Entergy

Entergy Operations, Inc.
River Bend Station
5485 U.S. Highway 61
P. O. Box 220
St. Francisville, LA 70775
Tel 225 336 6225
Fax 225 635 5068

Rick J. King
Director
Nuclear Safety Assurance

March 28, 2001

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

Subject: River Bend Station - Unit 1
Docket No. 50-458
License No. NPF-47
Tenth Fuel Cycle Core Operating Limits Report (COLR), Revision 3

File Nos.: G9.5, G9.25.1.5

RBG-45695
RBF1-01-0070

Ladies and Gentlemen:

Enclosed is Revision 3 of the River Bend Station (RBS) Core Operation Limits Report (COLR) for the tenth fuel cycle. This report is submitted in accordance with Technical Specification 5.6.5 of Appendix A of the Facility Operating License NPF-47.

In addition, this submittal also includes Revision 2 of the cycle 10 COLR which was implemented during October 2000.

There are no commitments in this letter. For further information, contact Mr. B. M. Burmeister at (225) 381-4148.

Sincerely,

Rick J. King

RJK/BMB
enclosures

A001

cc: Mr. Robert Moody
U. S. Nuclear Regulatory Commission
M/S OWFN 07-D1
Washington, DC 20555

NRC Resident Inspector
P. O. Box 1050
St. Francisville, LA 70775

U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011

Core Operating Limits Report
Cycle 10
Revision 3

RIVER BEND STATION, CYCLE 10

CORE OPERATING LIMITS REPORT (COLR)

PREPARED BY: Wai Law Date: 2/5/2001
Responsible Engineer WAI LAW

REVIEWED BY: Phu Vo 0754 Date: 2/5/2001
Review Engineer PHU V. VO

APPROVED BY: Paul A Sicard Date: 8 FEB 2001
Manager - Safety Analysis PAUL A SICARD

APPROVED BY: [signature] Date: 2/8/01
Director, Engineering
River Bend Nuclear Station

APPROVED BY: [signature] 1409 Date: 2/22/01
Facilities Review Committee
River Bend Nuclear Station

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INTRODUCTION AND SUMMARY

This report provides Cycle 10 values for the following Technical Specifications:

1. AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) limits,
2. MINIMUM CRITICAL POWER RATIO (MCPR) limits,
3. LINEAR HEAT GENERATION RATE (LHGR) limits,
4. FRACTION OF CORE BOILING BOUNDARY (FCBB),
5. REACTOR PROTECTION SYSTEM (RPS) APRM Flow Biased Simulated Thermal Power - High Allowable Values,
6. REACTOR PROTECTION SYSTEM (RPS) APRM Flow Biased Simulated Thermal Power time constant.
7. PERIOD BASED DETECTION SYSTEM (PBDS) region boundaries.

Technical Specification section 5.6.5 requires these values be determined using NRC-approved methodology and are established such that all applicable limits of the plant safety analysis are met.

This report also provides Cycle 10 values for the following Technical Requirements:

1. REACTOR PROTECTION SYSTEM (RPS) APRM Flow Biased Neutron Flux Power - High Allowable Values and Nominal Trip Setpoints[1],
2. CONTROL ROD BLOCK INSTRUMENTATION APRM Flow Biased Simulated Thermal Power High limits.

In some cases limits in the COLR differ from the limits in the core monitoring system. This is sometimes due to limitations in the core monitoring system to model the actual limits, in which case the core monitoring limits may be more conservative than the COLR limit. In other cases the limits in the COLR are presented in less detail than in the core monitoring system. When these situations exist the core monitoring limits will be explained or be referenced by the COLR and will be made available to Operations.

MCPRp for one pressure regulator out of service is shown in Figure A1 of Appendix A. LHGRp and MAPLHGRp for one pressure regulator out of service are shown Figure A2 of Appendix A.

The reload analyses were performed in accordance with GESTAR II and its applicability to Cycle 10 was confirmed by Reference 3.

[1] Note that for Figures 22 to 29, the Nominal Setpoints should be used for indicating the entry into a particular stability region as allowed and appropriate actions be taken prior to the entry

CONTROL RODS

The River Bend core utilizes both GE original equipment and ABB CR-82M bottom entry cruciform control rods. These Control Rod designs are discussed in more detail in reference 7.

REASONS FOR REVISION

Per GESTAR II Amendment 26, analysis for the pressure regulator – closed event is no longer required for BWR 6 plants with MEOD. Therefore, starting with Reload 9, Cycle 10, the standard pressure regulator – closed event analysis is not required for the determination of the thermal limits. In support of the operation without the backup pressure regulator, MCPR(p) and LHGR(p) with the pressure regulator – closed event are analyzed, and are reported in Appendix A for one pressure regulator out of service.

Revision 1 updated Figure 17, Figure 19, Pages 2, 3 and 4. Also, Figures A1 and A2, the MCPR(p) and LHGR(p) limits for one pressure regulator out of service, are added to this revision.

Revision 2 updated Table 1, Figures 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29 and Figure A1 & A2 to reflect the Operating Limits for the flow increase power uprate from 2894 MWt to 3039 MWt.

Revision 3 updated Figures 2, 3, 4, 5, 6, 7 and Figures 9, 10, 11, 12, 13, 14 to reflect the improved MAPLHGR and LHGR limits for GE11.

TECHNICAL SPECIFICATION 3.2.1

POWER DISTRIBUTION LIMITS

AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)

The limiting APLHGR (sometimes referred to as Maximum APLHGR, or MAPLHGR) value for the most limiting lattice (excluding natural uranium) of each fuel type as a function of AVERAGE PLANAR EXPOSURE is given in Figures 2 through 8. These values were determined with the SAFER/GESTR LOCA and GESTR-Mechanical methodology described in GESTAR-II (Reference 1). Core location by fuel type is provided in Figure 1 and is the reference core loading pattern in reference 3. These figures are used if alternate calculations are required. The limits of these figures shall be reduced to a value of 0.79 and 0.87 times the two recirculation loop operation limit when in single loop operation for GE11 and GE8, respectively (Reference 3). Thermal power and core flow dependent multipliers are provided. The value of the exposure dependent limit is reduced by the value of the multiplier at a given offrated power or flow condition. These multipliers are independent of the single loop multipliers and are shown on Figures 18 and 19.

The APLHGR limits in the core monitoring system are in more detail than the limits that appear in the COLR due to their proprietary nature. The core monitoring system has APLHGR limits for each lattice in a bundle rather than listing only the most limiting value for the entire bundle. Reference 4 lists the core monitoring system limits.

TECHNICAL SPECIFICATION 3.2.2

POWER DISTRIBUTION LIMITS

MINIMUM CRITICAL POWER RATIO (MCPR)

The MCPR limits for use in Technical Specification 3.2.2 for flow dependent MCPR ($MCPR_F$) (Reference 3), power dependent MCPR ($MCPR_P$) (Reference 3) are shown in Figures 16 through 17. The most limiting value from the applicable $MCPR_f$ and $MCPR_p$ figures is the operating limit. These values were determined with the GEMINI methodology and GEXL-PLUS critical power ratio correlation described in GESTAR-II (Reference 1) and are consistent with a Safety Limit MCPR from Technical Specification 2.0. The Operating Limit MCPR values in Figures 16 through 17 must be increased by 0.01 during single loop operation.

TECHNICAL SPECIFICATION 3.2.3

POWER DISTRIBUTION LIMITS

LINEAR HEAT GENERATION RATE (LHGR)

The limiting LHGR value for the most limiting lattice of each fuel type as a function of AVERAGE PLANAR EXPOSURE is given in Figures 9 through 15. These values were determined with GESTR-Mechanical methodology described in GESTAR-II (Reference 1). Core location by fuel type is provided in Figure 1 and is the reference core loading pattern in reference 3. These figures are used if alternate calculations are required. Thermal power and core flow dependent multipliers are provided in Figures 18 and 19. The value of the exposure dependent limit is reduced by the value of the multiplier at a given offrated power or flow condition.

The LHGR limits in the core monitoring system are in more detail than the limits that appear in the COLR due to their proprietary nature. The core monitoring system has LHGR limits for each lattice in a bundle rather than listing only the most limiting value for the entire bundle. Reference 4 lists the core monitoring system limits.

TECHNICAL SPECIFICATION 3.2.4

POWER DISTRIBUTION LIMITS

FRACTION OF CORE BOILING BOUNDARY (FCBB)

Restricted Region Boundary

Note: The boundary of the Restricted Region is established by analysis in terms of thermal power and core flow. The Restricted Region boundary is defined by the "non-setup" APRM Flow Biased Simulated Thermal Power - High Control Rod Block Setpoints, which are a function of reactor recirculation drive flow.

The Restricted Region boundaries as a function of aligned drive flow are given in Figures 22 through 25 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Simulated Thermal Power - High Scram setpoints as a function of aligned derive flow are given in Figures 22 through 25. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50^\circ F,$$

and rated equivalent at off-rated reactor conditions.

OR

$$P \leq 30\%$$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50^\circ F,$$

and rated equivalent at off-rated reactor conditions.

AND

$$P > 30\%$$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

TECHNICAL SPECIFICATION 3.3.1.1

INSTRUMENTATION

REACTOR PROTECTION SYSTEM (RPS) INSTRUMENTATION

AVERAGE POWER RANGE MONITORS

APRM Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Simulated Thermal Power - High scram setpoint Allowable Values are given in Figures 22 through 25 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

OR

$P \leq 30\%$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

AND

$P > 30\%$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

APRM Simulated Thermal Power Time Constant

The simulated thermal power time constant for use in Technical Specification Table 3.3.1.1-1, SR 3.3.1.1.14, is (Reference 6):

6 ± 0.6 seconds.

The maximum simulated thermal power time constant for use in Technical Specification surveillance Table 3.3.1.1-1, SR 3.3.1.1.14 is:

6.6 seconds

TECHNICAL SPECIFICATION 3.3.1.3

INSTRUMENTATION

PERIOD BASED DETECTION SYSTEM (PBDS)

Monitored Region Boundary

The Monitored Region Boundaries as a function of core flow are given in Figures 20 and 21.

Restricted Region Boundary

Note: The boundary of the Restricted Region is established by analysis in terms of thermal power and core flow. The Restricted Region boundary is defined by the "non-setup" APRM Flow Biased Simulated Thermal Power - High Control Rod Block Setpoints, which are a function of reactor recirculation drive flow.

The Restricted Region boundaries as a function of aligned drive flow are given in Figures 22 through 25 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

OR

$P \leq 30\%$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

AND

$P > 30\%$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

TECHNICAL REQUIREMENT 3.3.1.1

INSTRUMENTATION

REACTOR PROTECTION SYSTEM (RPS) INSTRUMENTATION

AVERAGE POWER RANGE MONITORS

APRM Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Simulated Thermal Power - High scram setpoint Nominal Trip Setpoints are given in Figures 22 through 25 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°F,$$

and rated equivalent at off-rated reactor conditions.

OR

$$P \leq 30\%$$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°F,$$

and rated equivalent at off-rated reactor conditions.

AND

$$P > 30\%$$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

TECHNICAL REQUIREMENT 3.3.2.1

INSTRUMENTATION

CONTROL ROD BLOCK INSTRUMENTATION

AVERAGE POWER RANGE MONITORS

APRM Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Neutron Flux - High rod block Allowable Values and Nominal Trip Setpoints are given in Figures 26 through 29 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

OR

$P \leq 30\%$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

AND

$P > 30\%$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

REFERENCES

1) NEDE-24011-P-A-14 and US Supplement, "General Electric Standard Application for Reactor Fuel," June 2000.

2) Letter, J.S. Charnley (GE) to M.W. Hodges (NRC), Recommended MAPLHGR Technical Specifications for Multiple Lattice Fuel Designs, March 9,1987

3) J11-03660SRLR Rev. 2 Supplemental Reload Licensing Report for River Bend Station Reload 9 Cycle 10" November 2000.

4) J11-03660MAPL, Revision 1 "Lattice Dependent MAPLHGR Report for River Bend Station Reload 9 Cycle 10" November 2000.

5) GESTAR Amendment 26.

6) Letter, R.E. Kingston to G. W. Scronce, "Time Constant Values for Simulated Thermal Power Monitor" GFP-1032 November 30, 1995.

7) RBS USAR Section 4.1

8) Calculation NEAD-SR-97/032.R2, "RBS E1A COLR Input".

Table 1. Aligned Drive Flow

$$W_D = \frac{101.206 \bullet \Delta^{40} - 31.084 \bullet \Delta^{100} + 70.122 \bullet W_{\tilde{D}}}{70.122 - (\Delta^{100} - \Delta^{40})}$$

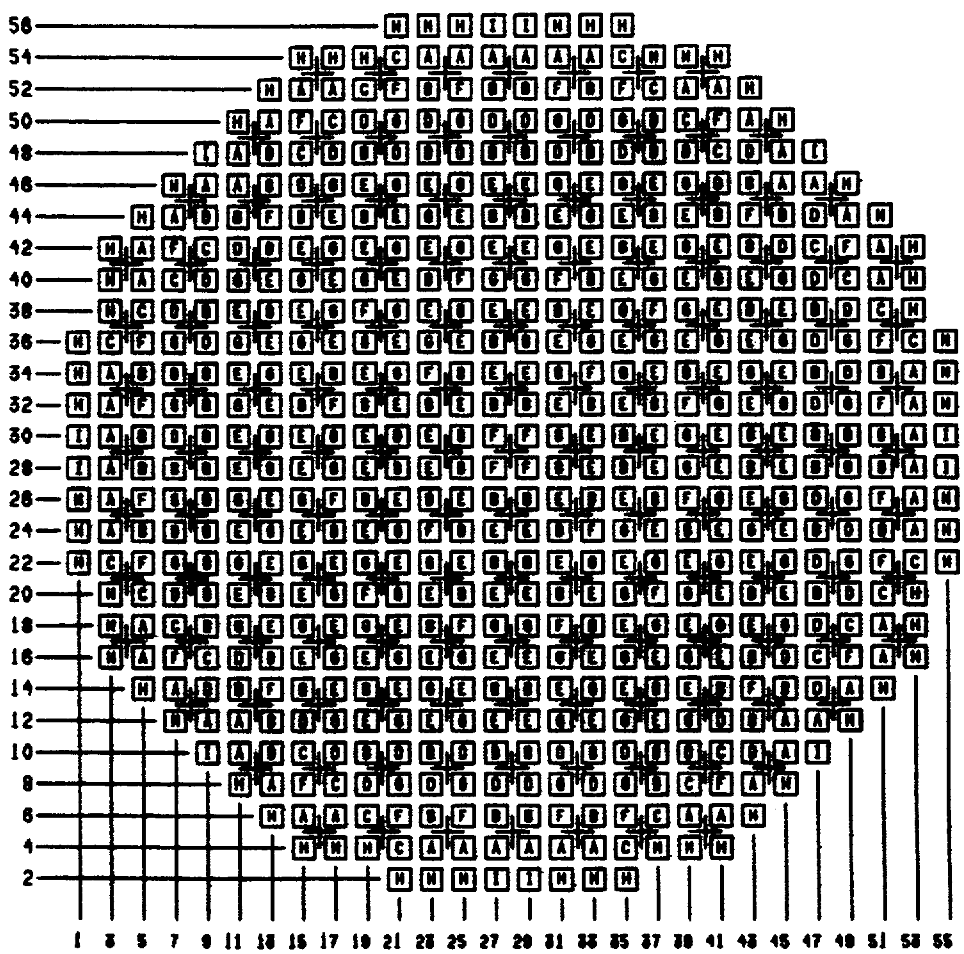
Where: $W_{\tilde{D}}$ = FCTR card input drive flow in percent rated,

W_D = Aligned drive flow in percent rated,

Δ^{40} = Low flow drive flow alignment setting, and

Δ^{100} = High flow drive flow alignment setting.

FIGURE 1. REFERENCE CORE LOADING PATTERN



Fuel Type			
A=GE11-P9SUB400-13GZ-120T-146-T	(Cycle 9)	F=GE11-P9SUB147-NOG-120T-146-T-2399	(Cycle 10)
B=GE11-P9SUB225-NOG-120T-146-T	(Cycle 9)	G=GE11-P9SUB388-13GZ-120T-146-T	(Cycle 9)
C=GE11-P9SUB388-13GZ-120T-146-T	(Cycle 9)	H=GE8B-P8SQB333-10GZ-120M-4WR-150-T	(Cycle 4)
D=GE11-P9SUB336-12GZ-120T-146-T-2401	(Cycle 10)	I=GE8B-P8SQB333-10GZ-120M-4WR-150-T	(Cycle 4)
E=GE11-P9SUB257-9GZ-120T-146-T-2400	(Cycle 10)		

FIGURE 2. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB336-12GZ-120T-146-T

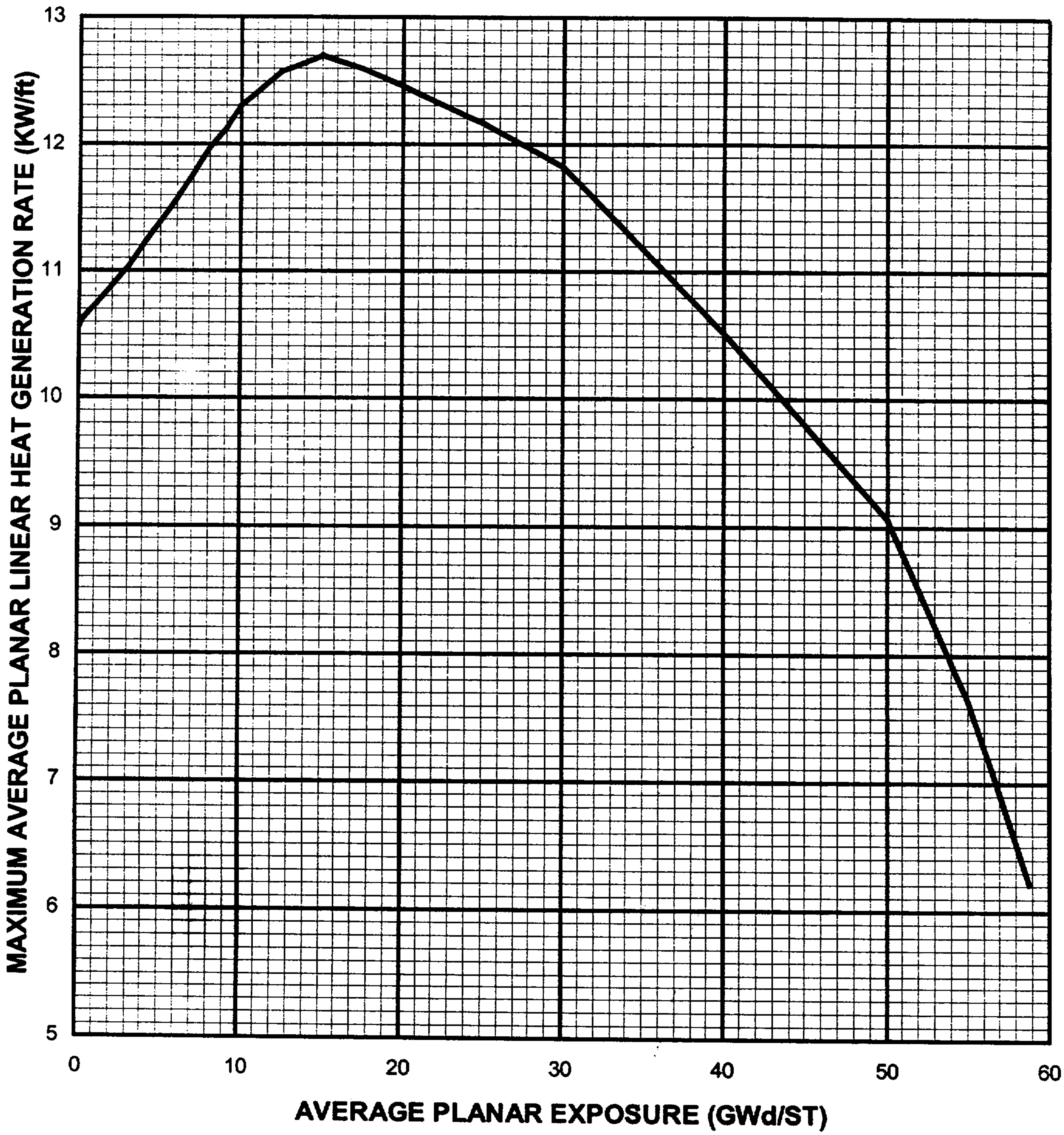


FIGURE 3. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB257-9GZ-120T-146-T

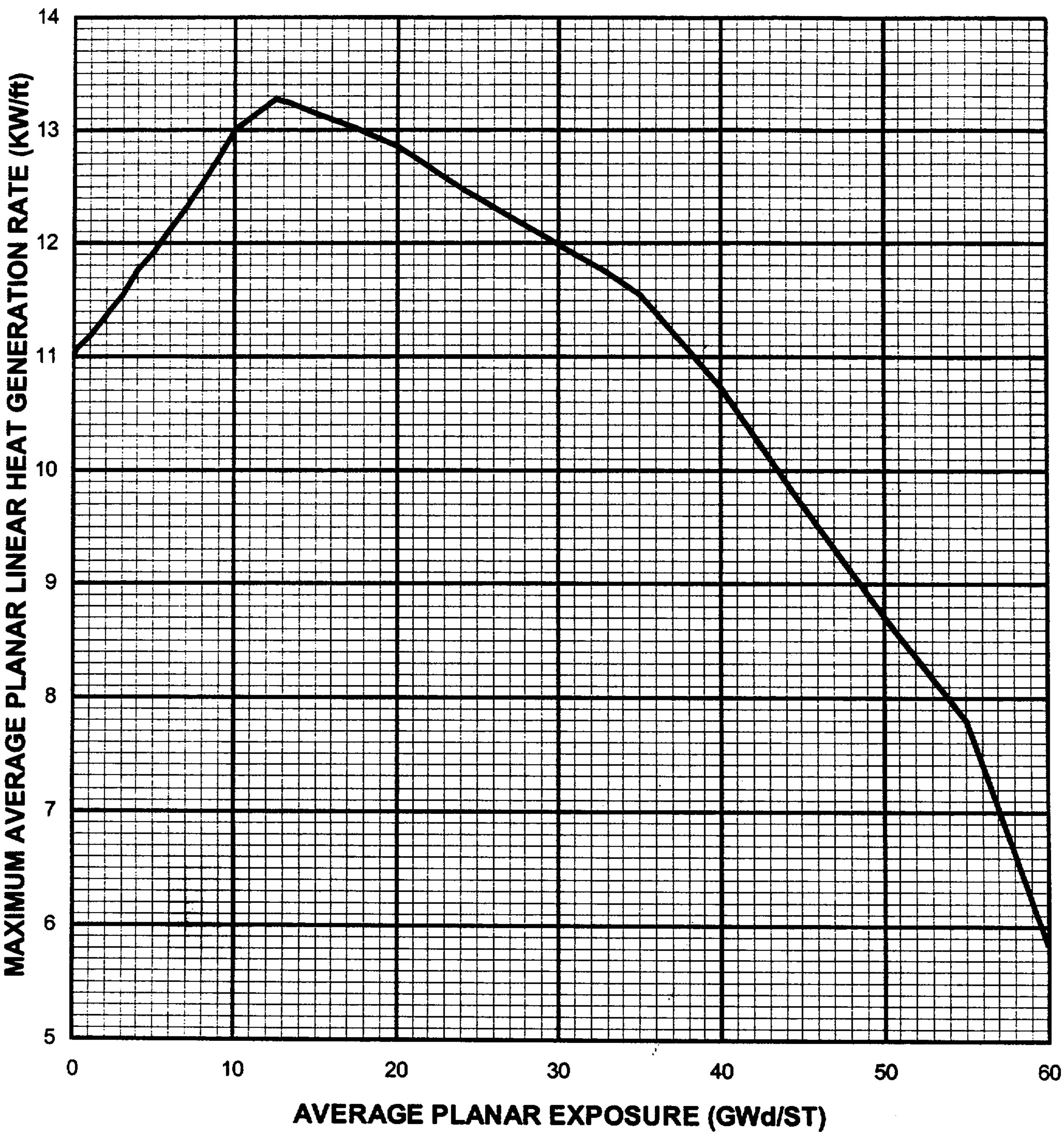


FIGURE 4. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB147-NOG-120T-146-T

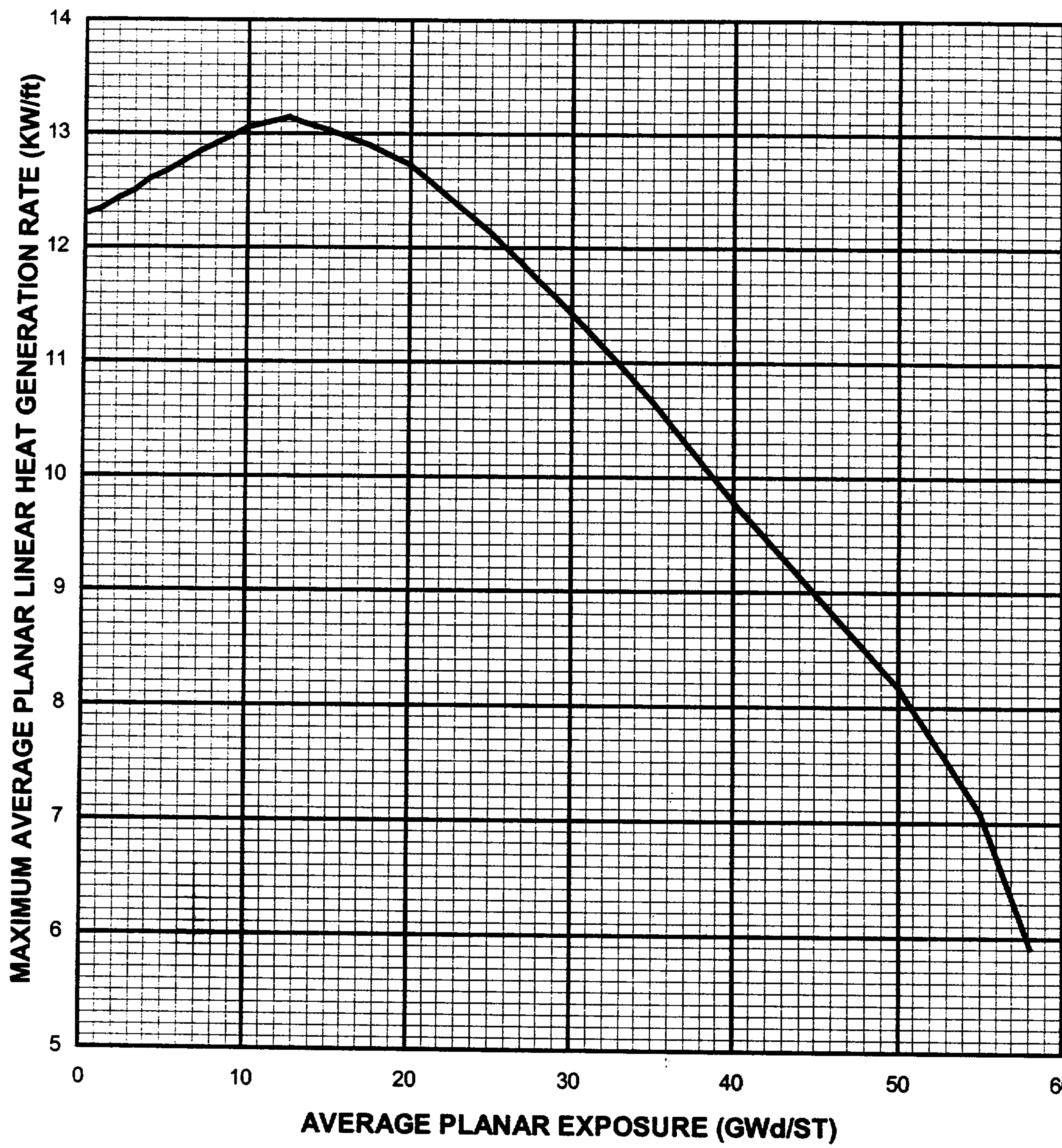


FIGURE 5. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FOR GE11-P9SUB400-13GZ-120T-146-T

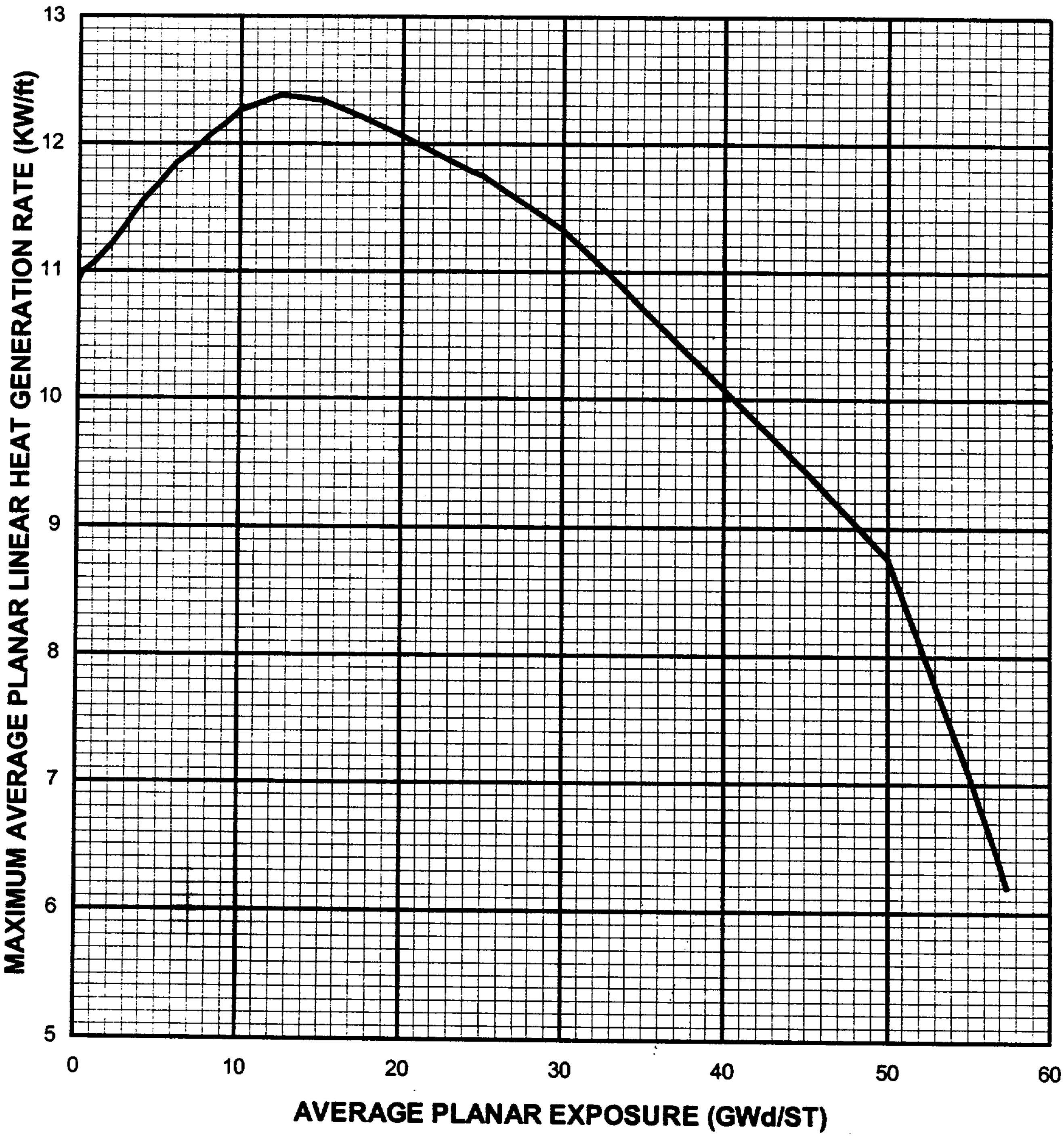


FIGURE 6. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FOR GE11-P9SUB225-NOG-120T-146-T

