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1CAN081203

August 30, 2012

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

Subject: ANO-1 Cycle 24 COLR, Revision 4
Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51

References:
1. Entergy letter dated October 31, 2011, "ANO-1 Cycle 24 COLR" (1CAN101101) (ML113040230)
2. Entergy letter dated November 11, 2011, "ANO-1 Cycle 24 COLR, Revision 1" (1CAN111103) (ML113180285)
3. Entergy letter dated November 23, 2011, "ANO-1 Cycle 24 COLR, Revision 2" (1CAN111104) (ML113290028)
4. Entergy letter dated April 4, 2012, "ANO-1 Cycle 24 COLR, Revision 3" (1CAN041201) (ML12096A019)

Dear Sir or Madam:

Entergy Operations, Inc. (Entergy) Arkansas Nuclear One, Unit 1 (ANO-1) Technical Specification 5.6.5 requires the submittal of the Core Operating Limits Report (COLR) for each reload cycle, including submittal of any revisions or supplements that may occur following initial issuance. Attached is Revision 4 of the ANO-1 Cycle 24 COLR.

Revision 4 of the COLR corrects editorial errors which occurred during transition of the information in the COLR base calculation (reload report) to development of the COLR itself. Specifically, the zero (0) foot elevation at a core burnup of 34000 MWd/mtU was inadvertently listed as a Linear Heat Rate (LHR) limit of 16.2 KW/ft in Figure 9A versus the 16.1 KW/ft listed in the reload report. This error has no impact on unit operation and at no time has the LHR limit challenged during Cycle 24 operation. This condition is documented in the ANO Corrective Action Program. In addition, the parenthetical underneath the title on COLR Page 14 is revised to state "Limits" instead of "Figure." Finally, the applicable lines illustrated on Figure 9A are adjusted to more accurately reflect the stated endpoint of (62000, 12.5). No other limits or other information contained in the COLR are affected by this change.

Please note that the latest approved revision number of the Babcock and Wilcox Topical Report BAW-10179P-A is identified in the COLR as Revision 8, May 2010. This completes the reporting requirement for the referenced specification.

This submittal contains no regulatory commitments. Should you have any questions, please contact me.

Sincerely,

ORIGINAL SIGNED BY STEPHENIE L. PYLE

SLP/dbb

Attachment: ANO-1 Cycle 24 Core Operating Limits Report (COLR), Revision 4

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Attachment to

1CAN081203

ANO-1 Cycle 24 Core Operating Limits Report (COLR), Revision 4

ENTERGY OPERATIONS

ARKANSAS NUCLEAR ONE
UNIT ONE

CYCLE 24

CORE OPERATING LIMITS REPORT

1.0 CORE OPERATING LIMITS

This Core Operating Limits Report for ANO-1 Cycle 24 has been prepared in accordance with the requirements of Technical Specification 5.6.5. The core operating limits have been developed using the methodology provided in the references.

The following cycle-specific core operating limits are included in this report:

1) 2.1.1.3 Variable Low RCS Pressure – Temperature Protective Limits
2) 3.1.1 SHUTDOWN MARGIN (SDM)
3) 3.1.8 PHYSICS TESTS Exceptions – MODE 1
4) 3.1.9 PHYSICS TEST Exceptions – MODE 2
5) 3.2.1 Regulating Rod Insertion Limits
6) 3.2.2 AXIAL POWER SHAPING RODS (APSR) Insertion Limits
7) 3.2.3 AXIAL POWER IMBALANCE Operating Limits
8) 3.2.4 QUADRANT POWER TILT (QPT)
9) 3.2.5 Power Peaking
10) 3.3.1 Reactor Protection System (RPS) Instrumentation
11) 3.4.1 RCS Pressure, Temperature, and Flow DNB Limits
12) 3.4.4 RCS Loops – MODES 1 and 2
13) 3.9.1 Boron Concentration

2.0 REFERENCES

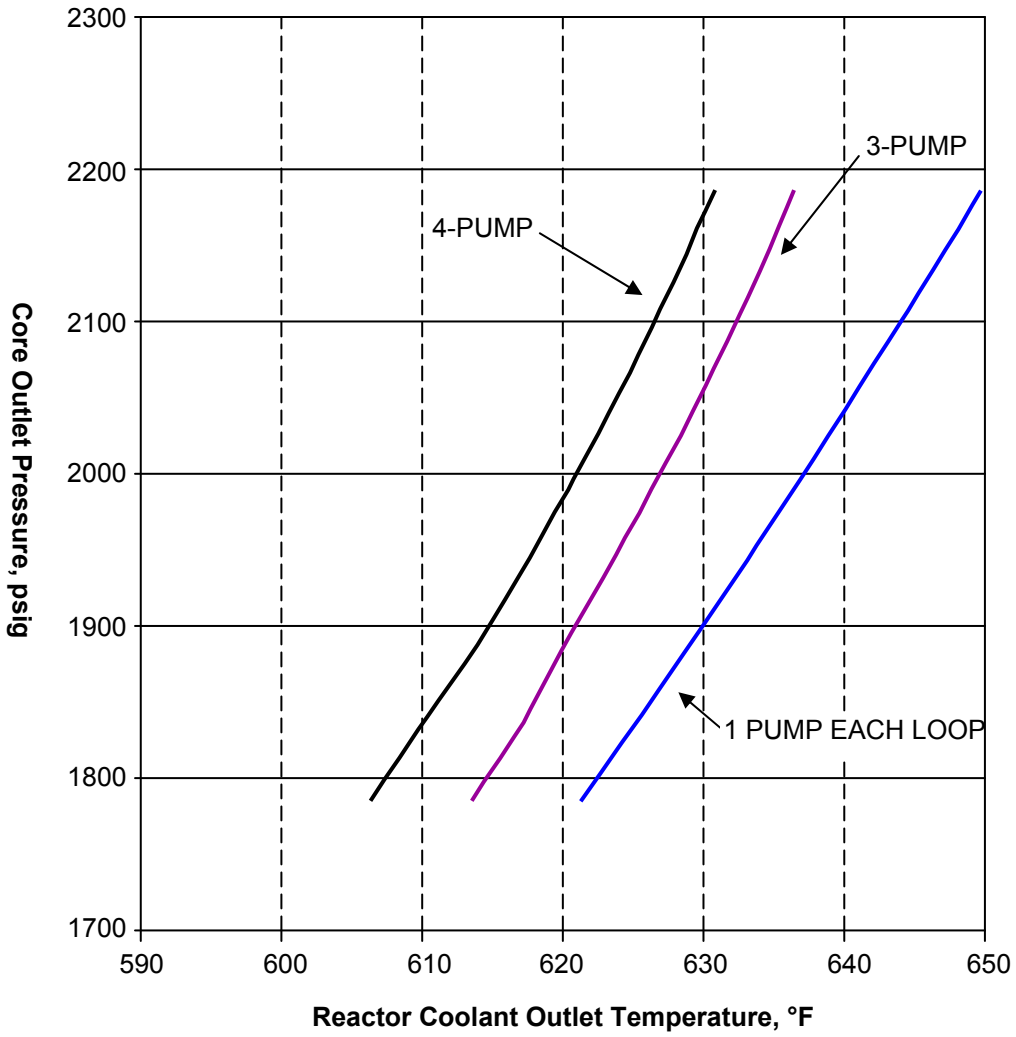
1. "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses," BAW-10179P-A, Rev. 8, Framatome ANP, Inc., Lynchburg, Virginia, May 2010.
2. Letter dated 4/9/02 from L.W. Barnett, USNRC, to J.M. Mallay, FRA-ANP, “Safety Evaluation of Framatome Technologies Topical Report BAW-10164P Revision 4, ‘RELAP5/MOD2- B&W, An Advanced Computer Program for Light Water Reactor LOCA and Non-LOCA Transient Analysis’ (TAC Nos. MA8465 and MA8468),” USNRC ADAMS Accession Number ML013390204.
3. RELAP5/MOD2-B&W – An Advanced Computer Program for Light Water Reactor LOCA Transient Analysis, BAW-10164PA, Rev. 6, Framatome Technologies, Inc., Lynchburg, Virginia, June 2007.
4. "Qualification of Reactor Physics Methods for the Pressurized Water Reactors of the Entergy System," ENEAD-01-P, Rev. 0, Entergy Operations, Inc., Jackson, Mississippi, December 1993.
5. “ANO-1 Cycle 24 Limits and Setpoints,” Areva Doc. No. 86-9158676-000, July 27, 2011.
6. “Arkansas Nuclear One, Unit 1, Cycle 24 Reload Report,” ANP-3033, Rev. 1, November, 2011 (CALC-ANO1-NE-11-00001).
7. “ANO-1 Refueling Boron for 1R23,” CALC-NEAD-SR-11/016, Rev. 0.
8. “IC (Initial Condition) DNB RCS Protection Criteria,” CALC-96-E-0023-02, Rev. 7.
9. “Arkansas Nuclear One Unit 1, Cycle 24 Reload Technical Document (RTD),” Areva Doc. No. 51-9165384-000, October, 2011 (CALC-ANO1-NE-11-00003).
10. “ANO-1 Cycle 24 Increased Quadrant Power Tilt Setpoint for Greater than 60% FP,” Areva Doc. No. 86-9172947-000, November, 2011.

Table Of Contents

FIGURE 1

Variable Low RCS Pressure – Temperature Protective Limits

(Figure is referred to by Technical Specification 2.1.1.3)



PUMPS OPERATING (TYPE OF LIMIT)	GPM*	POWER**
FOUR PUMPS (DNBR LIMIT)	383,680 (100%)	110%
THREE PUMPS (DNBR LIMIT)	284,307 (74.1%)	89%
ONE PUMP IN EACH LOOP (DNBR LIMIT)	188,003 (49%)	62.2%

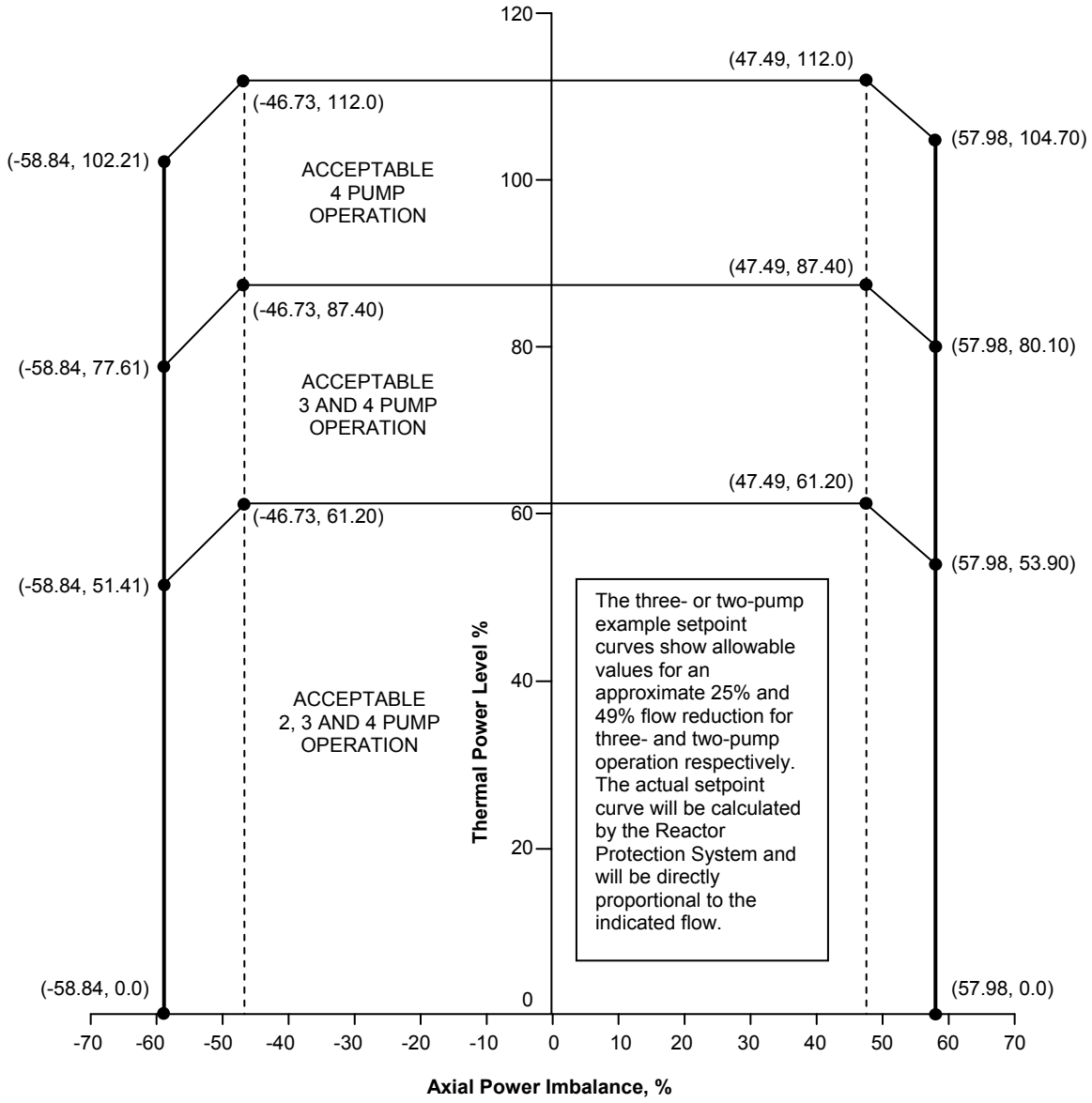
* 109% OF DESIGN FLOW (2.5% UNCERTAINTY INCLUDED IN STATISTICAL DESIGN LIMIT)

