Progress Energy

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U. S. Nuclear Regulatory Commission
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Subject: Brunswick Steam Electric Plant, Unit No. 1
Docket No. 50-325/License No. DPR-71
Core Operating Limits Report (COLR), Revision 2 for Unit 1, Cycle 15

Ladies and Gentlemen:

In accordance with the requirements of Technical Specification 5.6.5.d, Carolina Power & Light Company, now doing business as Progress Energy Carolinas, Inc. is submitting Revision 2 of the Core Operating Limits Report (COLR) for the Brunswick Steam Electric Plant (BSEP), Unit 1. Technical Specifications 5.6.5.d requires that the Core Operating Limits Report, including any mid cycle revisions or supplements, be provided to the NRC upon issuance.

A copy of the Unit 1, Cycle 15 COLR, October 2005, Revision 2, is provided enclosed. This revision of the Unit 1, Cycle 15 COLR becomes effective on November 15, 2005. The enclosed report was revised in response to General Electric's 10 CFR Part 21 Communication SC04-15, "Turbine Control System Impact on Transient Analyses."

Revision 1 of the COLR for BSEP Unit 1, Cycle 15, was submitted by letter dated June 29, 2005 (i.e., Accession Number ML051890080).

There are no regulatory commitments contained in this letter. Please refer any questions regarding this submittal to Mr. Leonard R. Beller, Supervisor - Licensing/Regulatory Programs, at (910) 457-2073.

Sincerely,

Edward T. O'Neil
Manager - Support Services
Brunswick Steam Electric Plant

A001

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Enclosure: Brunswick Unit 1, Cycle 15 Core Operating Limits Report, October 2005, Revision 2.

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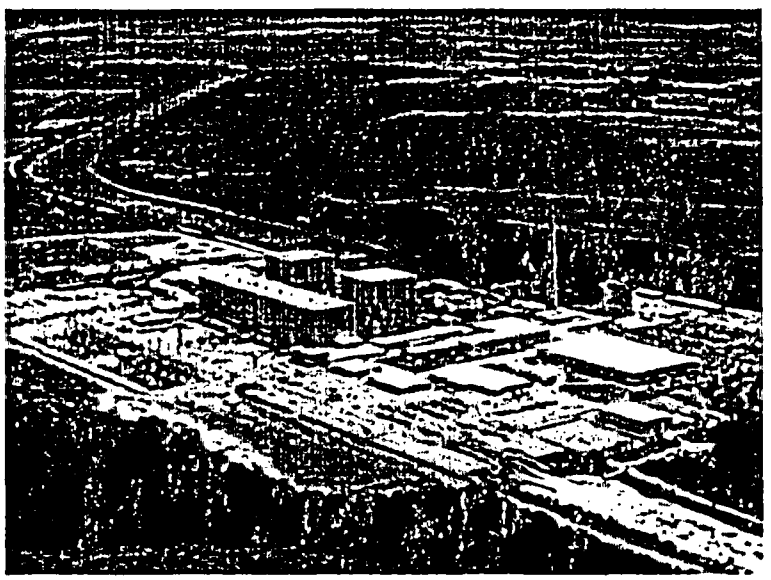
# Brunswick Unit 1, Cycle 15
# Core Operating Limits Report, October 2005, Revision 2

# BRUNSWICK UNIT 1, CYCLE 15

# CORE OPERATING LIMITS REPORT

## October 2005



Prepared By: Mourad Aissa Date: 10-25-05
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## LIST OF EFFECTIVE PAGES

| Page(s) | Revision |
|---|---|
| 1-2 | 2 |
| 3-6 | 0 |
| 7 | 2 |
| 8 | 0 |
| 9 | 2 |
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| 12 | 1 |
| 13-21 | 0 |
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**CAUTION**

References to COLR Figures or Tables should be made using titles only; figure and table numbers may change from cycle to cycle.

## LIST OF TABLES



## LIST OF FIGURES

## Introduction and Summary

**CAUTION**

References to COLR Figures or Tables should be made using titles only; figure and table numbers may change from cycle to cycle.

This COLR revision was performed to support Brunswick Unit 1, Cycle 15 operation at up to 2923 MWt. The main changes are those associated with the thermal limits and Power-Flow maps. This report provides the values of the power distribution limits and control rod withdrawal block instrumentation setpoints for Brunswick Unit 1, Cycle 15 as required by TS 5.6.5.

| OPERATING LIMIT | REQUIREMENT |
|---|---|
| Average Planar Linear Heat Generation Rate (APLHGR) limits (with associated core flow and core power adjustment factors) | TS 5.6.5.a.1 |
| Minimum Critical Power Ratio (MCPR) limits (with associated core flow and core power adjustment factors) | TS 5.6.5.a.2 |
| Period Based Detection Algorithm (PBDA) Setpoint for Function 2.f of TS 3.3.1.1, Oscillation Power Range Monitor (OPRM) | TS 5.6.5.a.3 |
| Allowable Values and power range setpoints for Rod Block Monitor Upscale Functions of TS 3.3.2.1 | TS 5.6.5.a.4 |

Per TS 5.6.5.b and 5.6.5.c, these values have been determined using NRC approved methodology and are established such that all applicable limits of the plant safety analysis are met. The limits specified in this report support single loop operation (SLO) as required by TS LCO 3.4.1 and inoperable Main Turbine Bypass System as required by TS 3.7.6.

In order to support the Stability Option III with an inoperable OPRM scram function, the following is also included in this report:

| OPERATING LIMIT | REQUIREMENT |
|---|---|
| BWROG Interim Corrective Action Stability Regions | TS 3.3.1.1 LCO Condition I |

This report conforms to Quality Assurance requirements as specified in Reference 1.

## Single Loop Operation

Brunswick Unit 1, Cycle 15 may operate over the entire MEOD range with Single Recirculation Loop Operation (SLO) as permitted by TS 3.4.1 with applicable limits specified in the COLR for TS LCO's 3.2.1, and 3.2.2. The applicable limits are:

LCO 3.2.1, Average Planar Linear Heat Generation Rate (APLHGR) Limits: per Reference 1, the Figures 9 and10 described in the APLHGR Limits section below include a SLO limitation of 0.8 on the MAPLHGR(F) and MAPLHGR(P) multipliers.

LCO 3.2.2, Minimum Critical Power Ratio (MCPR) Limits: per Reference 1, Table 1 and Figures 11 and 12, the MCPR limits presented apply to SLO without modification.

Various indicators on the Power/Flow maps are provided not as operating limits but rather as a convenience for the operators: a single loop operation (SLO) Entry Rod Line is shown on the two loop operation maps to avoid regions of instability in the event of a pump trip; a maximum core flow line is shown on the single loop operation maps to avoid vibration problems; and APRM STP Scram and Rod Block nominal trip setpoint limits are shown at the estimated core flow corresponding to the actual drive flow-based setpoints to indicate where the operator may encounter these setpoints (LCO 3.3.1.1, Reactor Protection System Instrumentation Function 2.b (Average Power Range Monitors Simulated Thermal Power - High Allowable Value).

## Inoperable Main Turbine Bypass System

Brunswick Unit 1, Cycle 15 may operate with an inoperable Main Turbine Bypass System in accordance with TS 3.7.6 with applicable limits specified in the COLR for TS LCO 3.2.1 and 3.2.2. Two or more bypass valves inoperable renders the System inoperable, although the Turbine Bypass Out-of-Service (TBPOOS) analysis supports operation with all bypass valves inoperable for the entire MEOD range and up to 110°F rated equivalent feedwater temperature reduction. The system response time assumed by the safety analyses from event initiation to start of bypass valve opening is 0.10 seconds, with 80% of the bypass flow capacity achieved in 0.30 seconds. The applicable limits are as follows:

LCO 3.2.1, Average Planar Linear Heat Generation Rate (APLHGR) Limits: in accordance with Reference 1 as shown in Figure 10, TBPOOS does not require an additional reduction in the MAPLGHR(P) limits, as the Turbine Bypass Operable and Inoperable limits are identical.

LCO 3.2.2, Minimum Critical Power Ratio (MCPR) Limits: in accordance with Reference 1, TBPOOS does not require an additional increase in the MCPR(P) multiplier as shown in Figure 12, as the Turbine Bypass Operable and Inoperable limits are identical. TBPOOS requires increased MCPR limits, included in Table 1.

## Feedwater Temperature Reduction

A variation within 10°F of nominal feedwater temperature has been evaluated as in compliance with normal operating limits. A feedwater temperature reduction of > 10°F requires the use of FWTR MCPR limits (Table 1) and Stability Option III limits (Figures 17 and 18).

## APLHGR Limits

The limiting APLHGR value for the most limiting lattice (excluding natural uranium) of each fuel type as a function of planar average exposure is given in Figures 1 through 8. These values were determined with the SAFER/GESTR LOCA methodology described in GESTAR-II (Reference 2). Figures 1 through 8 are to be used only when hand calculations are required as specified in the bases for TS 3.2.1. Hand calculated results may not match a POWERPLEX calculation since normal monitoring of the APLHGR limits with POWERPLEX uses the complete set of lattices for each fuel type provided in Reference 3. The core flow and core power adjustment factors for use in TS 3.2.1 are presented in Figures 9 and 10. For any given flow/power state, the minimum of MAPLHGR(F) determined from Figure 9 and MAPLHGR(P) determined from Figure 10 is used to determine the governing limit. Figure 10 was revised to include limits derived from Reference 11 for the power range $23\% \leq P < 40\%$.

## MCPR Limits

The Scram Speed MCPR OPTION A, OPTION B, and non-pressurization transient MCPR limits for use in TS 3.2.2 for each fuel type as a function of cycle average exposure are given in Table 1. These values were determined with the GEMINI(TRACG) methodology and GEXL-PLUS critical power correlation described in GESTAR-II (Reference 2), and are consistent with a Safety Limit MCPR of 1.11 specified by TS 2.1.1.2. The core flow and core power adjustment factors for use in TS 3.2.2 are presented in Figures 11 and 12. For any given power/flow state, the maximum of MCPR(F) determined from Figure 11 and MCPR(P) determined from Figure 12 is used to determine the governing limit. Figure 12 was revised to include limits derived from Reference 11 for the power range $23\% \leq P < 40\%$. All MCPR limits presented in Table 1, Figure 11 and Figure 12 apply to two recirculation pump operation and SLO without modification.

## RBM Rod Block Instrumentation Setpoints

The nominal trip setpoints and allowable values of the control rod withdrawal block instrumentation for use in TS 3.3.2.1 (Table 3.3.2.1-1) are presented in Table 2. These values were determined to be consistent with the bases of the ARTS program and the determination of MCPR limits with the GEMINI(TRACG) methodology and the GEXL-PLUS critical power correlation described in GESTAR-II (Reference 2). Reference 8 revised certain of these setpoints to reflect changes associated with the installation of the NUMAC PRNM system. The table also includes information

regarding required operability of the RBM, consistent with Technical Specification Table 3.3.2.1-1.

**Stability Option III**

Brunswick Unit 1 has implemented BWROG Long Term Stability Solution Option III (Oscillation Power Range Monitor-OPRM) with the methodology described in Reference 4. Plant specific analysis incorporating the Option III hardware is described in Reference 5. Reload validation has been performed in accordance with Reference 6. The resulting stability based MCPR Operating Limit is provided for two conditions as a function of OPRM amplitude setpoint in Table 3. If desirable, Table 3 would support higher stability limits for various MCPR operating limits greater than the least limiting Table 1 AOO OLMCPR values, but the suggested stability setpoints are bounded by Table 1. Table 3 shows that OLMCPR(SS) is never as limiting as Figure 11 for any listed OPRM setpoint (Amplitude Setpoint $S_p$). Table 3 also shows that OLMCPR(2PT) is never as limiting as Table 1 for an OPRM setpoint of 1.13. Therefore the OPRM PBDA setpoint limit referenced by function 2.f of Table 3.3.1.1-1 of Technical Specification 3.3.1.1 is 1.13 for Cycle 15. Per Table 3-2 of Reference 6, an $S_p$ value of 1.13 supports selection of a Confirmation Count Setpoint $N_p$ of 15 or less.

Six Power/Flow maps for use at up to 2923 MWt (Figures 13-18) were developed based on References 1 and 7 to facilitate operation under Stability Option III as implemented by function 2.f of Table 3.3.1.1-1 and LCO Condition I of Technical Specification 3.3.1.1. All six maps illustrate the region of the power/flow map above 25% power and below 60% flow where the system is required to be enabled.

The maps supporting an operable OPRM function 2.f (Figures 13, 15 and 17) show a Scram Avoidance Region, which is not a licensing requirement but is an operator aid to illustrate where the OPRM system may generate a scram to avoid an instability event. Figures 13 and 15 differ only in that the Figure 15 that supports SLO, indicates the maximum allowable core flow at 45 Mlbs/hr, and has the Simulated Thermal Power (STP) scram and rod block limits appropriately reduced for SLO. Note that the STP scram and rod block limits are defined in Technical Specifications, the Technical Requirements Manual, and Plant procedures, and are included in the COLR as an operator aid rather than a licensing requirement. Figure 17 differs from Figure 13 by extending the existing regions to provide additional stability protection during FWTR. Intentional operation with SLO and FWTR is prohibited.

The maps (Figures 14 and 16) supporting an inoperable OPRM function 2.f show the BWROG-94078 Interim Corrective Actions stability regions required to support LCO Condition I. Both figures also include a 5% Buffer Region around the Immediate Exit Region as an operator aid. Figures 14 and 16 differ only in that the Figure 16 that supports SLO, indicates the maximum allowable core flow at 45 Mlbs/hr, and has the STP scram and rod block limits appropriately reduced for SLO. Figure 18 differs from Figure 14 by extending the existing regions to provide additional stability protection during FWTR. Intentional operation with SLO and FWTR is prohibited.

## References

1) BNP Design Calculation 1B21-0625; "Preparation of the B1C15 Core Operating Limits Report," Revision 2, October 2005.