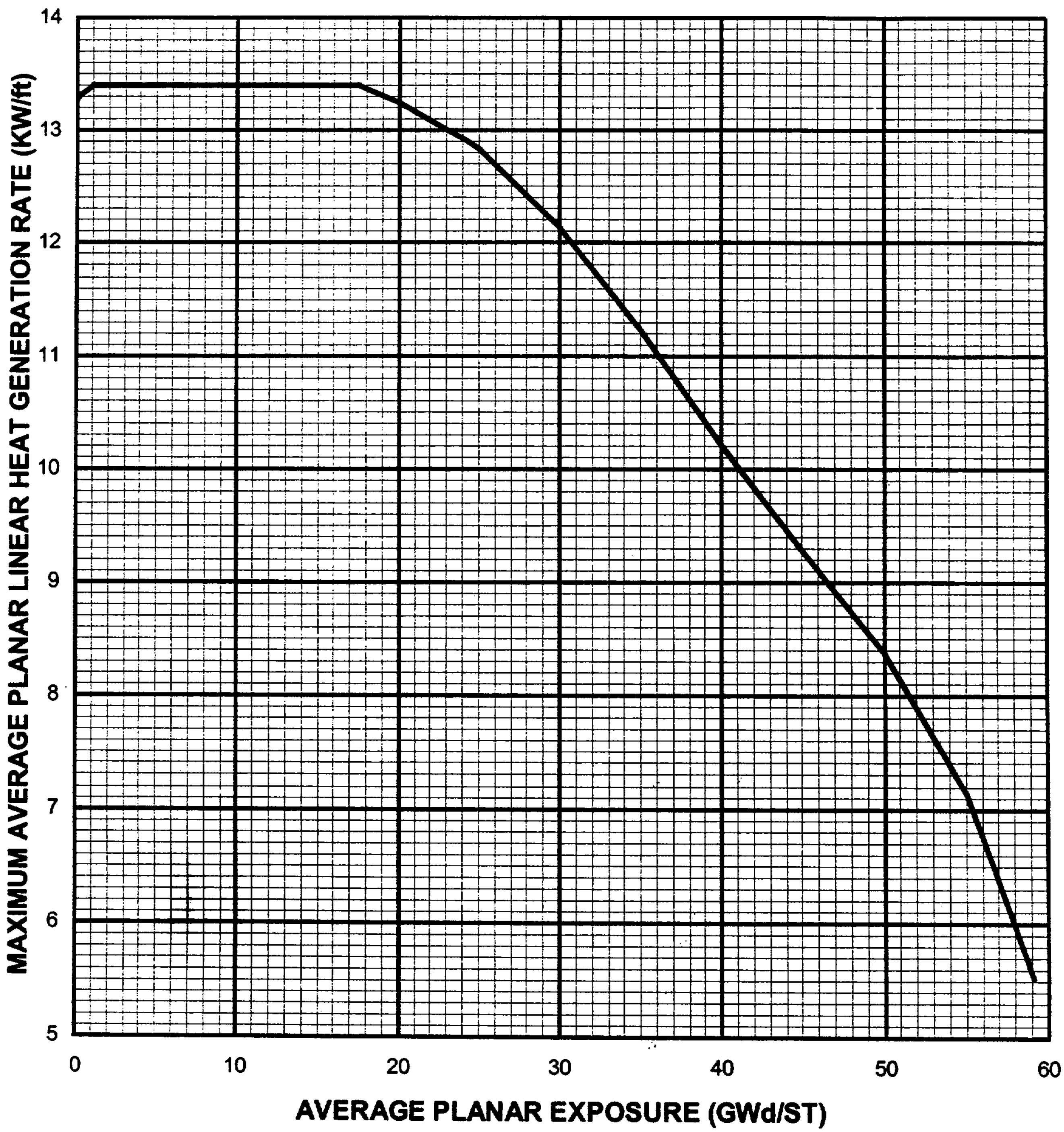


FIGURE 7. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FOR GE11-P9SUB388-13GZ-120T-146-T

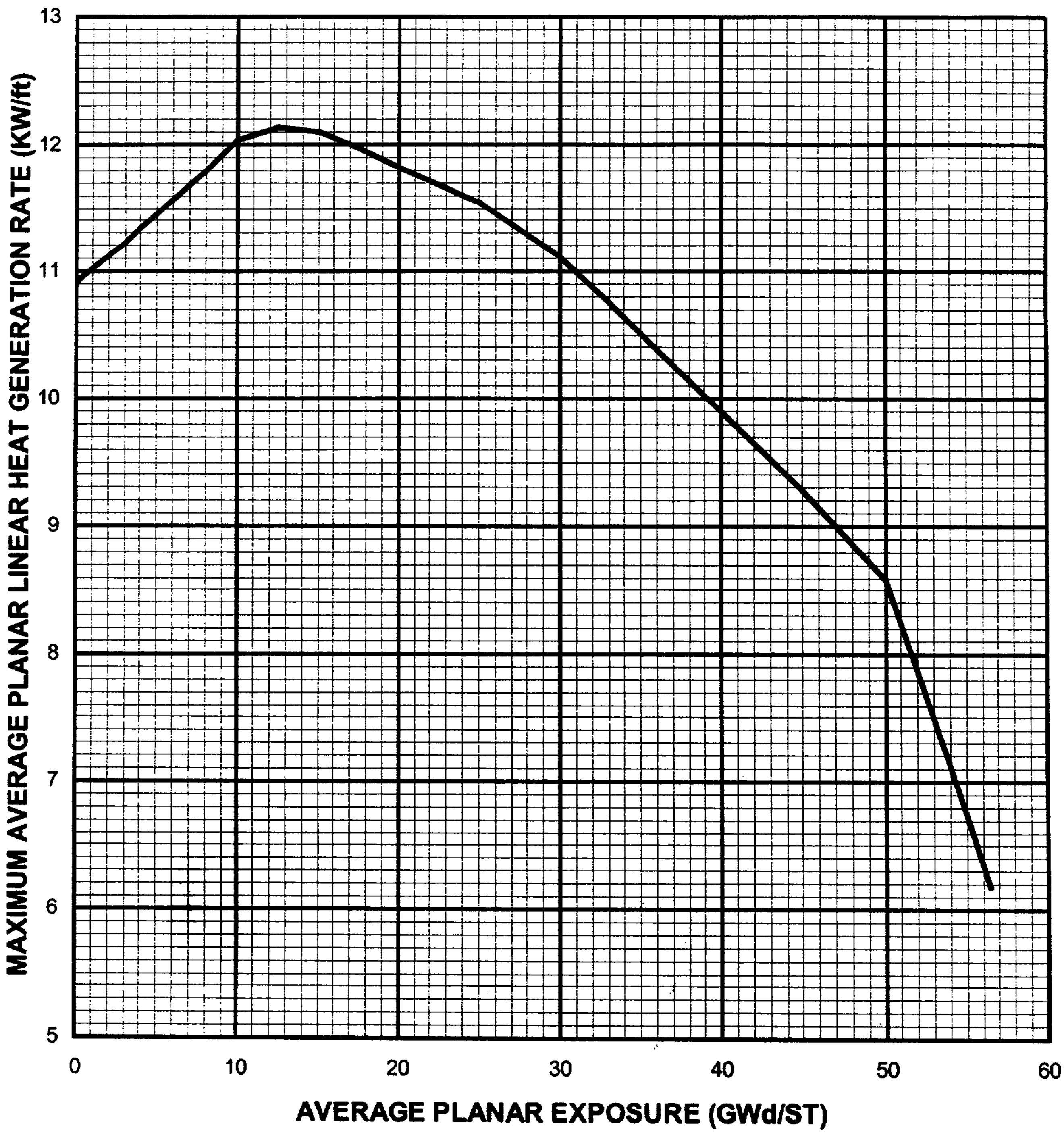


FIGURE 8. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE GE8B-P8SQB333-10GZ-120M-4WR-150-T

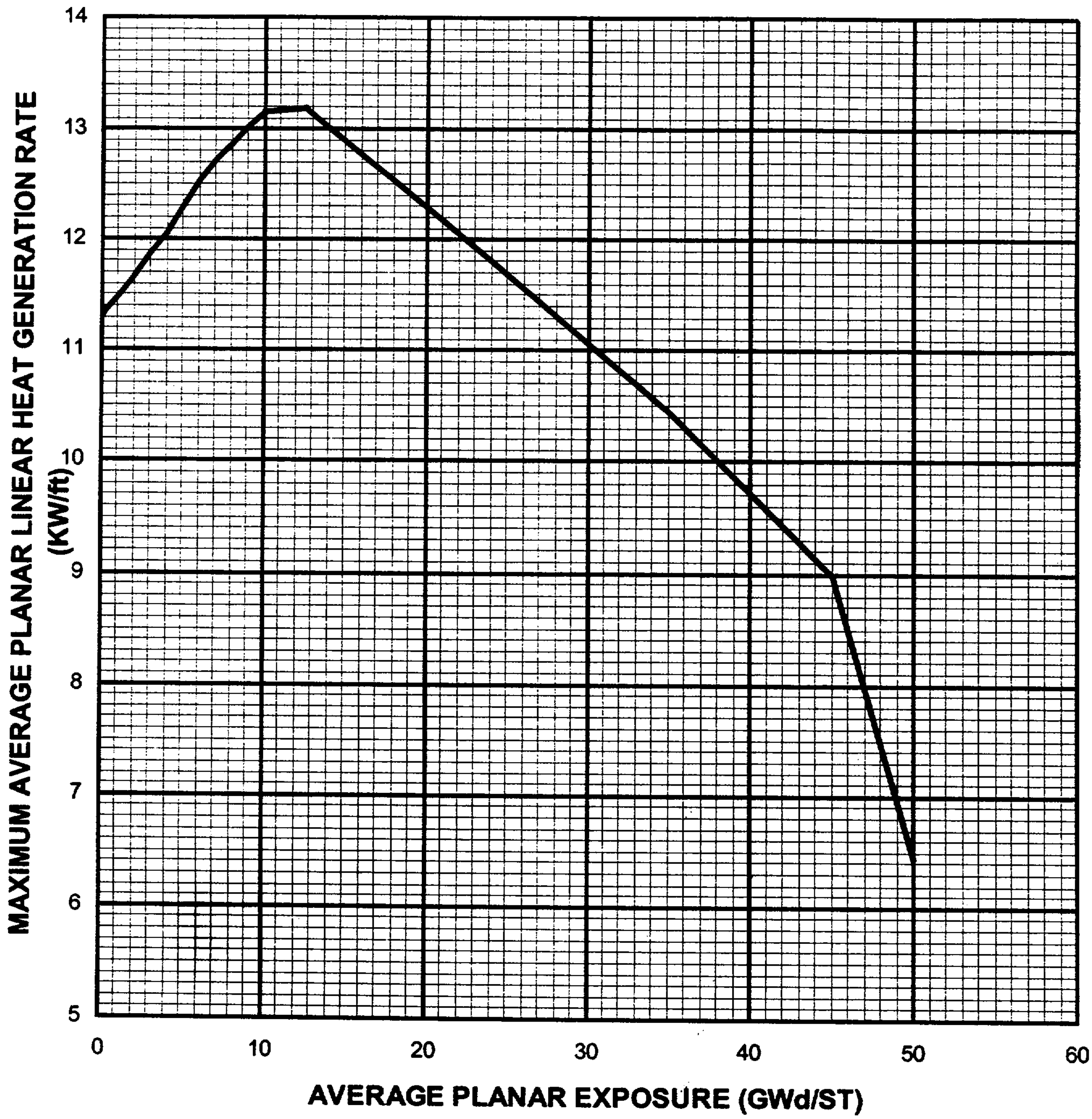


FIGURE 9. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB400-13GZ-120T-146-T

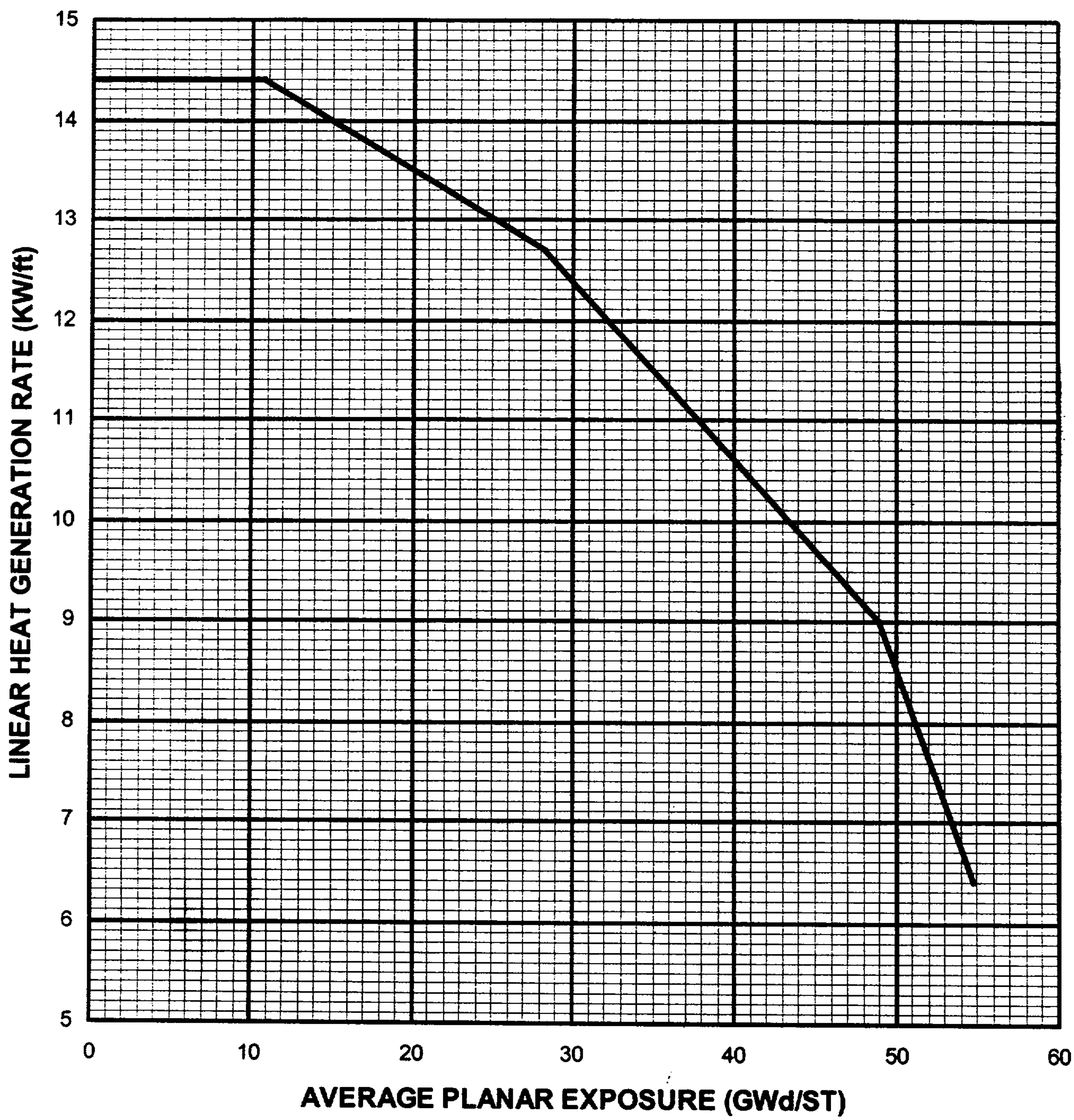


FIGURE 10. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB225-NOG-120T-146-T

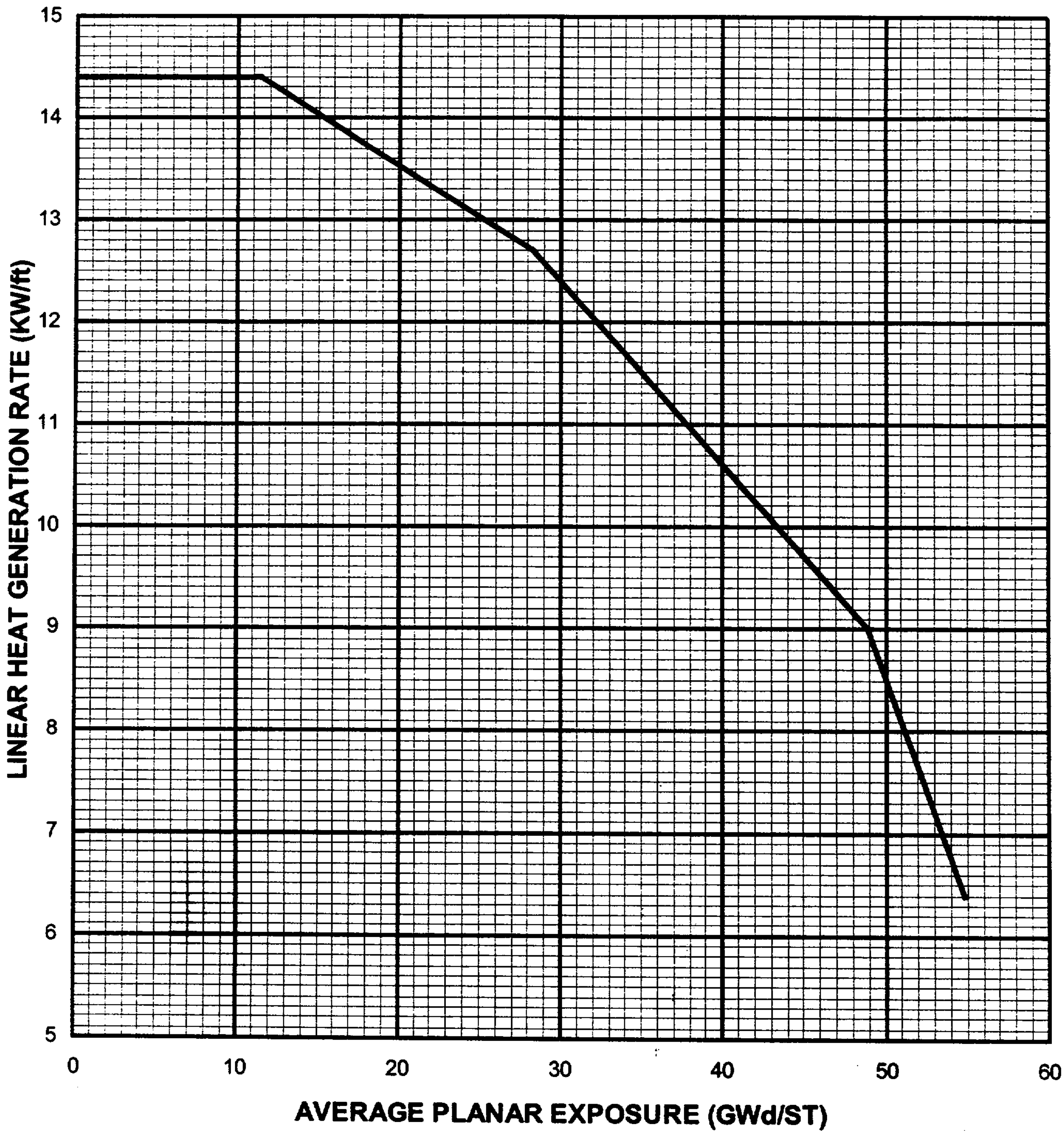


FIGURE 11. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB336-12GZ-120T-146-T

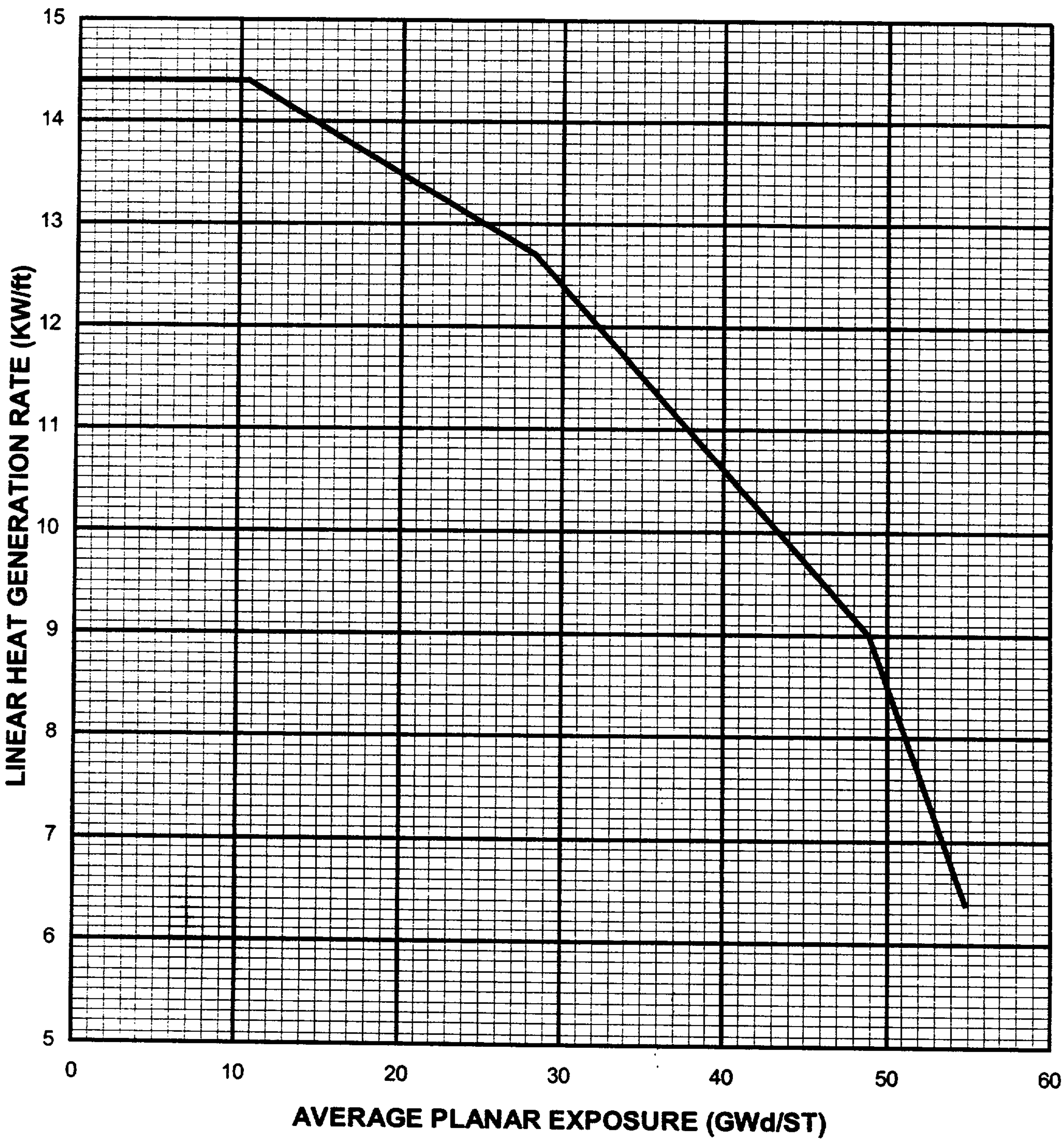


FIGURE 12. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB257-9GZ-120T-146-T

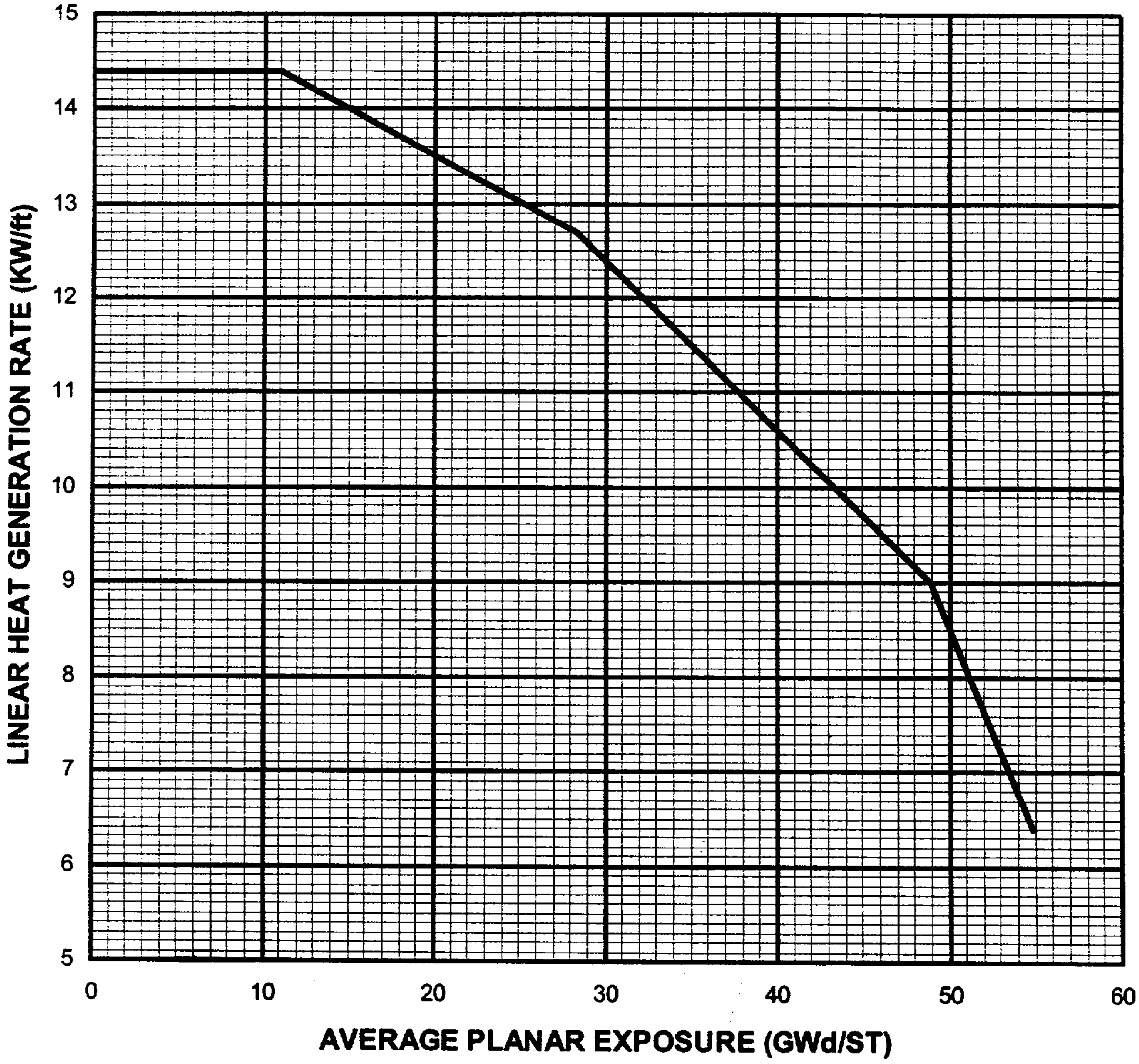


FIGURE 13. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB147-NOG-120T-146-T

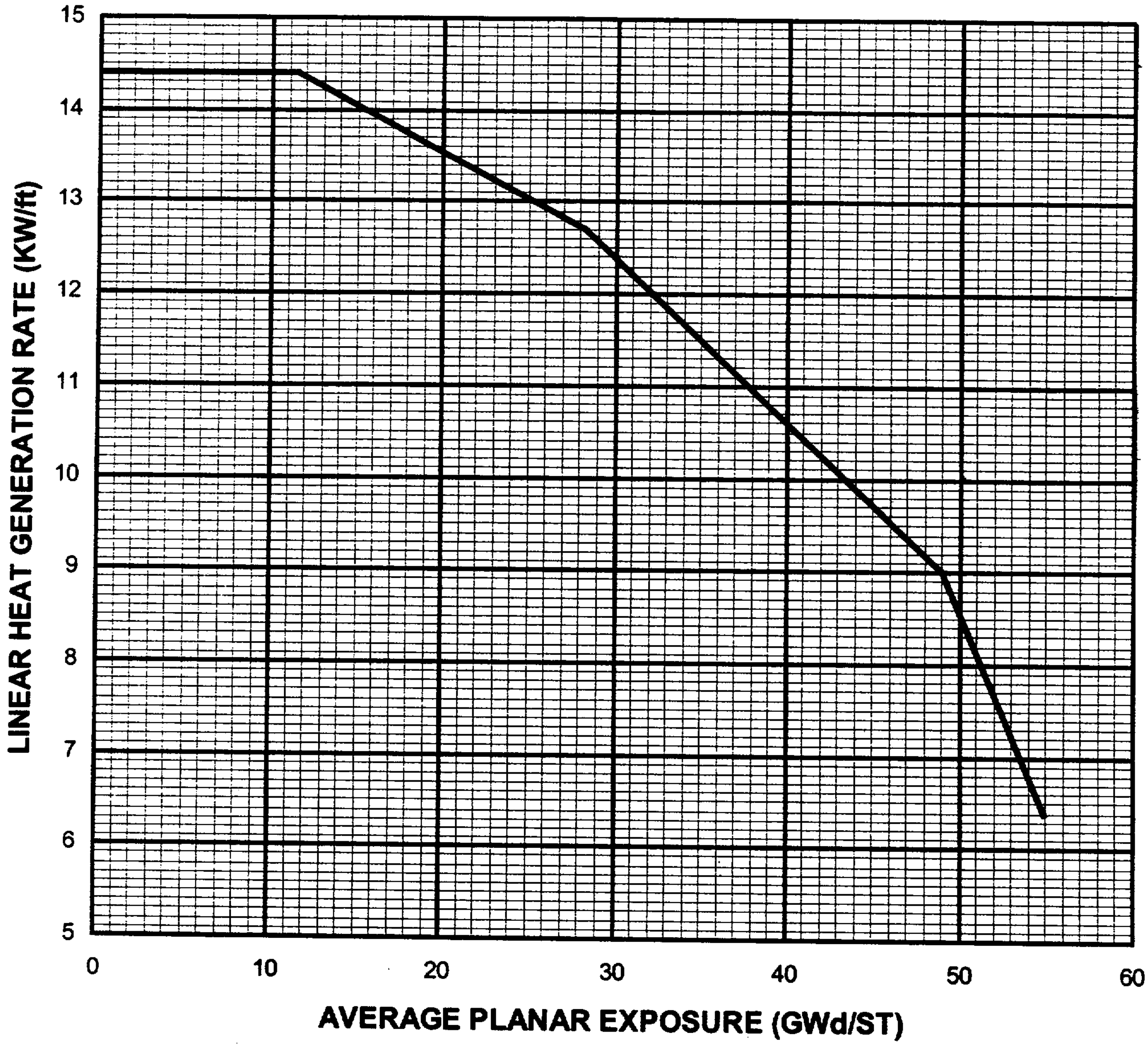


FIGURE 14. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-PSUB388-13GZ-120T-146-T

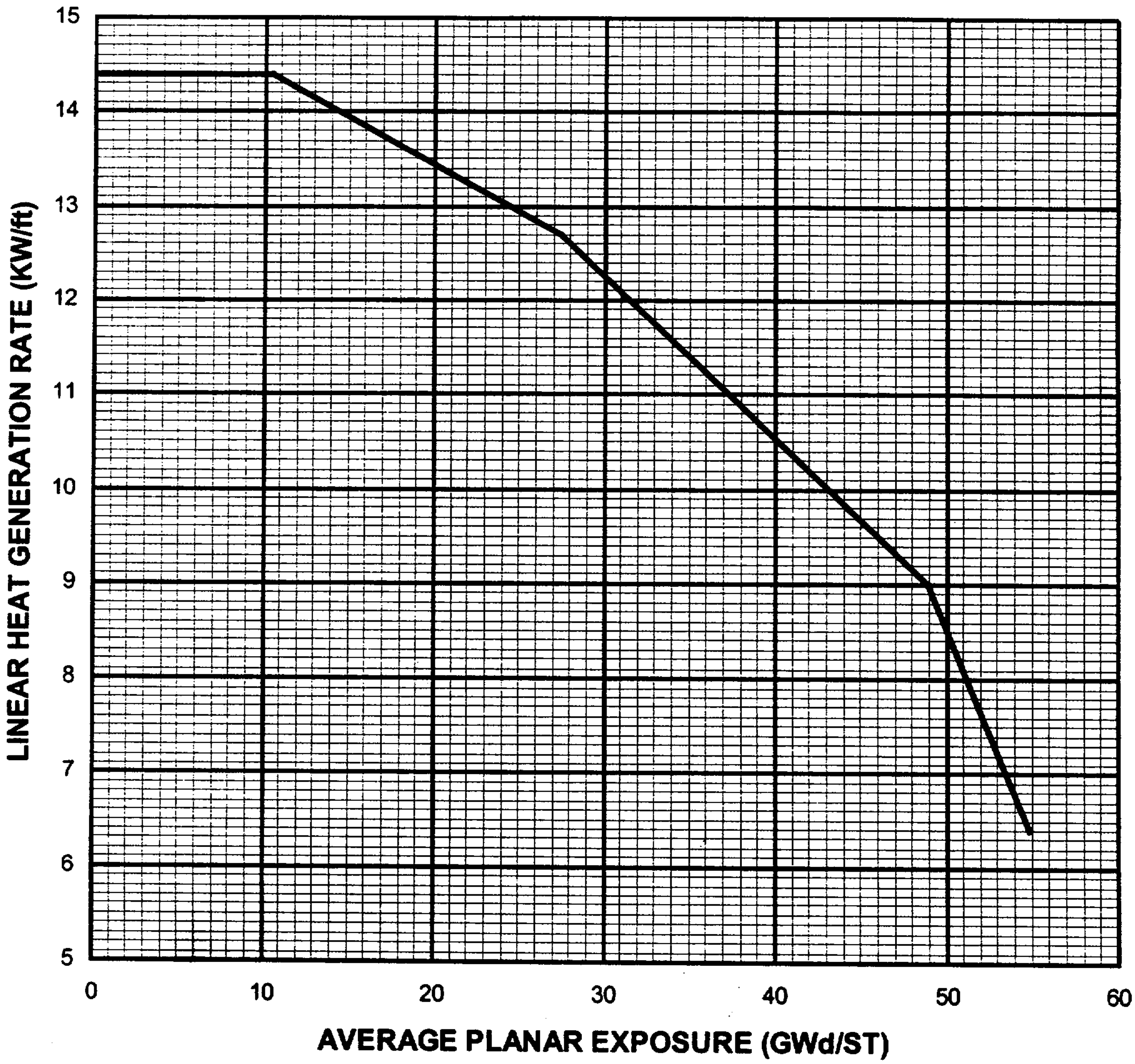


FIGURE 15. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE8B-P8SQB333-10GZ-120M-4WR-150-T

