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GNRO-2005/00057

October 17, 2005

U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Attention: Document Control Desk

Subject: Core Operating Limits Report Cycle 15 Revision - LDC 05060

Grand Gulf Nuclear Station  
Unit 1  
Docket No. 50-416  
License No. NPF-29

Ladies and Gentlemen:

Entergy Operations, Inc. is submitting revised pages to the Core Operating Limits Report (COLR) for Grand Gulf Nuclear Station (GGNS) (reference: Licensing Document Change LDC 05060) as required by GGNS Technical Specification 5.6.5. for a Cycle 15 Revision. The analytical methods used to determine the Cycle 15 Core Operating Limits were previously approved by the NRC and are listed in GGNS Technical Specification 5.6.5. **This letter does not contain any commitments.** If you have any questions or require additional information, please contact Mike Larson (601) 437-6685.

Yours truly,

A handwritten signature in black ink, appearing to be "CAB/MJL", written over a horizontal line.

CAB/MJL

attachment: GGNS Core Operating Limits Report

cc: see next page

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Page 2 of 2

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# **Grand Gulf Nuclear Station Core Operating Limits Report**

## CORE OPERATING LIMITS REPORT

### REASON FOR REVISION

This revision provides the cycle 15 core operating limits. These limits are based on a core power of 3898 MWt.

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# CORE OPERATING LIMITS REPORT

## 1.0 PURPOSE

On October 4, 1988, the NRC issued Generic Letter 88-16 [3.1.1] encouraging licensees to remove cycle-specific parameter limits from Technical Specifications and to place these limits in a formal report to be prepared by the licensee. As long as the parameter limits were developed with NRC-approved methodologies, the letter indicated that this would remove unnecessary burdens on licensee and NRC resources.

On October 29, 1992, Entergy Operations submitted a Proposed Amendment to the Grand Gulf Operating License requesting changes to the GGNS Technical Specifications to remove certain reactor physics parameter limits that change each fuel cycle [3.1.2]. This amendment committed to placing these operating limits in a separate Core Operating Limits Report (COLR) which is defined in Technical Specifications. This PCOL was approved by the NRC by SER dated January 21, 1993 [3.1.3].

The COLR is controlled as a License Basis Document and revised accordingly for each fuel cycle or remaining portion of a fuel cycle. Any revisions to the COLR must be submitted to the NRC for information as required by Tech Spec 5.6.5 and tracked by LCTS 29132. This COLR reports the Cycle 15 core operating and stability limits. |

## 2.0 SCOPE

As defined in Technical Specification 1.1, the COLR is the GGNS document that provides the core operating limits for the current fuel cycle. This document is prepared in accordance with Technical Specification 5.6.5 for each reload cycle using NRC-approved analytical methods.

The Cycle 15 core operating and stability limits included in this report are: |

- the Average Planar Linear Heat Generation Rate (APLHGR),
- the Minimum Critical Power Ratio (MCPR) (including EOC-RPT inoperable),
- the Linear Heat Generation Rate (LHGR) limit, and
- the EIA stability limits.

## CORE OPERATING LIMITS REPORT

### 3.0 REFERENCES

This section contains the background, cycle-specific, and methodology references used in the safety analysis of Grand Gulf Cycle 15.

#### 3.1 Background References

- 3.1.1 MAEC-88/0313, Generic Letter 88-16, "Removal of Cycle-Specific Parameter Limits from Technical Specifications", October 4, 1988.
- 3.1.2 GNRO-92-00093, Proposed Amendment to Grand Gulf Operating License, PCOL-92/07, dated October 29, 1992.
- 3.1.3 GNRI-93-0008, Amendment 106 to Grand Gulf Operating License, January 21, 1993.
- 3.1.4 GEXI 2000-00116, K.V. Walters to J.B. Lee, "Technical Specification and COLR References for Grand Gulf Nuclear Station and River Bend Station," November 3, 2000.

#### 3.2 Current Cycle References

- 3.2.1 EMF-3204 Revision 0, Grand Gulf Nuclear Station Cycle 15 Reload Analysis, dated June 2005.
- 3.2.2 CEO 2000-00094, Jim Head to M.D. Withrow, "Revised E1A Related COLR Input," dated April 20, 2000.
- 3.2.3 JLR:05:131, J.L. Raklios to J.A. Elam, "Grand Gulf Cycle 15 Final Core Loading Report-Revision 1," dated October 6, 2005.

## CORE OPERATING LIMITS REPORT

### 3.3 Methodology References

- 3.3.1 XN-NF-81-58(P)(A) Revision 2 and Supplements 1 and 2, "RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model," Exxon Nuclear Company, March 1984.
- 3.3.2 XN-NF-85-67(P)(A) Revision 1, "Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel," Exxon Nuclear Company, September 1986.
- 3.3.3 EMF-85-74(P) Revision 0 Supplement 1 (P)(A) and Supplement 2 (P)(A), "RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model, Siemens Power Corporation," February 1998.
- 3.3.4 ANF-89-98(P)(A) Revision 1 and Supplement 1, "Generic Mechanical Design Criteria for BWR Fuel Designs," Advanced Nuclear Fuels Corporation, May 1995.
- 3.3.5 EMF-93-177(P)(A) **Revision 1**, "Mechanical Design for BWR Fuel Channels," **dated August 2005**.
- 3.3.6 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.
- 3.3.7 XN-NF-80-19(P)(A) Volume 4 Revision 1, "Exxon Nuclear Methodology for Boiling Water Reactors: Application of the ENC Methodology to BWR Reloads, Exxon Nuclear Company," June 1986.
- 3.3.8 EMF-2158(P)(A) Revision 0, "Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-MICROBURN-B2, Siemens Power Corporation," October 1999.
- 3.3.9 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.
- 3.3.10 XN-NF-84-105(P)(A), Volume 1 and Supplements 1 and 2, "XCOBRA-T: A Computer Code for BWR Transient Thermal Hydraulic Core Analysis," Exxon Nuclear Company, February 1987.
- 3.3.11 ANF-524(P)(A) Revision 2 and Supplements 1 and 2, "ANF Critical Power Methodology for Boiling Water Reactors," Advanced Nuclear Fuels Corporation, November 1990.
- 3.3.12 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.
- 3.3.13 XN-NF-825(P)(A) Supplement 2, "BWR/6 Generic Rod Withdrawal Error Analysis, MCPR<sub>p</sub> for Plant Operation Within the Extended Operating Domain," Exxon Nuclear Company, October 1986.
- 3.3.14 ANF-1358(P)(A) Revision 1, "The Loss of Feedwater Heating Transient in Boiling Water Reactors," Advanced Nuclear Fuels Corporation, September 1992.
- 3.3.15 EMF-1997(P)(A) Revision 0, "ANFB-10 Critical Power Correlation," Siemens Power Corporation, July 1998.

