CP&L

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MAR 1 7 2000

SERIAL: BSEP 00-0035

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

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 1
DOCKET NO. 50-325/LICENSE NO. DPR-71
TRANSMITTAL OF CORE OPERATING LIMITS REPORT, SUPPLEMENTAL RELOAD LICENSING REPORT, AND LOSS-OF-COOLANT ACCIDENT ANALYSIS REPORT

Gentlemen:

The purpose of this letter is to submit the latest revisions of the Core Operating Limits Report, Supplemental Reload Licensing Report, and Loss of Coolant Accident Analysis Report for the Brunswick Steam Electric Plant (BSEP), Unit No. 1.

Technical Specification 5.6.5.d requires that the Core Operating Limits Report be provided to the NRC upon issuance for each reload cycle. A copy of "Brunswick Unit 1, Cycle 13 Core Operating Limits Report," dated March 2000, is provided in Enclosure 1. The NRC's Safety Evaluation for Amendment 19 to General Electric Licensing Topical Report NEDE-24011-P-A (GESTAR-II), "General Electric Standard Application For Reactor Fuel," states that the Technical Specifications will include, for each multiple lattice fuel bundle type, a plot of the limiting value of Average Planar Linear Heat Generation Rate (APLHGR) for the most limiting lattice as a function of exposure. Consistent with the guidance in NRC Generic Letter 88-16, "Removal of Cycle-Specific Parameter Limits From Technical Specifications," the limiting value of APLHGR for the most limiting lattice as a function of exposure has been relocated from the Technical Specifications to the Core Operating Limits Report. A plot of the limiting value of APLHGR, as a function of average planar exposure for each reload fuel type, is included in the enclosed Core Operating Limits Report.

The NRC's Safety Evaluation for Amendment 19 to GESTAR-II also states that each reload submittal should include a table of the most limiting and least limiting Maximum Planar Linear Heat Generation Rate (MAPLHGR) for each multiple lattice bundle type. A copy of "Supplemental Reload Licensing Report for Brunswick Steam Electric Plant Unit 1 Reload 12 Cycle 13," J11-03594SRLR, Revision 0, Class I, dated January 2000, is provided in Enclosure 2. The most limiting and least limiting MAPLHGR values for the new reload fuel types are provided in a table included in the Supplemental Reload Licensing Report for BSEP, Unit 1.

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Finally, the NRC's Safety Evaluation for Amendment 19 to NEDE-24011-P-A states that each licensee should submit to the NRC, on a proprietary basis, information for each bundle type on the axial location of each lattice in the bundle and composite MAPLHGR as a function of average exposure for each lattice in the bundle. A copy of "Loss-of-Coolant Accident Analysis Report for Brunswick Steam Electric Plant Unit 1 Reload 12 Cycle 13," NEDC-31624P, Supplement 1, Revision 5, Class III, January 2000, is provided in Enclosure 3. This report contains MAPLHGR as a function of exposure for each lattice of the fuel designs.

Global Nuclear Fuel considers the Loss-of-Coolant Accident Analysis Report in Enclosure 3 to be proprietary information. Therefore, the document should be withheld from public disclosure in accordance with 10 CFR 9.17 and 10 CFR 2.790. An affidavit supporting the request for withholding the document is provided in Enclosure 4.

Please refer any questions regarding this submittal to Mr. Steven F. Tabor, Supervisor - Licensing, at (910) 457-2178.

Sincerely,

Warren J. Dorman
Manager - Regulatory Affairs
Brunswick Steam Electric Plant

WRM/wrm

Enclosures:

1. Brunswick Unit 1, Cycle 13 Core Operating Limits Report, March 2000
2. Supplemental Reload Licensing Report for Brunswick Steam Electric Plant Unit 1 Reload 12 Cycle 13, J11-03594SRLR, Revision 0, Class I, January 2000
3. Loss-of-Coolant Accident Analysis Report for Brunswick Steam Electric Plant Unit 1 Reload 12 Cycle 13, NEDC-31624P, Supplement 1, Revision 5, Class III, January 2000 **[PROPRIETARY INFORMATION]**
4. Affidavit From Global Nuclear Fuel Regarding Withholding From Public Disclosure In Accordance With 10 CFR 9.17 and 10 CFR 2.790

cc (with enclosures):

U. S. Nuclear Regulatory Commission, Region II
ATTN: Mr. Luis A. Reyes, Regional Administrator
Atlanta Federal Center
61 Forsyth Street, SW, Suite 23T85
Atlanta, GA 30303-8931

U. S. Nuclear Regulatory Commission
ATTN: Mr. Theodore A. Easlick, NRC Senior Resident Inspector
8470 River Road
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U. S. Nuclear Regulatory Commission
ATTN: Mr. Allen G. Hansen (Mail Stop OWFN 8G9)
11555 Rockville Pike
Rockville, MD 20852-2738

cc (without enclosures):

Ms. Jo A. Sanford
Chair - North Carolina Utilities Commission
P.O. Box 29510
Raleigh, NC 27626-0510

ENCLOSURE 4

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 1
DOCKET NO. 50-325
LICENSE NO. DPR-71
TRANSMITTAL OF CORE OPERATING LIMITS REPORT,
SUPPLEMENTAL RELOAD LICENSING REPORT, AND
LOSS-OF-COOLANT ACCIDENT ANALYSIS REPORT

Affidavit From Global Nuclear Fuel
Regarding Withholding From Public Disclosure
In Accordance With 10 CFR 9.17 and 10 CFR 2.790

Affidavit

I, Glen A. Watford, being duly sworn, depose and state as follows:

(1) I am Manager, Nuclear Fuel Engineering, Global Nuclear Fuel – Americas, L.L.C. ("GNF-A") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in the report, NEDC-31624P, Supplement 1, Revision 5, *Loss-of-Coolant Accident Analysis Report for Brunswick Steam Electric Plant Unit 1 Reload 12 Cycle 13*, January 2000.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GNF-A relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4) and 2.790(a)(4) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information," and some portions also qualify under the narrower definition of "trade secret," within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GNF-A's competitors without license from GNF-A constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals cost or price information, production capacities, budget levels, or commercial strategies of GNF-A, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future GNF-A customer–funded development plans and programs, of potential commercial value to GNF-A;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b., above.

(5) The information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GNF-A, and is in fact so held. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in (6) and (7) following. The information sought to be withheld has, to the best of my

knowledge and belief, consistently been held in confidence by GNF-A, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GNF-A. Access to such documents within GNF-A is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GNF-A are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2) is classified as proprietary because it contains details of GNF-A's fuel design and licensing methodology.

The development of the methods used in these analyses, along with the testing, development and approval of the supporting methodology was achieved at a significant cost, on the order of several million dollars, to GNF-A or its licensor.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GNF-A's competitive position and foreclose or reduce the availability of profit–making opportunities. The fuel design and licensing methodology is part of GNF-A's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC–approved methods.

The research, development, engineering, analytical, and NRC review costs comprise a substantial investment of time and money by GNF-A or its licensor.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GNF-A's competitive advantage will be lost if its competitors are able to use the results of the GNF-A experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GNF-A would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GNF-A of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

State of North Carolina)
County of New Hanover) SS:

Glen A. Watford, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at Wilmington, North Carolina, this 9th day of March, 2000

Glen A. Watford
Global Nuclear Fuel – Americas, LLC

Subscribed and sworn before me this 9th day of March, 2000

Joan M. Anderson
Notary Public, State of North Carolina

My Commission Expires 10/08/01

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ENCLOSURE 1

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 1
DOCKET NO. 50-325
LICENSE NO. DPR-71
TRANSMITTAL OF CORE OPERATING LIMITS REPORT,
SUPPLEMENTAL RELOAD LICENSING REPORT, AND
LOSS-OF-COOLANT ACCIDENT ANALYSIS REPORT

Brunswick Unit 1, Cycle 13
Core Operating Limits Report
March 2000

BRUNSWICK UNIT 1, CYCLE 13

CORE OPERATING LIMITS REPORT

March 2000

Prepared By: Charles Stroupe & Roger Thomas **Date:** 3/10/2000

Approved By: George E. Smith **Date:** 3-10-2000

George E. Smith
Superintendent
BWR Fuel Engineering

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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.

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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 report provides the values of the power distribution limits and control rod withdrawal block instrumentation setpoints for Brunswick Unit 1, Cycle 13 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
Allowable Values for Function 2.b of TS 3.3.1.1, APRM Flow Biased Simulated Thermal Power -High	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 Thermal Hydraulic Instability (THI) E1A Stability Solution, the following is also included in this report:

OPERATING LIMIT	REQUIREMENT
Thermal Hydraulic Instability (THI) E1A Stability Solution Monitored Region and Restricted Region	TS 3.2.3, 3.3.1.3, and TRMS 3.2
Thermal Hydraulic Instability (THI) E1A Stability Solution Exclusion Region	Implicit
"Setup" and "Non-Setup" scram values of the APRM Flow Biased Simulated Thermal Power-High Allowable Value ("Flow Biased Scram")	TS 3.2.3 and 3.3.1.1
"Setup" and "Non-Setup" control rod block values of the APRM Flow Biased - Upscale Allowable Value ("Flow Biased Rod Block")	TRMS 3.3

Preparation of this report was performed in accordance with Quality Assurance requirements as specified in Reference 1.

Single Loop Operation

Brunswick Unit 1, Cycle 13 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, 3.2.2 and 3.3.1.1. The applicable limits are:

LCO 3.2.1, Average Planar Linear Heat Generation Rate (APLHGR) Limits: per Reference 1, the Figures 9 and 10 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.

LCO 3.3.1.1, Reactor Protection System Instrumentation Function 2.b (Average Power Range Monitors Flow Biased Simulated Thermal Power - High) Allowable Value: per Reference 1 and the THI E1A STABILITY SOLUTION, these limits apply to SLO without modification.

Inoperable Main Turbine Bypass System

Brunswick Unit 1, Cycle 13 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. One bypass valve 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% bypass flow 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 requires a reduction in the MAPLGHR(P) limits between 25% and 30% power.

LCO 3.2.2, Minimum Critical Power Ratio (MCPR) Limits: in accordance with Reference 1, TBPOOS requires an increase in the MCPR(P) multiplier between 25% and 30% power, as shown in Figure 12. TBPOOS also requires increased MCPR limits, included in Table 1.

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 6. These values were determined with the SAFER/GESTR LOCA methodology described in GESTAR-II (Reference 2). Figures 1 through 6 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.

MCPR Limits

The ODYN OPTION A, ODYN 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 methodology and GEXL-PLUS critical power correlation described in GESTAR-II (Reference 2) and are consistent with a Safety Limit MCPR of 1.10 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.

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 consistent with the bases of the ARTS program and the determination of MCPR limits with the GEMINI methodology and GEXL-PLUS critical power correlation described in GESTAR-II (Reference 2).

THI E1A Stability Solution

The Enhanced Option 1A methodology was used to develop the THI E1A Stability Solution, which involves exclusion from certain areas of the power/flow map and specific restrictions for operating in other areas.

The COLR provides the Stability Regions on the power/(core) flow map in Figures 13-16. These Figures define the Monitored and Restricted Regions for compliance with TS 3.2.3, TS 3.3.1.3 and TRMS 3.2 (and indirectly TS 3.3.1.1 and TRMS 3.3), and include the Exclusion Region (for which definition in the COLR is not a TS requirement). Core flow nominal trip setpoint values on Figures 13-16 correspond to the nominal trip setpoint values translated into drive flow and installed in the Flow Control Trip Reference (FCTR) cards.

Automatic features of the THI E1A Stability Solution implementation use digital FCTR cards that incorporate Trip Reference setpoints which are equivalent or more restrictive than the pre-Stability Solution APRM flow-biased and clamped limits. The FCTR cards support TS 3.3.1.1 (automatic APRM Flow-biased Scram) and TRMS 3.2 (Restricted Region Entry Alarm, which uses the TRMS 3.3 Flow-biased Rod Block setpoint). Figures 17-20, E1A Setpoint Allowable Values Versus Aligned Drive Flow, are based on drive flow and not core flow to support the flow signal used for the FCTR cards. Also, Figures 17-20 allow quantification of Technical Specification compliance once the drive flow input is aligned in accordance with Table 3.

"Non-Setup" setpoints (Figures 13, 15, 17, 19) enforce the normal Exclusion and Restricted Regions described above. Setup setpoints (Figures 14, 16, 18, 20) are to be used only when FCBB $\leq$ 1.0 and allow operation in the Restricted Region. When operating in Setup, the Flow-biased Rod Block setpoints generally increase in power to the Flow-biased Scram or power/flow map boundaries. The Flow-biased Scram setpoint generally increases by an equivalent amount (within the power/flow map boundaries) to avoid spurious scrams from power spikes. The inherent stability from maintaining FCBB less than one justifies continued operation in the Restricted Region, but not in that portion of the power/flow map which, in Setup, becomes unprotected by the Flow-biased Scram. The alarm associated with the Rod Block ceases to be a RREA when in Setup, but signals to Operations a similar need to immediately move to a more stable region of the power/flow map.

For BNP the two loop operation (TLO) Flow-biased Scram and Rod Block setpoints, and TLO Stability Regions, are equivalent to the SLO counterparts over all applicable portions of the operating domain.

The E1A Stability Solution provides for distinct Flow-biased Scram and Rod Block setpoints for normal and reduced feedwater temperature conditions ("normal" and "alternate" setpoints) because the core is more susceptible to instabilities with decreasing feedwater temperature. Normal setpoints (Figures 13, 14, 17, 18) are to be used below 30% power or when feedwater temperature is within 50°F rated equivalent of nominal. Alternate setpoints (Figures 15, 16 19, 20) are to be used above 30% power when feedwater is reduced by more than 50°F rated equivalent
(50°F * (% power/100)$^{0.385}$) in accordance with 1OP-32.

References

1) BNP Design Calculation 1B21-0570; "Preparation of the B1C13 Core Operating Limits Report," Revision 0, March 2000.

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 12 Cycle 13," Supplement 1, Revision 5, January 2000.

Table 1

MCPR Limits

<table>
<tr><th colspan="4">Steady State, Non-pressurization Transient MCPR Limits</th></tr>
<tr><td colspan="2">Fuel Type</td><td colspan="2">Exposure Range: BOC - EOC</td></tr>
<tr><td colspan="2">GE13</td><td colspan="2">1.25</td></tr>
<tr><th colspan="4">Pressurization Transient MCPR Limits, OLMCPR (100%P): Turbine Bypass System Operable</th></tr>
<tr><th rowspan="2">MCPR Option</th><th rowspan="2">Fuel Type</th><td colspan="2">Normal and Reduced Feedwater Temperature</td></tr>
<tr><td>Exposure Range:
BOC to EOFPC-2756 MWd/MT</td><td>Exposure Range:
EOFPC-2756 MWd/MT to EOC</td></tr>
<tr><td>A</td><td>GE13</td><td>1.41</td><td>1.46</td></tr>
<tr><td>B</td><td>GE13</td><td>1.36</td><td>1.38</td></tr>
<tr><th colspan="4">Pressurization Transient MCPR Limits, OLMCPR (100%P): Turbine Bypass System Inoperable</th></tr>
<tr><th>MCPR Option</th><th>Fuel Type</th><td colspan="2">Normal Feedwater Temperature
BOC to EOC</td></tr>
<tr><td>A</td><td>GE13</td><td colspan="2">1.49</td></tr>
<tr><td>B</td><td>GE13</td><td colspan="2">1.41</td></tr>
<tr><th>MCPR Option</th><th>Fuel Type</th><td colspan="2">Reduced Feedwater Temperature
BOC to EOC</td></tr>
<tr><td>A</td><td>GE13</td><td colspan="2">1.50</td></tr>
<tr><td>B</td><td>GE13</td><td colspan="2">1.42</td></tr>
</table>

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

Table 2

RBM System Setpoints

Setpoint	Trip Setpoint	Allowable Value
Lower Power Setpoint (LPSP[a])	27.0	≤ 29.0
Intermediate Power Setpoint (IPSP[a])	62.0	≤ 64.0
High Power Setpoint (HPSP[a])	82.0	≤ 84.0
Low Trip Setpoint (LTSP[b])	≤ 115.1	≤ 115.5
Intermediate Trip Setpoint (ITSP[b])	≤ 109.3	≤ 109.7
High Trip Setpoint (HTSP[b])	≤ 105.5	≤ 105.9
t_{d2}	≤ 2.0 seconds	≤ 2.0 seconds

a Setpoints in percent of Rated Thermal Power.

b Setpoints relative to a full scale reading of 125. For example, ≤ 115.1 means ≤ 115.1/125.0 of full scale.

