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October 27, 2025

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

Subject: ANO-1 Cycle 33 Core Operating Limits Report

Arkansas Nuclear One – Unit 1
NRC Docket No. 50-313
Renewed Facility Operating License No. DPR-51

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) upon issuance for each reload cycle. Enclosed are the ANO-1 Cycle 33 COLR Revisions 0 and 1.

Revision 0 of the ANO-1 Cycle 33 COLR was issued for Mode 6 (Refueling) only as it required revalidation after a leaking fuel pin was discovered on one fuel assembly during core offload. The assembly containing the leaking pin was reconstituted, with the damaged fuel pin replaced by a stainless-steel pin. The refueling boron concentration was verified to remain valid with the reconstituted fuel assembly, and Revision 0 of the COLR was issued to reflect this.

The remainder of the COLR was marked "Operation in Modes 1, 2, 3, 4, and 5 is prohibited" until Framatome, the fuel vendor, could revalidate it for reload with the reconstituted fuel assembly. This allowed core reload to occur while the revalidation was performed.

Revision 1 of the ANO-1 Cycle 33 COLR was subsequently issued after the revalidation process was completed, allowing for operation in all applicable modes.

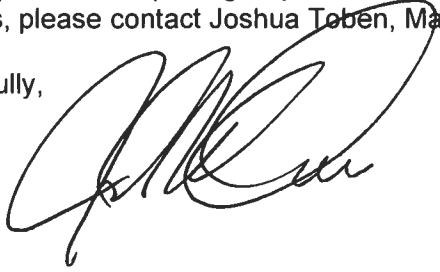
No core operating limits, protective limits, or trip setpoints contained in Revision 0 of the ANO-1 COLR required revision as a result of the reconstituted fuel assembly. The reload report was reviewed and no values or limits changed between Revision 0 and Revision 1 of the COLR. All fuel design limits continue to be met.

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 9, November 2017. In addition, the approved revision number of the Entergy Reactor Physics Methods Report is identified in the COLR as Revision 0, December 1993.

There are no new commitments contained in this submittal.

This completes the reporting requirement of the stated specification. Should you have any questions, please contact Joshua Toben, Manager, Regulatory Assurance at 479-858-3135.

Respectfully,

A handwritten signature in black ink, appearing to read 'JT', is written over the word 'Respectfully,'.

JT/mar

Enclosure 1: ANO-1 Cycle 33 Core Operating Limits Report (COLR) Revision 0

Enclosure 2: ANO-1 Cycle 33 Core Operating Limits Report (COLR) Revision 1

cc: NRC Region IV Regional Administrator
NRC Senior Resident Inspector – Arkansas Nuclear One
NRC Project Manager – Arkansas Nuclear One
Designated Arkansas State Official

Enclosure 1

1CAN102501

ANO-1 Cycle 33 Core Operating Limits Report (COLR) Revision 0

(31 pages)

ENTERGY OPERATIONS

ARKANSAS NUCLEAR ONE
UNIT ONE

CYCLE 33

CORE OPERATING LIMITS REPORT

REVISION 0

1.0 CORE OPERATING LIMITS

This Core Operating Limits Report for ANO-1 Cycle 33 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. 9, Framatome ANP, Inc., Lynchburg, Virginia, November 2017
2. "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
3. Framatome Document, "Transmittal of ANO-1 Cycle 33 Limits and Setpoints," FS1-0079307-1.0
4. Framatome Document, "Transmittal of ANO-1 Cycle 33 Core Loading Plan," FS1-0078298-1.0
5. "IC (Initial Condition) DNB RCS Protection Criteria," CALC-96-E-0023-02, Rev. 7
6. Framatome Document, "Transmittal of ANO-1 Generic Reload Technical Document," FS1-0071774-1.0, CALC-ANO1-NE-23-00005
7. Framatome Document, "Transmittal of ANO-1 Cycle 33 Refueling Boron Confirmation," FS1-0081238-1.0