## CORE OPERATING LIMITS REPORT

### 3.3 Methodology References (continued)

- 3.3.16 EMF-1997(P), Supplement 1(P)(A), Revision 0, "ANFB-10 Critical Power Correlation: High Local Peaking Results, Siemens Power Corporation," July 1998.
- 3.3.17 EMF-2209(P)(A) Revision 1 and errata sheet, "SPCB Critical Power Correlation, Siemens Power Corporation," July 2000.
- 3.3.18 EMF-2245(P)(A) Revision 0, "Application of Siemens Power Corporation's Critical Power Correlations to Co-Resident Fuel," Siemens Power Corporation, August 2000.
- 3.3.19 XN-NF-80-19(P)(A), Volumes 2, 2A, 2B, and 2C, "Exxon Nuclear Methodology for Boiling Water Reactors: EXEM BWR ECCS Evaluation Model," Exxon Nuclear Company, September 1982.
- 3.3.20 ANF-91-048(P)(A), "Advanced Nuclear Fuels Corporation Methodology for Boiling Water Reactors EXEM BWR Evaluation Model, Advanced Nuclear Fuel Corporation," January 1993.
- 3.3.21 ANF-91-048(P)(A), Supplements 1 and 2, "BWR Jet Pump Model Revision for RELAX," Siemens Power Corporation, October 1997.
- 3.3.22 XN-CC-33(A) Revision 1, "HUXY: A Generalized Multirod Heatup Code with 10 CFR 50 Appendix K Heatup Option Users Manual," Exxon Nuclear Company, November 1975.
- 3.3.23 EMF-2292(P)(A) Revision 0, "ATRIUM-10: Appendix K Spray Heat Transfer Coefficients, Siemens Power Corporation," September 2000.
- 3.3.24 EMF-CC-074(P)(A) Volume 4 Revision 0, "BWR Stability Analysis-Assessment of STAF with Input from MICROBURN-B2," Siemens Power Corporation, August 2000.
- 3.3.25 NEDE-24011-P-A, General Electric Standard Application for Reactor Fuel (GESTAR-II)

## CORE OPERATING LIMITS REPORT

### 4.0 DEFINITIONS

- 4.1 Average Planar Linear Heat Generation Rate (APLHGR) - the APLHGR shall be applicable to a specific planar height and is equal to the sum of the linear heat generation rates for all the fuel rods in the specified bundle at the specified height divided by the number of fuel rods in the fuel bundle.
- 4.2 Average Planar Exposure - the Average Planar Exposure shall be applicable to a specific planar height and is equal to the sum of the exposure of all the fuel rods in the specified bundle at the specified height divided by the number of fuel rods in the fuel bundle.
- 4.3 Critical Power Ratio (CPR) - the ratio of that power in the assembly, which is calculated by application of the fuel vendor's appropriate boiling correlation, to cause some point in the assembly to experience boiling transition, divided by the actual assembly operating power.
- 4.4 Core Operating Limits Report (COLR) - The Grand Gulf Nuclear Station specific document that provides core operating limits for the current reload cycle in accordance with Technical Specification 5.6.5.
- 4.5 Linear Heat Generation Rate (LHGR) - the LHGR shall be the heat generation per unit length of fuel rod. It is the integral of the heat flux over the heat transfer area associated with the unit length.
- 4.6 Minimum Critical Power Ratio (MCPR) - the MCPR shall be the smallest CPR which exists in the core.
- 4.7 MCPR Safety Limit - the minimum value of the CPR at which the fuel could be operated with the expected number of rods in boiling transition not exceeding 0.1% of the fuel rods in the core.
- 4.8 Aligned Drive Flow - Adjusted FCTR card input drive flow signal that accounts for actual variations in the core flow to drive flow relationship.
- 4.9 Monitored Region - The area of the core power and flow operating domain where the reactor may be susceptible to reactor instabilities under conditions exceeding the licensing basis of the current reactor system.
- 4.10 Restricted Region - The area of the core power and flow operating domain where the reactor is susceptible to reactor instabilities in the absence of restrictions on core void distributions.
- 4.11 Setpoint "Setup" - A FCTR card feature that sets the normal "non-setup" E1A APRM flow-biased scram and control rod block trip reference setpoints associated with the Exclusion and Restricted Regions higher to permit required reactor maneuvering in the Restricted Region when stability controls are in effect.
- 4.12 Middle of Cycle (MOC) - The Cycle 15 MOC Core Average Exposure (CAE) is 32,319 Mwd/MTU [3.2.1].
- 4.13 End of Cycle (EOC) - The Cycle 15 EOC CAE is 33,893 Mwd/MTU [3.2.1].
- 4.14 Extended End of Cycle (EEOC) - The Cycle 15 EEOC CAE is 34,715 Mwd/MTU [3.2.1].

## CORE OPERATING LIMITS REPORT

### 5.0 GENERAL REQUIREMENTS

#### 5.1 Average Planar Linear Heat Generation Rates

Consistent with Technical Specification 3.2.1, all APLHGRs shall not exceed the exposure-dependent limits reported in Figure 1-1 [3.2.1, 3.2.3].

#### 5.2 Minimum Critical Power Ratio

Consistent with Technical Specification 3.2.2, the MCPR shall be equal to or greater than the limits reported in Figure(s) 2 as functions of power, flow, and exposure [3.2.1, 3.2.3].

Additional MCPR operating limits are provided to support operation with EOC-RPT inoperable as described in Technical Specification 3.3.4.1.

#### 5.3 Linear Heat Generation Rate

Consistent with Technical Specification 3.2.3, the LHGR shall not exceed the exposure-dependent limits reported in Figure 3-1 multiplied by the smaller of either the power-dependent or flow-dependent LHGR factors reported in Figures 3-2 and 3-3, respectively [3.2.1, 3.2.3].

The LHGR limits given in Figure 3-1 may be linearly extrapolated beyond a pellet exposure of 70.4 Gwd/MTU provided the rod and fuel assembly exposure limits are maintained [3.2.1].

#### 5.4 Stability

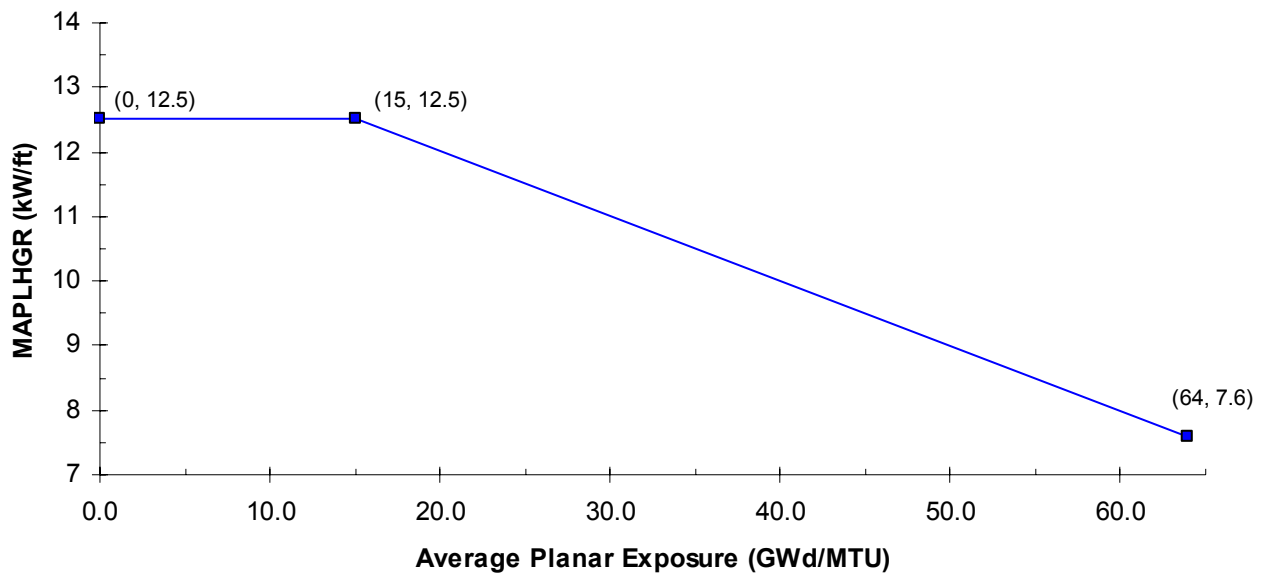
The stability regions and allowable values specified in Technical Specifications are reported in Figure(s) 4 [3.2.2].

#### 5.5 Applicability

The following core operating limits are applicable for operation in the Maximum Extended Operating Domain (MEOD), with Feedwater Heaters Out of Service (FHOOS), and EOC-RPT inoperable. For operation with EOC-RPT inoperable, the alternate MCPR limits described in Section 5.2 above must be implemented. Since the maximum licensed GGNS feedwater temperature reduction is 50 °F at rated power operation, an alternate set of stability limits is not required. For single-loop operation (SLO), the following additional requirements must be satisfied.

