

Standard No.: GGNS-MS-48.0

Revision: 3

Date:

**Grand Gulf Nuclear Station
Core Operating Limits Report
Safety-Related**

9505300211 950522
PDR ADDCK 05000413
P PDR

GRAND GULF NUCLEAR STATION

NUCLEAR PLANT ENGINEERING

REVIEW AND APPROVAL SHEET

STANDARD NO.: GGNS-MS-48.0REVISION: 3STANDARD TITLE: Core Operating Limits Report

This document specifies items related to nuclear safety YES [X] NO []

Signatures certify that the above standard was originated, verified, reviewed or waived and approved as noted below:

ORIGINATED BY: [Signature] DATE: 5/5/95
VERIFIED BY: [Signature] DATE: 5/5/95
REVIEWED BY: M. D. Withrow DATE: 5/8/95
Cognizant Group Supervisor

| NPE SECTION | REVIEWED BY | REVIEW WAIVED BY | DATE |
|------------------|----------------------|------------------|---------------|
| ELECTRICAL/I&C | <u>[Signature]</u> | | <u>5/9/95</u> |
| MECHANICAL/CIVIL | <u>[Signature]</u> | | <u>5/8/95</u> |
| SAFETY ANALYSIS | <u>M. D. Withrow</u> | | <u>5/8/95</u> |

ANII: N/A DATE: _____
(Insert N/A if not applicable)APPROVED BY: M. D. Withrow DATE: 5/17/95
Responsible Manager

SAFETY EVALUATION APPLICABILITY REVIEW FORM

- A) Document Evaluated: Standard GGNS-MS-48.0, Revision 3
- B) Description of the Proposed Change: Per GNRI-93-008, Amendment 106 to the Grand Gulf Operating License, Entergy committed to removing certain reactor physics parameters from the Technical Specifications and placing them in a separate report prepared for each fuel cycle. Standard GGNS-MS-48.0 is the Core Operating Limits Report (COLR) and establishes these parameters. Revision 3 to GGNS-MS-48.0 reports the Cycle 8 core operating limits.

PRE-SCREENING

Check the applicable boxes below. If any of the boxes are checked, neither a safety evaluation applicability review nor a safety evaluation is necessary and steps C, D, E, and F may be skipped. The preparer and reviewer must sign at the bottom of the form.

- ☐ The change is editorial only.
- ☐ 10CFR50.54 applies to the change instead of 10CFR50.59.
- ☒ An approved safety evaluation covering all aspects of this subject already exists.
Reference SE# The Cycle 8 core operating limits have been evaluated in the Cycle 8 reload safety evaluation, 95-0022-R00.
- ☐ The change, in its entirety, has been approved by the NRC.
Reference: _____
- ☐ The change is an FSAR change that meets the exclusion criteria outlined in Site Directive G4.803

Safety Evaluation Applicability Review

If any of the following questions are answered "yes", then a full 50.59 Safety Evaluation must be completed.

- C) Does the proposed change or activity represent a change to the Technical Specifications?
- YES ☐ Explain: _____
NO ☐ _____
- D) Does the proposed change or activity represent:
- (1) A change to the facility which alters, or has the potential to alter, the information, operation, function or ability to perform the function of a system, structure or component described in the SAR?
- YES ☐ Explain: _____
NO ☐ _____

- (2) A change to a procedure which alters, or has the potential to alter, a procedure described, outlined or summarized in the SAR?

YES ☐ Explain: _____

NO ☐ _____

- (3) A test or experiment not described in the SAR or which requires that a system be operated in an abnormal manner that is not described or previously analyzed in the SAR?

YES ☐ Explain: _____

NO ☐ _____

PREPARER

[Signature]
Name

Eng. III
Job Title

5/8/95
Date

REVIEWER

[Signature]
Name

Eng. Mgr.
Job Title

5/8/95
Date

If the preparer performed an applicability review, the reviewer should check below to indicate by which means the independent review reached the same conclusions.

- ☒ Reviewed the applicability review documentation.
☐ Completed an independent applicability review.
☐ Performed a verbal review with the preparer.

REVISION STATUS SHEET**STANDARD REVISION SUMMARY**

| <u>REVISION</u> | <u>ISSUE DATE</u> | <u>DESCRIPTION</u> |
|-----------------|-------------------|--------------------|
| 0 | April 1, 1993 | Issued for use |
| 1 | November 12, 1993 | Issued for use |
| 2 | August, 26, 1994 | Issued for use |
| 3 | | Issued for use |

PAGE REVISION STATUS

| <u>PAGE NO.</u> | <u>REVISION</u> | <u>PAGE NO.</u> | <u>REVISION</u> |
|-----------------|-----------------|-----------------|-----------------|
| i-vi | 3 | 8 | 3 |
| 1 | 3 | 9 | 3 |
| 2 | 3 | 10 | 3 |
| 3 | 3 | 11 | 3 |
| 4 | 3 | 12 | 3 |
| 5 | 3 | 13 | 3 |
| 6 | 3 | 14 | 3 |
| 7 | 3 | 15 | 3 |

APPENDIX/ATTACHMENT STATUS

TABLE OF CONTENTS

| | | |
|-----|---------------------------|---|
| 1.0 | PURPOSE..... | 1 |
| 2.0 | SCOPE..... | 2 |
| 3.0 | REFERENCES | 3 |
| 4.0 | DEFINITIONS..... | 6 |
| 5.0 | GENERAL REQUIREMENTS..... | 7 |

1.0 PURPOSE

On October 4, 1988, the NRC issued Generic Letter 88-16 (Reference 28) 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 complied with this letter by submission of a Proposed Amendment to the Grand Gulf Operating License (Reference 29). This document requested changes to the GGNS Technical Specifications to remove certain reactor physics parameter limits that change each fuel cycle. This amendment committed to placing these operating limits in a separate Core Operating Limits Report (COLR) which will be defined in Technical Specifications. This PCOL was approved by the NRC by SER dated January 21, 1993 (Reference 30).