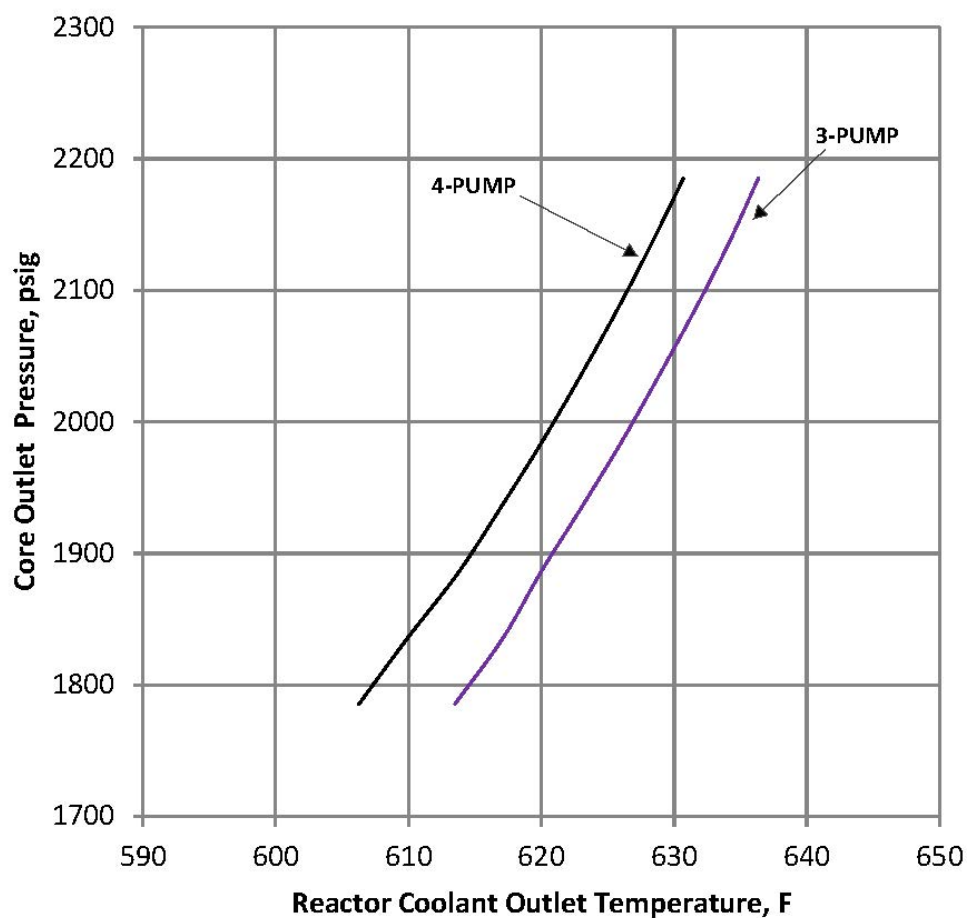
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FIGURE 1**Variable Low RCS Pressure – Temperature Protective Limits**

(Figure is referred to by Technical Specification 2.1.1.3)



<u>PUMPS OPERATING (TYPE OF LIMIT)</u>	<u>GPM*</u>	<u>POWER**</u>
FOUR PUMPS (DNBR LIMIT)	383,680 (100%)	110%
THREE PUMPS (DNBR LIMIT)	284,307 (74.1%)	89%