** AN ADDITIONAL 2% POWER UNCERTAINTY IS INCLUDED IN STATISTICAL DESIGN LIMIT

Figure 2

AXIAL POWER IMBALANCE Protective Limits
(measurement system independent)

(Figure is referred to by Technical Specification 2.1.1 Bases)



SHUTDOWN MARGIN (SDM)

(Limits are referred to by Technical Specifications 3.1.1, 3.1.4, 3.1.5, 3.1.8, 3.1.9, and 3.3.9)

Verify SHUTDOWN MARGIN per the table below.

APPLICABILITY	REQUIRED SHUTDOWN MARGIN	TECHNICAL SPECIFICATION REFERENCE
MODE 1*	≥ 1 %Δk/k	3.1.4, 3.1.5
MODE 2*	≥ 1 %Δk/k	3.1.4, 3.1.5, 3.3.9
MODE 3	≥ 1 %Δk/k	3.1.1, 3.3.9
MODE 4	≥ 1 %Δk/k	3.1.1, 3.3.9
MODE 5	≥ 1 %Δk/k	3.1.1, 3.3.9
MODE 1 PHYSICS TESTS Exceptions**	≥ 1 %Δk/k	3.1.8
MODE 2 PHYSICS TESTS Exceptions	≥ 1 %Δk/k	3.1.9

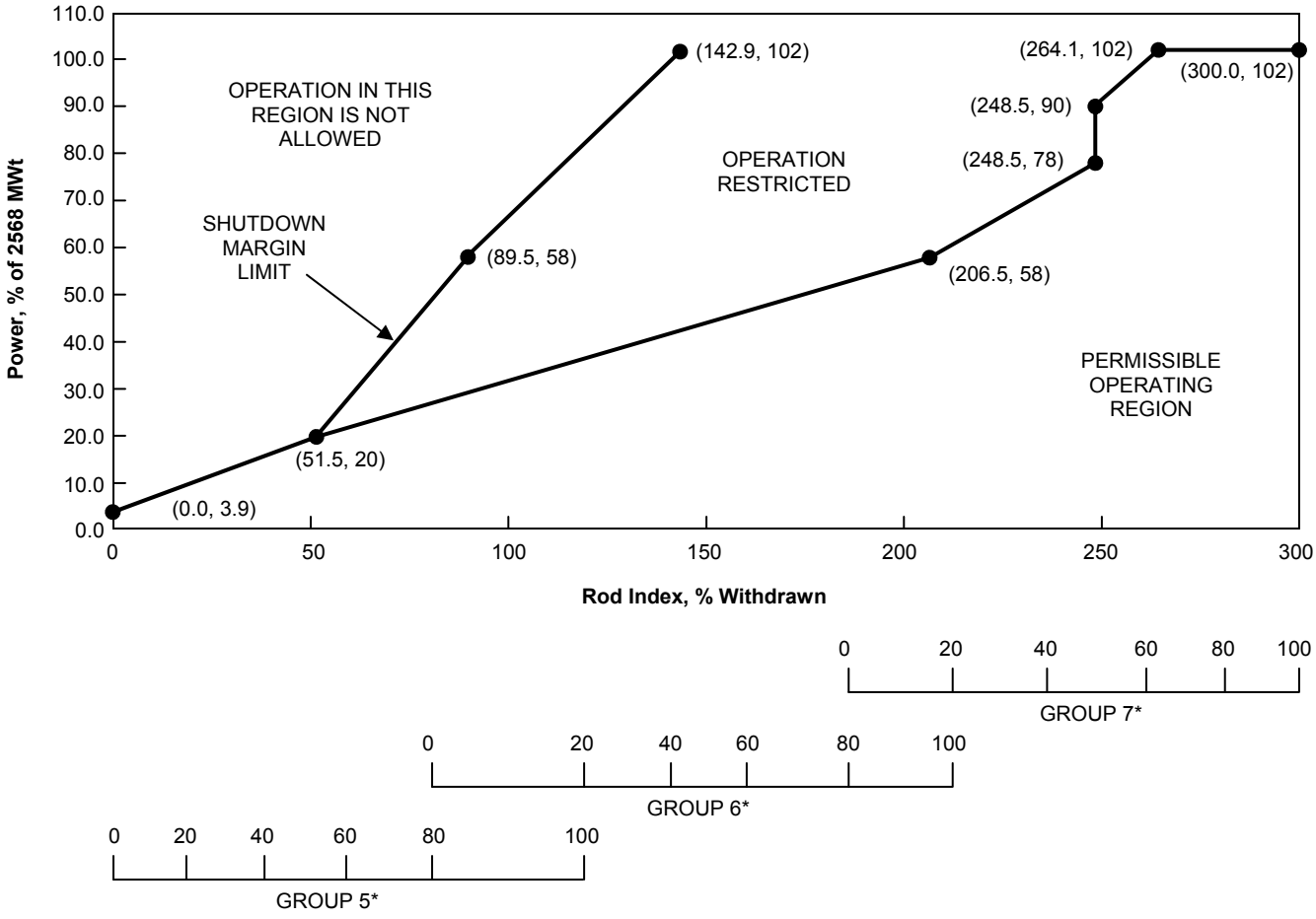
* The required Shutdown Margin capability of 1 %Δk/k in MODE 1 and MODE 2 is preserved by the Regulating Rod Insertion Limits specified in Figures 3-A&B, 4-A&B, and 5-A&B, as required by Technical Specification 3.2.1.

** Entry into Mode 1 Physics Tests Exceptions is not supported by existing analyses and as such requires actual shutdown margin to be ≥ 1 %Δk/k.

Figure 3-A

Regulating Rod Insertion Limits for Four-Pump Operation From 0 to 200 ± 10 EFPD

(Figure is referred to by Technical Specification 3.2.1)

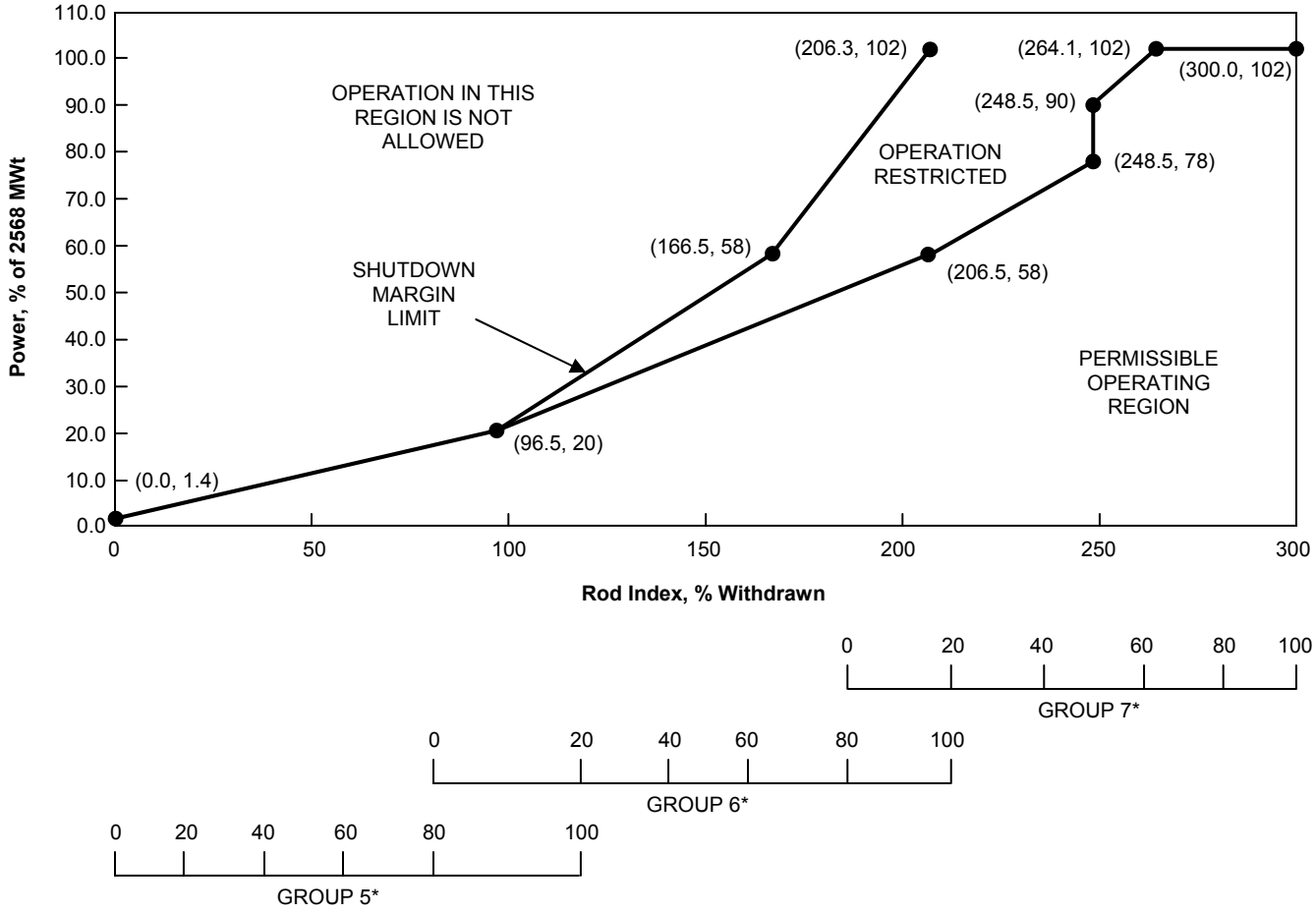


* Operating rod group overlap is 20% ± 5% between two sequential groups, except for physics tests.