The COLR is controlled via Mechanical Standard GGNS-MS-48.0. This standard is revised accordingly for each fuel cycle or remaining portion of a fuel cycle. Revision 3 of the COLR reports the Cycle 8 core operating 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 8 core operating limits included in this report are:

1. the Average Planar Linear Heat Generation Rate (APLHGR) limits for each fuel type for both two-loop and single-loop operation. (Technical Specification 3.2.1),
2. the Minimum Critical Power Ratio (MCPR) operating limit including the power (as a function of exposure) and flow dependent curves. (Technical Specification 3.2.2), and
3. the Linear Heat Generation Rate (LHGR) limit for each fuel type including the power and flow dependent parametric adjustment factor curves, $LHGRFAC_p$ and $LHGRFAC_f$, respectively. (Technical Specification 3.2.3)

The cycle-specific MCPR safety limits are documented in Technical Specification 2.1.1.2.

3.0 REFERENCES

This section contains the methodology and cycle-specific references used in the safety analysis of Grand Gulf Cycle 8. The supplements and revisions of the current analytical methodology references are included below in accordance with Technical Specification 5.6.5, Core Operating Limits Report.

METHODOLOGY REFERENCES:

- 1.) XN-NF-79-71(P), Revision 2 including Supplements 1, 2, and 3, Exxon Nuclear Plant Transient Methodology for Boiling Water Reactors, Exxon Nuclear Company, Inc., Richland, WA, November 1981. Approved by NRC letter dated October 24, 1986.
- 2.) 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, Inc., Richland, WA, March 1983.
- 3.) XN-NF-80-19(P)(A), Volume 1 Supplements 3 and 4, Advanced Nuclear Fuels Methodology for Boiling Water Reactors: Benchmark Results for the CASMO-3G/MICROBURN-B Calculation Methodology, Advanced Nuclear Fuels Corporation, Inc., Richland, WA, November 1990.
- 4.) 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, Inc., Richland, WA, January 1987.
- 5.) 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 Analysis, Advanced Nuclear Fuels Corporation, Richland, WA, August 1990.
- 6.) ANF-1125 (P)(A) and Supplements 1 and 2, ANFB Critical Power Correlation, Advanced Nuclear Fuels Corporation, Richland, WA, April 1990.
- 7.) 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, Inc., Richland, WA, February 1987.
- 8.) XN-NF-573(P), RAMPEX Pellet-Clad Interaction Evaluation Code for Power Ramps, Exxon Nuclear Company, Inc., Richland, WA, May 1982. Approved by NRC letter dated August 28, 1990.
- 9.) XN-NF-81-58(P)(A) and Supplements 1 and 2, Revision 2, RODEX2: Fuel Rod Thermal-Mechanical Response Evaluation Model, Exxon Nuclear Company, Inc., Richland, WA, March 1984.

- 10.) XN-NF-85-74(P)(A), RODEX2A (BWR): Fuel Rod Thermal-Mechanical Response Evaluation Model, Exxon Nuclear Company, Inc., Richland, WA, August 1986.
- 11.) XN-CC-33(P)(A), Revision 1, HUXY: A Generalized Multirod Heatup Code with 10CFR50 Appendix K Heatup Option, Exxon Nuclear Company, Inc., Richland, WA, November 1975.
- 12.) XN-NF-825(P)(A) Supplement 2, BWR/6 Generic Rod Withdrawal Error Analysis, MCPR_p for Plant Operation Within the Extended Operating Domain, Exxon Nuclear Company, Inc., Richland, WA, October 1986.
- 13.) XN-NF-81-51(P)(A), LOCA-Seismic Structural Response of an Exxon Nuclear Company BWR Jet Pump Fuel Assembly, Advanced Nuclear Fuels Corporation, Richland, WA, May 1986.
- 14.) XN-NF-84-97(P)(A), LOCA-Seismic Structural Response of an ENC 9x9 BWR Jet Pump Fuel Assembly, Exxon Nuclear Company, Inc., Richland, WA, August 1986.
- 15.) XN-NF-86-37(P), Generic LOCA Break Spectrum Analysis for BWR/6 Plants, Exxon Nuclear Company, Inc., Richland, WA, April 1986. Approved by NRC letter dated October 24, 1986.
- 16.) XN-NF-82-07(P)(A), Revision 1, Exxon Nuclear Company ECCS Cladding Swelling and Rupture Model, Exxon Nuclear Company, Inc., Richland, WA, November 1982.
- 17.) XN-NF-80-19(A), Volumes 2, 2A, 2B, and 2C, Exxon Nuclear Methodology for Boiling Water Reactors EXEM BWR ECCS Evaluation Model, Exxon Nuclear Company, Inc., Richland, WA, September 1982.
- 18.) XN-NF-79-59(P)(A), Methodology for Calculation of Pressure Drop in BWR Fuel Assemblies, Exxon Nuclear Company, Inc., Richland, WA, November 1983.
- 19.) ANF-1358(P)(A), Revision 1 and Correspondence, The Loss of Feedwater Heating in Boiling Water Reactors, Siemens Power Corporation, Richland, WA, September 1992.

CURRENT CYCLE REFERENCES:

- 20.) EMF-94-187, Grand Gulf Unit 1 Cycle 8 Plant Transient Analysis, Siemens Power Corporation, Richland, WA, December 1994.
- 21.) EMF-94-186, Grand Gulf Unit 1 Cycle 8 Reload Analysis, Siemens Power Corporation, Richland, WA, December 1994.