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

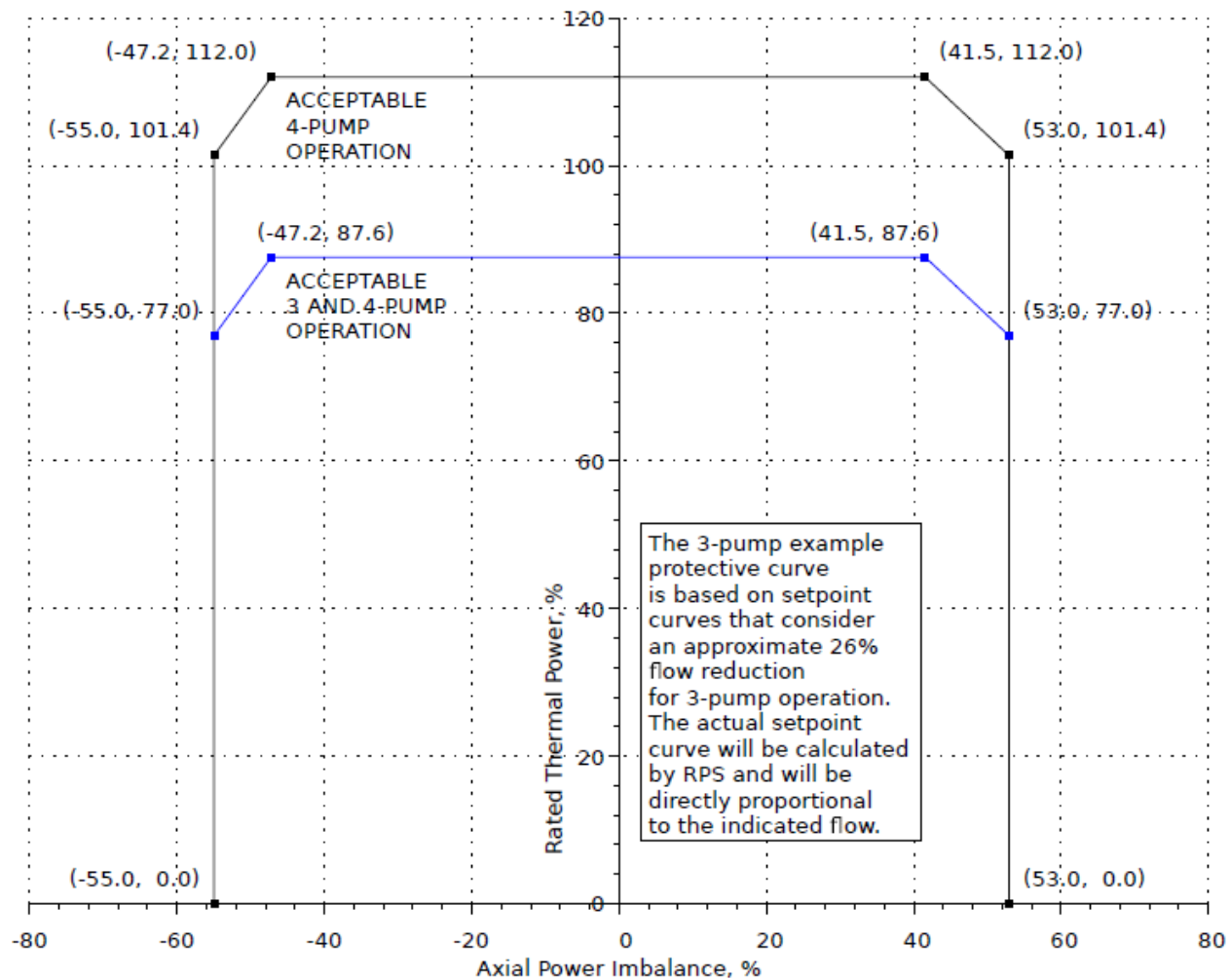
** AN ADDITIONAL 2% POWER UNCERTAINTY IS INCLUDED IN STATISTICAL DESIGN LIMIT

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 2**AXIAL POWER IMBALANCE Protective Limits**

(measurement system independent)

(Figure is referred to by Technical Specification 2.1.1 Bases)

**OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.**

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*	$\geq 1 \% \Delta k/k$	3.1.4, 3.1.5
MODE 2*	$\geq 1 \% \Delta k/k$	3.1.4, 3.1.5, 3.3.9
MODE 3	$\geq 1 \% \Delta k/k$	3.1.1, 3.3.9
MODE 4	$\geq 1 \% \Delta k/k$	3.1.1, 3.3.9
MODE 5	$\geq 1 \% \Delta k/k$	3.1.1, 3.3.9
MODE 1 PHYSICS TESTS Exceptions**	$\geq 1 \% \Delta k/k$	3.1.8
MODE 2 PHYSICS TESTS Exceptions	$\geq 1 \% \Delta k/k$	3.1.9

