Xcel Energy®

2807 West County Road 75
Monticello, MN 55362

May 2, 2023

L-MT-23-021
Technical Specification 5.6.3.d

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

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

Core Operating Limits Report (COLR) for the Monticello Nuclear Generating Plant for Cycle 32

Reference: 1) NSPM to NRC, "Core Operating Limits Report (COLR) for Monticello Nuclear Generating Plant Cycle 31, Revision 3 (ADAMS Accession No. ML23087A090), dated March 28, 2023

Pursuant to the requirements of Technical Specification 5.6.3.d, Northern States Power Company, a Minnesota corporation, doing business as Xcel Energy (hereafter "NSPM"), is submitting the Core Operating Limits Report (COLR) for the Monticello Nuclear Generating Plant (MNGP) for Cycle 32.

The COLR for Cycle 32 supercedes Reference 1 and reflects the adoption of the Framatome, Inc., ATRIUM 11 fuel type together with the associated analysis methodology changes. The enclosure provides a copy of the MNGP COLR for Cycle 32 (NAD-MN-053).

If you have any questions about this submittal, please contact Rick Loeffler, Senior Regulatory Engineer, at rick.a.loeffler@xcelenergy.com.

Summary of Commitments

This letter makes no new commitments and no revisions to existing commitments.

Shawn C. Hafen
Plant Manager, Monticello Nuclear Generating Plant
Northern States Power Company – Minnesota

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, Monticello, USNRC
Resident Inspector, Monticello, USNRC
State of Minnesota

ENCLOSURE

MONTICELLO NUCLEAR GENERATING PLANT

CYCLE 32

CORE OPERATING LIMITS REPORT

NAD-MN-053

(26 pages follow)

Xcel Energy

Monticello Nuclear Generating Plant

Cycle 32

Core Operating Limits Report

Revision 0

NAD-MN-053

Prepared By: Prepared per LDC 600001101638
Steven Winston
Senior Engineer, Nuclear Analysis and Design

Verified By: Verified per LDC 600001101637
Sam Jenko
Senior Engineer, Nuclear Analysis and Design

Reviewed By: Reviewed per LDC 600001101640
Kevin Austin
Reactor Engineering – Monticello

Approved By: Approved per LDC 600001101639
Darius Ahrar
Manager, Nuclear Analysis and Design

Table of Contents

Section/Description | Page #

List of Tables

Table/Description

List of Figures

Figure/Description Page #

1.0 Core Operating Limits Report (COLR)

This Core Operating Limits Report for Monticello Nuclear Generating Plant (MNGP) Cycle 32 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.

A 0.03 penalty has been applied to the SLMCPR when the ratio of core power to core flow is ≥ 42 MWt / Mlbm/hr in the EFW region. This penalty has been incorporated into the OLMCPR. 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. Note that Single Loop Operation is not permitted in the EFW region.

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

This report includes using S-RELAP5 Reference [1], XCOBRA Reference [2], RODEX4 Reference [3] and CASMO-4/MICROBURN-B2 Reference [4] as described in the Framatome THERMEX methodology report Reference [2] and neutronics methodology report Reference [5].

2.0 References

1.0 ANP-10300P-A, Revision 1, "AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Transient and Accident Scenarios", January 2018.

2.0 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.

3.0 BAW-10247PA Revision 0, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors", February 2008.

4.0 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.

5.0 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.

6.0 ANP-4039P, Revision 0, "Monticello Cycle 32 Reload Safety Analysis", March 2023.

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

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

9.0 ANP-10344P-A, Revision 0, "Framatome Best-estimate Enhanced Option III Methodology" March 2021

10.0 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.

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

3.0 Rod Block Monitor Operability Requirements

The Rod Withdrawal Error (RWE) analysis Reference [6] validated that the following MCPR values provide the required margin for full withdrawal of any control rod during Monticello Cycle 32:

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

For Power ≥ 30% and < 90%: MCPR ≥ 2.17 (for TLO)

For Power ≥ 30% and < 90%: MCPR ≥ 2.19 (for SLO)

For Power ≥ 90%: MCPR ≥ 1.60 (for TLO)

When the core power is greater than or equal to 30% and less than 90% of rated in two-loop operation and the MCPR is less than 2.17, 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 30% and less than 90% of rated in single loop operation and the MCPR is less than 2.19, 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 90% and the MCPR is less than 1.60, 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 [7].

5.0 Minimum Critical Power Ratio (MCPR)

The cycle specific MCPR limits protect the $MCPR_{95\%/95\%}$ limit of 1.05 which is a generic value based on the ATRIUM 10XM/ATRIUM 11 fuel type and the ACE MCPR correlations.

The cycle specific MCPR limits presented in Figures 3-5, and Figures 7-9 are based on TLO and SLO $MCPR_{99.9\%}$ values of 1.09 and 1.11 which meets the requirement in Technical Specification. 2.1.1.3

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 (TLO) as follows, where core thermal power is denoted by (P):

For 25% ≤ (P) ≤ 100%:

1. The TSSS OLMCPR is the greater of {MCPR(P) from Figure 3} or {MCPR(F) from Figure 5}

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.

5.2.1 NSS OLMCPR for Two Recirculation Loop Operation

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

For 25% ≤ (P) ≤ 100%:

1. The NSS OLMCPR is the greater of {MCPR(P) from Figure 4} or {MCPR(F) from Figure 5}.

Reference: Technical Specification Section 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:

$$\tau^P_{ave} = \frac{\sum_{i=1}^{N} \tau^P_i}{N} \quad (1)$$

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 not declared slow ($N \leq 121$).
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 not declared slow (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:

$$\tau^P_{ave} \leq NSS^P \quad (2)$$

where:

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

NSS Scram Insertion Time to CRD Notch Position

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.

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 Failure Down-Scale (PRFDS) event without backup pressure regulator was evaluated for Monticello (Reference [6]). 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 power dependent limits have been generated for Cycle 32 (Reference [6]). Figure 7 provides the required more restrictive power dependent MCPR limits. The Pressure Regulator Out of Service limits are applicable for Cycle 32 (Reference [6]).