Figure 3-B

Regulating Rod Insertion Limits for Four-Pump Operation From 200 ± 10 EFPD to EOC

(Figure is referred to by Technical Specification 3.2.1)

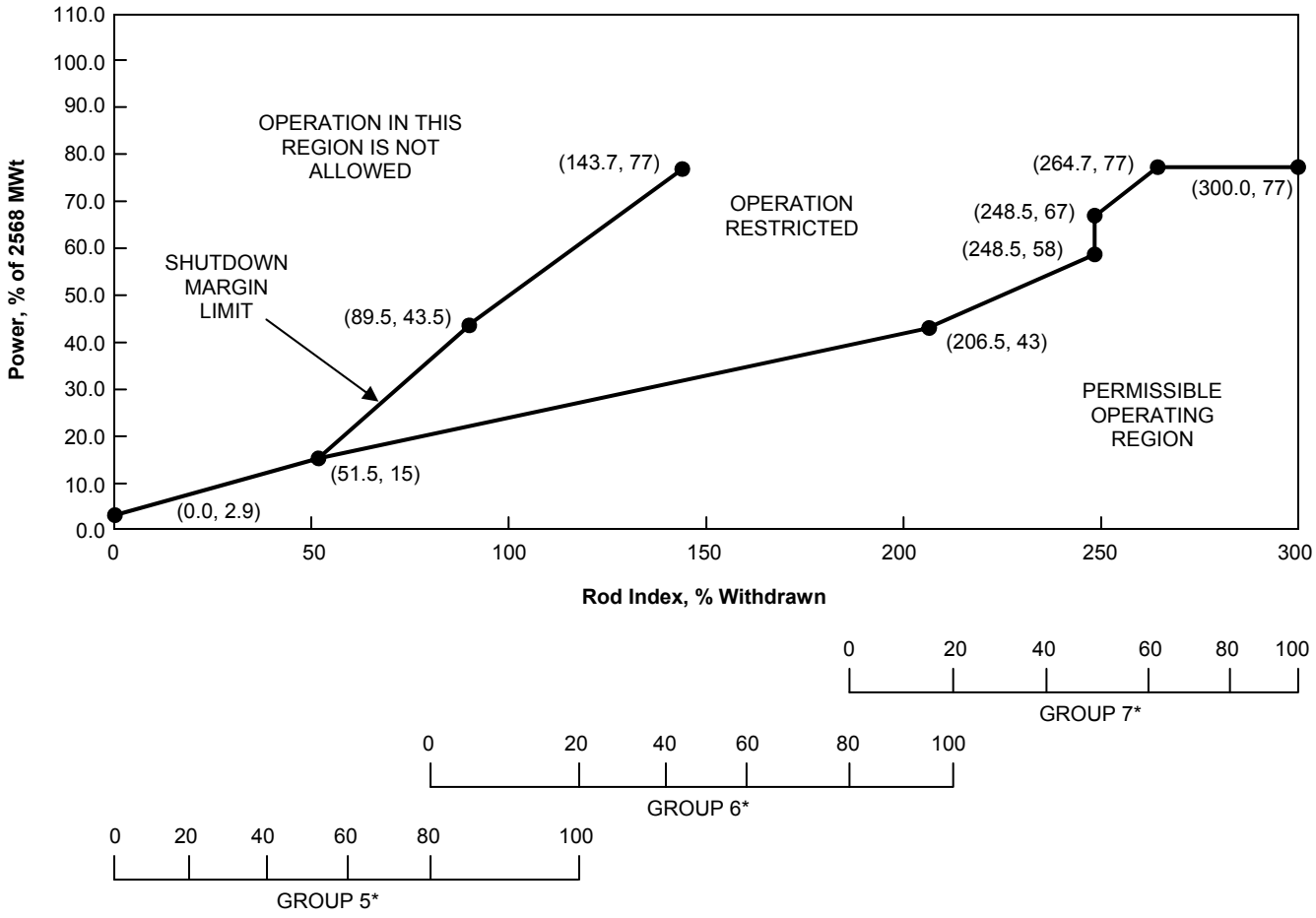


* Operating rod group overlap is 20% ± 5% between two sequential groups, except for physics tests.

Figure 4-A

Regulating Rod Insertion Limits for Three-Pump Operation From 0 to 200 ± 10 EFPD

(Figure is referred to by Technical Specification 3.2.1)

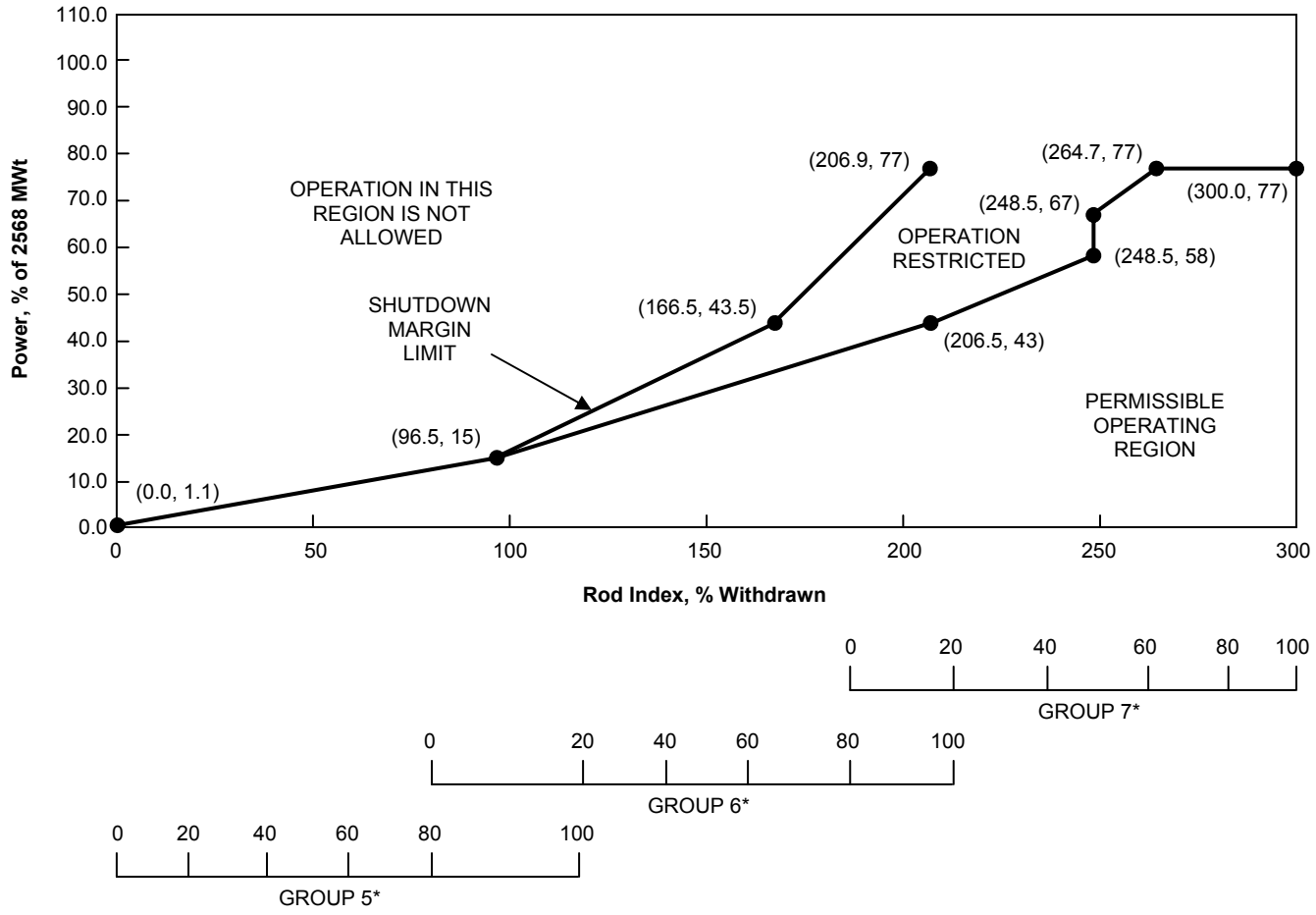


* Operating rod group overlap is 20% ± 5% between two sequential groups, except for physics tests.

Figure 4-B

Regulating Rod Insertion Limits for Three-Pump Operation From 200 ± 10 EFPD to EOC

(Figure is referred to by Technical Specification 3.2.1)

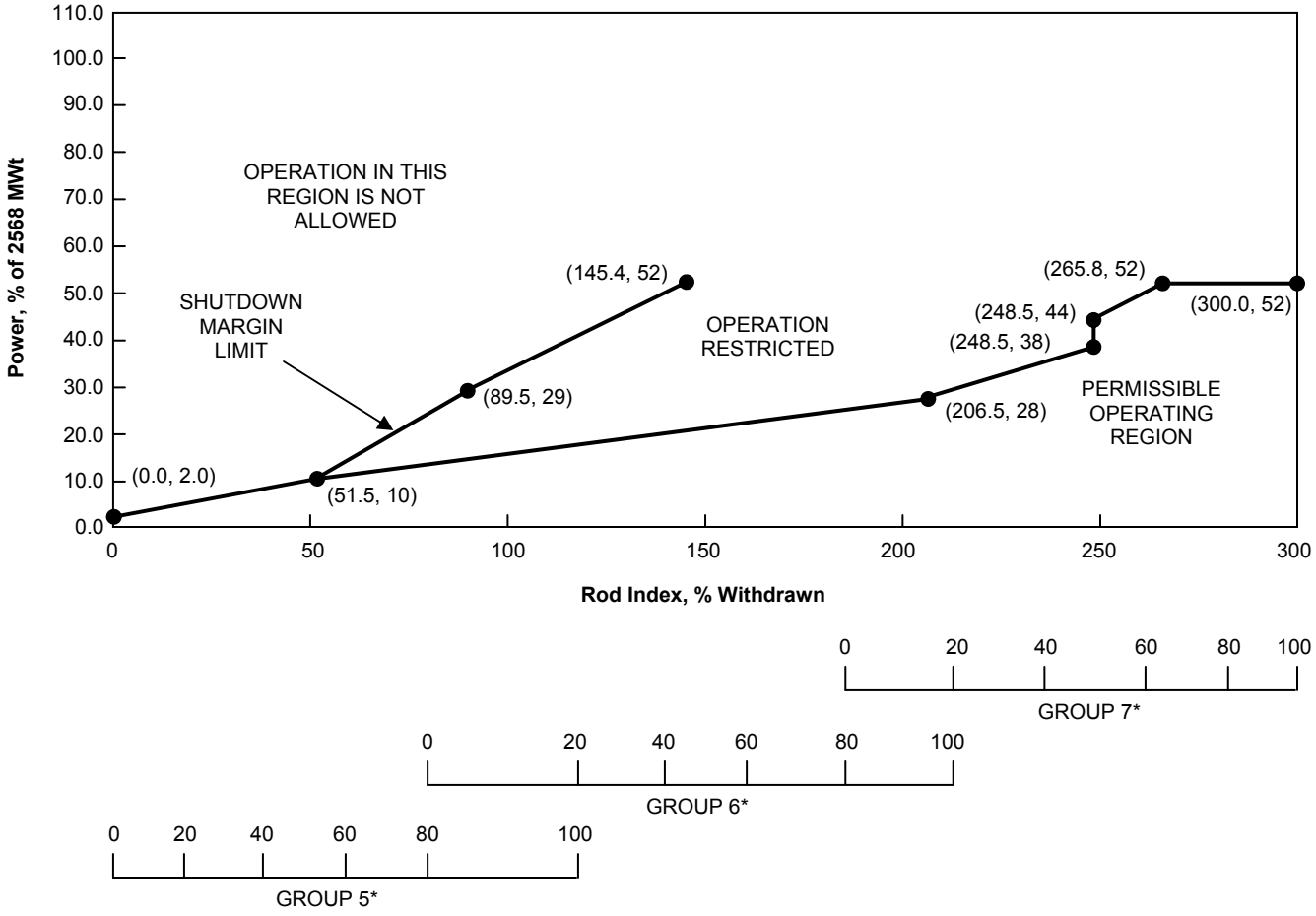


* Operating rod group overlap is 20% ± 5% between two sequential groups, except for physics tests.