- 22.) EMF-94-105, Grand Gulf 1 ANF-1.7 Design Report, Mechanical, Thermal-Hydraulic and Neutronic Design for Advanced Nuclear Fuels 9X9-5 Fuel Assemblies, Advanced Nuclear Fuels, Richland, WA, July 1994.
- 23.) ANF-86-133, Revision 4, Principal ECCS and Plant Transient Analysis Parameters Grand Gulf Unit 1, Advanced Nuclear Fuels Corporation, Richland, WA, June 1991.
- 24.) EMF-91-172, Grand Gulf Unit 1 LOCA Analysis for Single Loop Operation, Siemens Power Corporation, Richland, WA, October 1991.
- 25.) ANF-88-152(P)(A) with Amendment 1 and Supplement 1, Generic Mechanical Design for Advanced Nuclear Fuels 9X9-5 BWR Reload Fuel, Advanced Nuclear Fuels Corporation, Richland, WA, November 1990.
- 25A.) GEXI-94/00449, S.L. Leonard (SPC) to J.B. Lee (Entergy), "Transmittal of Mechanical Design Review of the 9x9-5 Fuel Design for the Higher Peak Pellet Exposure Limit", dated July 1, 1994.
- 25B.) GEXI-94/00448, D.P. Austin (SPC) to J.B. Lee (Entergy), "Retransmittal of Justification for Increasing the 9x9-5 Peak Pellet Exposure Limit", dated July 1, 1994.

CYCLE 7 REFERENCES:

- 26.) ANF-92-190(P), Grand Gulf 1 ANF-1.6 Design Report, Mechanical, Thermal-Hydraulic and Neutronic Design for Advanced Nuclear Fuels 9X9-5 Fuel Assemblies, Advanced Nuclear Fuels, Richland, WA, December 1992.

CYCLE 6 REFERENCES:

- 27.) ANF-91-080(P), Grand Gulf 1 ANF-1.5 Design Report, Mechanical, Thermal-Hydraulic and Neutronic Design for Advanced Nuclear Fuels 9X9-5 Fuel Assemblies, Advanced Nuclear Fuels, Richland, WA, July 1991.

GENERAL REFERENCES:

- 28.) MAEC-88/0313, Generic Letter 88-16, "Removal of Cycle-Specific Parameter Limits from Technical Specifications", October 4, 1988.
- 29.) GNRO-92-00093, Proposed Amendment to Grand Gulf Operating License, PCOL-92/07, dated October 29, 1992.
- 30.) GNRI-93-0008, Amendment 106 to Grand Gulf Operating License, January 21, 1993.

4.0 DEFINITIONS

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.
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.
3. Critical Power Ratio (CPR) - the ratio of that power in the assembly which is calculated by application of the ANFB boiling correlation (Reference 6) to cause some point in the assembly to experience boiling transition, divided by the actual assembly operating power.
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.
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.
6. Minimum Critical Power Ratio (MCPR) - the MCPR shall be the smallest CPR which exists in the core.
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.

5.0 GENERAL REQUIREMENTS

This section reports the Grand Gulf Cycle 8 core operating limits. These limits are taken from Reference 21 Sections 5.7, 6.1.3, and 7.2.3. As discussed in Technical Specifications 3.2.1, 3.2.2, and 3.2.3, these operating limits are applicable when the core thermal power is greater than 25% of rated power.

Average Planar Linear Heat Generation Rates (Technical Specification 3.2.1)

During two-loop operation, all AVERAGE PLANAR LINEAR HEAT GENERATION RATES (APLHGRs) as a function of AVERAGE PLANAR EXPOSURE shall not exceed the limits in Figure 5.1.

During single-loop operation, the APLHGR as a function of average planar exposure shall not exceed the limits shown in Figure 5.1 multiplied by 0.86.

Minimum Critical Power Ratio (MCPR) (Technical Specification 3.2.2)

The MCPR shall be equal to or greater than the $MCPR_f$ and $MCPR_p$ limits at the indicated core flow and thermal power, for the exposure range, as shown in Figures 5.2, 5.3, 5.4, and 5.5.

Linear Heat Generation Rate (LHGR) (Technical Specification 3.2.3)

The LHGR shall not exceed the limits shown in Figure 5.6 as multiplied by the smaller of either the flow-dependent LHGR factor ($LHGRFAC_f$) of Figure 5.7 or the power-dependent LHGR factor ($LHGRFAC_p$) of Figure 5.8.