Figure 7 shows the more restrictive limits determined in Reference [6] for PROOS operation. Figure 7 should only be used for operation without a backup pressure regulator. Figure 7 is valid for both TSSS and NSS OLMCPR limits.

An interim MFLCPR Limit is provided in Figure 8. This limit should only be used if the Gardel thermal limit input has not been modified as described in Section 5.4.1 to account for pressure regulator out of service operation. That is, only Figure 7 or Figure 8 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 PROOS TSSS OLMCPR and NSS OLMCPR shall be determined for two recirculation loop operation as follows:

For 25% ≤ (P) ≤ 100%:

1. the OLMCPR is the greater of {MCPR(P) from Figure 7} or {MCPR(F) from Figure 5}

5.5 OLMCPR for Single Recirculation Loop Operation

For single recirculation loop operation, there are not separate TSSS, NSS and PROOS OLMCPRs. The OLMCPR is bounded in all three conditions by the same limit. It shall be determined as follows:

1. the OLMCPR is the greater of {MCPR(P) from Figure 9} or {MCPR(F) from Figure 5}

Reference: Technical Specification Section 3.2.2.

6.0 Power-Flow Map

The Power-Flow Operating Map based on analysis to support Cycle 32 is shown in Figure 6. The Power-Flow Operating Map is consistent with a rated power of 2004 MWt as described in Reference [8]. The Backup Stability Protection (BSP) lines are described in Section 9.0 of this report.

Region I in Figure 6 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

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
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-10247PA	Rev. 0	"Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors," February 2008
ANP-10298PA	Rev. 1	"ACE/ATRIUM 10XM Critical Power Correlation," March 2014
ANP-10307PA	Rev. 0	"AREVA MCPR Safety Limit Methodology for Boiling Water Reactors," June 2011
BAW-10255(P)(A)	Rev. 2	"Cycle-Specific DIVOM Methodology Using the RAMONA5-FA Code," May 2008
BAW-10247P-A	Rev. 0	Supplement 2P-A "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors Supplement 2 Mechanical Methods" August 2018
ANP-10340P-A	Rev. 0	"Incorporation of Chromia Doped Fuel Properties in AREVA Approved Methods" May 2018
ANP-10335P-A	Rev. 0	"ACE/ATRIUM 11 Critical Power Correlation" May 2018
ANP-10333P-A	Rev. 0	"AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Control Rod Drop Accident (CRDA)" March 2018
ANP-10300P-A	Rev. 1	"AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Transient and Accident Scenarios" January 2018
ANP-10332P-A	Rev. 0	"AURORA-B: An Evaluation Model for Boiling Water Reactors; Application to Loss of Coolant Accident Scenarios" June 2019
ANP-10344P-A	Rev. 0	Framatome Best-estimate Enhanced Option III Methodology" March 2021
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"
NEDO-31960-A		"BWR Owners Group – Long Term Stability Solutions Licensing Methodology with Supplement 1" November 1995
NEDO-32465-A		"Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications" August 1996

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 2 and Table 3 are conservative values bounding all fuel lattice types in a given fuel bundle design and are intended only for use to determine bounding thermal limits 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 ATRIUM 11 fuel 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.

To determine bounding MAPLHGR limits:

8.1.1 Single and 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 2 through Table 3.

The MAPLHGR limit for single (SLO) and two recirculation loop (TLO) operation are determined as follows:

1. For ATRIUM 10XM:
    a. For **TLO**, the MAPLHGR limits are listed in Table 2
    b. For **SLO**, multiply the MAPLHGR limit in Table 2 by 0.70.
2. For ATRIUM 11:
    a. For **TLO**, the MAPLHGR limits are listed in Table 3.
    b. For **SLO**, multiply the MAPLHGR limit in Table 3 by 0.80.

Straight line interpolation between nearest data points is permitted only within each individual Table from Table 2 through Table 3

8.2 Linear Heat Generation Rate (LHGR)

For ATRIUM 10XM fuel, the LHGR limits provided in Table 4 are applicable to all ATRIUM 10XM fuel in Cycle 32. 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. There are no separate single loop operation specific multipliers applicable to LHGR, as such TLO and SLO limits are the same.

For ATRIUM 11 fuel, the LHGR limits provided in Table 5 are applicable to all ATRIUM 11 fuel in Cycle 32. 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. There are no separate single loop operation specific multipliers applicable to LHGR, as such TLO and SLO limits are the same.

The individual LHGR limits for the uranium dioxide and gadolinia fuel rods in each fuel bundle type used in Cycle 32, 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 to determine bounding thermal limits to demonstrate compliance with Technical Specification 3.2.3.

To determine bounding LHGR limits:

8.2.1 Single and 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 4 and Table 5.

LHGR limits are adjusted for off-rated core thermal power and core flow conditions as follows:

1. For ATRIUM 10XM calculate the minimum of:

    a. LHGR(P) = LHGRFAC(P) * LHGR limit from Table 4 where LHGRFAC(P) comes from Figure 1.

    <u>OR</u>

    b. LHGR(F) = LHGRFAC(F) * LHGR limit from Table 4 where LHGRFAC(F) comes from Figure 2.

2. For ATRIUM 11 calculate the minimum of:

    a. LHGR(P) = LHGRFAC(P) * LHGR limit from Table 5 where LHGRFAC(P) comes from Figure 1.

    <u>OR</u>

    b. LHGR(F) = LHGRFAC(F) * LHGR limit from Table 5 where LHGRFAC(F) comes from Figure 2.

8.3 Pressure Regulator Out of Service (PROOS) Operation

The Pressure Regulator Failure Down-Scale (PRFDS) event without backup pressure regulator was evaluated for Monticello in Reference [6]. The results show for both ATRIUM 10XM and ATRIUM 11 the MAPLHGR **limits are unchanged** from Section 8.1, and the LHGR **limits are unchanged** from Section 8.2.