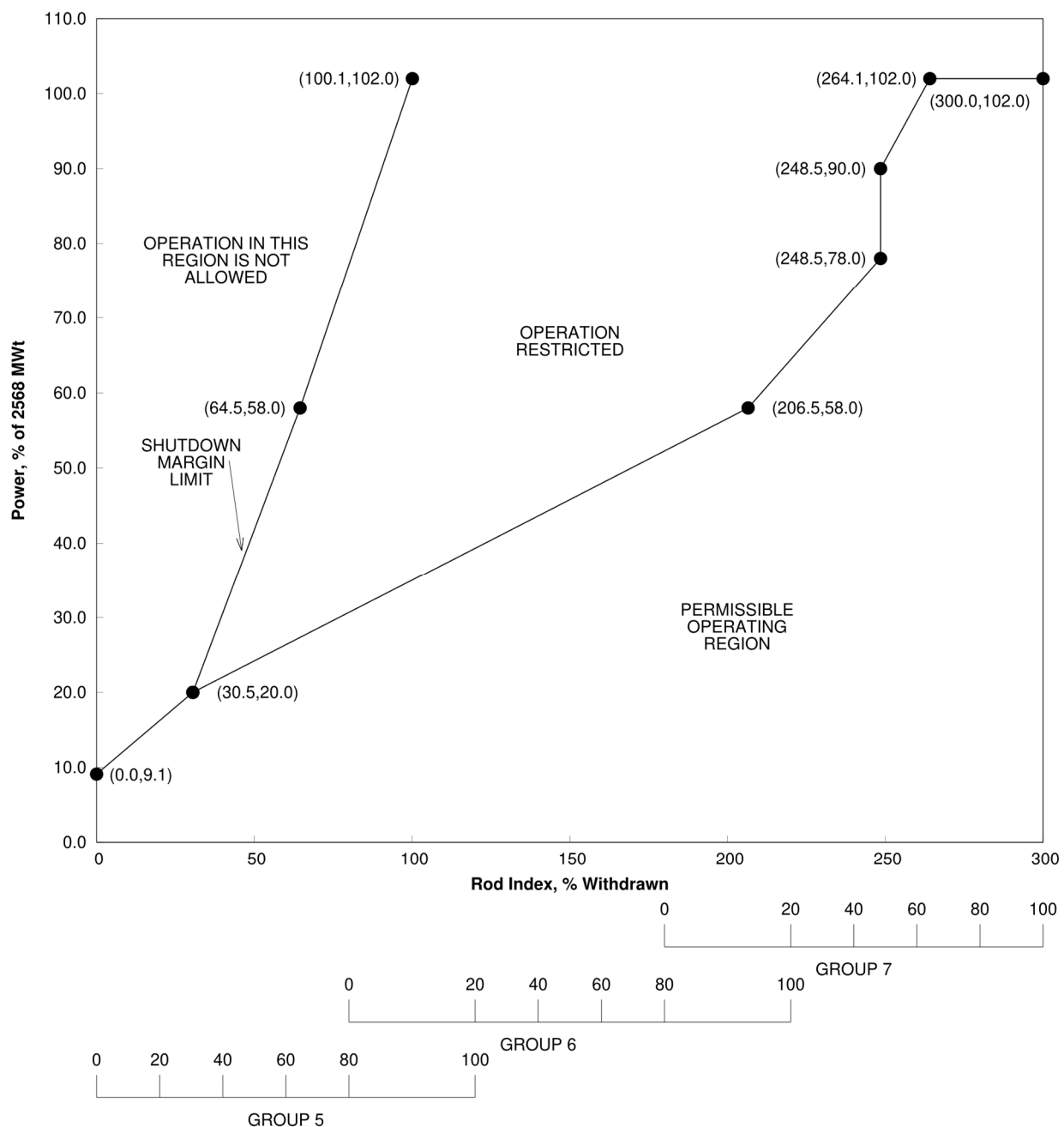
* The required Shutdown Margin capability of $1 \% \Delta k/k$ in MODE 1 and MODE 2 is preserved by the Regulating Rod Insertion Limits specified in Figures 3-A&B, and 4-A&B, as required by Technical Specification 3.2.1.