Cycle 8 Maximum Average Planar Linear Heat Generation Rate

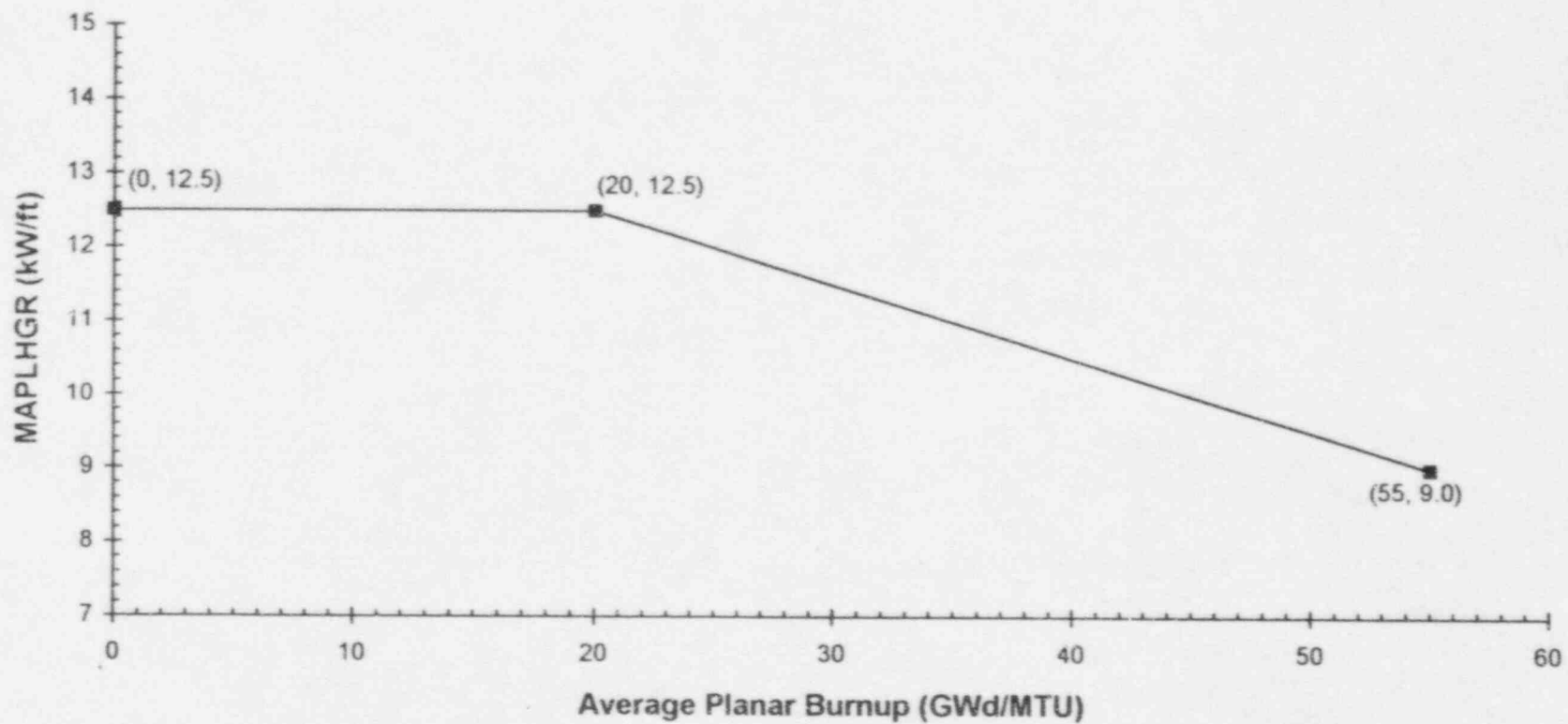


Figure 5.1 Cycle 8 MAPLHGR Limits

Cycle 8 Flow-Dependent MCPR Limit

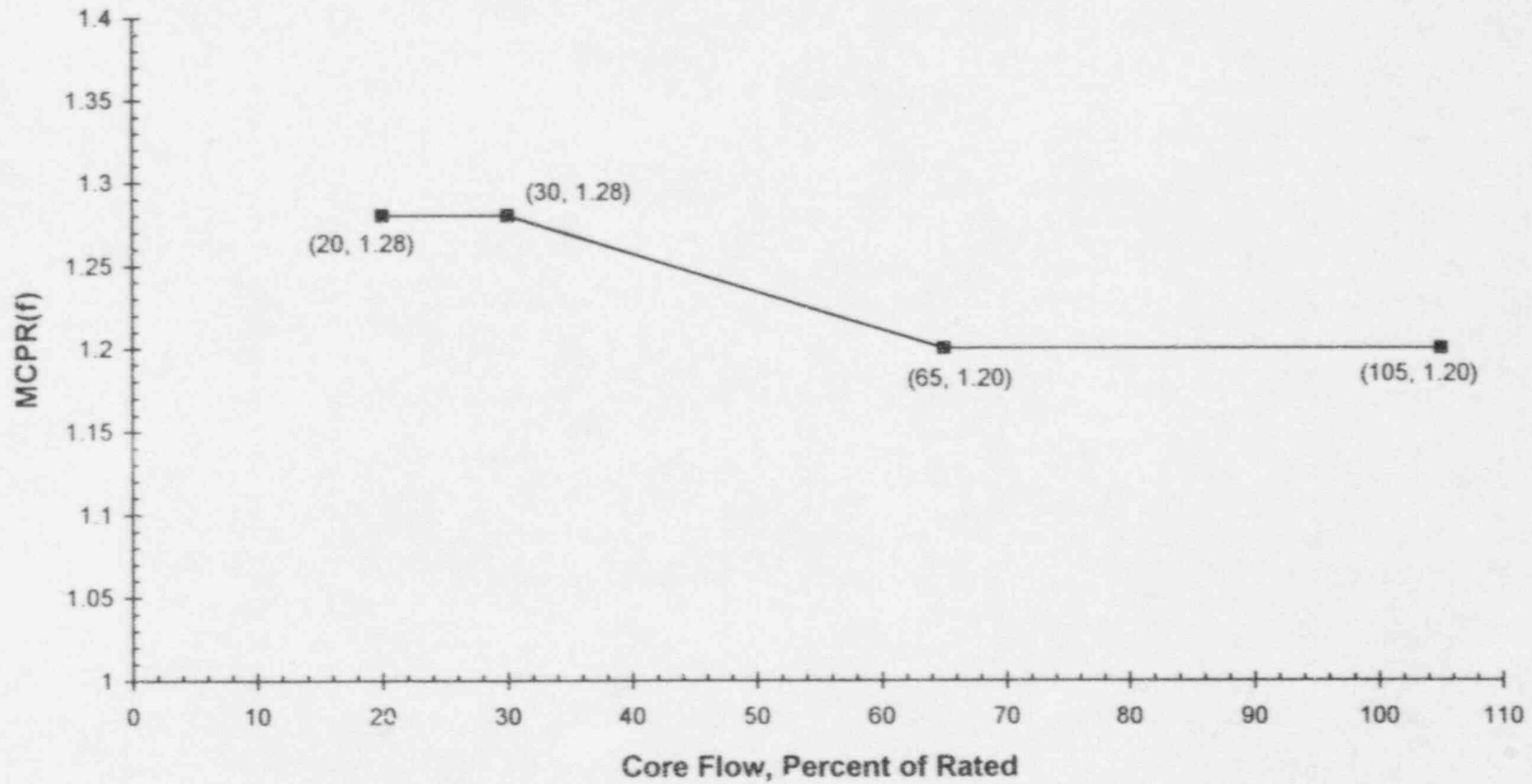