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

Table 3

Aligned Drive Flow

The Scram and Rod Block trip setpoints are provided by Flow Control Trip Reference (FCTR) cards. The FCTR cards have their drive flows calibrated each cycle by 0PT-50.10, "APRM FCTR Card Drive Flow Alignment". The calibration "aligns" the current cycle drive flow to the drive flow used when the E1A flow mapping solution was developed for BNP. The COLR presents the Scram and Rod Block trip setpoints as a function of aligned drive flow. This table provides an equation for deriving the aligned drive flow from the FCTR card input drive flow signal:

$$W_D = \frac{100.005 \cdot \Delta^{40} - 30.2946 \cdot \Delta^{100} + 69.7104 \cdot W_{\tilde{D}}}{69.7104 - (\Delta^{100} - \Delta^{40})}$$

where: W_D is the aligned drive flow to be used for Figures 17 through 20

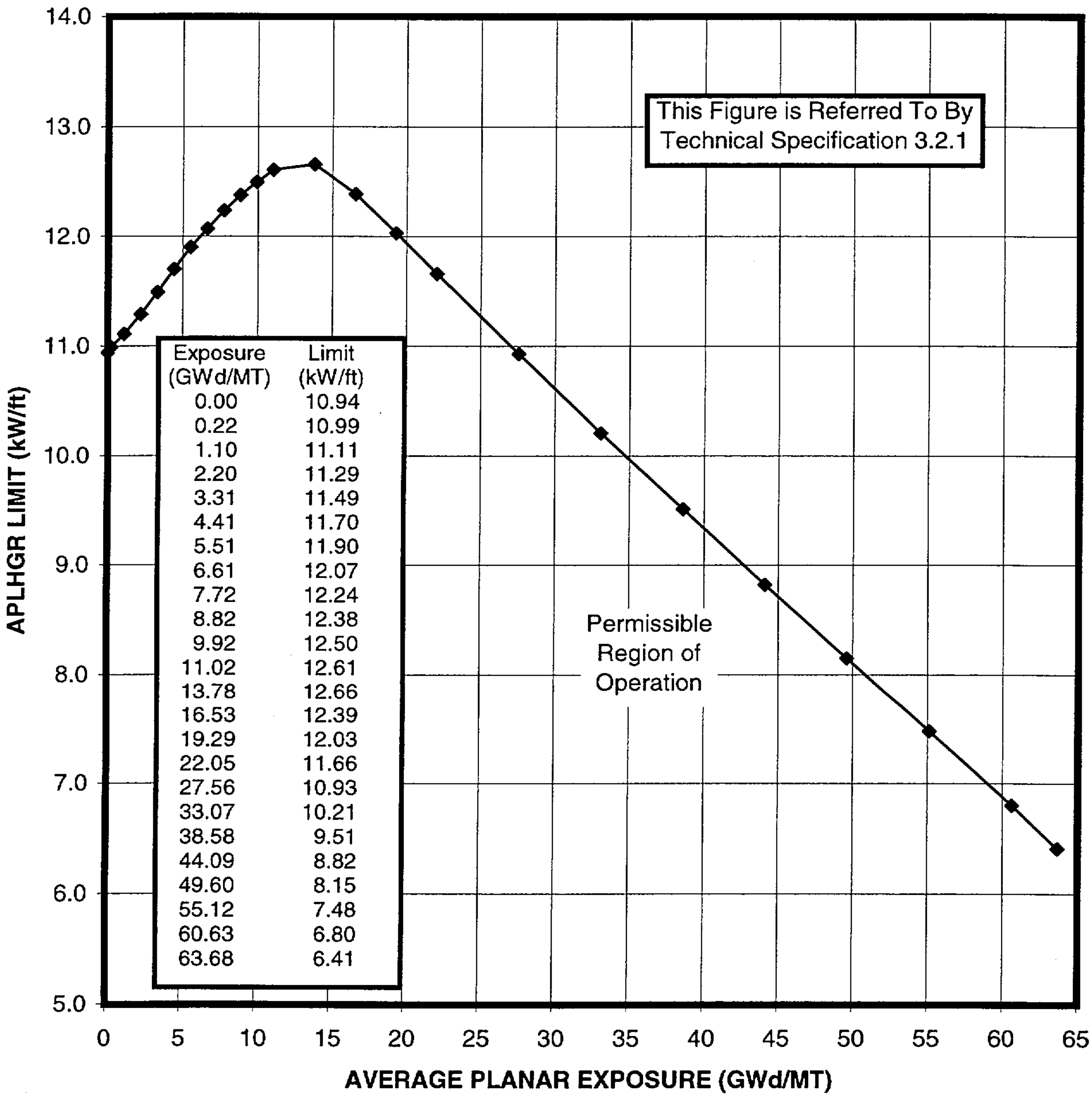
Δ^{40} and Δ^{100} are the current values for the FCTR card alignment

$W_{\tilde{D}}$ is the input drive flow signal

This Table supports Technical Specifications 3.2.3 and 3.3.1.1 and Technical Requirements Manual Specifications 3.2 and 3.3.

Figure 1

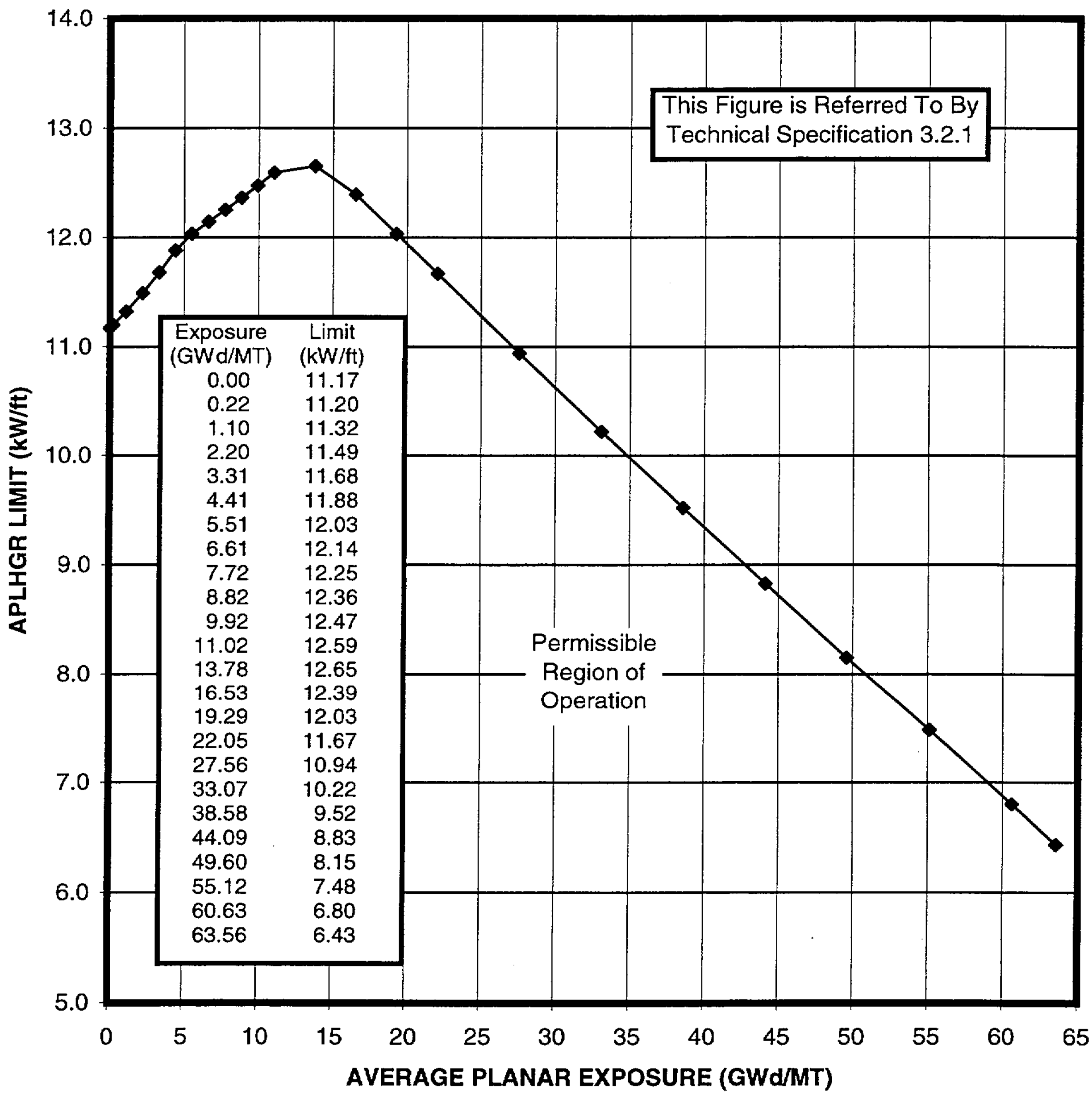
Fuel Type GE13-P9DTB380-11G5.0A-100T-146-T (GE13)
Average Planar Linear Heat Generation Rate (APLHGR) Limit
Versus Average Planar Exposure



Exposure (GWd/MT)	Limit (kW/ft)
0.00	10.94
0.22	10.99
1.10	11.11
2.20	11.29
3.31	11.49
4.41	11.70
5.51	11.90
6.61	12.07
7.72	12.24
8.82	12.38
9.92	12.50
11.02	12.61
13.78	12.66
16.53	12.39
19.29	12.03
22.05	11.66
27.56	10.93
33.07	10.21
38.58	9.51
44.09	8.82
49.60	8.15
55.12	7.48
60.63	6.80
63.68	6.41

Figure 2

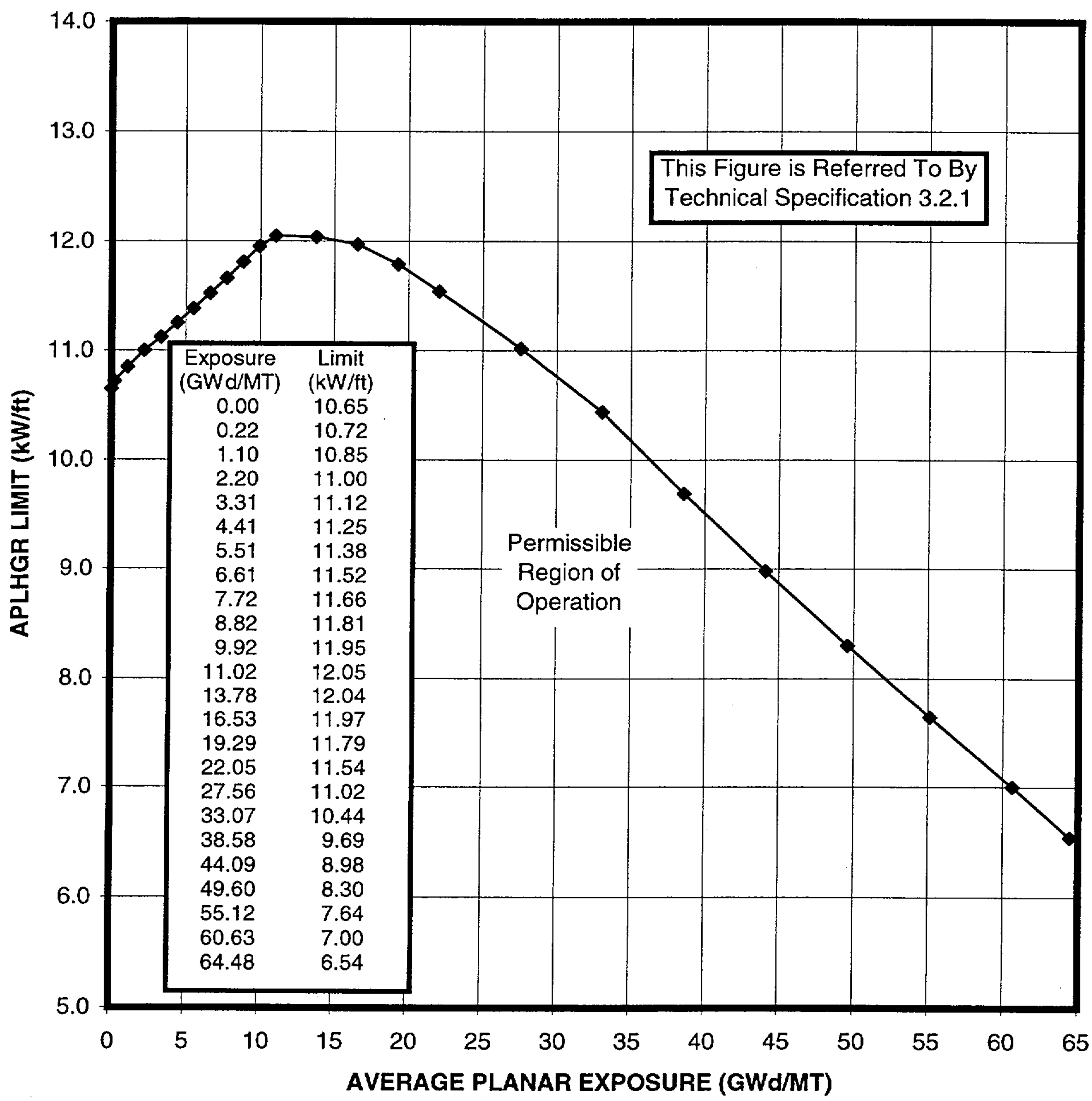
Fuel Type GE13-P9DTB380-10G5.0A-100T-146-T (GE13) Average Planar Linear Heat Generation Rate (APLHGR) Limit Versus Average Planar Exposure



Exposure (GWd/MT)	Limit (kW/ft)
0.00	11.17
0.22	11.20
1.10	11.32
2.20	11.49
3.31	11.68
4.41	11.88
5.51	12.03
6.61	12.14
7.72	12.25
8.82	12.36
9.92	12.47
11.02	12.59
13.78	12.65
16.53	12.39
19.29	12.03
22.05	11.67
27.56	10.94
33.07	10.22
38.58	9.52
44.09	8.83
49.60	8.15
55.12	7.48
60.63	6.80
63.56	6.43

Figure 3

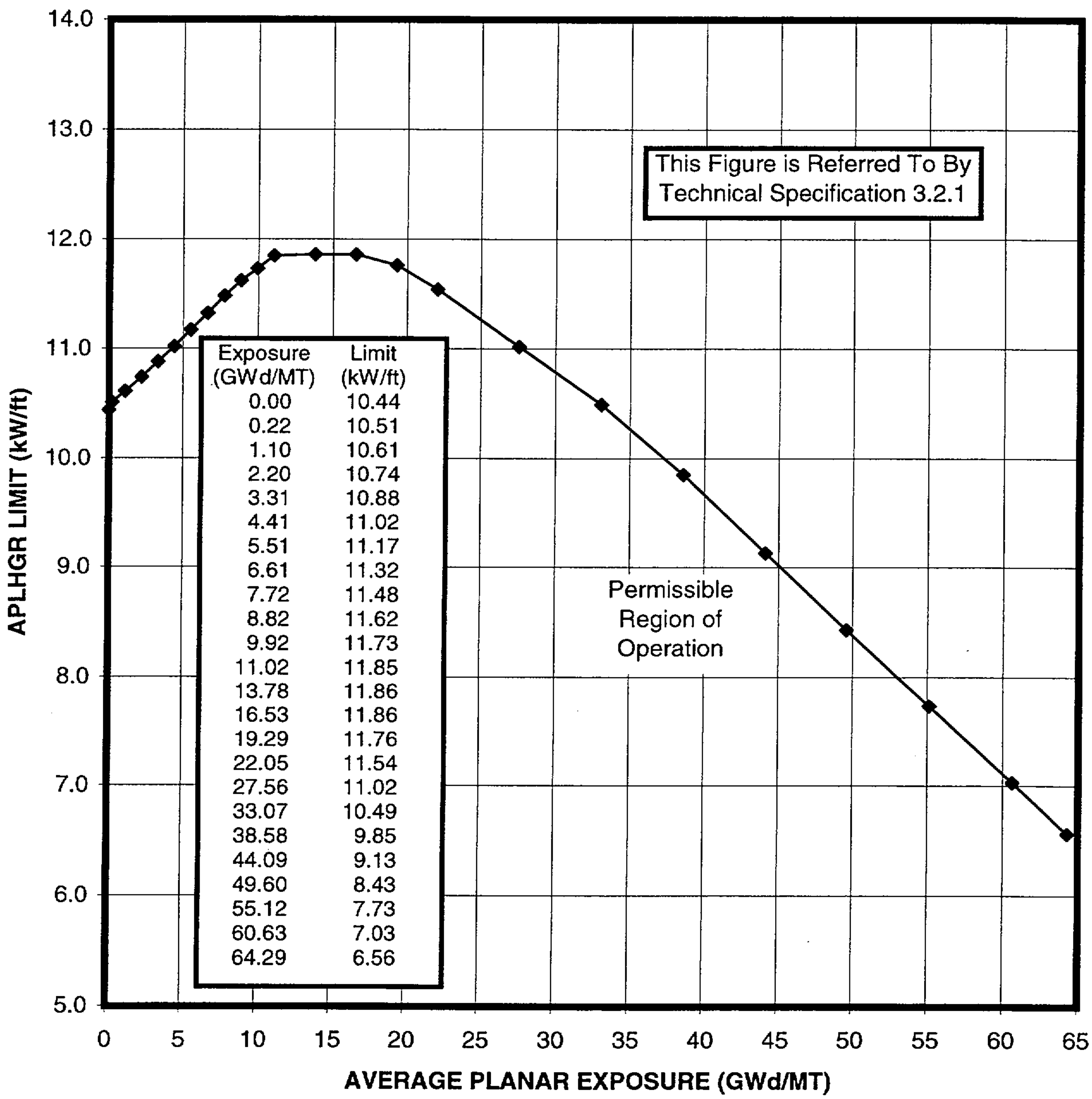
**Fuel Type GE13-P9DTB403-5G6.0/7G5.0-100T-146-T (GE13)
Average Planar Linear Heat Generation Rate (APLHGR) Limit
Versus Average Planar Exposure**



Exposure (GWd/MT)	Limit (kW/ft)
0.00	10.65
0.22	10.72
1.10	10.85
2.20	11.00
3.31	11.12
4.41	11.25
5.51	11.38
6.61	11.52
7.72	11.66
8.82	11.81
9.92	11.95
11.02	12.05
13.78	12.04
16.53	11.97
19.29	11.79
22.05	11.54
27.56	11.02
33.07	10.44
38.58	9.69
44.09	8.98
49.60	8.30
55.12	7.64
60.63	7.00
64.48	6.54