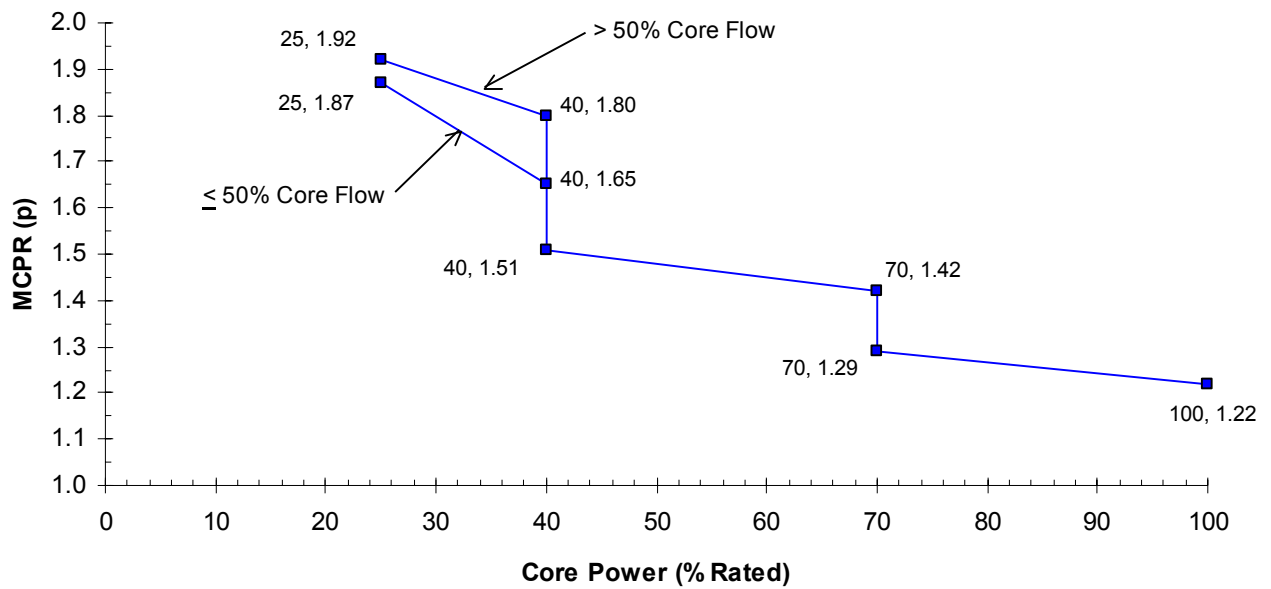
1. A SLO MAPLHGR multiplier of 0.87 is required [3.2.1, 3.2.3].
2. The MCPR shall be equal to or greater than the limits determined in accordance with Section 5.2 above increased by 0.02 to account for the difference between the two-loop and single-loop MCPR safety limits for the allowable range of single-loop operation [3.2.1, 3.2.3].

## CORE OPERATING LIMITS REPORT

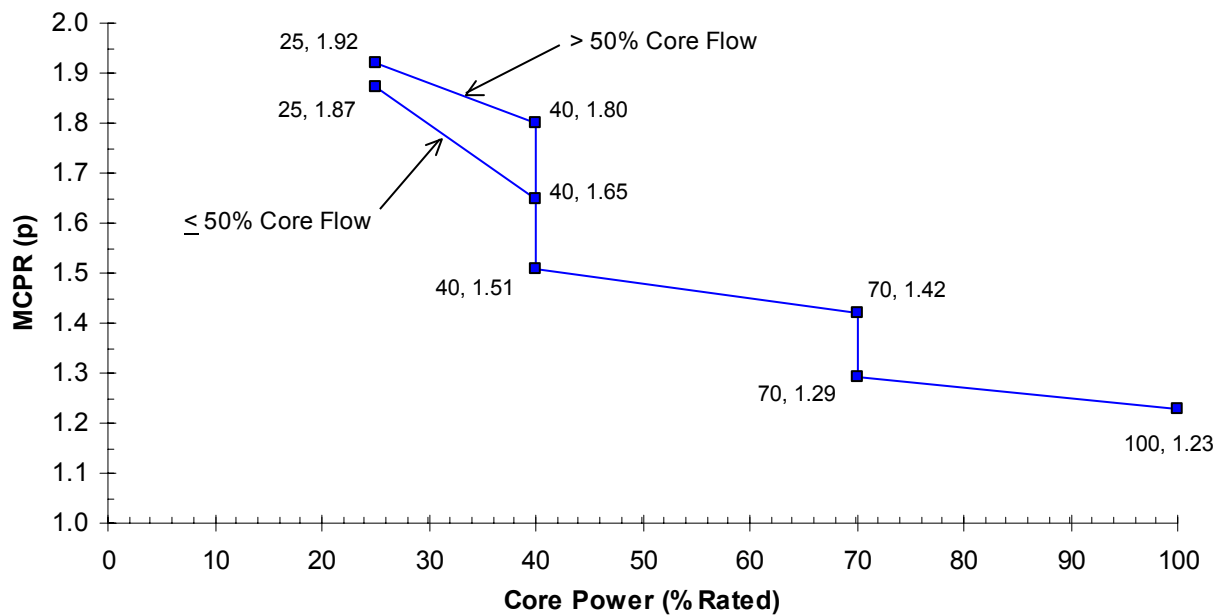


**Figure 1-1**  
**Maximum Average Planar Linear Heat Generation Rate**  
**Note: Actual limits described in Sections 5.1 and 5.5**