Figure 5.2 Cycle 8 Flow-Dependent MCPR Limits

Cycle 8 Power-Dependent MCPR Limit BOC to EOC-30 EFPD

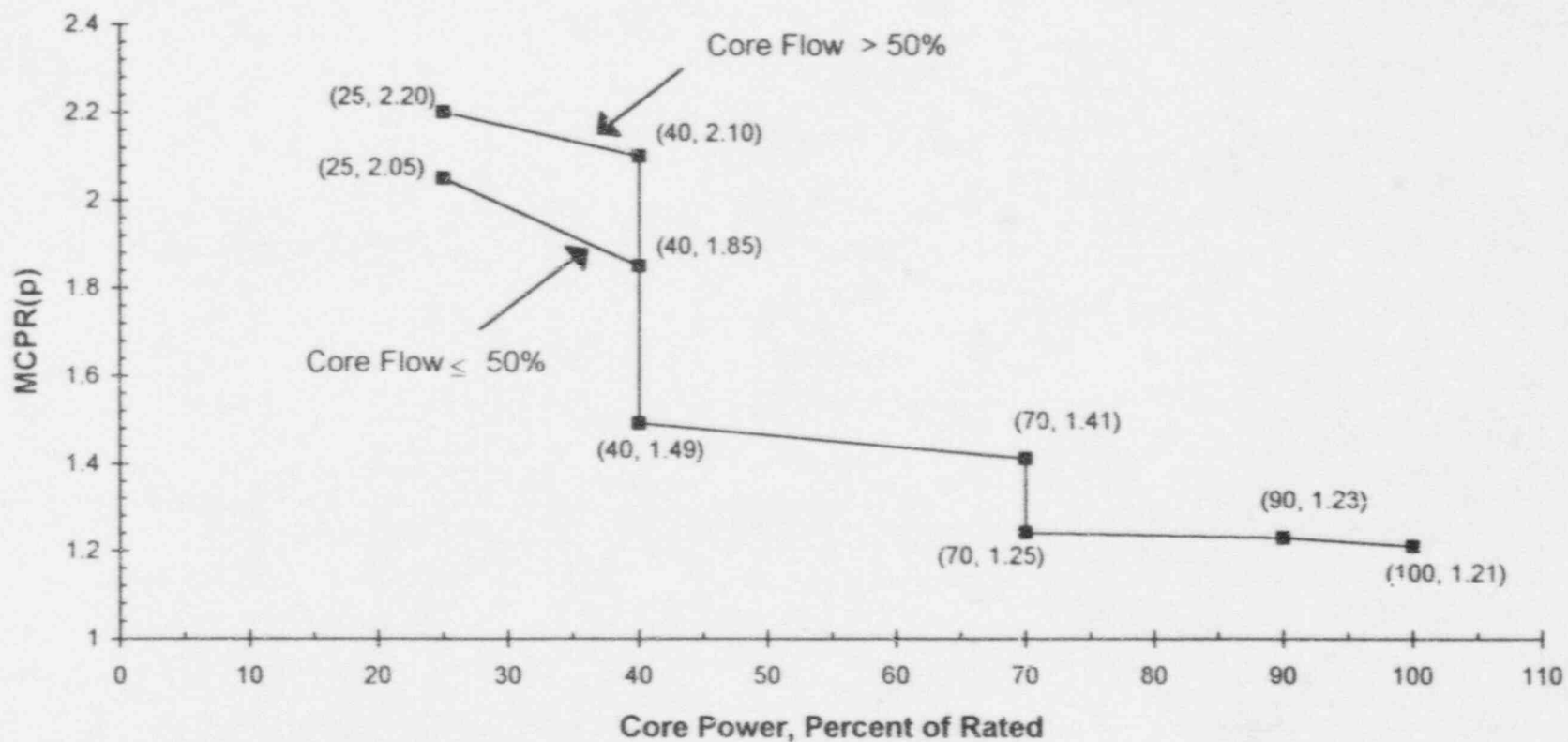


Figure 5.3 Cycle 8 Power-Dependent MCPR Limits for Exposures From BOC to EOC-30 EFPD