2) NEDE-24011-P-A; "General Electric Standard Application for Reactor Fuel," (latest approved version).

3) NEDC-31624P, "Loss-of-Coolant Accident Analysis Report for Brunswick Steam Electric Plant Unit 1 Reload 14 Cycle 15," Supplement 1, Revision 8, February 2004.

4) NEDO-31960-A, "BWR Owners Group Long-Term Stability Solutions Licensing Methodology," November 1995.

5) GE-NE-C51-00251-00-01, Revision 0, "Licensing Basis Hot Bundle Oscillation Magnitude for Brunswick 1 and 2," March 2001.

6) NEDO-32465-A, "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Application," August 1996.

7) Design Calculation 0B21-1015, Revision 2, "BNP Power/Flow Maps for Stability Option III," July 2003.

8) Design Calculation 1C51-0001 Revision 2, "BNP Power Range Neutron Monitoring System Setpoint Uncertainty and Scaling Calculation (1-C51-APRM 1 through 4 Loops and 1-C51-RBM-A and B Loops," October 2003.

9) NEDE-32906P-A, Revision 1, "TRACG Application for Anticipated Operational Occurrences (AOO) Transient Analyses," April 2003.

10) GE-NE-0000-0022-8180-R0, "Brunswick Nuclear Station TRACG Implementation for Reload Licensing Transient Analysis," February 2004.

11) GE-NE-0000-0036-9469-R0, Revision 0, "Brunswick 1 and 2 Off-Rated Analyses Below the PLU Power Level," June 2005.

# Table 1

## MCPR Limits

| Non-pressurization Transient MCPR Limits | |
|---|---|
| Fuel Type | Exposure Range: BOC - EOC |
| GE13 & GE14 | 1.28 |

| Pressurization Transient MCPR Limits | | | | | |
|---|---|---|---|---|---|
| Turbine Bypass System Operable? | Feedwater Temperature Normal? | Fuel Type | Scram Speed MCPR Option | 100% Power OLMCPR | |
| | | | | Exposure Range: BOC to EOFPC-5029 MWd/MT | Exposure Range: EOFPC-5029 MWd/MT to EOC |
| Operable | Normal | GE13 & GE14 | A | 1.51 | 1.56 |
| | | | B | 1.33 | 1.38 |
| Operable | Reduced | GE13 & GE14 | A | 1.51 | 1.56 |
| | | | B | 1.33 | 1.38 |
| Inoperable | Normal | GE13 & GE14 | A | 1.60 | 1.60 |
| | | | B | 1.42 | 1.42 |
| Inoperable | Reduced | GE13 & GE14 | A | 1.66 | 1.66 |
| | | | B | 1.48 | 1.48 |

This Table is referred to by Technical Specifications 3.2.2, 3.4.1 and 3.7.6.

# Table 2

## RBM System Setpoints

| Setpoint[a] | Trip Setpoint | Allowable Value |
|---|---|---|
| Lower Power Setpoint (LPSP[b]) | 27.7 | ≤ 29.0 |
| Intermediate Power Setpoint (IPSP[b]) | 62.7 | ≤ 64.0 |
| High Power Setpoint (HPSP[b]) | 82.7 | ≤ 84.0 |
| Low Trip Setpoint (LTSP[c]) | ≤ 114.1 | ≤ 114.6 |
| Intermediate Trip Setpoint (ITSP[c]) | ≤ 108.3 | ≤ 108.8 |
| High Trip Setpoint (HTSP[c]) | ≤ 104.5 | ≤ 105.0 |
| RBM Time Delay ($t_{d2}$) | ≤ 2.0 seconds | ≤ 2.0 seconds |

[a] RBM Operability requirements are not applicable:
(1) if MCPR ≥ 1.70; or
(2) if MCPR ≥ 1.45 and thermal power ≥ 90% Rated Thermal Power.

[b] Setpoints in percent of Rated Thermal Power.

[c] Setpoints relative to a full scale reading of 125.
For example, ≤ 114.1 means ≤ 114.1/125.0 of full scale.

This Table is referred to by Technical Specification 3.3.2.1 (Table 3.3.2.1-1).

# Table 3

## PBDA Setpoints

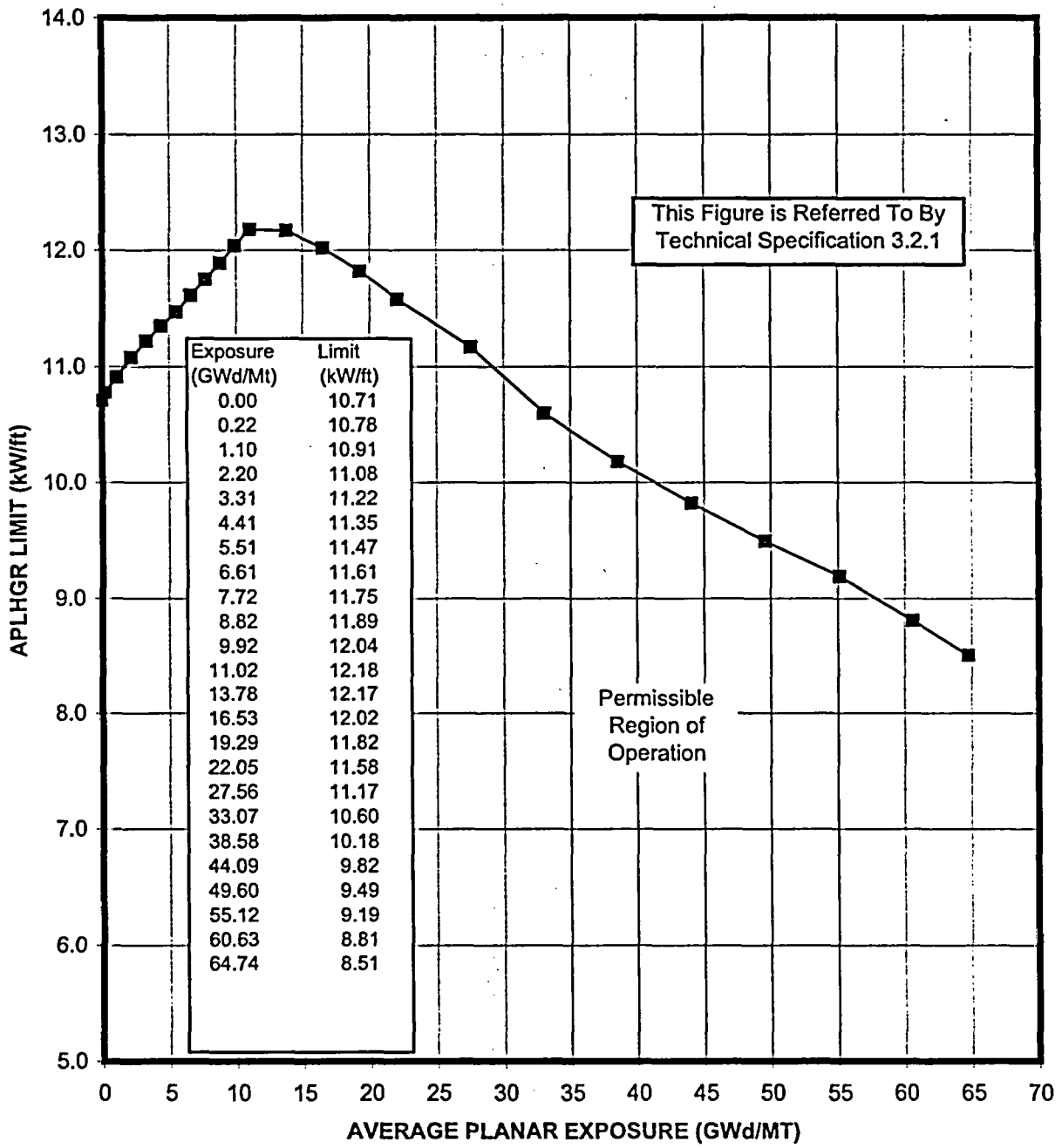
| OPRM Setpoint | OLMCPR(SS) | OLMCPR(2PT) |
|---|---|---|
| 1.05 | 1.2375 | 1.0925 |
| 1.06 | 1.2651 | 1.1169 |
| 1.07 | 1.2940 | 1.1424 |
| 1.08 | 1.3243 | 1.1691 |
| 1.09 | 1.3559 | 1.1971 |
| 1.10 | 1.3892 | 1.2264 |
| 1.11 | 1.4224 | 1.2558 |
| 1.12 | 1.4573 | 1.2866 |
| **1.13** | **1.4940** | **1.3190** |
| 1.14 | 1.5325 | 1.3530 |
| 1.15 | 1.5731 | 1.3888 |
| Acceptance Criteria | Off-rated OLMCPR @ 45% Flow | Rated Power OLMCPR |

| PDBA Setpoint | Setpoint Value | | |
|---|---|---|---|
| **Amplitude $S_p$** | **1.13** | 1.14 | 1.15 |
| **Confirmation Count $N_p$** | **15** | 16 | 16 |

This Table is referred to by Technical Specification 3.3.1.1 (Table 3.3.1.1-1).

## Figure 1

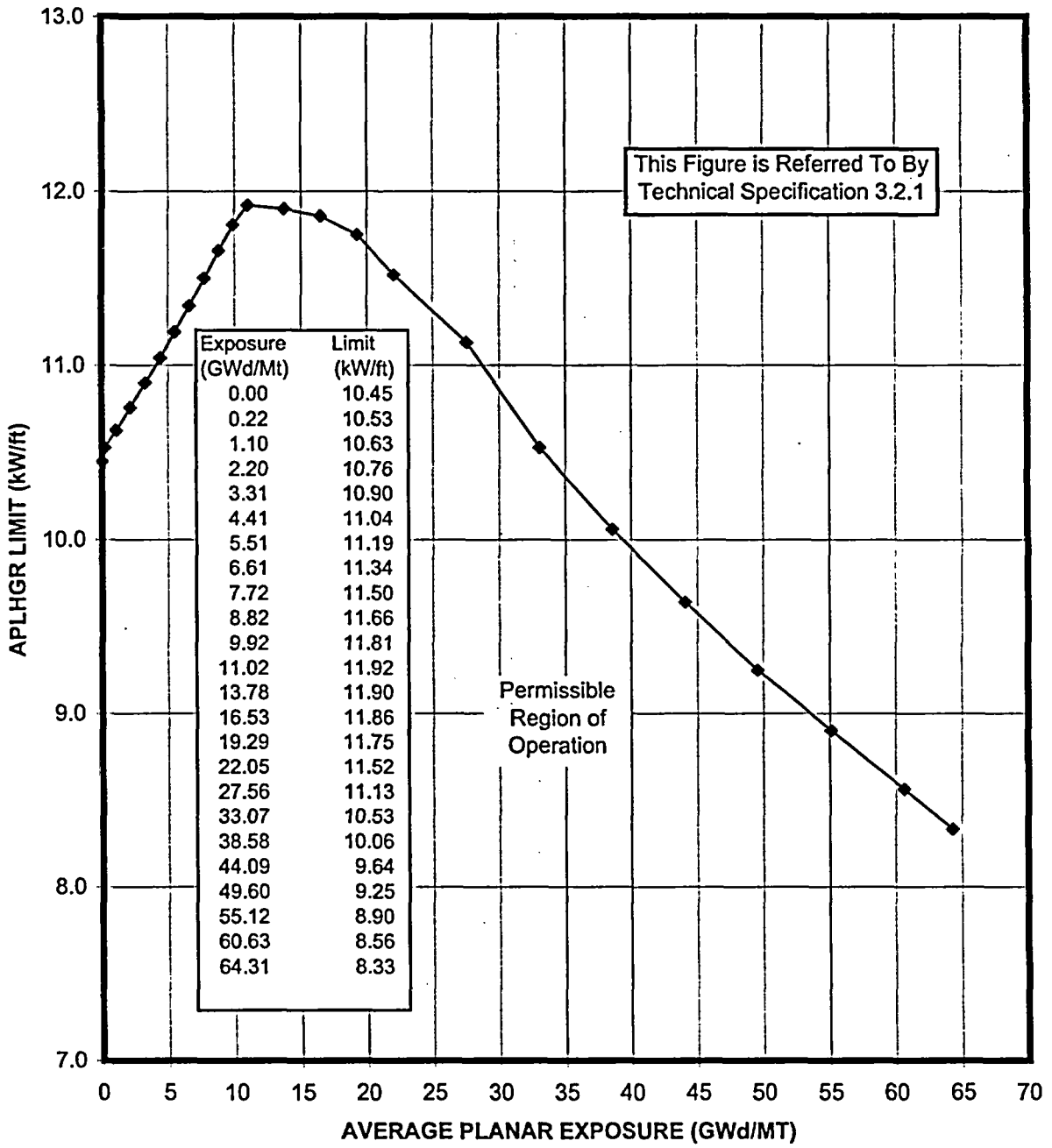
### Fuel Type GE13-P9DTB405-5G6.0/7G5.0-100T-146-T-2378 (GE13)
### Average Planar Linear Heat Generation Rate (APLHGR) Limit
### Versus Average Planar Exposure




| Exposure (GWd/Mt) | Limit (kW/ft) |
|---|---|
| 0.00 | 10.71 |
| 0.22 | 10.78 |
| 1.10 | 10.91 |
| 2.20 | 11.08 |
| 3.31 | 11.22 |
| 4.41 | 11.35 |
| 5.51 | 11.47 |
| 6.61 | 11.61 |
| 7.72 | 11.75 |
| 8.82 | 11.89 |
| 9.92 | 12.04 |
| 11.02 | 12.18 |
| 13.78 | 12.17 |
| 16.53 | 12.02 |
| 19.29 | 11.82 |
| 22.05 | 11.58 |
| 27.56 | 11.17 |
| 33.07 | 10.60 |
| 38.58 | 10.18 |
| 44.09 | 9.82 |
| 49.60 | 9.49 |
| 55.12 | 9.19 |
| 60.63 | 8.81 |
| 64.74 | 8.51 |