Figure 5-A

Regulating Rod Insertion Limits for Two-Pump Operation From 0 to 200 ± 10 EFPD

(Figure is referred to by Technical Specification 3.2.1)

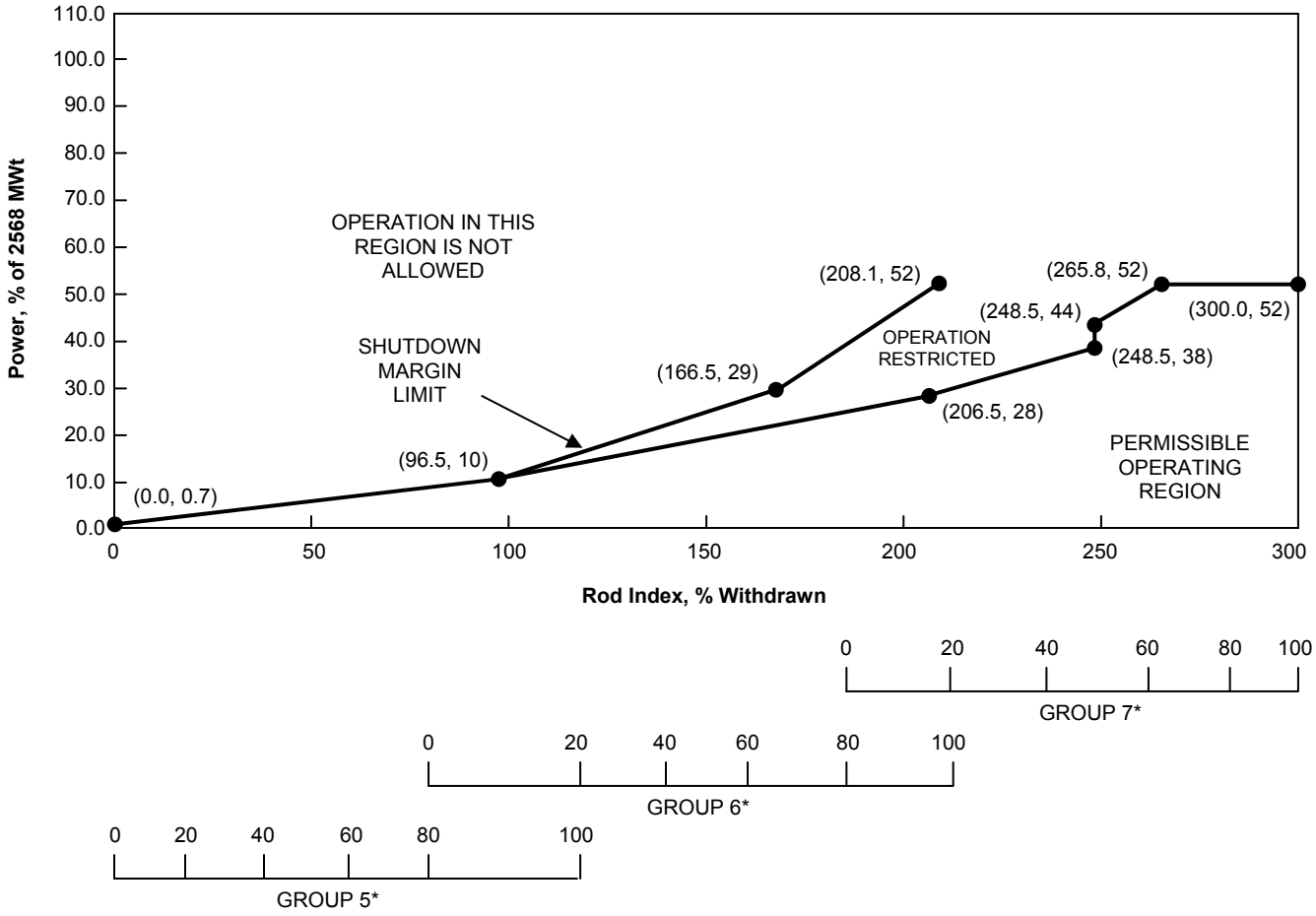


* Operating rod group overlap is 20% ± 5% between two sequential groups, except for physics tests.

Figure 5-B

Regulating Rod Insertion Limits for Two-Pump Operation From 200 ± 10 EFPD to EOC

(Figure is referred to by Technical Specification 3.2.1)



* Operating rod group overlap is 20% ± 5% between two sequential groups, except for physics tests.

AXIAL POWER SHAPING RODS (APSR) INSERTION LIMITS

(Limits referred to by Technical Specification 3.2.2)

Up to 436 ± 10 EFPD, the APSRs may be positioned as necessary for transient imbalance control. However, the APSRs shall be fully withdrawn by 446 EFPD. After the APSR withdrawal at 436 ± 10 EFPD, the APSRs shall not be reinserted, except prior to end of cycle shutdown when the reactor power is equal to, or less than, 30% FP.

Figure 6-A

AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Four-Pump Operation from 0 to EOC

(Figure is referred to by Technical Specification 3.2.3)

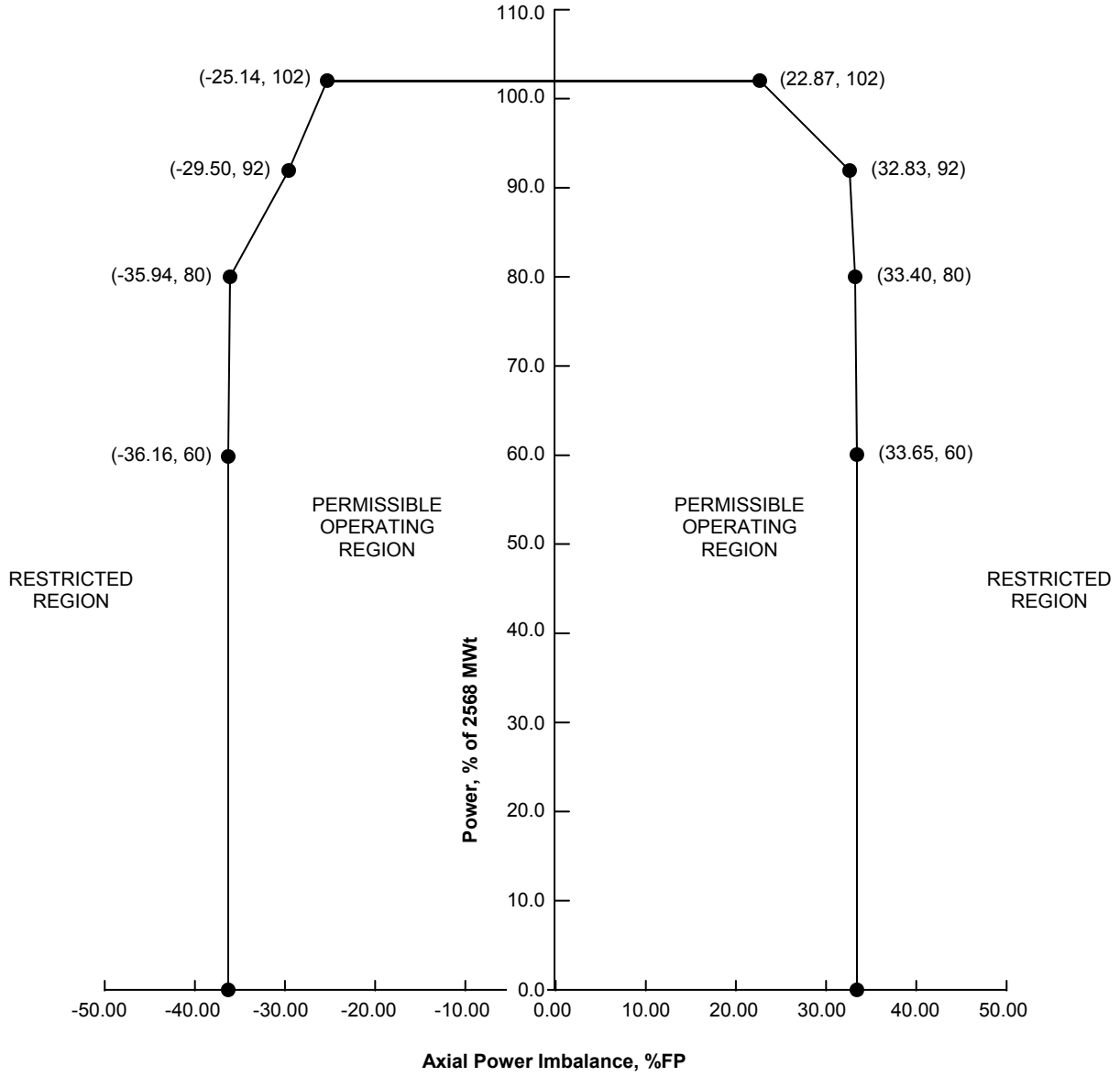
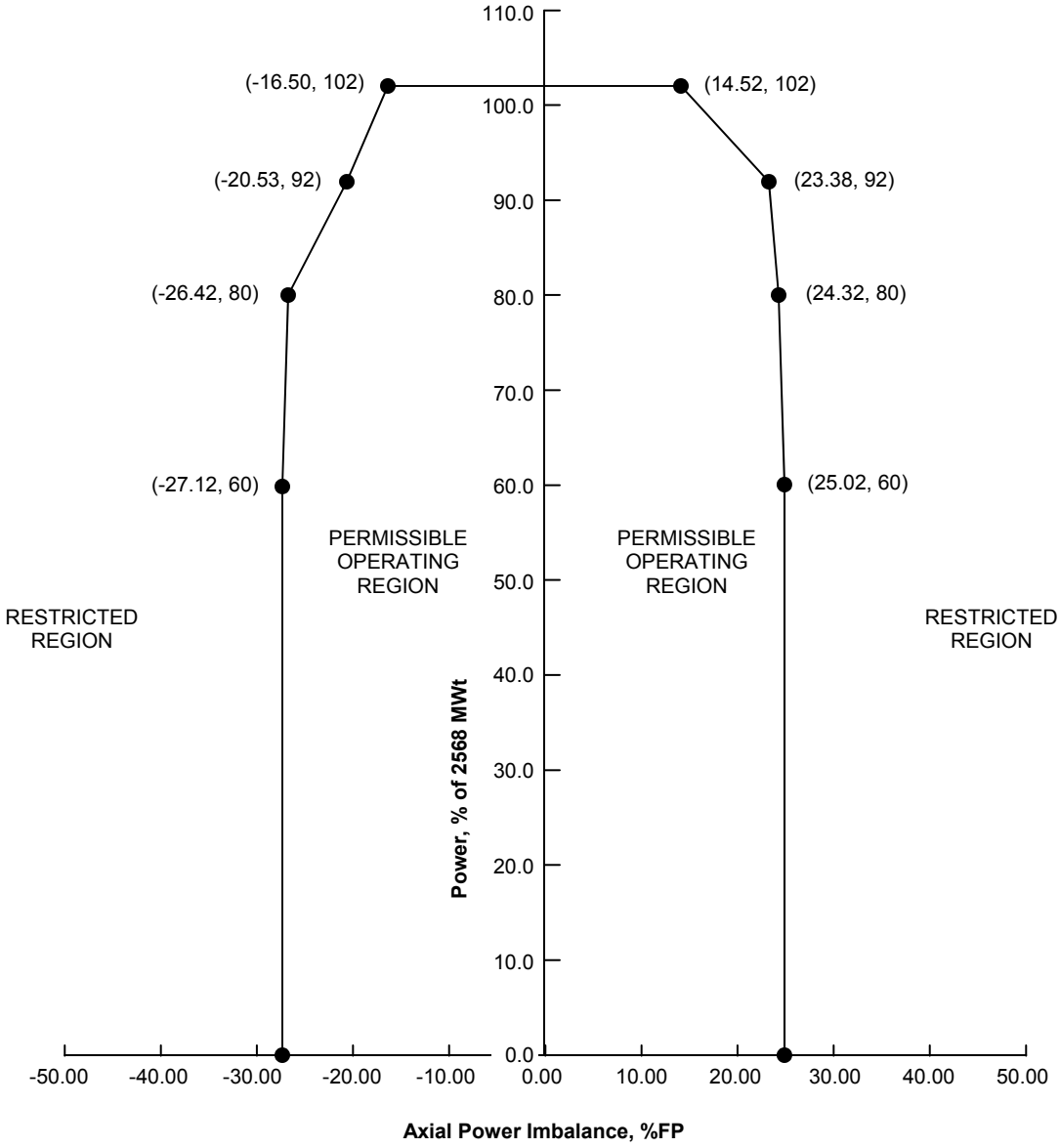


Figure 6-B

AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Four-Pump Operation from 0 to EOC

(Figure is referred to by Technical Specification 3.2.3)



* Assumes that no individual long emitter detector affecting the minimum incore tilt calculation exceeds 73% sensitivity depletion. The minimum incore detector setpoint must be reduced to 1.50% (power levels > 60% FP) and to 2.19% (power levels ≤ 60 % FP) at the earliest time-in-life that this assumption is no longer valid.