Cycle 8 Power-Dependent MCPR Limit EOC-30 EFPD to EOC

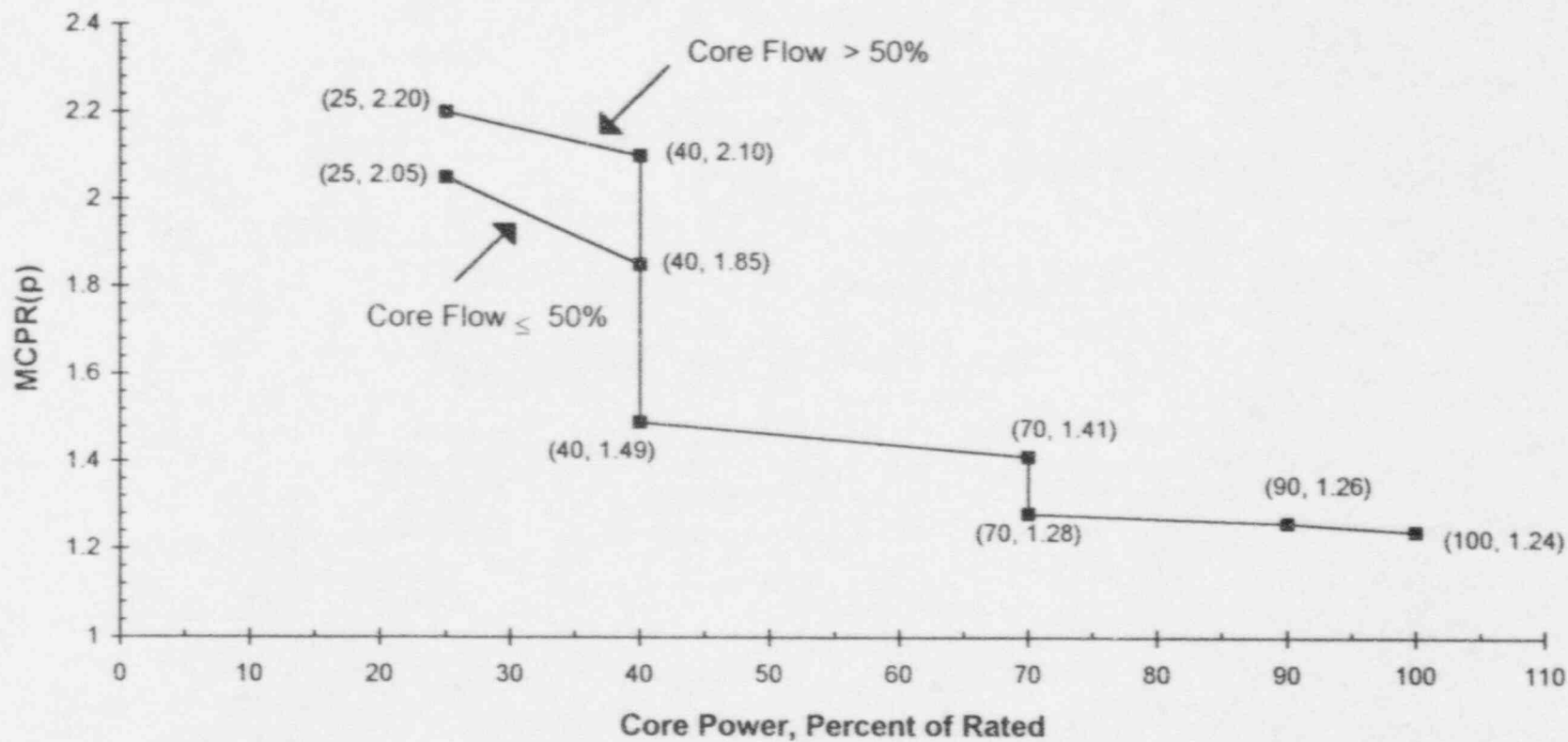


Figure 5.4 Cycle 8 Power-Dependent MCPR Limits for Exposures From EOC-30 EFPD To EOC

Cycle 8 Power-Dependent MCPR Limit EOC to EOC+30 EFPD

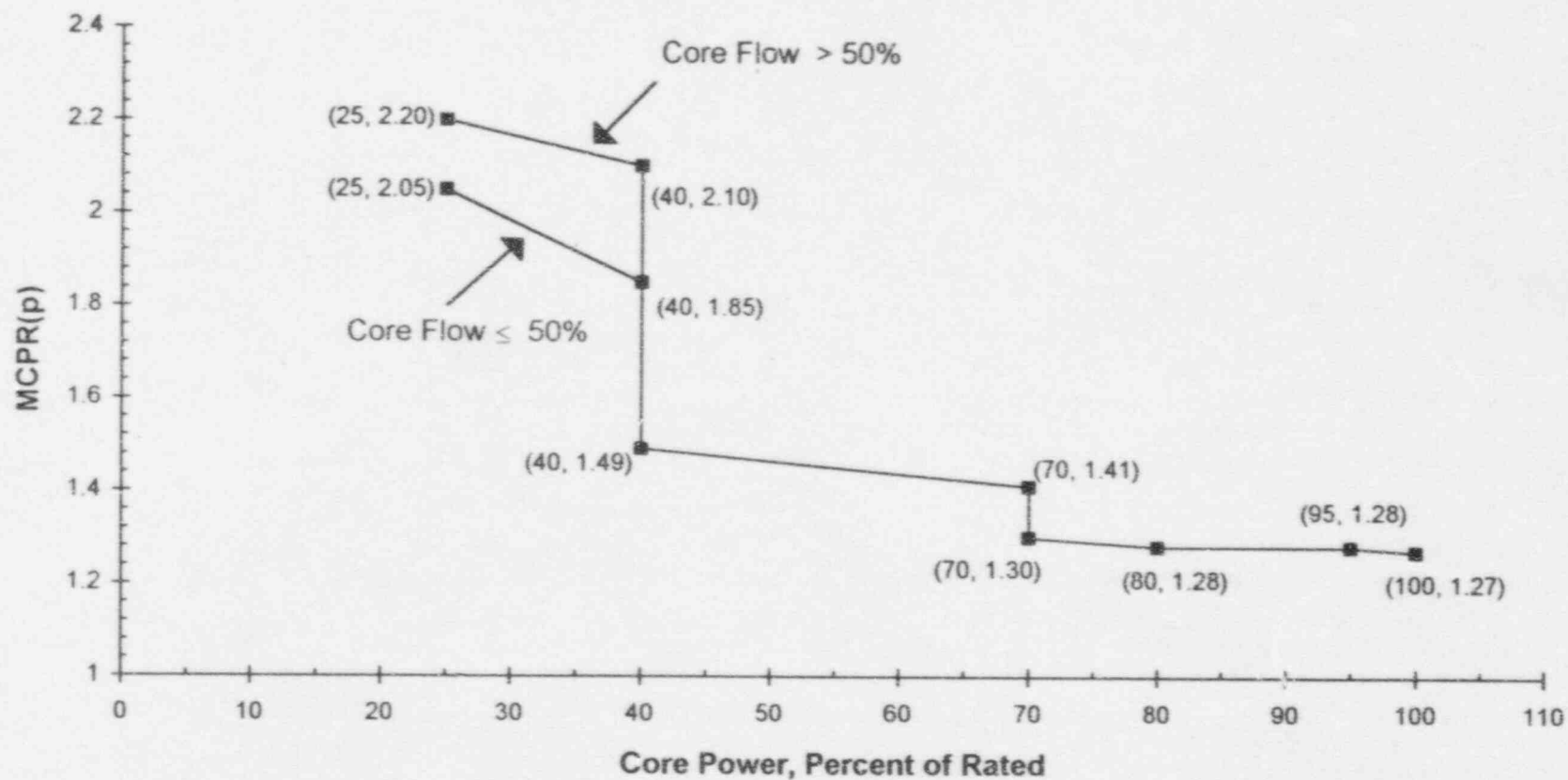


Figure 5.5 Cycle 8 Power-Dependent MCPR Limits for Exposures From EOC To EOC+30 EFPD