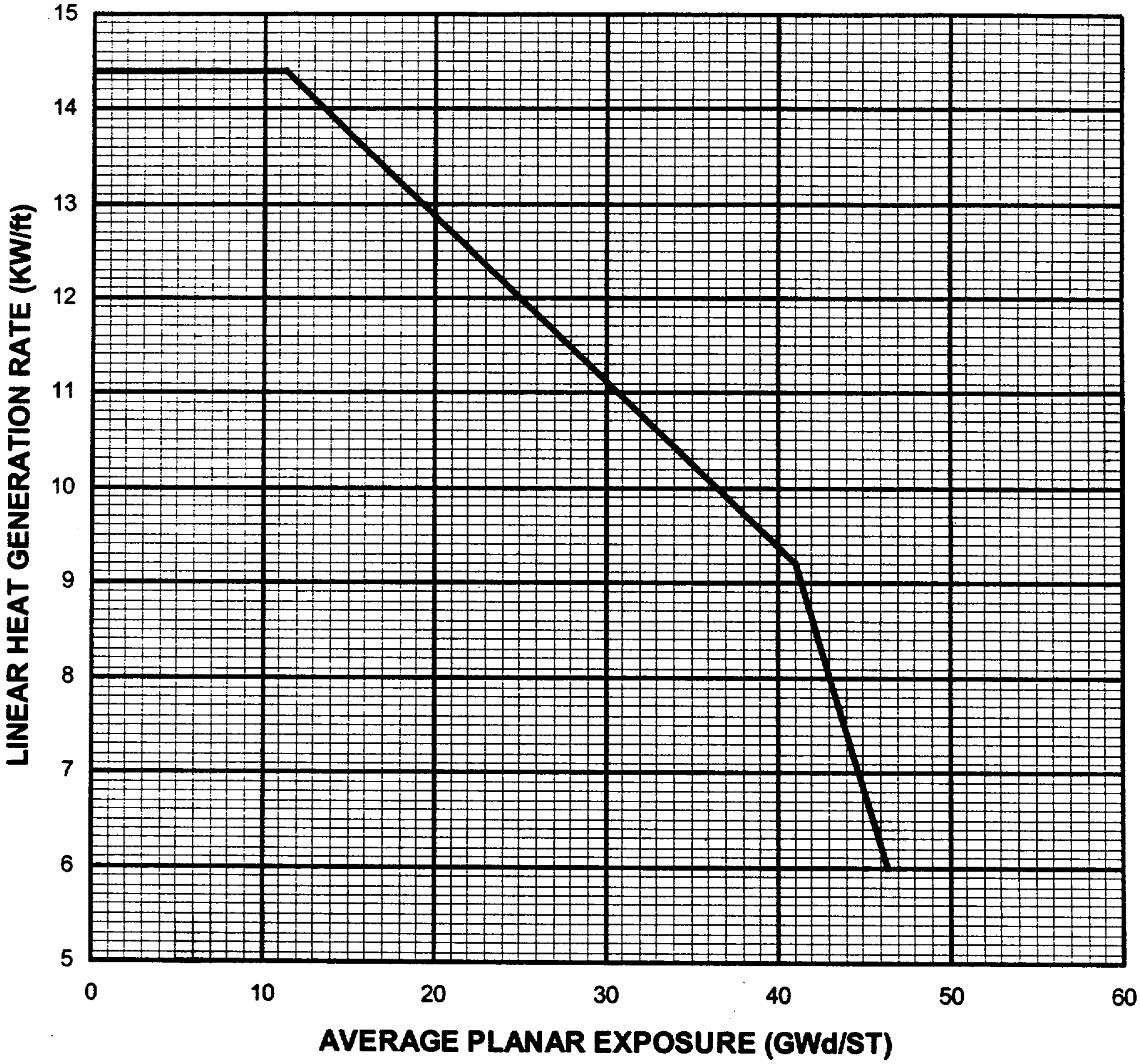
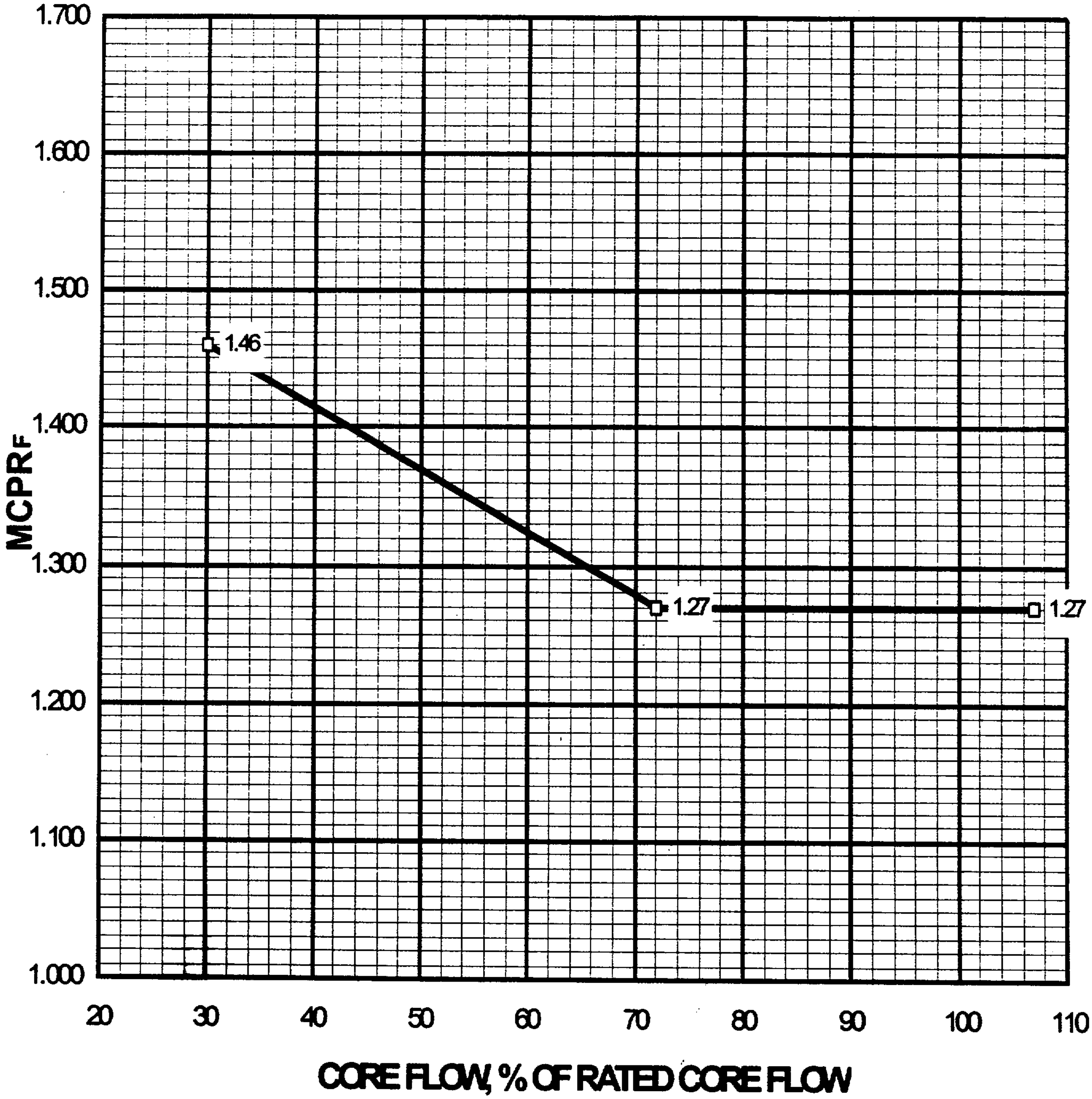
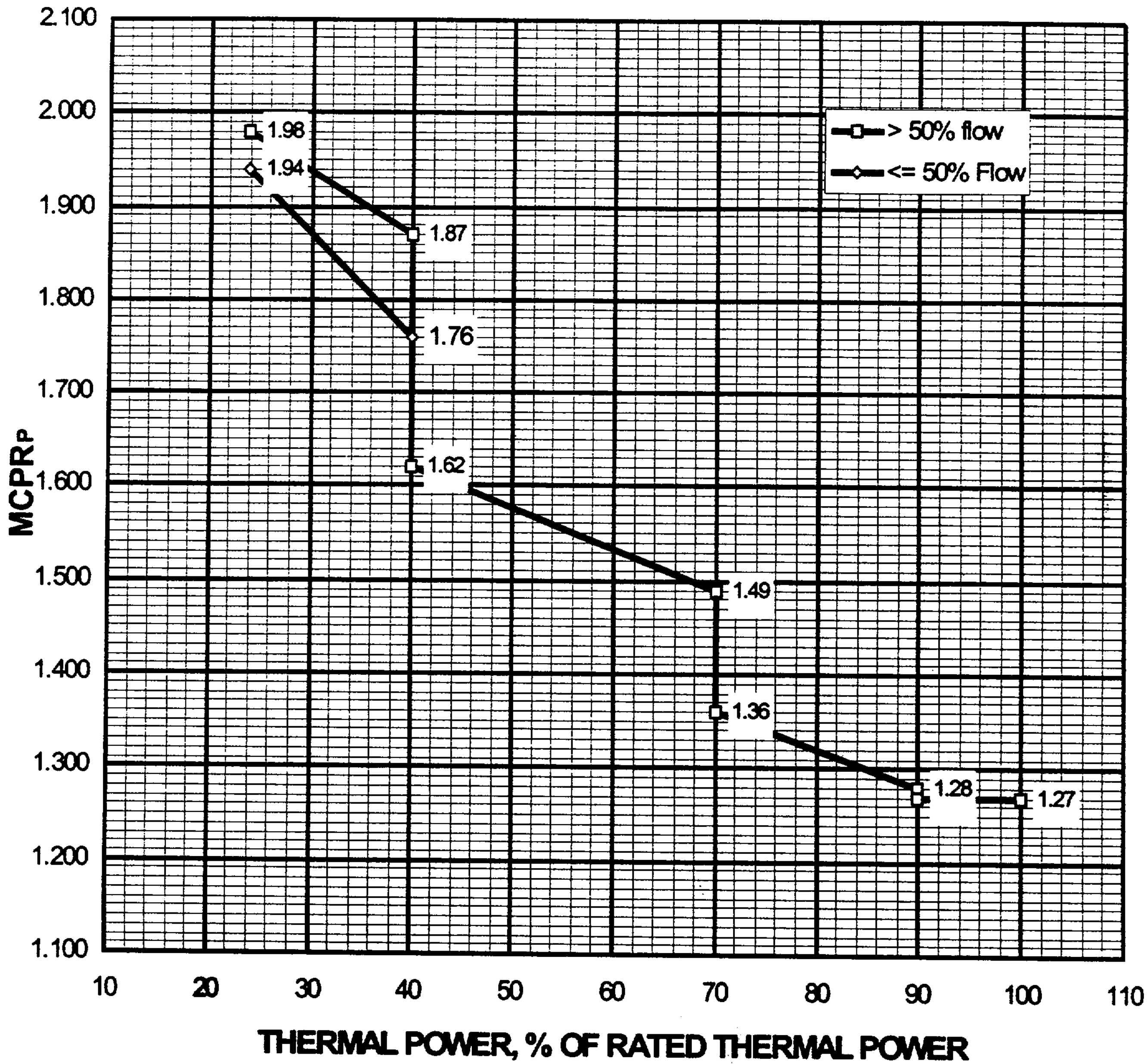


FIGURE 16. OPERATING LIMIT MCPR ($MCPR_F$) VERSUS CORE FLOW *



* These values must be increased by 0.01 during single loop operation.

FIGURE 17. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER*



* These values must be increased by 0.01 during single loop operation.

FIGURE 18. LHGR AND MAPLHGR MULTIPLIER VERSUS CORE FLOW

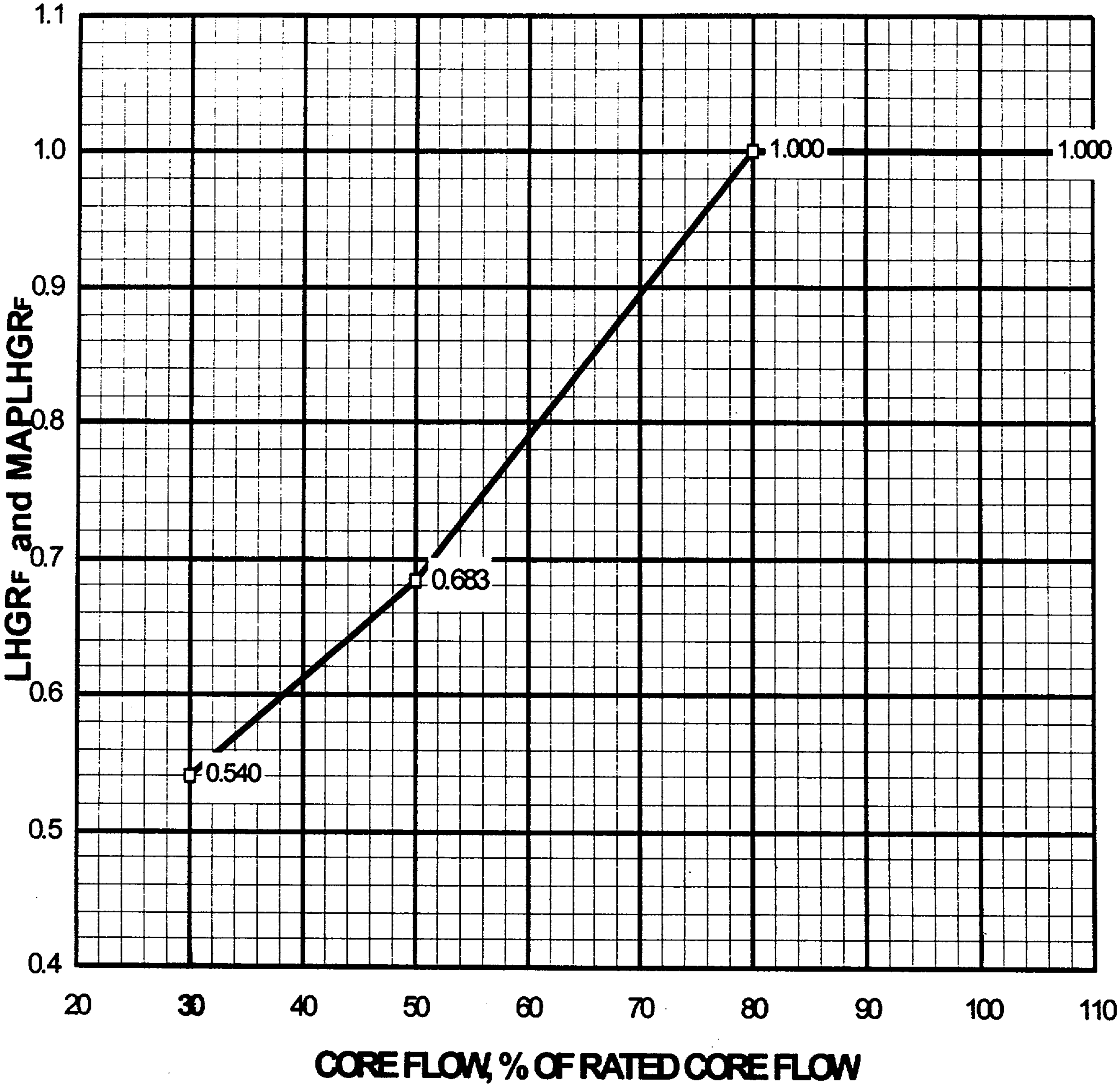


FIGURE 19. LHGR AND MAPLHGR MULTIPLIER VERSUS CORE POWER

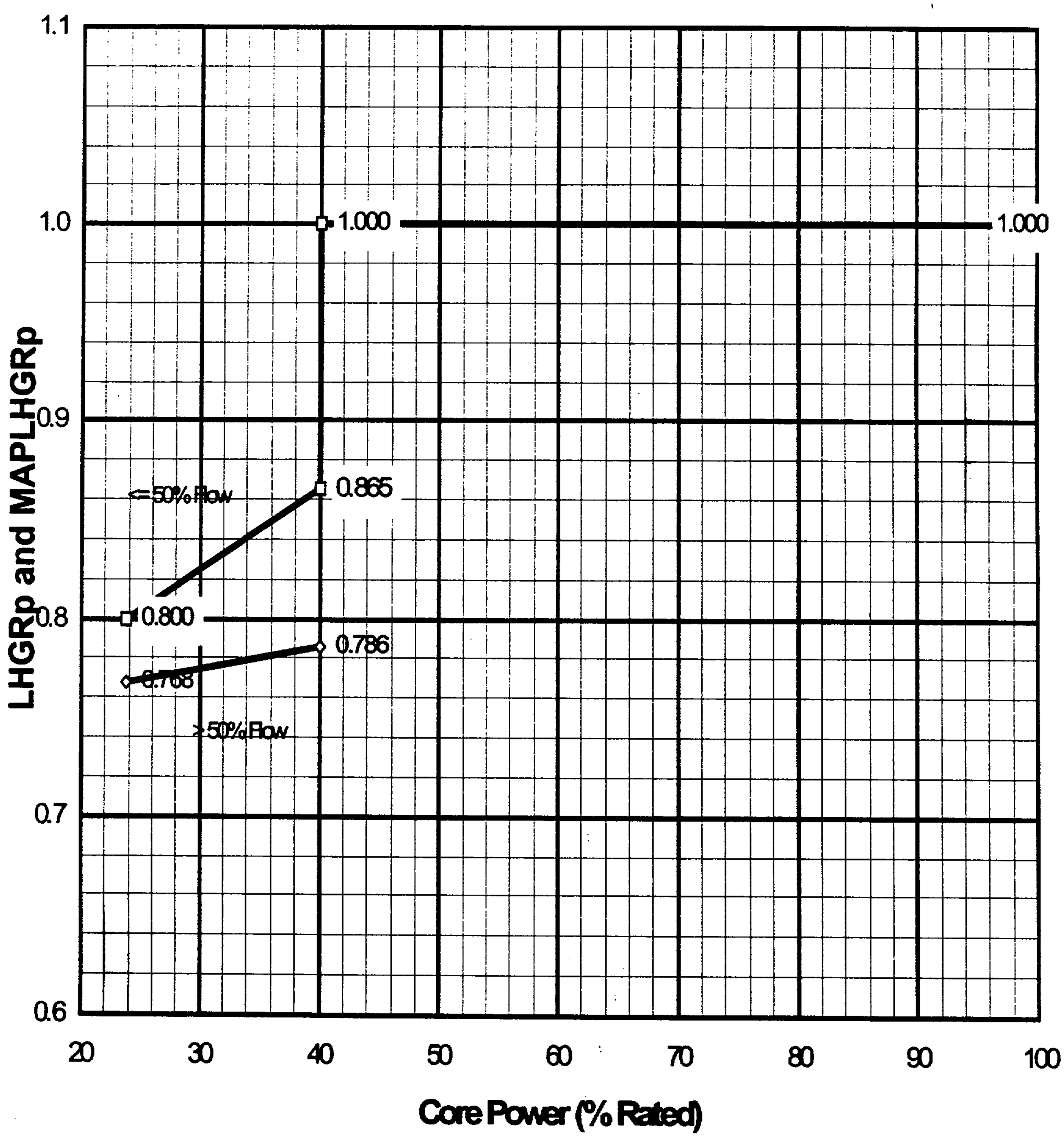


FIGURE 20. MONITORED REGION BOUNDARY (CASE 1)

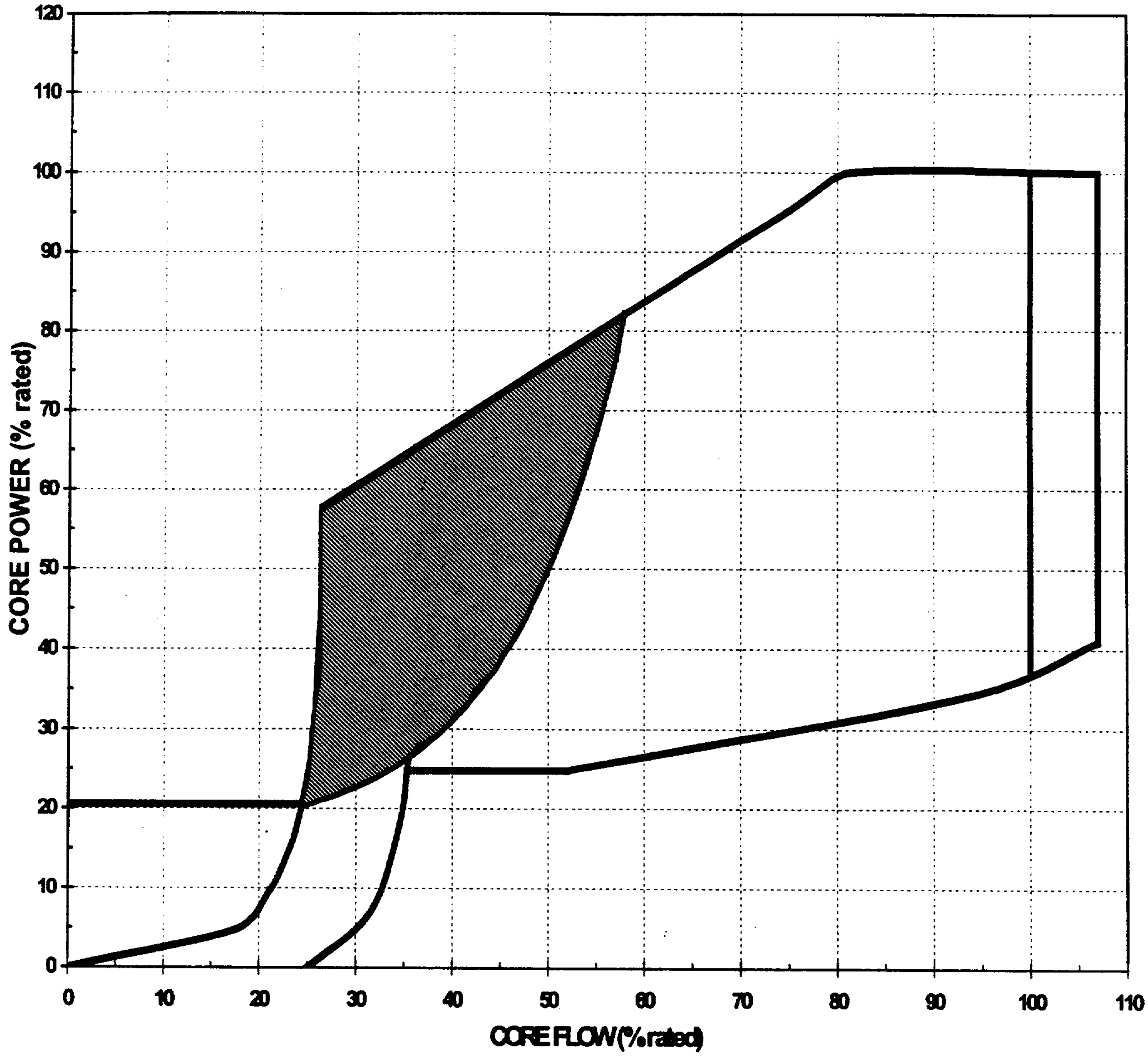


FIGURE 21. MONITORED REGION BOUNDARY (CASE 2)

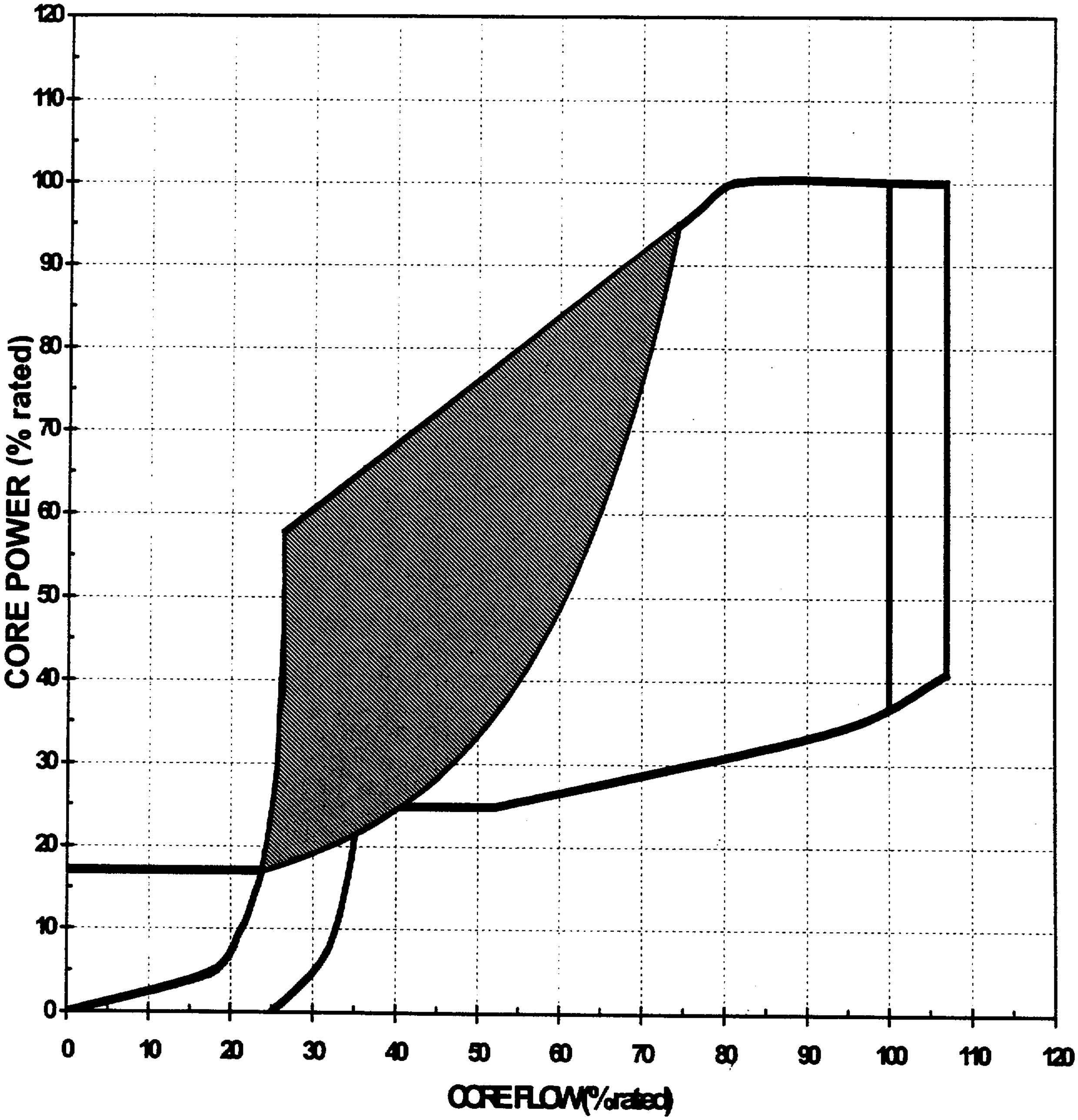


FIGURE 22. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(TWO RECIRCULATION LOOP OPERATION - CASE 1)

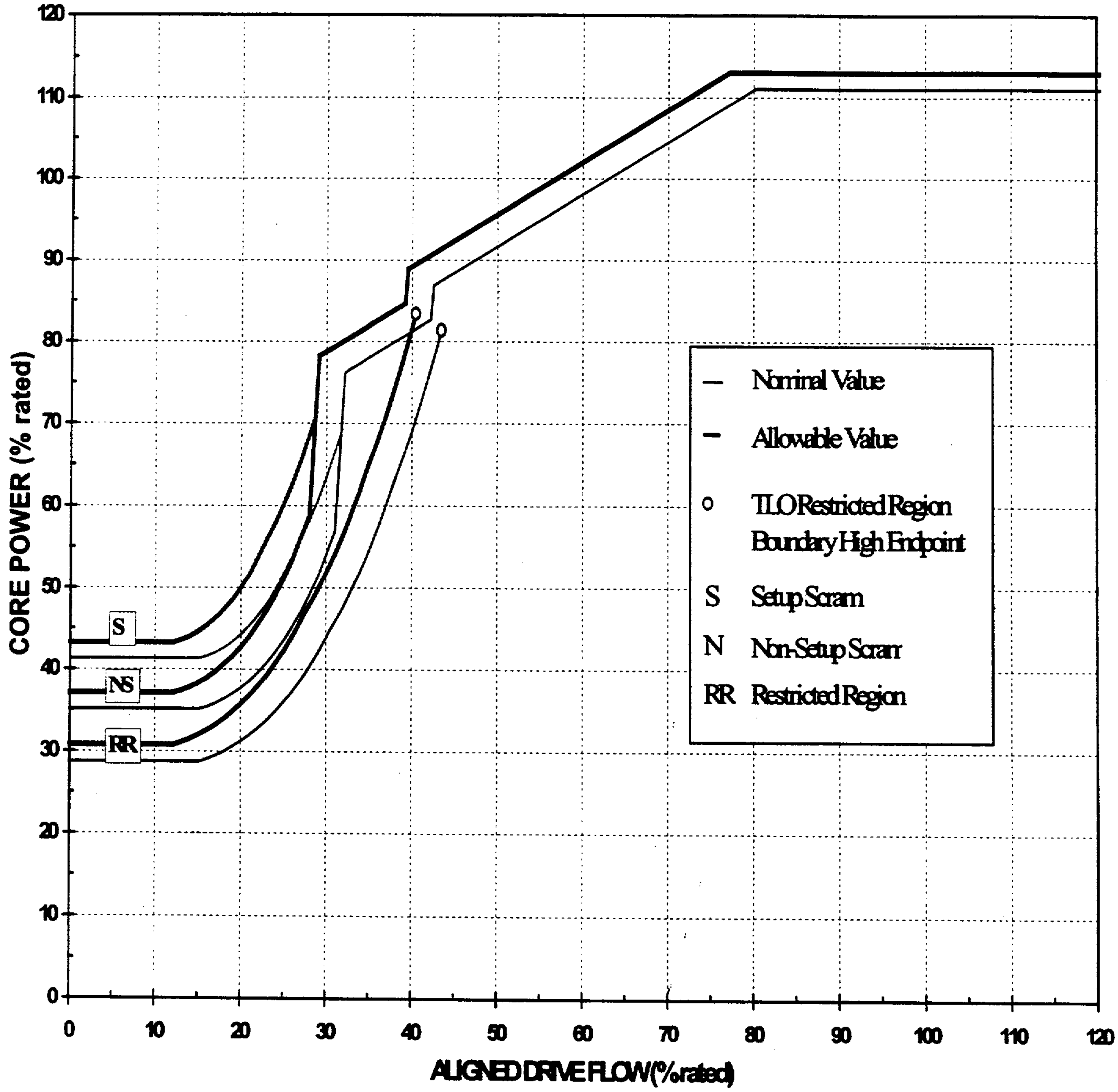


FIGURE 23. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(SINGLE RECIRCULATION LOOP OPERATION - CASE 1)