The MCPR limits for the PROOS event are discussed in Section 5.4.

Table 2
MAPLHGR Limits, ATRIUM 10XM

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

Notes:
(1) Applicable multipliers per Section 8.1 will be applied to the data in this table for two recirculation loop and single recirculation loop operations.
(2) MAPLHGR Data, Reference [6].

Table 3
MAPLHGR Limits, ATRIUM 11

Average Planar Exposure GWD/MTU	MAPLHGR Limit (kW/ft)[(1)(2)]
0.00	10.0
20.00	10.0
60.00	9.0
69.00	7.2

Notes:
(1) Applicable multipliers per Section 8.1 will be applied to the data in this table for two recirculation loop and single recirculation loop operations.
(2) MAPLHGR Data, Reference [6].

Table 4
ATRIUM 10XM Steady-State LHGR Limits

Peak Pellet Exposure GWD/MTU	LHGR Limit [(a)(b)(c)] (kW/ft)
0.0	14.1
18.9	14.1
74.4	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 is from Reference [6].
(c) Extrapolation beyond the exposure in this table is allowed as long as the full length fuel rod exposure does not exceed the licensing limit of 62.0 GWD/MTU.

Table 5
ATRIUM 11 Steady-State LHGR Limits

Peak Pellet Exposure GWD/MTU	LHGR Limit [(a)(b)(c)] (kW/ft)
0.0	13.6
21.0	13.6
53.0	10.2
80.0	3.5

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 is from Reference [6].
(c) Extrapolation beyond the exposure in this table is allowed as long as the full length fuel rod exposure does not exceed the licensing limit of 62.0 GWD/MTU.

8.4 Main Steam Isolation Valve Out of Service (MSIVOOS) Operation

The Main Steam Line Isolation Valve Out of Service (MSIVOOS) event is not analyzed for Cycle 32.

9.0 Core Stability Requirements

9.1 Stability Best-estimate BEO-III Solution

Monticello has implemented the Framatome Best-estimate Enhanced Option III (BEO-III) Long Term Stability solution using the Oscillation Power Range Monitor (OPRM) as described in Reference [9]. Exposure points are analyzed to provide margin to MCPR and Independent Channel Oscillation at a 95/95 confidence level. The Cycle 32 Best-estimate Enhanced Option III (BEO-III) Stability Evaluation is documented in Reference [6]. A Backup Stability Protection (BSP) evaluation is also documented in Reference [6].

Reference: Technical Specification 3.3.1.1

9.2 Best-estimate Enhanced Option III OPRM Setpoints

A reload Best-estimate Enhanced Option III evaluation has been performed in accordance with the licensing methodology described in Reference [9].

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

Table 6
Licensed OPRM Amplitude Setpoint

Confirmation Count Setpoint	OPRM Amplitude Setpoint
20	1.24

Reference: Technical Specification 3.3.1.1

9.3 Backup Stability Protection Regions

The Backup Stability Protection (BSP) regions are shown in Figure 6. 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 (Reference [6]) performed using NRC-approved methodology

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 32 for nominal feedwater temperature conditions. The endpoints of the regions are defined in Table 7. The region boundaries shown in Figure 6 are defined using the Generic Shape Function (GSF), which is described in Reference [9].

Table 7
BSP Endpoints for Normal Feedwater Temperature

Endpoint	Power (%)	Flow (%)	Definition
A1	56.5	40.0	Scram Region Boundary, high flow control line (HFCL)
B1	42.5	33.7	Scram Region Boundary, intersection of the 100% OLTP load line and Natural Circulation Line (NCL)
A2	64.4	50.0	Controlled Entry Region Boundary, HFCL
B2	28.5	31.2	Controlled Entry Region Boundary, intersection of the 70% OLTP load line and NCL

Reference: Technical Specification 3.3.1.1

9.4 Actions For Entry Into Scram Region

If the Upscale Trip function of the OPRM is inoperable, initiate immediate manual scram upon determination that Region I has been entered. If entry is unavoidable, early scram initiation is appropriate.

9.5 Actions For Entry Into Controlled Entry Region

If the Upscale Trip function of the OPRM is inoperable, and entry into Region II 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) ≥ 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 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):

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

where:

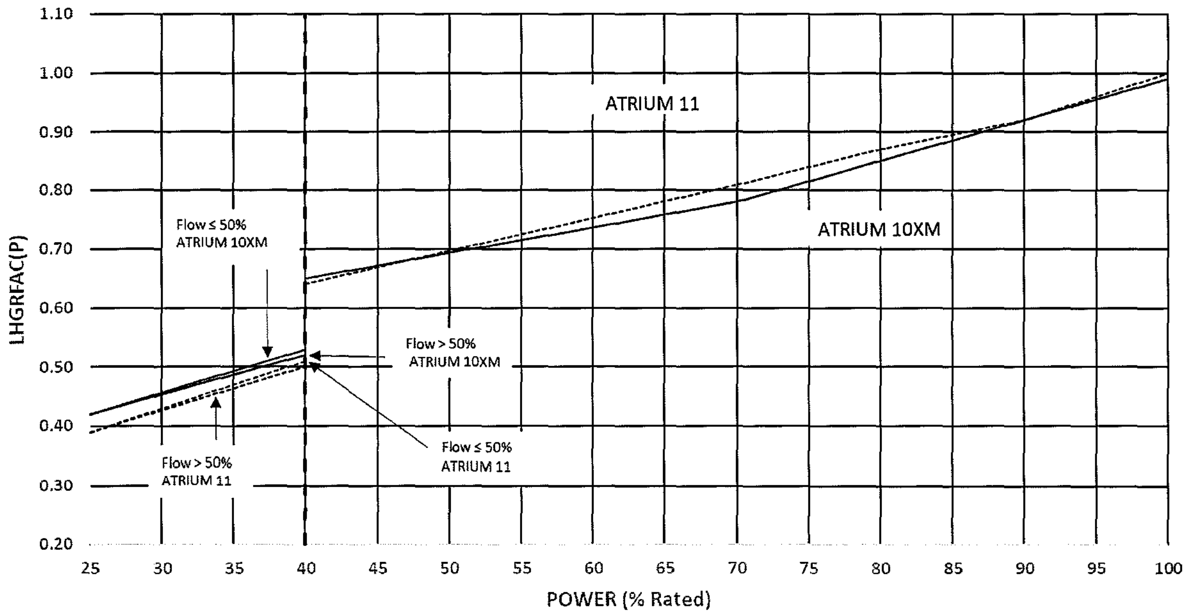
S_{STP} = Scram setting in percent of rated thermal power (2004 MWt)