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

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

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)

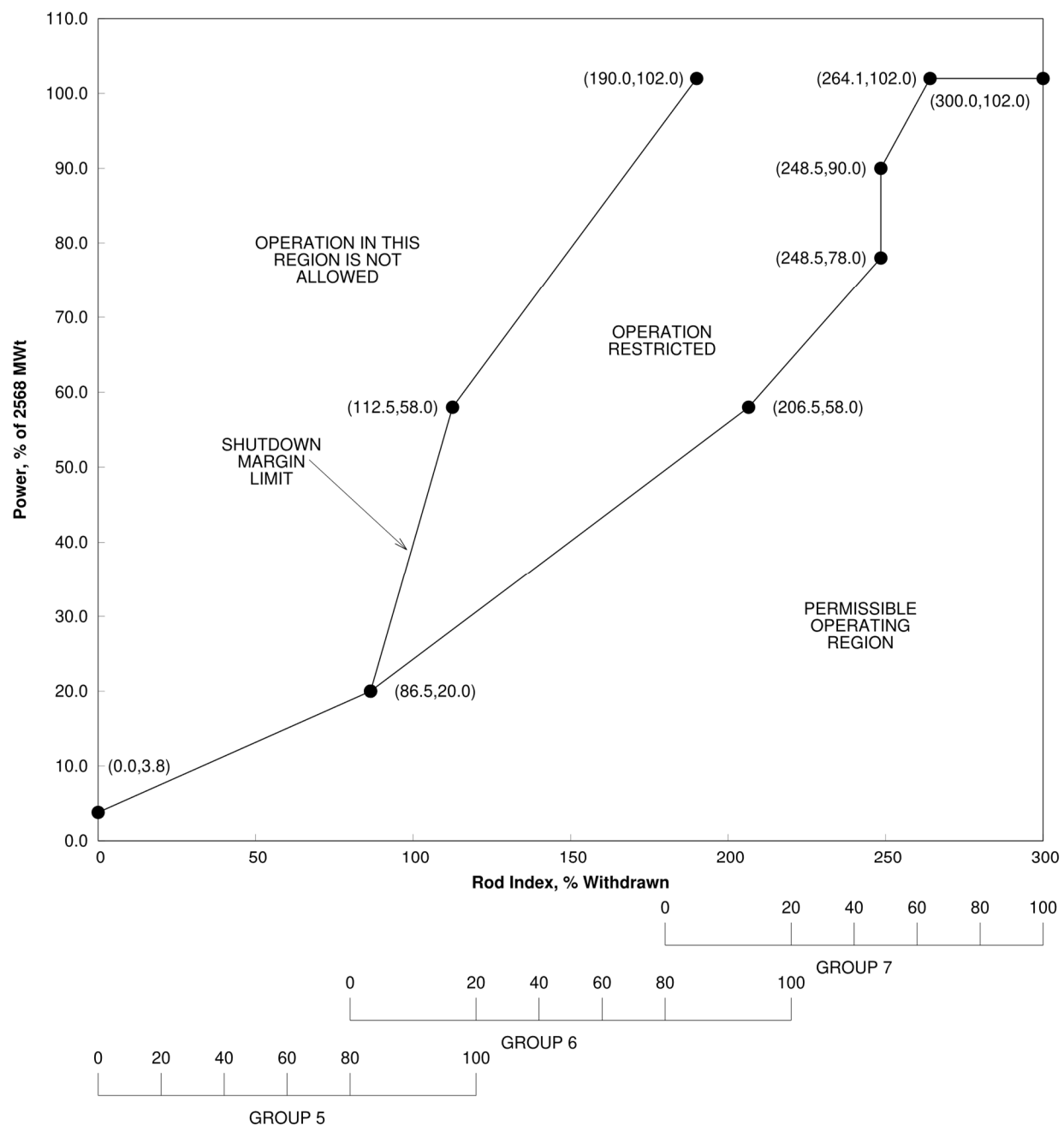


Operating rod group overlap in the above figure is $20\% \pm 5\%$ between two sequential groups, except for physics tests.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

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)