Figure 4

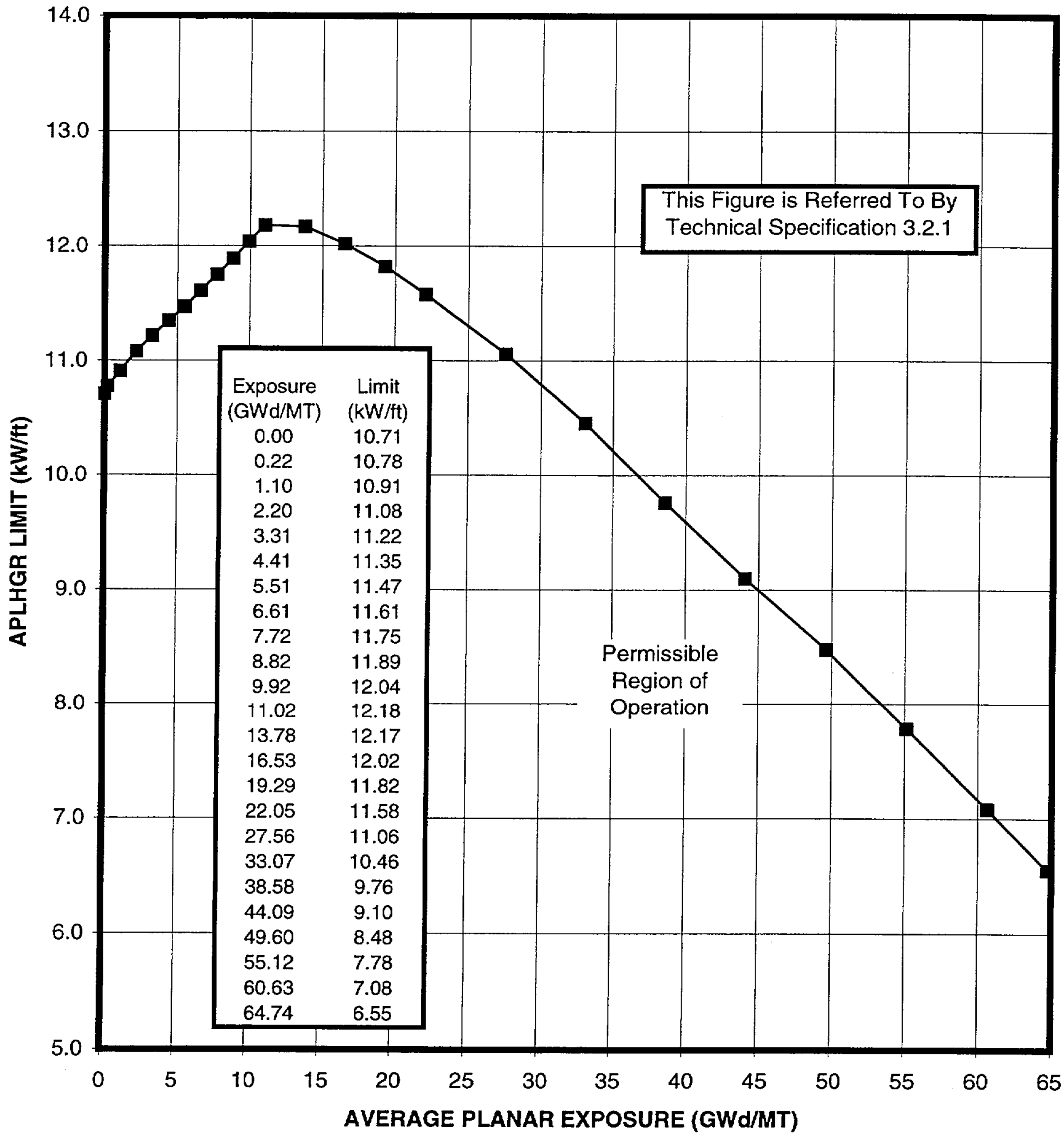
Fuel Type GE13-P9DTB403-7G6.0/7G5.0-100T-146-T (GE13)
Average Planar Linear Heat Generation Rate (APLHGR) Limit
Versus Average Planar Exposure



Exposure (GWd/MT)	Limit (kW/ft)
0.00	10.44
0.22	10.51
1.10	10.61
2.20	10.74
3.31	10.88
4.41	11.02
5.51	11.17
6.61	11.32
7.72	11.48
8.82	11.62
9.92	11.73
11.02	11.85
13.78	11.86
16.53	11.86
19.29	11.76
22.05	11.54
27.56	11.02
33.07	10.49
38.58	9.85
44.09	9.13
49.60	8.43
55.12	7.73
60.63	7.03
64.29	6.56

Figure 5

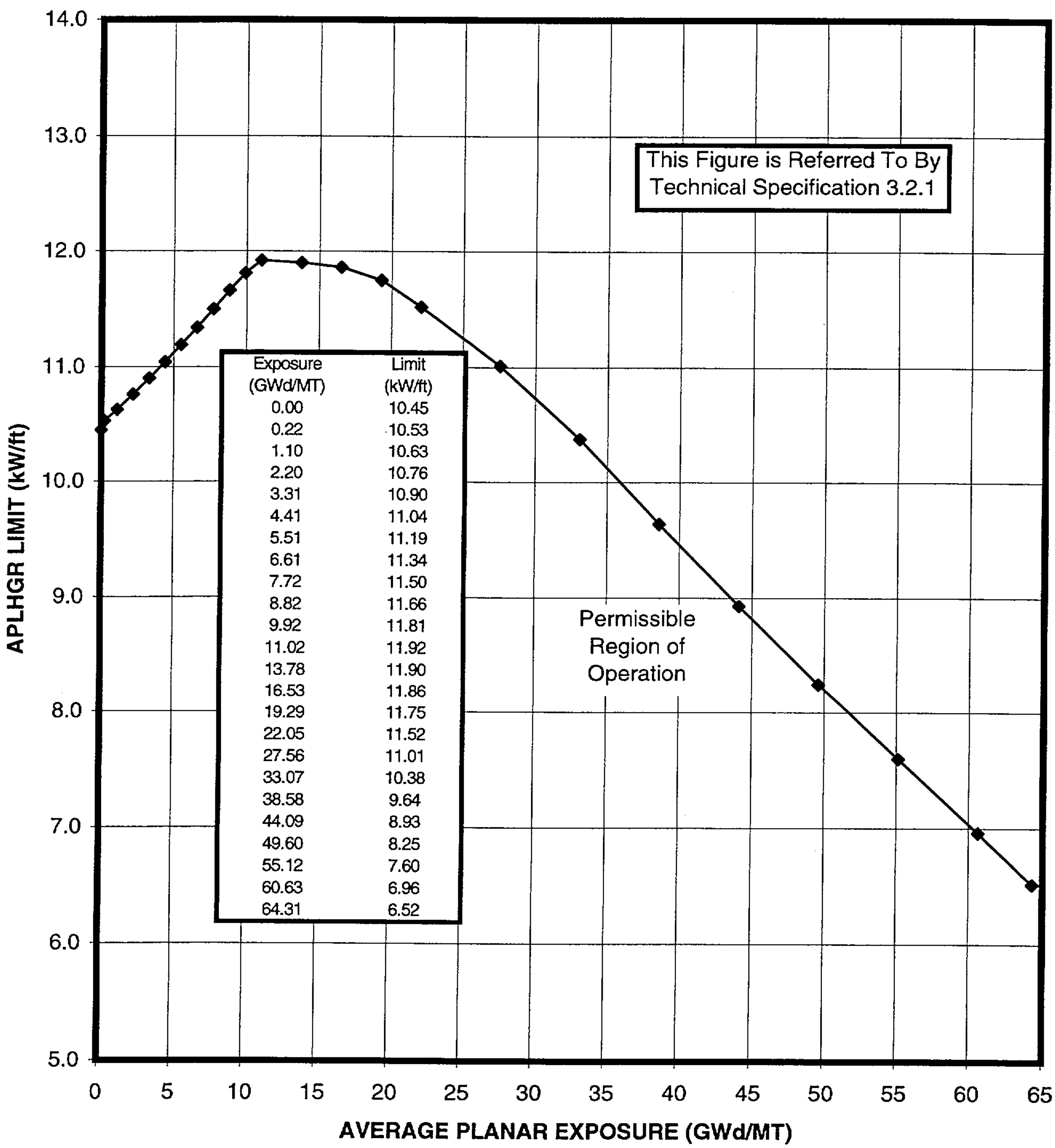
Fuel Type GE13-P9DTB405-5G6.0/7G5.0-100T-146-T (GE13) Average Planar Linear Heat Generation Rate (APLHGR) Limit Versus Average Planar Exposure



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	11.06
33.07	10.46
38.58	9.76
44.09	9.10
49.60	8.48
55.12	7.78
60.63	7.08
64.74	6.55

Figure 6

Fuel Type GE13-P9DTB402-13G6.0/1G2.0-100T-146-T (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	11.01
33.07	10.38
38.58	9.64
44.09	8.93
49.60	8.25
55.12	7.60
60.63	6.96
64.31	6.52

Figures 7 and 8 are **Not Used**

Figure 9

Flow-Dependent MAPLHGR Limit, MAPLHGR(F)

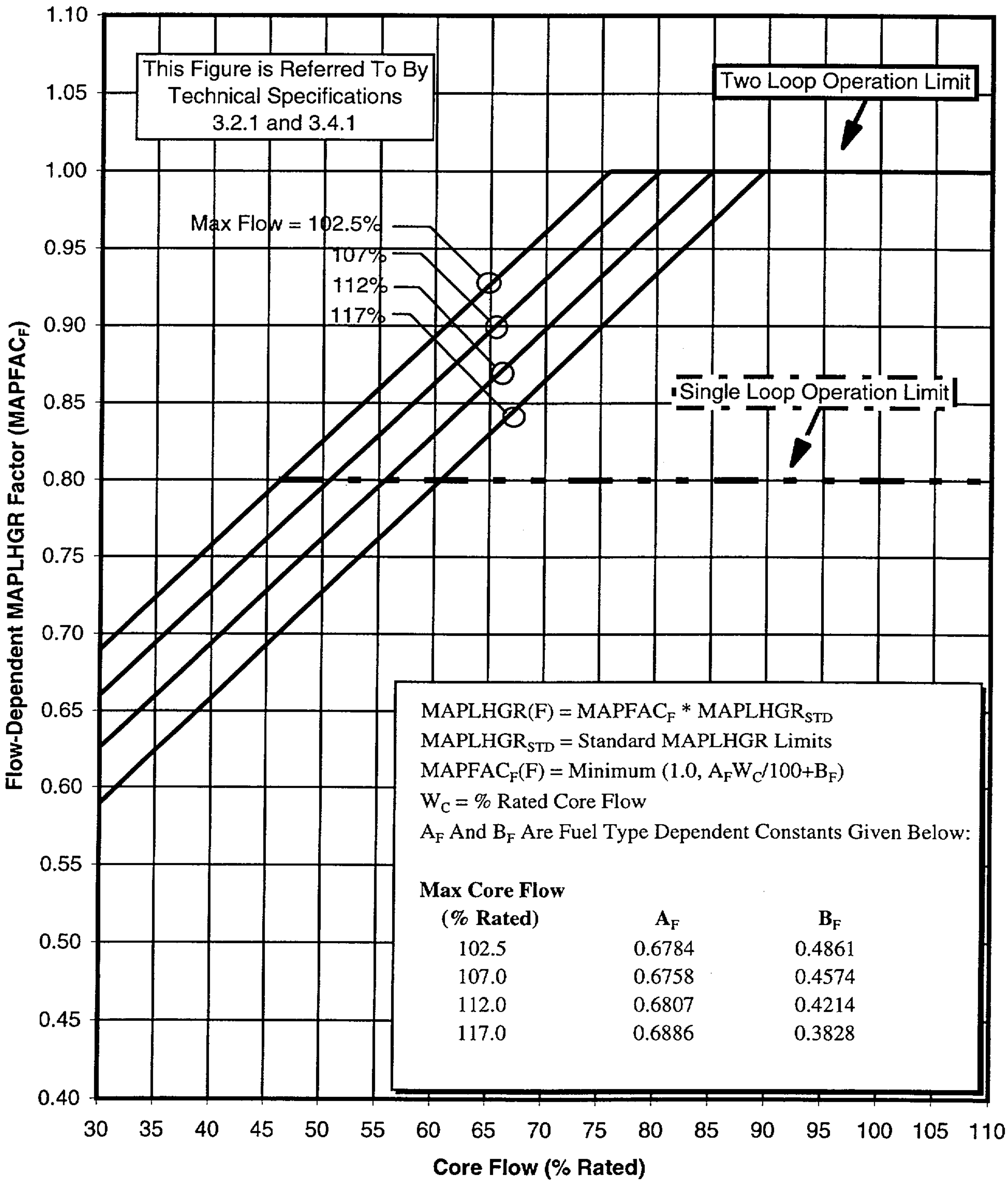


Figure 10

Power-Dependent MAPLHGR Limit, MAPLHGR (P)

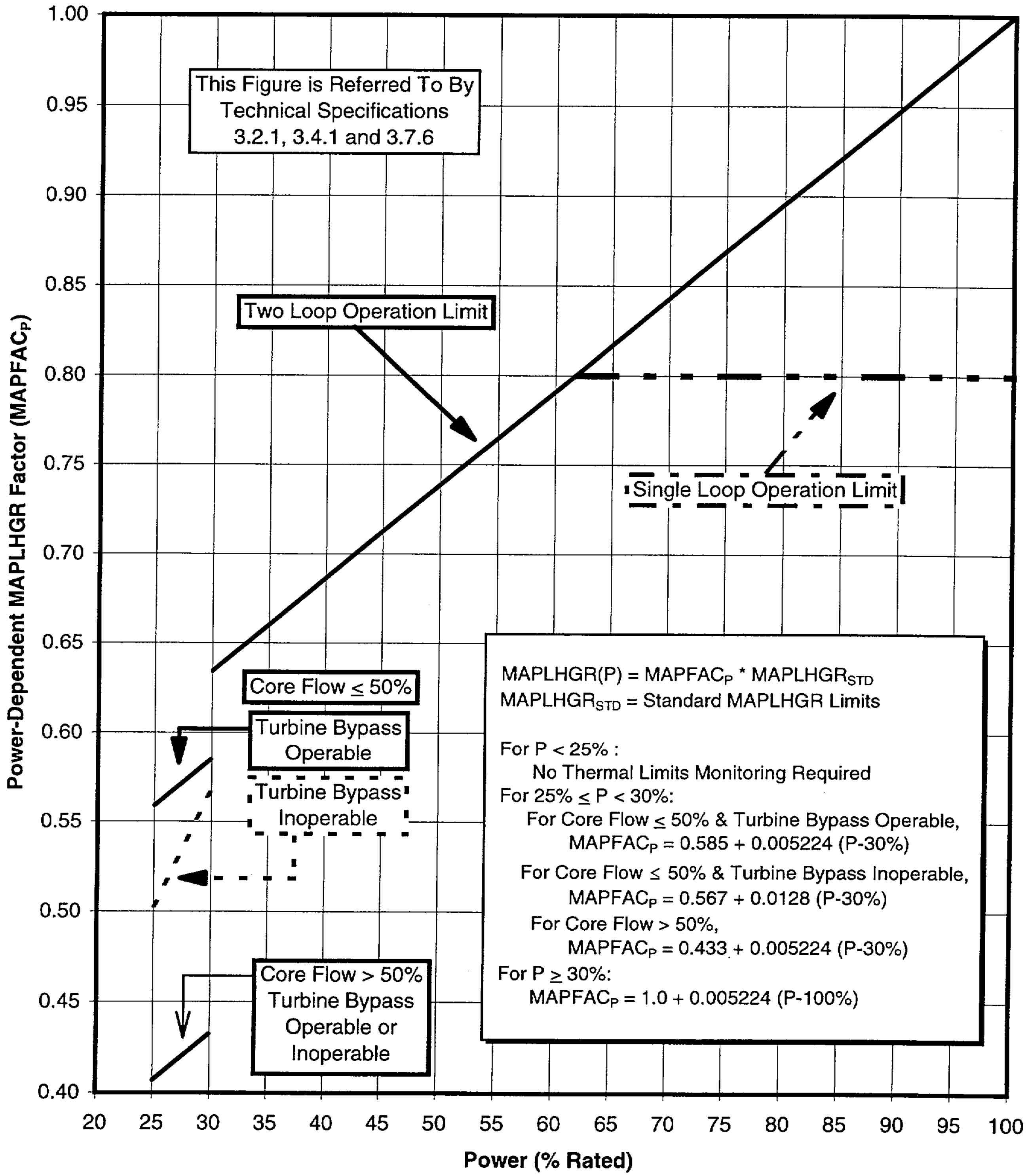


Figure 11

Flow-Dependent MCPR Limit, MCPR(F)