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 [10]

Figure 1
Power Dependent LHGR Multipliers



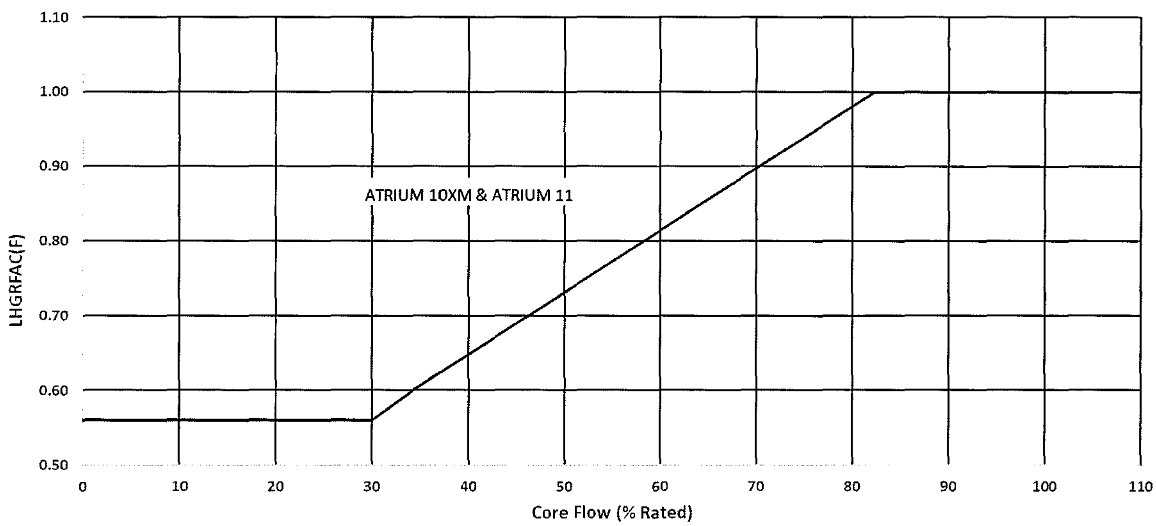
$$LHGRFAC_P = A + B*P$$

Flow	Type	Power	A	B
F ≤ 50	A10XM	25 ≤ P ≤ 40	0.2367	0.00733
F > 50	A10XM	25 ≤ P ≤ 40	0.2532	0.00667
All	A10XM	40 < P ≤ 70	0.4768	0.00433
All	A10XM	70 < P ≤ 80	0.2900	0.00700
All	A10XM	80 < P ≤ 90	0.2900	0.00700
All	A10XM	90 < P ≤ 100	0.2900	0.00700
F ≤ 50	ATRIUM 11	25 ≤ P ≤ 40	0.1900	0.00800
F > 50	ATRIUM 11	25 ≤ P ≤ 40	0.2067	0.00733
All	ATRIUM 11	40 < P ≤ 70	0.4132	0.00567
All	ATRIUM 11	70 < P ≤ 80	0.3900	0.00600
All	ATRIUM 11	80 < P ≤ 90	0.4700	0.00500
All	ATRIUM 11	90 < P ≤ 100	0.2000	0.00800

P = Percent of Rated Core Power
F = Percent of Rated Core Flow

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

Figure 2
Flow Dependent LHGR Multipliers



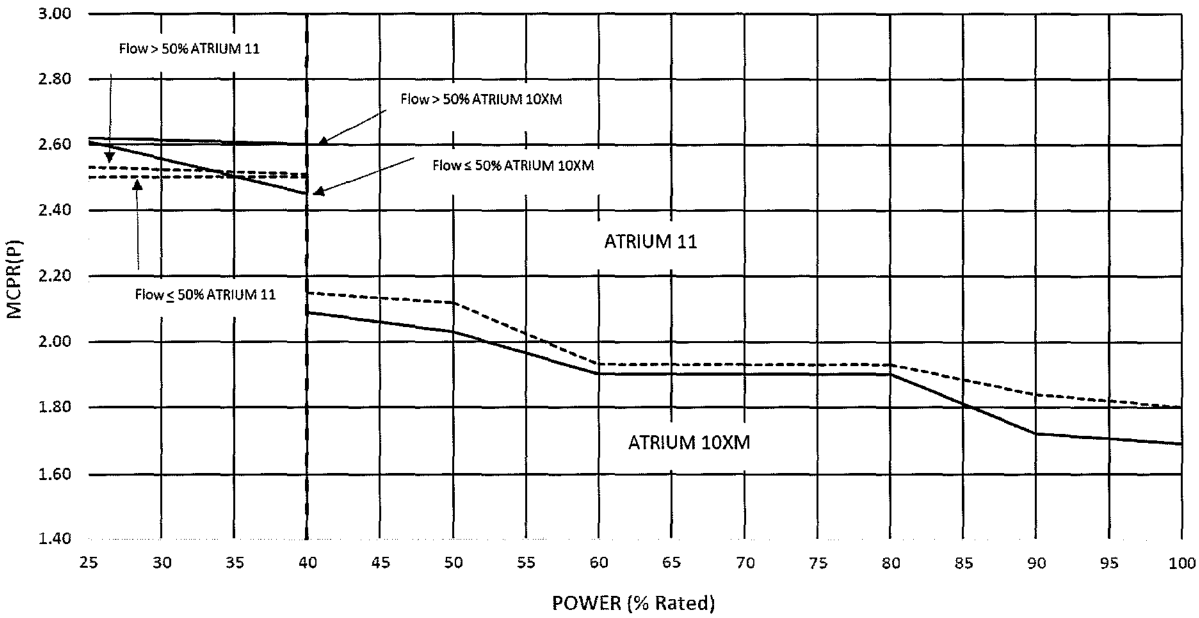
$$LHGRFAC_F = A + B*F$$

Flow	Type	Power	A	B
0.0 ≤ F ≤ 30.0	A10XM & ATRIUM 11	All	0.5600	0.00000
30 < F ≤ 34.2	A10XM & ATRIUM 11	All	0.2744	0.00952
34.2 < F ≤ 82.3	A10XM & ATRIUM 11	All	0.3154	0.00832
82.3 < F ≤ 107	A10XM & ATRIUM 11	All	1.0000	0.00000