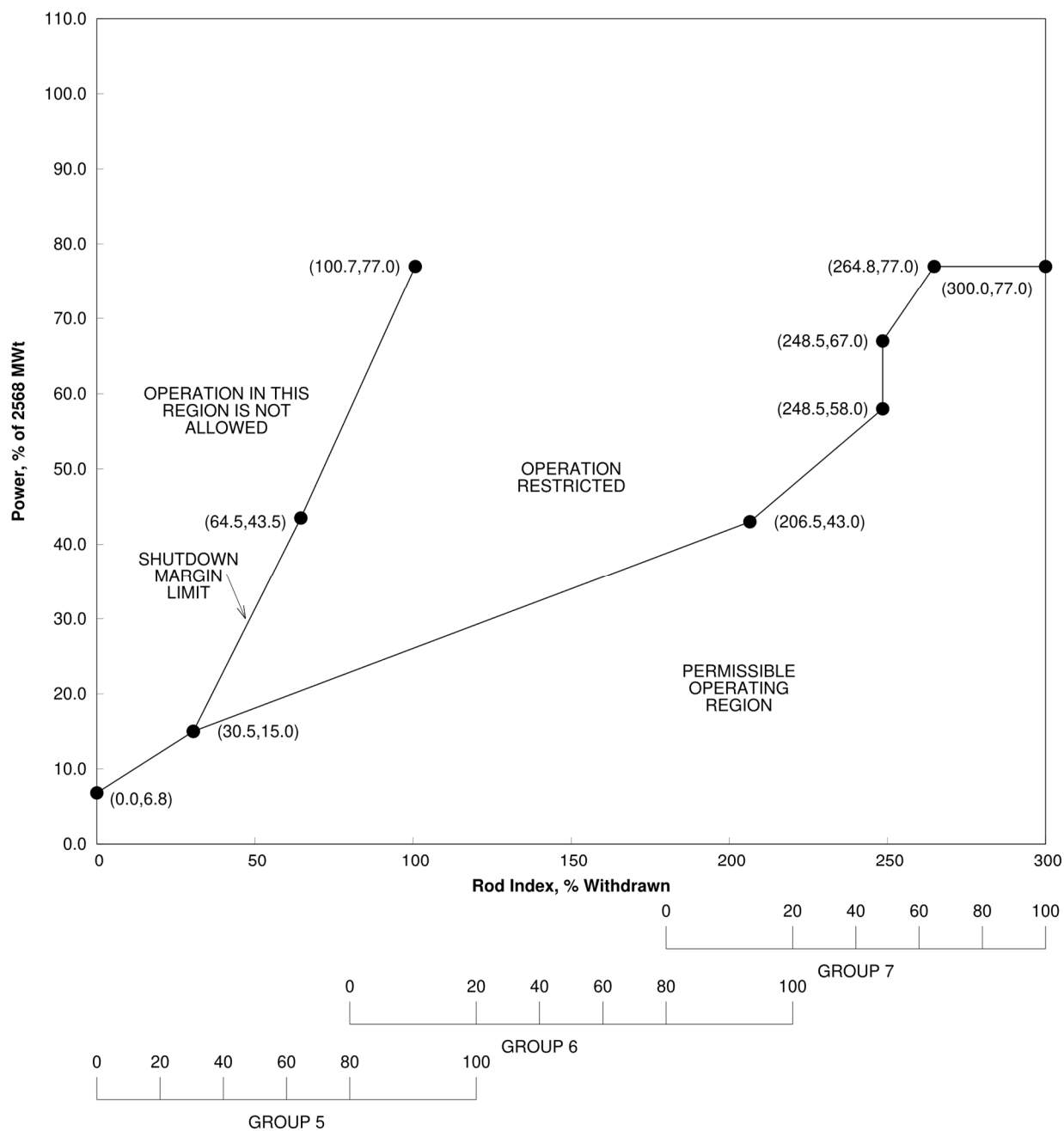


Operating rod group overlap of Groups 5, 6, 7 in the above figure is $20\% \pm 5\%$ between two sequential groups, except for physics tests.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

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)

