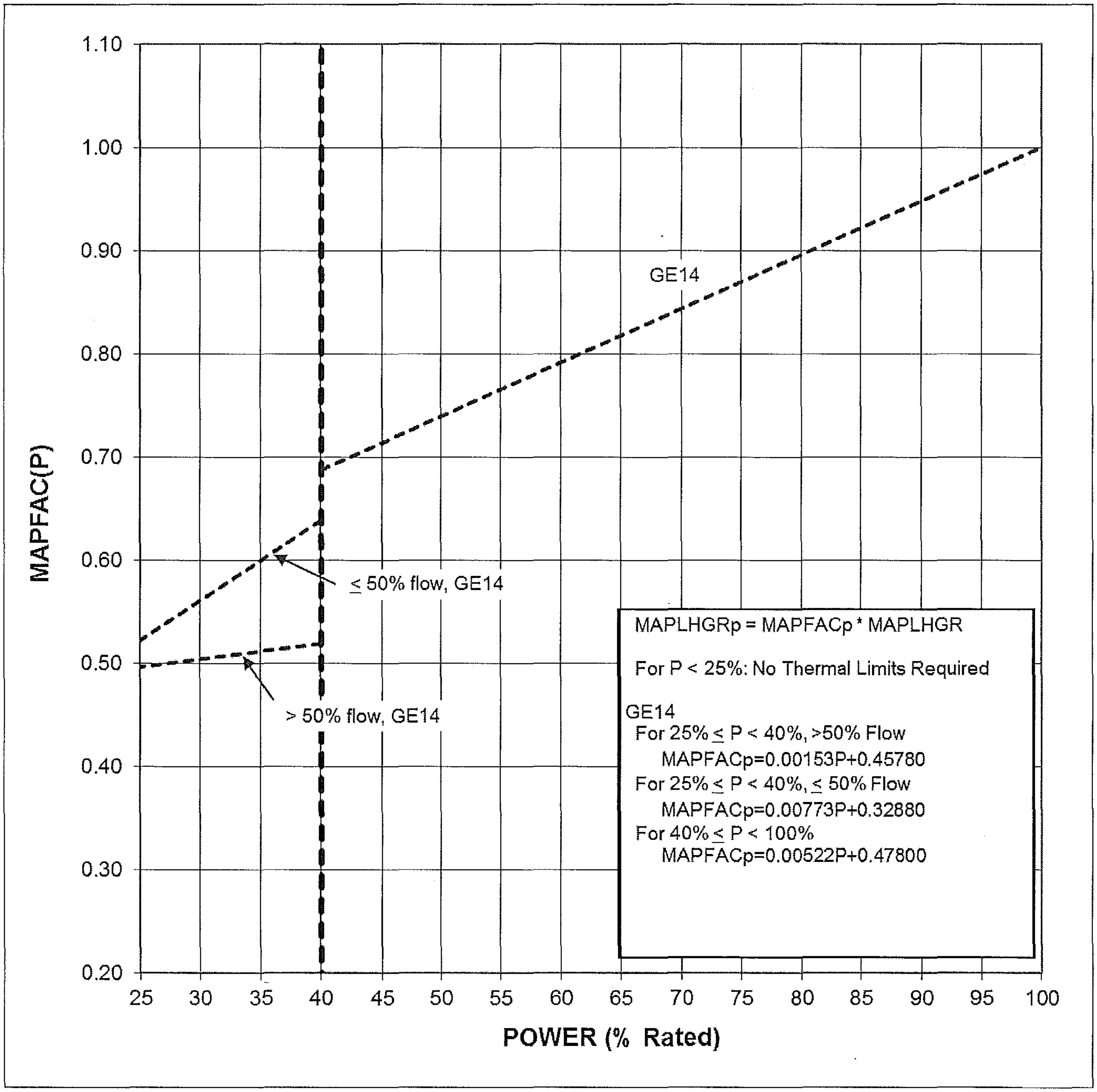
Results from the equations above are accurate to two decimal places.