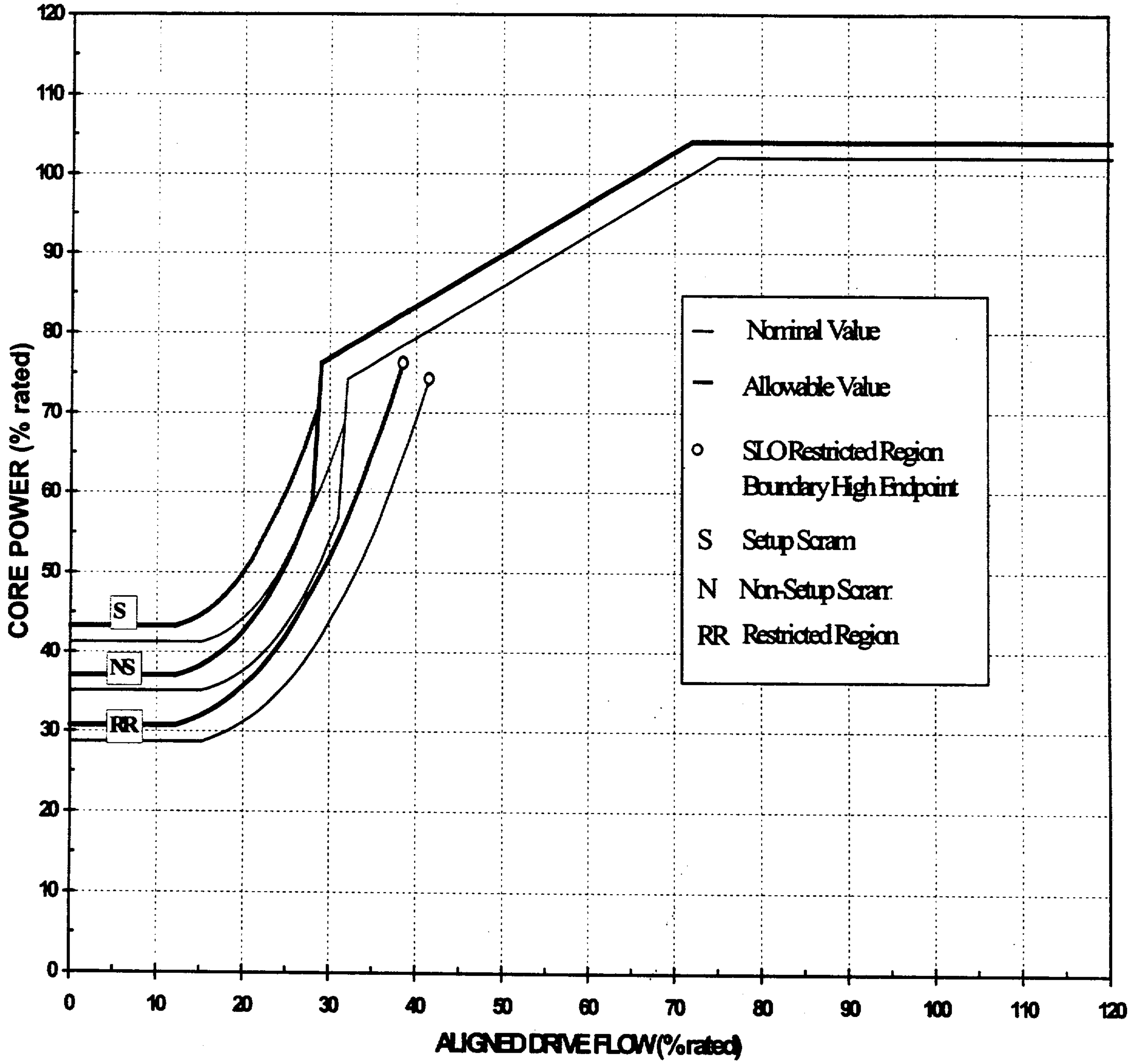


FIGURE 24. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(TWO RECIRCULATION LOOP OPERATION - CASE 2)

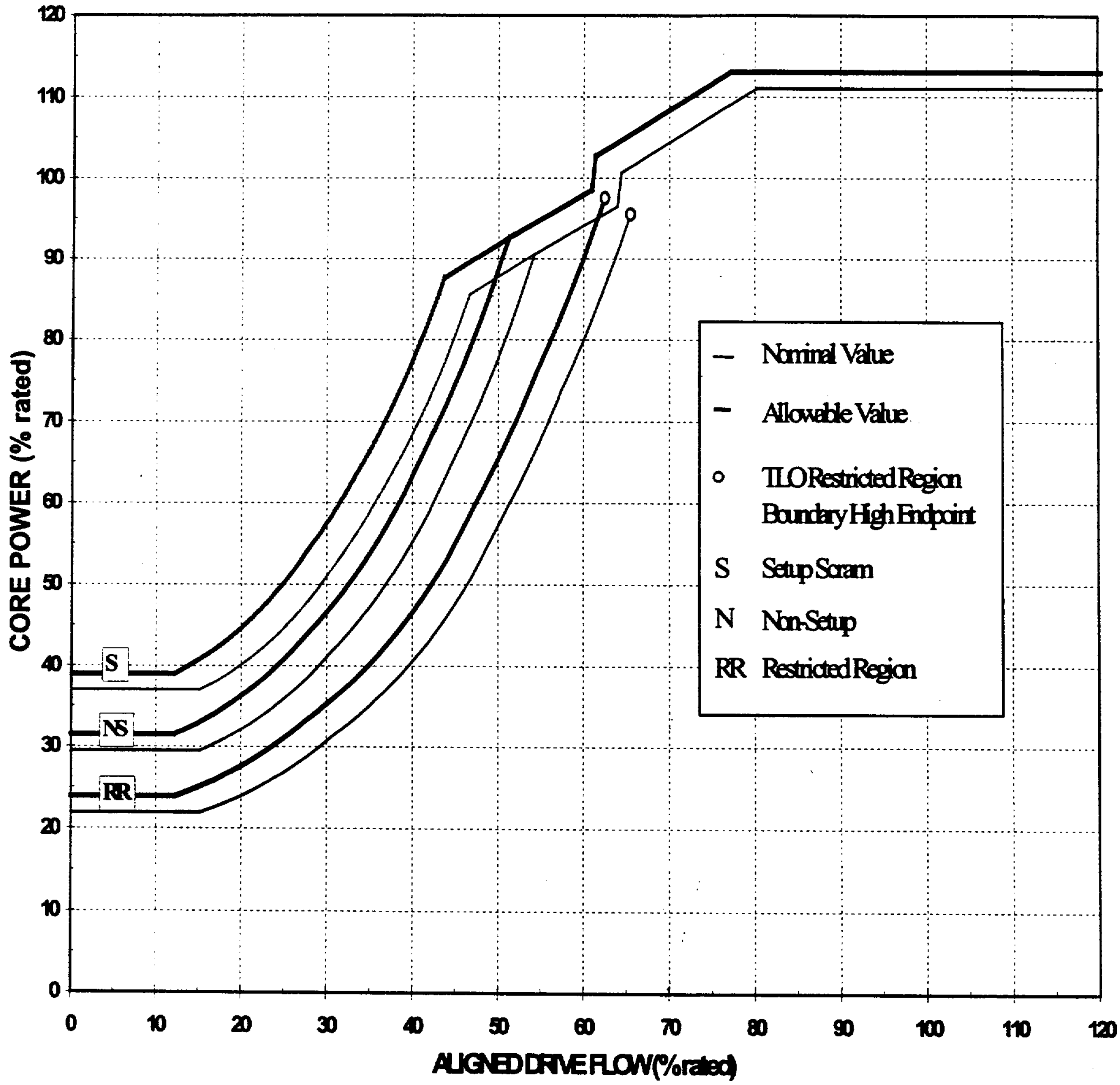


FIGURE 25. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(SINGLE RECIRCULATION LOOP OPERATION - CASE 2)

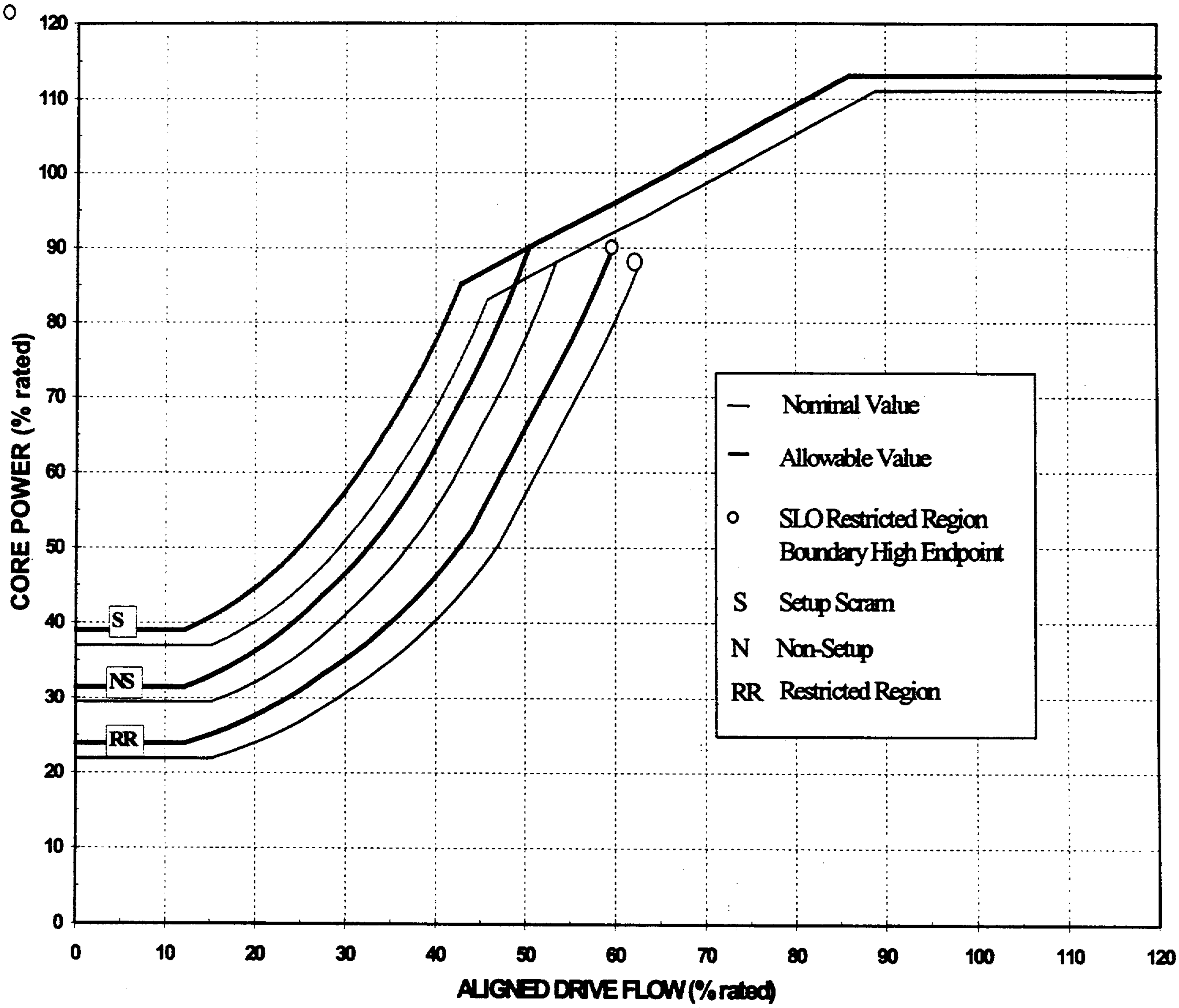


FIGURE 26. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(TWO RECIRCULATION LOOP OPERATION - CASE 1)

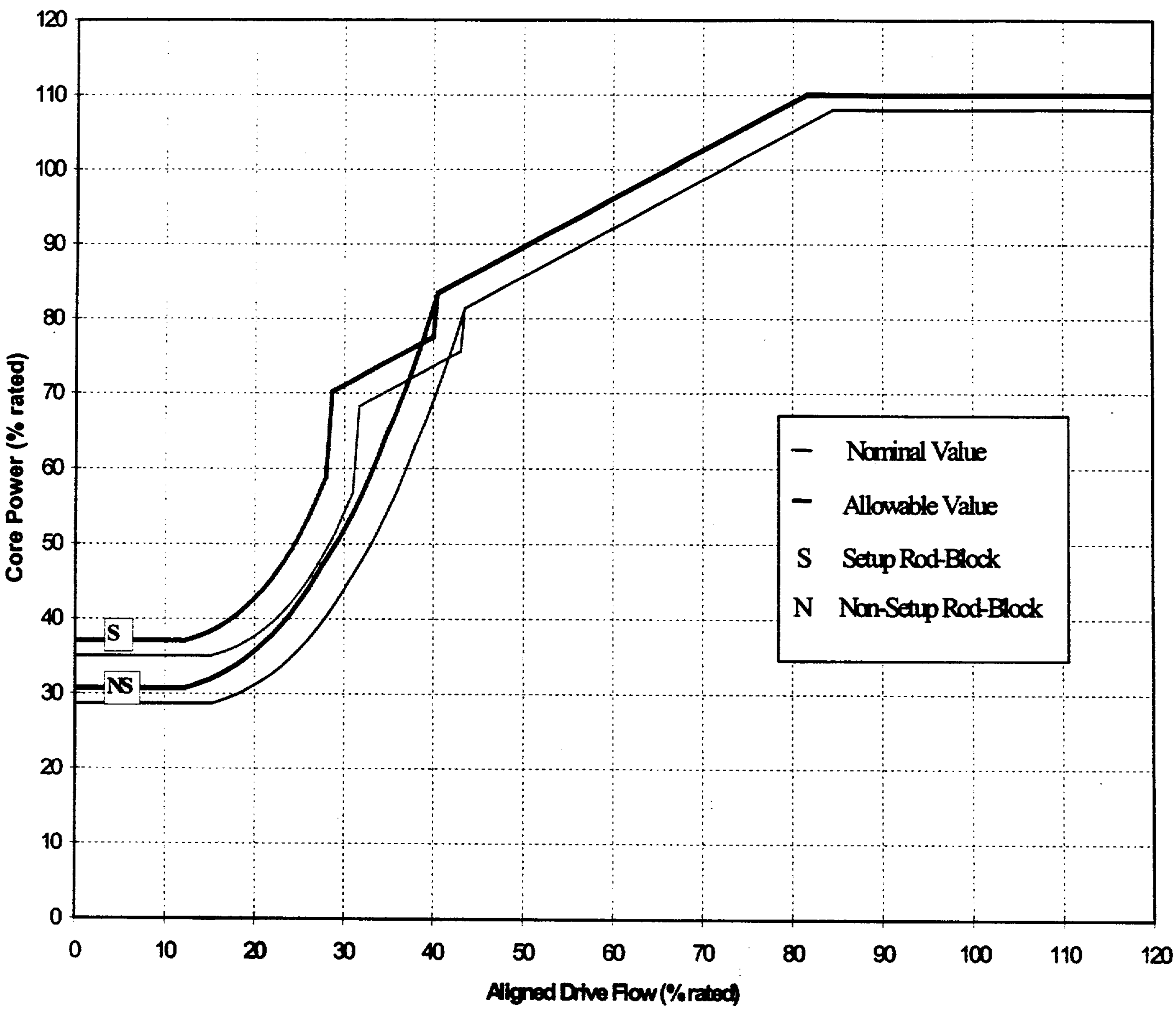


FIGURE 27. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(SINGLE RECIRCULATION LOOP OPERATION - CASE 1)

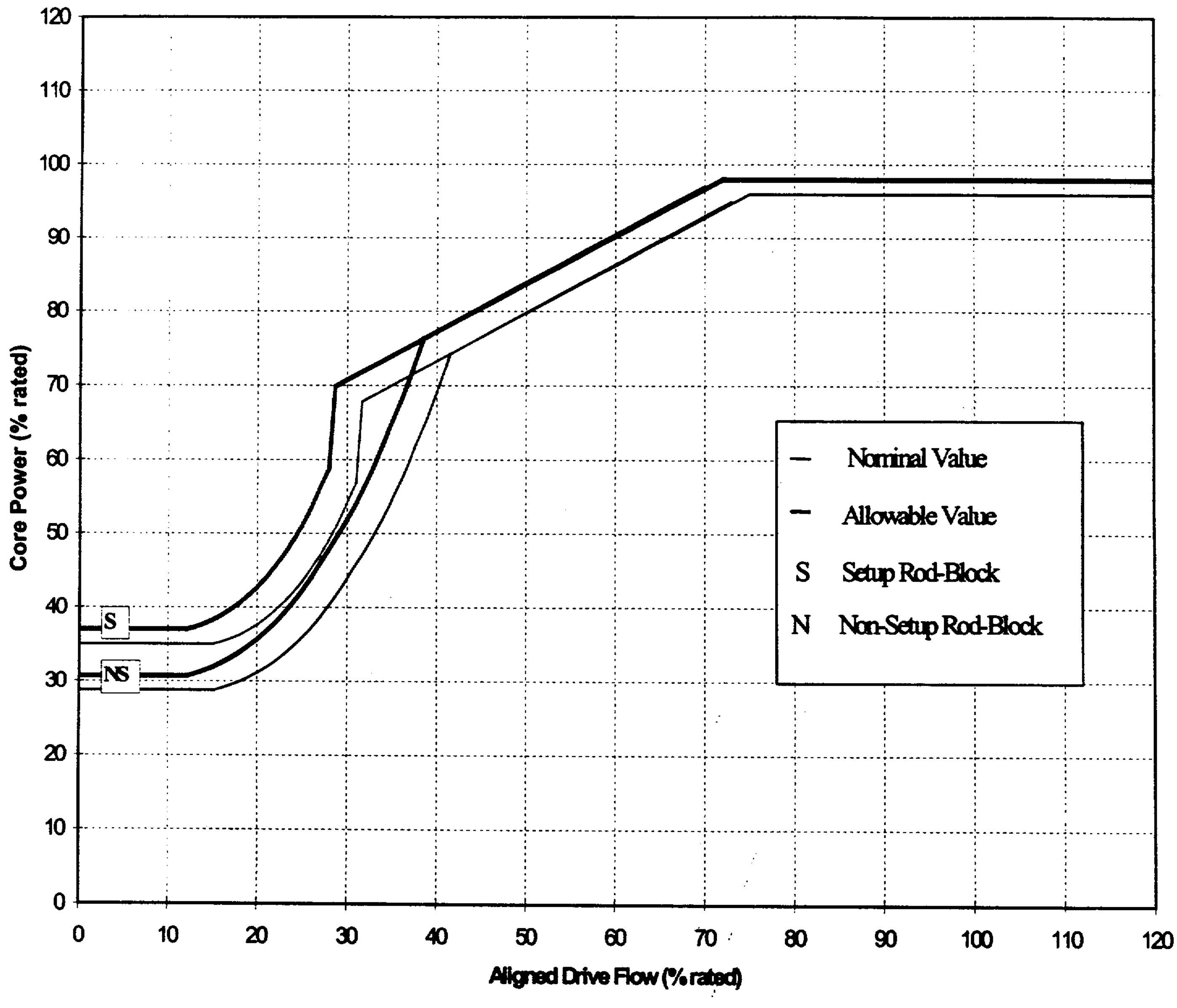


FIGURE 28. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(TWO RECIRCULATION LOOP OPERATION - CASE 2)

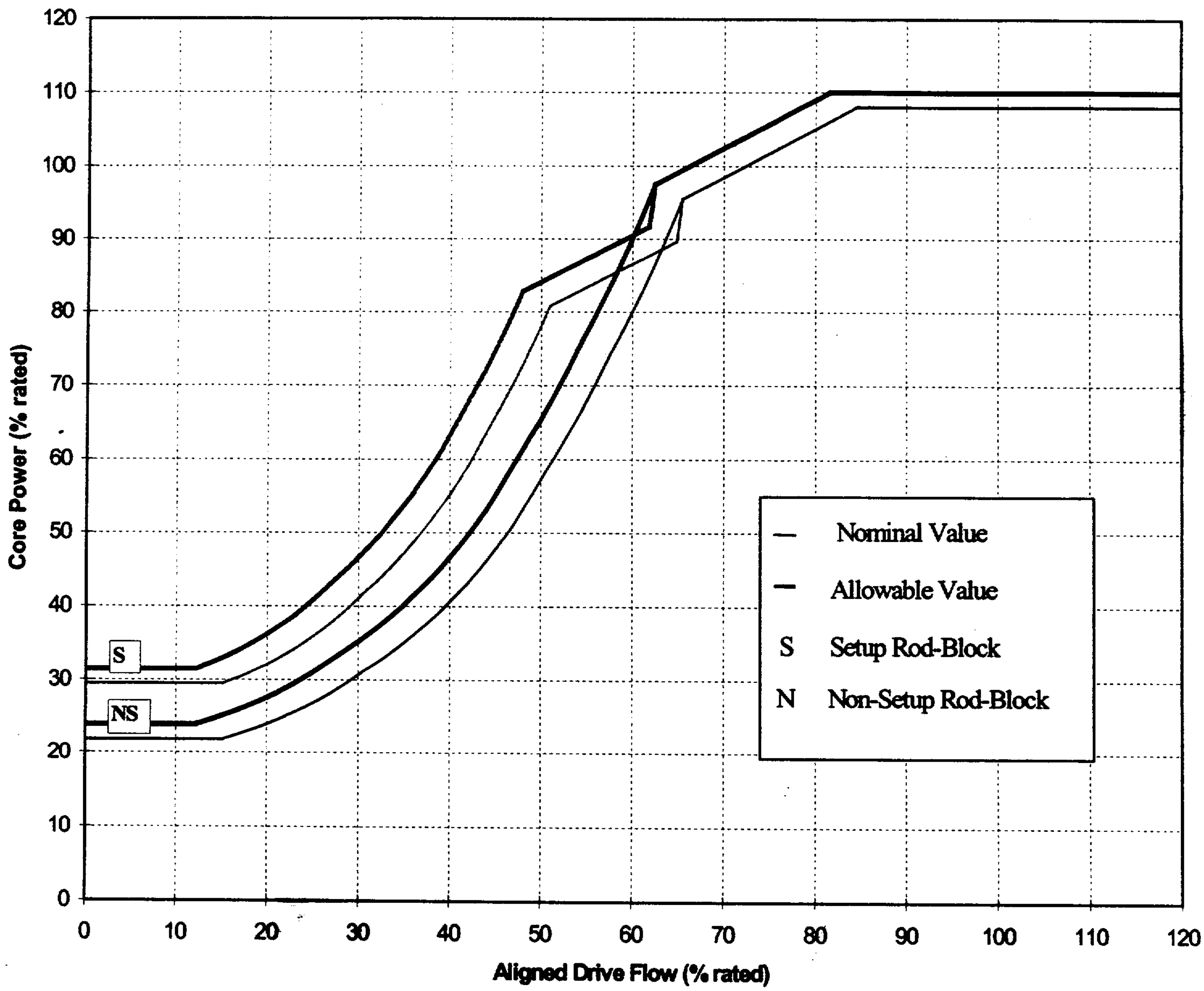
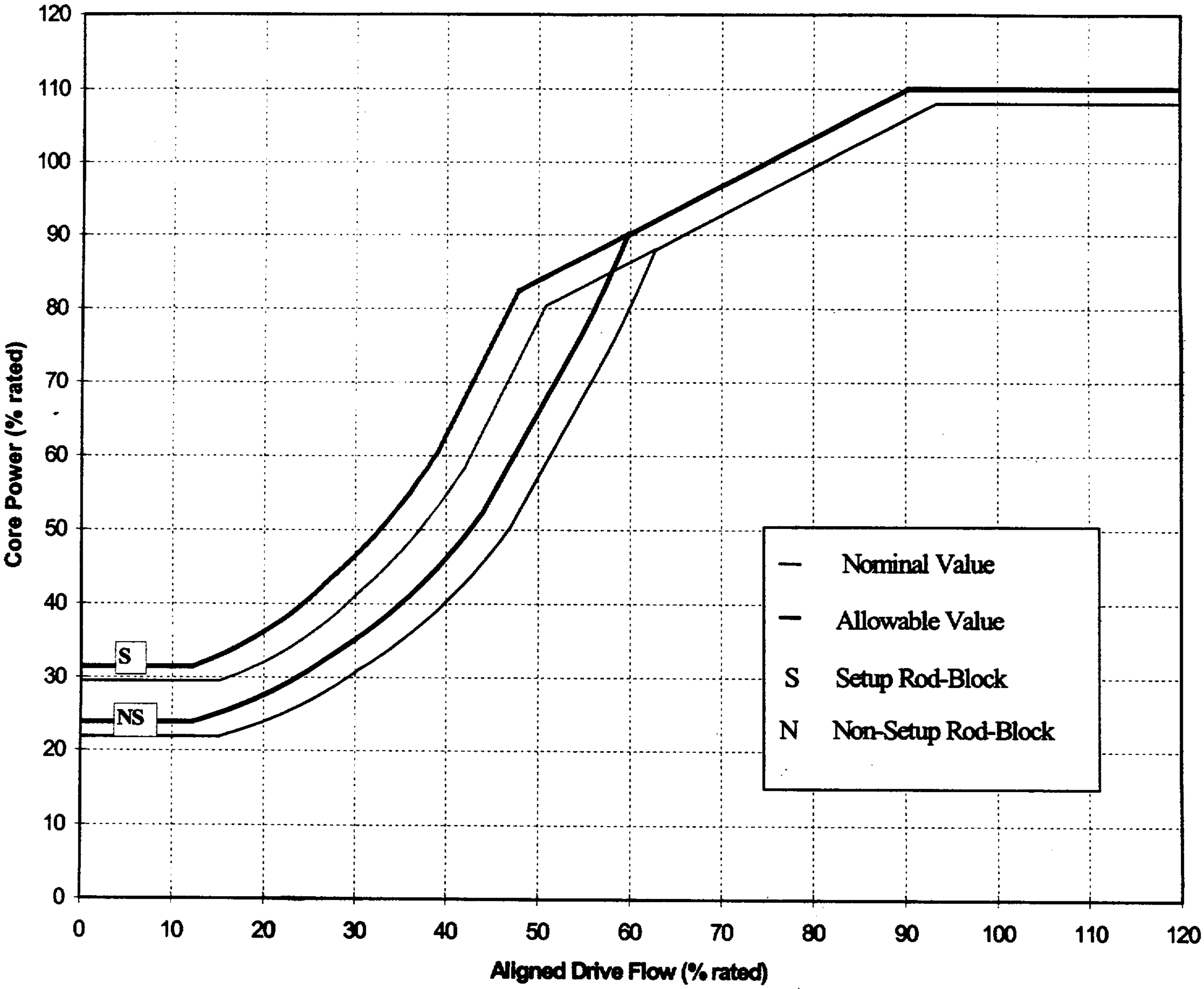


FIGURE 29. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(SINGLE RECIRCULATION LOOP OPERATION - CASE 2)

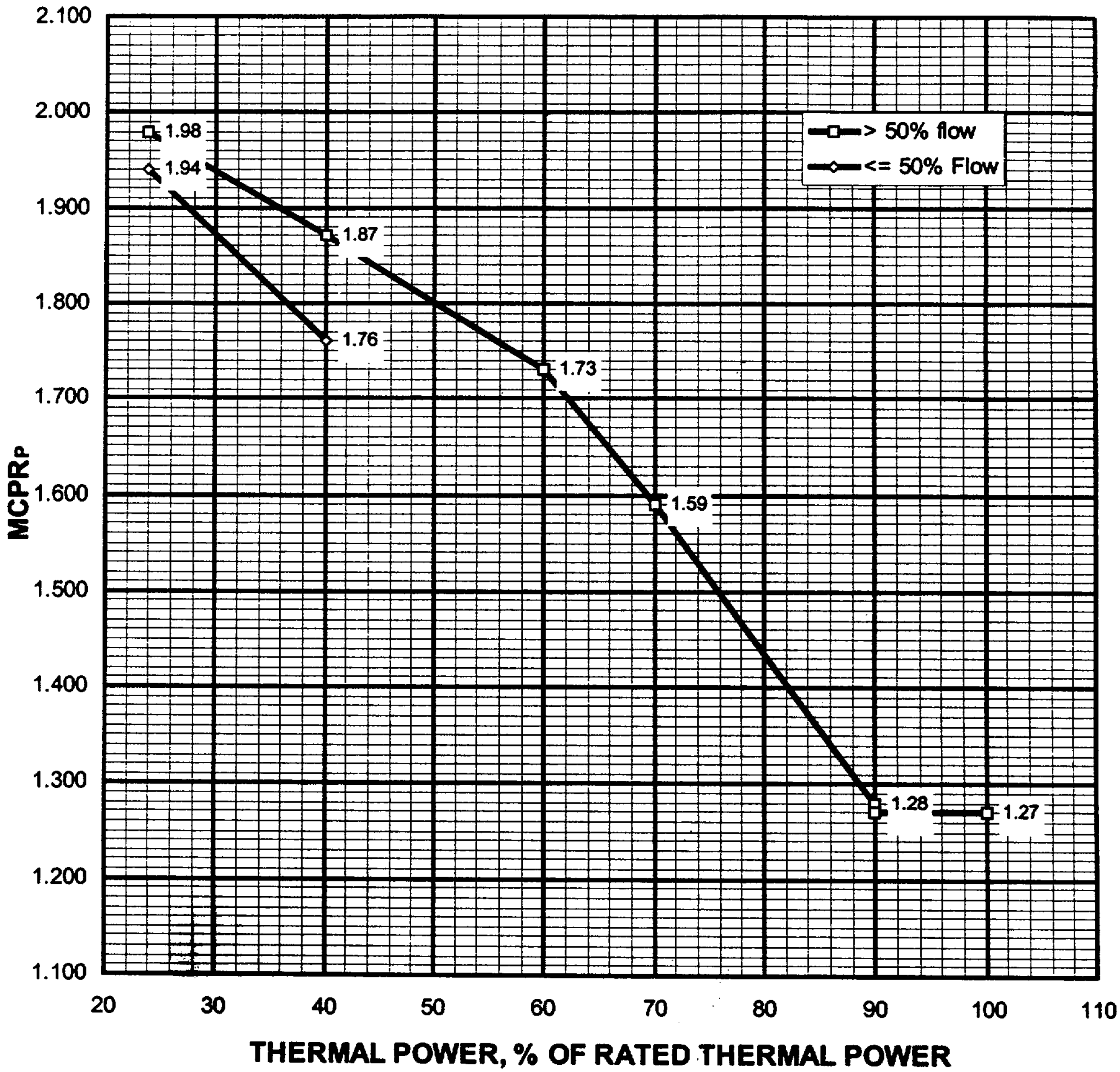


APPENDIX A

One Pressure Regulator Out of Service

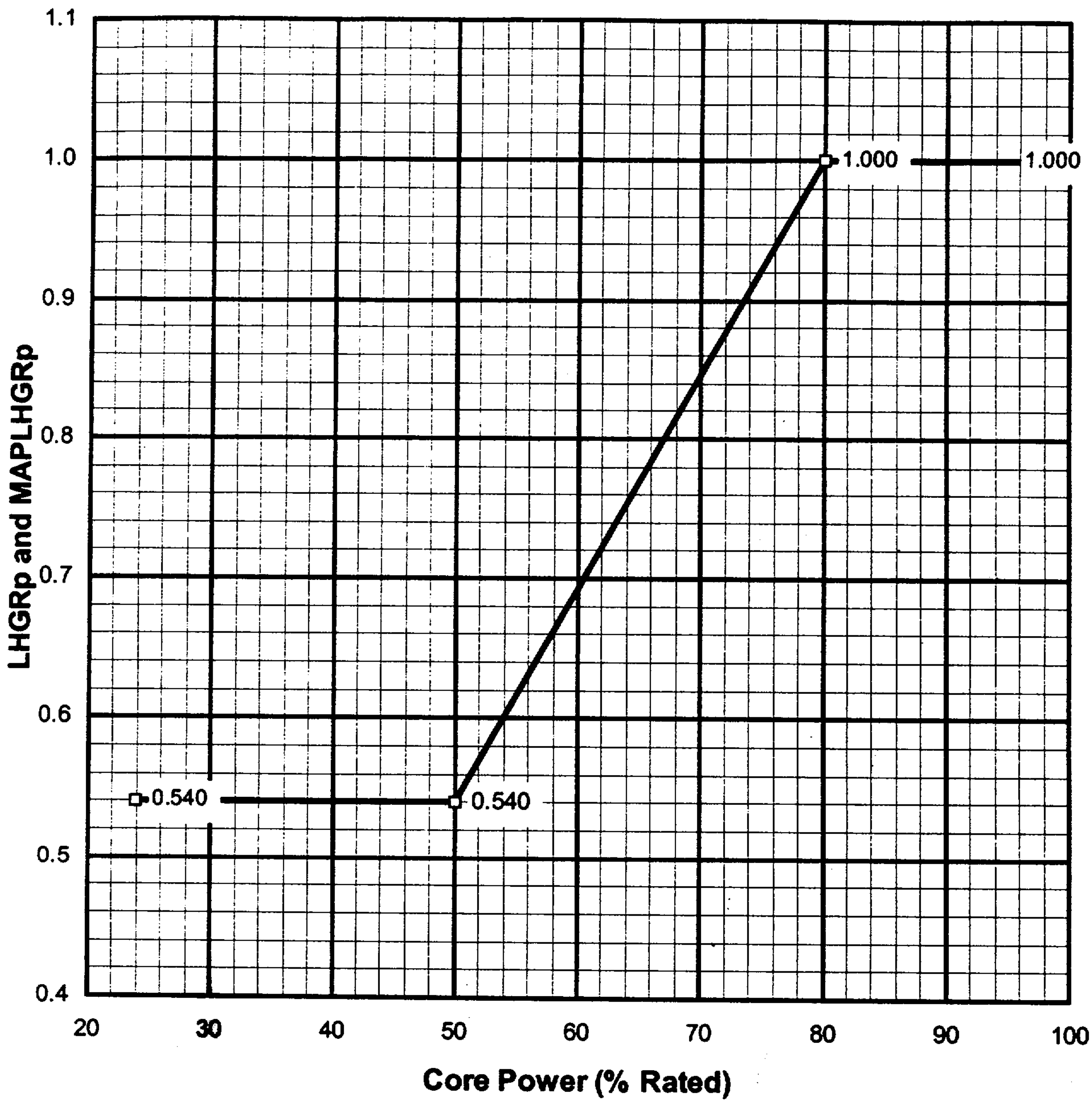
Per GESTAR II Amendment 26 (Reference 5), analysis for the pressure regulators – closed event is no longer required for BWR 6 plants with MEOD. Therefore, starting with Reload 9, Cycle 10, the standard pressure regulator – closed event analysis is not required for the determination of the thermal limits. In support of the operation without the backup pressure regulator, MCPR(p) and LHGR(p) with the pressure regulator – closed event are analyzed, and are reported in Appendix A for one pressure regulator out of service. Technical Surveillance Requirements for pressure regulators are discussed in TRM 3.2.5.