Figure 6-C

AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Four-Pump Operation from 0 to EOC

(Figure is referred to by Technical Specification 3.2.3)

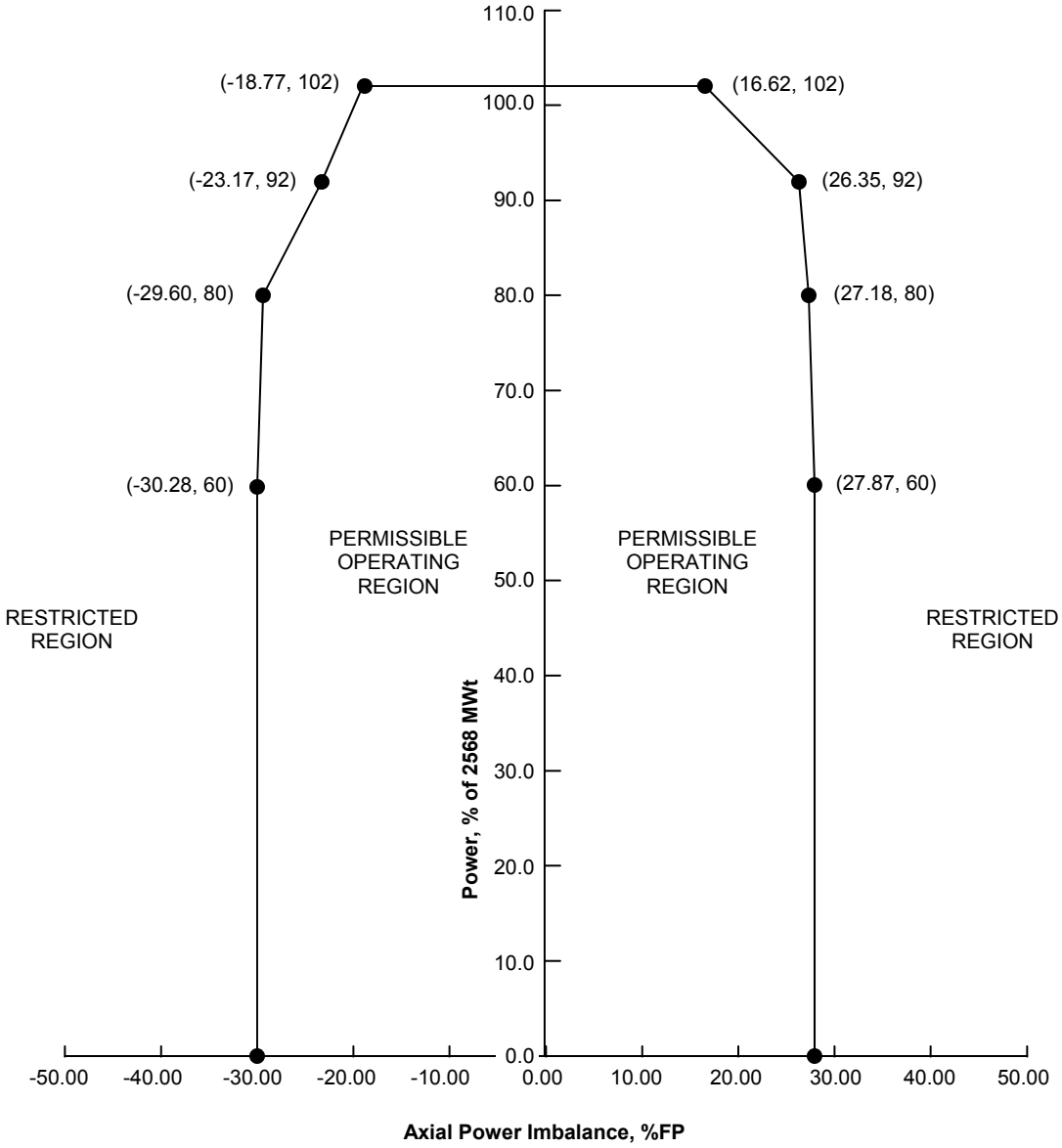


Figure 7-A

AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Three-Pump Operation from 0 to EOC

(Figure is referred to by Technical Specification 3.2.3)

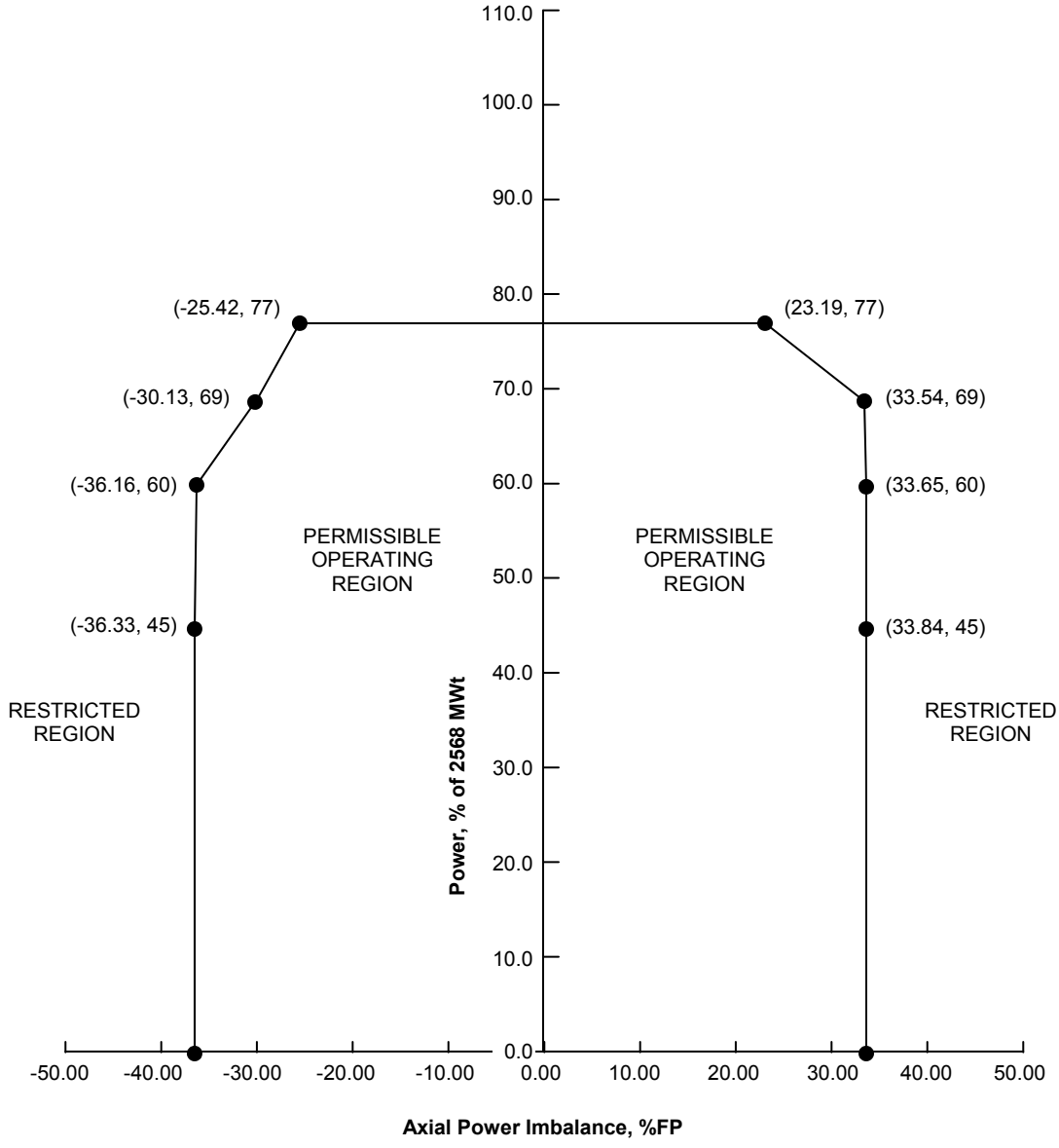
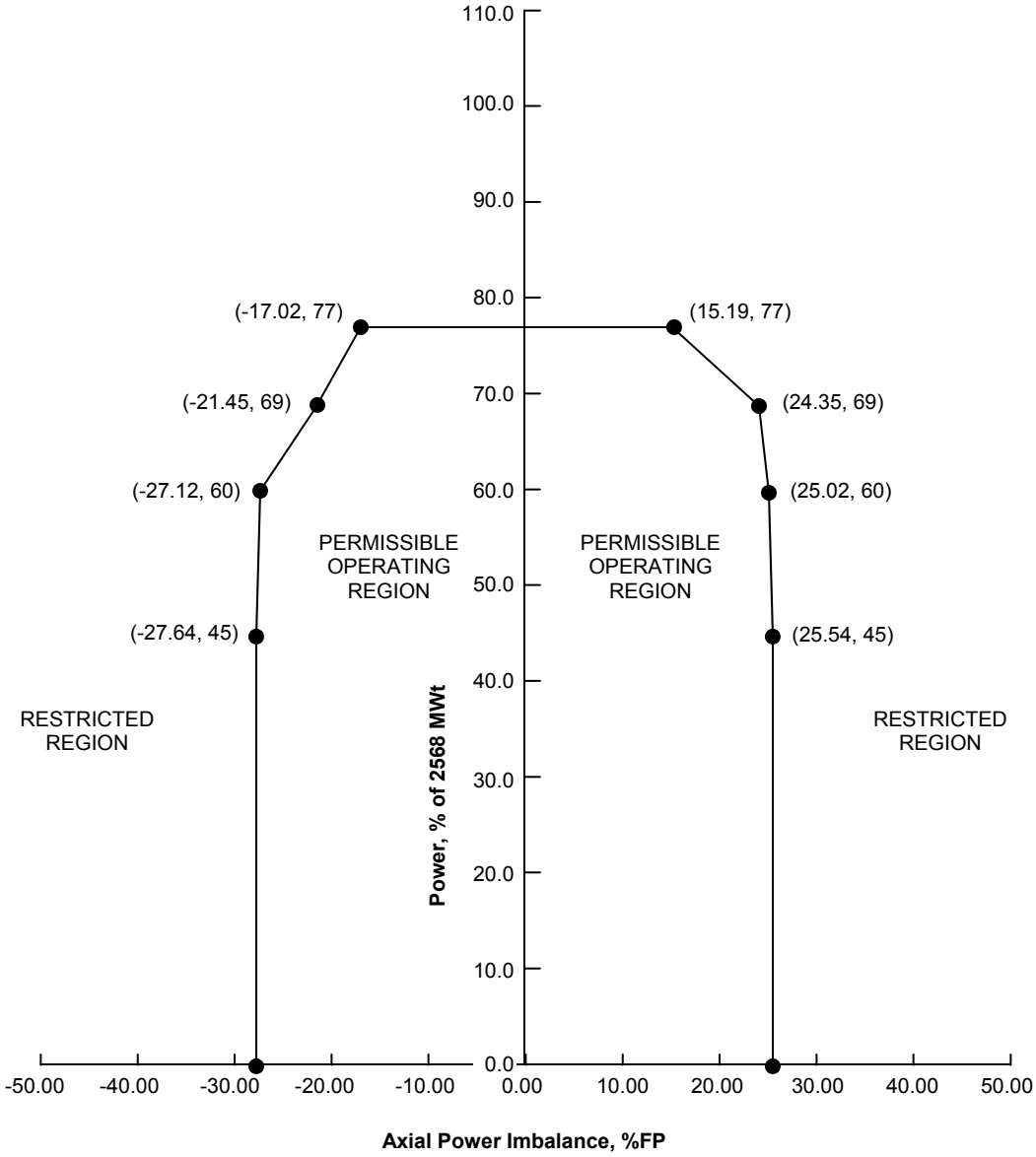


Figure 7-B

AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Three-Pump Operation from 0 to EOC

(Figure is referred to by Technical Specification 3.2.3)



* Assumes that no individual long emitter detector affecting the minimum incore tilt calculation exceeds 73% sensitivity depletion. The minimum incore detector setpoint must be reduced to 1.50% (power levels > 60% FP) and to 2.19% (power levels ≤ 60 % FP) at the earliest time-in-life that this assumption is no longer valid.