## Figure 2

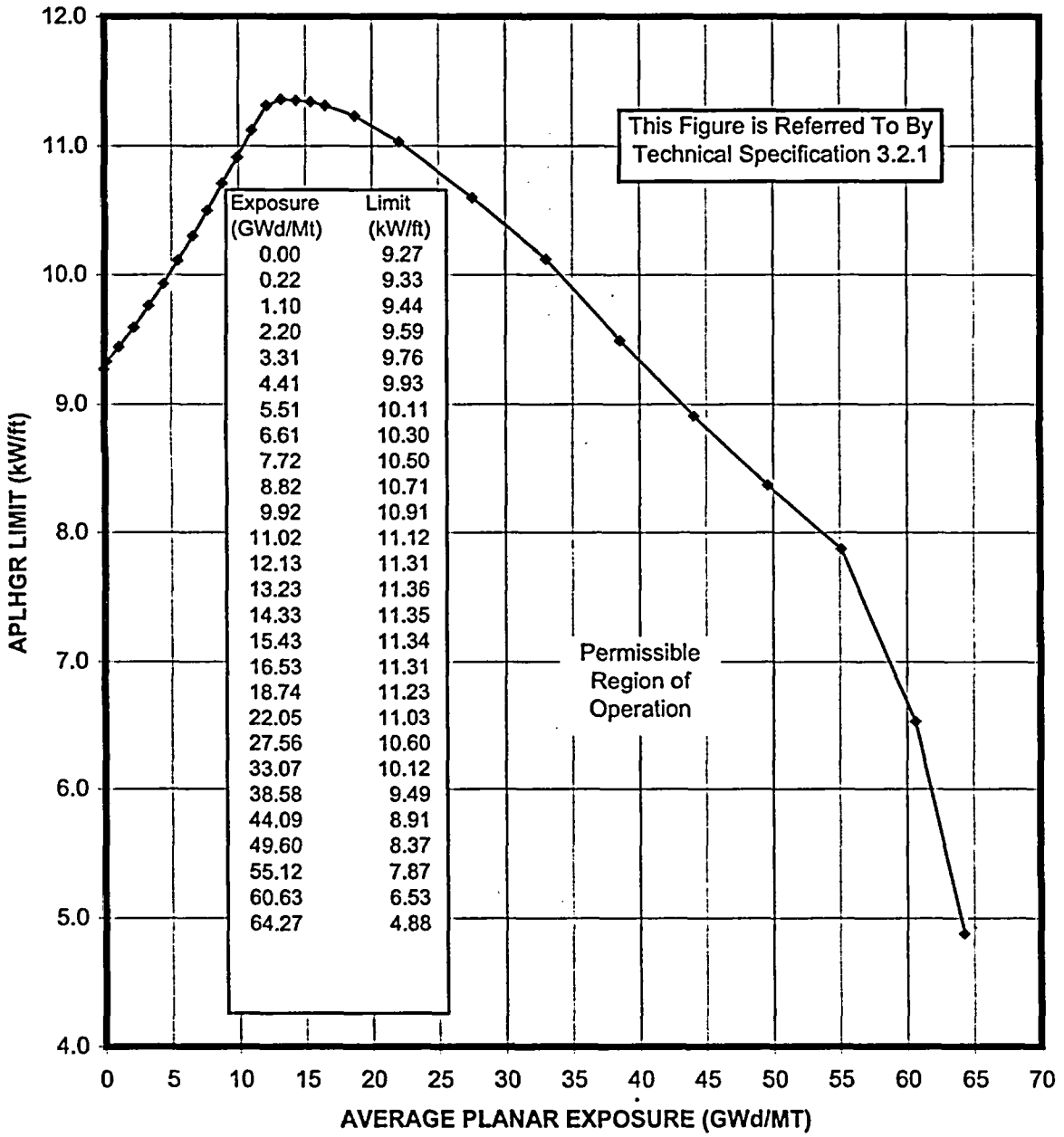
### Fuel Type GE13-P9DTB402-13G6.0/1G2.0-100T-146-T-2379 (GE13) Average Planar Linear Heat Generation Rate (APLHGR) Limit Versus Average Planar Exposure




| Exposure (GWd/Mt) | Limit (kW/ft) |
|---|---|
| 0.00 | 10.45 |
| 0.22 | 10.53 |
| 1.10 | 10.63 |
| 2.20 | 10.76 |
| 3.31 | 10.90 |
| 4.41 | 11.04 |
| 5.51 | 11.19 |
| 6.61 | 11.34 |
| 7.72 | 11.50 |
| 8.82 | 11.66 |
| 9.92 | 11.81 |
| 11.02 | 11.92 |
| 13.78 | 11.90 |
| 16.53 | 11.86 |
| 19.29 | 11.75 |
| 22.05 | 11.52 |
| 27.56 | 11.13 |
| 33.07 | 10.53 |
| 38.58 | 10.06 |
| 44.09 | 9.64 |
| 49.60 | 9.25 |
| 55.12 | 8.90 |
| 60.63 | 8.56 |
| 64.31 | 8.33 |

## Figure 3

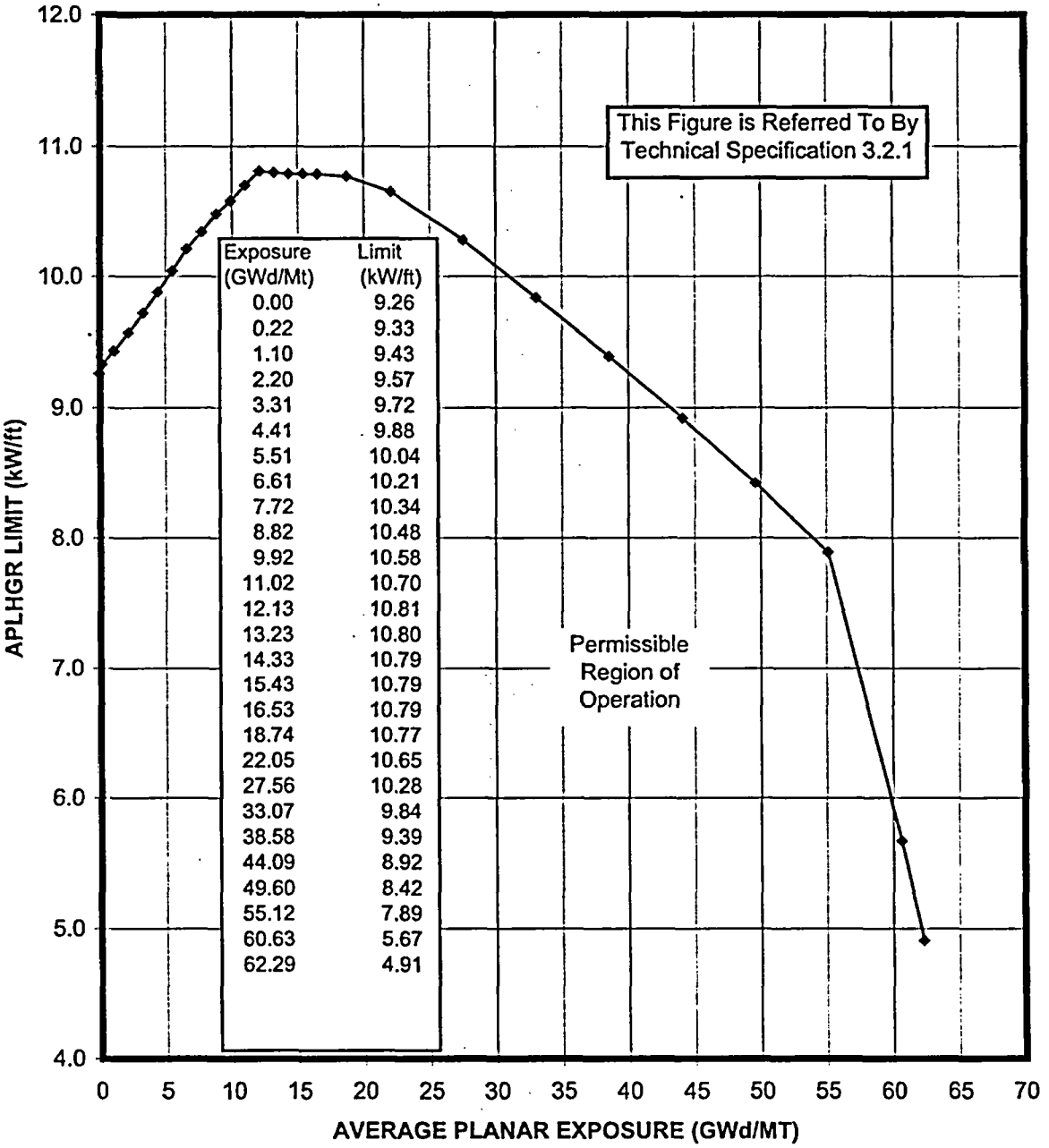
### Fuel Type GE14-P10DNAB416-17GZ-100T-150-T-2496 (GE14) Average Planar Linear Heat Generation Rate (APLHGR) Limit Versus Average Planar Exposure




| Exposure (GWd/Mt) | Limit (kW/ft) |
|---|---|
| 0.00 | 9.27 |
| 0.22 | 9.33 |
| 1.10 | 9.44 |
| 2.20 | 9.59 |
| 3.31 | 9.76 |
| 4.41 | 9.93 |
| 5.51 | 10.11 |
| 6.61 | 10.30 |
| 7.72 | 10.50 |
| 8.82 | 10.71 |
| 9.92 | 10.91 |
| 11.02 | 11.12 |
| 12.13 | 11.31 |
| 13.23 | 11.36 |
| 14.33 | 11.35 |
| 15.43 | 11.34 |
| 16.53 | 11.31 |
| 18.74 | 11.23 |
| 22.05 | 11.03 |
| 27.56 | 10.60 |
| 33.07 | 10.12 |
| 38.58 | 9.49 |
| 44.09 | 8.91 |
| 49.60 | 8.37 |
| 55.12 | 7.87 |
| 60.63 | 6.53 |
| 64.27 | 4.88 |

## Figure 4

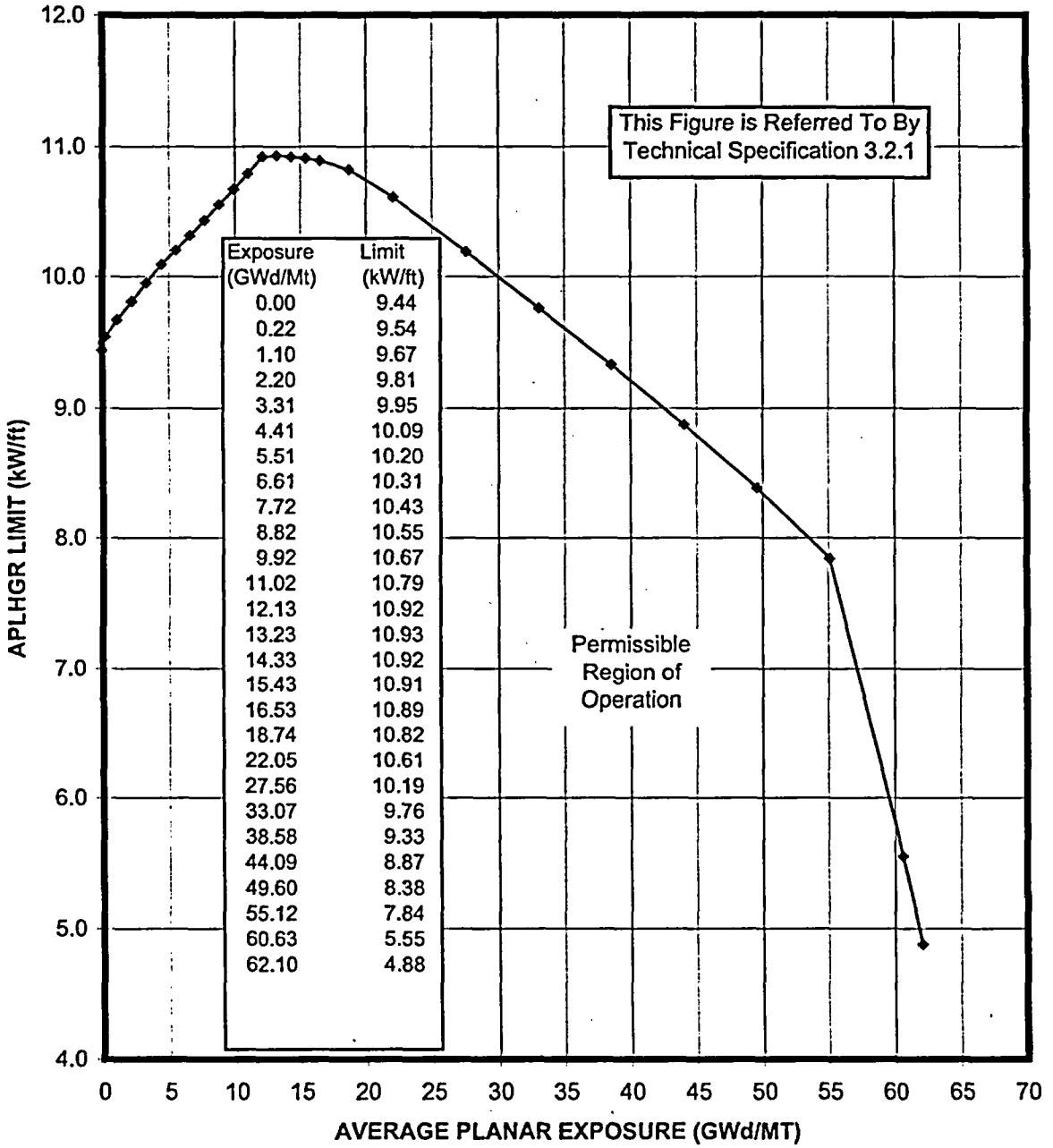
### Fuel Type GE14-P10DNAB425-16GZ-100T-150-T-2497 (GE14) Average Planar Linear Heat Generation Rate (APLHGR) Limit Versus Average Planar Exposure




| Exposure (GWd/Mt) | Limit (kW/ft) |
|---|---|
| 0.00 | 9.26 |
| 0.22 | 9.33 |
| 1.10 | 9.43 |
| 2.20 | 9.57 |
| 3.31 | 9.72 |
| 4.41 | 9.88 |
| 5.51 | 10.04 |
| 6.61 | 10.21 |
| 7.72 | 10.34 |
| 8.82 | 10.48 |
| 9.92 | 10.58 |
| 11.02 | 10.70 |
| 12.13 | 10.81 |
| 13.23 | 10.80 |
| 14.33 | 10.79 |
| 15.43 | 10.79 |
| 16.53 | 10.79 |
| 18.74 | 10.77 |
| 22.05 | 10.65 |
| 27.56 | 10.28 |
| 33.07 | 9.84 |
| 38.58 | 9.39 |
| 44.09 | 8.92 |
| 49.60 | 8.42 |
| 55.12 | 7.89 |
| 60.63 | 5.67 |
| 62.29 | 4.91 |