Cycle 8 Linear Heat Generation Rate

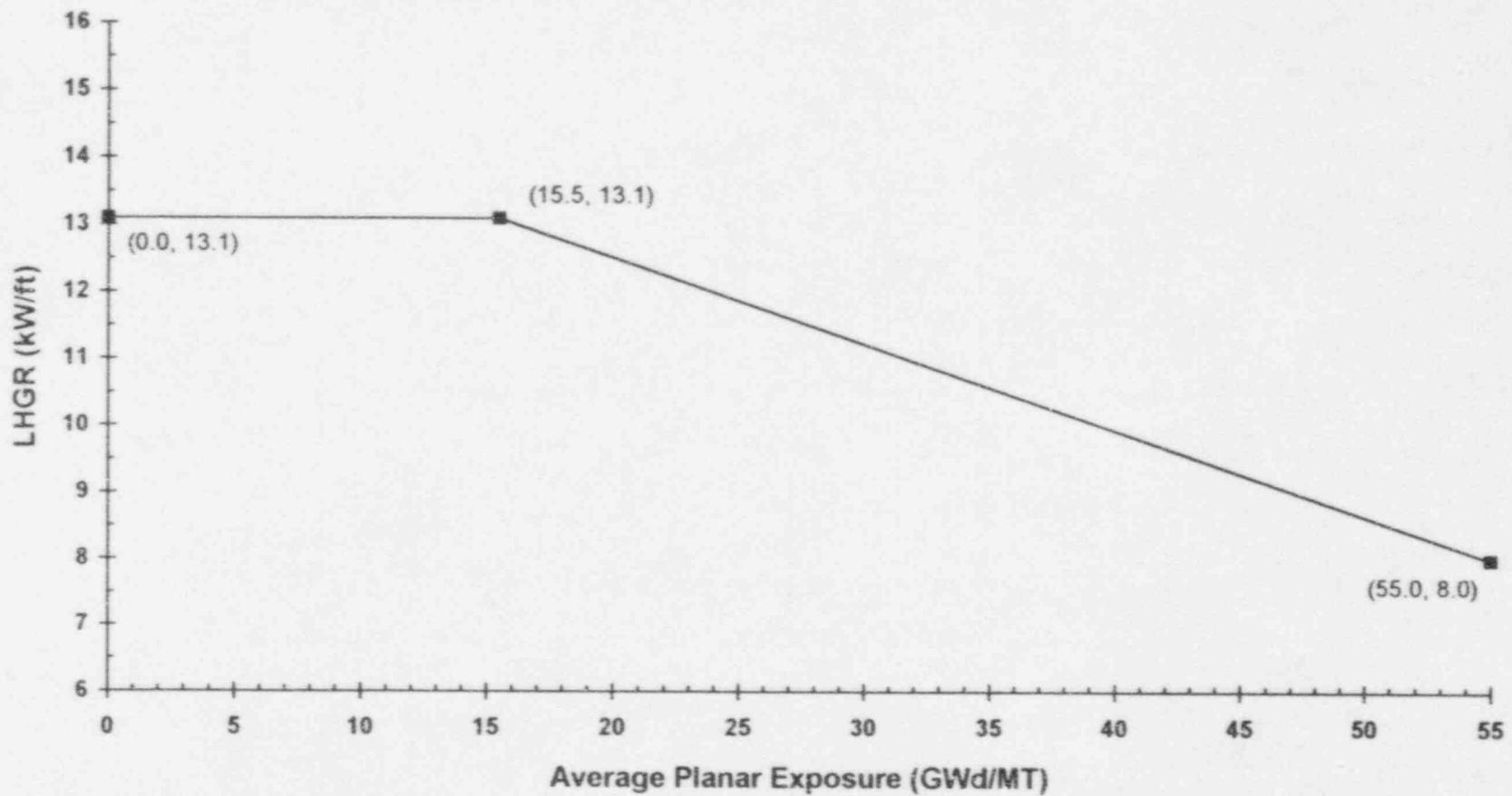


Figure 5.6 Cycle 8 LHGR Limits

Cycle 8 Flow-Dependent LHGR Factor

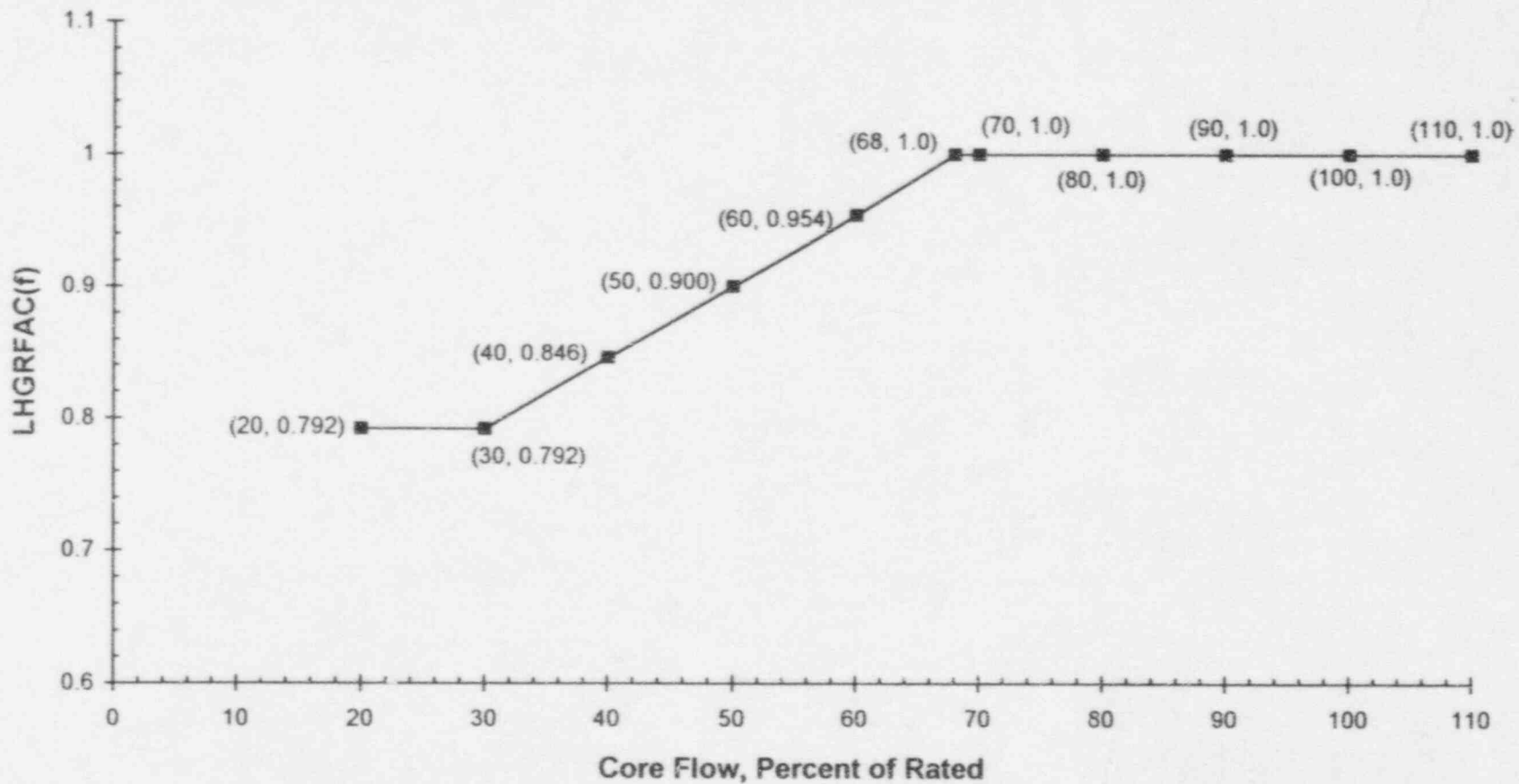