Figure 7-C

AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Three-Pump Operation from 0 to EOC

(Figure is referred to by Technical Specification 3.2.3)

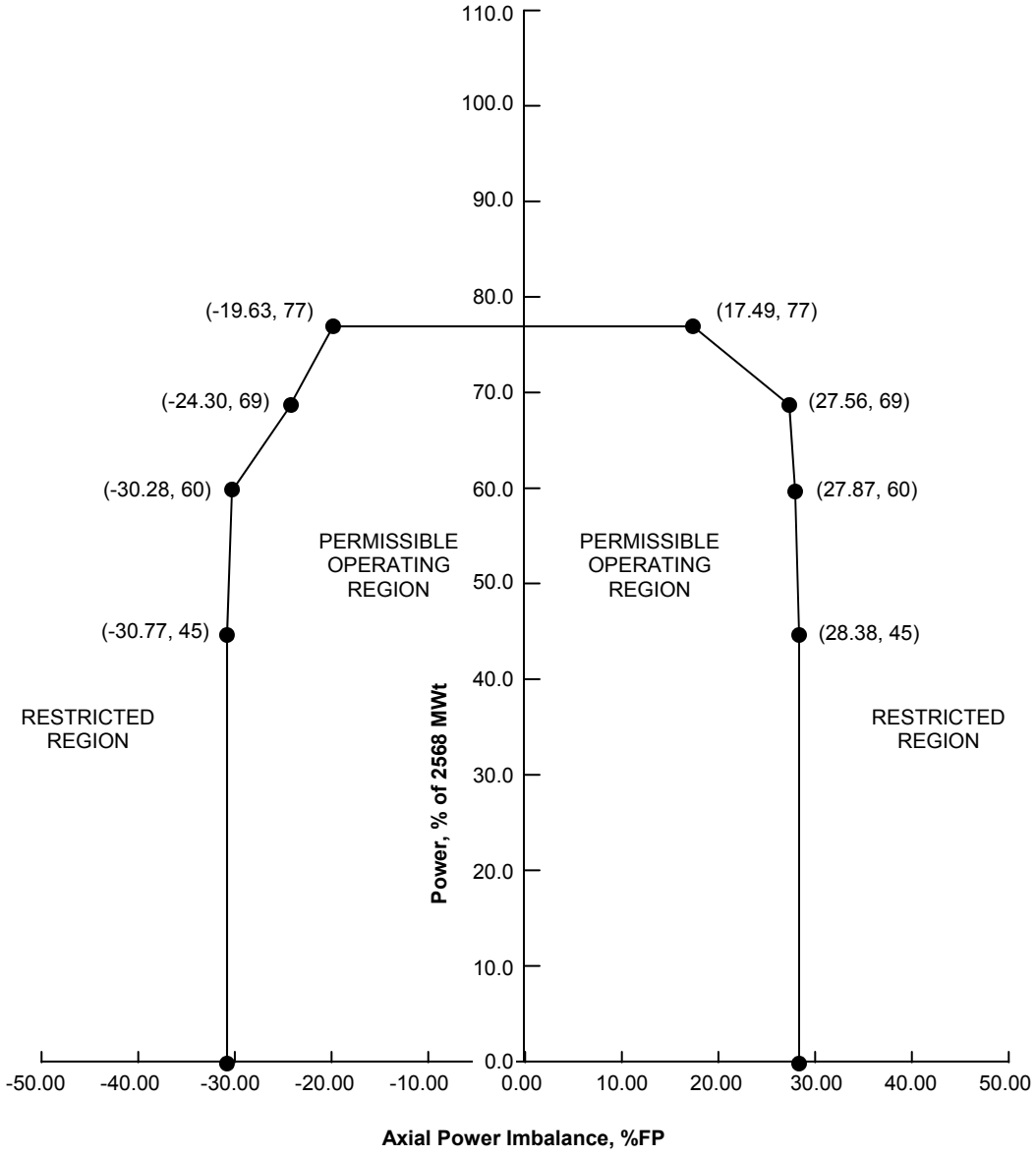


Figure 8-A

AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Two-Pump Operation from 0 to EOC

(Figure is referred to by Technical Specification 3.2.3)

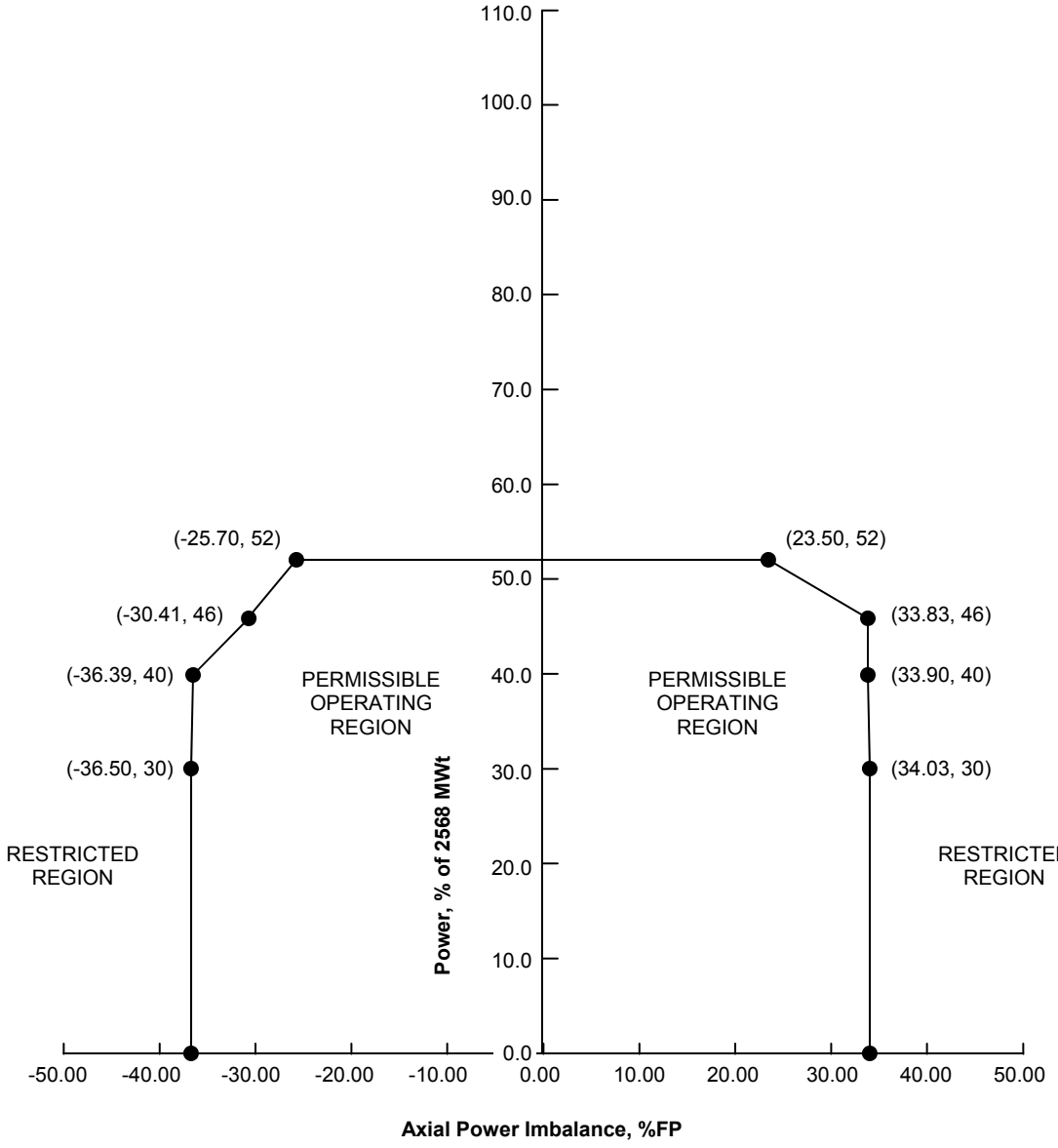
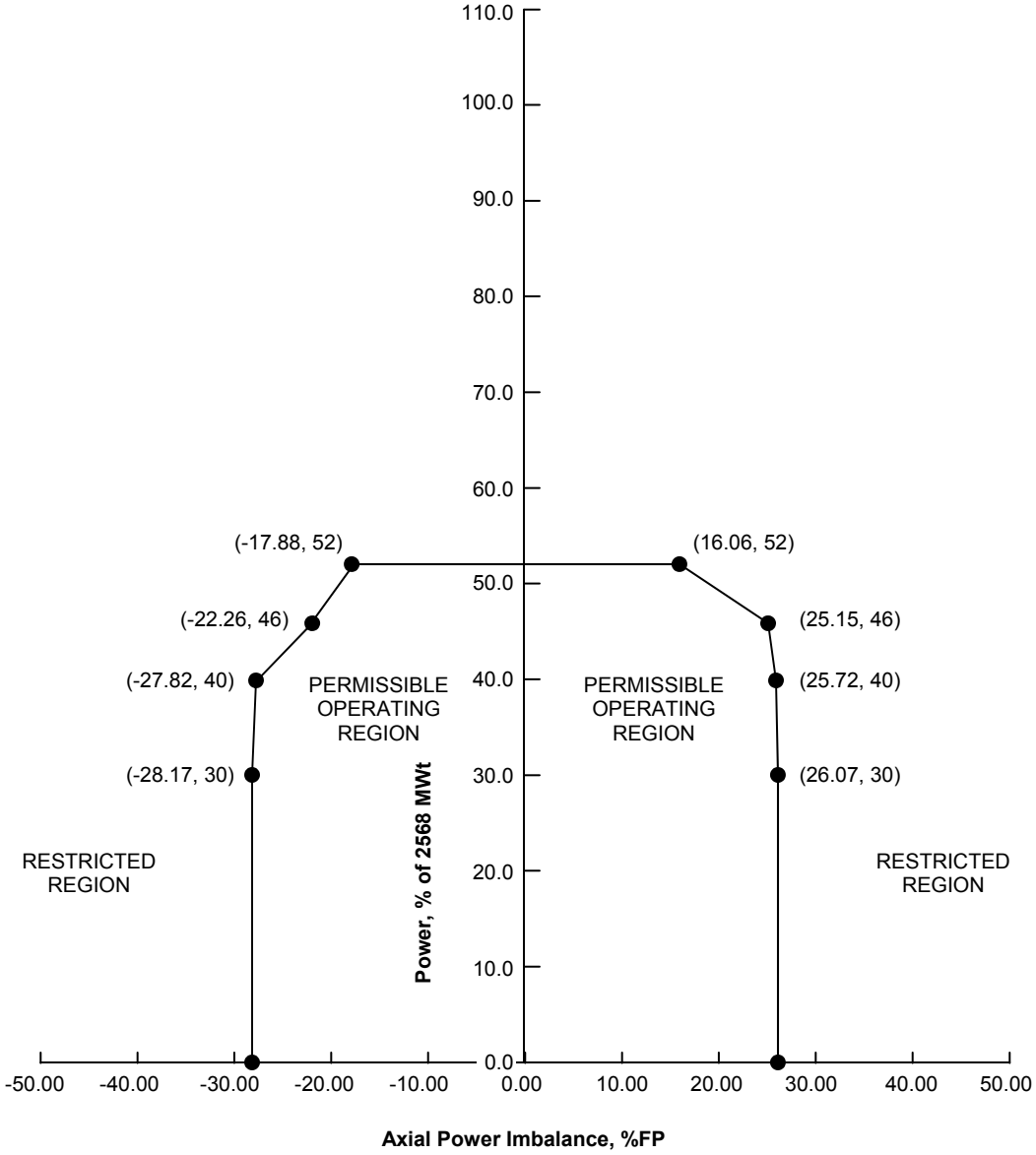