F = Percent of Rated Core Flow

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

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



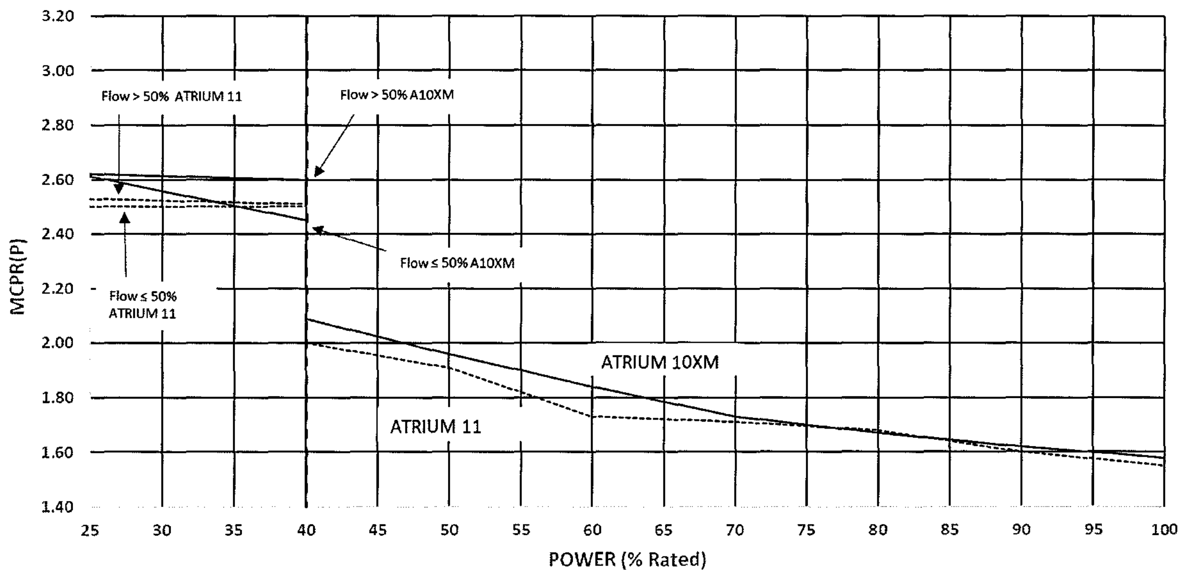
$$MCPR_P = A + B*P$$

Flow	Type	Power	A	B
F ≤ 50	A10XM	25 ≤ P ≤ 40	2.8768	-0.01067
F >50	A10XM	25 ≤ P ≤ 40	2.6533	-0.00133
All	A10XM	40 < P ≤ 50	2.3300	-0.00600
All	A10XM	50 < P ≤ 60	2.6800	-0.01300
All	A10XM	60 < P ≤ 70	1.9000	0.00000
All	A10XM	70 < P ≤ 80	1.9000	0.00000
All	A10XM	80 < P ≤ 90	3.3400	-0.01800
All	A10XM	90 < P ≤ 100	1.9900	-0.00300
F ≤ 50	ATRIUM 11	25 ≤ P ≤ 40	2.5000	0.00000
F >50	ATRIUM 11	25 ≤ P ≤ 40	2.5633	-0.00133
All	ATRIUM 11	40 < P ≤ 50	2.2700	-0.00300
All	ATRIUM 11	50 < P ≤ 60	3.0700	-0.01900
All	ATRIUM 11	60 < P ≤ 70	1.9300	0.00000
All	ATRIUM 11	70 < P ≤ 80	1.9300	0.00000
All	ATRIUM 11	80 < P ≤ 90	2.6500	-0.00900
All	ATRIUM 11	90 < P ≤ 100	2.2000	-0.00400