FIGURE A1. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER - ONE PRESSURE REGULATOR OUT OF SERVICE*



* These values must be increased by 0.01 during single loop operation.

FIGURE A2. LHGR AND MAPLHGR MULTIPLIER VERSUS THERMAL POWER – ONE PRESSURE REGULATOR OUT OF SERVICE



Core Operating Limits Report
Cycle 10
Revision 2

RIVER BEND STATION, CYCLE 10

CORE OPERATING LIMITS REPORT (COLR)

PREPARED BY: Wai Law **Date:** 9/25/2000
Responsible Engineer WAI LAW

REVIEWED BY: Jen Vo **Date:** 9/25/2000
Review Engineer PHU V. VO

APPROVED BY: Jen Vo for [illegible] **Date:** 9/25/2000
Manager - Safety Analysis

APPROVED BY: [illegible] **Date:** 9/25/2000
Director, Engineering
River Bend Nuclear Station

APPROVED BY: [illegible] Leavines 0144 **Date:** 10/3/2000
Facilities Review Committee
River Bend Nuclear Station

TABLE OF CONTENTS

INTRODUCTION AND SUMMARY

This report provides Cycle 10 values for the following Technical Specifications:

1. AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) limits,
2. MINIMUM CRITICAL POWER RATIO (MCPR) limits,
3. LINEAR HEAT GENERATION RATE (LHGR) limits,
4. FRACTION OF CORE BOILING BOUNDARY (FCBB),
5. REACTOR PROTECTION SYSTEM (RPS) APRM Flow Biased Simulated Thermal Power - High Allowable Values,
6. REACTOR PROTECTION SYSTEM (RPS) APRM Flow Biased Simulated Thermal Power time constant.
7. PERIOD BASED DETECTION SYSTEM (PBDS) region boundaries.

Technical Specification section 5.6.5 requires these values be determined using NRC-approved methodology and are established such that all applicable limits of the plant safety analysis are met.

This report also provides Cycle 10 values for the following Technical Requirements:

1. REACTOR PROTECTION SYSTEM (RPS) APRM Flow Biased Neutron Flux Power - High Allowable Values and Nominal Trip Setpoints[1],
2. CONTROL ROD BLOCK INSTRUMENTATION APRM Flow Biased Simulated Thermal Power High limits.

In some cases limits in the COLR differ from the limits in the core monitoring system. This is sometimes due to limitations in the core monitoring system to model the actual limits, in which case the core monitoring limits may be more conservative than the COLR limit. In other cases the limits in the COLR are presented in less detail than in the core monitoring system. When these situations exist the core monitoring limits will be explained or be referenced by the COLR and will be made available to Operations.

MCPRp for one pressure regulator out of service is shown in Figure A1 of Appendix A. LHGRp and MAPLHGRp for one pressure regulator out of service are shown Figure A2 of Appendix A.

The reload analyses were performed in accordance with GESTAR II and its applicability to Cycle 10 was confirmed by Reference 3.

[1] Note that for Figures 22 to 29, the Nominal Setpoints should be used for indicating the entry into a particular stability region as allowed and appropriate actions be taken prior to the entry

CONTROL RODS

The River Bend core utilizes both GE original equipment and ABB CR-82M bottom entry cruciform control rods. These Control Rod designs are discussed in more detail in reference 7.

REASONS FOR REVISION

Per GESTAR II Amendment 26, analysis for the pressure regulator – closed event is no longer required for BWR 6 plants with MEOD. Therefore, starting with Reload 9, Cycle 10, the standard pressure regulator – closed event analysis is not required for the determination of the thermal limits. In support of the operation without the backup pressure regulator, MCPR(p) and LHGR(p) with the pressure regulator – closed event are analyzed, and are reported in Appendix A for one pressure regulator out of service.

Revision 1 updated Figure 17, Figure 19, Pages 2, 3 and 4. Also, Figures A1 and A2, the MCPR(p) and LHGR(p) limits for one pressure regulator out of service, are added to this revision.

Revision 2 updated Table 1, Figures 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29 and Figure A1 & A2 to reflect the Operating Limits for the flow increase power uprate from 2894 MWt to 3039 MWt.

TECHNICAL SPECIFICATION 3.2.1

POWER DISTRIBUTION LIMITS

AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)

The limiting APLHGR (sometimes referred to as Maximum APLHGR, or MAPLHGR) value for the most limiting lattice (excluding natural uranium) of each fuel type as a function of AVERAGE PLANAR EXPOSURE is given in Figures 2 through 8. These values were determined with the SAFER/GESTR LOCA and GESTR-Mechanical methodology described in GESTAR-II (Reference 1). Core location by fuel type is provided in Figure 1 and is the reference core loading pattern in reference 3. These figures are used if alternate calculations are required. The limits of these figures shall be reduced to a value of 0.79 and 0.87 times the two recirculation loop operation limit when in single loop operation for GE11 and GE8, respectively (Reference 3). Thermal power and core flow dependent multipliers are provided. The value of the exposure dependent limit is reduced by the value of the multiplier at a given offrated power or flow condition. These multipliers are independent of the single loop multipliers and are shown on Figures 18 and 19.

The APLHGR limits in the core monitoring system are in more detail than the limits that appear in the COLR due to there proprietary nature. The core monitoring system has APLHGR limits for each lattice in a bundle rather than listing only the most limiting value for the entire bundle. Reference 4 lists the core monitoring system limits.

TECHNICAL SPECIFICATION 3.2.2

POWER DISTRIBUTION LIMITS

MINIMUM CRITICAL POWER RATIO (MCPR)

The MCPR limits for use in Technical Specification 3.2.2 for flow dependent MCPR ($MCPR_F$) (Reference 3), power dependent MCPR ($MCPR_P$) (Reference 3) are shown in Figures 16 through 17. The most limiting value from the applicable $MCPR_f$ and $MCPR_p$ figures is the operating limit. These values were determined with the GEMINI methodology and GEXL-PLUS critical power ratio correlation described in GESTAR-II (Reference 1) and are consistent with a Safety Limit MCPR from Technical Specification 2.0. The Operating Limit MCPR values in Figures 16 through 17 must be increased by 0.01 during single loop operation.

TECHNICAL SPECIFICATION 3.2.3

POWER DISTRIBUTION LIMITS

LINEAR HEAT GENERATION RATE (LHGR)

The limiting LHGR value for the most limiting lattice of each fuel type as a function of AVERAGE PLANAR EXPOSURE is given in Figures 9 through 15. These values were determined with GESTR-Mechanical methodology described in GESTAR-II (Reference 1). Core location by fuel type is provided in Figure 1 and is the reference core loading pattern in reference 3. These figures are used if alternate calculations are required. Thermal power and core flow dependent multipliers are provided in Figures 18 and 19. The value of the exposure dependent limit is reduced by the value of the multiplier at a given offrated power or flow condition.

The LHGR limits in the core monitoring system are in more detail than the limits that appear in the COLR due to their proprietary nature. The core monitoring system has LHGR limits for each lattice in a bundle rather than listing only the most limiting value for the entire bundle. Reference 4 lists the core monitoring system limits.

TECHNICAL SPECIFICATION 3.2.4

POWER DISTRIBUTION LIMITS

FRACTION OF CORE BOILING BOUNDARY (FCBB)

Restricted Region Boundary

Note: The boundary of the Restricted Region is established by analysis in terms of thermal power and core flow. The Restricted Region boundary is defined by the "non-setup" APRM Flow Biased Simulated Thermal Power - High Control Rod Block Setpoints, which are a function of reactor recirculation drive flow.

The Restricted Region boundaries as a function of aligned drive flow are given in Figures 22 through 25 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Simulated Thermal Power - High Scram setpoints as a function of aligned derive flow are given in Figures 22 through 25. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°F,$$

and rated equivalent at off-rated reactor conditions.

OR

$P \leq 30\%$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°F,$$

and rated equivalent at off-rated reactor conditions.

AND

$P > 30\%$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

TECHNICAL SPECIFICATION 3.3.1.1

INSTRUMENTATION

REACTOR PROTECTION SYSTEM (RPS) INSTRUMENTATION

AVERAGE POWER RANGE MONITORS

APRM Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Simulated Thermal Power - High scram setpoint Allowable Values are given in Figures 22 through 25 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

OR

$$P \leq 30\%$$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

AND

$$P > 30\%$$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

APRM Simulated Thermal Power Time Constant

The simulated thermal power time constant for use in Technical Specification Table 3.3.1.1-1, SR 3.3.1.1.14, is (Reference 6):

6 ± 0.6 seconds.

The maximum simulated thermal power time constant for use in Technical Specification surveillance Table 3.3.1.1-1, SR 3.3.1.1.14 is:

6.6 seconds

TECHNICAL SPECIFICATION 3.3.1.3

INSTRUMENTATION

PERIOD BASED DETECTION SYSTEM (PBDS)

Monitored Region Boundary

The Monitored Region Boundaries as a function of core flow are given in Figures 20 and 21.

Restricted Region Boundary

Note: The boundary of the Restricted Region is established by analysis in terms of thermal power and core flow. The Restricted Region boundary is defined by the "non-setup" APRM Flow Biased Simulated Thermal Power - High Control Rod Block Setpoints, which are a function of reactor recirculation drive flow.

The Restricted Region boundaries as a function of aligned drive flow are given in Figures 22 through 25 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

OR

$$P \leq 30\%$$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

AND

$$P > 30\%$$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

TECHNICAL REQUIREMENT 3.3.1.1

INSTRUMENTATION

REACTOR PROTECTION SYSTEM (RPS) INSTRUMENTATION

AVERAGE POWER RANGE MONITORS

APRM Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Simulated Thermal Power - High scram setpoint Nominal Trip Setpoints are given in Figures 22 through 25 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

OR

$$P \leq 30\%$$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

AND

$$P > 30\%$$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

TECHNICAL REQUIREMENT 3.3.2.1

INSTRUMENTATION

CONTROL ROD BLOCK INSTRUMENTATION

AVERAGE POWER RANGE MONITORS

APRM Flow Biased Simulated Thermal Power - High Limits

The APRM Flow Biased Neutron Flux - High rod block Allowable Values and Nominal Trip Setpoints are given in Figures 26 through 29 in terms of aligned drive flow. The aligned drive flow is calculated from the input drive flow using the relationship given in Table 1.

a. Case 1 - Normal Feedwater Heating Operation or Low Reactor Power:

$$T_{FW}(\text{at rated}) \geq T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

OR

$P \leq 30\%$

b. Case 2 - Reduced Feedwater Heating Operation

$$T_{FW}(\text{at rated}) < T_{FW}^{DESIGN}(\text{at rated}) - 50°\,F,$$

and rated equivalent at off-rated reactor conditions.

AND

$P > 30\%$

Where: T_{FW} is feedwater temperature in °F, and P is reactor power in percent of rated.

REFERENCES

1) NEDE-24011-P-A-14 and US Supplement, "General Electric Standard Application for Reactor Fuel," June 2000.

2) Letter, J.S. Charnley (GE) to M.W. Hodges (NRC), Recommended MAPLHGR Technical Specifications for Multiple Lattice Fuel Designs, March 9,1987

3) J11-03660SRLR Rev. 1 Supplemental Reload Licensing Report for River Bend Station Reload 9 Cycle 10" September 2000.

4) J11-03660MAPL, Revision 0 "Lattice Dependent MAPLHGR Report for River Bend Station Reload 9 Cycle 10" February 2000.

5) GESTAR Amendment 26.

6) Letter, R.E. Kingston to G. W. Scronce, "Time Constant Values for Simulated Thermal Power Monitor" GFP-1032 November 30, 1995.

7) RBS USAR Section 4.1

8) Calculation NEAD-SR-97/032.R2, "RBS E1A COLR Input".

Table 1. Aligned Drive Flow

$$W_D = \frac{101.206 \bullet \Delta^{40} - 31.084 \bullet \Delta^{100} + 70.122 \bullet W_{\breve{D}}}{70.122 - (\Delta^{100} - \Delta^{40})}$$

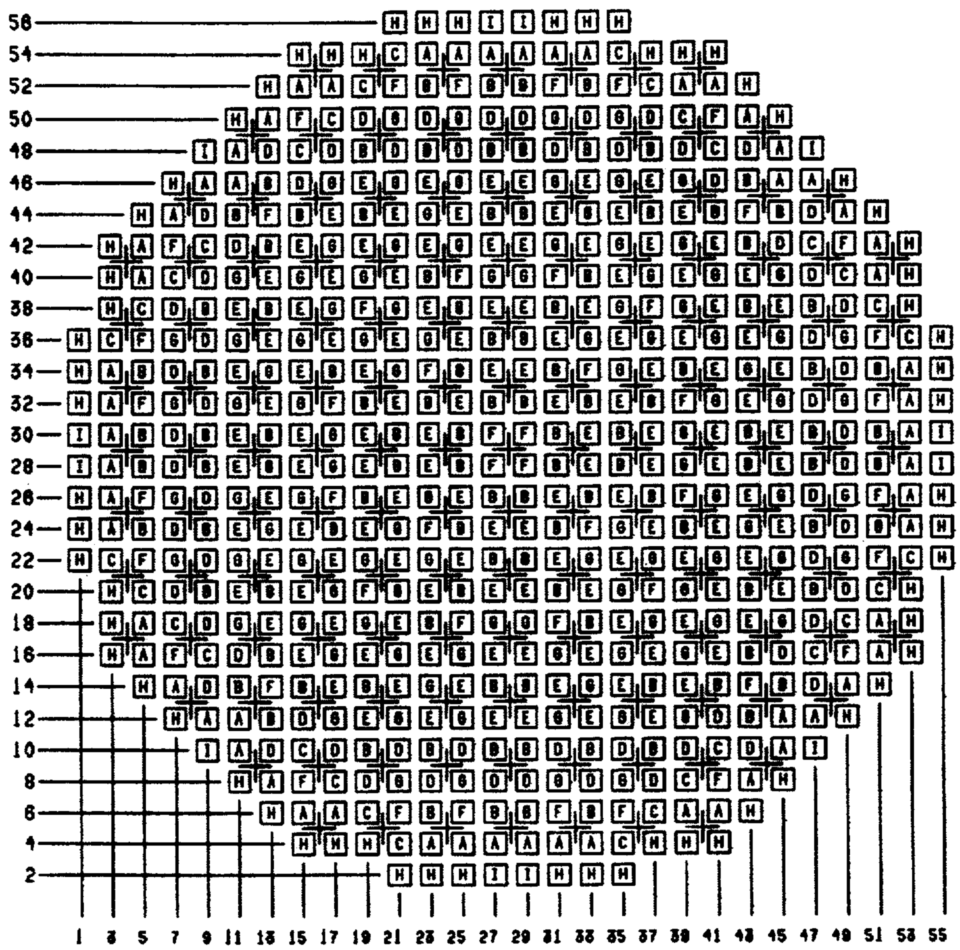
Where: $W_{\breve{D}}$ = FCTR card input drive flow in percent rated,

W_D = Aligned drive flow in percent rated,

Δ^{40} = Low flow drive flow alignment setting, and

Δ^{100} = High flow drive flow alignment setting.

FIGURE 1. REFERENCE CORE LOADING PATTERN



Fuel Type			
A=GE11-P9SUB400-13GZ-120T-146-T	(Cycle 9)	F=GE11-P9SUB147-NOG-120T-146-T-2399	(Cycle 10)
B=GE11-P9SUB225-NOG-120T-146-T	(Cycle 9)	G=GE11-P9SUB388-13GZ-120T-146-T	(Cycle 9)
C=GE11-P9SUB388-13GZ-120T-146-T	(Cycle 9)	H=GE8B-P8SQB333-10GZ-120M-4WR-150-T	(Cycle 4)
D=GE11-P9SUB336-12GZ-120T-146-T-2401	(Cycle 10)	I=GE8B-P8SQB333-10GZ-120M-4WR-150-T	(Cycle 4)
E=GE11-P9SUB257-9GZ-120T-146-T-2400	(Cycle 10)		

FIGURE 2. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB336-12GZ-120T-146-T

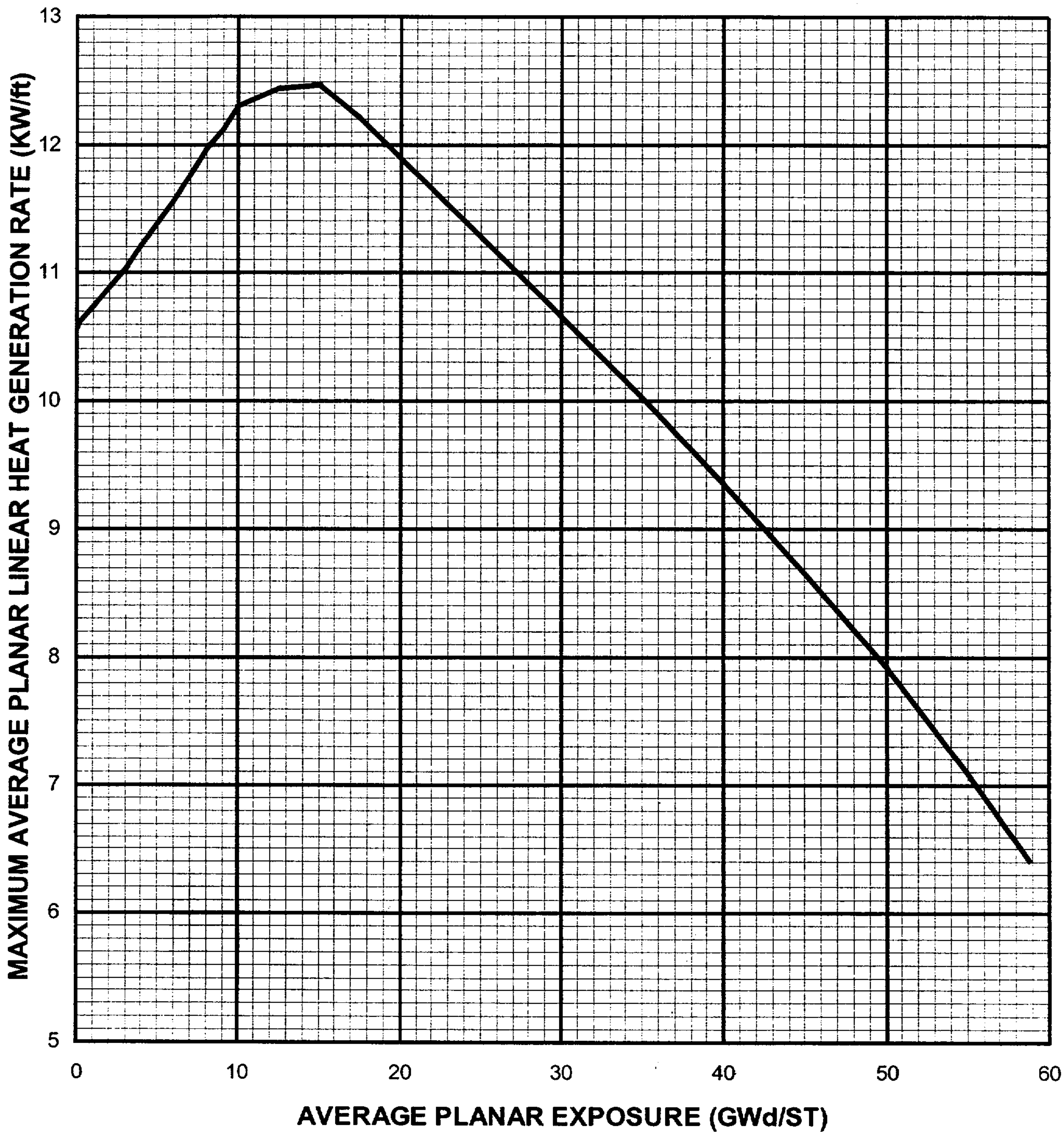


FIGURE 3. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB257-9GZ-120T-146-T

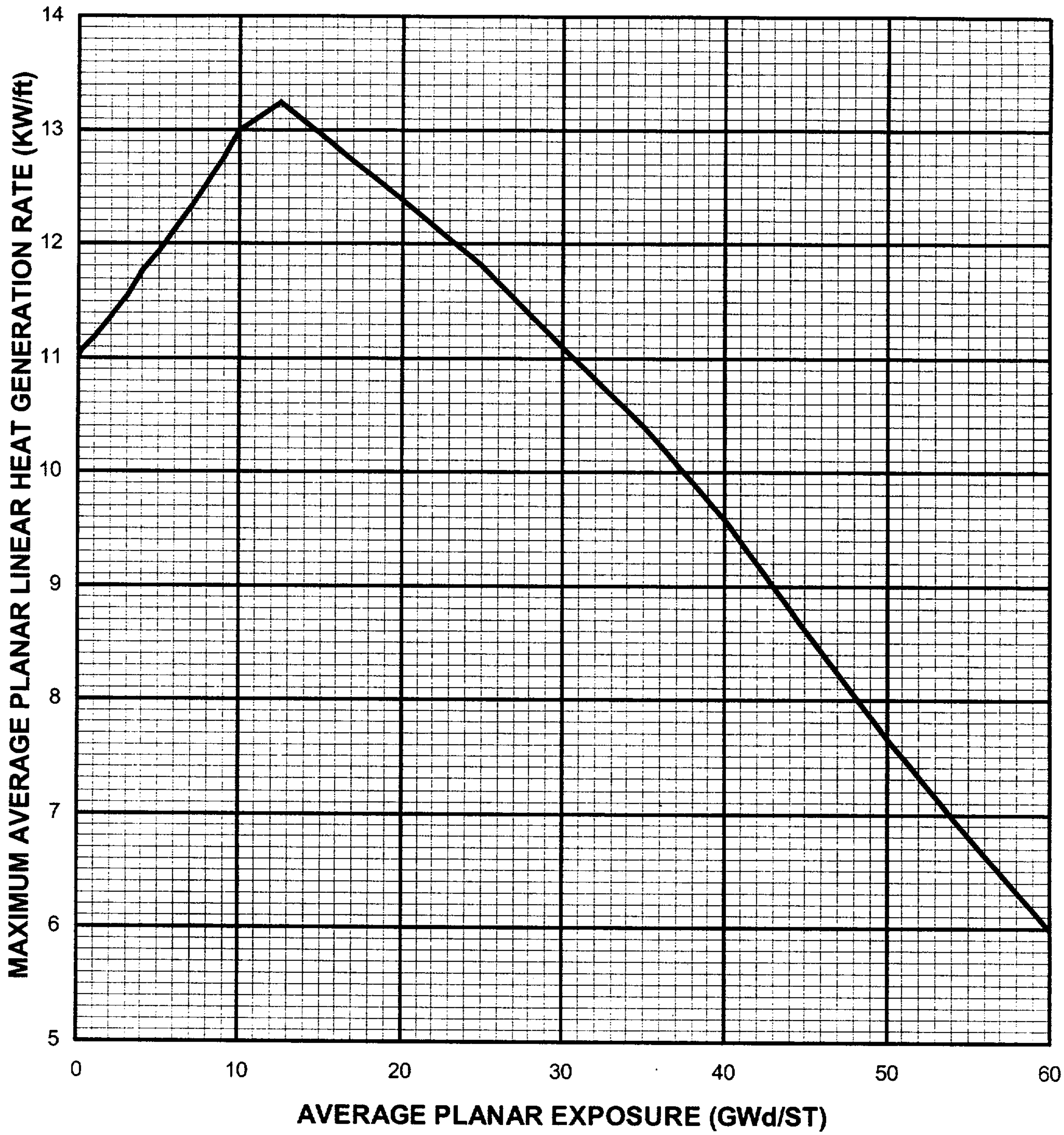


FIGURE 4. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB147-NOG-120T-146-T

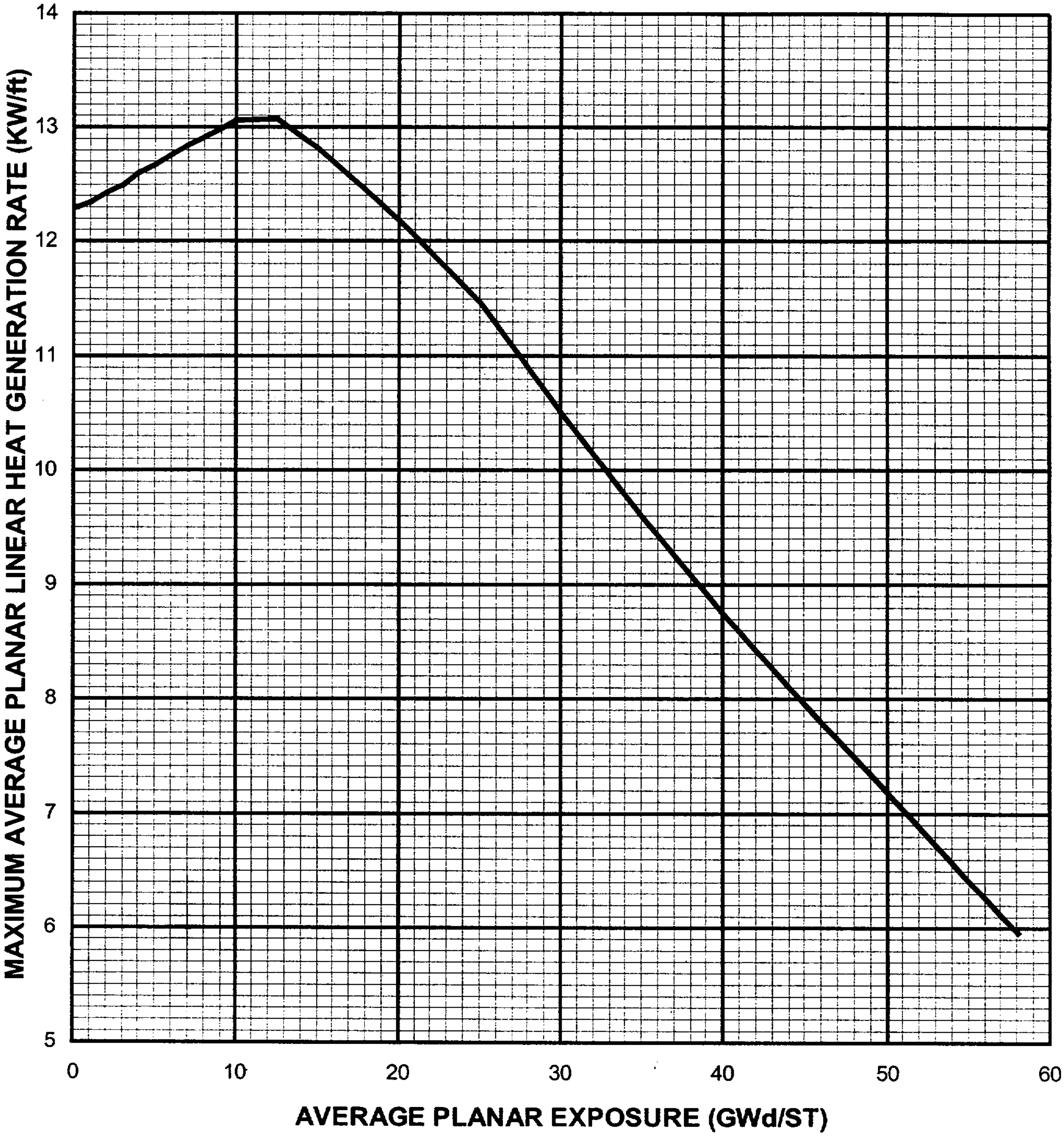


FIGURE 5. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FOR GE11-P9SUB400-13GZ-120T-146-T

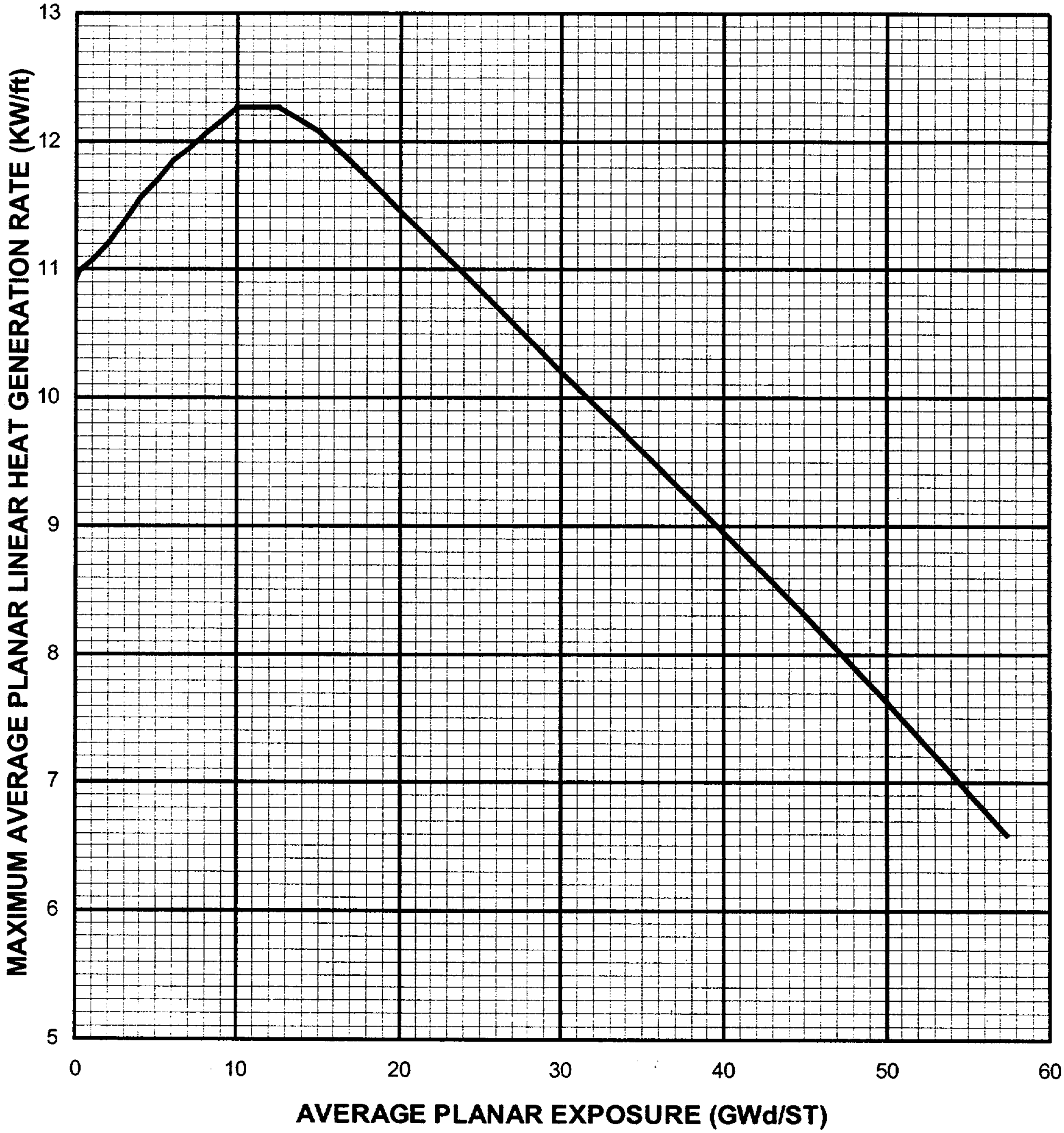


FIGURE 6. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FOR GE11-P9SUB225-NOG-120T-146-T