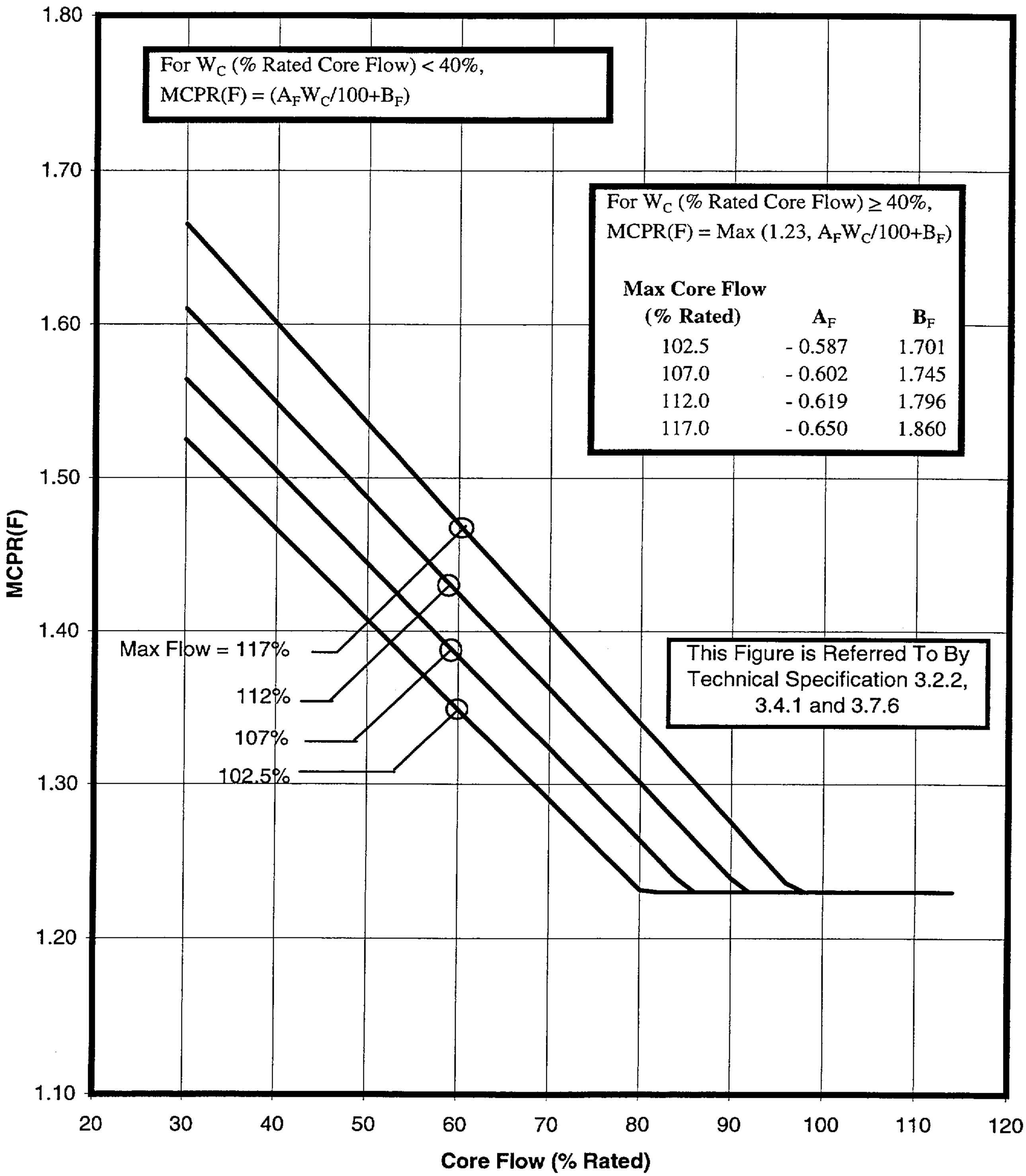


Figure 12

Power - Dependent MCPR Limit, MCPR (P)

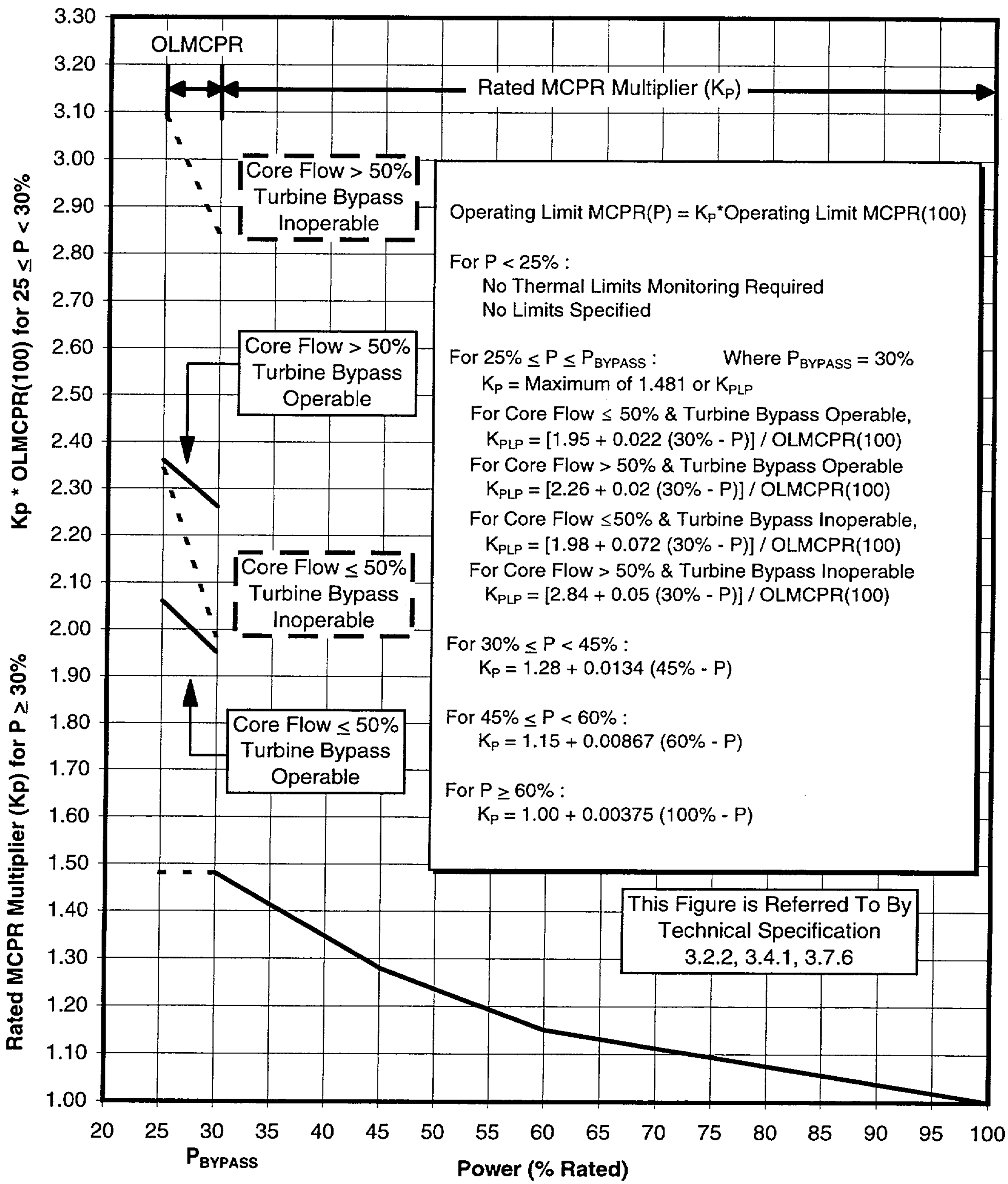
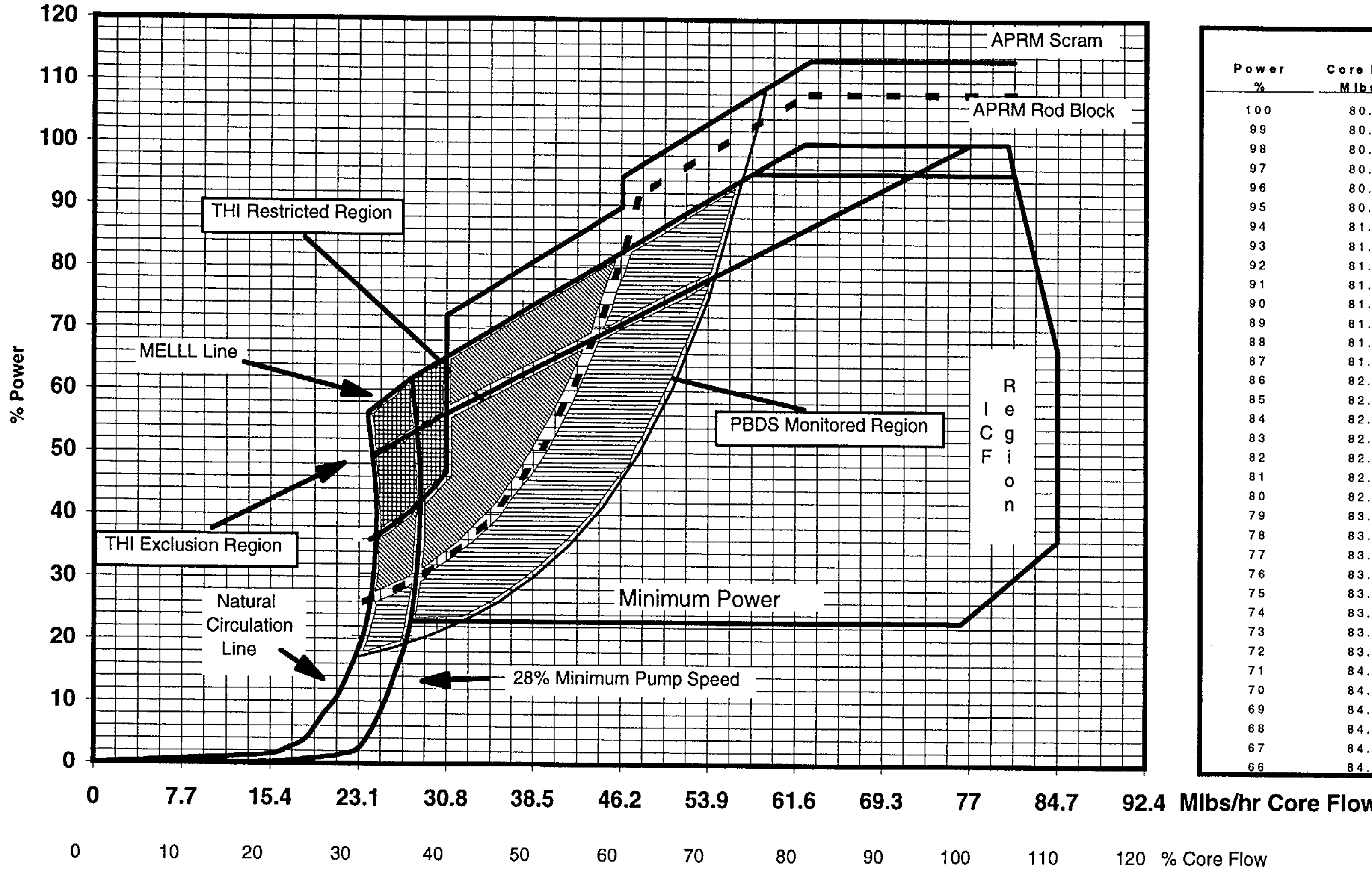


Figure 13
Power/Flow Map Stability Regions:
Normal T_{FW}, Non-Setup

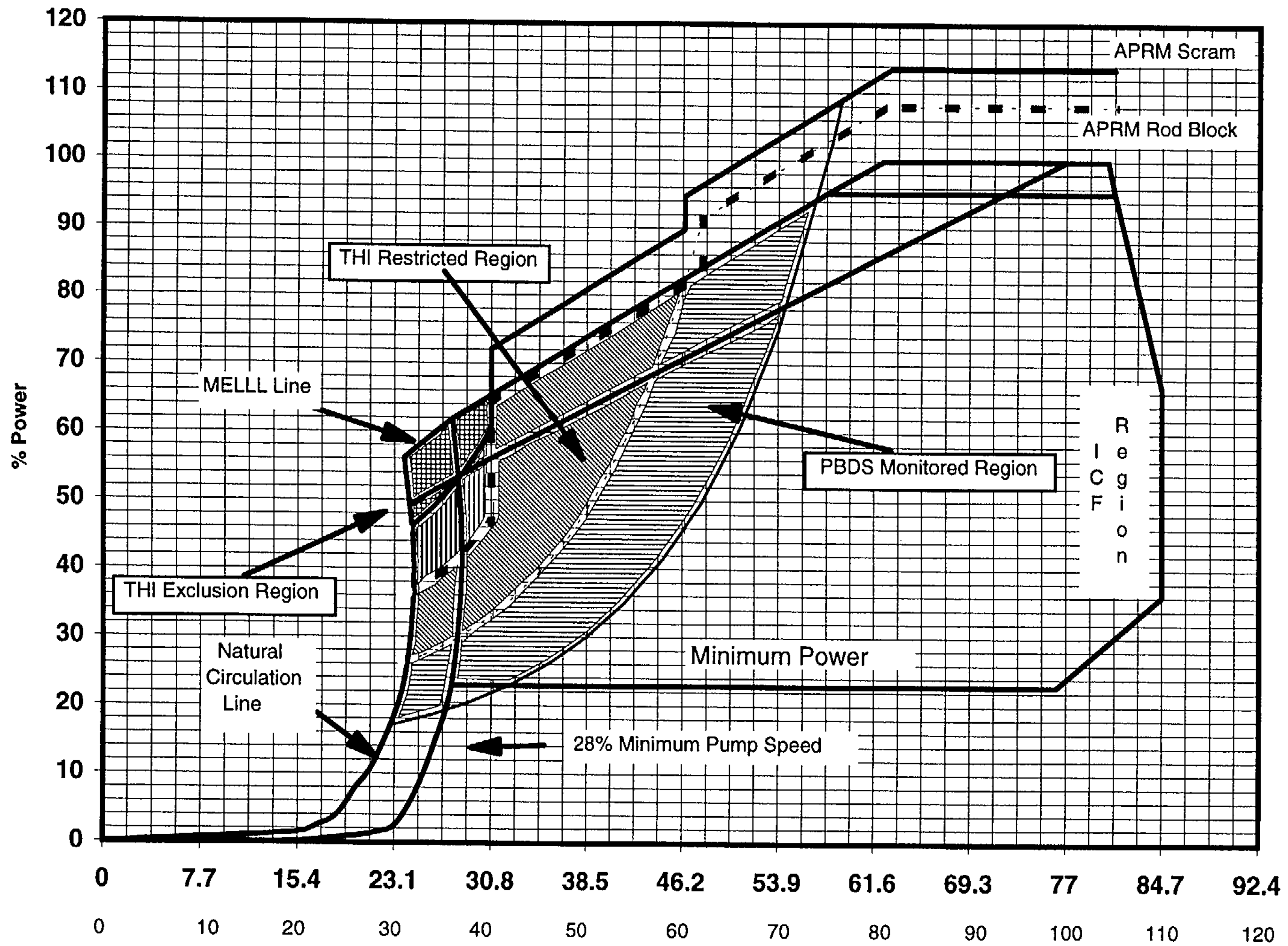
This Figure supports Improved Technical Specifications 3.2.3, 3.3.1.1 and 3.3.1.3 and the Technical Requirements Manual Specifications 3.2 and 3.3



Power %	Core Flow, Mlbs/hr
100	80.31
99	80.42
98	80.54
97	80.65
96	80.76
95	80.87
94	81.01
93	81.15
92	81.28
91	81.42
90	81.55
89	81.69
88	81.82
87	81.96
86	82.09
85	82.23
84	82.36
83	82.50
82	82.63
81	82.77
80	82.90
79	83.04
78	83.17
77	83.31
76	83.44
75	83.58
74	83.71
73	83.85
72	83.98
71	84.12
70	84.25
69	84.39
68	84.53
67	84.66
66	84.70

Figure 14
Power/Flow Map Stability Regions:
Normal T_{FW}, Setup

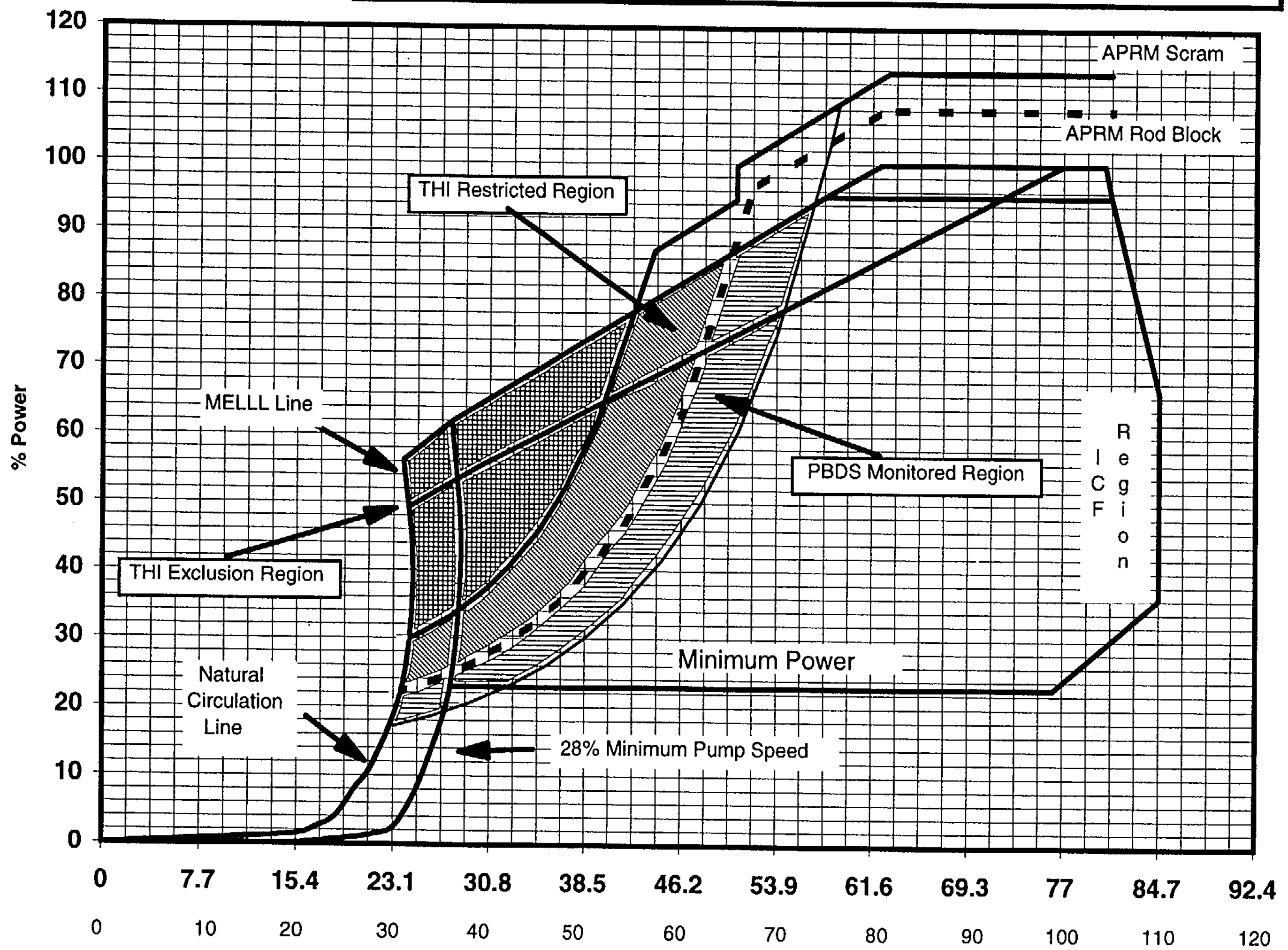
This Figure supports Improved Technical Specifications 3.2.3, 3.3.1.1 and 3.3.1.3 and the Technical Requirements Manual Specifications 3.2 and 3.3