## CORE OPERATING LIMITS REPORT

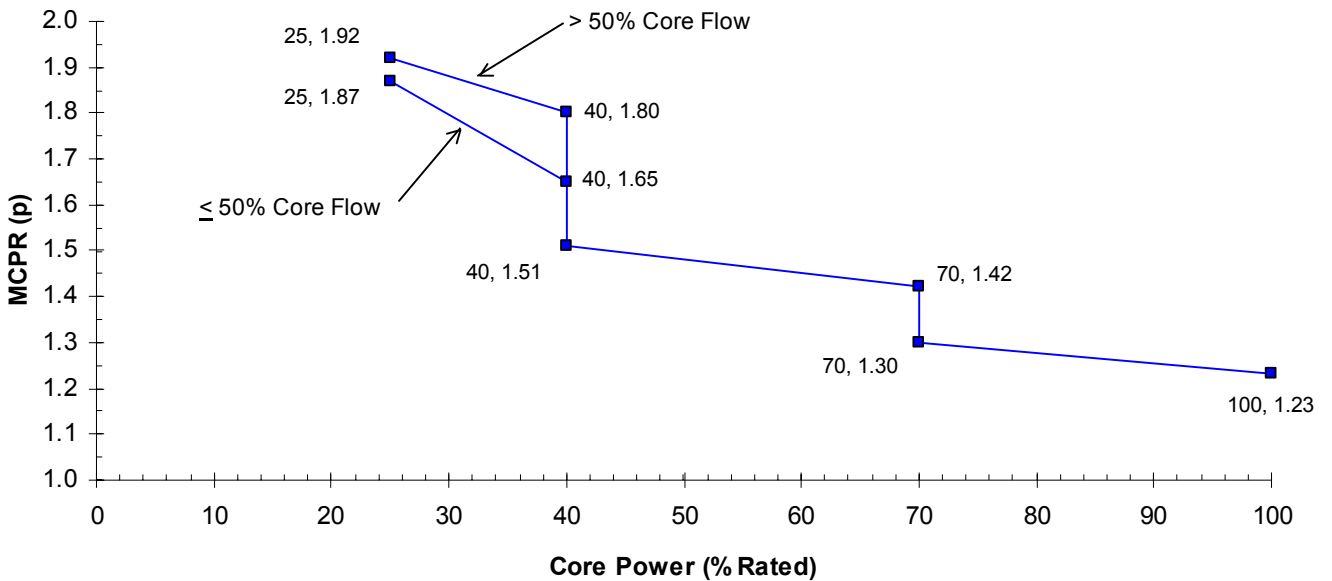


**Figure 2-1 Cycle 15 Power-Dependent MCPR Limits  
BOC to MOC**

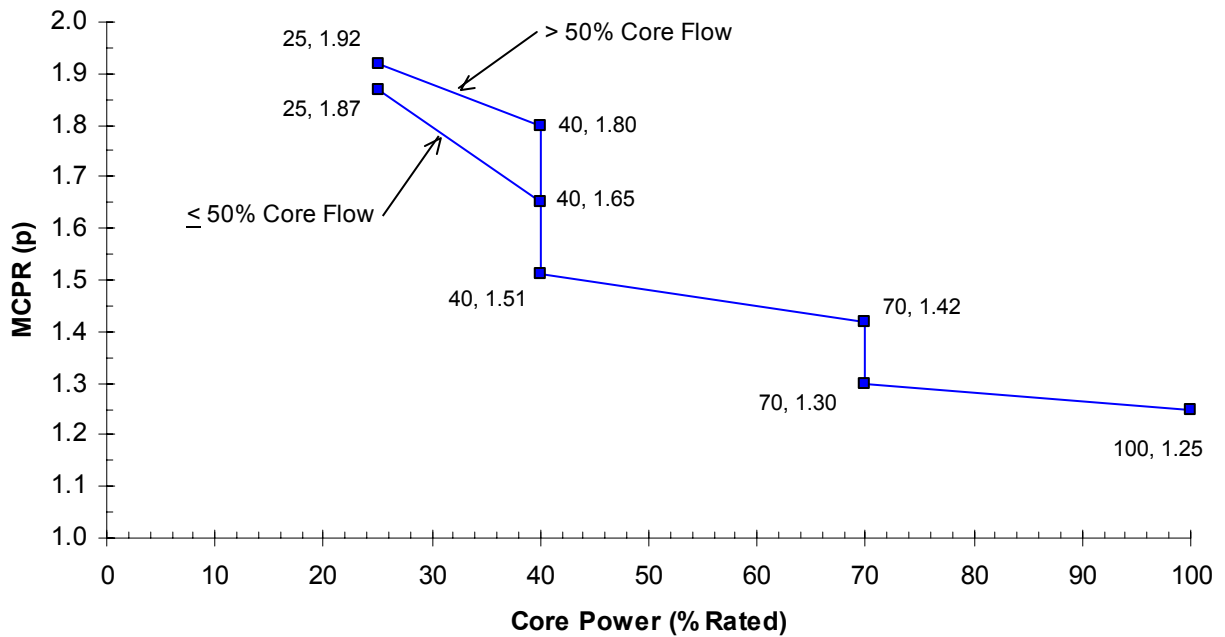


**Figure 2-2 Cycle 15 Power-Dependent MCPR Limits  
BOC to MOC with EOC-RPT Inoperable**

## CORE OPERATING LIMITS REPORT

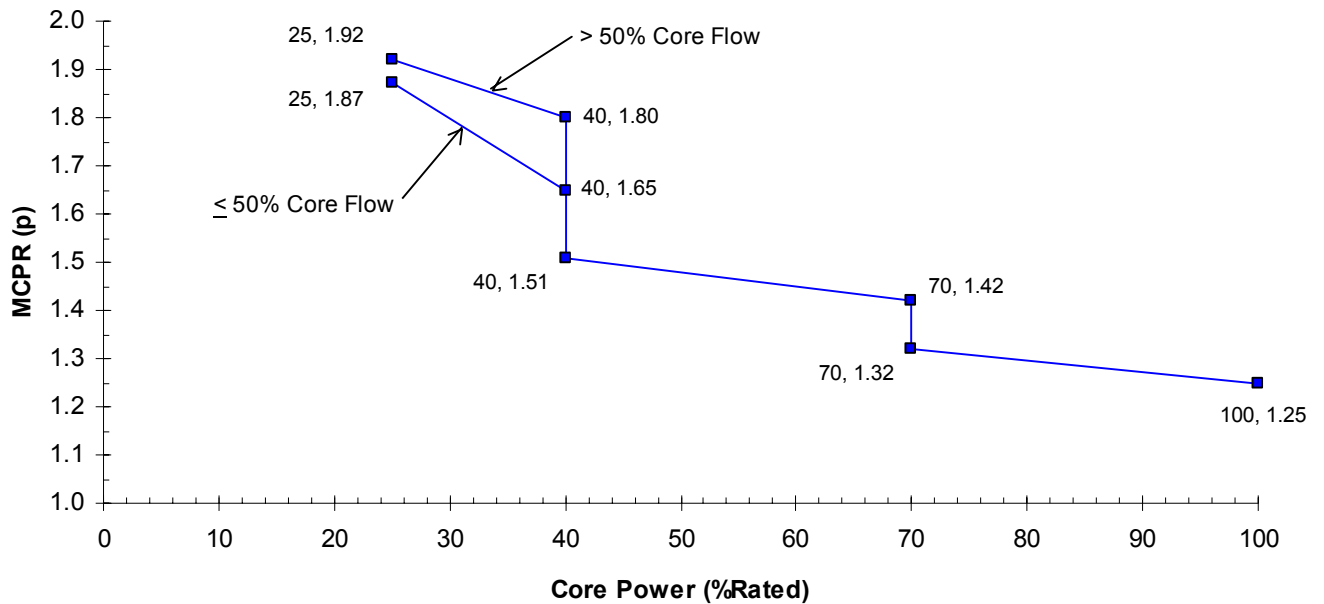


**Figure 2-3 Cycle 15 Power-Dependent MCPR Limits  
MOC to EOC**