## Figure 5

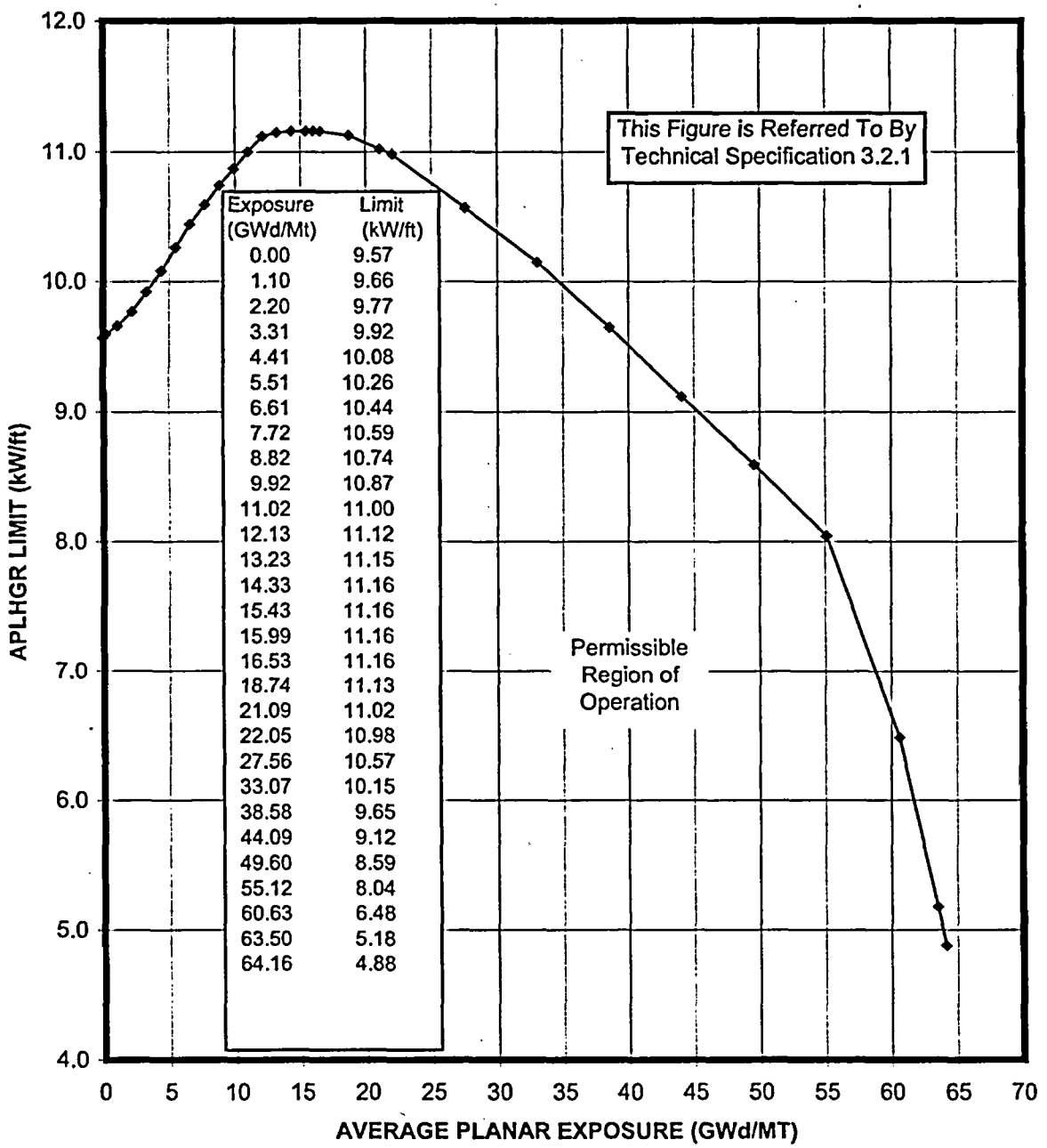
### Fuel Type GE14-P10DNAB438-12G6.0-100T-150-T-2498 (GE14) Average Planar Linear Heat Generation Rate (APLHGR) Limit Versus Average Planar Exposure




| Exposure (GWd/Mt) | Limit (kW/ft) |
|---|---|
| 0.00 | 9.44 |
| 0.22 | 9.54 |
| 1.10 | 9.67 |
| 2.20 | 9.81 |
| 3.31 | 9.95 |
| 4.41 | 10.09 |
| 5.51 | 10.20 |
| 6.61 | 10.31 |
| 7.72 | 10.43 |
| 8.82 | 10.55 |
| 9.92 | 10.67 |
| 11.02 | 10.79 |
| 12.13 | 10.92 |
| 13.23 | 10.93 |
| 14.33 | 10.92 |
| 15.43 | 10.91 |
| 16.53 | 10.89 |
| 18.74 | 10.82 |
| 22.05 | 10.61 |
| 27.56 | 10.19 |
| 33.07 | 9.76 |
| 38.58 | 9.33 |
| 44.09 | 8.87 |
| 49.60 | 8.38 |
| 55.12 | 7.84 |
| 60.63 | 5.55 |
| 62.10 | 4.88 |

## Figure 6

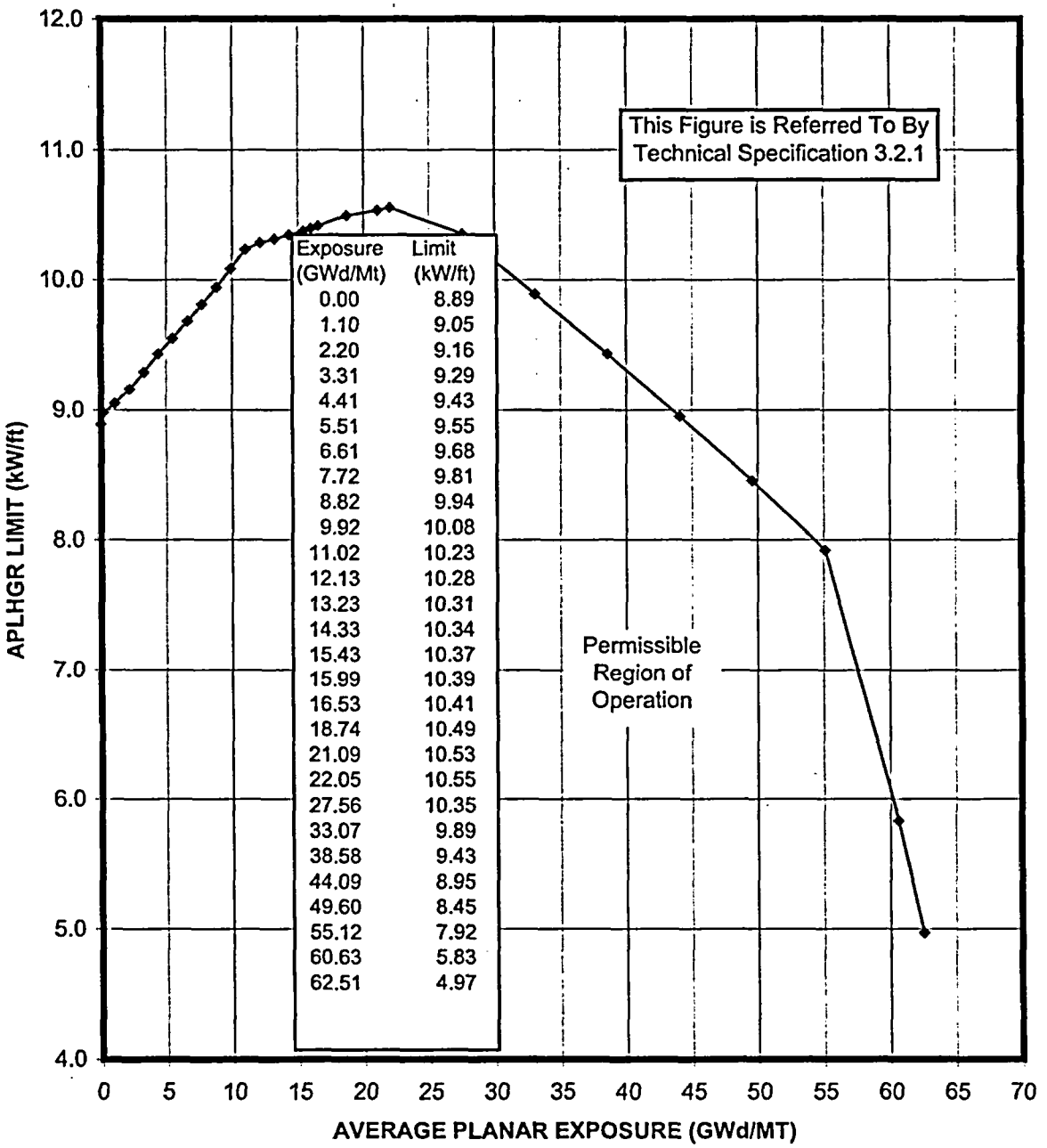
### Fuel Type GE14-P10DNAB413-16GZ-100T-150-T-2660 (GE14) Average Planar Linear Heat Generation Rate (APLHGR) Limit Versus Average Planar Exposure




| Exposure (GWd/Mt) | Limit (kW/ft) |
|---|---|
| 0.00 | 9.57 |
| 1.10 | 9.66 |
| 2.20 | 9.77 |
| 3.31 | 9.92 |
| 4.41 | 10.08 |
| 5.51 | 10.26 |
| 6.61 | 10.44 |
| 7.72 | 10.59 |
| 8.82 | 10.74 |
| 9.92 | 10.87 |
| 11.02 | 11.00 |
| 12.13 | 11.12 |
| 13.23 | 11.15 |
| 14.33 | 11.16 |
| 15.43 | 11.16 |
| 15.99 | 11.16 |
| 16.53 | 11.16 |
| 18.74 | 11.13 |
| 21.09 | 11.02 |
| 22.05 | 10.98 |
| 27.56 | 10.57 |
| 33.07 | 10.15 |
| 38.58 | 9.65 |
| 44.09 | 9.12 |
| 49.60 | 8.59 |
| 55.12 | 8.04 |
| 60.63 | 6.48 |
| 63.50 | 5.18 |
| 64.16 | 4.88 |

## Figure 7

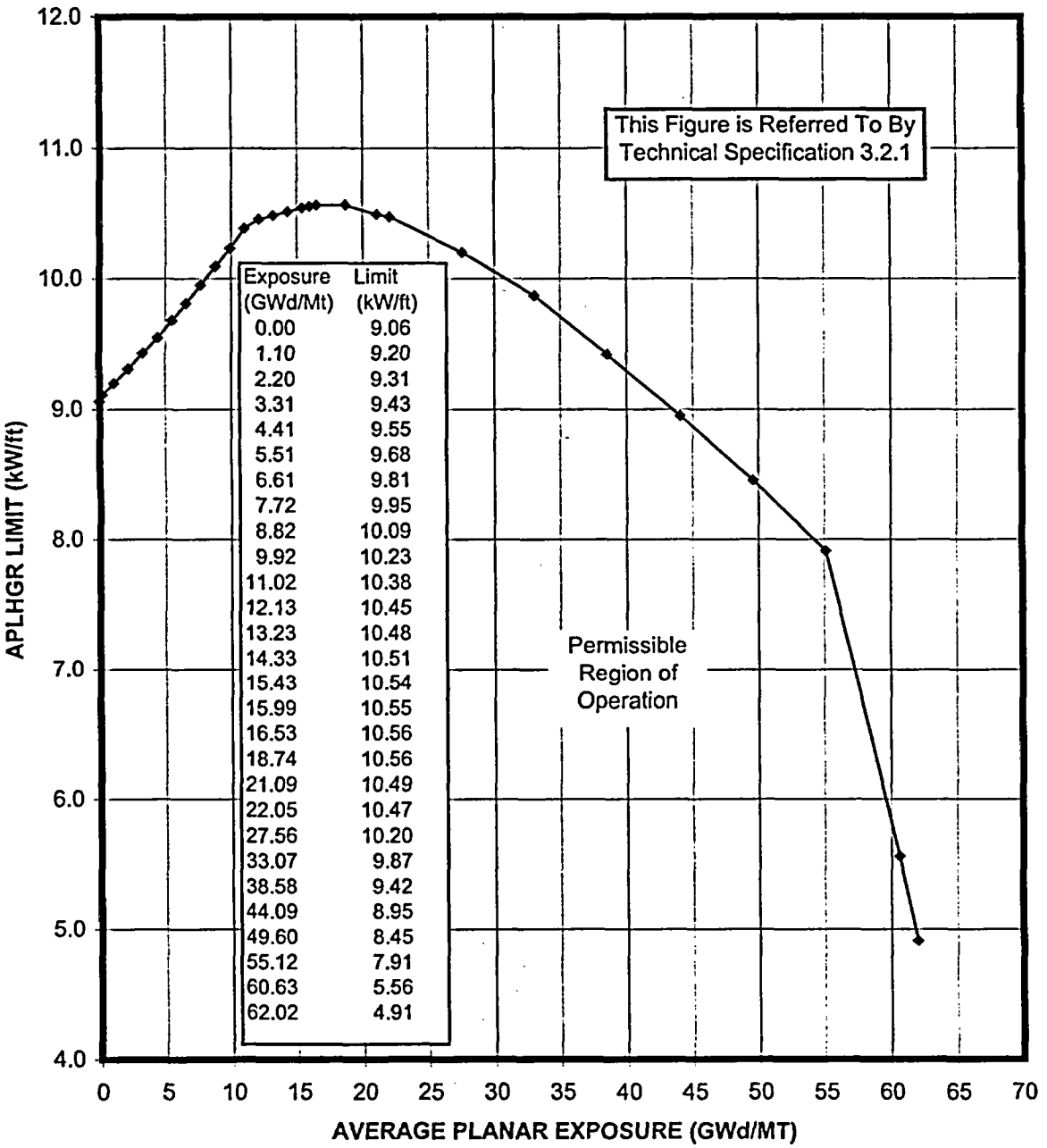
### Fuel Type GE14-P10DNAB429-18GZ-100T-150-T-2661 (GE14) Average Planar Linear Heat Generation Rate (APLHGR) Limit Versus Average Planar Exposure