Figure 13
Power Dependent MCPR(P) Limits for SLO with NSS/TSSS Insertion Rates



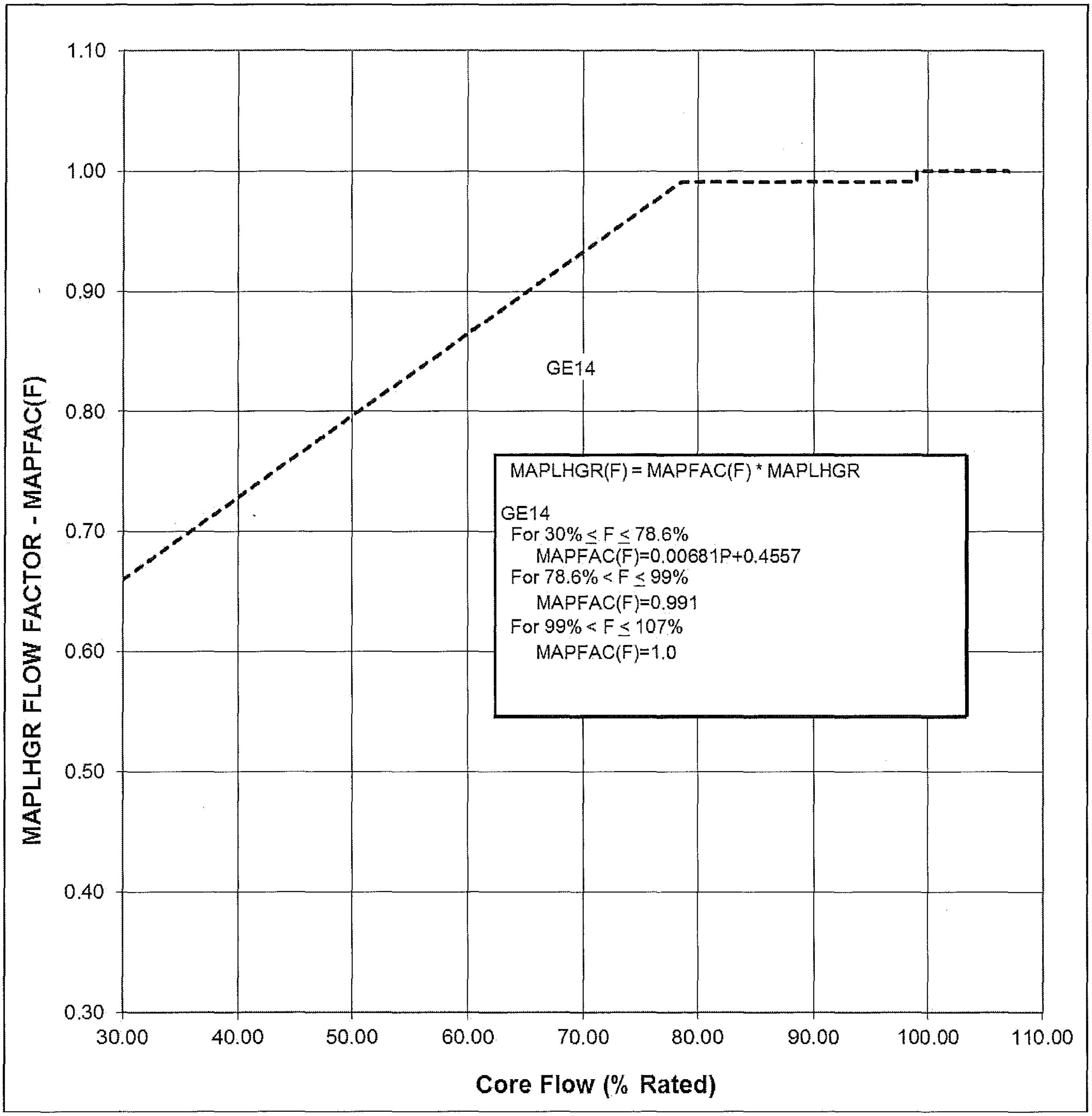
Results from the equations above are accurate to three decimal places.

Figure 14
Power Dependent MAPLHGR Multipliers



Results from the equations above are accurate to three decimal places.