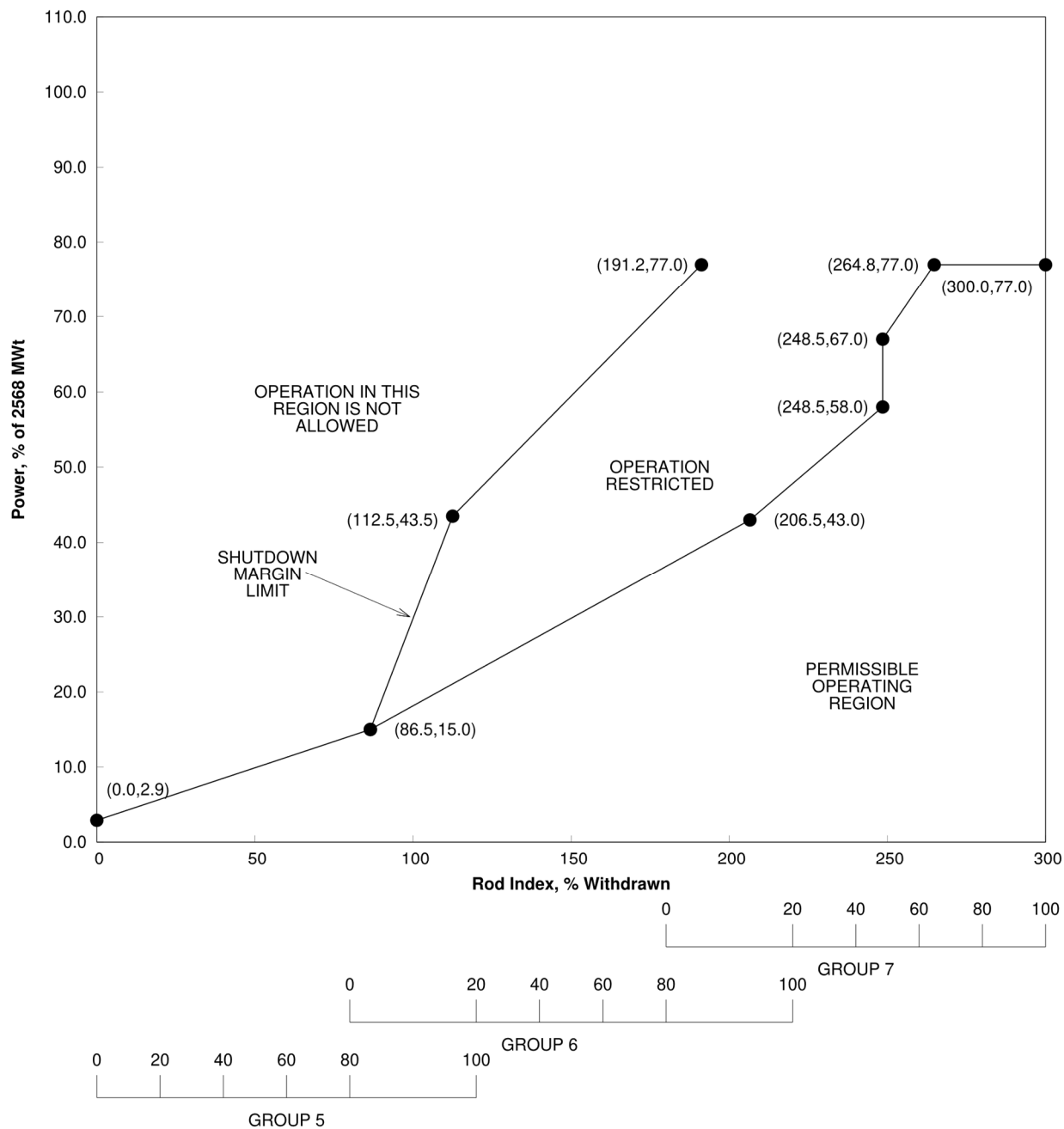


Operating rod group overlap of Groups 5, 6, 7 in the above figure is $20\% \pm 5\%$ between two sequential groups, except for physics tests.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

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 of Groups 5, 6, 7 in the above figure is $20\% \pm 5\%$ between two sequential groups, except for physics tests.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