Power %	Core Flow, Mlbs/hr
100	80.31
99	80.42
98	80.54
97	80.65
96	80.76
95	80.87
94	81.01
93	81.15
92	81.28
91	81.42
90	81.55
89	81.69
88	81.82
87	81.96
86	82.09
85	82.23
84	82.36
83	82.50
82	82.63
81	82.77
80	82.90
79	83.04
78	83.17
77	83.31
76	83.44
75	83.58
74	83.71
73	83.85
72	83.98
71	84.12
70	84.25
69	84.39
68	84.53
67	84.66
66	84.70

Figure 15
Power/Flow Map Stability Regions:
Reduced T_{FW}, Non-Setup

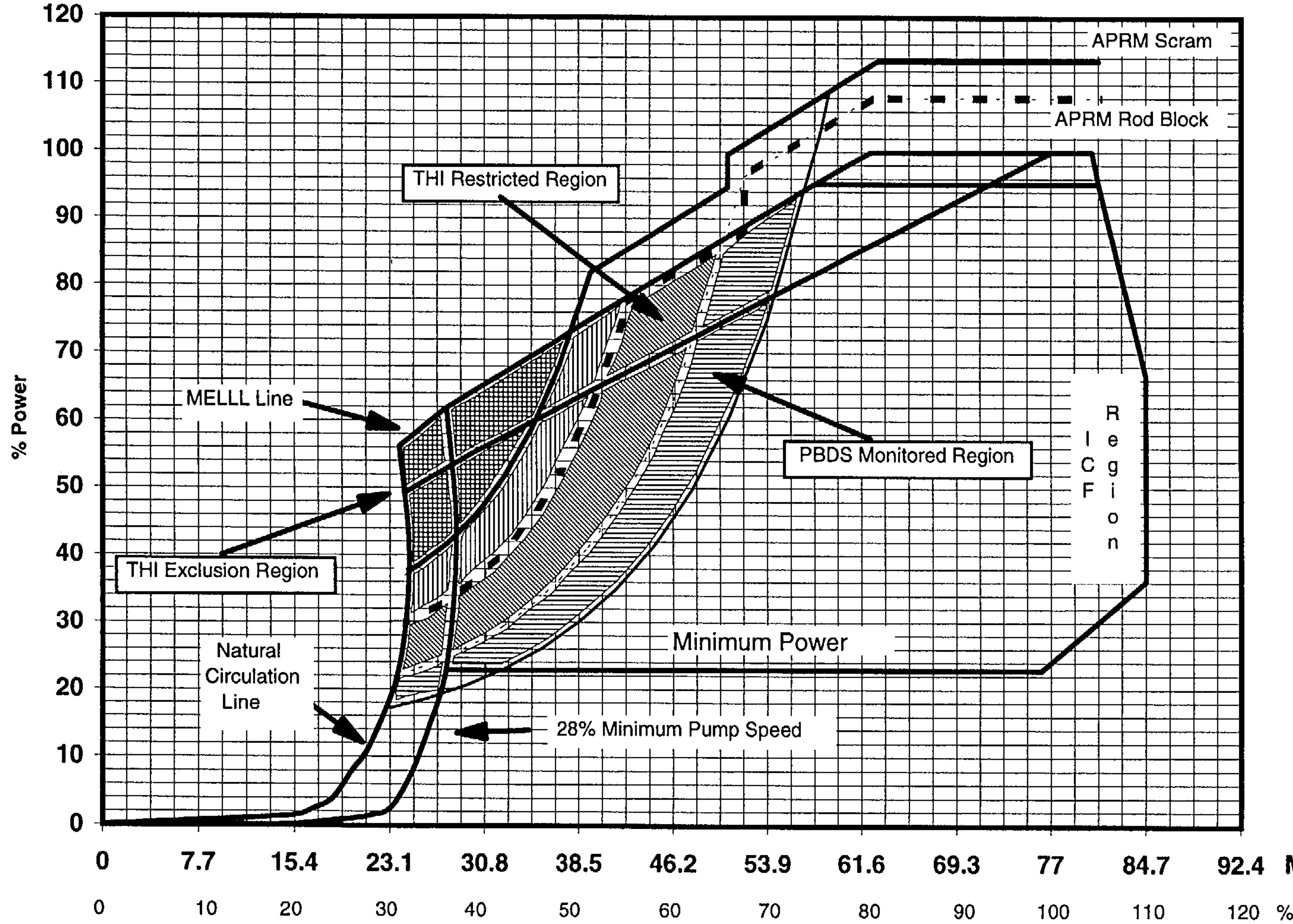
This Figure supports Improved Technical Specifications 3.2.3, 3.3.1.1 and 3.3.1.3 and the Technical Requirements Manual Specifications 3.2 and 3.3



Power %	Core Flow, Mlbs/hr
100	80.31
99	80.42
98	80.54
97	80.65
96	80.76
95	80.87
94	81.01
93	81.15
92	81.28
91	81.42
90	81.55
89	81.69
88	81.82
87	81.96
86	82.09
85	82.23
84	82.36
83	82.50
82	82.63
81	82.77
80	82.90
79	83.04
78	83.17
77	83.31
76	83.44
75	83.58
74	83.71
73	83.85
72	83.98
71	84.12
70	84.25
69	84.39
68	84.53
67	84.66
66	84.70

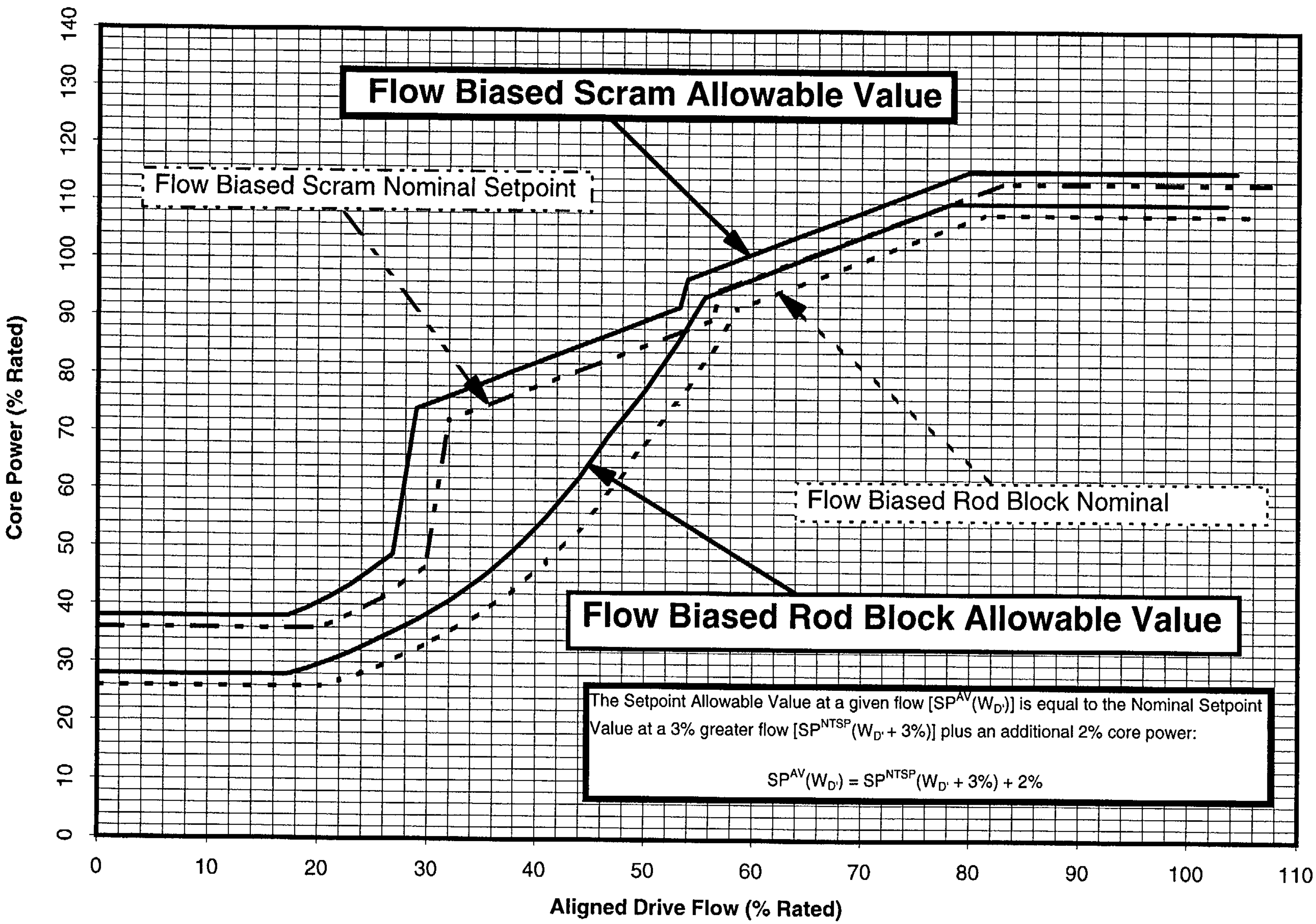
Figure 16
Power/Flow Map Stability Regions:
Reduced T_{FW}, Setup

This Figure supports Improved Technical Specifications 3.2.3, 3.3.1.1 and 3.3.1.3 and the Technical Requirements Manual Specifications 3.2 and 3.3



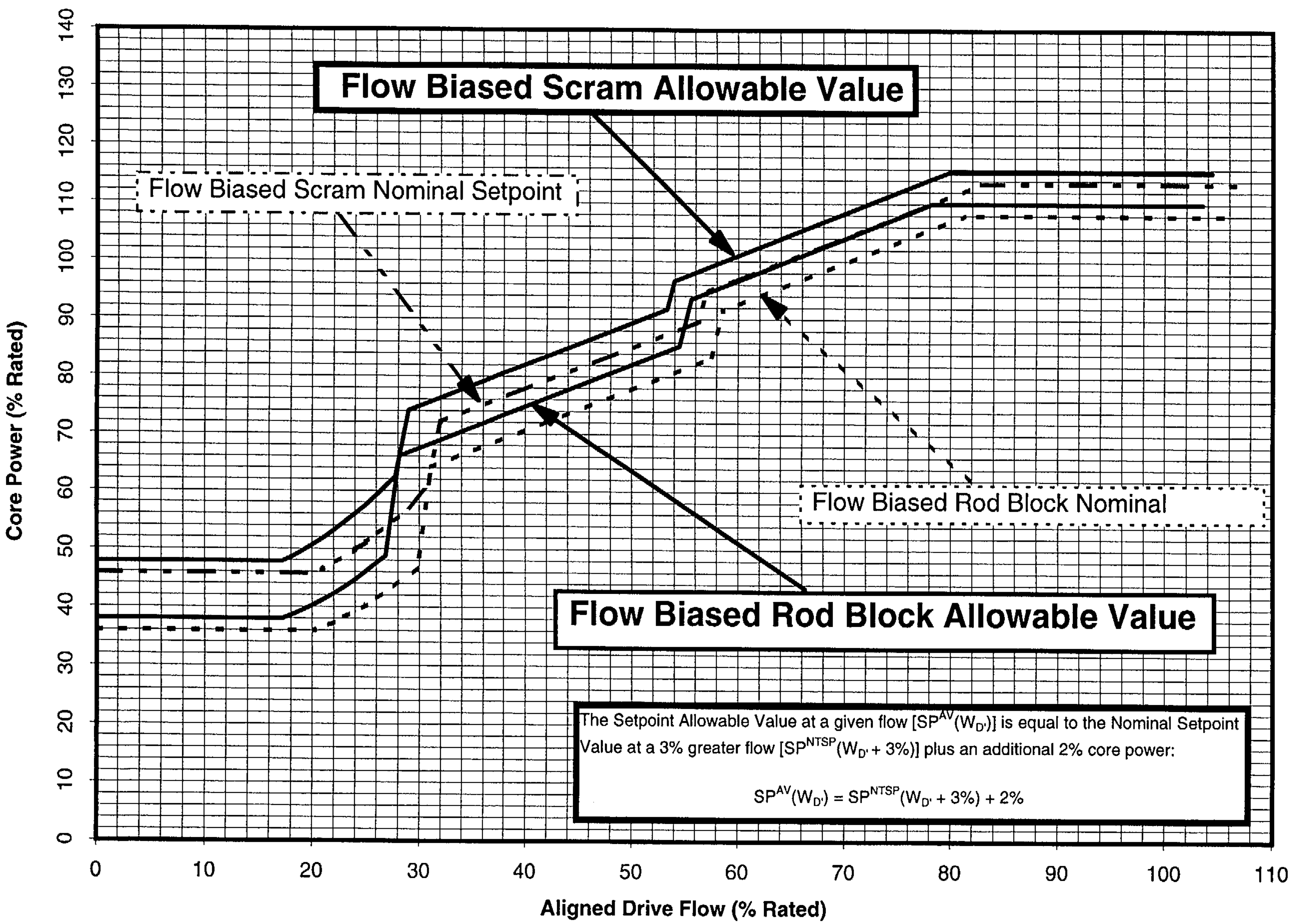
Power %	Core Flow, Mlbs/hr
100	80.31
99	80.42
98	80.54
97	80.65
96	80.76
95	80.87
94	81.01
93	81.15
92	81.28
91	81.42
90	81.55
89	81.69
88	81.82
87	81.96
86	82.09
85	82.23
84	82.36
83	82.50
82	82.63
81	82.77
80	82.90
79	83.04
78	83.17
77	83.31
76	83.44
75	83.58
74	83.71
73	83.85
72	83.98
71	84.12
70	84.25
69	84.39
68	84.53
67	84.66
66	84.70

Figure 17
E1A Setpoint Allowable Values versus Aligned Drive Flow:
Normal T_{FW}, Non-Setup



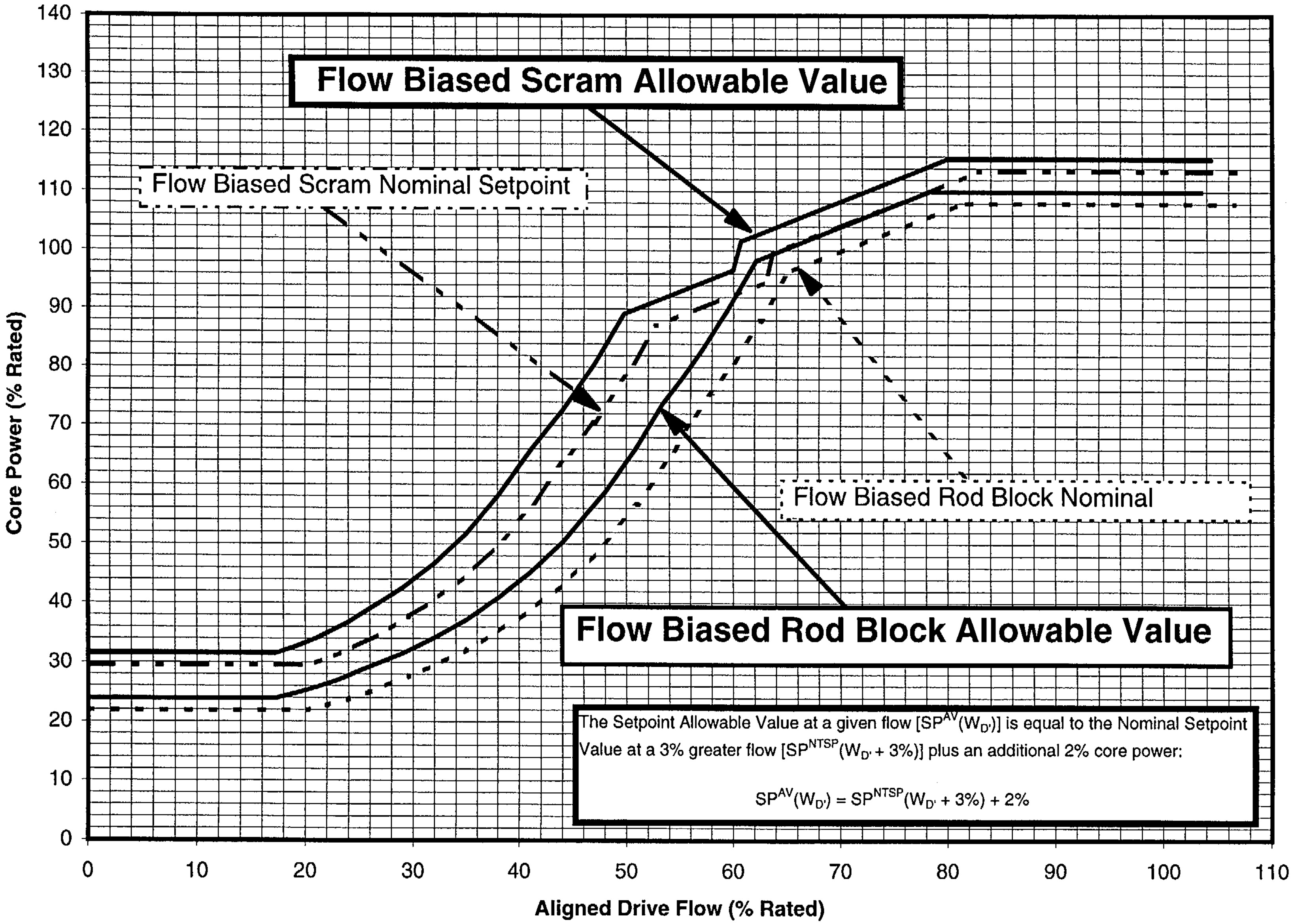
This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specifications 3.2 and 3.3