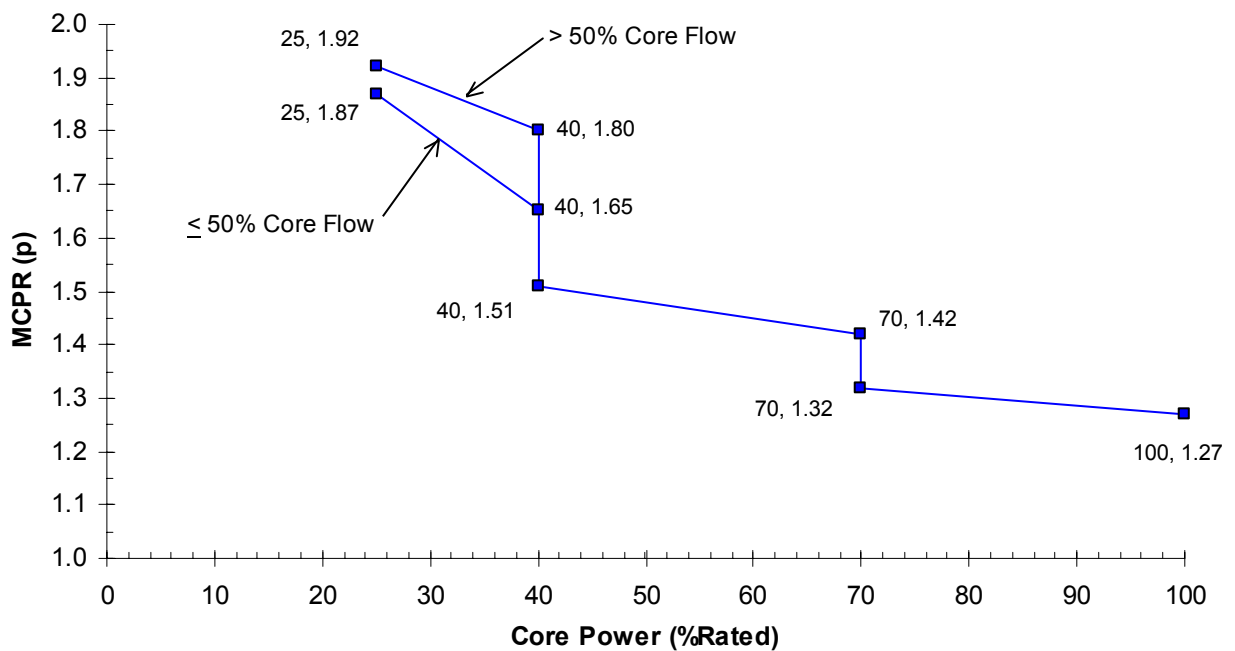


**Figure 2-4 Cycle 15 Power-Dependent MCPR Limits  
MOC to EOC with EOC-RPT Inoperable**

## CORE OPERATING LIMITS REPORT



**Figure 2-5 Cycle 15 Power-Dependent MCPR Limits  
EOC to EEOC**



**Figure 2-6 Cycle 15 Power-Dependent MCPR Limits  
EOC to EEOC with EOC-RPT Inoperable**

## CORE OPERATING LIMITS REPORT

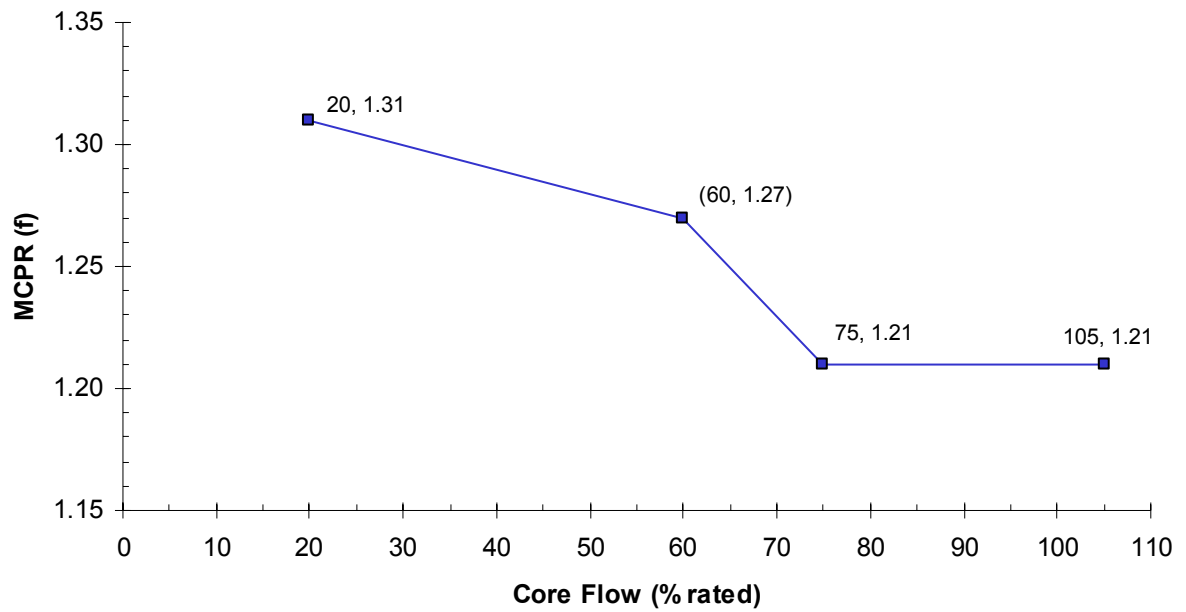
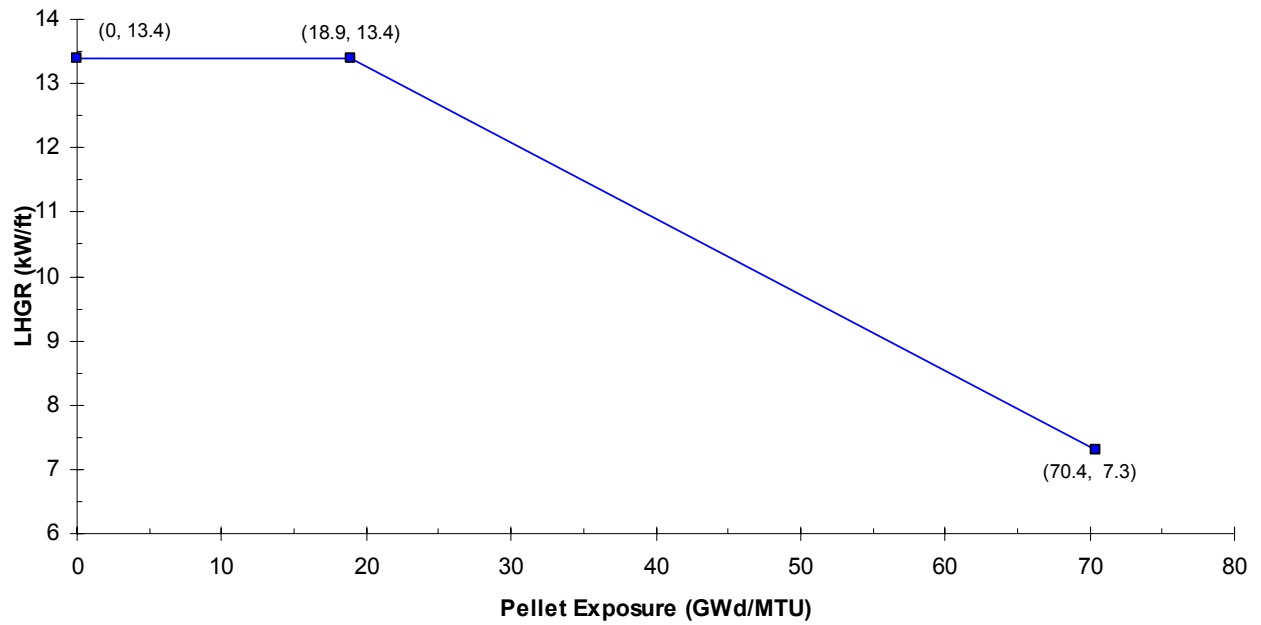