Figure 5.7 Cycle 8 Flow-Dependent LHGR Factors

Cycle 8 Power-Dependent LHGR Factor

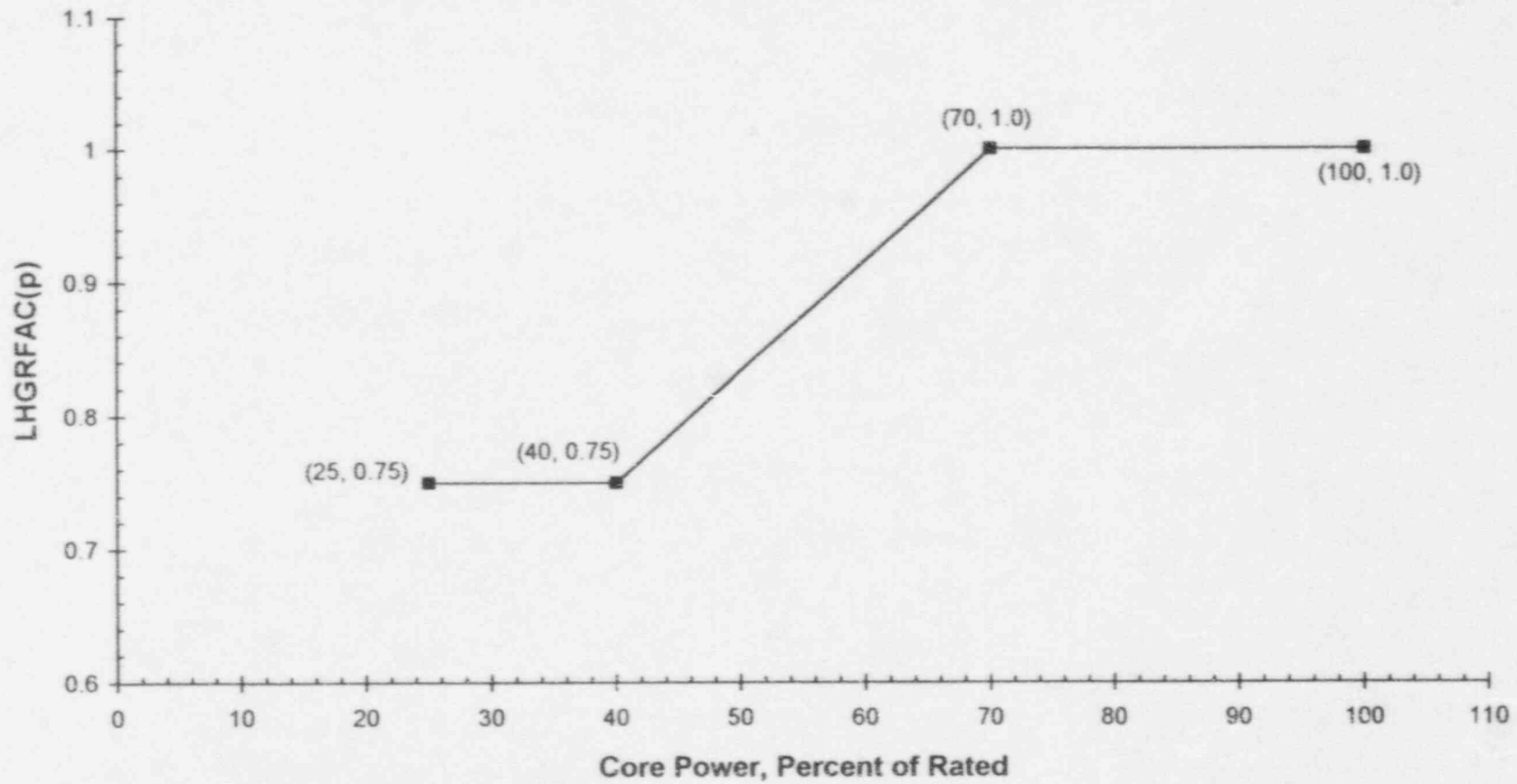


Figure 5.8 Cycle 8 Power-Dependent LHGR Factors