Figure 18
E1A Setpoint Allowable Values versus Aligned Drive Flow:
Normal T_{FW}, Setup



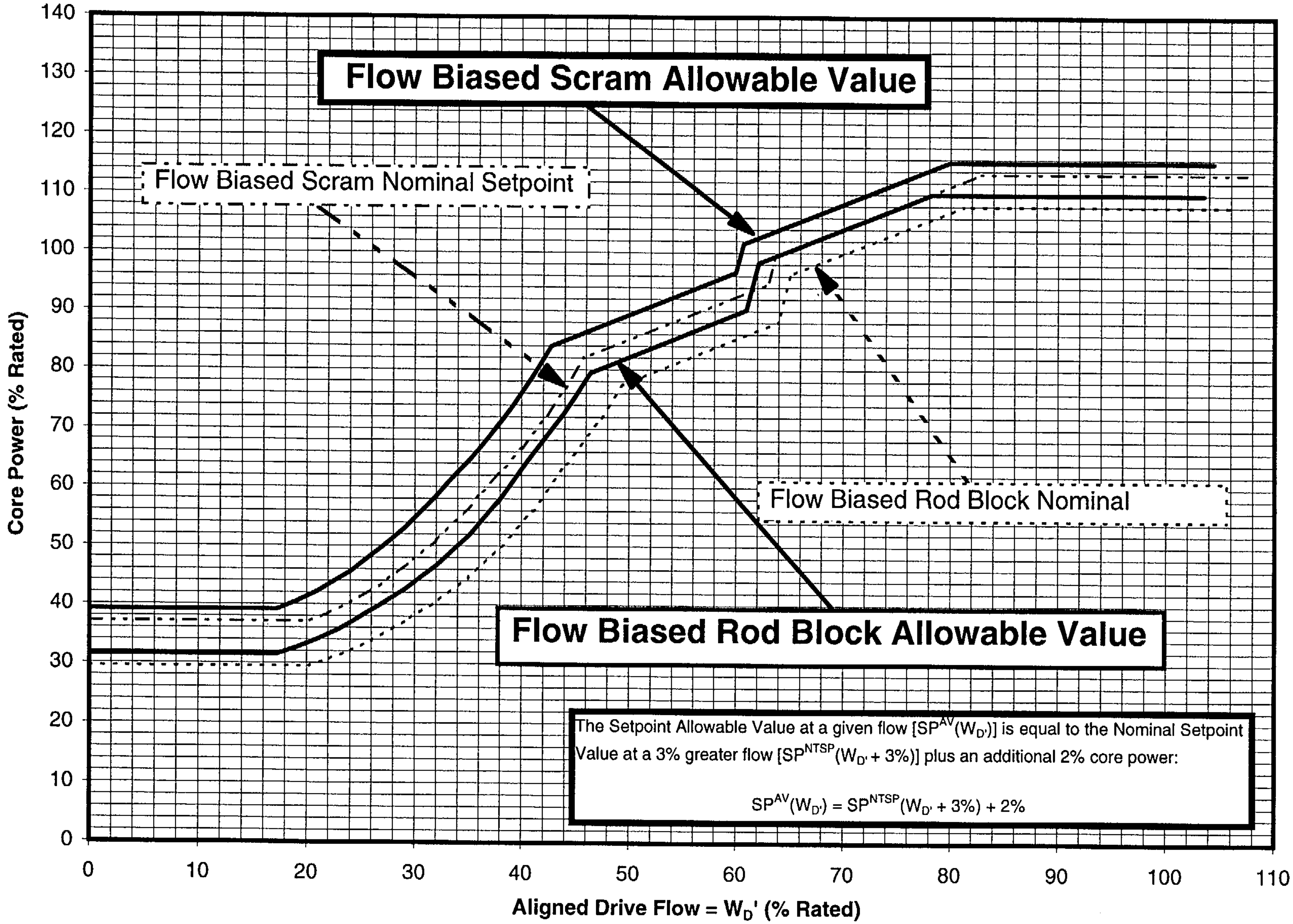
This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specifications 3.2 and 3.3

Figure 19
E1A Setpoint Allowable Values versus Aligned Drive Flow:
Reduced T_{FW}, Non-Setup



This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specifications 3.2 and 3.3

Figure 20
E1A Setpoint Allowable Values versus Aligned Drive Flow:
Reduced T_{FW}, Setup



This Figure supports Improved Technical Specification 3.3.1.1 and the Technical Requirements Manual Specifications 3.2 and 3.3

ENCLOSURE 2

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NO. 1
DOCKET NO. 50-325
LICENSE NO. DPR-71
TRANSMITTAL OF CORE OPERATING LIMITS REPORT,
SUPPLEMENTAL RELOAD LICENSING REPORT, AND
LOSS-OF-COOLANT ACCIDENT ANALYSIS REPORT

Supplemental Reload Licensing Report
For
Brunswick Steam Electric Plant Unit 1
Reload 12 Cycle 13,
J11-03594SRLR, Revision 0,
Class I, January 2000

Global Nuclear Fuel

A Joint Venture of GE, Toshiba, & Hitachi

J11-03594SRLR
Revision 0
Class I
January 2000

J11-03594SRLR, Rev. 0

Supplemental Reload Licensing Report

for

Brunswick Steam Electric Plant Unit 1

Reload 12 Cycle 13

Approved

G. A. Watford, Manager
Nuclear Fuel Engineering

Approved

W. H. Hetzel
Fuel Project Manager

Important Notice Regarding

Contents of This Report

Please Read Carefully

This report was prepared by Global Nuclear Fuel – Americas, LLC (GNF) solely for Carolina Power and Light Company (CP&L) for CP&L's use in defining operating limits for the Brunswick Steam Electric Plant Unit 1. The information contained in this report is believed by GNF to be an accurate and true representation of the facts known or obtained or provided to GNF at the time this report was prepared.

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Acknowledgement

The engineering and reload licensing analyses, which form the technical basis of this Supplemental Reload Licensing Report, were performed by Nuclear Fuel Engineering and Nuclear & Safety Analysis personnel. The Supplemental Reload Licensing Report was prepared by R. M. Butrovich. This document has been verified by S. B. Shelton.

The basis for this report is *General Electric Standard Application for Reactor Fuel*, NEDE-24011-P-A-13, August 1996; and the U.S. Supplement, NEDE-24011-P-A-13-US, August 1996.

1. Plant-unique Items

Appendix A: Analysis Conditions
Appendix B: Main Steamline Isolation Valve Out of Service (MSIVOOS)
Appendix C: Decrease in Core Coolant Temperature Events
Appendix D: Feedwater Temperature Reduction (FWTR)
Appendix E: Maximum Extended Operating Domain (MEOD)
Appendix F: Turbine Bypass Out of Service (TBPOOS)
Appendix G. Basis for Analysis of SLCS Shutdown Capability

2. Reload Fuel Bundles

Fuel Type	Cycle Loaded	Number
Irradiated:		
GE13-P9DTB380-10G5.0A-100T-146-T (GE13)	11	96
GE13-P9DTB380-11G5.0A-100T-146-T (GE13)	11	48
GE13-P9DTB403-5G6.0/7G5.0-100T-146-T (GE13)	12	36
GE13-P9DTB403-7G6.0/7G5.0-100T-146-T (GE13)	12	160
New:		
GE13-P9DTB402-13G6.0/1G2.0-100T-146-T (GE13)	13	168
GE13-P9DTB405-5G6.0/7G5.0-100T-146-T (GE13)	13	52
Total		560

3. Reference Core Loading Pattern[1]

Nominal previous cycle core average exposure at end of cycle:	30569 MWd/MT (27732 MWd/ST)
Minimum previous cycle core average exposure at end of cycle from cold shutdown considerations:	30174 MWd/MT (27373 MWd/ST)
Assumed reload cycle core average exposure at beginning of cycle:	15093 MWd/MT (13692 MWd/ST)
Assumed reload cycle core average exposure at end of cycle:	32443 MWd/MT (29432 MWd/ST)
Reference core loading pattern:	Figure 1

[1] The previous cycle core average exposure at beginning of cycle is 14339 MWd/MT (13008 MWd/ST).

4. Calculated Core Effective Multiplication and Control System Worth - No Voids, 20°C

Beginning of Cycle, $k_{effective}$	
Uncontrolled	1.112
Fully controlled	0.957
Strongest control rod out	0.987
R, Maximum increase in cold core reactivity with exposure into cycle, Δk	0.003

5. Standby Liquid Control System Shutdown Capability[2]

Boron (ppm) (at 160°C)	Shutdown Margin (Δk) (at 160°C, Xenon Free)
726	0.025

6. Reload Unique GETAB Anticipated Operational Occurrences (AOO) Analysis Initial Condition Parameters[3]

Exposure: BOC13 to EOC13-2756 MWd/MT (2500 MWd/ST) with ICF							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GE13	1.45	1.43	1.47	1.020	6.356	110.0	1.37

Exposure: EOC13-2756 MWd/MT (2500 MWd/ST) to EOC13 with ICF							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GE13	1.45	1.37	1.55	1.020	6.113	113.6	1.36

[2] See Appendix G.
[3] EOC13 is defined as the end of full power capability with all rods out at 104.3% rated core flow.

Exposure: BOC13 to EOC13 with ICF and TBPOOS							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GE13	1.45	1.35	1.55	1.020	6.025	114.2	1.38

Exposure: BOC13 to EOC13 with ICF, TBPOOS and FWTR							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GE13	1.45	1.50	1.24	1.020	6.665	107.8	1.39

7. Selected Margin Improvement Options

Recirculation pump trip:	No
Rod withdrawal limiter:	No
Thermal power monitor:	Yes
Improved scram time:	Yes (ODYN Option B)
Measured scram time:	No
Exposure dependent limits:	Yes
Exposure points analyzed:	2 (EOC13-2756 MWd/MT and EOC13)

8. Operating Flexibility Options

Single-loop operation:	Yes
Load line limit:	Yes
Extended load line limit:	Yes
Maximum extended load line limit:	Yes
Increased core flow throughout cycle:	Yes
Flow point analyzed:	104.3 %
Feedwater temperature reduction throughout cycle:	Yes
Temperature reduction:	110.3°F
Final feedwater temperature reduction:	Yes
ARTS Program:	Yes
Maximum extended operating domain:	Yes
Moisture separator reheater OOS:	No
Turbine bypass system OOS:	Yes
Safety/relief valves OOS:	Yes

(credit taken for 9 of 11 valves, however, ATWS evaluations require 10 in-service for power uprate)

ADS OOS:	Yes (2 valves OOS)
EOC RPT OOS:	No
Main steam isolation valves OOS:	Yes

9. Core-wide AOO Analysis Results

Methods used: GEMINI; GEXL-PLUS

Exposure range: BOC13 to EOC13-2756 MWd/MT (2500 MWd/ST) with ICF				
			Uncorrected ΔCPR	
Event	**Flux (%NBR)**	**Q/A (%NBR)**	**GE13**	**Fig.**
Load Reject w/o Bypass	567	125	0.26	2

Exposure range: EOC13-2756 MWd/MT (2500 MWd/ST) to EOC13 with ICF				
			Uncorrected ΔCPR	
Event	**Flux (%NBR)**	**Q/A (%NBR)**	**GE13**	**Fig.**
Load Reject w/o Bypass	571	127	0.26	3

Exposure range: BOC13 to EOC13 with ICF and TBPOOS				
			Uncorrected ΔCPR	
Event	**Flux (%NBR)**	**Q/A (%NBR)**	**GE13**	**Fig.**
FW Controller Failure	643	133	0.29	4

Exposure range: BOC13 to EOC13 with ICF, TBPOOS and FWTR				
			Uncorrected ΔCPR	
Event	**Flux (%NBR)**	**Q/A (%NBR)**	**GE13**	**Fig.**
FW Controller Failure	424	125	0.30	5

10. Local Rod Withdrawal Error (With Limiting Instrument Failure) AOO Summary

The rod withdrawal error (RWE) event in the maximum extended operating domain was originally analyzed in the GE BWR Licensing Report, *Maximum Extended Operating Domain Analysis for Brunswick Steam Electric Plant*, NEDC-31654P, February 1989. The analysis resulted in a RWE ΔCPR of 0.15 at a rod block monitor setpoint of 108%. The MCPR for rod withdrawal error is bounded by the operating limit MCPRs presented in Section 11 of this report for RBM setpoints shown in Table 10-5(a) or 10-5(b) of NEDC-31654P. In addition, the RMB System setpoints shown in Table 10-5(c) for a Rated ΔCPR of 0.23 are supported for Brunswick Unit 1 Cycle 13. The RBM operability requirements specified in Section 10.5 of NEDC-31654P have been evaluated and shown to be sufficient to ensure that the Safety Limit MCPR and cladding 1% plastic strain criteria will not be exceeded in the event of an unblocked RWE event.

11. Cycle MCPR Values [4] [5]

Safety limit: 1.10

Single loop operation safety limit: 1.11

Non-pressurization events:

Exposure range: BOC13 to EOC13	
	GE13
Fuel Loading Error (misoriented)	1.22
Fuel Loading Error (mislocated)	1.21
Control Rod Withdrawal Error (RBM setpoint at 108%)	1.25[6]

Pressurization events:

Exposure range: BOC13 to EOC13-2756 MWd/MT (2500 MWd/ST) with ICF **Exposure point: EOC13-2756 MWd/MT (2500 MWd/ST)**		
	Option A	**Option B**
	GE13	**GE13**
Load Reject w/o Bypass	1.41	1.36

Exposure range: EOC13-2756 MWd/MT (2500 MWd/ST) to EOC13 with ICF **Exposure point: EOC13**		
	Option A	**Option B**
	GE13	**GE13**
Load Reject w/o Bypass	1.46	1.38

Exposure range: BOC13 to EOC13 with ICF and TBPOOS **Exposure point: EOC13**		
	Option A	**Option B**
	GE13	**GE13**
FW Controller Failure	1.49	1.41

[4] The Operating Limit MCPR for two loop operation (TLO) bounds the Operating Limit MCPR for single loop operation (SLO); therefore, the Operating Limit MCPR need not be changed for SLO.
[5] The ICF Operating Limits for the exposure range of BOC13 to EOC13 bound the Operating Limits for the following domains: MELLL, ICF and FWTR, MSIVOOS and ICF.
[6] Based on a RWE analysis that resulted in a ΔCPR of 0.15.

Exposure range: BOC13 to EOC13 with ICF, TBPOOS and FWTR **Exposure point: EOC13**		
	Option A	**Option B**
	GE13	**GE13**
FW Controller Failure	1.50	1.42

12. Overpressurization Analysis Summary

Event	Psl (psig)	Pv (psig)	Plant Response
MSIV Closure (Flux Scram)	1288	1319	Figure 6

13. Loading Error Results

Variable water gap misoriented bundle analysis: Yes [7]

Misoriented Fuel Bundle	ΔCPR
GE13-P9DTB403-5G6.0/7G5.0-100T-146-T (GE13)	0.06
GE13-P9DTB403-7G6.0/7G5.0-100T-146-T (GE13)	0.10
GE13-P9DTB405-5G6.0/7G5.0-100T-146-T (GE13)	0.08
GE13-P9DTB402-13G6.0/1G2.0-100T-146-T (GE13)	0.12

Mislocated Fuel Bundle	ΔCPR
Fuel Loading Error (mislocated)	0.11

14. Control Rod Drop Analysis Results

This is a banked position withdrawal sequence plant, therefore, the control rod drop accident analysis is not required. NRC approval is documented in NEDE-24011-P-A-US.

15. Stability Analysis Results

Brunswick Unit 1 Cycle 11, Reactor Stability Long-Term Solution Enhanced Option I-A, Stability Region Boundary Generation and Validation, GENE-A13-00367-47 documents the Enhanced Option I-A (EIA) stability region boundaries for Brunswick Unit 1 Cycle 11 and the analysis associated with their generation and validation.

Brunswick Unit 1 has implemented BWROG Long Term Stability Solution Enhanced Option I-A (E1A) in

[7] Includes a 0.02 penalty due to variable water gap R-factor uncertainty.

accordance with NEDO-32339-A, Rev. 1, *Licensing Topical Report Reactor Stability Long-Term Solution: Enhanced Option I-A,* April 1998. E1A stability region boundaries for the Normal Trip Reference (NTR) set and the Alternate Trip Reference (ATR) set are defined in *Brunswick Unit 1 Cycle 11 Reactor Stability Long-Term Solution Enhanced Option I-A Stability Region Boundary Generation and Validation*, GENE-A13-00367-47, December 1996. Reload analysis is performed to document that the E1A region boundaries are applicable to Brunswick Unit 1 Cycle 13. In accordance with NEDO-32339-A, Rev. 1, only the NTR set must be validated for Cycle 13 since Brunswick Unit 1 employs the E1A Maximal Region Boundaries for the ATR set.

Reload analysis consists of calculating the core and hot channel decay ratios for seven (7) Reload Validation Matrix (RVM) state points using the methodology described in NEDO-32339-A Rev. 1. The existing region boundaries are validated if the RVM decay ratios are within the ODYSY stability criteria. The RVM results confirm that the existing NTR set region boundaries are validated for Brunswick Unit 1 Cycle 13 as shown in Figure 7. Therefore, the existing Brunswick Unit 1 E1A region boundaries remain valid for Cycle 13.

Reload validation was demonstrated without using the optional statistical approach to reload analysis defined in NEDO-32339-A, Rev. 1.

16. Loss-of-Coolant Accident Results

LOCA method used: SAFER/GESTR-LOCA

The GE8x8EB LOCA analysis results, presented in Sections 5 and 6 of *Brunswick Steam Electric Plant Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis,* NEDC-31624P, Revision 2, July 1990, yielded a licensing basis peak clad temperature of 1533 °F, a peak local oxidation fraction of <0.30%, and a core-wide metal-water reaction of 0.046%.