P = Percent of Rated Core Power
F = Percent of Rated Core Flow

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

Figure 4
Power Dependent MCPR(P) Limits for TLO, NSS Insertion Rates



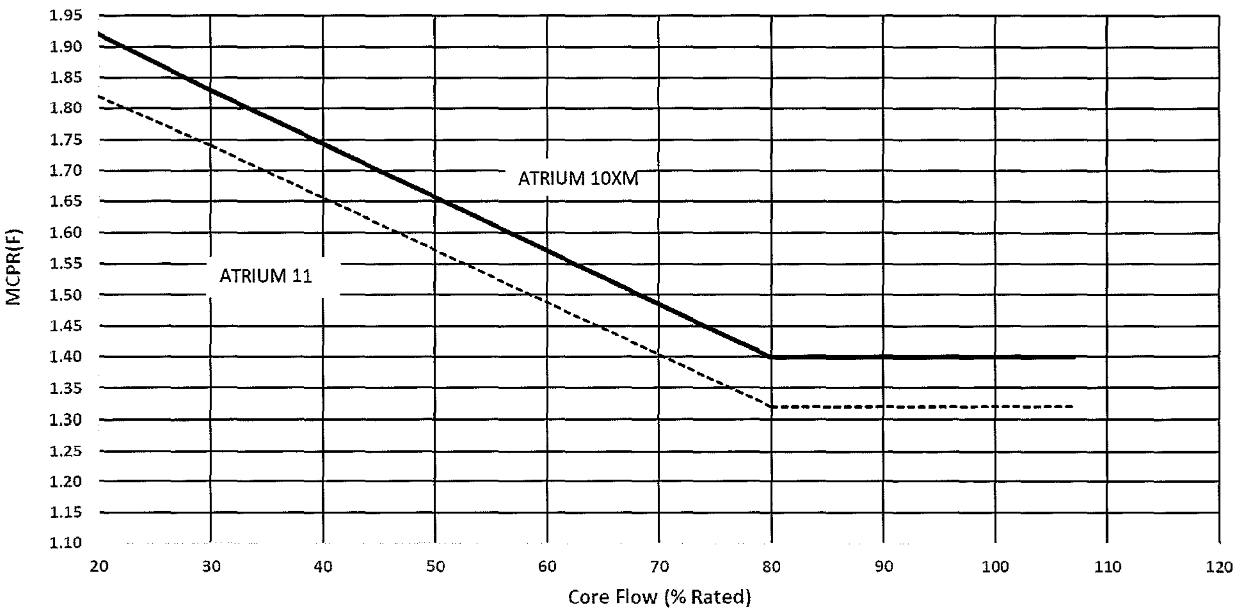
$$MCPR_P = A + B*P$$

Flow	Type	Power	A	B
F ≤ 50	A10XM	25 ≤ P ≤ 40	2.8768	-0.01067
F >50	A10XM	25 ≤ P ≤ 40	2.6533	-0.00133
All	A10XM	40 < P ≤ 50	2.6100	-0.01300
All	A10XM	50 < P ≤ 60	2.5600	-0.01200
All	A10XM	60 < P ≤ 70	2.5000	-0.01100
All	A10XM	70 < P ≤ 80	2.1500	-0.00600
All	A10XM	80 < P ≤ 90	2.0700	-0.00500
All	A10XM	90 < P ≤ 100	1.9800	-0.00400
F ≤ 50	ATRIUM 11	25 ≤ P ≤ 40	2.5000	0.00000
F >50	ATRIUM 11	25 ≤ P ≤ 40	2.5633	-0.00133
All	ATRIUM 11	40 < P ≤ 50	2.3600	-0.00900
All	ATRIUM 11	50 < P ≤ 60	2.8100	-0.01800
All	ATRIUM 11	60 < P ≤ 70	1.8500	-0.00200
All	ATRIUM 11	70 < P ≤ 80	1.9200	-0.00300
All	ATRIUM 11	80 < P ≤ 90	2.3200	-0.00800
All	ATRIUM 11	90 < P ≤ 100	2.0500	-0.00500

P = Percent of Rated Core Power
F = Percent of Rated Core Flow

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

Figure 5
Flow Dependent MCPR(F) Limits



$$MCPR_F = A + B*F$$

Flow	Type	Power	A	B
20 ≤ F ≤ 30	A10XM	All	2.1000	-0.00900
30 < F ≤ 80	A10XM	All	2.0880	-0.00860
80 < F ≤ 107	A10XM	All	1.4000	0.00000
20 ≤ F ≤ 30	ATRIUM 11	All	1.9800	-0.00800
30 < F ≤ 80	ATRIUM 11	All	1.9920	-0.00840
80 < F ≤ 107	ATRIUM 11	All	1.3200	0.00000