Figure 8-B

AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Two-Pump Operation from 0 to EOC

(Figure is referred to by Technical Specification 3.2.3)

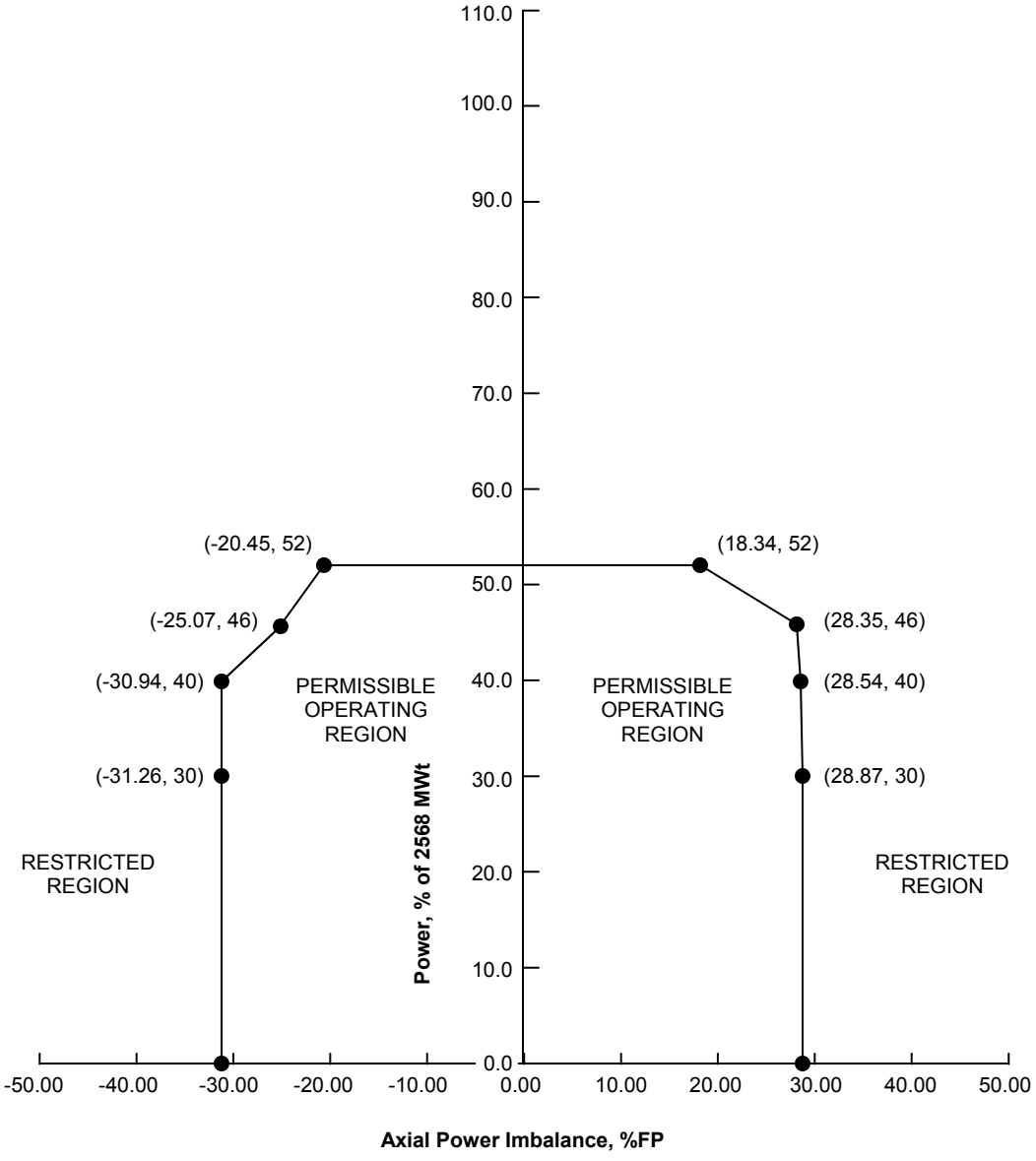


* Assumes that no individual long emitter detector affecting the minimum incore tilt calculation exceeds 73% sensitivity depletion. The minimum incore detector setpoint must be reduced to 1.50% (power levels > 60% FP) and to 2.19% (power levels ≤ 60 % FP) at the earliest time-in-life that this assumption is no longer valid.

Figure 8-C

AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Two-Pump Operation from 0 to EOC

(Figure is referred to by Technical Specification 3.2.3)



Quadrant Power Tilt Limits And Setpoints

(Limits are referred to by Technical Specification 3.2.4)

From 0 EFPD to EOC

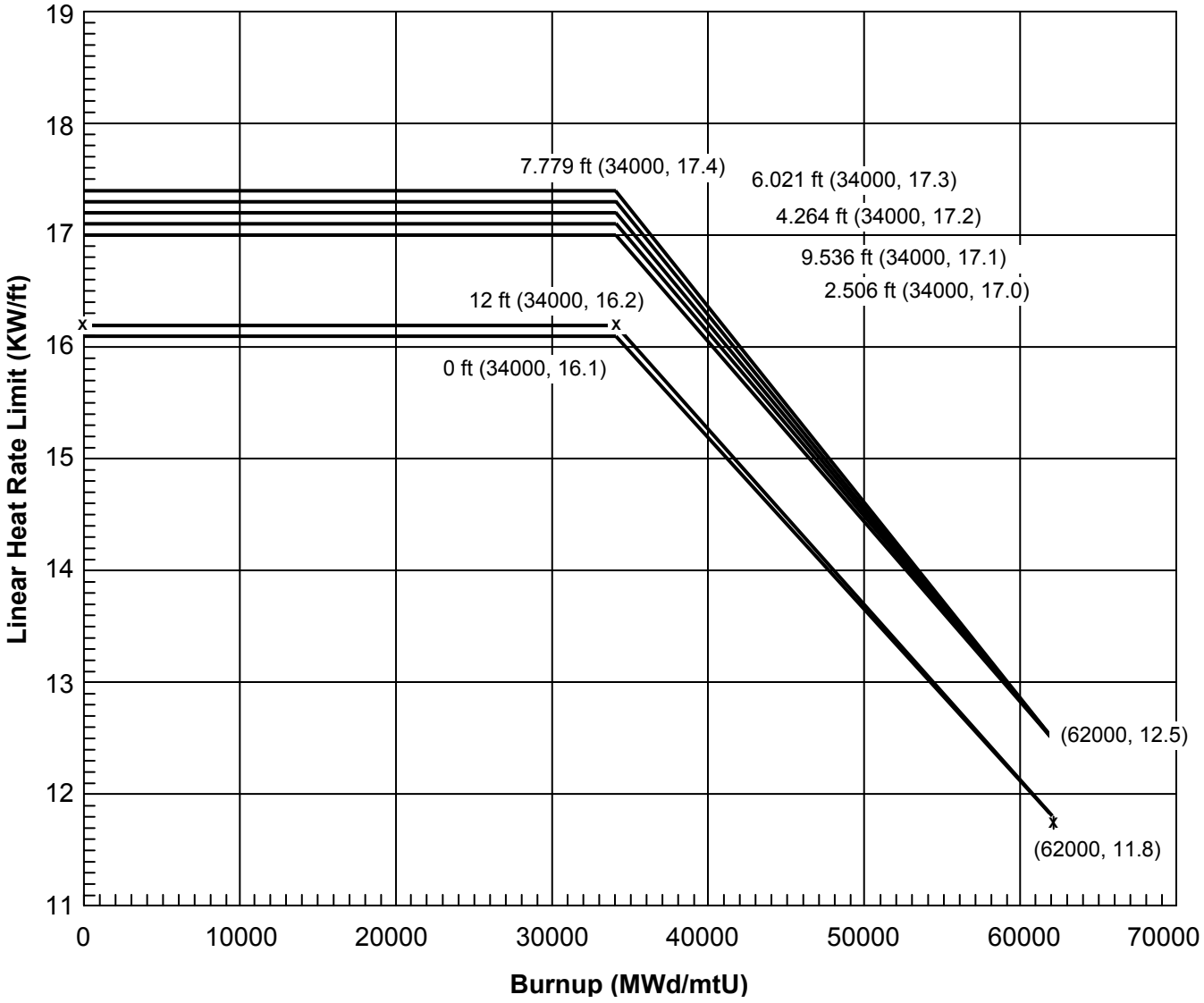
Measurement System	Steady State Value (%)		Maximum Value (%)
	≤ 60 % FP	> 60 % FP	
Full In-core Detector System Setpoint	6.83	6.33	25.00
Minimum In-core Detector System Setpoint	2.78*	1.90*	25.00
Ex-core Power Range NI Channel Setpoint	4.05	1.96	25.00
Measurement System Independent Limit	7.50	4.92	25.00

* Assumes that no individual long emitter detector affecting the minimum in-core tilt calculation exceeds 73% sensitivity depletion. The setpoint must be reduced to 1.50% (power levels > 60% FP) and to 2.19% (power levels ≤ 60% FP) at the earliest time-in-life that this assumption is no longer valid.

Figure 9A

LOCA Linear Heat Rate Limits for Mark-B-HTP Fuel

(Figure is referred to by Technical Specification 3.1.8 and 3.2.5)



DNB Power Peaking Factors

(Limits are referred to by Technical Specification 3.1.8 and 3.2.5)

The following total power peaking factors define the Maximum Allowable Peaking (MAP) limits to protect the initial conditions assumed in the DNB Loss of Flow transient analysis. The total power peaking factors for the Mark-B-HTP fuel are provided. The total power peaking factors for IC-DNB 4-pump and 3-pump are identical; hence one set of IC-DNB values are provided for both 4-pump and 3-pump operation.