An additional LOCA analysis was performed for the GE13, unique fuel type loaded in the cycle 13 core. The results, presented in *Brunswick Steam Electric Plant Units 1 and 2, SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis: Application to GE13 Fuel*, NEDC-31624P, Supplement 3, Revision 0, January 1996, show a licensing basis peak clad temperature of 1535 °F. The peak local oxidation fraction <0.30%, and core-wide metal-water reaction <0.036%.

This analysis did not establish new Licensing Basis PCTs for the fuels in Brunswick Unit 1. Therefore, the following changes and error effects must be added to the Licensing Basis PCT of 1535 °F: 10 °F for the omission of the Bottom Head Drainline Break in the determination of the DBA break area (see *Reporting of Changes and Errors in ECCS Evaluation Models*, MFN-020-96, February 20, 1996), 50 °F for a sensitivity of small input parameters changes for BWR/4 plants with LPCI injection into the lower plenum (see *Reporting of Changes and Errors in ECCS Evaluation Models*, MFN-090-93, June 30, 1993).

A single loop operation MAPLHGR multiplier of 0.80 is applicable to GE13 fuel. Therefore, the power- and flow-dependent MAPLHGR adjustment factors identified in Figures 4-2 and 4-4 of *Maximum Extended Operating Domain Analysis for the Brunswick Steam Electric Plant*, NEDC-31654P, Class III (GE Nuclear Energy Proprietary), February 1989, should be used with the limitation that no multiplier greater than 0.80 is used during SLO.

The most and least limiting MAPLHGRs for the new GE13 fuel designs are as follows:

16. Loss-of-Coolant Accident Results (cont.)

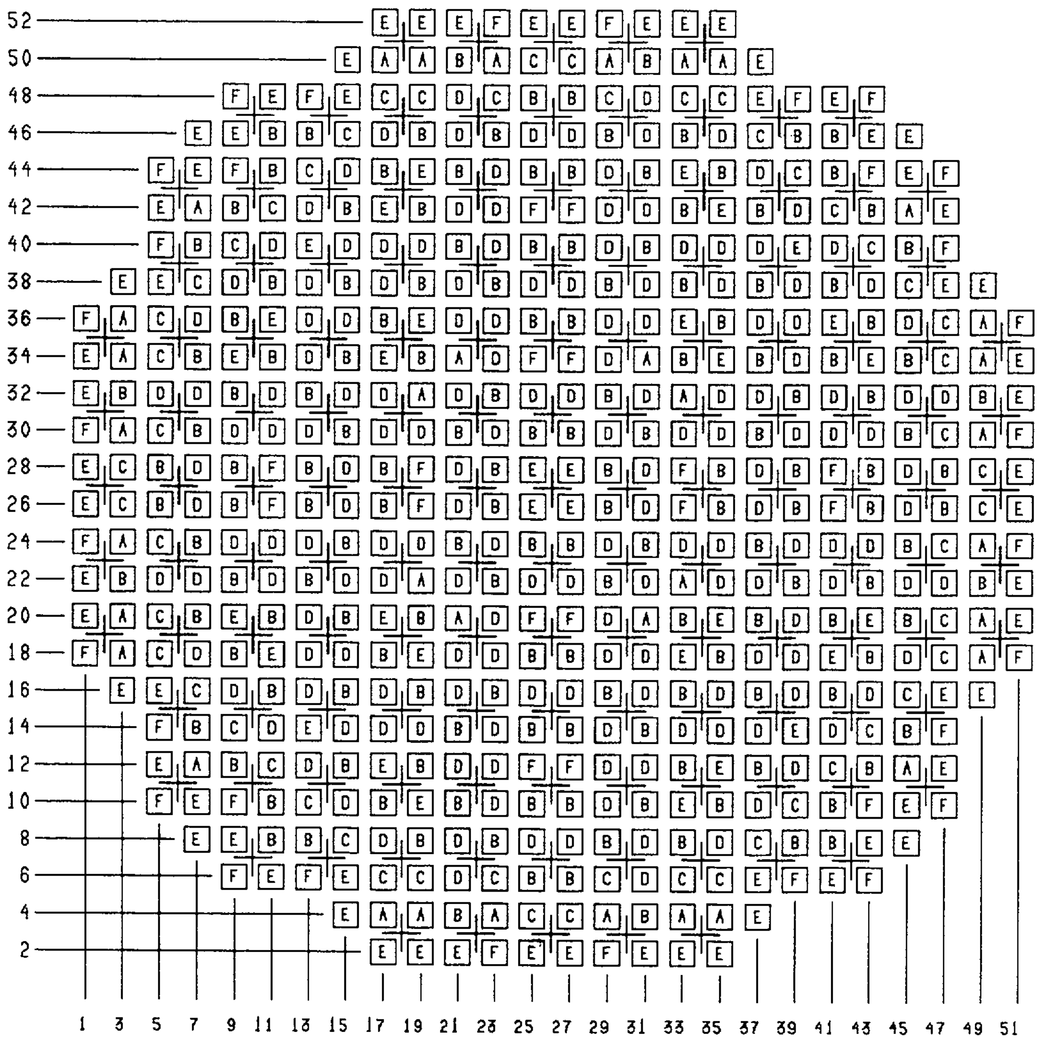
Bundle Type: GE13-P9DTB405-5G6.0/7G5.0-100T-146-T

Average Planar Exposure		MAPLHGR (kw/ft)	
(GWd/ST)	(GWd/MT)	Most Limiting	Least Limiting
0.00	0.00	10.71	10.85
0.20	0.22	10.78	10.90
1.00	1.10	10.91	10.99
2.00	2.20	11.08	11.10
3.00	3.31	11.22	11.27
4.00	4.41	11.35	11.46
5.00	5.51	11.47	11.61
6.00	6.61	11.61	11.76
7.00	7.72	11.75	11.92
8.00	8.82	11.89	12.08
9.00	9.92	12.04	12.22
10.00	11.02	12.18	12.36
12.50	13.78	12.17	12.45
15.00	16.53	12.02	12.34
17.50	19.29	11.82	12.12
20.00	22.05	11.58	11.85
25.00	27.56	11.06	11.22
30.00	33.07	10.46	10.54
35.00	38.58	9.76	9.91
40.00	44.09	9.10	9.19
45.00	49.60	8.48	8.48
50.00	55.12	7.78	7.87
55.00	60.63	7.08	7.25
58.73	64.74	6.55	6.77
59.47	65.55	--	6.68

16. Loss-of-Coolant Accident Results (cont.)

Bundle Type: GE13-P9DTB402-13G6.0/1G2.0-100T-146-T

Average Planar Exposure		MAPLHGR (kw/ft)	
(GWd/ST)	(GWd/MT)	Most Limiting	Least Limiting
0.00	0.00	10.45	10.46
0.20	0.22	10.53	10.53
1.00	1.10	10.63	10.64
2.00	2.20	10.76	10.79
3.00	3.31	10.90	10.95
4.00	4.41	11.04	11.11
5.00	5.51	11.19	11.28
6.00	6.61	11.34	11.45
7.00	7.72	11.50	11.63
8.00	8.82	11.66	11.80
9.00	9.92	11.81	11.95
10.00	11.02	11.92	12.10
12.50	13.78	11.90	12.19
15.00	16.53	11.86	12.21
17.50	19.29	11.75	12.05
20.00	22.05	11.52	11.78
25.00	27.56	11.01	11.13
30.00	33.07	10.38	10.48
35.00	38.58	9.64	9.83
40.00	44.09	8.93	9.12
45.00	49.60	8.25	8.42
50.00	55.12	7.60	7.72
55.00	60.63	6.96	7.02
58.34	64.31	6.52	6.55
59.04	65.08	--	6.43



Fuel Type	
A=GE13-P9DTB403-5G6.0/7G5.0-100T-146-T (Cycle 12)	D=GE13-P9DTB402-13G6.0/1G2.0-100T-146-T (Cycle 13)
B=GE13-P9DTB403-7G6.0/7G5.0-100T-146-T (Cycle 12)	E=GE13-P9DTB380-10G5.0A-100T-146-T (Cycle 11)
C=GE13-P9DTB405-5G6.0/7G5.0-100T-146-T (Cycle 13)	F=GE13-P9DTB380-11G5.0A-100T-146-T (Cycle 11)

Figure 1 Reference Core Loading Pattern

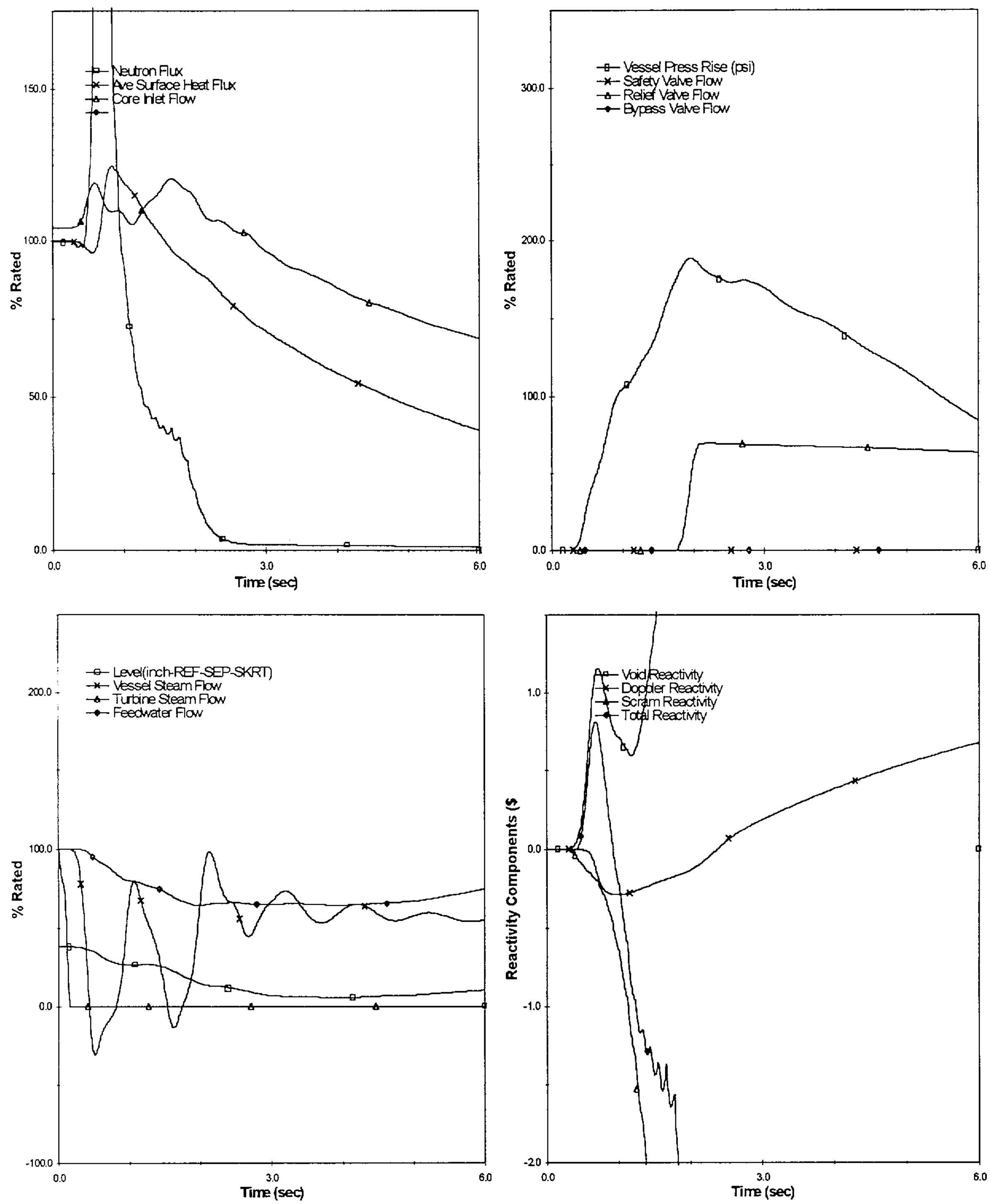


Figure 2 Plant Response to Load Reject w/o Bypass (BOC13 to EOC13-2756 MWd/MT (2500 MWd/ST) with ICF)

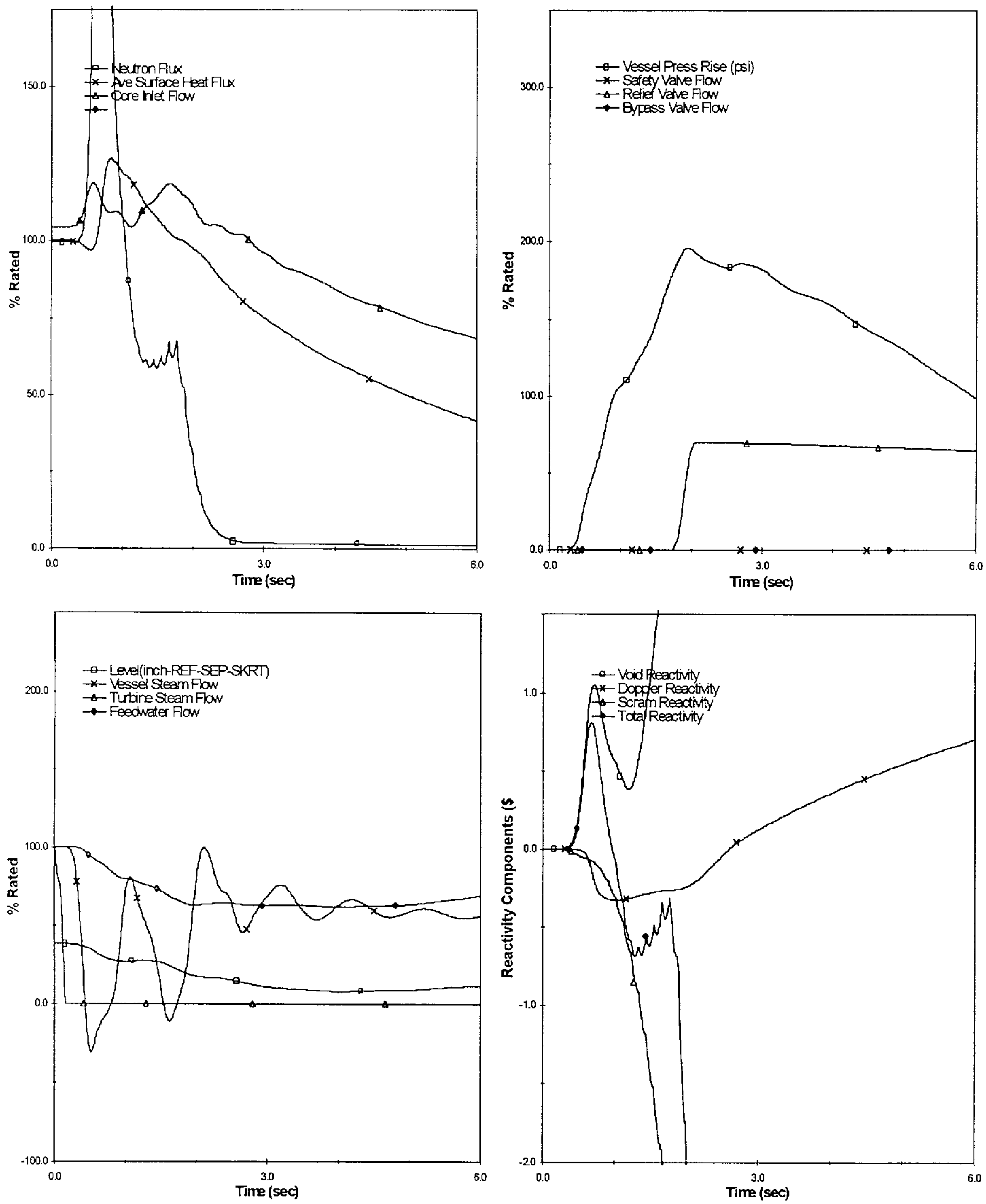


Figure 3 Plant Response to Load Reject w/o Bypass (EOC13-2756 MWd/MT (2500 MWd/ST) to EOC13 with ICF)

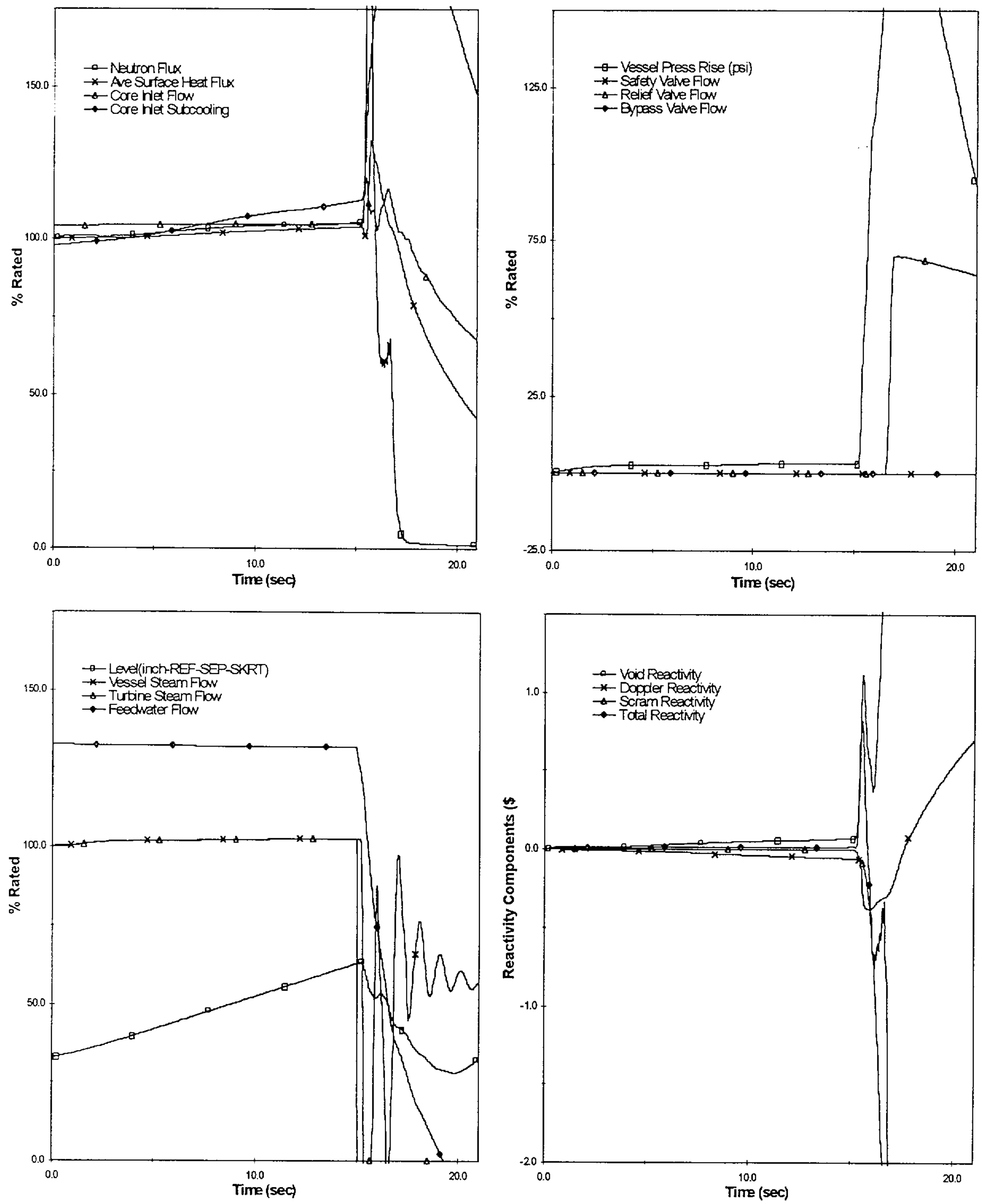


Figure 4 Plant Response to FW Controller Failure (BOC13 to EOC13 with ICF and TBPOOS)