| Exposure (GWd/Mt) | Limit (kW/ft) |
|---|---|
| 0.00 | 8.89 |
| 1.10 | 9.05 |
| 2.20 | 9.16 |
| 3.31 | 9.29 |
| 4.41 | 9.43 |
| 5.51 | 9.55 |
| 6.61 | 9.68 |
| 7.72 | 9.81 |
| 8.82 | 9.94 |
| 9.92 | 10.08 |
| 11.02 | 10.23 |
| 12.13 | 10.28 |
| 13.23 | 10.31 |
| 14.33 | 10.34 |
| 15.43 | 10.37 |
| 15.99 | 10.39 |
| 16.53 | 10.41 |
| 18.74 | 10.49 |
| 21.09 | 10.53 |
| 22.05 | 10.55 |
| 27.56 | 10.35 |
| 33.07 | 9.89 |
| 38.58 | 9.43 |
| 44.09 | 8.95 |
| 49.60 | 8.45 |
| 55.12 | 7.92 |
| 60.63 | 5.83 |
| 62.51 | 4.97 |

## Figure 8

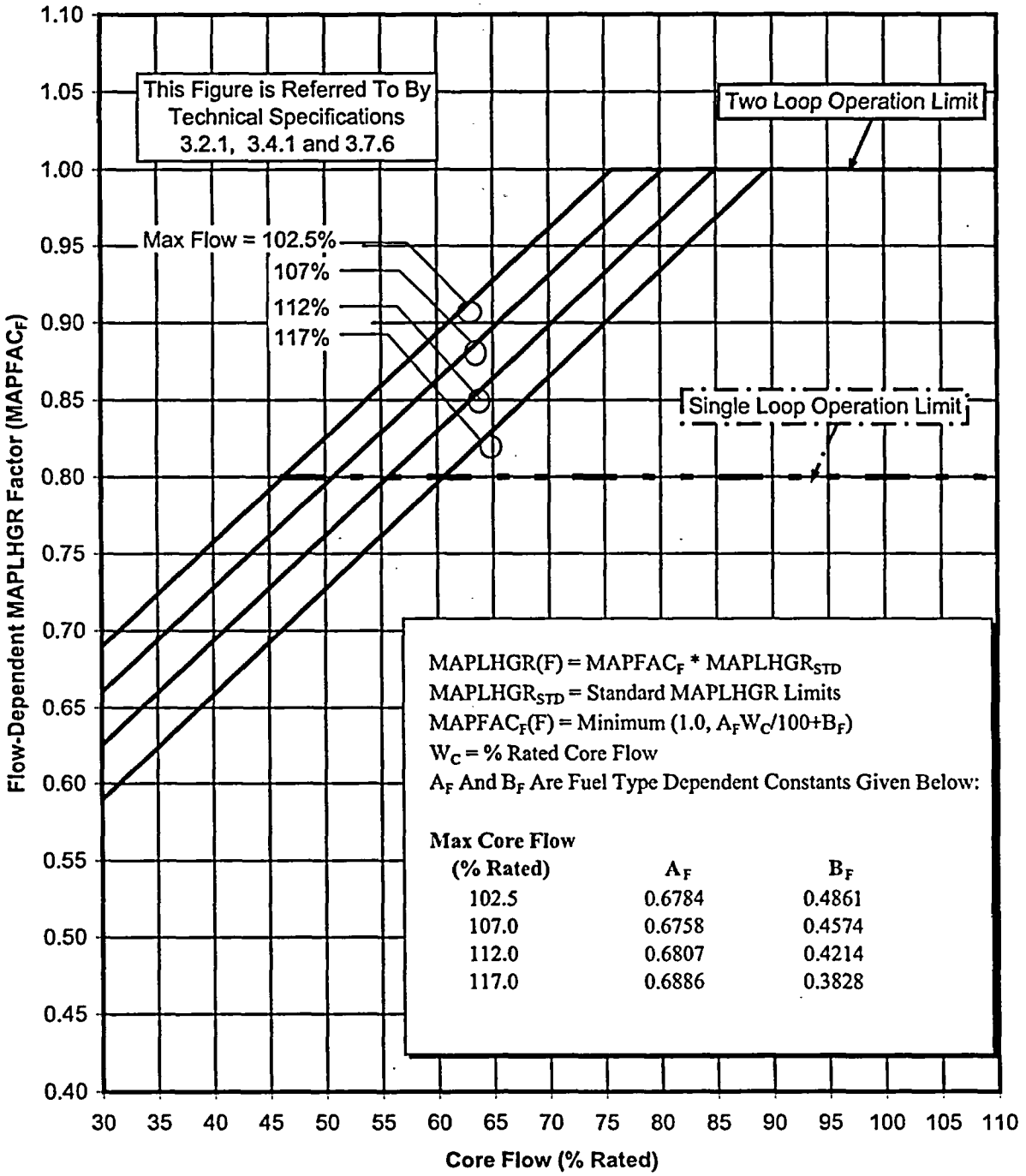
### Fuel Type GE14-P10DNAB437-12G6.0-100T-150-T-2662 (GE14) Average Planar Linear Heat Generation Rate (APLHGR) Limit Versus Average Planar Exposure




| Exposure (GWd/Mt) | Limit (kW/ft) |
|---|---|
| 0.00 | 9.06 |
| 1.10 | 9.20 |
| 2.20 | 9.31 |
| 3.31 | 9.43 |
| 4.41 | 9.55 |
| 5.51 | 9.68 |
| 6.61 | 9.81 |
| 7.72 | 9.95 |
| 8.82 | 10.09 |
| 9.92 | 10.23 |
| 11.02 | 10.38 |
| 12.13 | 10.45 |
| 13.23 | 10.48 |
| 14.33 | 10.51 |
| 15.43 | 10.54 |
| 15.99 | 10.55 |
| 16.53 | 10.56 |
| 18.74 | 10.56 |
| 21.09 | 10.49 |
| 22.05 | 10.47 |
| 27.56 | 10.20 |
| 33.07 | 9.87 |
| 38.58 | 9.42 |
| 44.09 | 8.95 |
| 49.60 | 8.45 |
| 55.12 | 7.91 |
| 60.63 | 5.56 |
| 62.02 | 4.91 |

## Figure 9

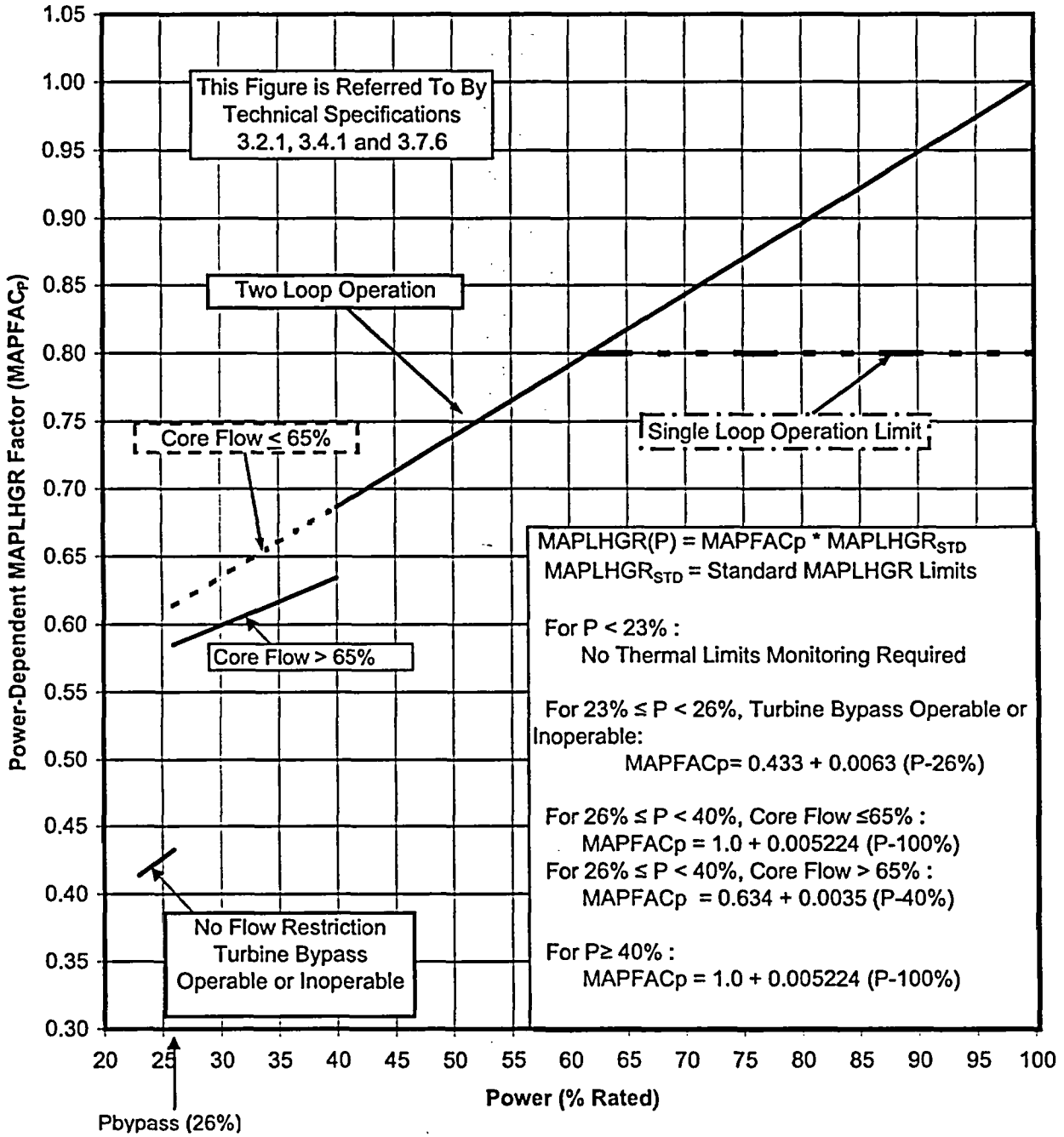
### GE13 and GE14 Flow-Dependent MAPLHGR Limit, MAPLHGR(F)




| Max Core Flow (% Rated) | $A_F$ | $B_F$ |
|---|---|---|
| 102.5 | 0.6784 | 0.4861 |
| 107.0 | 0.6758 | 0.4574 |
| 112.0 | 0.6807 | 0.4214 |
| 117.0 | 0.6886 | 0.3828 |