Figure 2-7 Cycle 15 Flow-Dependent MCPR Limits

## CORE OPERATING LIMITS REPORT



**Figure 3-1**  
**Maximum Linear Heat Generation Rate**  
**Note: Actual limits described in Section 5.3**

## CORE OPERATING LIMITS REPORT

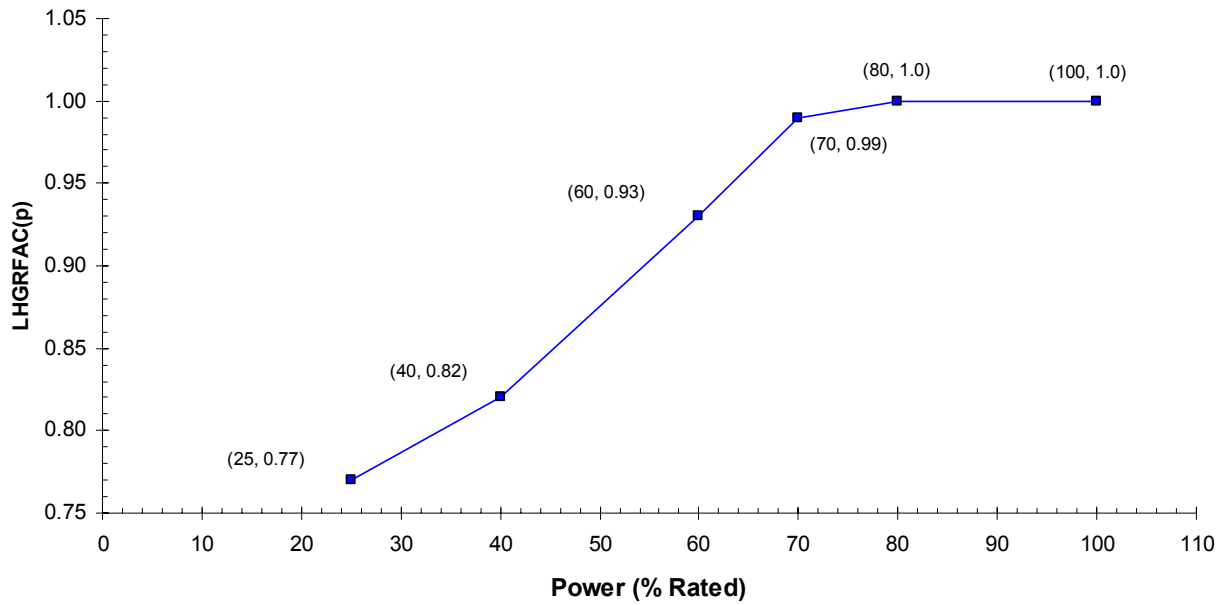


Figure 3-2

### Cycle 15 Power-Dependent LHGR Factor BOC-EEOC

Note: These factors to be applied to the exposure-dependent limits as described in Section 5.3

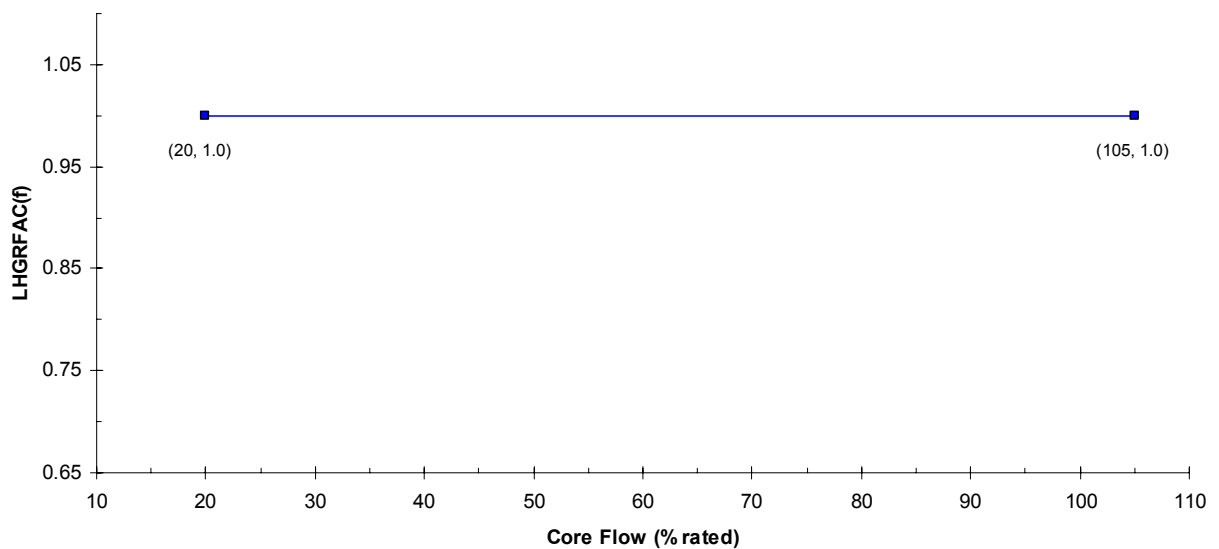


Figure 3-3

### Cycle 15 Flow-Dependent LHGR Factor BOC-EEOC

Note: These factors to be applied to the exposure-dependent limits as described in Section 5.3