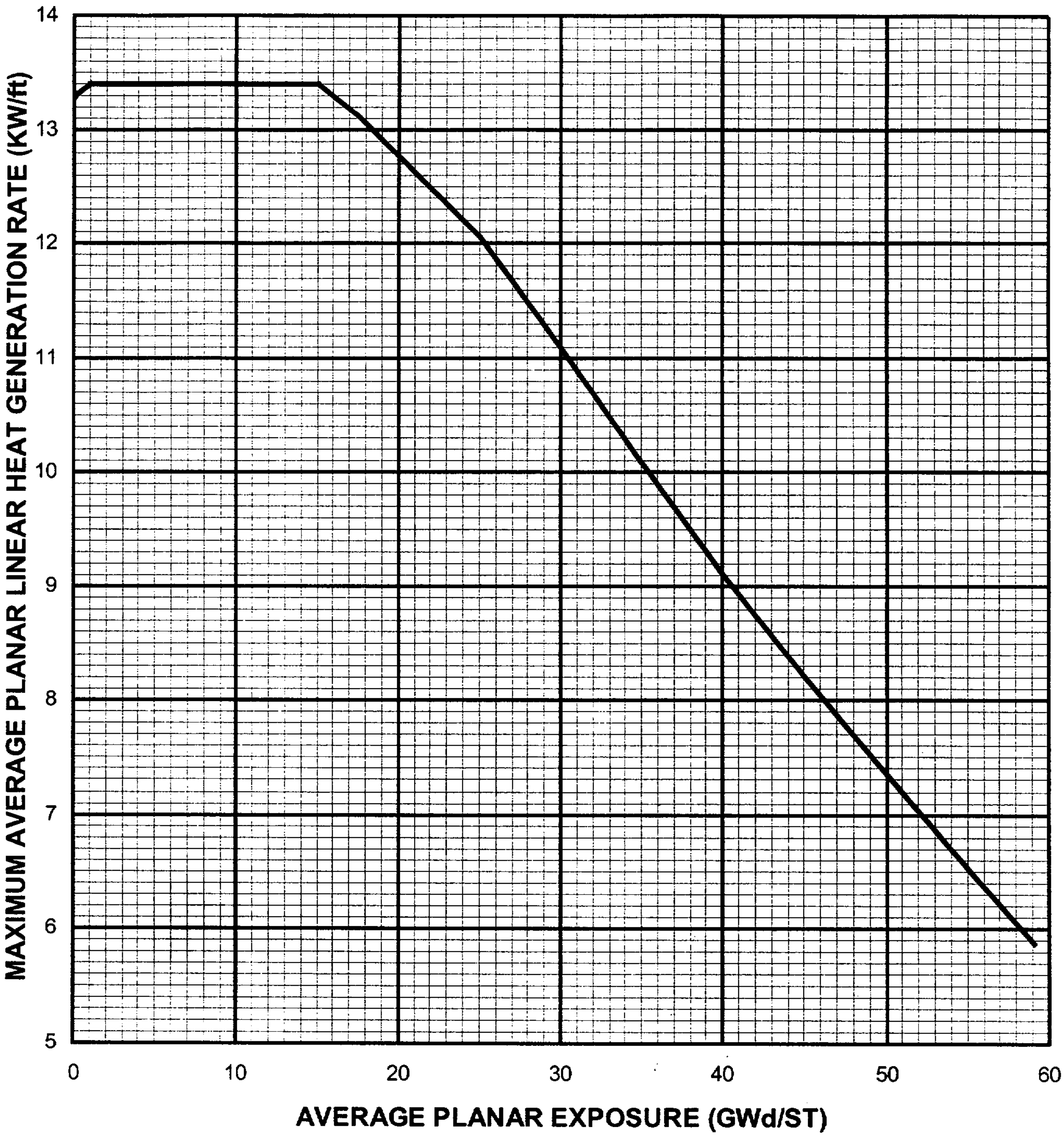


FIGURE 7. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE FOR GE11-P9SUB388-13GZ-120T-146-T

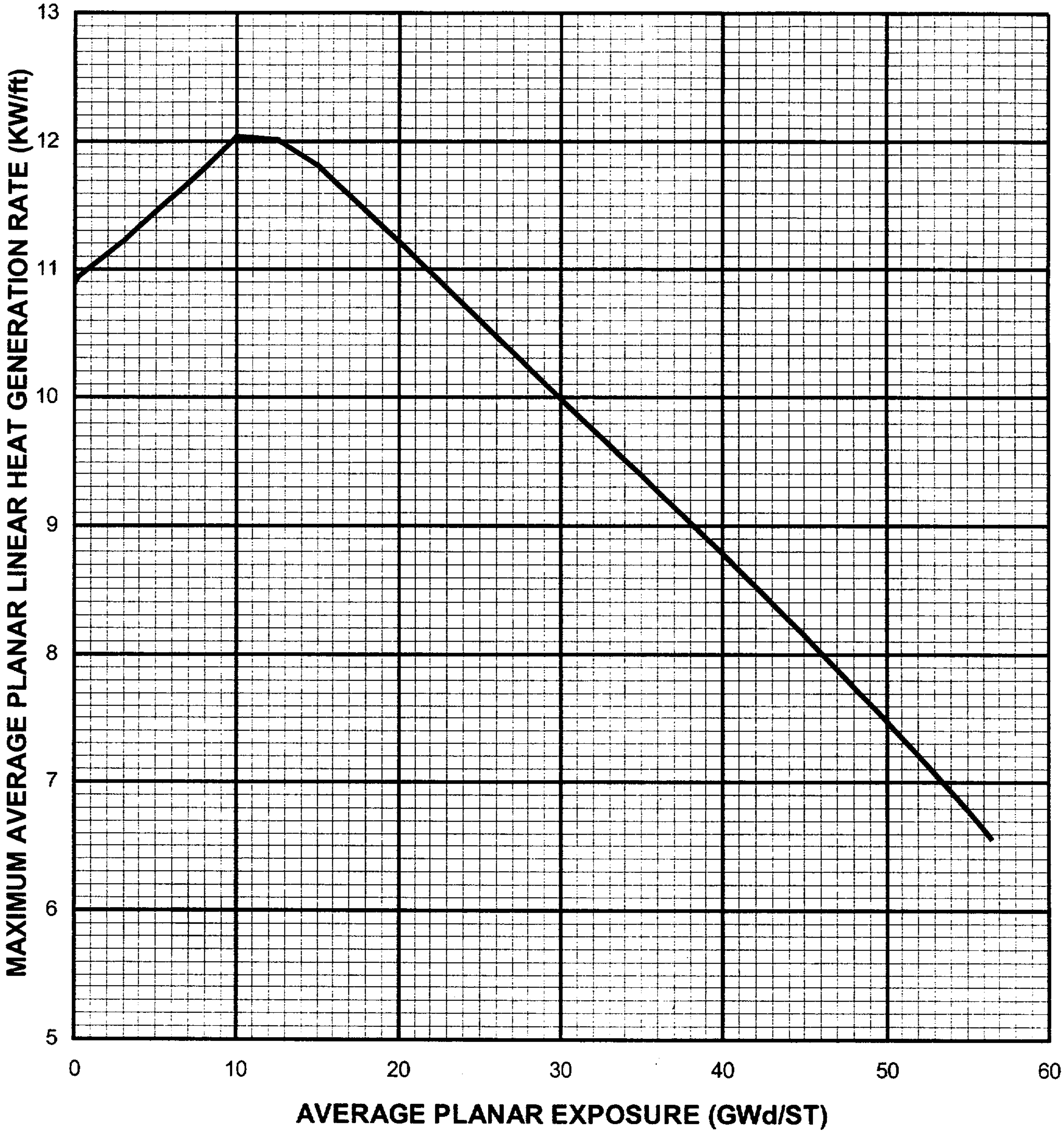


FIGURE 8. MAXIMUM AVERAGE PLANAR LINEAR HEAT GENERATION RATE (MAPLHGR) VERSUS AVERAGE PLANAR EXPOSURE GE8B-P8SQB333-10GZ-120M-4WR-150-T

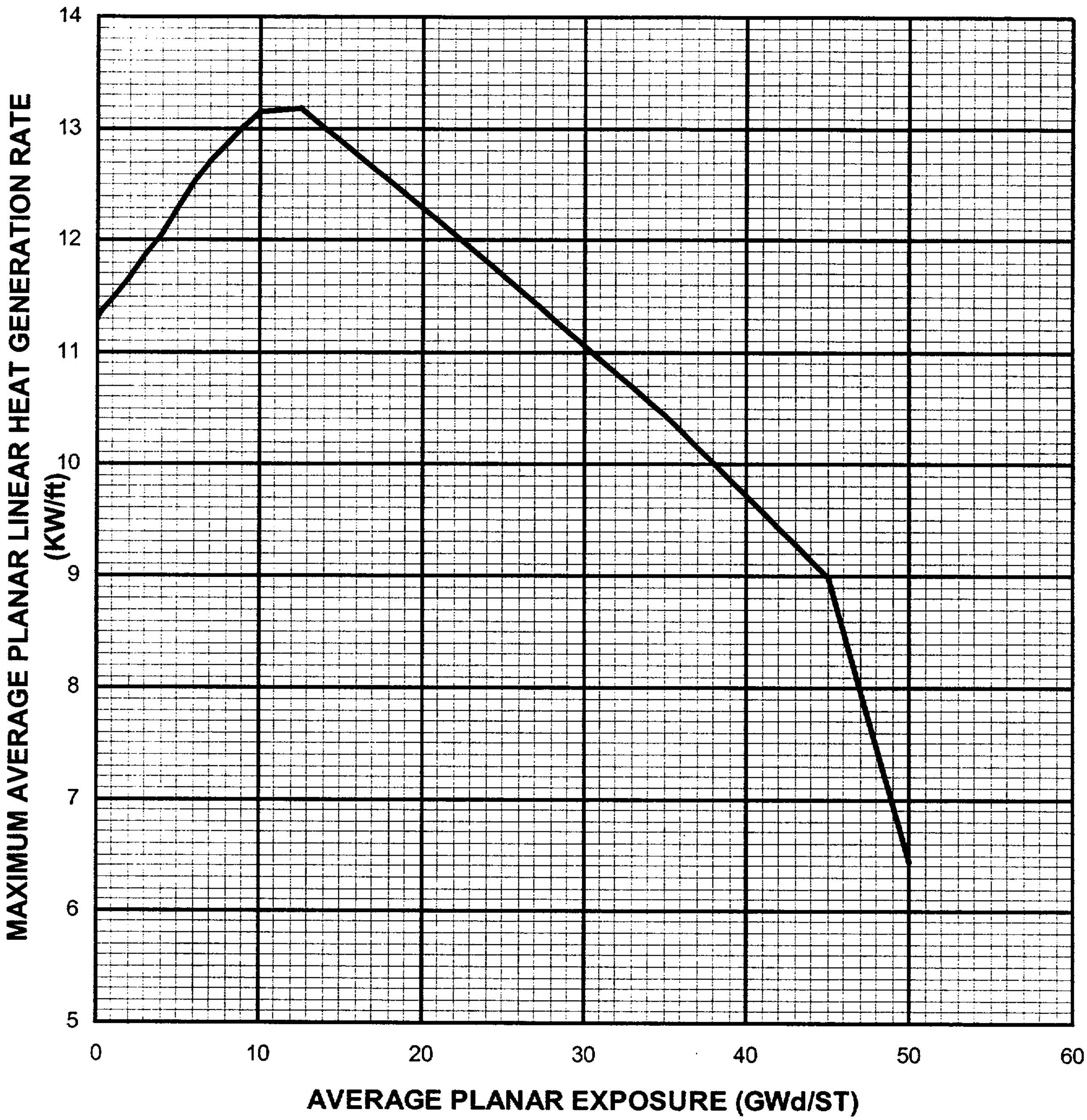


FIGURE 9. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB400-13GZ-120T-146-T

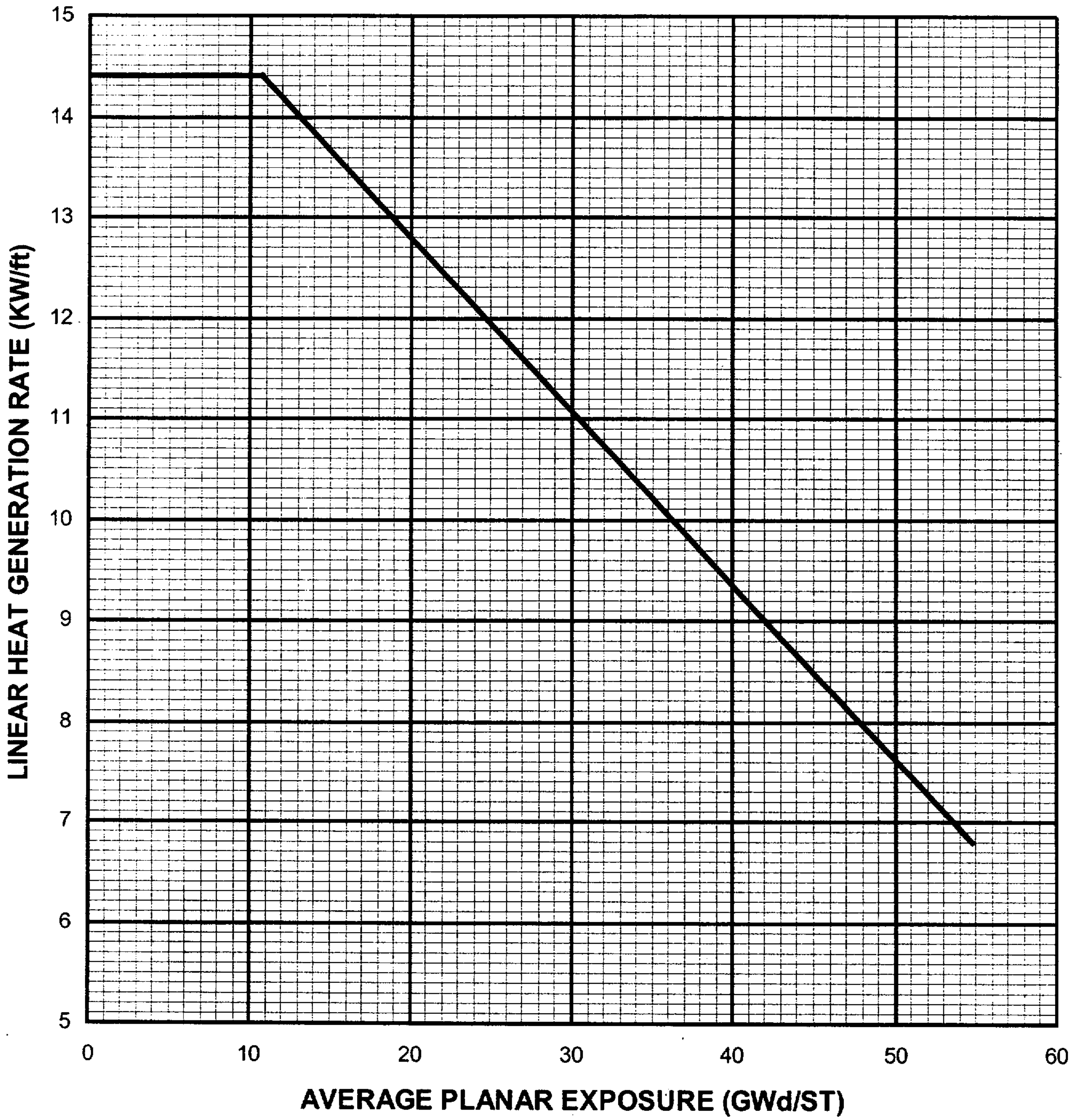


FIGURE 10. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB225-NOG-120T-146-T

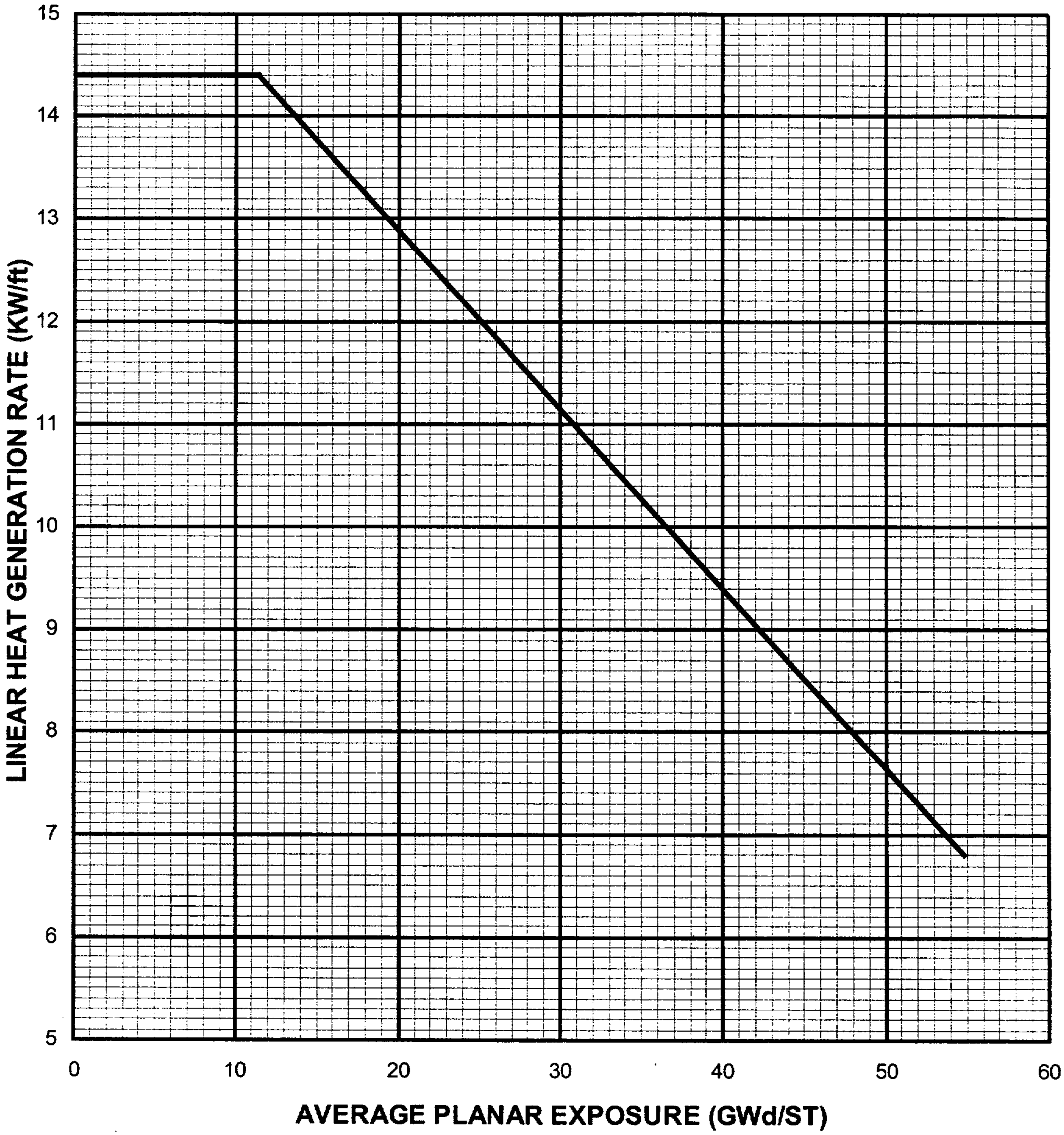


FIGURE 11. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB336-12GZ-120T-146-T

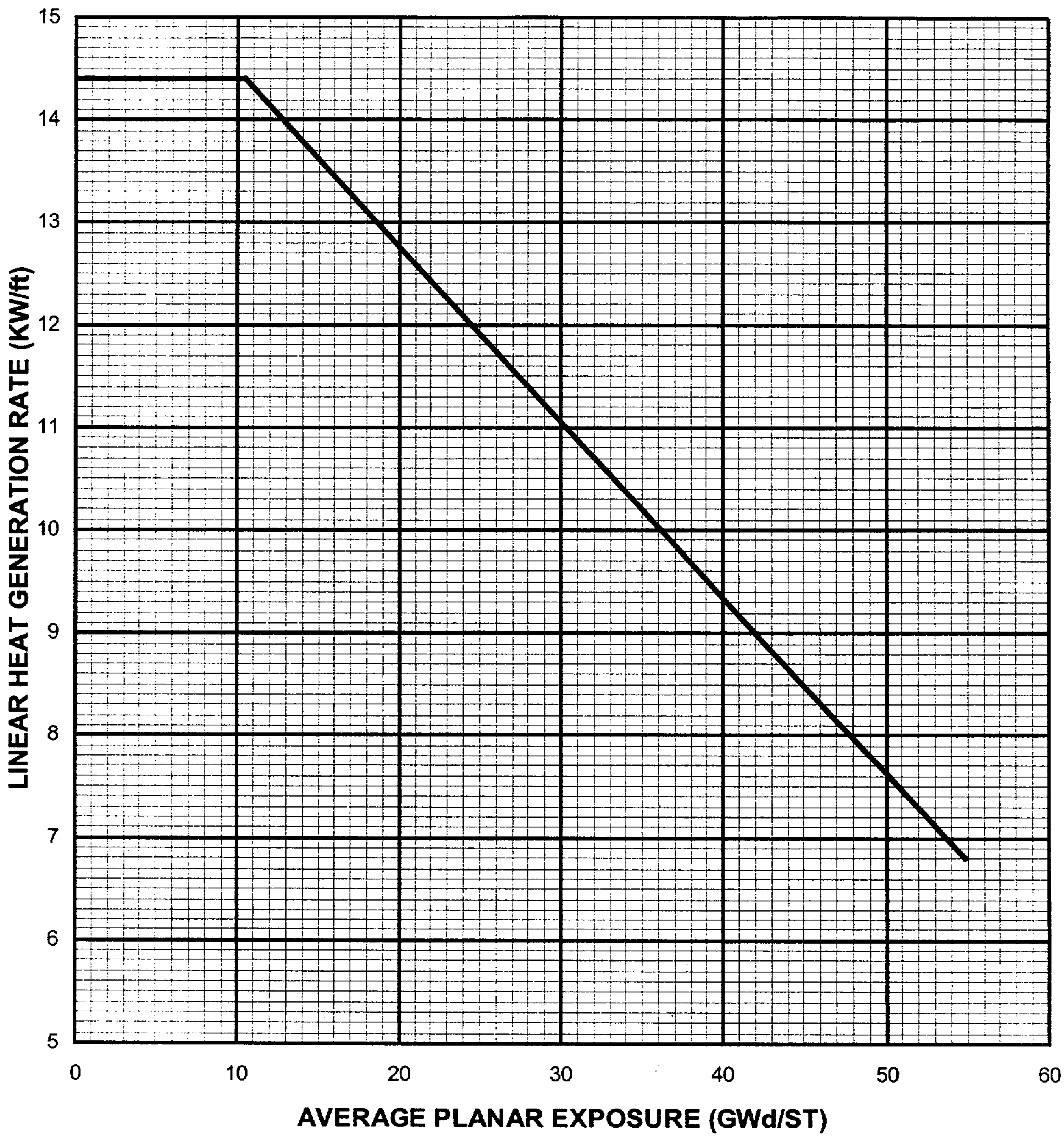


FIGURE 12. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB257-9GZ-120T-146-T

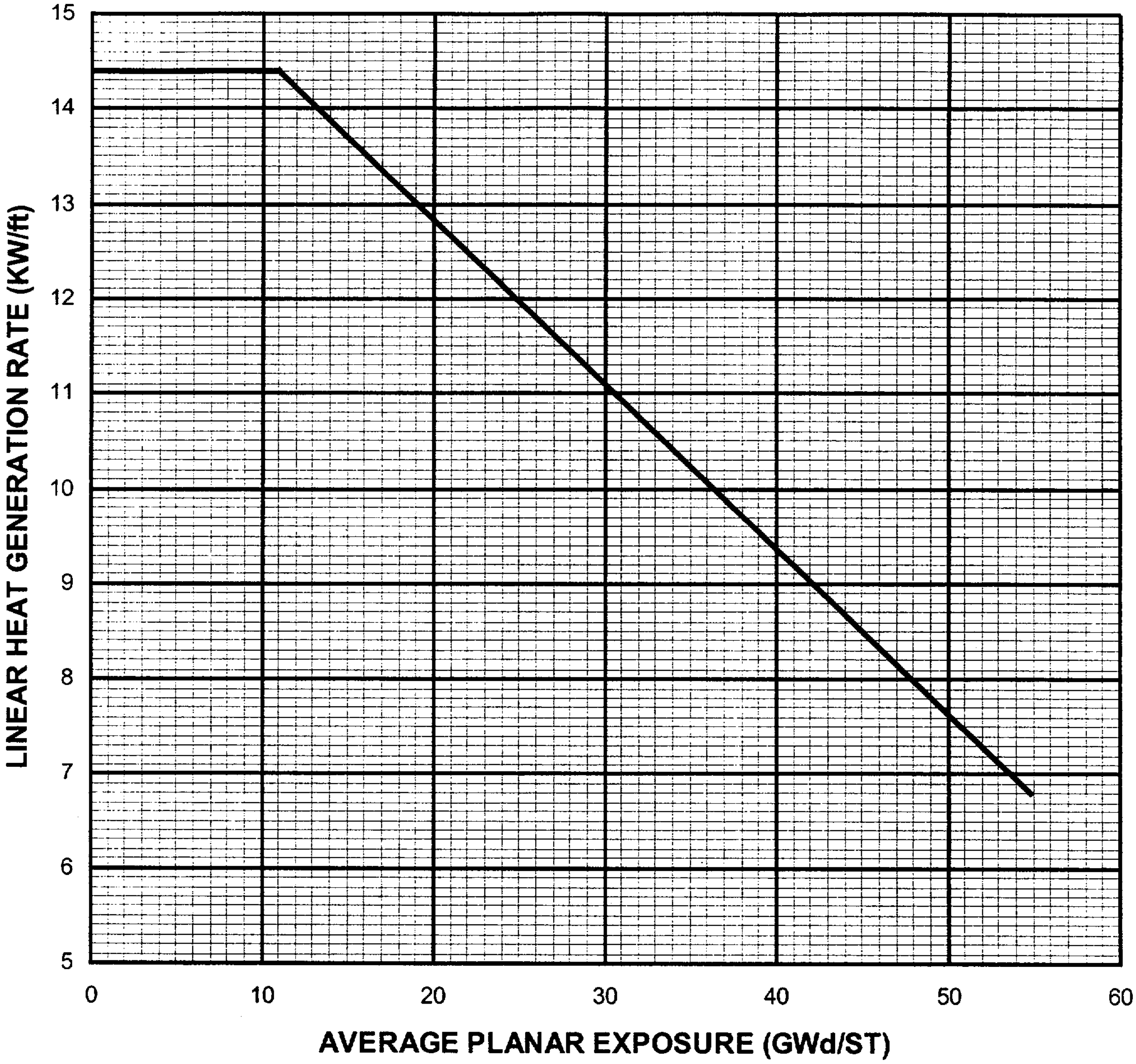


FIGURE 13. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-P9SUB147-NOG-120T-146-T

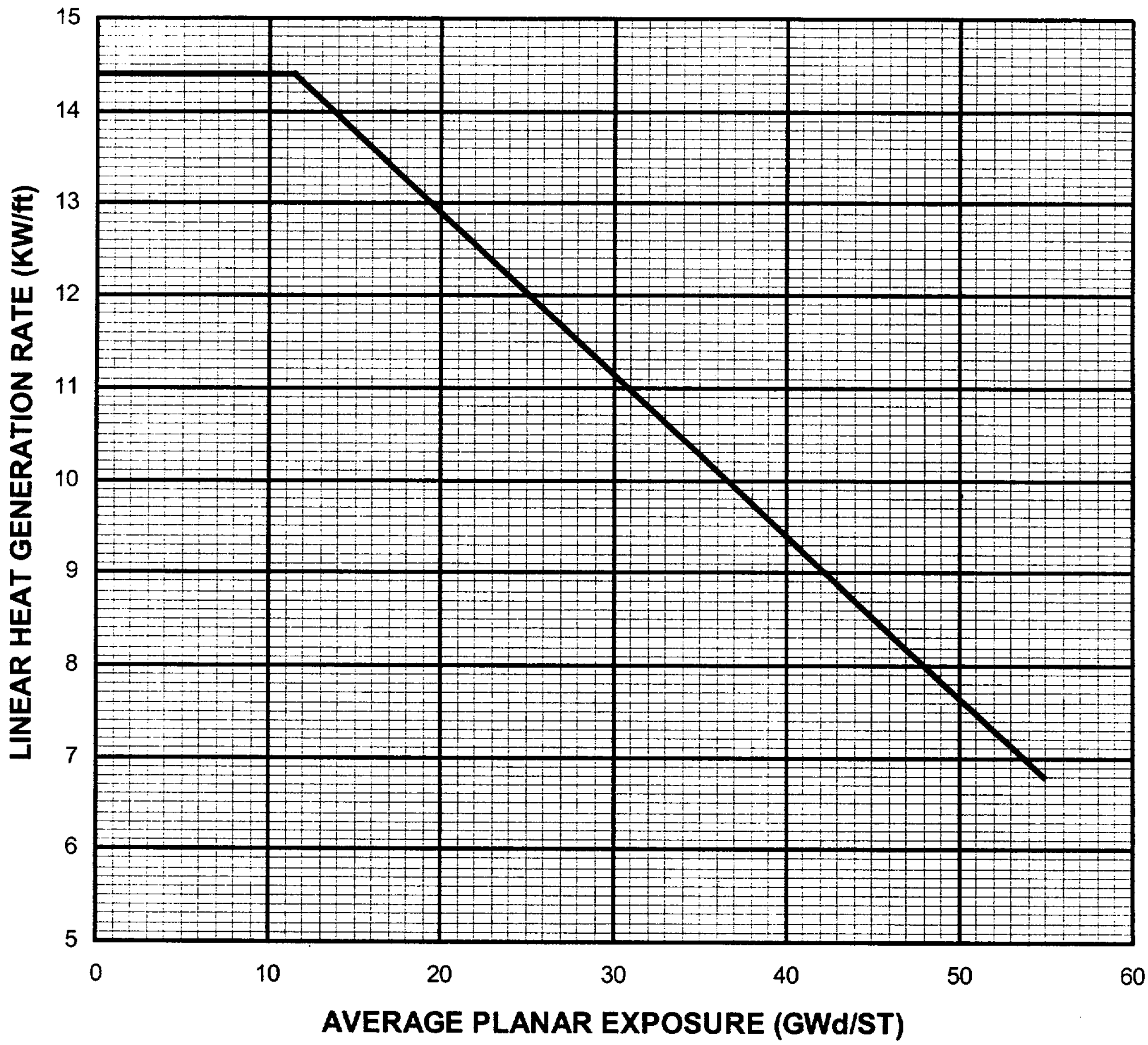


FIGURE 14. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE11-PSUB388-13GZ-120T-146-T