F = Percent of Rated Core Flow

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

Figure 6
Power/Flow Map

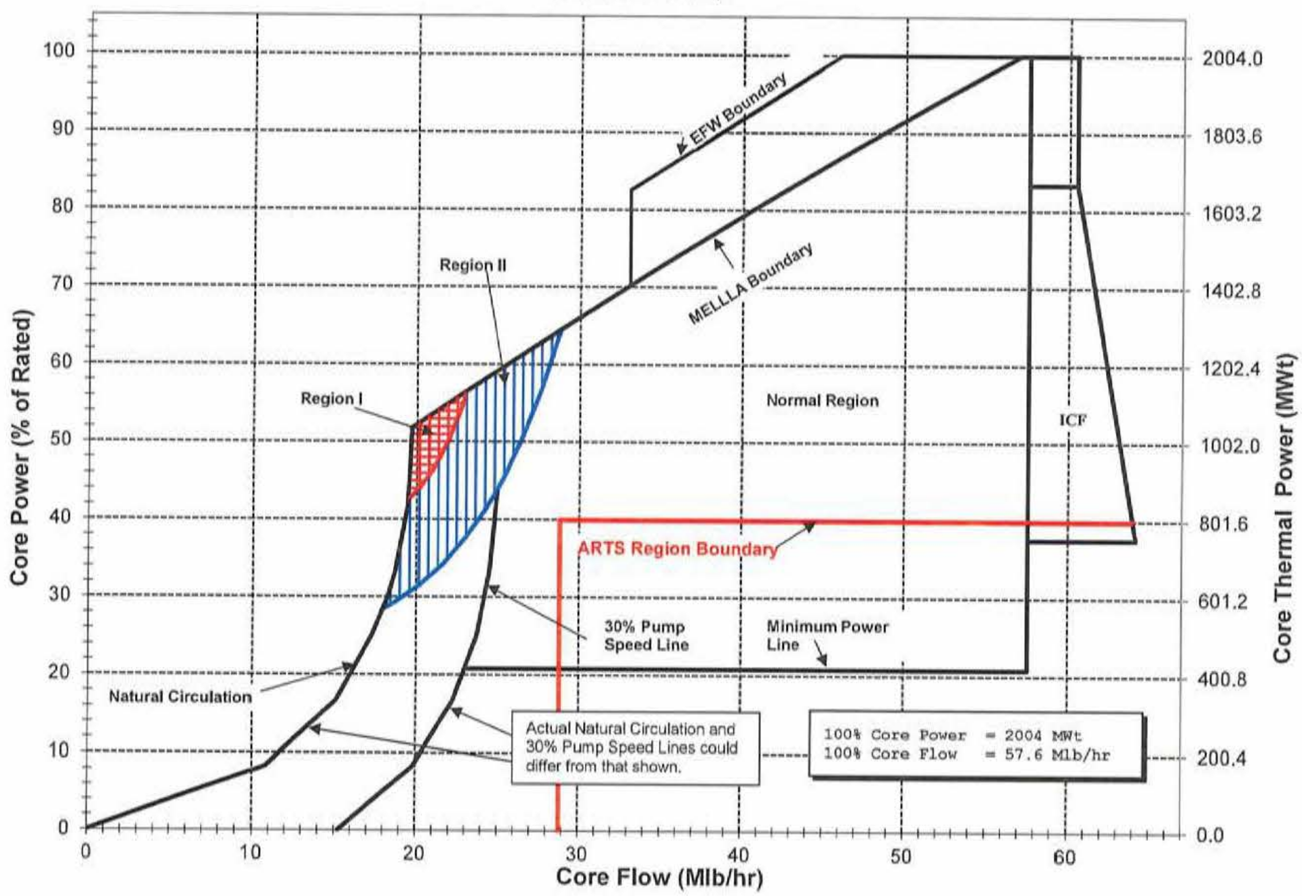
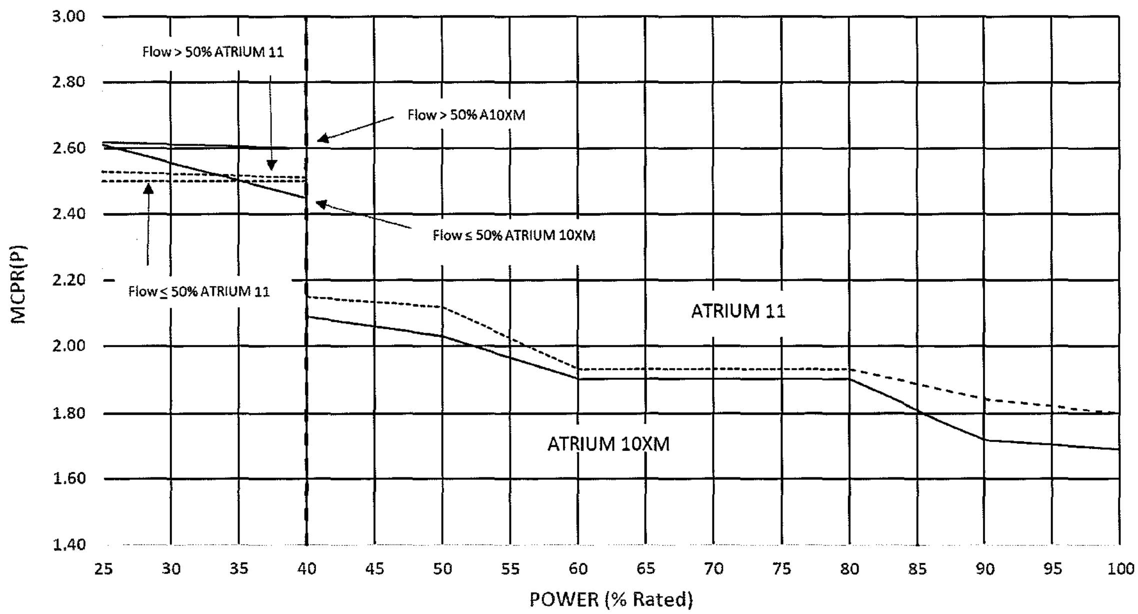


Figure 7
Power Dependent MCPR(P) Limits for TLO
Pressure Regulator Out of Service (PROOS)