## CORE OPERATING LIMITS REPORT

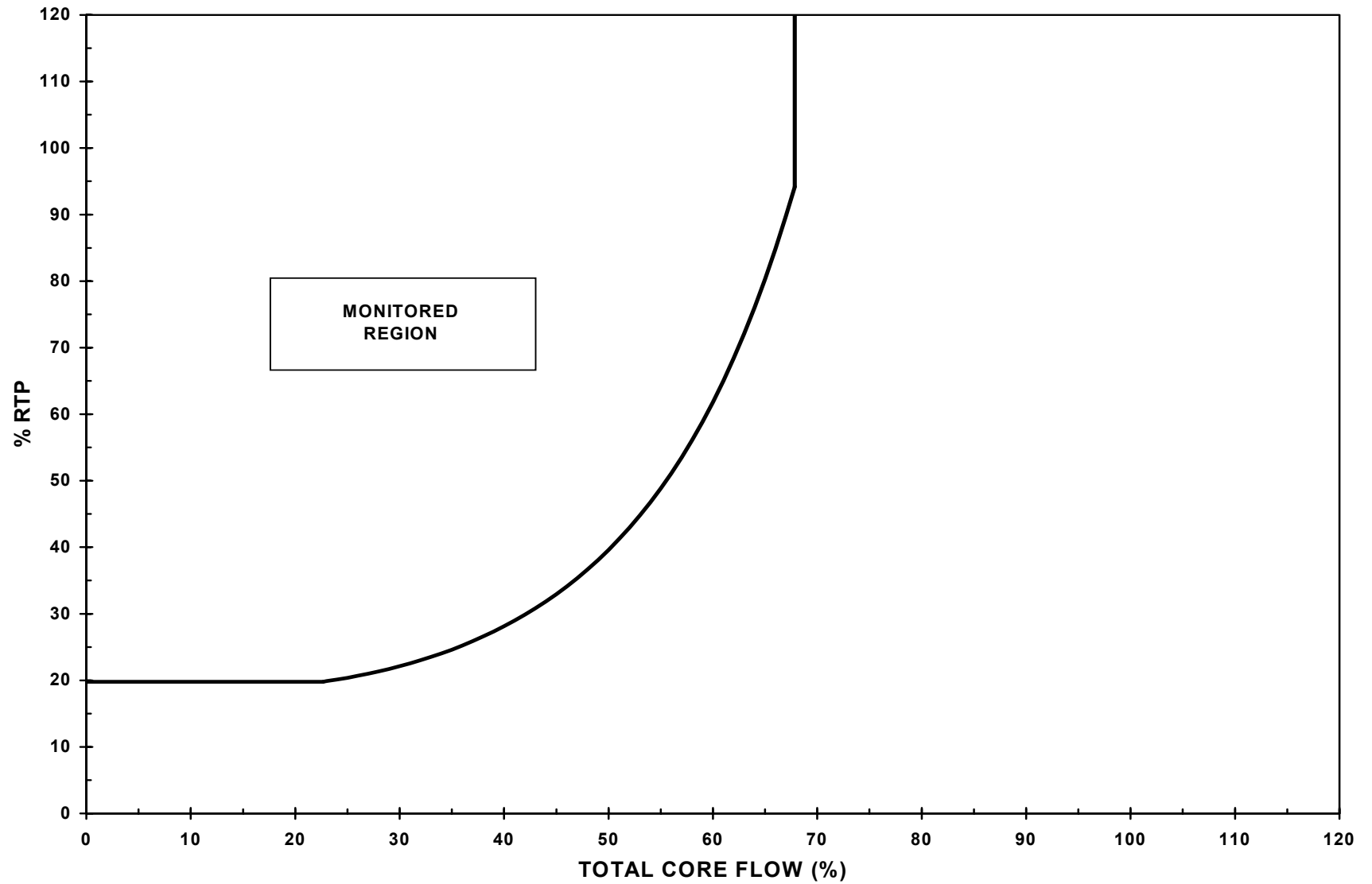


Figure 4-1 Monitored Region Boundary

## CORE OPERATING LIMITS REPORT

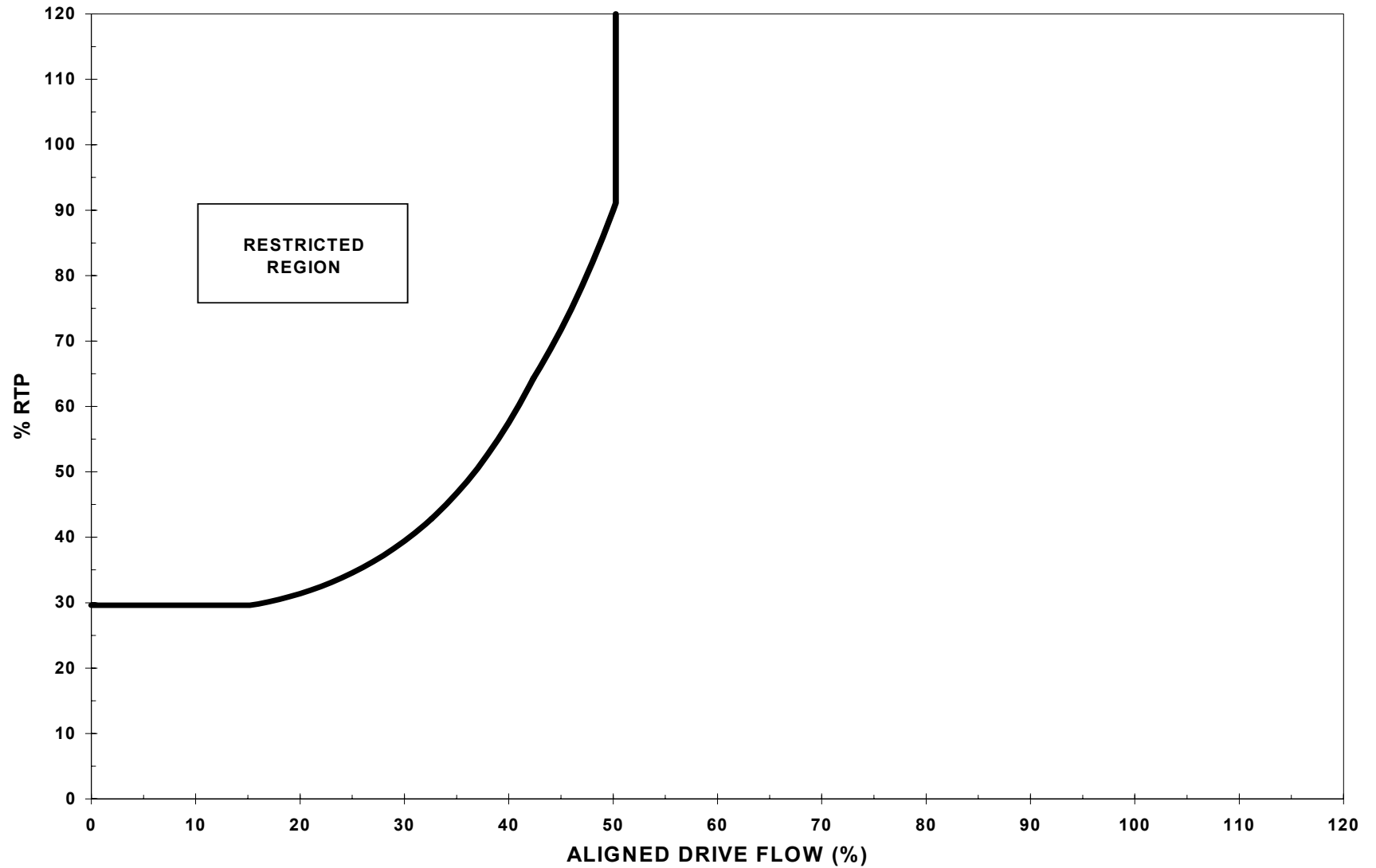


Figure 4-2 Restricted Region Boundary for Two-Loop Operation

## CORE OPERATING LIMITS REPORT

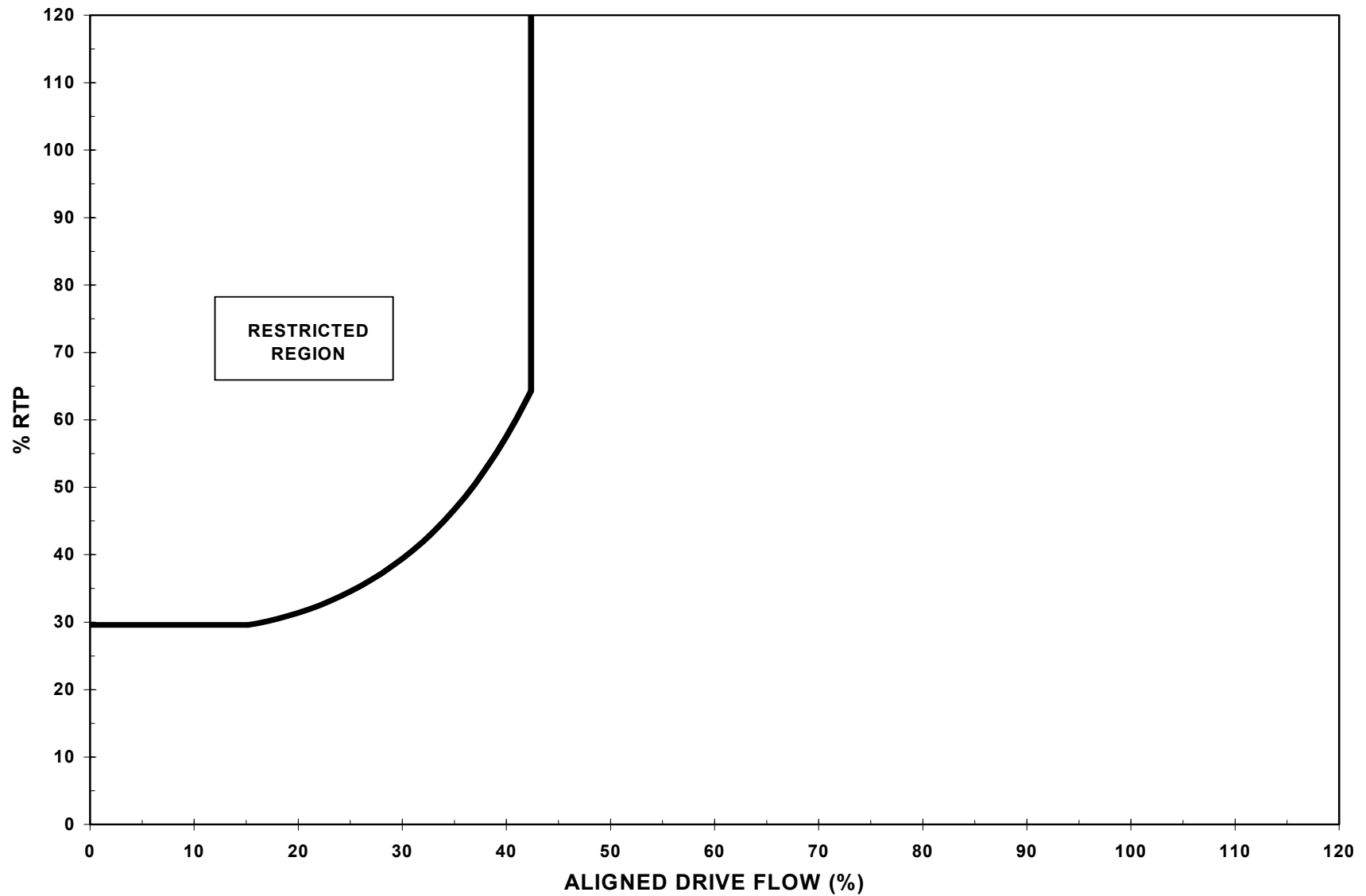


Figure 4-3 Restricted Region Boundary for Single-Loop Operation