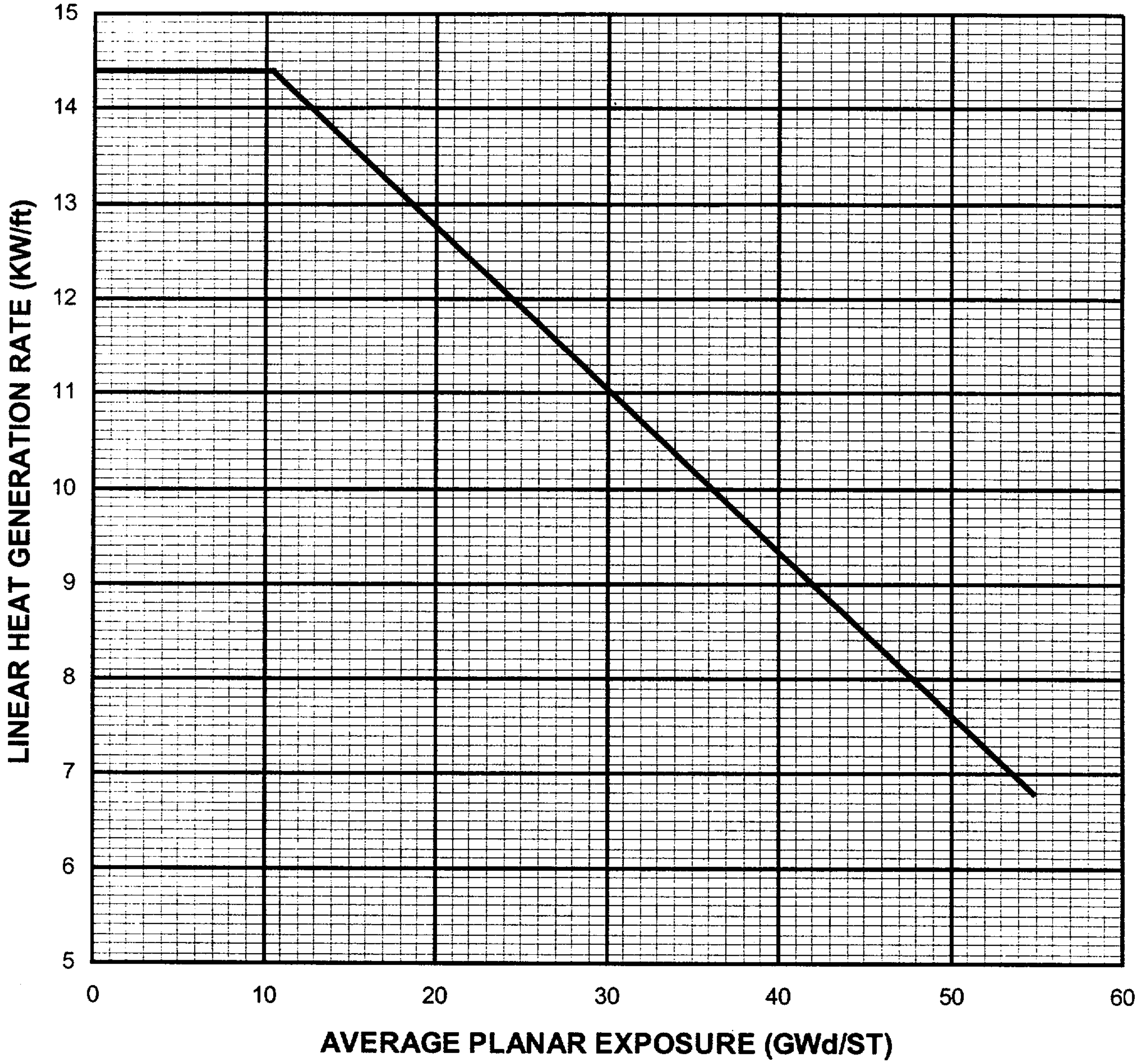


FIGURE 15. LINEAR HEAT GENERATION RATE (LHGR) LIMIT VERSUS AVERAGE PLANAR EXPOSURE GE8B-P8SQB333-10GZ-120M-4WR-150-T

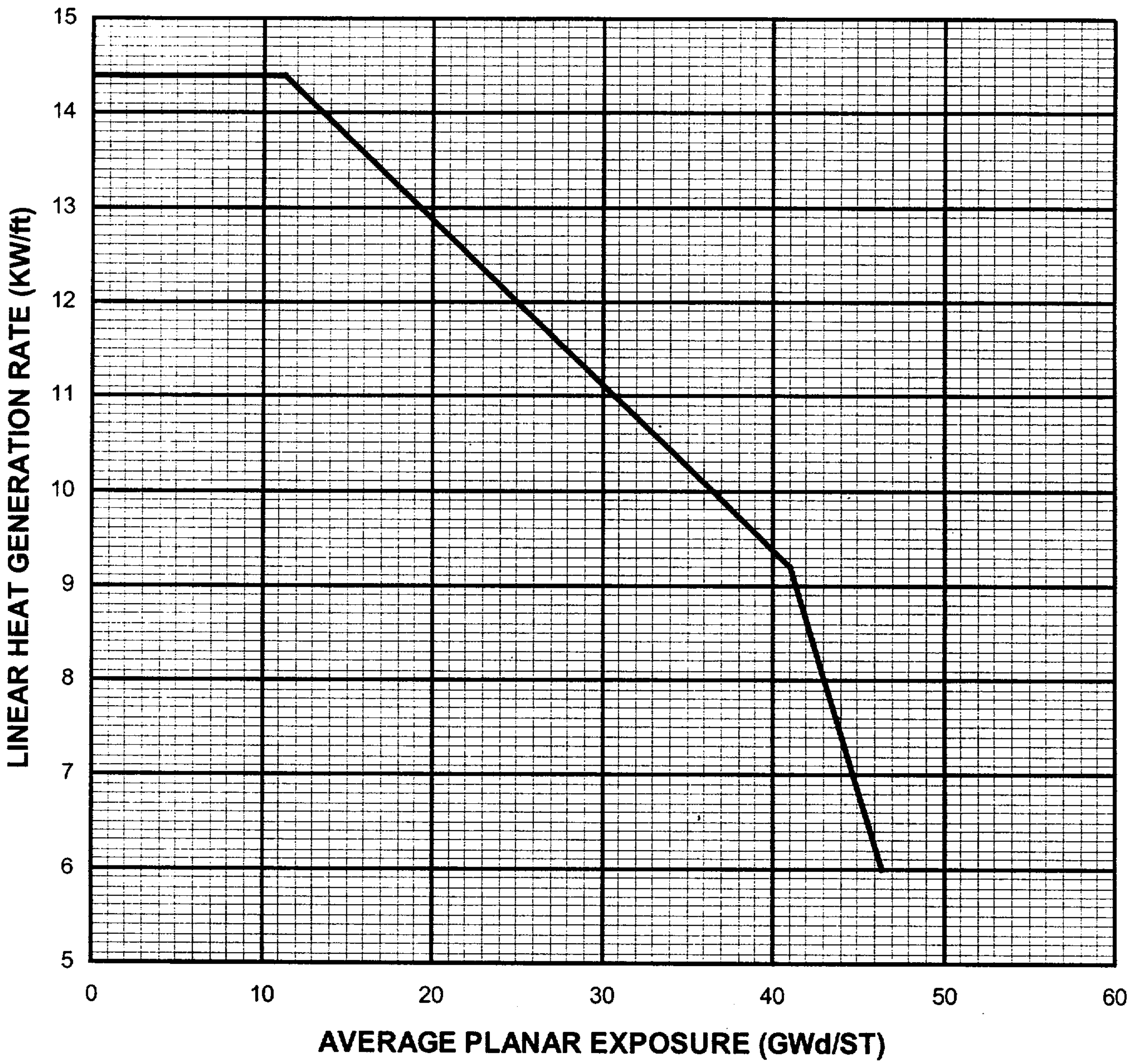
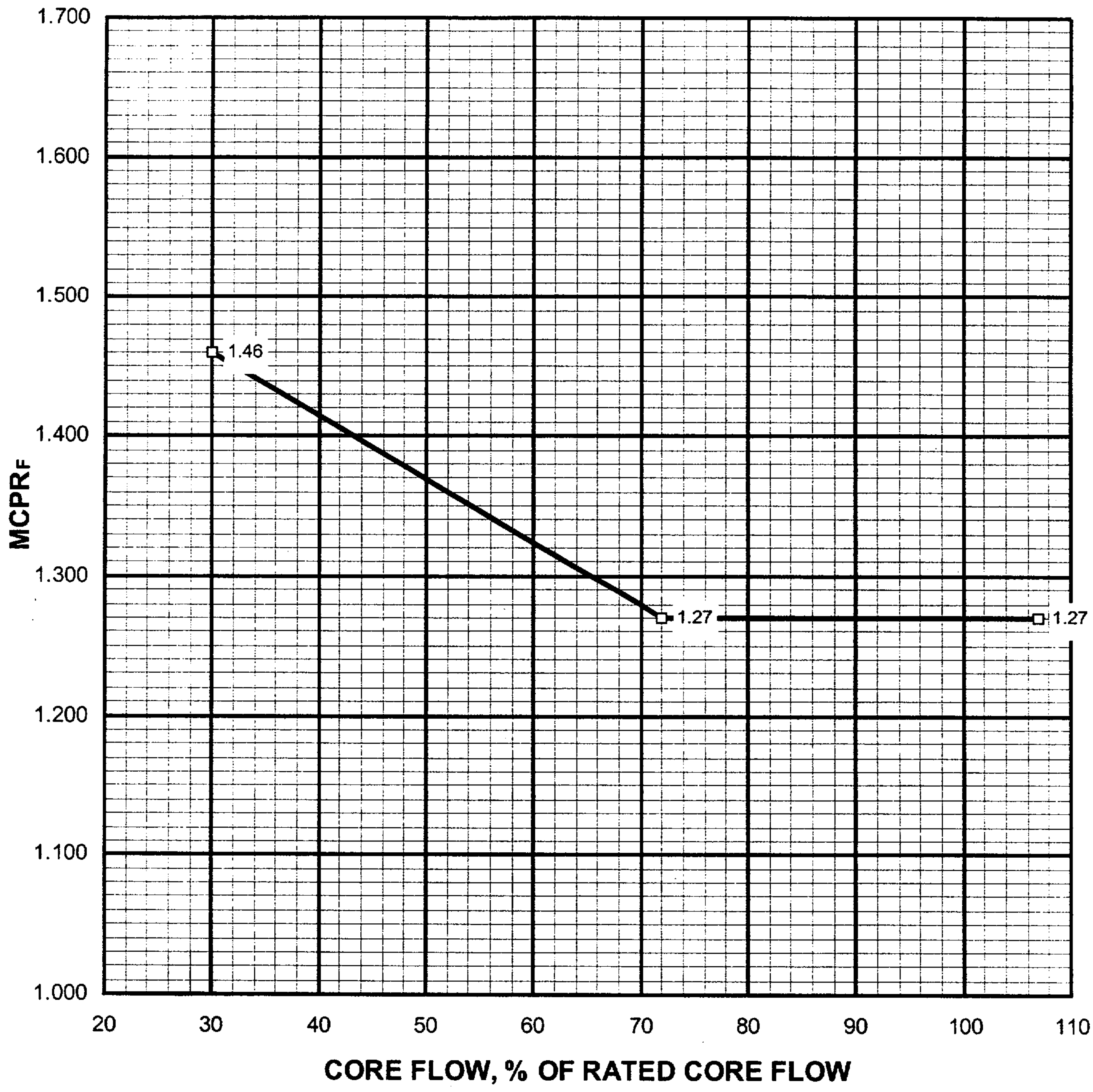
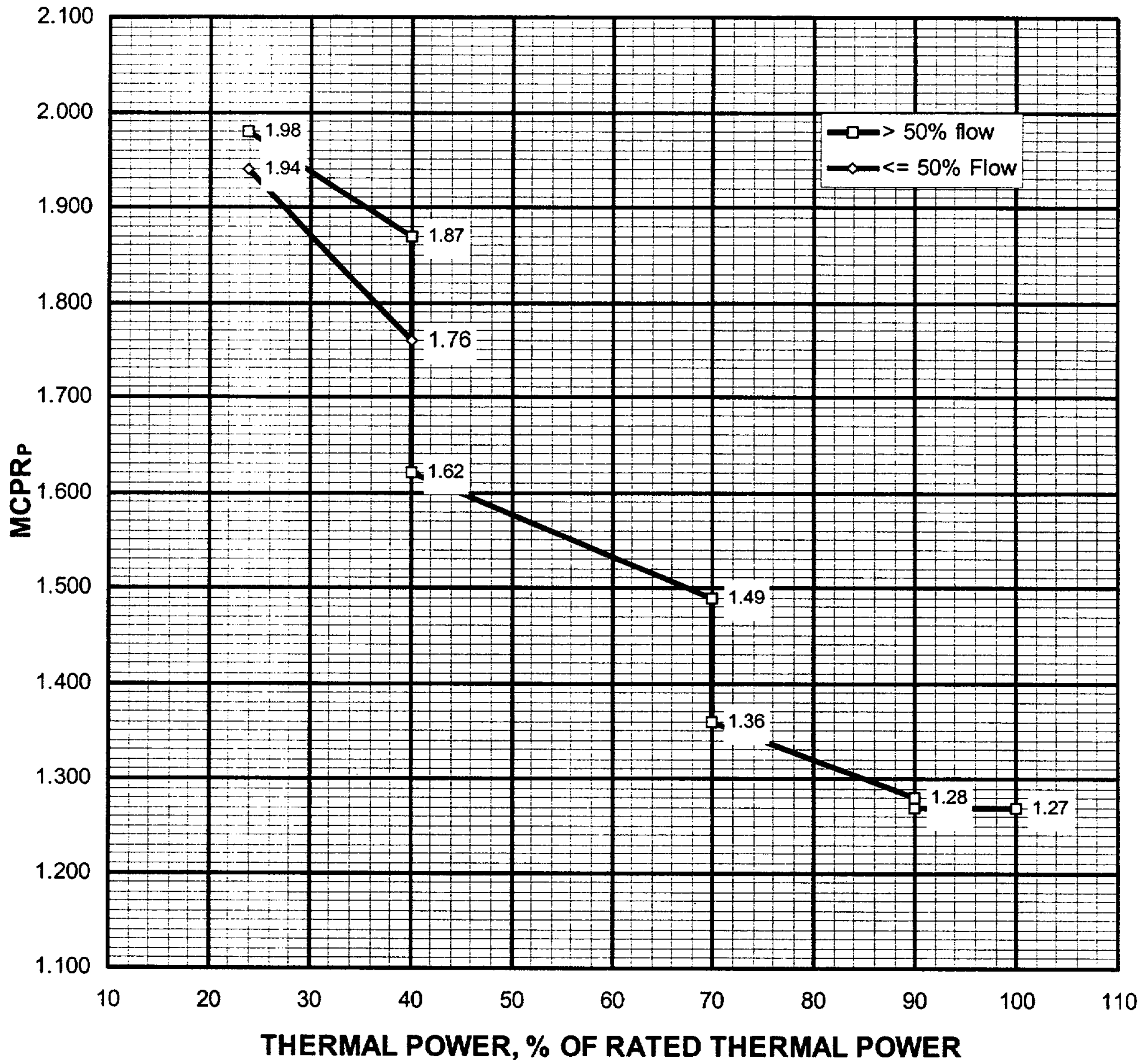


FIGURE 16. OPERATING LIMIT MCPR ($MCPR_F$) VERSUS CORE FLOW *



* These values must be increased by 0.01 during single loop operation.

FIGURE 17. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER*



* These values must be increased by 0.01 during single loop operation.

FIGURE 18. LHGR AND MAPLHGR MULTIPLIER VERSUS CORE FLOW

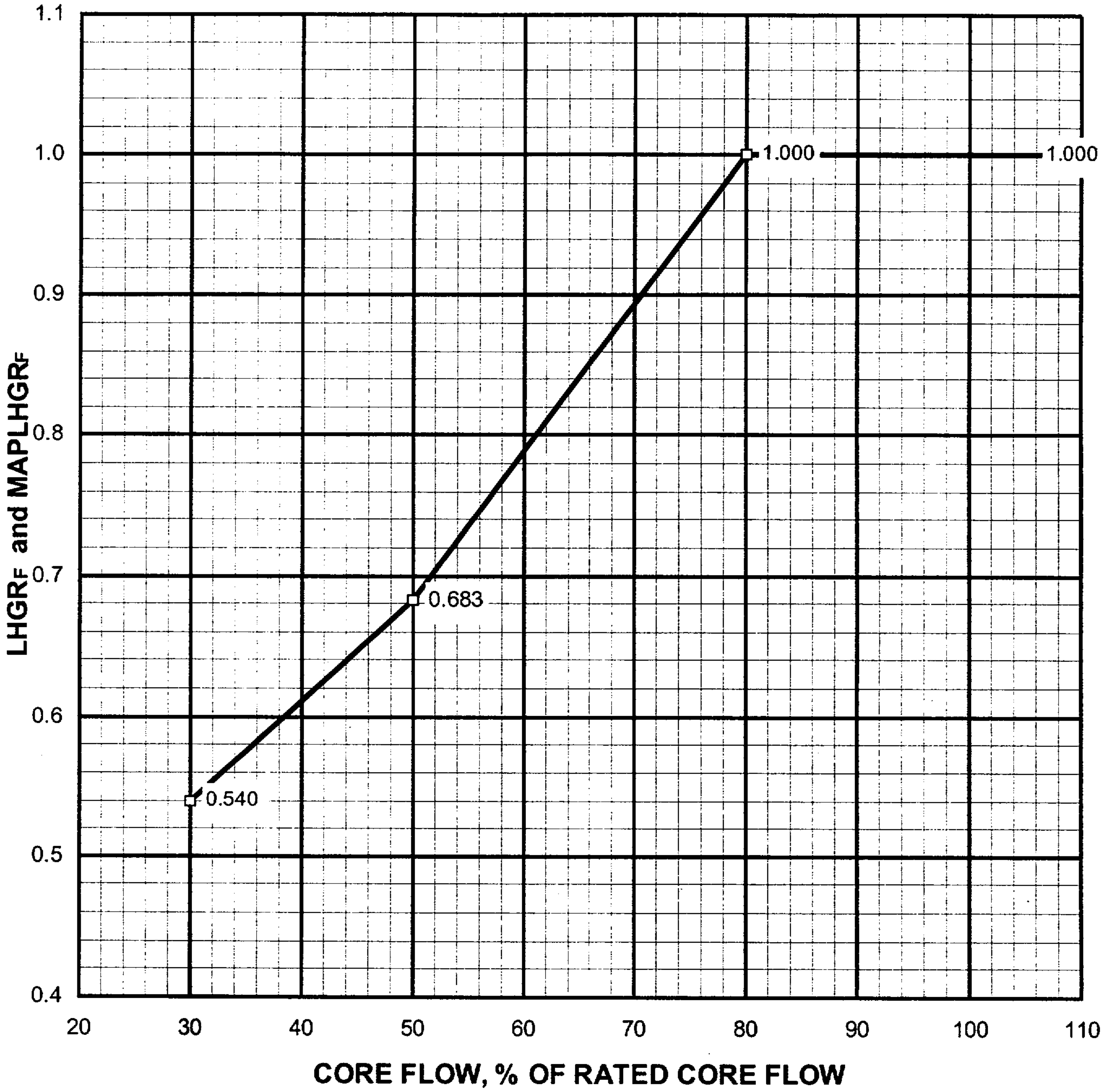


FIGURE 19. LHGR AND MAPLHGR MULTIPLIER VERSUS CORE POWER

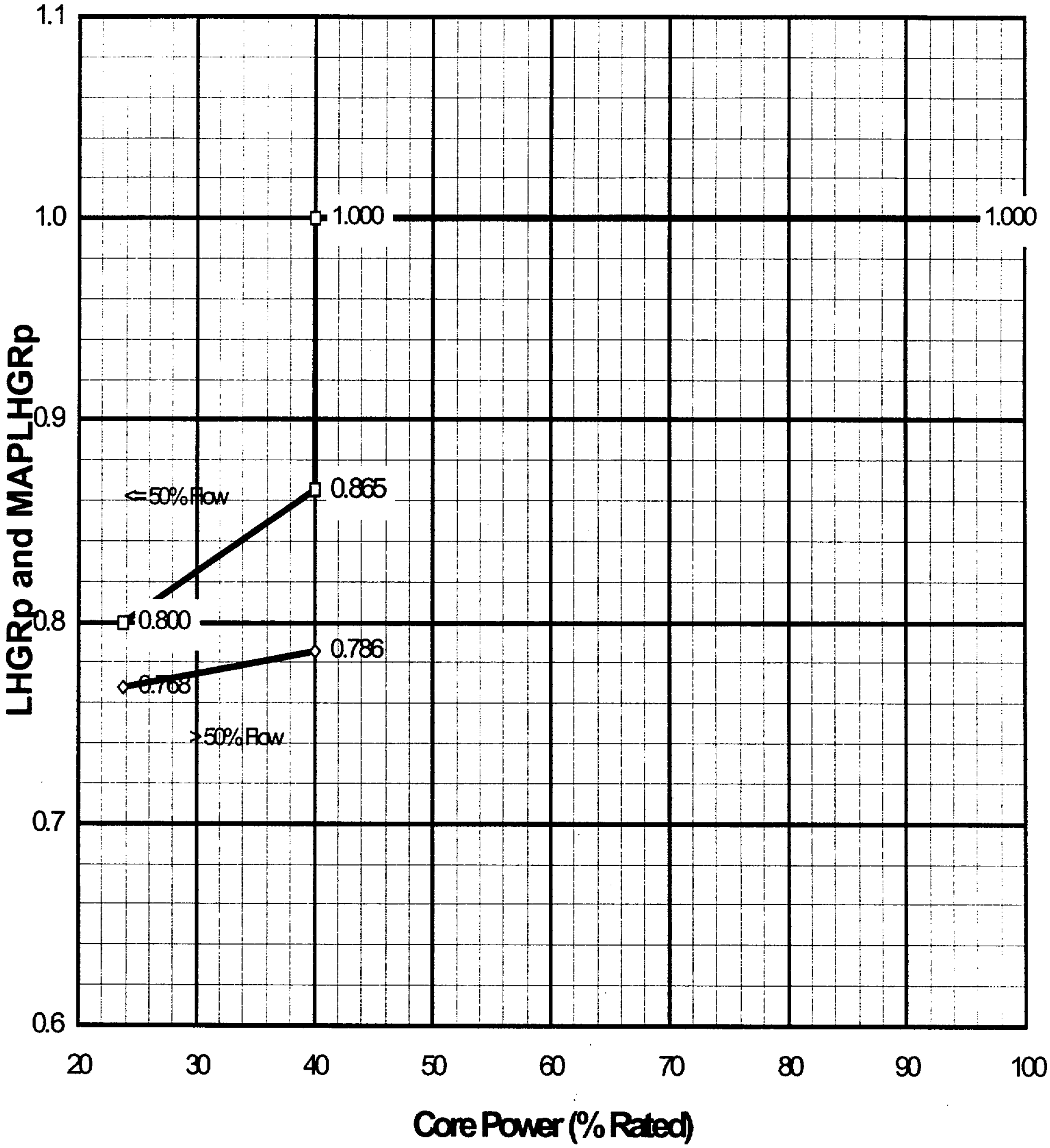


FIGURE 20. MONITORED REGION BOUNDARY (CASE 1)

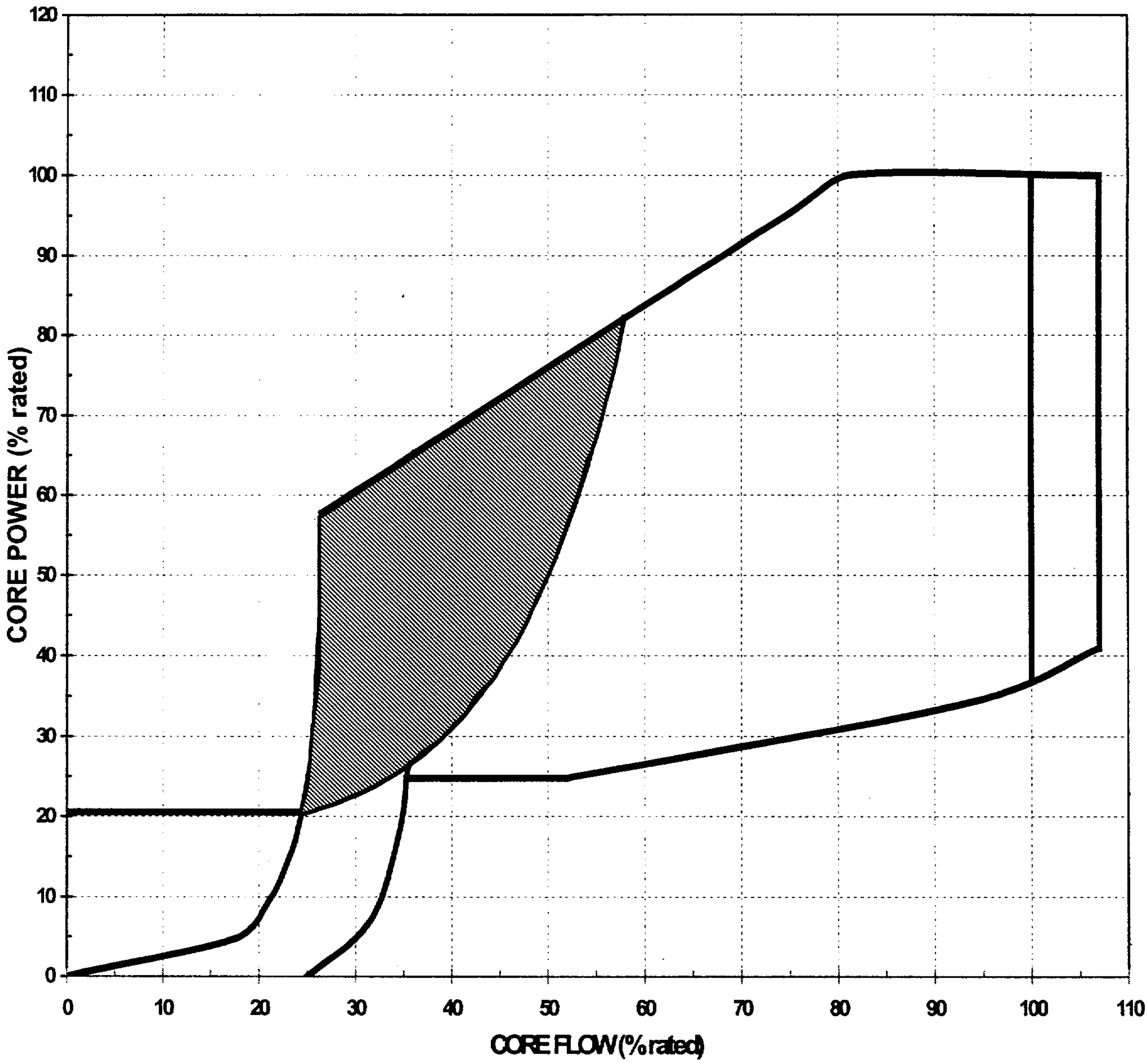


FIGURE 21. MONITORED REGION BOUNDARY (CASE 2)

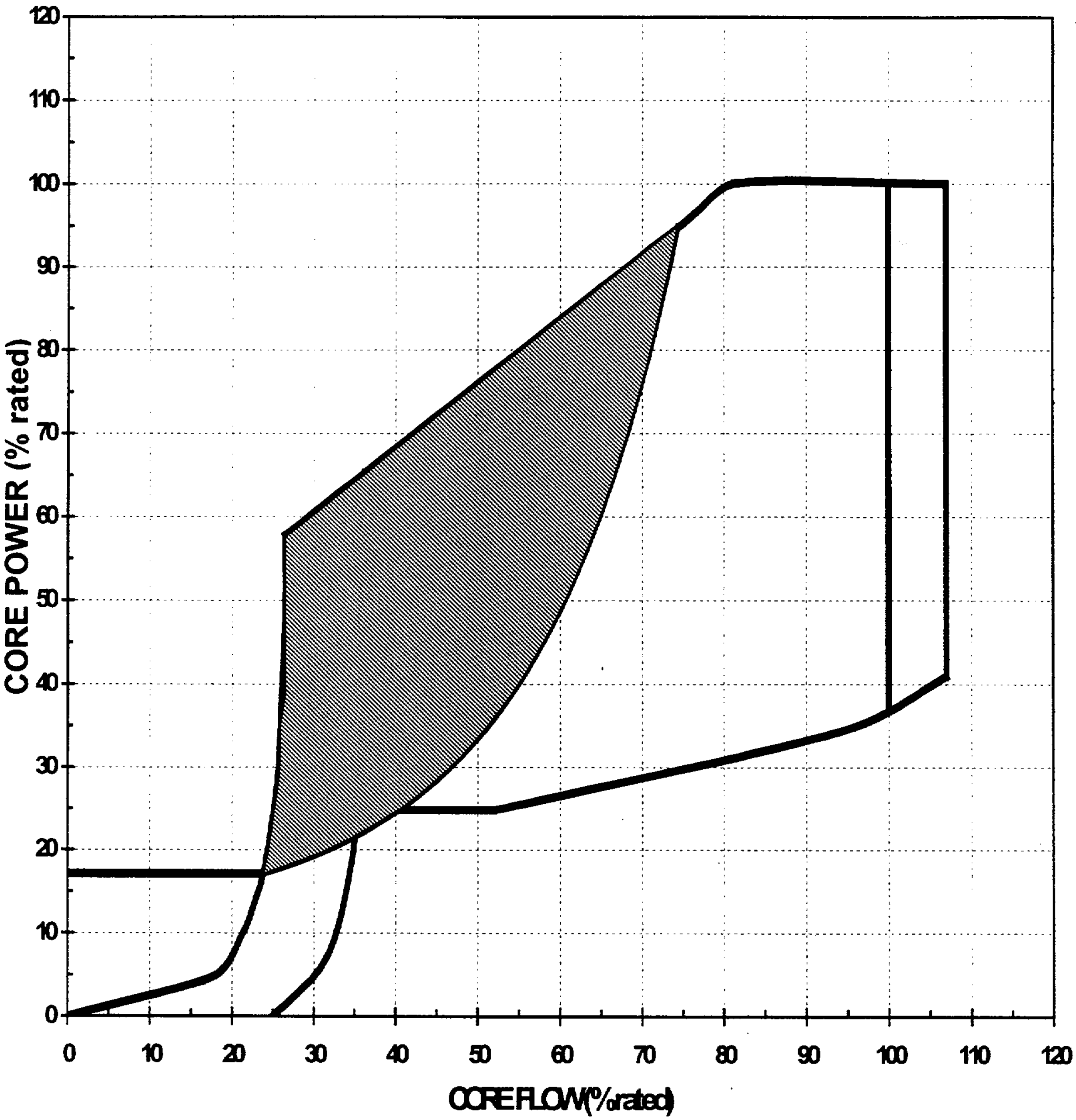


FIGURE 22. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(TWO RECIRCULATION LOOP OPERATION - CASE 1)

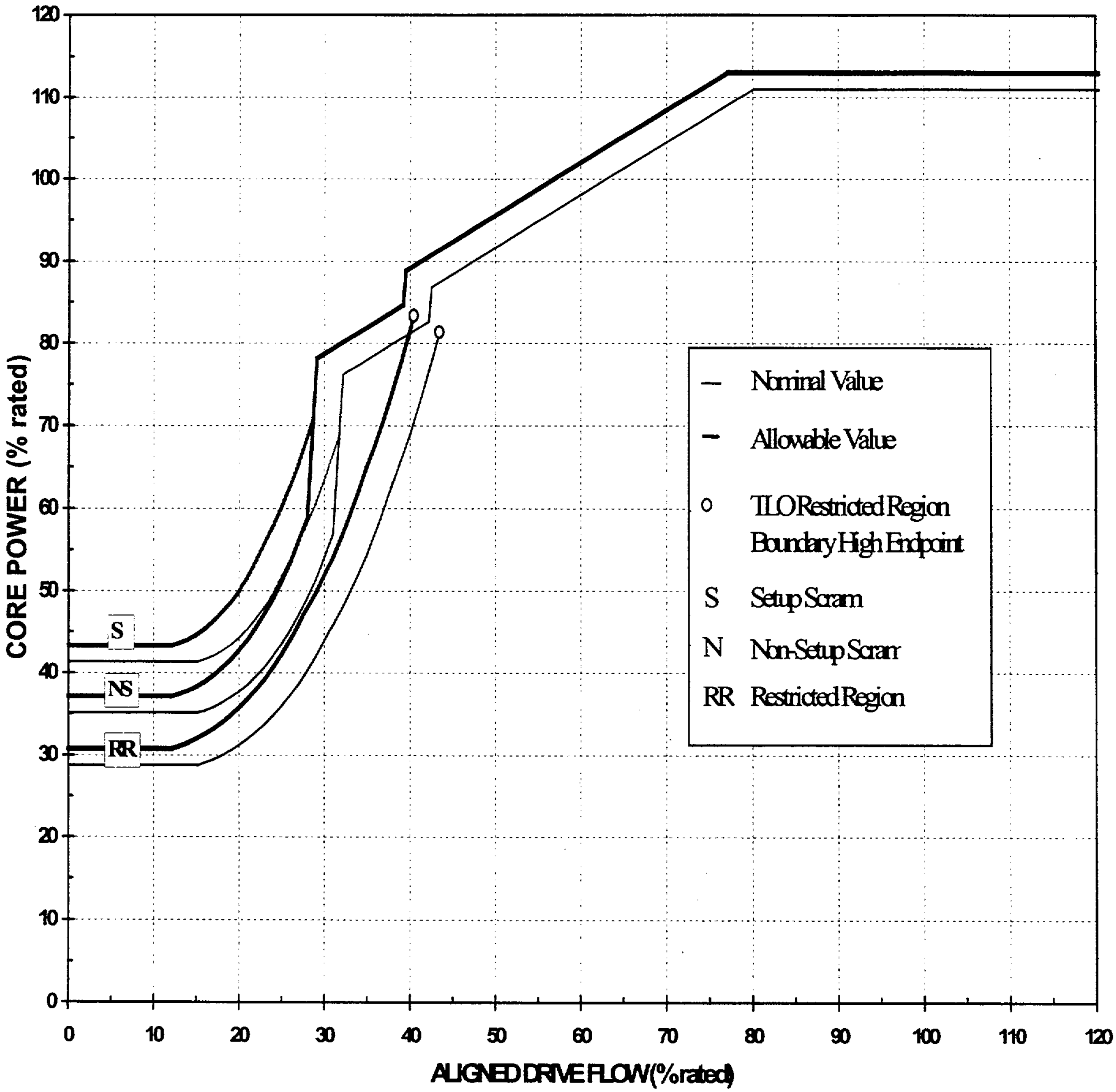


FIGURE 23. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(SINGLE RECIRCULATION LOOP OPERATION - CASE 1)