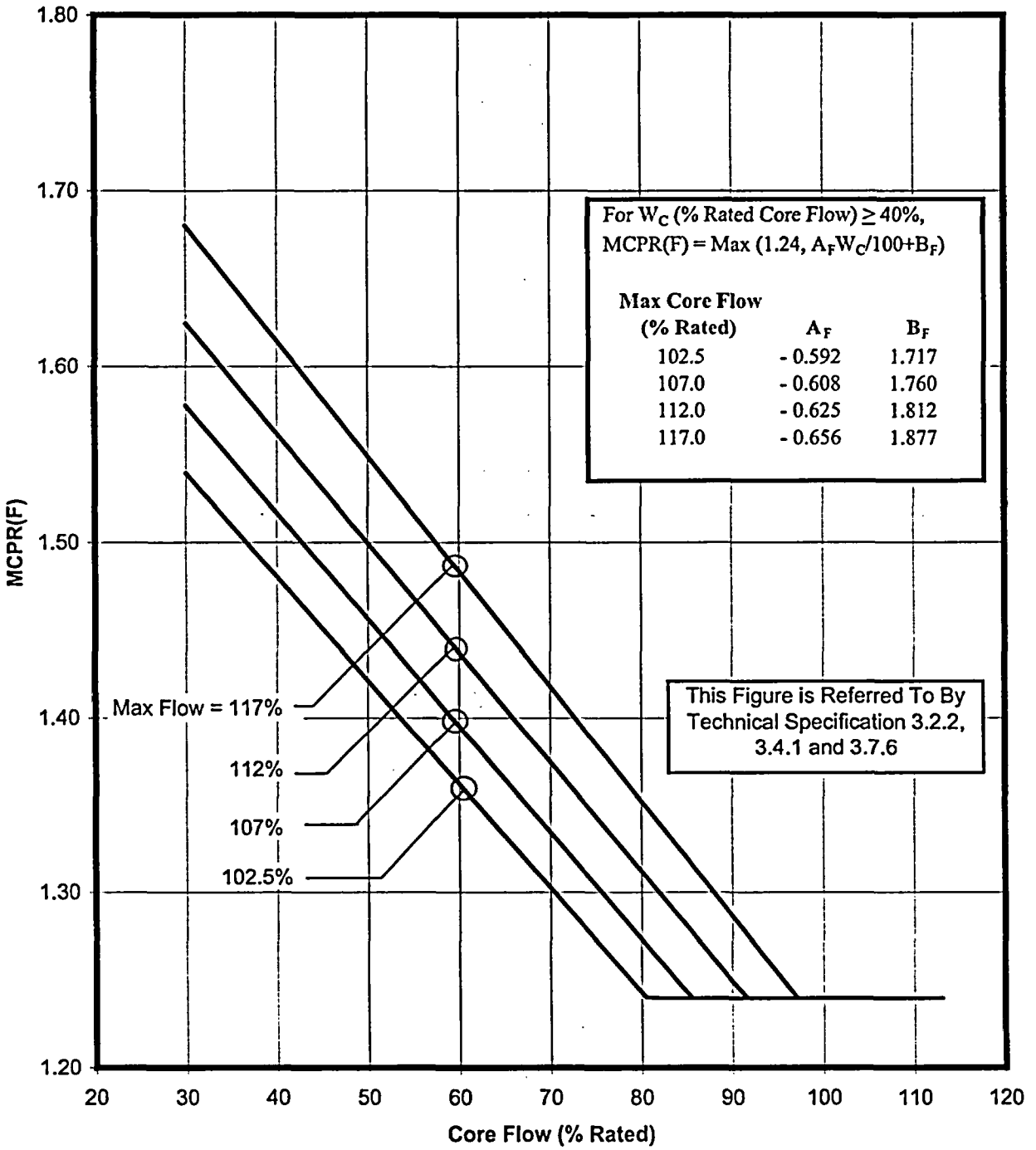
**Figure 10**

**GE13 and GE14 Power-Dependent MAPLHGR Limit, MAPLHGR (P)**



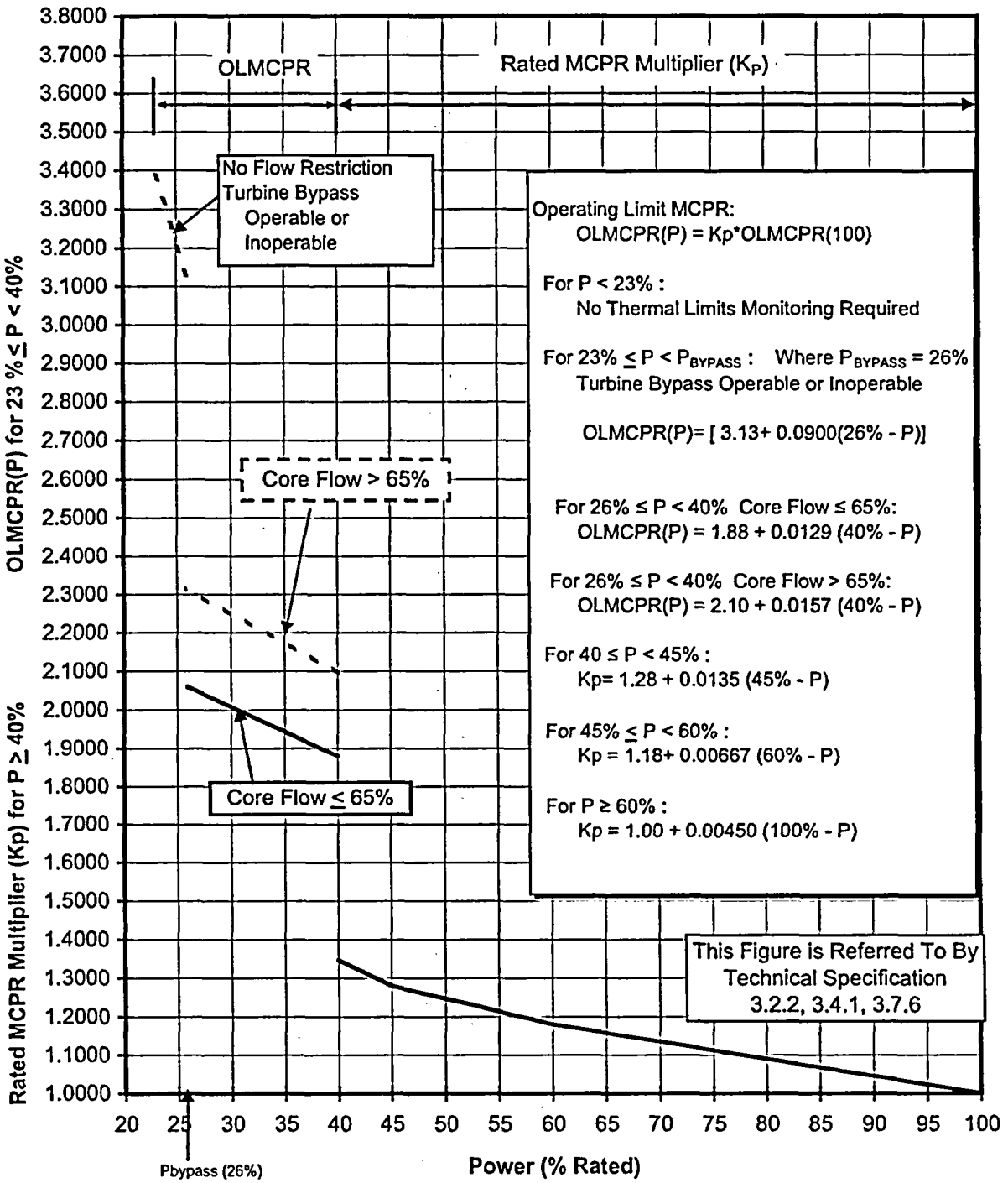
## Figure 11

### GE13 and GE14 Flow-Dependent MCPR Limit, MCPR(F)



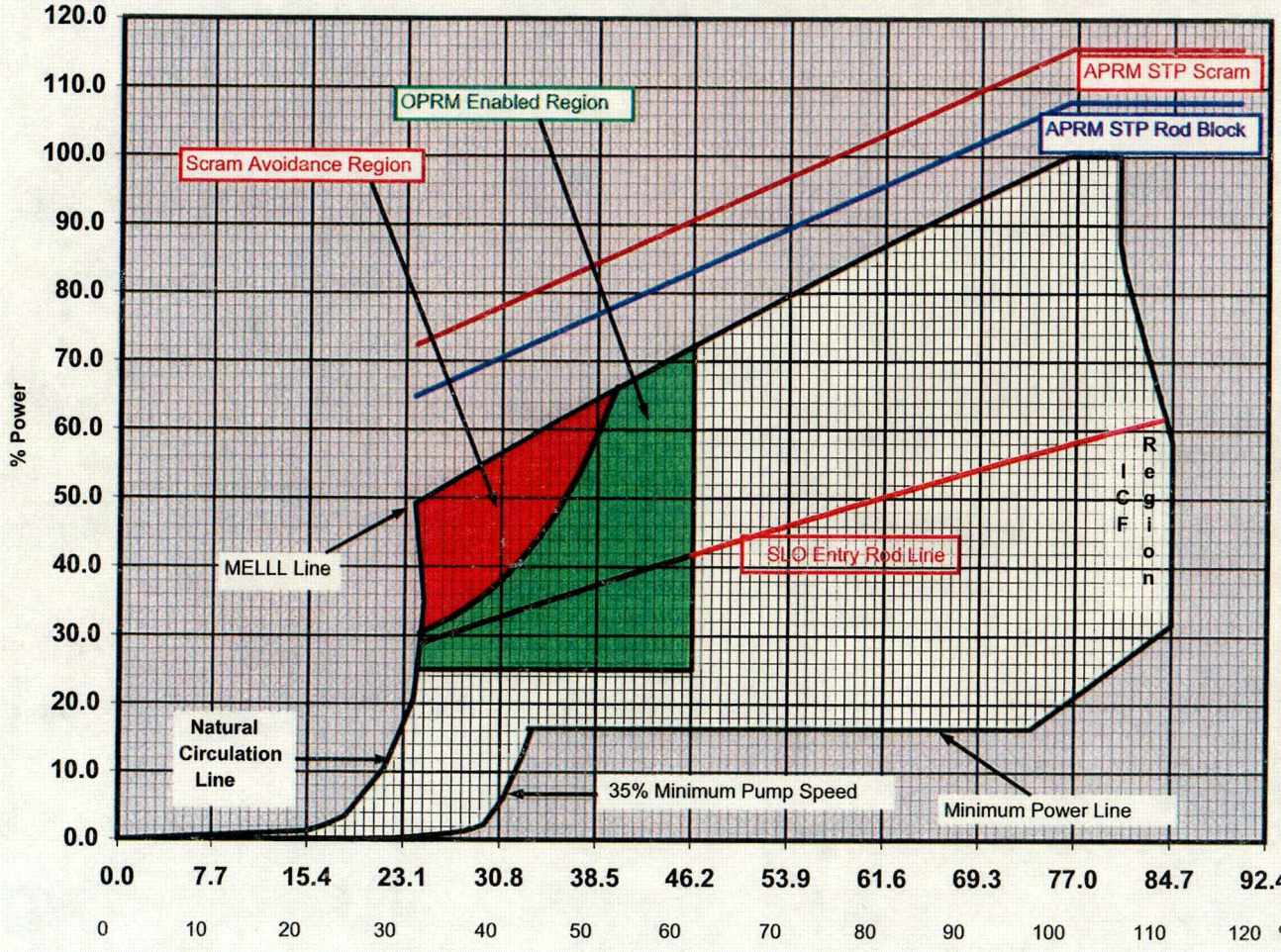
## Figure 12

### GE13 and GE14 Power - Dependent MCPR Limit, MCPR (P)



OPRM Operable, Two Loop Operation, 2923 MWt

**This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3**

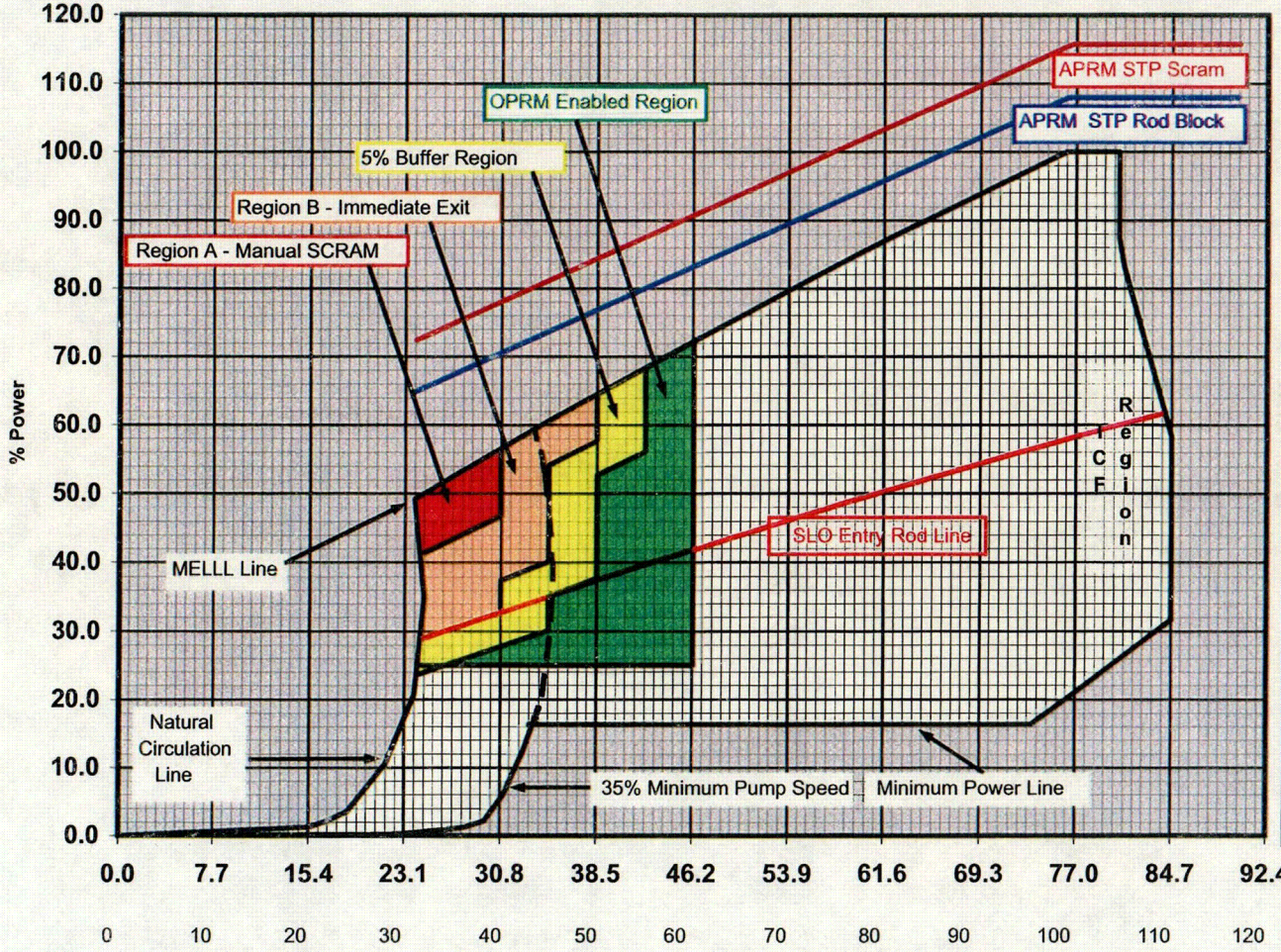



| Power % | Minimum (MELLL) Core Flow, Mlbs/hr | Maximum (ICF) Core Flow, Mlbs/hr |
|---|---|---|
| 100 | 76.19 | 80.47 |
| 99 | 75.04 | 80.47 |
| 98 | 73.89 | 80.47 |
| 97 | 72.75 | 80.47 |
| 96 | 71.61 | 80.47 |
| 95 | 70.49 | 80.47 |
| 94 | 69.36 | 80.47 |
| 93 | 68.25 | 80.47 |
| 92 | 67.13 | 80.47 |
| 91 | 66.03 | 80.47 |
| 90 | 64.93 | 80.47 |
| 89 | 63.83 | 80.47 |
| 88 | 62.74 | 80.47 |
| 87 | 61.66 | 80.51 |
| 86 | 60.58 | 80.60 |
| 85 | 59.50 | 80.70 |
| 84 | 58.43 | 80.79 |
| 83 | 57.37 | 80.90 |
| 82 | 56.31 | 81.05 |
| 81 | 55.25 | 81.21 |
| 80 | 54.20 | 81.36 |
| 79 | 53.16 | 81.52 |
| 78 | 52.12 | 81.67 |
| 77 | 51.08 | 81.83 |
| 76 | 50.05 | 81.98 |
| 75 | 49.02 | 82.13 |
| 74 | 48.00 | 82.29 |
| 73 | 46.98 | 82.44 |
| 72 | 45.96 | 82.60 |
| 71 | 44.95 | 82.75 |
| 70 | 43.94 | 82.91 |
| 69 | 42.94 | 83.06 |
| 68 | 41.94 | 83.21 |
| 67 | 40.95 | 83.37 |
| 66 | 39.96 | 83.52 |
| 65 | 38.97 | 83.68 |
| 64 | 37.99 | 83.83 |
| 63 | 37.01 | 83.99 |
| 62 | 36.04 | 84.14 |
| 61 | 35.06 | 84.29 |
| 60 | 34.10 | 84.45 |
| 59 | 33.13 | 84.60 |
| 58 | 32.17 | 84.70 |