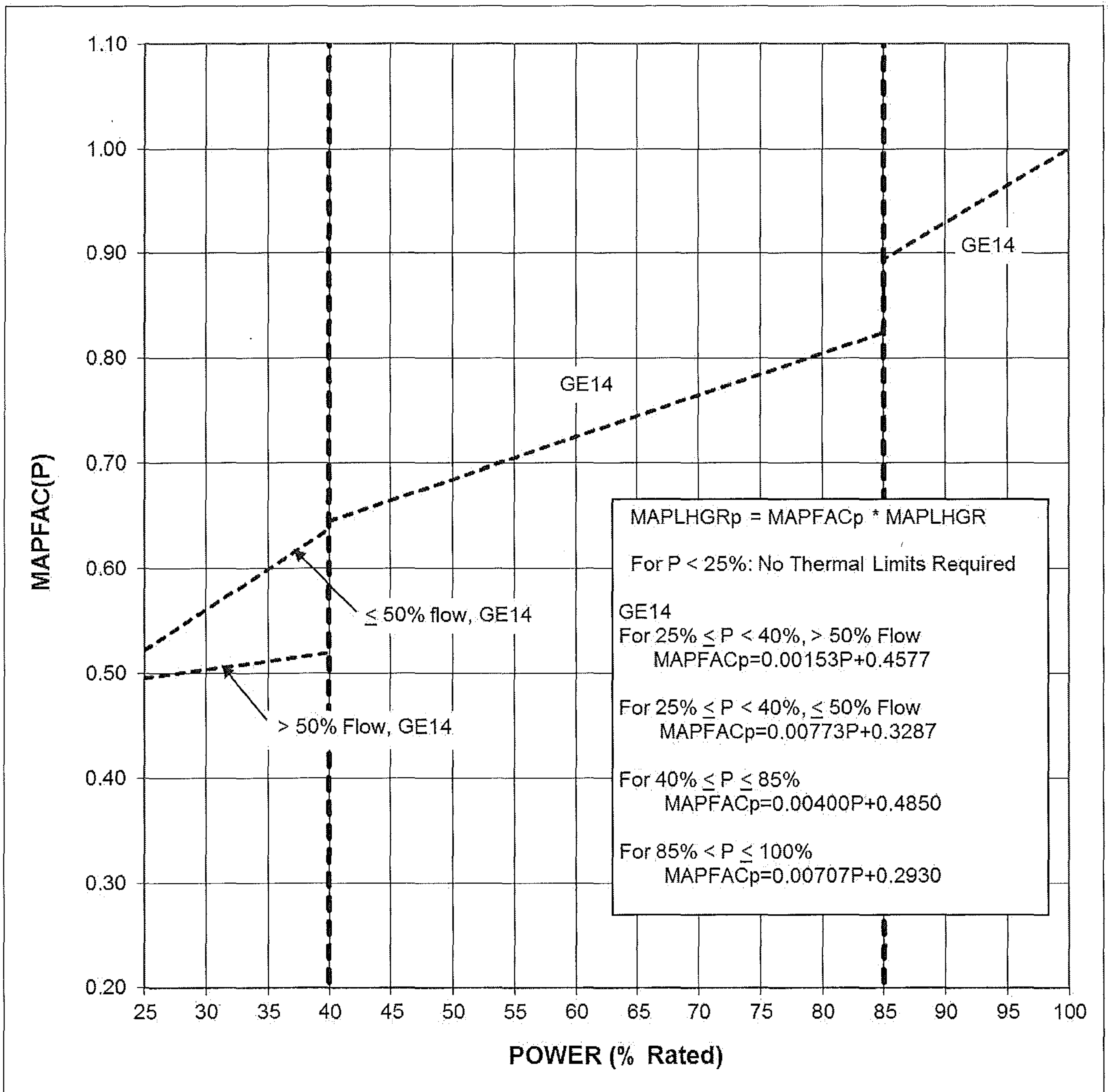
Figure 15
Flow Dependent MAPLHGR Multipliers



In addition to the flow dependent multipliers, Monticello also requires an ECCS MAPLHGR multiplier of 0.9908 for operation at or below 99% core flow for GE14 fuel. This multiplier ensures that the off-rated limits assumed in the EPU ECCS-LOCA analyses bound the cycle-specific off-rated limits calculated for MELLLA+ (EFW) operation.