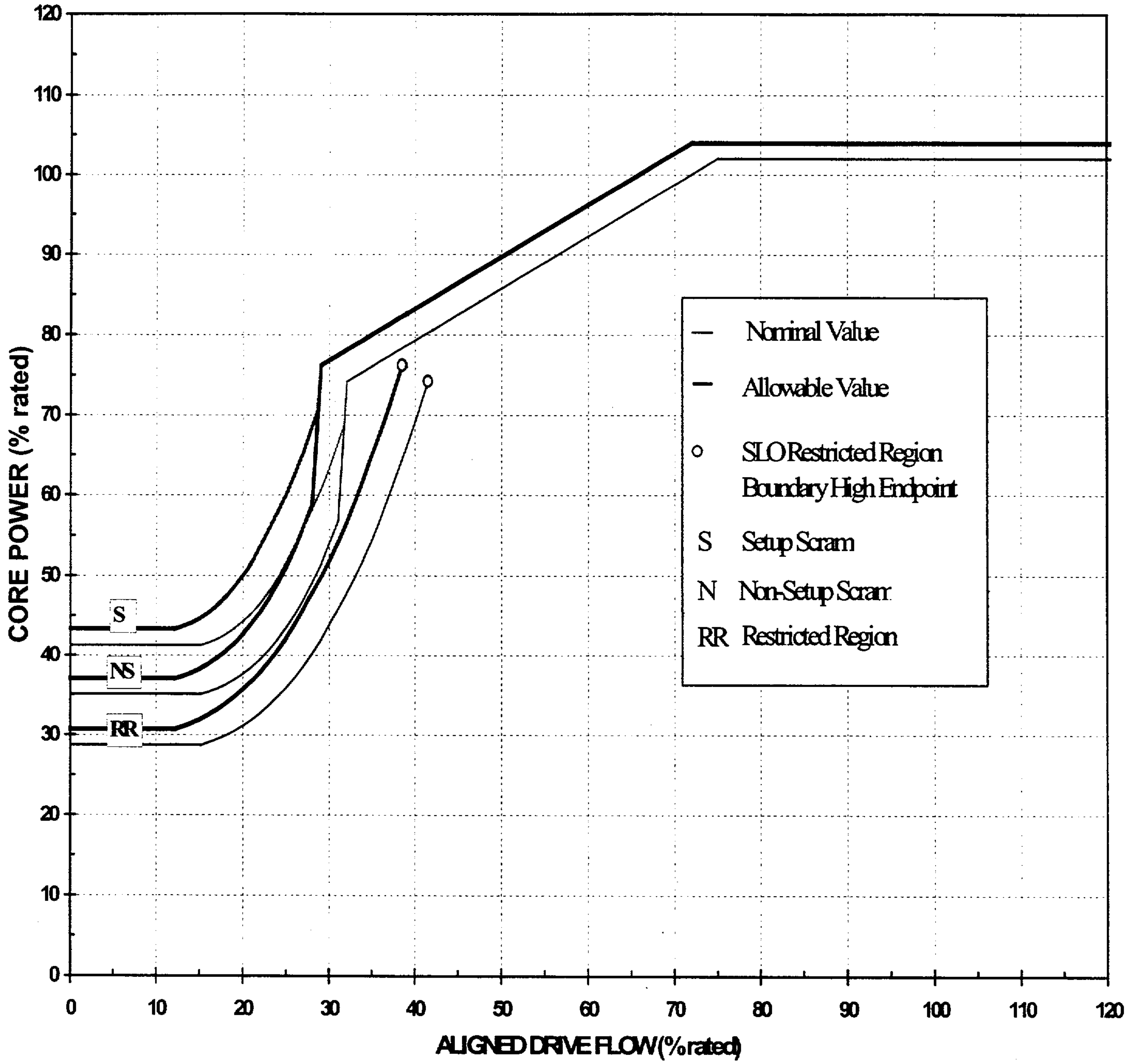


FIGURE 24. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(TWO RECIRCULATION LOOP OPERATION - CASE 2)

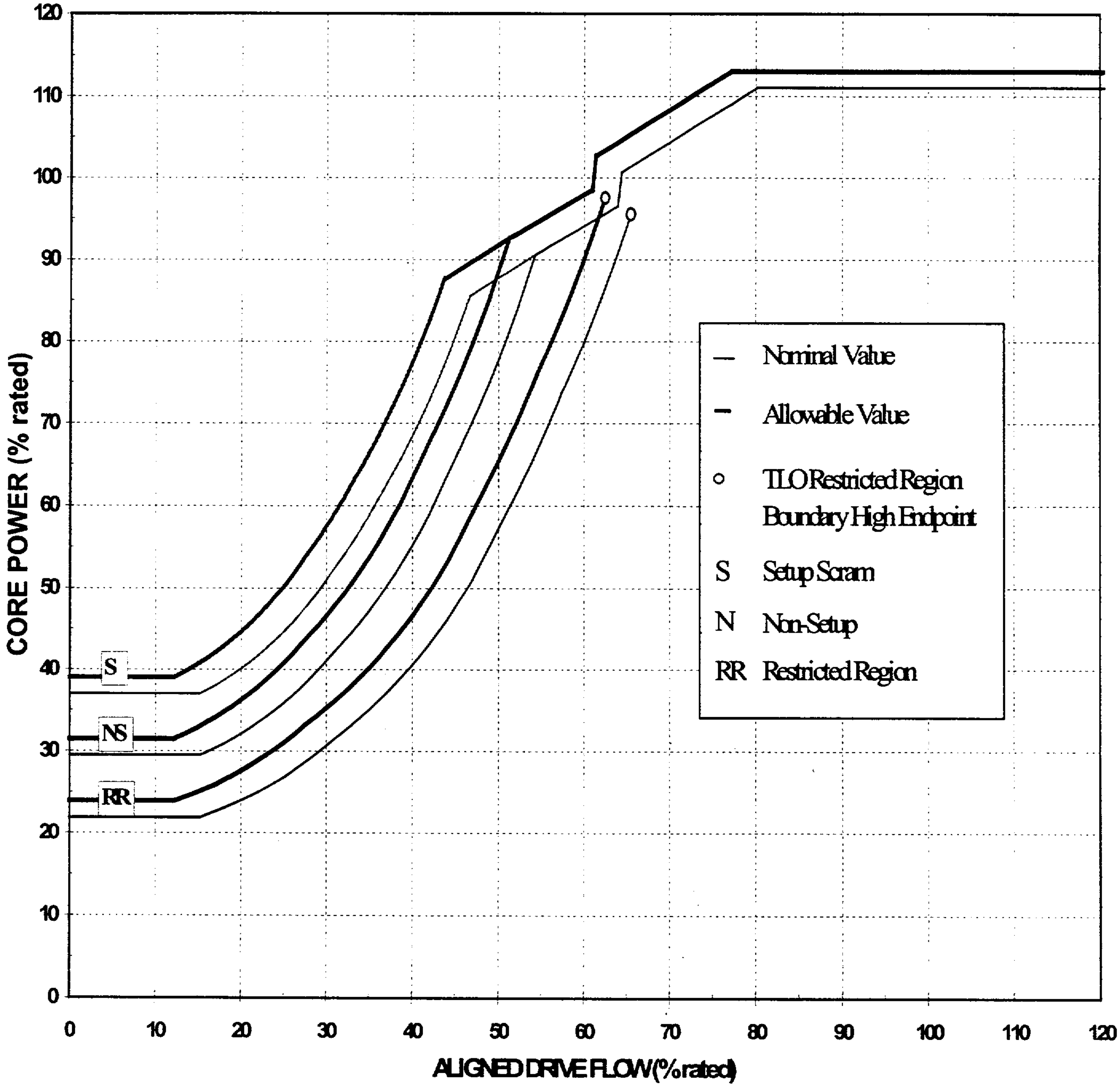


FIGURE 25. APRM FLOW BIASED SIMULATED THERMAL POWER - HIGH SCRAM SETPOINTS AND RESTRICTED REGION BOUNDARY

(SINGLE RECIRCULATION LOOP OPERATION - CASE 2)

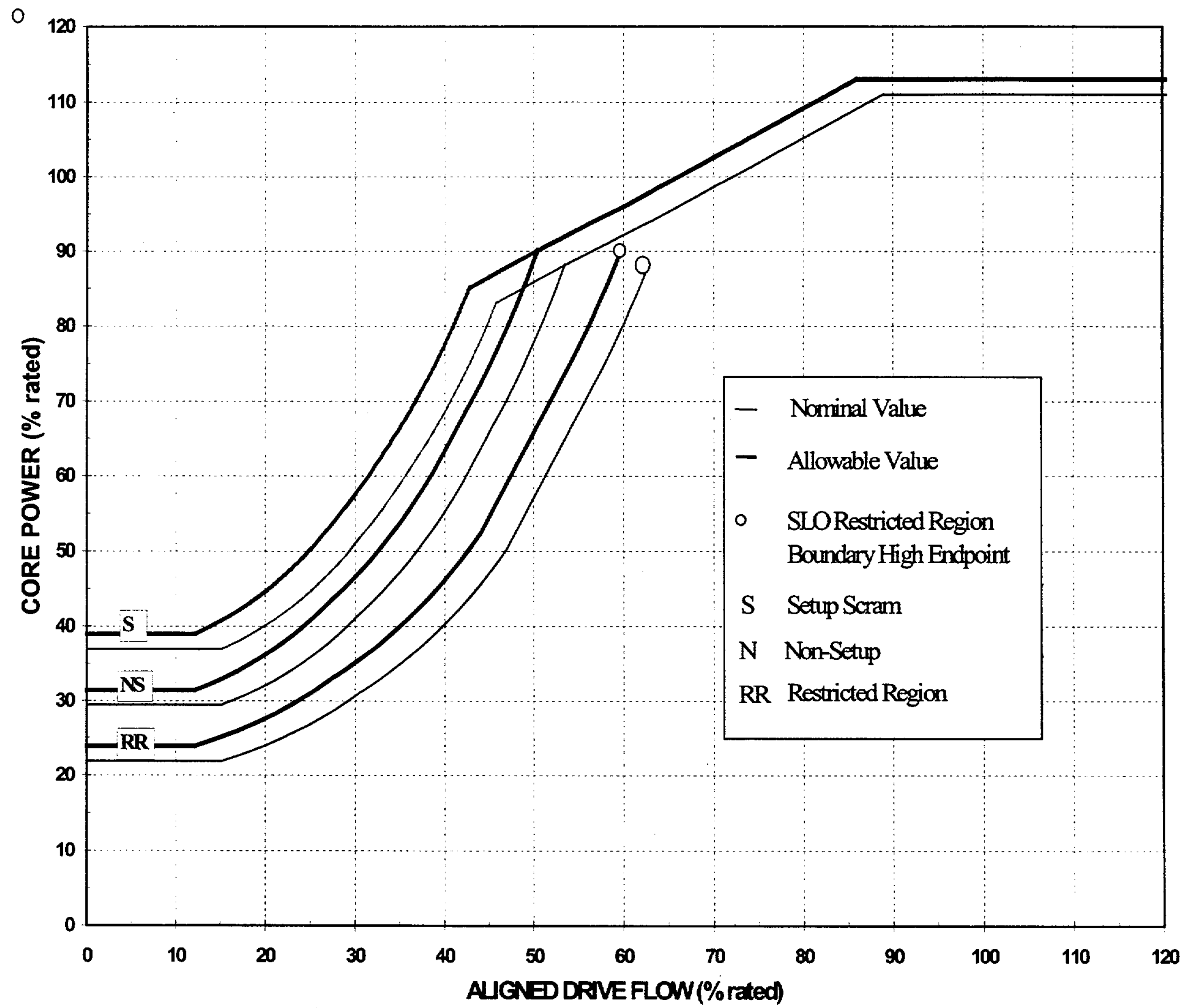


FIGURE 26. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(TWO RECIRCULATION LOOP OPERATION - CASE 1)

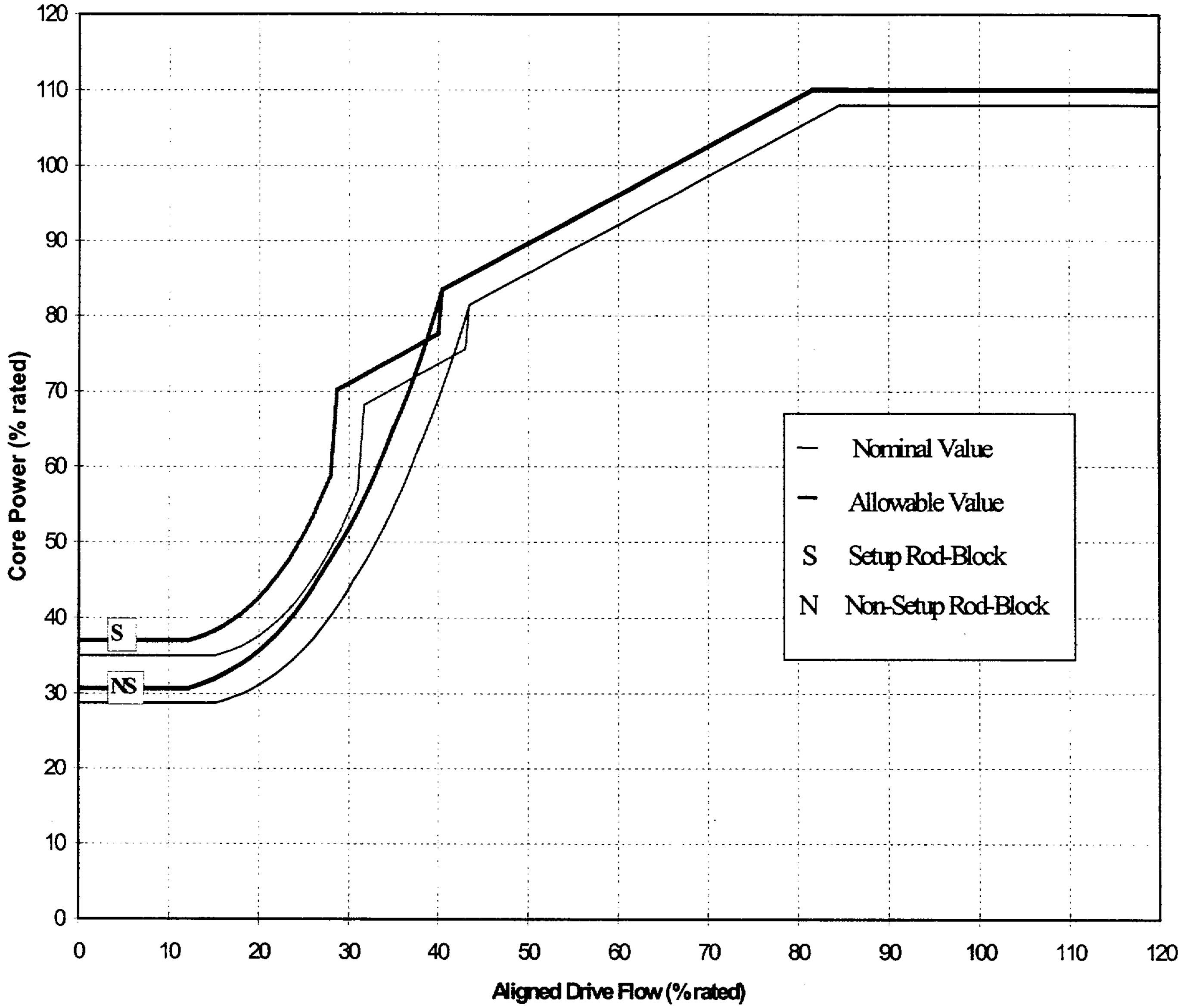


FIGURE 27. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(SINGLE RECIRCULATION LOOP OPERATION - CASE 1)

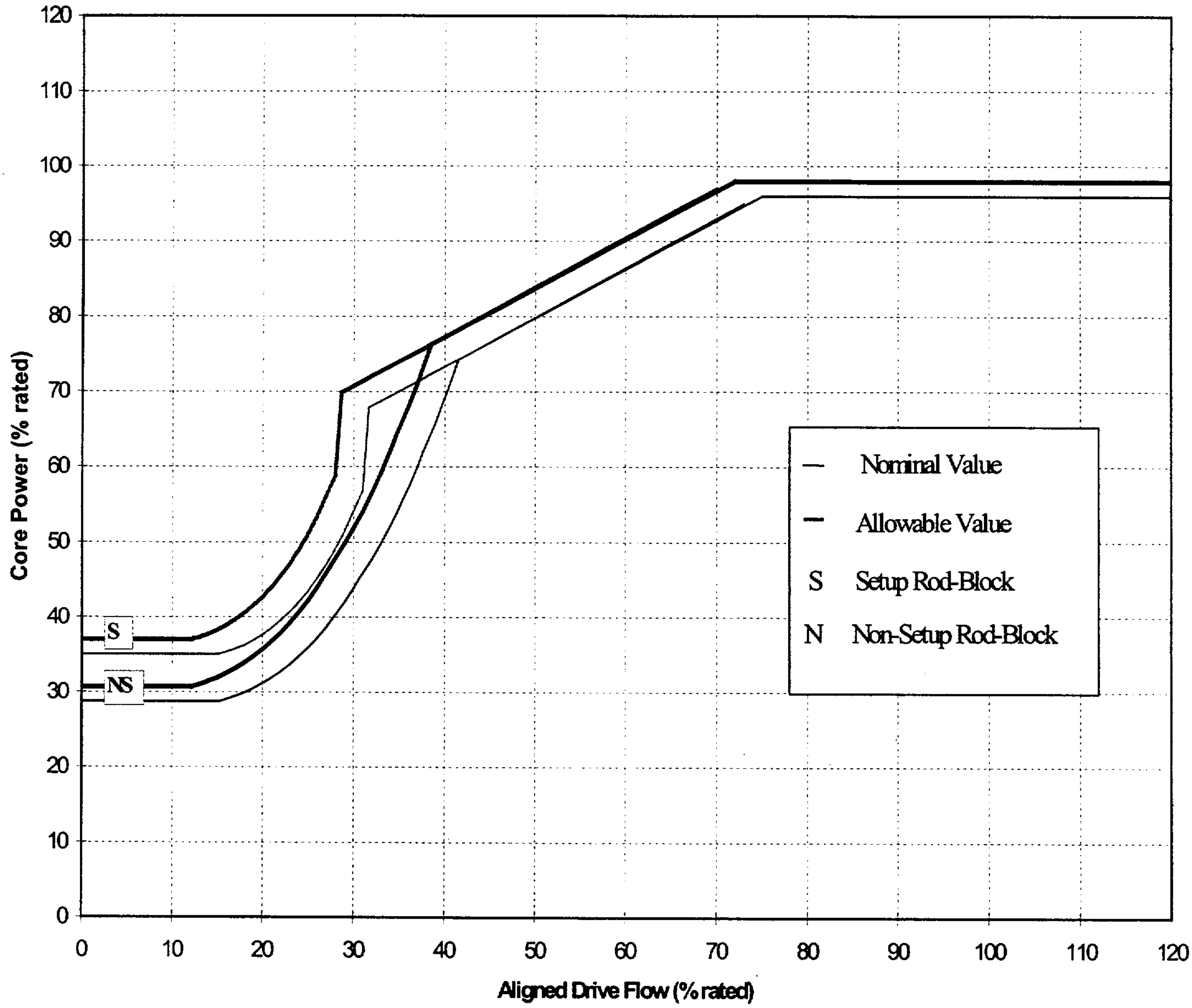


FIGURE 28. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(TWO RECIRCULATION LOOP OPERATION - CASE 2)

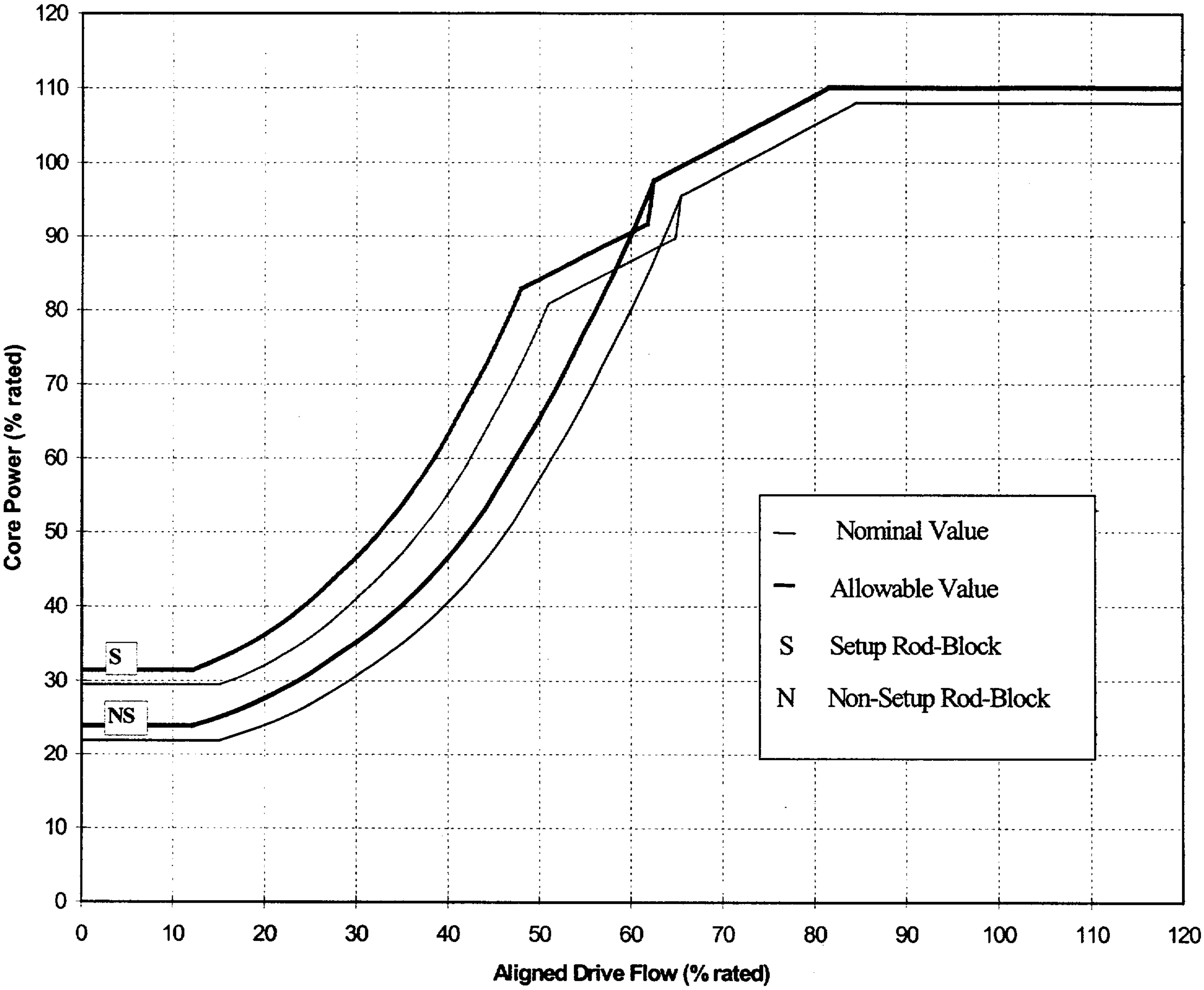
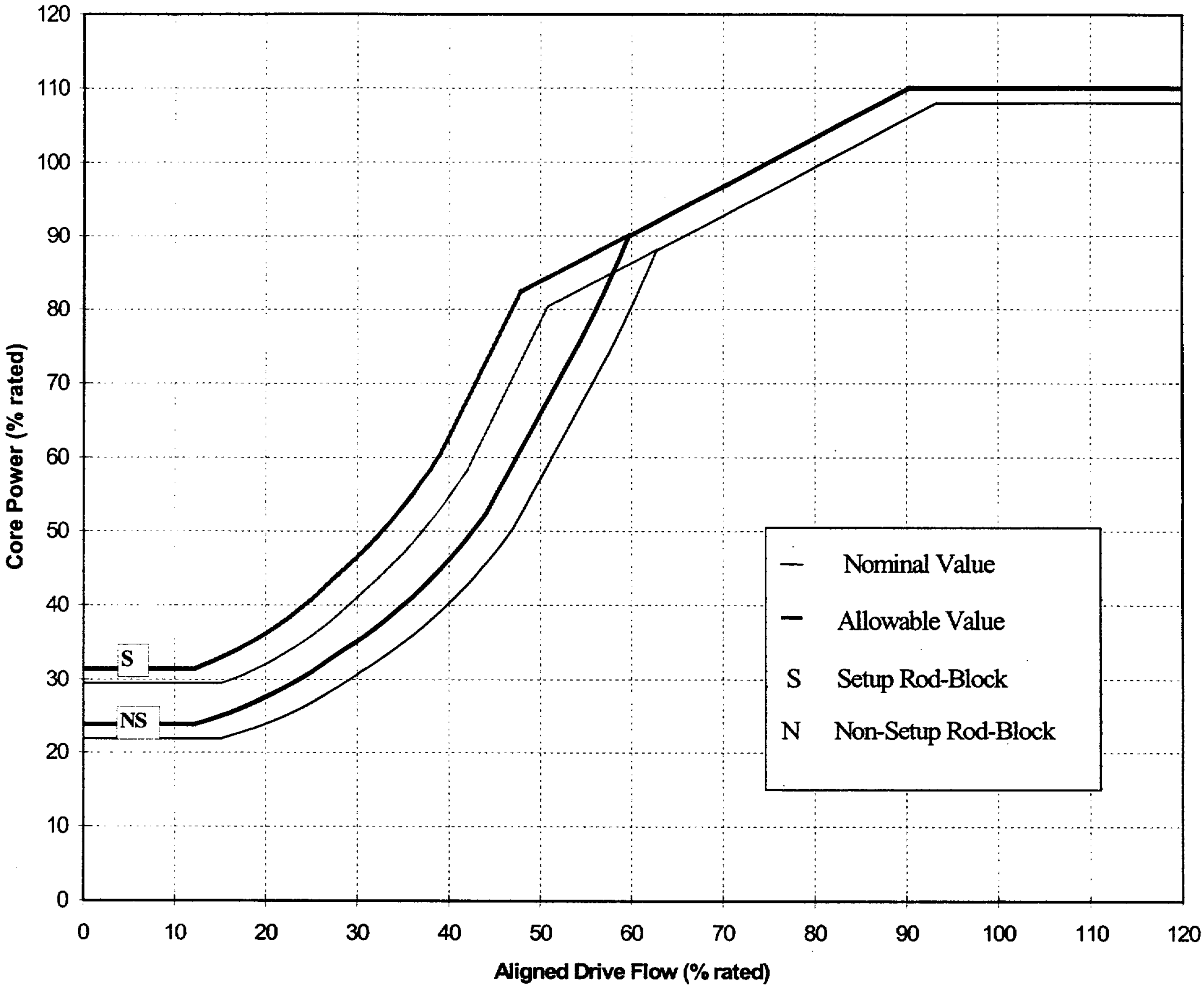


FIGURE 29. APRM FLOW BIASED NEUTRON FLUX - HIGH ROD-BLOCK SETPOINTS

(SINGLE RECIRCULATION LOOP OPERATION - CASE 2)

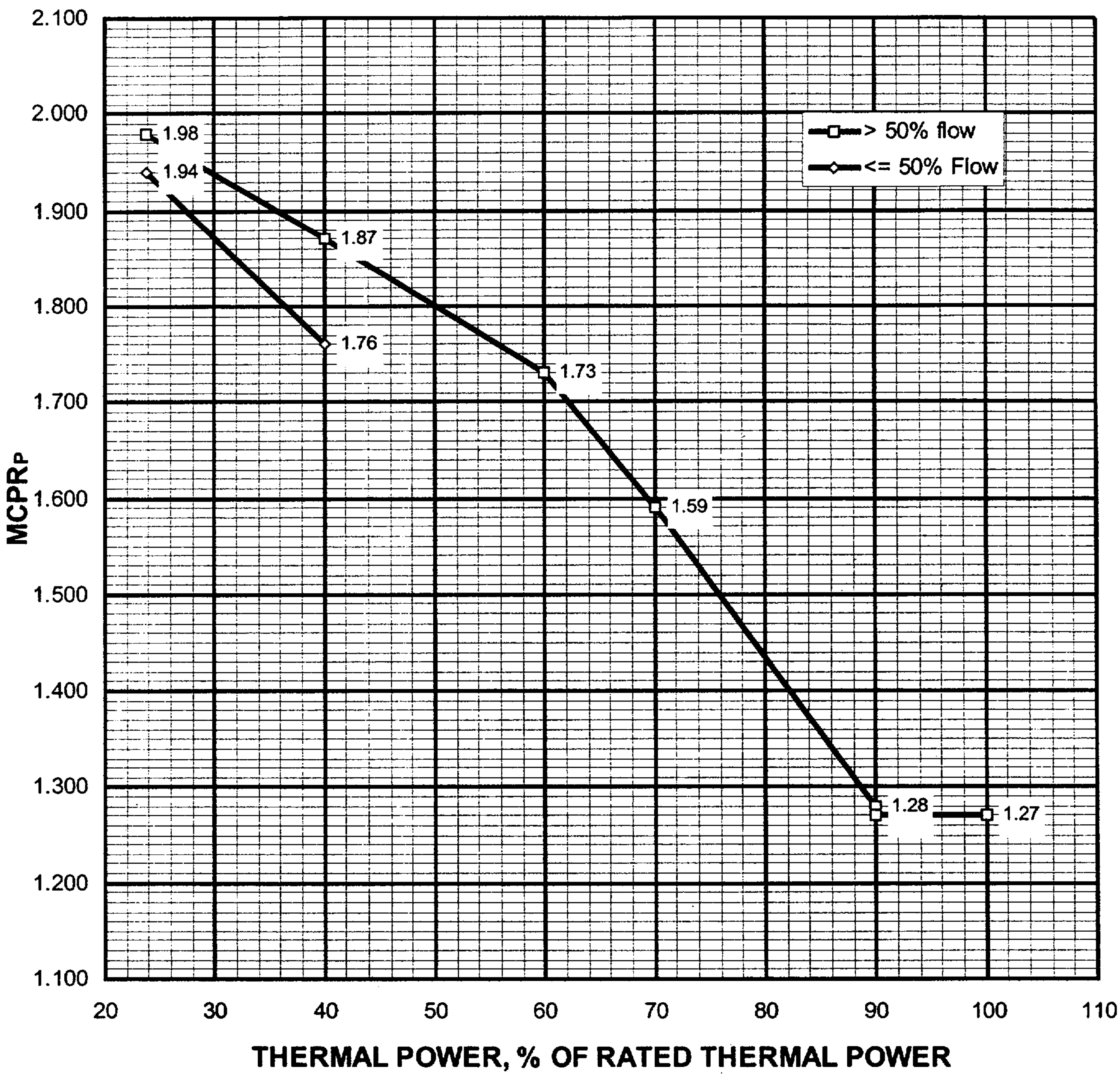


APPENDIX A

One Pressure Regulator Out of Service

Per GESTAR II Amendment 26 (Reference 5), analysis for the pressure regulators – closed event is no longer required for BWR 6 plants with MEOD. Therefore, starting with Reload 9, Cycle 10, the standard pressure regulator – closed event analysis is not required for the determination of the thermal limits. In support of the operation without the backup pressure regulator, MCPR(p) and LHGR(p) with the pressure regulator – closed event are analyzed, and are reported in Appendix A for one pressure regulator out of service. Technical Surveillance Requirements for pressure regulators are discussed in TRM 3.2.5.

FIGURE A1. OPERATING LIMIT MCPR ($MCPR_P$) VERSUS CORE POWER -ONE PRESSURE REGULATOR OUT OF SERVICE*



* These values must be increased by 0.01 during single loop operation.

FIGURE A2. LHGR AND MAPLHGR MULTIPLIER VERSUS THERMAL POWER – ONE PRESSURE REGULATOR OUT OF SERVICE