## CORE OPERATING LIMITS REPORT

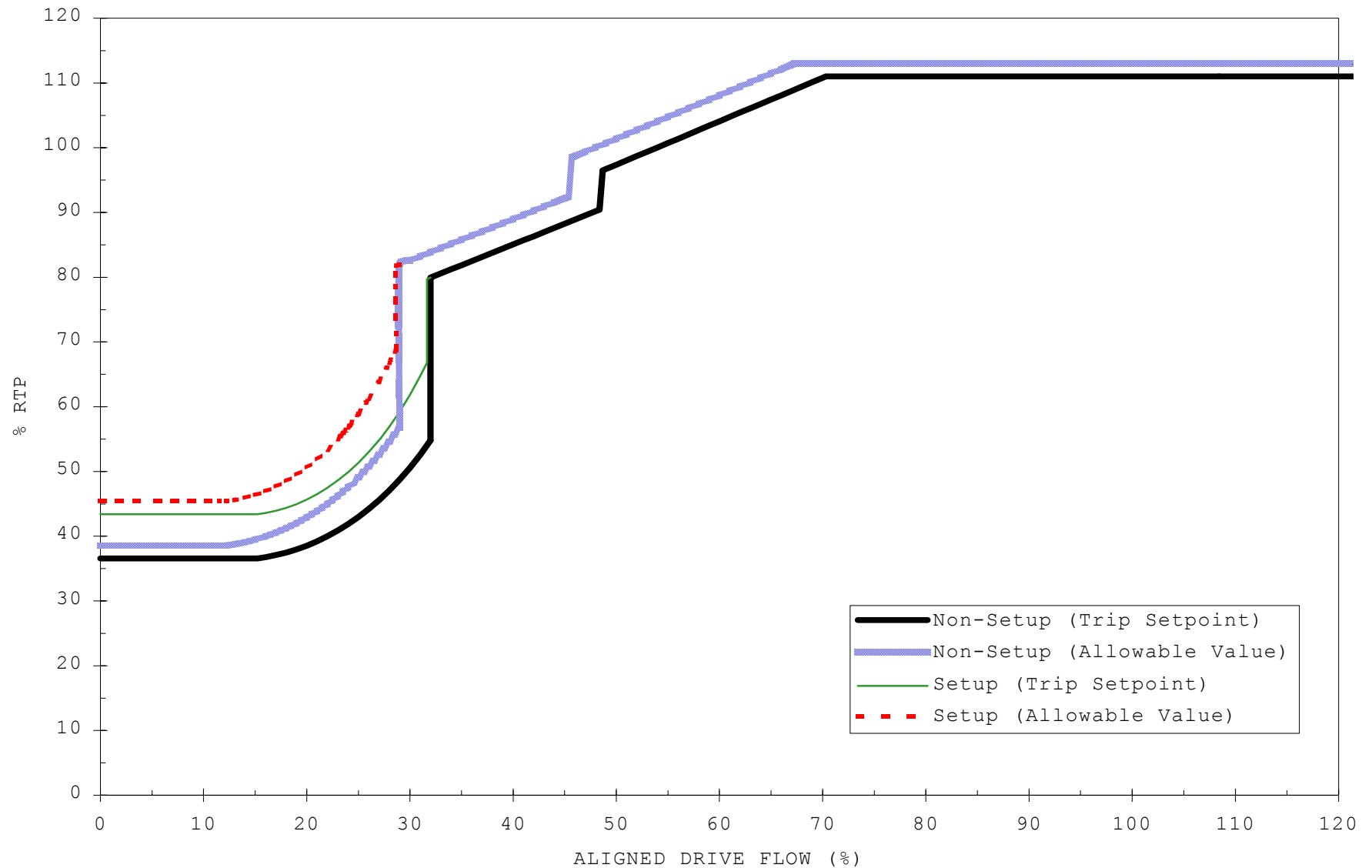


Figure 4-4 APRM Flow-Biased Simulated Thermal Power – High Scram Allowable Values for Two-Loop Operation

## CORE OPERATING LIMITS REPORT

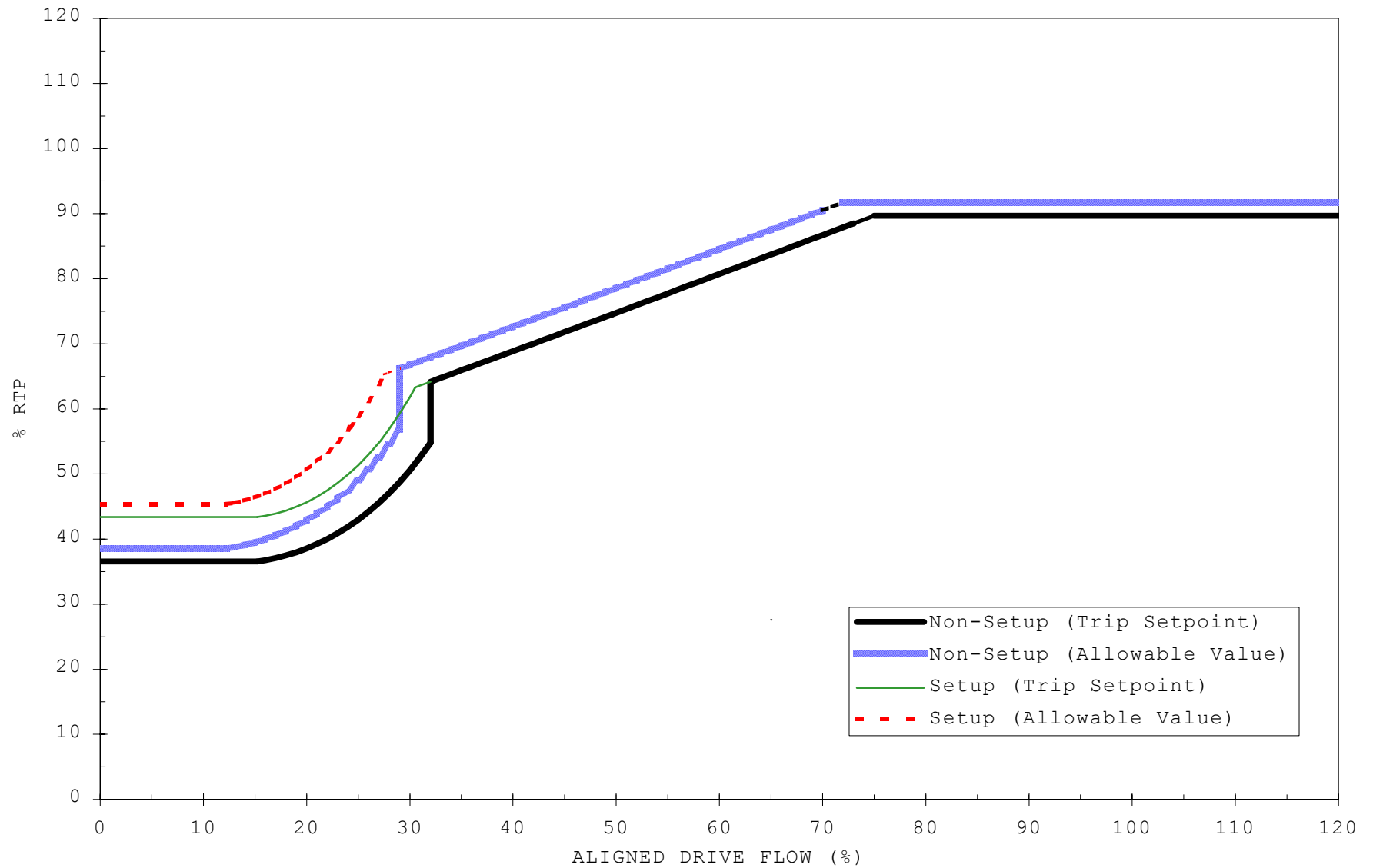


Figure 4-5 APRM Flow-Biased Simulated Thermal Power – High Scram Allowable Values for Single-Loop Operation