C01

OPRM Inoperable, Two Loop Operation, 2923 MWt

This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3

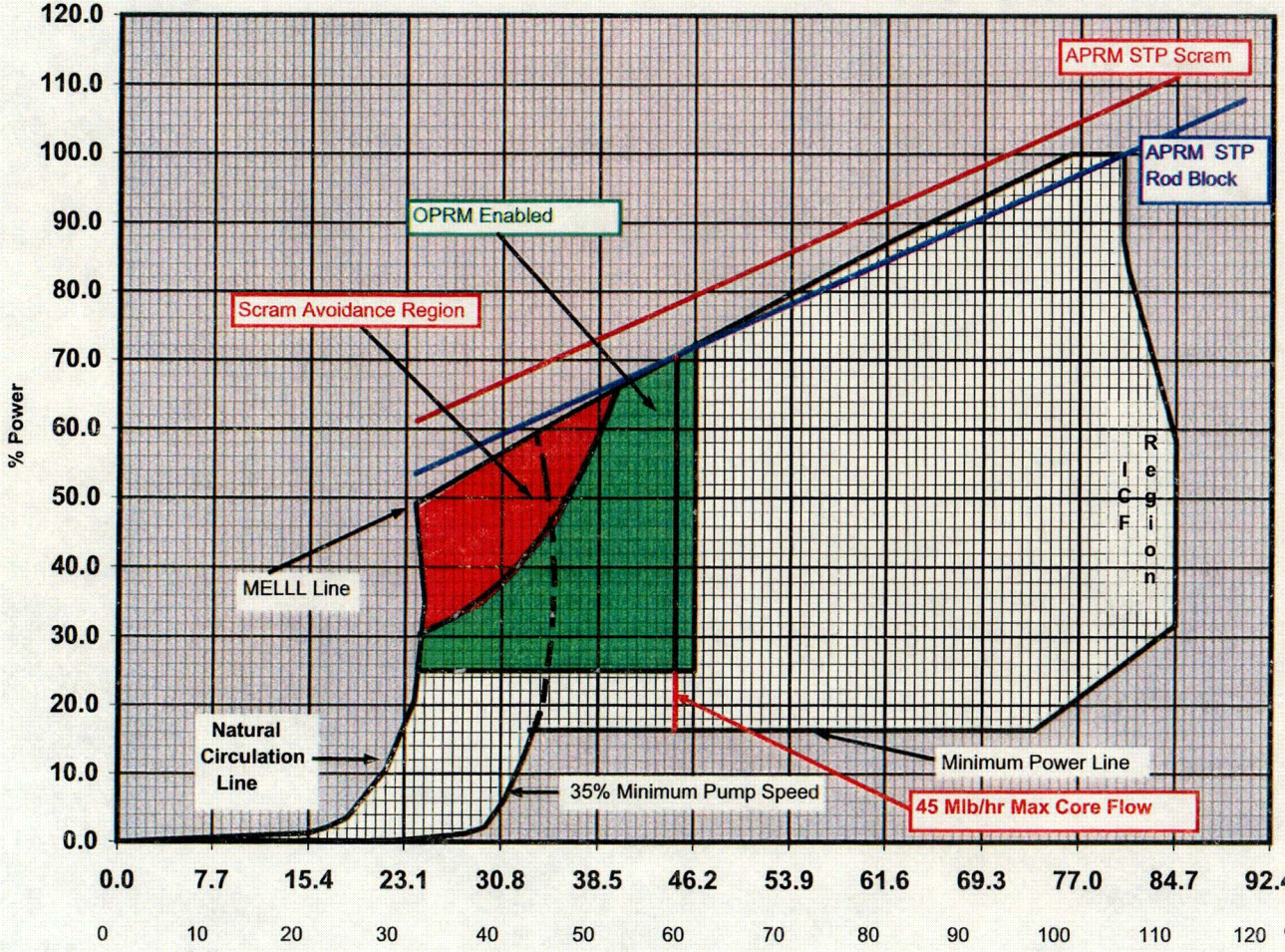



| Power % | Minimum (MELLL) Core Flow, Mlbs/hr | Maximum (ICF) Core Flow, Mlbs/hr |
|---|---|---|
| 100 | 76.19 | 80.47 |
| 99 | 75.04 | 80.47 |
| 98 | 73.89 | 80.47 |
| 97 | 72.75 | 80.47 |
| 96 | 71.61 | 80.47 |
| 95 | 70.49 | 80.47 |
| 94 | 69.36 | 80.47 |
| 93 | 68.25 | 80.47 |
| 92 | 67.13 | 80.47 |
| 91 | 66.03 | 80.47 |
| 90 | 64.93 | 80.47 |
| 89 | 63.83 | 80.47 |
| 88 | 62.74 | 80.47 |
| 87 | 61.66 | 80.51 |
| 86 | 60.58 | 80.60 |
| 85 | 59.50 | 80.70 |
| 84 | 58.43 | 80.79 |
| 83 | 57.37 | 80.90 |
| 82 | 56.31 | 81.05 |
| 81 | 55.25 | 81.21 |
| 80 | 54.20 | 81.36 |
| 79 | 53.16 | 81.52 |
| 78 | 52.12 | 81.67 |
| 77 | 51.08 | 81.83 |
| 76 | 50.05 | 81.98 |
| 75 | 49.02 | 82.13 |
| 74 | 48.00 | 82.29 |
| 73 | 46.98 | 82.44 |
| 72 | 45.96 | 82.60 |
| 71 | 44.95 | 82.75 |
| 70 | 43.94 | 82.91 |
| 69 | 42.94 | 83.06 |
| 68 | 41.94 | 83.21 |
| 67 | 40.95 | 83.37 |
| 66 | 39.96 | 83.52 |
| 65 | 38.97 | 83.68 |
| 64 | 37.99 | 83.83 |
| 63 | 37.01 | 83.99 |
| 62 | 36.04 | 84.14 |
| 61 | 35.06 | 84.29 |
| 60 | 34.10 | 84.45 |
| 59 | 33.13 | 84.60 |
| 58 | 32.17 | 84.70 |

C02

OPRM Operable, Single Loop Operation, 2923 MWt

This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3

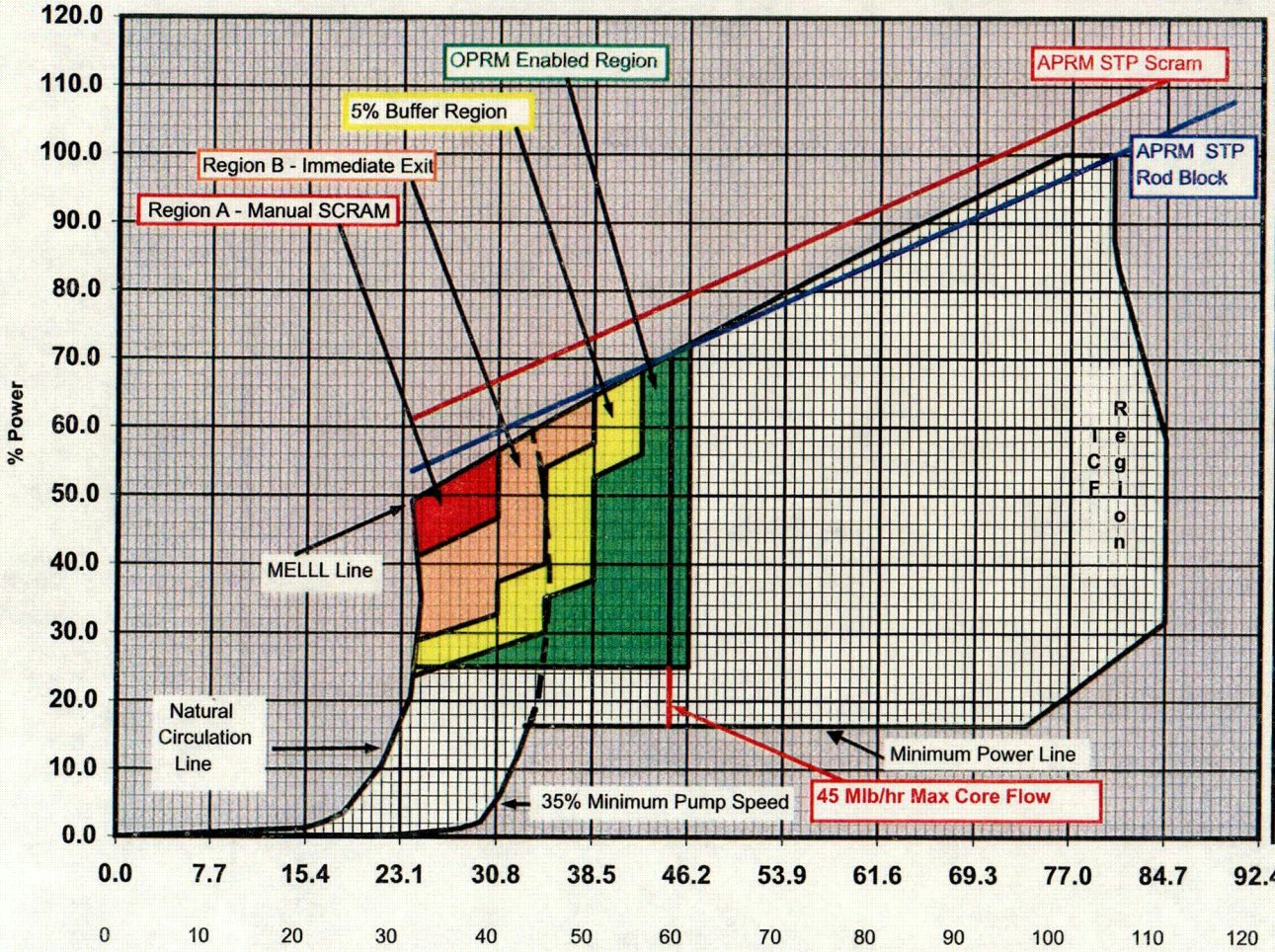



| Power % | Minimum (MELLL) Core Flow, Mlbs/hr | Maximum (ICF) Core Flow, Mlbs/hr |
|---|---|---|
| 100 | 76.19 | 80.47 |
| 99 | 75.04 | 80.47 |
| 98 | 73.89 | 80.47 |
| 97 | 72.75 | 80.47 |
| 96 | 71.61 | 80.47 |
| 95 | 70.49 | 80.47 |
| 94 | 69.36 | 80.47 |
| 93 | 68.25 | 80.47 |
| 92 | 67.13 | 80.47 |
| 91 | 66.03 | 80.47 |
| 90 | 64.93 | 80.47 |
| 89 | 63.83 | 80.47 |
| 88 | 62.74 | 80.47 |
| 87 | 61.66 | 80.51 |
| 86 | 60.58 | 80.60 |
| 85 | 59.50 | 80.70 |
| 84 | 58.43 | 80.79 |
| 83 | 57.37 | 80.90 |
| 82 | 56.31 | 81.05 |
| 81 | 55.25 | 81.21 |
| 80 | 54.20 | 81.36 |
| 79 | 53.16 | 81.52 |
| 78 | 52.12 | 81.67 |
| 77 | 51.08 | 81.83 |
| 76 | 50.05 | 81.98 |
| 75 | 49.02 | 82.13 |
| 74 | 48.00 | 82.29 |
| 73 | 46.98 | 82.44 |
| 72 | 45.96 | 82.60 |
| 71 | 44.95 | 82.75 |
| 70 | 43.94 | 82.91 |
| 69 | 42.94 | 83.06 |
| 68 | 41.94 | 83.21 |
| 67 | 40.95 | 83.37 |
| 66 | 39.96 | 83.52 |
| 65 | 38.97 | 83.68 |
| 64 | 37.99 | 83.83 |
| 63 | 37.01 | 83.99 |
| 62 | 36.04 | 84.14 |
| 61 | 35.06 | 84.29 |
| 60 | 34.10 | 84.45 |
| 59 | 33.13 | 84.60 |
| 58 | 32.17 | 84.70 |