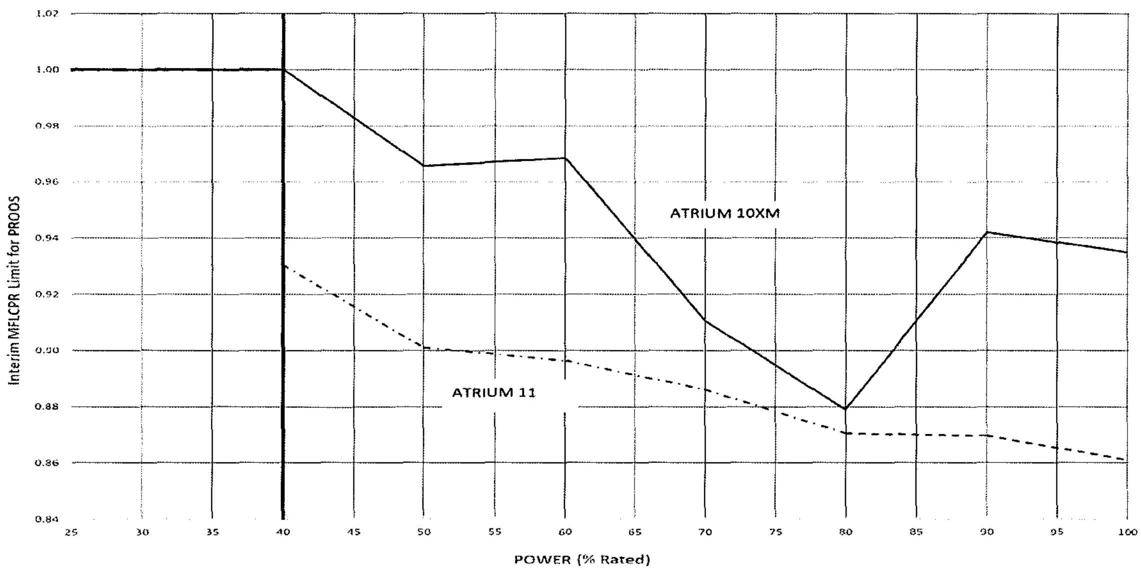
$$MCPR_P = A + B*P$$

Flow	Type	Power	A	B
F ≤ 50	A10XM	25 ≤ P ≤ 40	2.8768	-0.01067
F >50	A10XM	25 ≤ P ≤ 40	2.6533	-0.00133
All	A10XM	40 < P ≤ 50	2.3300	-0.00600
All	A10XM	50 < P ≤ 60	2.6800	-0.01300
All	A10XM	60 < P ≤ 70	1.9000	0.00000
All	A10XM	70 < P ≤ 80	1.9000	0.00000
All	A10XM	80 < P ≤ 90	3.3400	-0.01800
All	A10XM	90 < P ≤ 100	1.9900	-0.00300
F ≤ 50	ATRIUM 11	25 ≤ P ≤ 40	2.5000	0.00000
F >50	ATRIUM 11	25 ≤ P ≤ 40	2.5633	-0.00133
All	ATRIUM 11	40 < P ≤ 50	2.2700	-0.00300
All	ATRIUM 11	50 < P ≤ 60	3.0700	-0.01900
All	ATRIUM 11	60 < P ≤ 70	1.9300	0.00000
All	ATRIUM 11	70 < P ≤ 80	1.9300	0.00000
All	ATRIUM 11	80 < P ≤ 90	2.6500	-0.00900
All	ATRIUM 11	90 < P ≤ 100	2.2000	-0.00400

P = Percent of Rated Core Power
F = Percent of Rated Core Flow

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

Figure 8
Pressure Regulator Out of Service TLO
Interim MFLCPR Limit



MFLCPR = A + B*P

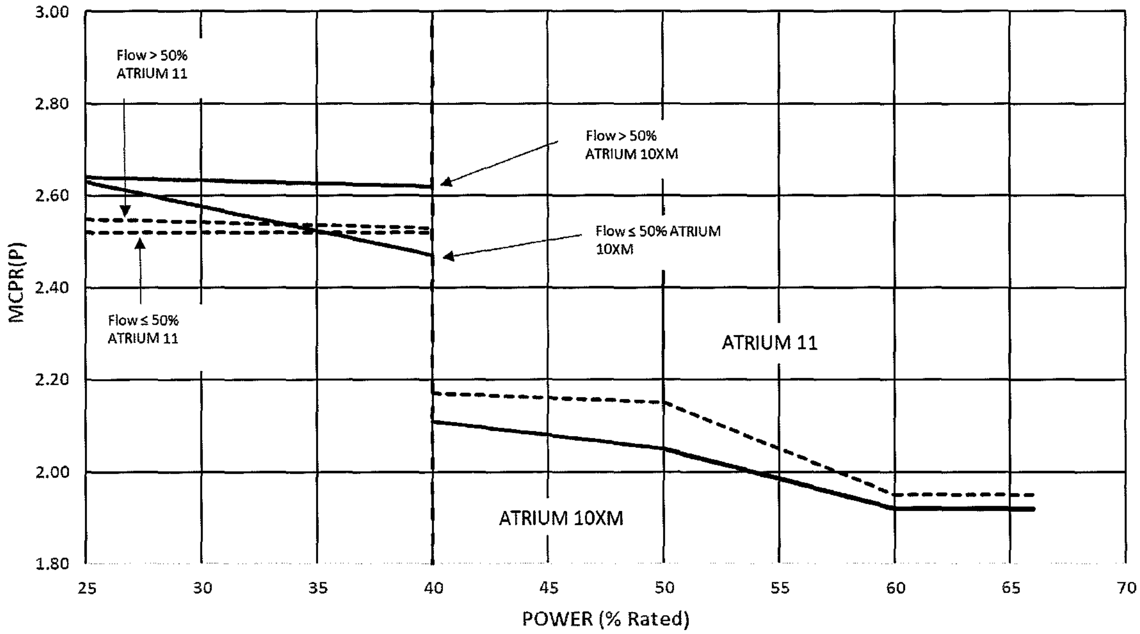
Flow	Type	Power	A	B
All	A10XM	25 ≤ P ≤ 40	1.0000	0.00000
All	A10XM	40 < P ≤ 50	1.1380	-0.00345
All	A10XM	50 < P ≤ 60	0.9510	0.00029
All	A10XM	60 < P ≤ 70	1.3158	-0.00579
All	A10XM	70 < P ≤ 80	1.1317	-0.00316
All	A10XM	80 < P ≤ 90	0.3757	0.00629
All	A10XM	90 < P ≤ 100	1.0039	-0.00069
All	ATRIUM 11	25 ≤ P ≤ 40	1.0000	0.00000
All	ATRIUM 11	40 < P ≤ 50	1.0474	-0.00293
All	ATRIUM 11	50 < P ≤ 60	0.9239	-0.00046
All	ATRIUM 11	60 < P ≤ 70	0.9587	-0.00104
All	ATRIUM 11	70 < P ≤ 80	0.9945	-0.00155
All	ATRIUM 11	80 < P ≤ 90	0.8776	-0.00009
All	ATRIUM 11	90 < P ≤ 100	0.9460	-0.00085

P = Percent of Rated Core Power

Table is valid for NSS and TSSS times.
The limits are not dependent on core flow.

Results from the Table above are accurate to two decimal places

Figure 9
Power Dependent MCPR(P) Limits for SLO with NSS/TSSS Insertion Rates



MCPR(P) = A + B*P

Flow	Type	Power	A	B
F ≤ 50	A10XM	25 ≤ P ≤ 40	2.8968	-0.01067
F >50	A10XM	25 ≤ P ≤ 40	2.6733	-0.00133
All	A10XM	40 < P ≤ 50	2.3500	-0.00600
All	A10XM	50 < P ≤ 60	2.7000	-0.01300
All	A10XM	60 < P ≤ 66	1.9200	0.00000
F ≤ 50	ATRIUM 11	25 ≤ P ≤ 40	2.5200	0.00000
F >50	ATRIUM 11	25 ≤ P ≤ 40	2.5833	-0.00133
All	ATRIUM 11	40 < P ≤ 50	2.2500	-0.00200
All	ATRIUM 11	50 < P ≤ 60	3.1500	-0.02000
All	ATRIUM 11	60 < P ≤ 66	1.9500	0.00000

P = Percent of Rated Core Power

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