IC-DNB Total Power Peaking Factors

Mark-B-HTP								
Axial Peak	**x/L**	**IC MAP Limits**	**Axial Peak**	**x/L**	**IC MAP Limits**	**Axial Peak**	**x/L**	**IC MAP Limits**
1.1	0.01	2.08970	1.4	0.01	2.68281	1.7	0.01	2.74462
	0.14	2.09061		0.14	2.58266		0.14	2.58449
	0.20	2.09081		0.20	2.64487		0.20	2.65108
	0.30	2.09080		0.30	2.74565		0.30	2.75329
	0.40	2.09048		0.40	2.78466		0.40	2.82309
	0.50	2.09030		0.50	2.69263		0.50	2.86702
	0.60	2.08995		0.60	2.58415		0.60	2.79623
	0.70	2.08979		0.70	2.49099		0.70	2.70161
	0.80	2.08866		0.80	2.37534		0.80	2.58298
	0.89	2.04041		0.89	2.30086		0.89	2.50578
	0.99	1.94602		0.99	2.21159		0.99	2.41376
1.2	0.01	2.38393	1.5	0.01	2.70611	1.8	0.01	2.76248
	0.14	2.38637		0.14	2.58407		0.14	2.58536
	0.20	2.38711		0.20	2.64723		0.20	2.65100
	0.30	2.38666		0.30	2.74950		0.30	2.75344
	0.40	2.38616		0.40	2.81333		0.40	2.82636
	0.50	2.38612		0.50	2.77586		0.50	2.87190
	0.60	2.38553		0.60	2.66315		0.60	2.85278
	0.70	2.30194		0.70	2.56832		0.70	2.75823
	0.80	2.20190		0.80	2.44935		0.80	2.64208
	0.89	2.13510		0.89	2.37414		0.89	2.56412
	0.99	2.04448		0.99	2.28275		0.99	2.47374
1.3	0.01	2.66050	1.6	0.01	2.72554	1.9	0.01	2.78038
	0.14	2.58201		0.14	2.58400		0.14	2.58548
	0.20	2.64238		0.20	2.64915		0.20	2.65223
	0.30	2.70551		0.30	2.75237		0.30	2.75356
	0.40	2.68966		0.40	2.81854		0.40	2.82802
	0.50	2.59373		0.50	2.84445		0.50	2.87614
	0.60	2.49505		0.60	2.73470		0.60	2.89110
	0.70	2.40470		0.70	2.63922		0.70	2.80738
	0.80	2.29341		0.80	2.51853		0.80	2.69523
	0.89	2.22210		0.89	2.44208		0.89	2.61744
	0.99	2.13400		0.99	2.34902		0.99	2.52919

Notes

1. The values above are not error corrected.
2. The values above were generated using SCD methods which incorporate a 3.8% radial peak uncertainty in the DNBR design limit. Therefore, the above IC MAP limits can be compared to predicted peaks without the addition of up to 3.8% in radial peak calculation uncertainty. These limits, however, do not incorporate any grid bias uncertainty.
3. The present T-H methodology allows for an increase in the design radial-local peak for power levels below 100% full power. The equations defining the multipliers are as follows:

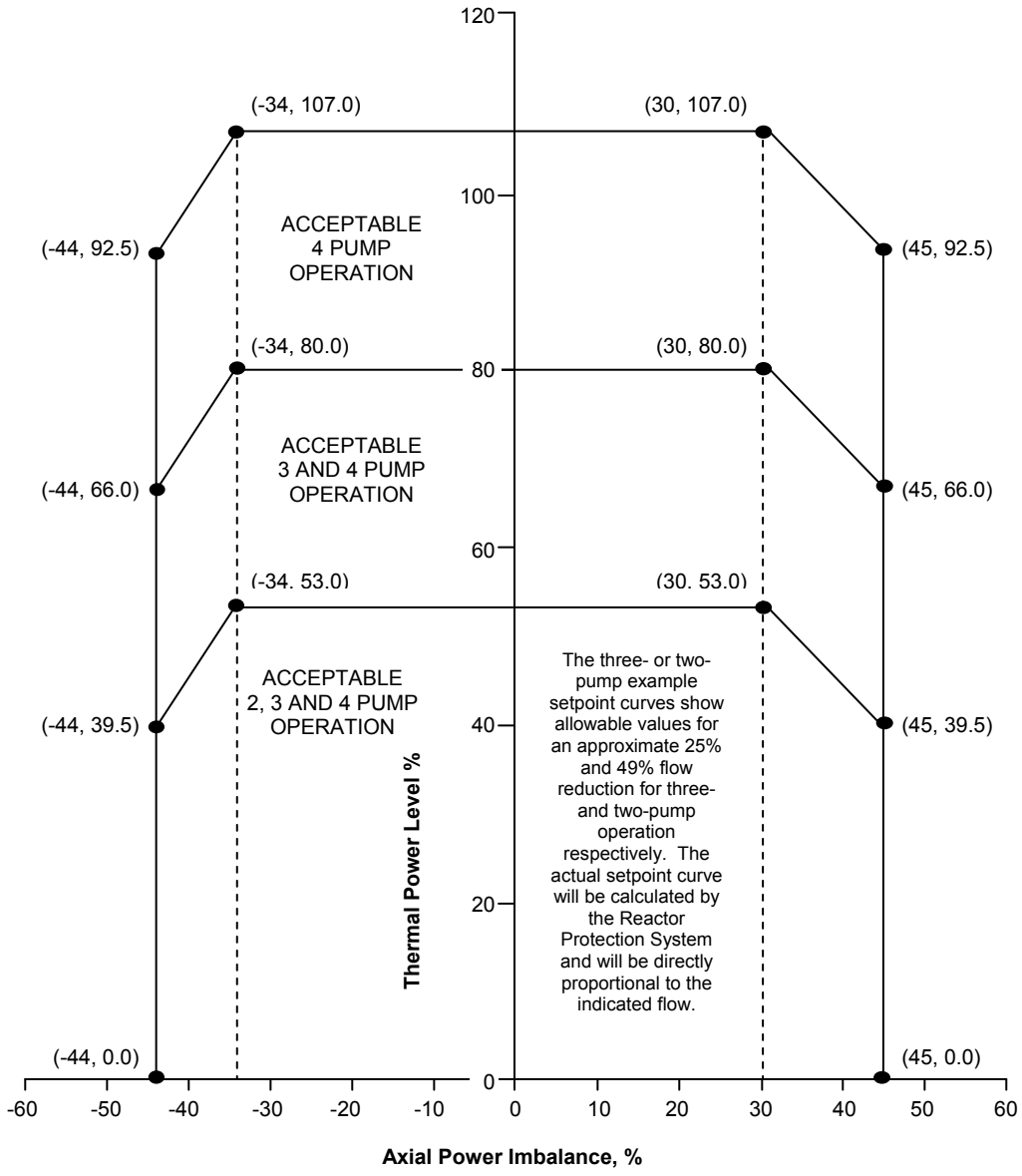
	$P/P_m = 1.00$	$P/P_m < 1.00$
MAP Multiplier	1.0	$1 + 0.3(1 - P/P_m)$

Where P = core power fraction, and
P_m = 1.00 for 4-pump operation, or
= 0.75 for 3-pump operation

Figure 10

Reactor Protection System Maximum Allowable Setpoints for Axial Power Imbalance

(Figure is referred to by Technical Specification 2.1.1.1, 2.1.1.2, and 3.3.1)

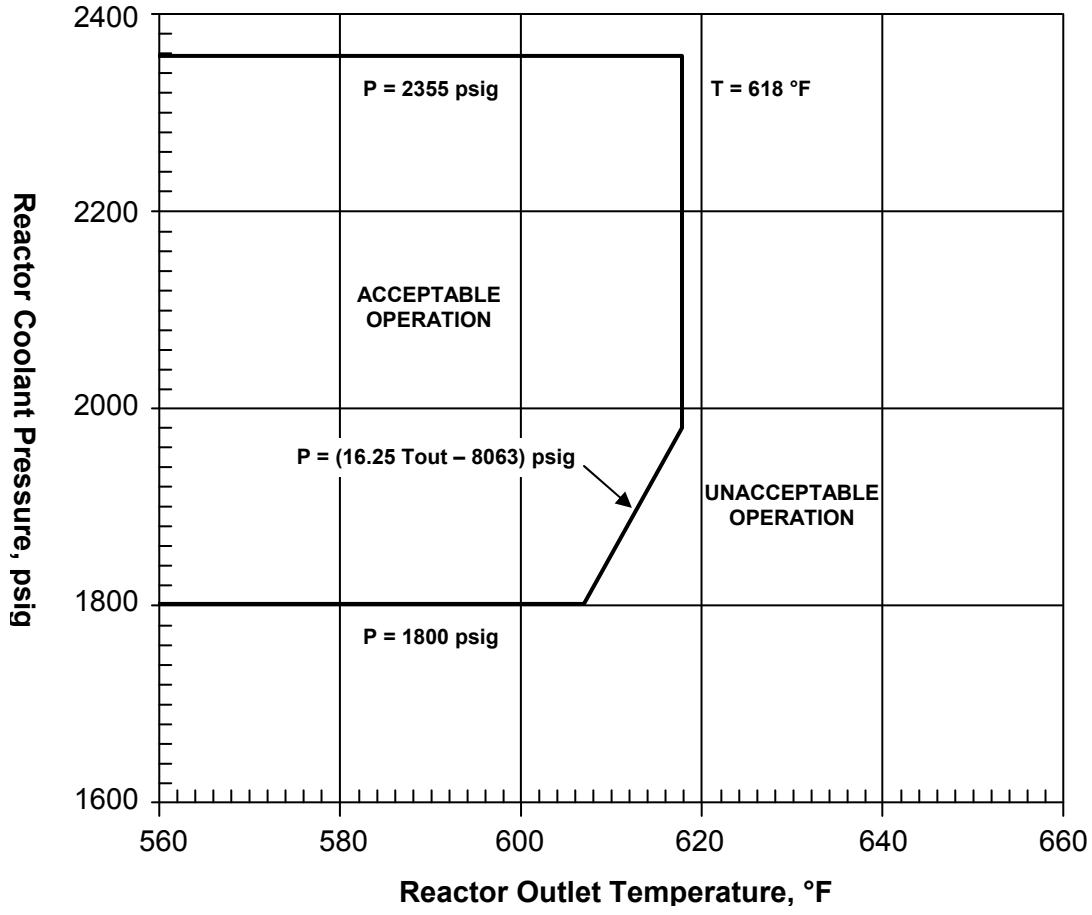


	Flux / Flow Setpoint (% Power / % Flow)
Four Pump Operation	1.07
Three Pump Operation	1.07
Two Pump Operation	1.07

Figure 11

Reactor Protection System Variable Low Pressure Temperature Envelope Setpoints

(Figure is referred to by Technical Specification 3.3.1)



RCS Pressure, Temperature, and Flow
DNB Surveillance Limits

(Limit is referred to by Technical Specification 3.4.1)

	Four-Pump Operation	Three-Pump Operation	Two-Pump Operation
Minimum RCS Hot Leg Pressure (psig) Note 1	2082.2	2081.2 Note 4 2120.4 Note 5	2118.1
Maximum RCS Hot Leg Temperature (°F) Note 2	602.6	602.9	603.15
Minimum RCS Total Flow (Mlb_m/hr) Note 3	143.36 Note 6 138.01 Note 9	106.46 Note 7 102.45 Note 9	70.64 Note 8 67.96 Note 9

Note 1 -- Using individual indications P1021, P1023, P1038 and P1039 (or equivalent) from the plant computer.

Note 2 -- Using individual indications T1011NR, T1014NR, T1039NR, T1042NR, T1012, T1013, T1040 and T1041 or averages TOUTA, XTOUTA, TOUTB, XTOUTB, TOUT, XTOUT from the plant computer.

Note 3 -- Using indication WRCFT (or equivalent) from the plant computer, and can be linearly interpolated between these values provided the T_{ave} versus Power level curve is followed.

Note 4 -- Applies to the RCS loop with two RCPs operating.

Note 5 -- Applies to the RCS loop with one RCP operating.

Note 6 -- For T_{cold} = 556.57 °F.

Note 7 -- For T_{cold} = 556.3 °F.

Note 8 -- For T_{cold} = 556.1 °F.

Note 9 -- For T_{cold} = 580 °F.

RCS Loops – Mode 1 and Mode 2

(Limit is referred to by Technical Specification 3.4.4)

	Nominal Operating Power Level (% Power)
Four Pump Operation	100
Three Pump Operation	75
Two Pump Operation*	49

* Technical Specification 3.4.4 does not allow indefinite operation in Modes 1 and 2 with only two pumps operating.

Refueling Boron Concentration

(Limit is referred to by Technical Specification 3.9.1)

The minimum required boron concentration (which includes uncertainties) for use during refueling as a function of EFPD is 2303 ppm.