C03

OPRM Inoperable, Single Loop Operation, 2923 MWt

This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3

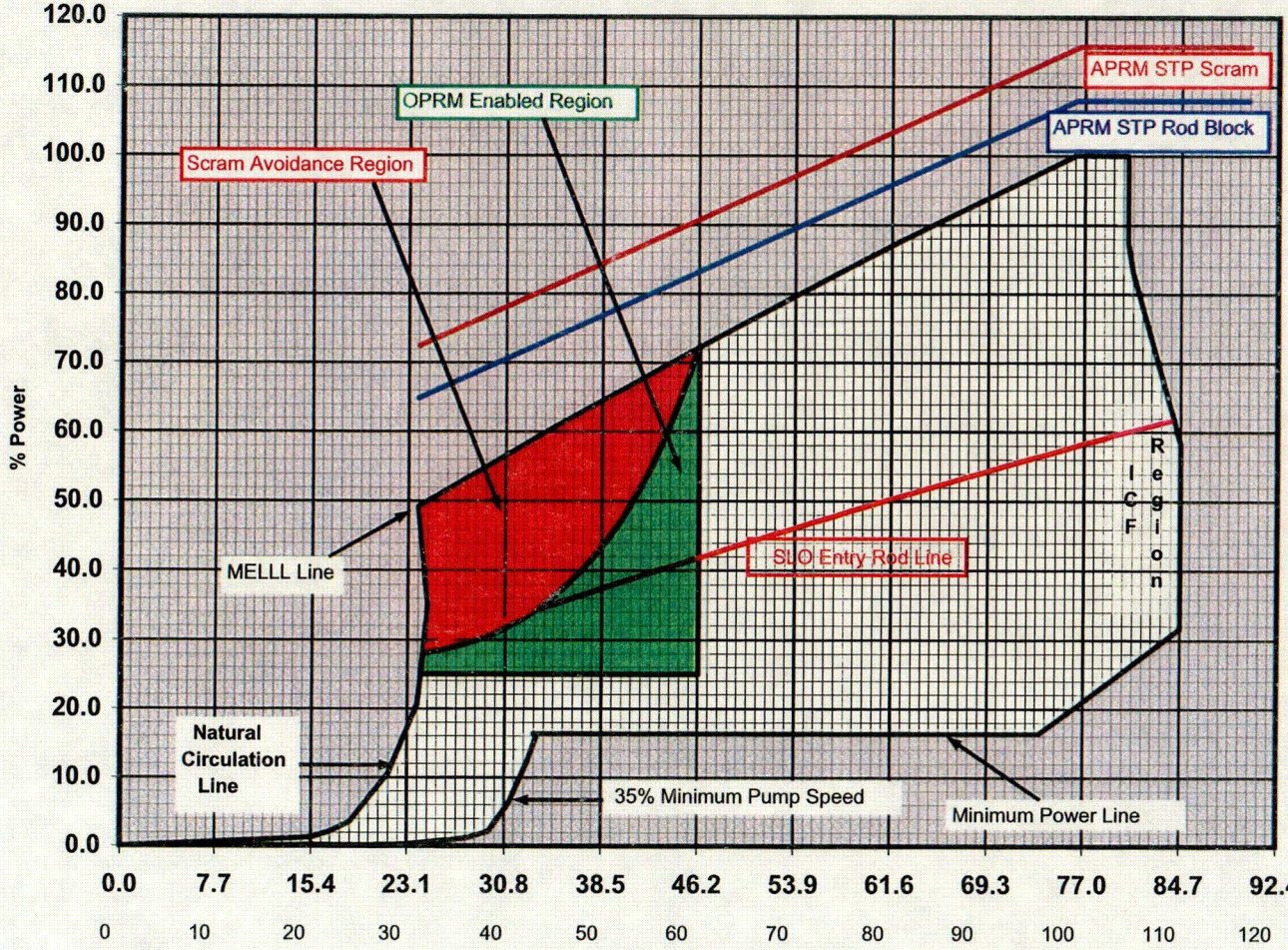



| Power % | Minimum (MELLL) Core Flow, Mlbs/hr | Maximum (ICF) Core Flow, Mlbs/hr |
|---|---|---|
| 100 | 76.19 | 80.47 |
| 99 | 75.04 | 80.47 |
| 98 | 73.89 | 80.47 |
| 97 | 72.75 | 80.47 |
| 96 | 71.61 | 80.47 |
| 95 | 70.49 | 80.47 |
| 94 | 69.36 | 80.47 |
| 93 | 68.25 | 80.47 |
| 92 | 67.13 | 80.47 |
| 91 | 66.03 | 80.47 |
| 90 | 64.93 | 80.47 |
| 89 | 63.83 | 80.47 |
| 88 | 62.74 | 80.47 |
| 87 | 61.66 | 80.51 |
| 86 | 60.58 | 80.60 |
| 85 | 59.50 | 80.70 |
| 84 | 58.43 | 80.79 |
| 83 | 57.37 | 80.90 |
| 82 | 56.31 | 81.05 |
| 81 | 55.25 | 81.21 |
| 80 | 54.20 | 81.36 |
| 79 | 53.16 | 81.52 |
| 78 | 52.12 | 81.67 |
| 77 | 51.08 | 81.83 |
| 76 | 50.05 | 81.98 |
| 75 | 49.02 | 82.13 |
| 74 | 48.00 | 82.29 |
| 73 | 46.98 | 82.44 |
| 72 | 45.96 | 82.60 |
| 71 | 44.95 | 82.75 |
| 70 | 43.94 | 82.91 |
| 69 | 42.94 | 83.06 |
| 68 | 41.94 | 83.21 |
| 67 | 40.95 | 83.37 |
| 66 | 39.96 | 83.52 |
| 65 | 38.97 | 83.68 |
| 64 | 37.99 | 83.83 |
| 63 | 37.01 | 83.99 |
| 62 | 36.04 | 84.14 |
| 61 | 35.06 | 84.29 |
| 60 | 34.10 | 84.45 |
| 59 | 33.13 | 84.60 |
| 58 | 32.17 | 84.70 |

C04

OPRM Operable, FWTR, 2923 MWt

**This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3**

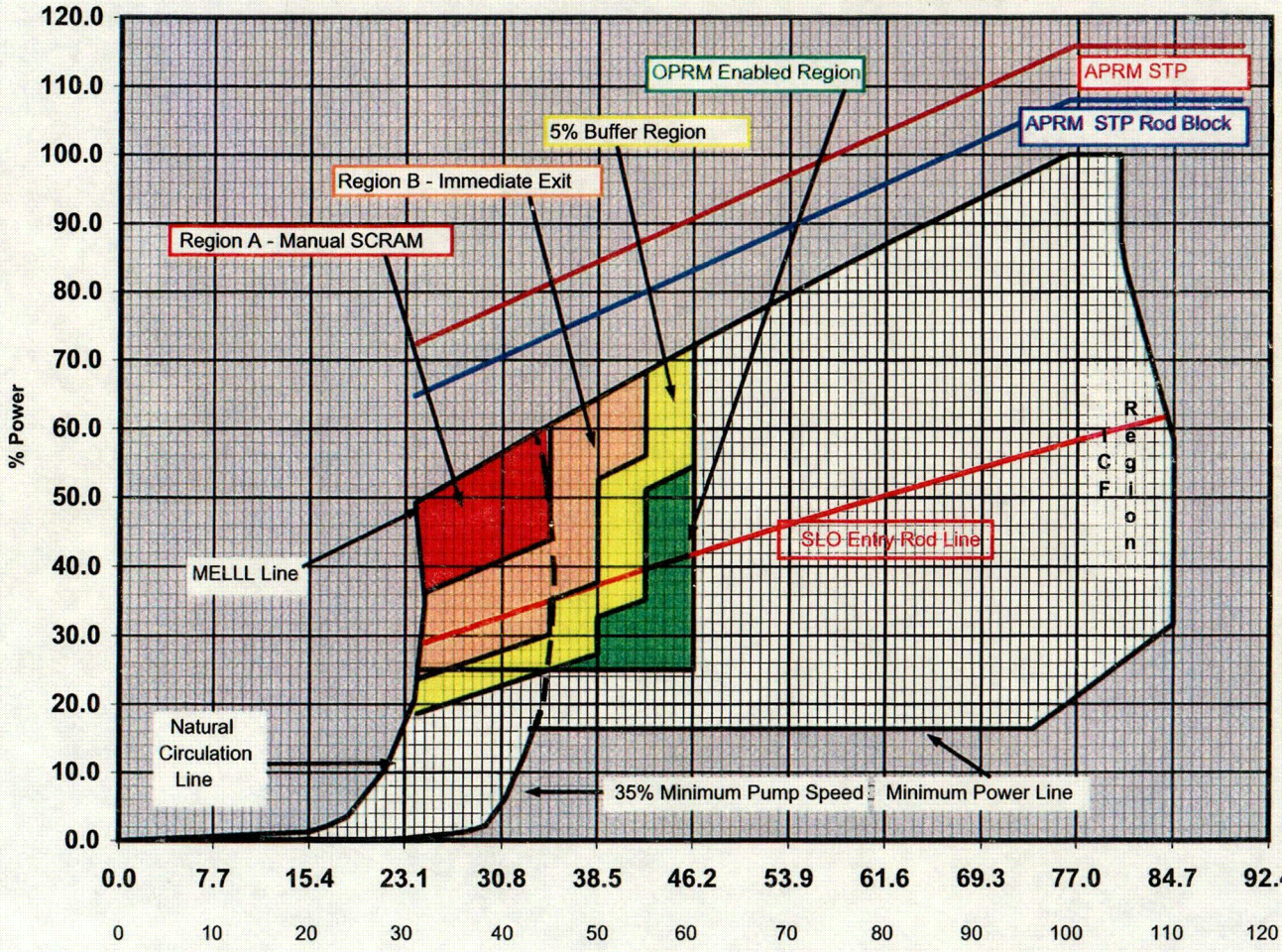



| Power % | Minimum (MELLL) Core Flow, Mlbs/hr | Maximum (ICF) Core Flow, Mlbs/hr |
|---|---|---|
| 100 | 76.19 | 80.47 |
| 99 | 75.04 | 80.47 |
| 98 | 73.89 | 80.47 |
| 97 | 72.75 | 80.47 |
| 96 | 71.61 | 80.47 |
| 95 | 70.49 | 80.47 |
| 94 | 69.36 | 80.47 |
| 93 | 68.25 | 80.47 |
| 92 | 67.13 | 80.47 |
| 91 | 66.03 | 80.47 |
| 90 | 64.93 | 80.47 |
| 89 | 63.83 | 80.47 |
| 88 | 62.74 | 80.47 |
| 87 | 61.66 | 80.51 |
| 86 | 60.58 | 80.60 |
| 85 | 59.50 | 80.70 |
| 84 | 58.43 | 80.79 |
| 83 | 57.37 | 80.90 |
| 82 | 56.31 | 81.05 |
| 81 | 55.25 | 81.21 |
| 80 | 54.20 | 81.36 |
| 79 | 53.16 | 81.52 |
| 78 | 52.12 | 81.67 |
| 77 | 51.08 | 81.83 |
| 76 | 50.05 | 81.98 |
| 75 | 49.02 | 82.13 |
| 74 | 48.00 | 82.29 |
| 73 | 46.98 | 82.44 |
| 72 | 45.96 | 82.60 |
| 71 | 44.95 | 82.75 |
| 70 | 43.94 | 82.91 |
| 69 | 42.94 | 83.06 |
| 68 | 41.94 | 83.21 |
| 67 | 40.95 | 83.37 |
| 66 | 39.96 | 83.52 |
| 65 | 38.97 | 83.68 |
| 64 | 37.99 | 83.83 |
| 63 | 37.01 | 83.99 |
| 62 | 36.04 | 84.14 |
| 61 | 35.06 | 84.29 |
| 60 | 34.10 | 84.45 |
| 59 | 33.13 | 84.60 |
| 58 | 32.17 | 84.70 |

C05

OPRM Inoperable, FWTR, 2923 MWt

This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specification 3.3




| Power % | Minimum (MELLL) Core Flow, Mlbs/hr | Maximum (ICF) Core Flow, Mlbs/hr |
|---|---|---|
| 100 | 76.19 | 80.47 |
| 99 | 75.04 | 80.47 |
| 98 | 73.89 | 80.47 |
| 97 | 72.75 | 80.47 |
| 96 | 71.61 | 80.47 |
| 95 | 70.49 | 80.47 |
| 94 | 69.36 | 80.47 |
| 93 | 68.25 | 80.47 |
| 92 | 67.13 | 80.47 |
| 91 | 66.03 | 80.47 |
| 90 | 64.93 | 80.47 |
| 89 | 63.83 | 80.47 |
| 88 | 62.74 | 80.47 |
| 87 | 61.66 | 80.51 |
| 86 | 60.58 | 80.60 |
| 85 | 59.50 | 80.70 |
| 84 | 58.43 | 80.79 |
| 83 | 57.37 | 80.90 |
| 82 | 56.31 | 81.05 |
| 81 | 55.25 | 81.21 |
| 80 | 54.20 | 81.36 |
| 79 | 53.16 | 81.52 |
| 78 | 52.12 | 81.67 |
| 77 | 51.08 | 81.83 |
| 76 | 50.05 | 81.98 |
| 75 | 49.02 | 82.13 |
| 74 | 48.00 | 82.29 |
| 73 | 46.98 | 82.44 |
| 72 | 45.96 | 82.60 |
| 71 | 44.95 | 82.75 |
| 70 | 43.94 | 82.91 |
| 69 | 42.94 | 83.06 |
| 68 | 41.94 | 83.21 |
| 67 | 40.95 | 83.37 |
| 66 | 39.96 | 83.52 |
| 65 | 38.97 | 83.68 |
| 64 | 37.99 | 83.83 |
| 63 | 37.01 | 83.99 |
| 62 | 36.04 | 84.14 |
| 61 | 35.06 | 84.29 |
| 60 | 34.10 | 84.45 |
| 59 | 33.13 | 84.60 |
| 58 | 32.17 | 84.70 |

COG