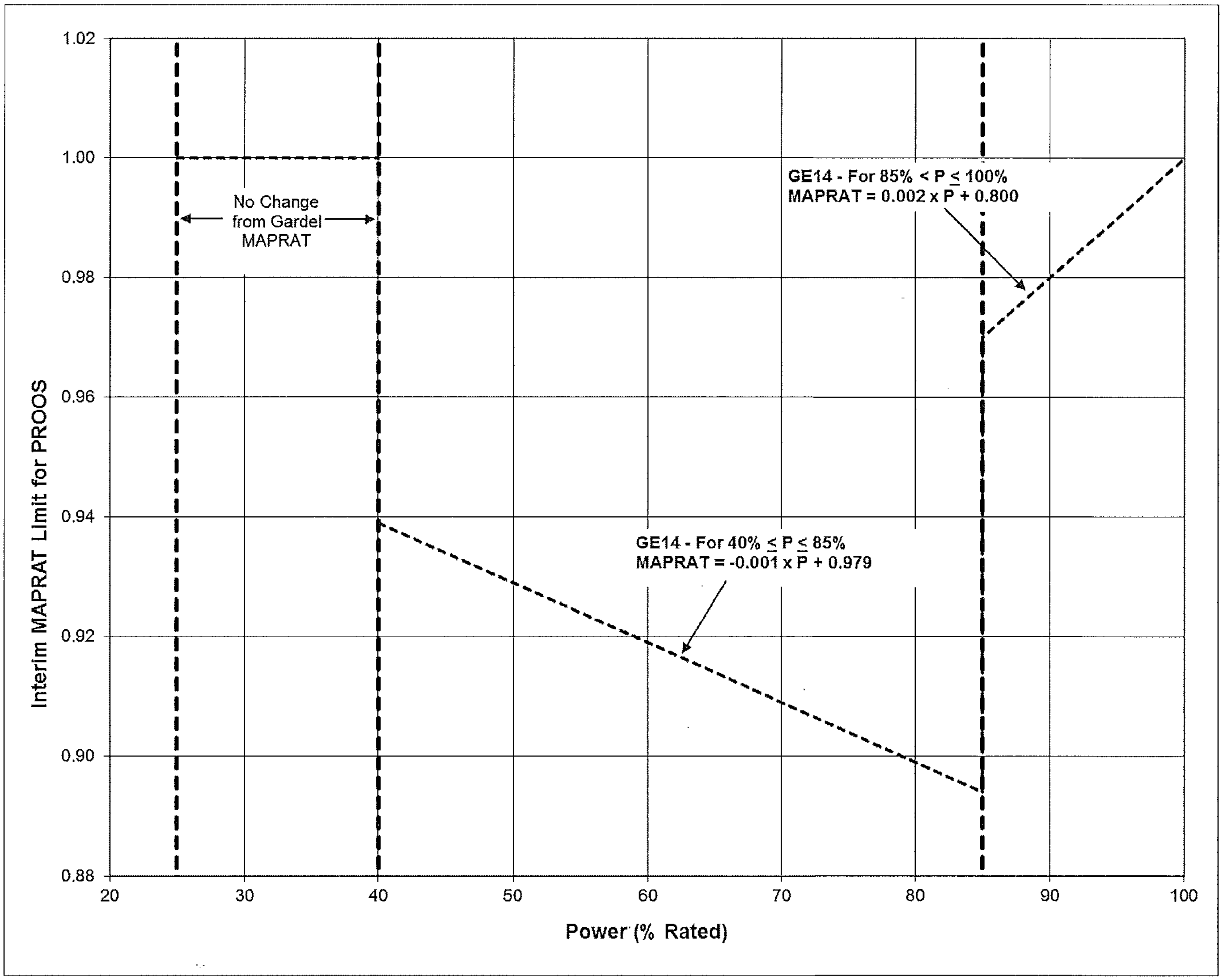
Results from the equations above are accurate to three decimal places.

Figure 16
Pressure Regulator Out Of Service (PROOS)
Power Dependent MAPLHGR Multipliers



Results from the equations above are accurate to three decimal places.

Figure 17
Pressure Regulator Out of Service (PROOS)
Interim MAPRAT Limits



Results from the equations above are accurate to three decimal places.

<u>ENCLOSURE 2</u>

MONTICELLO NUCLEAR GENERATING PLANT

AFFIDAVIT FOR PROPRIETARY

CYCLE 29

CORE OPERATING LIMITS REPORT

NAD-MN-042P

(3 pages follow)

Global Nuclear Fuel – Americas

AFFIDAVIT

I, Brian R. Moore, state as follows:

(1) I am the General Manager, Core & Fuel Engineering, Global Nuclear Fuel – Americas, LLC ("GNF-A"), and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 1 of GNF's letter VSP-NMC-EK1-17-046, Vickie Perry to David Mienke (Xcel Energy), entitled "Monticello Nuclear Generating Plant Cycle 29 Core Operating Limits Report Revision 2," June 21, 2017. GNF proprietary information in Enclosure 1, which is entitled "Monticello Nuclear Generating Plant Cycle 29 Core Operating Limits Report Revision 2," is identified by a dotted underline inside double square brackets. [[This sentence is an example.{3}]] A "[[" marking at the beginning of a table, figure, or paragraph closed with a "]]" marking at the end of the table, figure or paragraph is used to indicate that the entire content between the double brackets is proprietary. In each case, the superscript notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GNF-A relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GNF-A's competitors without license from GNF-A constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future GNF-A customer-funded development plans and programs, resulting in potential products to GNF-A;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. above.

(5) To address 10 CFR 2.390 (b) (4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GNF-A, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GNF-A, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GNF-A.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GNF-A are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2) is classified as proprietary because it contains details of GNF-A's fuel design and licensing methodology.

The development of the methods used in these analyses, along with the testing, development and approval of the supporting methodology was achieved at a significant cost to GNF-A or its licensor.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GNF-A's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GNF-A's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical, and NRC review costs comprise a substantial investment of time and money by GNF-A.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GNF-A's competitive advantage will be lost if its competitors are able to use the results of the GNF-A experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GNF-A would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GNF-A of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 20th day of June 2017.

B R Moore

Brian R. Moore
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