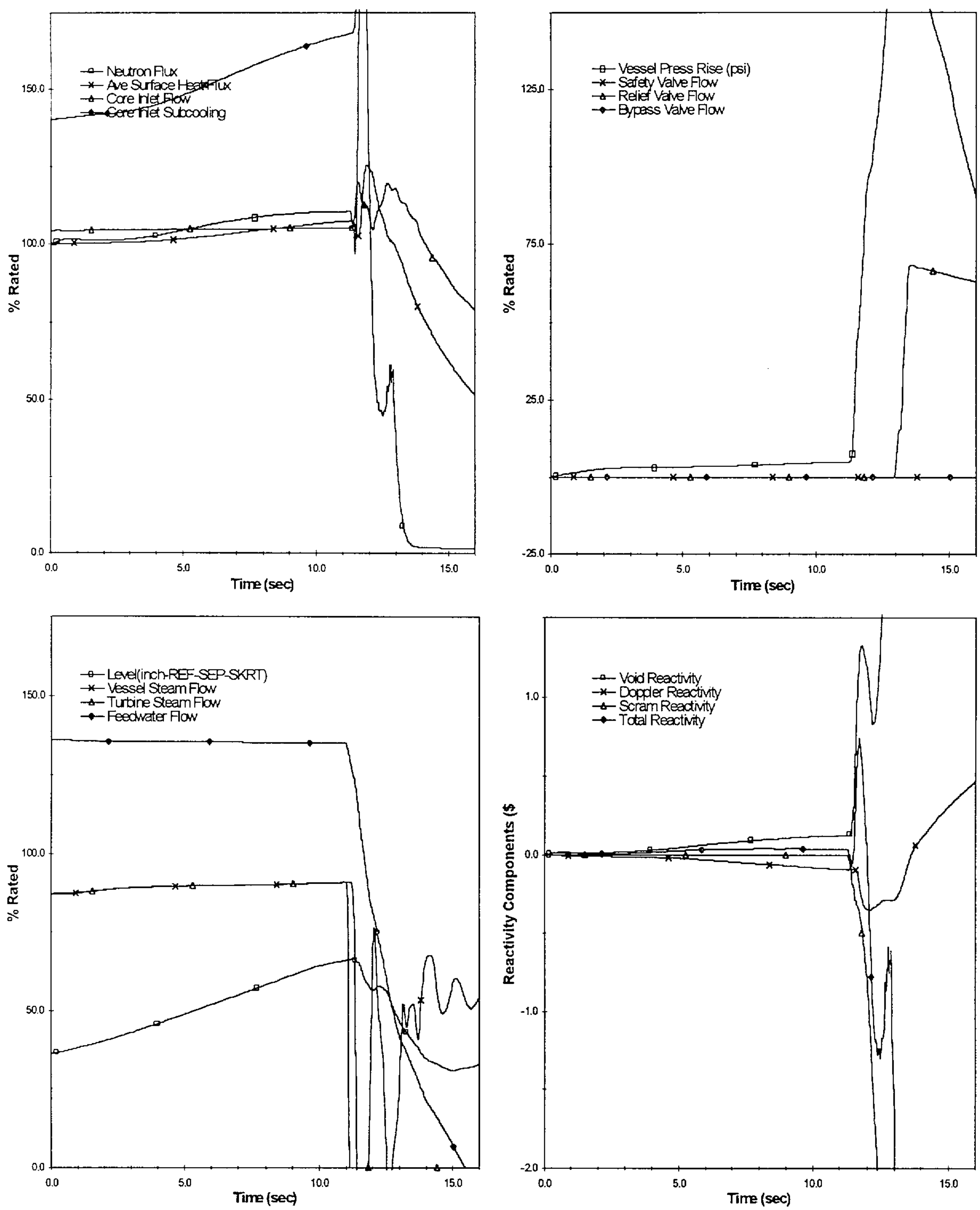


Figure 5 Plant Response to FW Controller Failure (BOC13 to EOC13 with ICF, TBPOOS and FWTR)

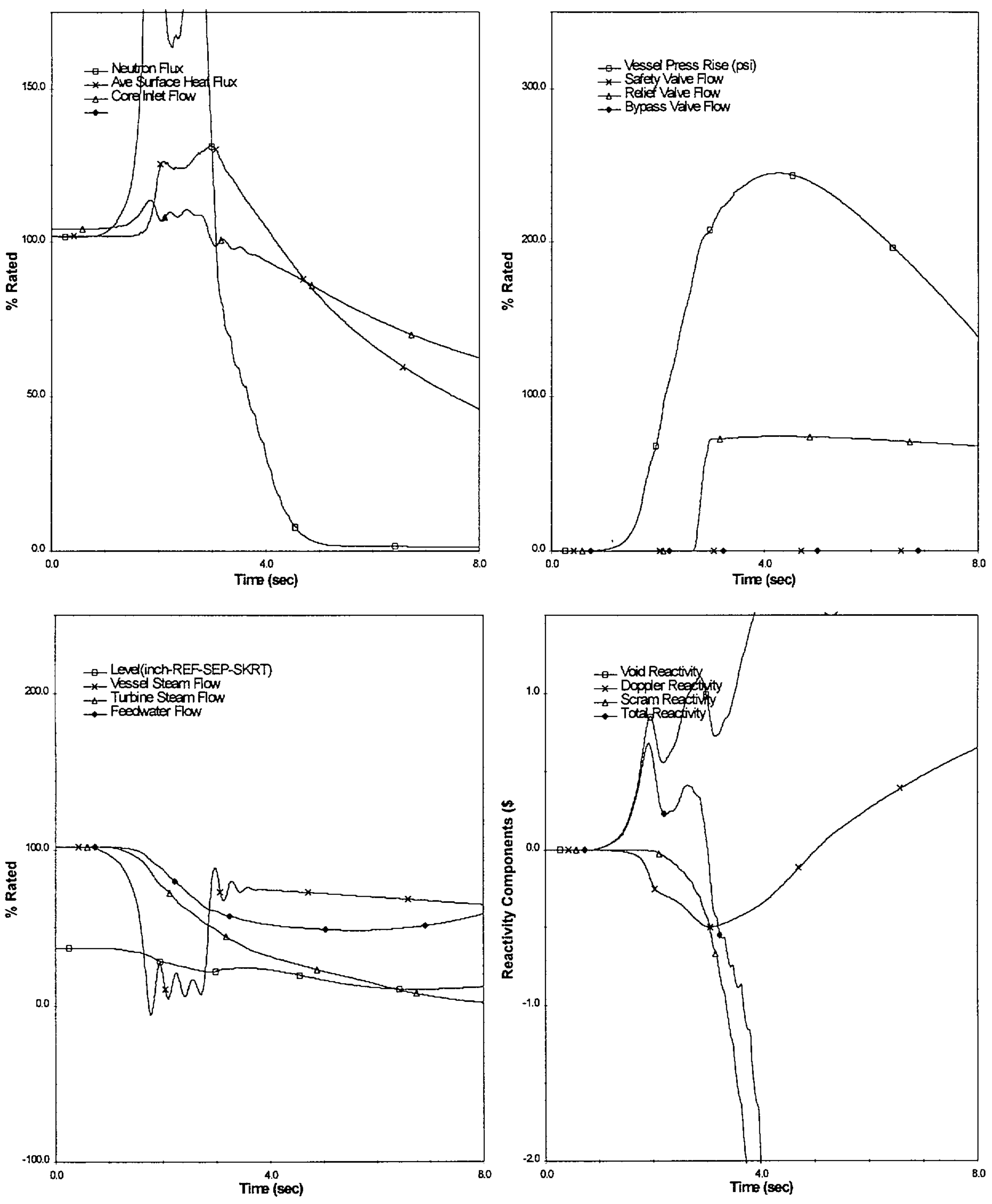


Figure 6 Plant Response to MSIV Closure (Flux Scram)

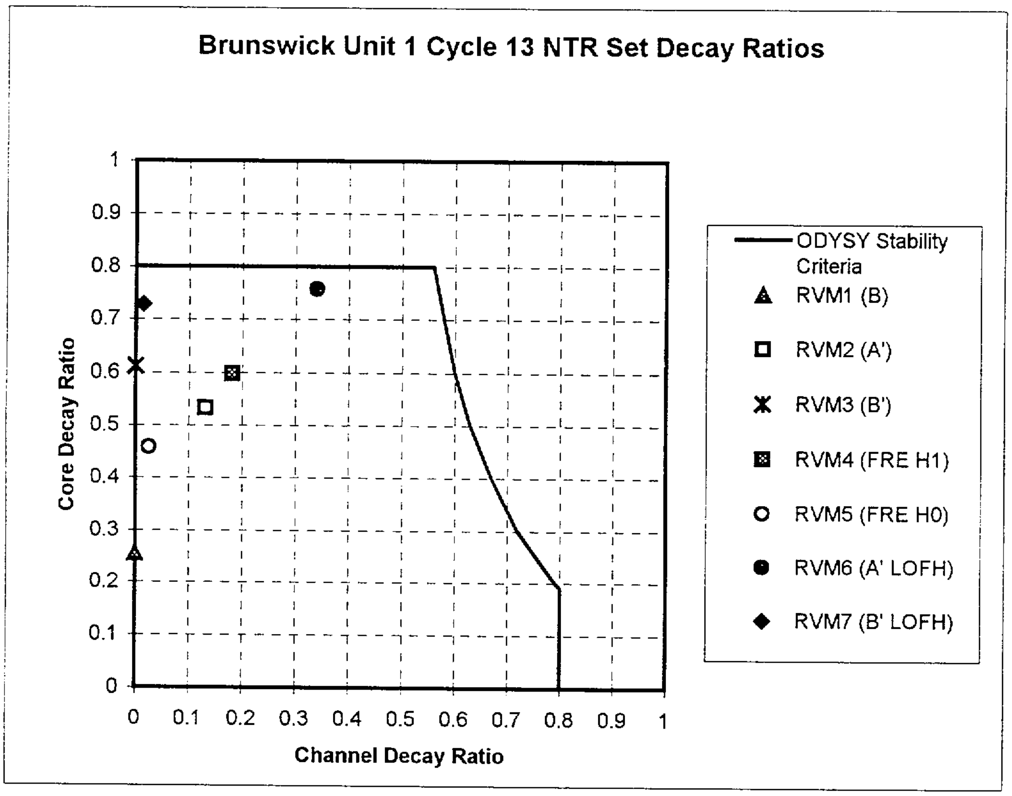


Figure 7 RVM Results versus ODYSY Stability Criteria

Appendix A
Analysis Conditions

To reflect actual plant parameters accurately, the values shown in Table A-1 were used this cycle.

Table A-1

	Analysis Value	
Parameter	**ICF**	**FWTR**
Thermal power, MWt	2558.0	2558.0
Core flow, Mlb/hr	80.3	80.3
Reactor pressure, psia	1060.8	1044.5
Inlet enthalpy, BTU/lb	530.7	517.4
Non-fuel power fraction	0.036	0.036
Steam flow, Mlb/hr	11.09	9.66
Dome pressure, psig	1030.0	1015.0
Turbine pressure, psig	984.8	980.4
No. of Safety/Relief Valves	9	9
Relief mode lowest setpoint, psig	1164.0	1164.0
Recirculation pump power source	on-site[8]	on-site[8]
Turbine control valve mode of operation	Partial arc	Partial arc

[8] Bounds operation with off-site power source for reload licensing events for Cycle 13.

Appendix B
Main Steamline Isolation Valve Out of Service (MSIVOOS)

Reference B-1 provided a basis for operation of the Brunswick Steam Electric Plant (BSEP) with one Main Steamline Isolation Valve Out of Service (MSIVOOS) (three steamline operation) and all S/RVs in service. For this mode of operation in BSEP Unit 1 throughout Cycle 13, the ICF operating limit MCPRs presented in Section 11 of this report are bounding and should be applied when operating in the MSIVOOS mode at any time during the cycle. The peak steamline and peak vessel pressures for the limiting overpressurization event (MSIV closure with flux scram) were not calculated for the MSIVOOS mode of operation. In this mode of operation it is required that all S/RVs be operational versus the assumed two S/RVs OOS for the events evaluated during normal plant operation. Previous cycles analyses have shown that the MSIV closure with flux scram, evaluated in the MSIVOOS mode, has resulted in the peak vessel pressure being reduced by more than 25 psi, when compared to the same case evaluated with all (four) steamlines operational.

Reference

B-1. *Main Steamline Isolation Valve Out of Service for the Brunswick Steam Electric Plant*, EAS-117-0987, GE Nuclear Energy, April 1988.

Appendix C
Decrease in Core Coolant Temperature Events

The Loss of Feedwater Heater (LFWH) event and the Inadvertent HPCI start-up event are the only cold water injection AOOs checked on a cycle-by-cycle basis.

The LFWH transient was last analyzed for Brunswick 1 Cycle 11 (a power uprate GE13 reload) and had a resulting ΔCPR of 0.12. There is no difference in equipment performance in Brunswick 1 Cycle 13 as compared to Brunswick 1 Cycle 11 which would indicate a need for a cycle specific analysis. The results of the AOOs presented in Section 11 of this report sufficiently bound the expected results of the LFWH event. Therefore, the LFWH event is not limiting and analysis is not required.

In addition, the Inadvertent HPCI start-up event was shown to be bounded by the LFWH event in Brunswick 1 Cycle 11. No parameters in Brunswick 1 Cycle 13 differ so as to invalidate the Brunswick 1 Cycle 11 determination. Therefore, the Brunswick 1 Cycle 11 analysis is applicable to Brunswick 1 Cycle 13 and the Inadvertent HPCI transient is bounded by LFWH.

Appendix D
Feedwater Temperature Reduction (FWTR)

Reference D-1 provides the basis for operation of the BSEP with Feedwater Temperature Reduction (FWTR). The MCPR limits presented in Section 11 of this report are bounding and should be applied when operating with FWTR. The MCPR limits apply to operation up to the exposure attainable using Increased Core Flow with Final Feedwater Temperature. Previous analysis has shown that the FWCF event is most severe at ICF and FWTR. The analyses used to calculate FWTR limits were based on constant turbine pressure which bounds constant dome pressure.

Reference

D-1. *Feedwater Temperature Reduction with Maximum Extended Load Line Limit and Increased Core Flow for Brunswick Steam Electric Plant Units 1 and 2*. NEDC-32457P, Revision 1, December 1995.

Appendix E
Maximum Extended Operating Domain (MEOD)

Reference E-1 provided a basis for operation of the BSEP in the Maximum Extended Operating Domain (MEOD). Previous cycles have shown that these low flow conditions are bounded by ICF, therefore this domain was not analyzed for Cycle 13. Application of the GEXL-PLUS correlation to the reload fuel has been confirmed as required in reference E-1. The applicability of GE13 was addressed and found acceptable.

Reference

E-1. *Maximum Extended Operating Domain Analysis for Brunswick Steam Electric Plant,* NEDC-31654P, February 1989.

Appendix F
Turbine Bypass Out Of Service (TBPOOS)

Reference F-1 provided a basis for operation of the BSEP with all Turbine Bypass Valves Out of Service (TBPOOS) and two S/RVs Out of Service (2 SRVOOS). Reference F-1 has been confirmed applicable to the operation of BSEP Unit 1 for Cycle 13. Section 11 of this report presents the MCPR limits for the modes of operation with TBPOOS.

Reference

F-1. *Turbine Bypass Out of Service Analysis for Carolina Power & Light Company's Brunswick Nuclear Plants Units 1 and 2.* NEDC-32813P, Revision 3, June 1998.

Appendix G
Basis for Analysis of
Standby Liquid Control System Shutdown Capability

The minimum required boron shutdown margin is dependent on the fuel type and the calculational method. The minimum required boron shutdown margin represents the biases and uncertainties needed to assure subcriticality. For the analysis reported in this Supplemental Reload Licensing Report fuel specific borated libraries were generated using lattice physics methods at 160°C and 726 ppm boron. A boron concentration of 726 ppm boron at 160°C is equivalent to 660 ppm boron at 20°C resulting from the change in water density and inventory. The margin requirement for this method is 1.3% (GE13).