AXIAL POWER SHAPING RODS (APSR) INSERTION LIMITS

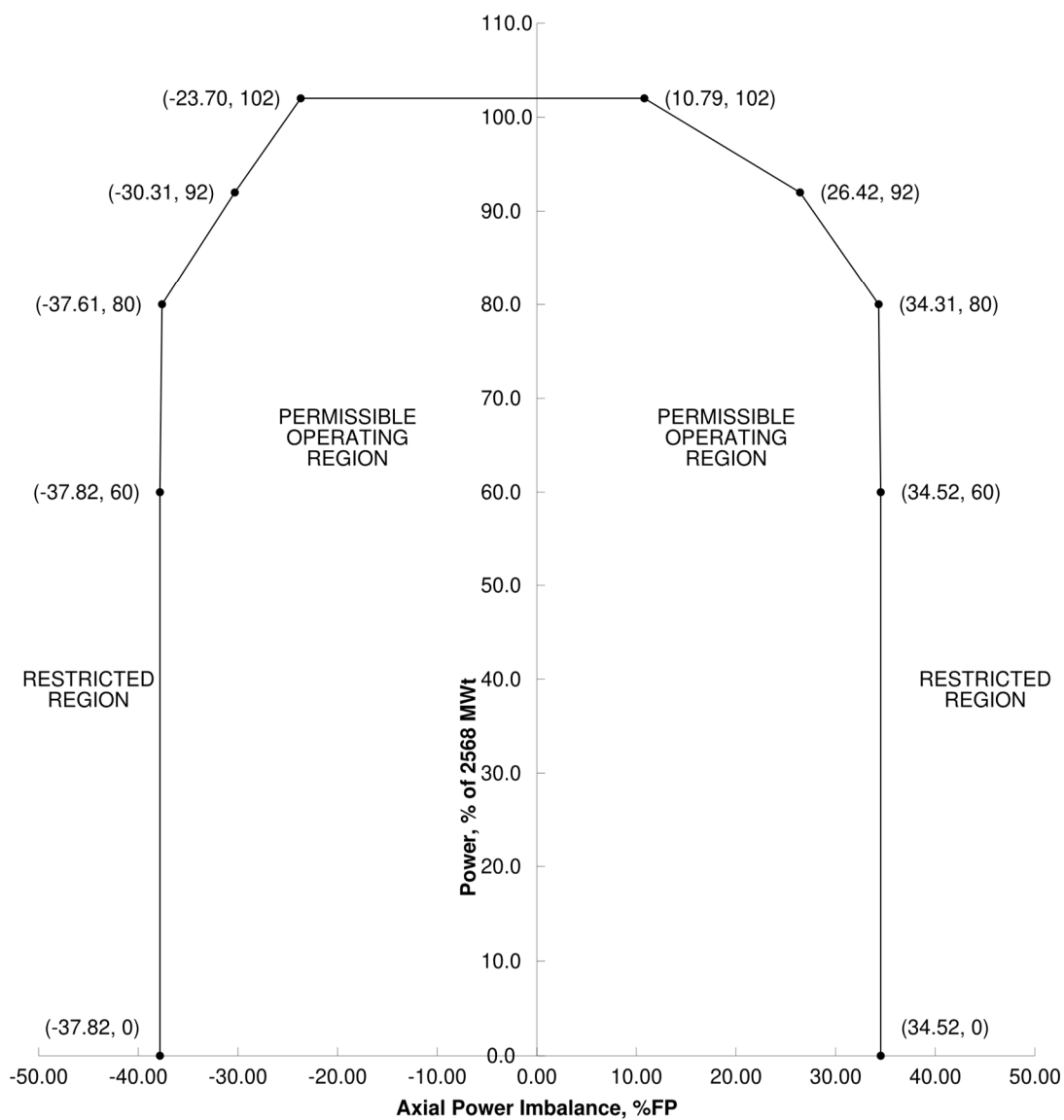
(Limits are referred to by Technical Specification 3.2.2)

Up to 454 ± 10 EFPD, the APSRs may be positioned as necessary for transient imbalance control; however, the APSRs shall be fully withdrawn by 464 EFPD. After the APSRs withdrawal at 454 ± 10 EFPD, the APSRs shall not be reinserted, except during the end-of-cycle shutdown when the reactor power is equal to, or less than, 30 % FP.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 5-A1**AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Four-Pump Operation from 0 EFPD to 200 +10/-10 EFPD**

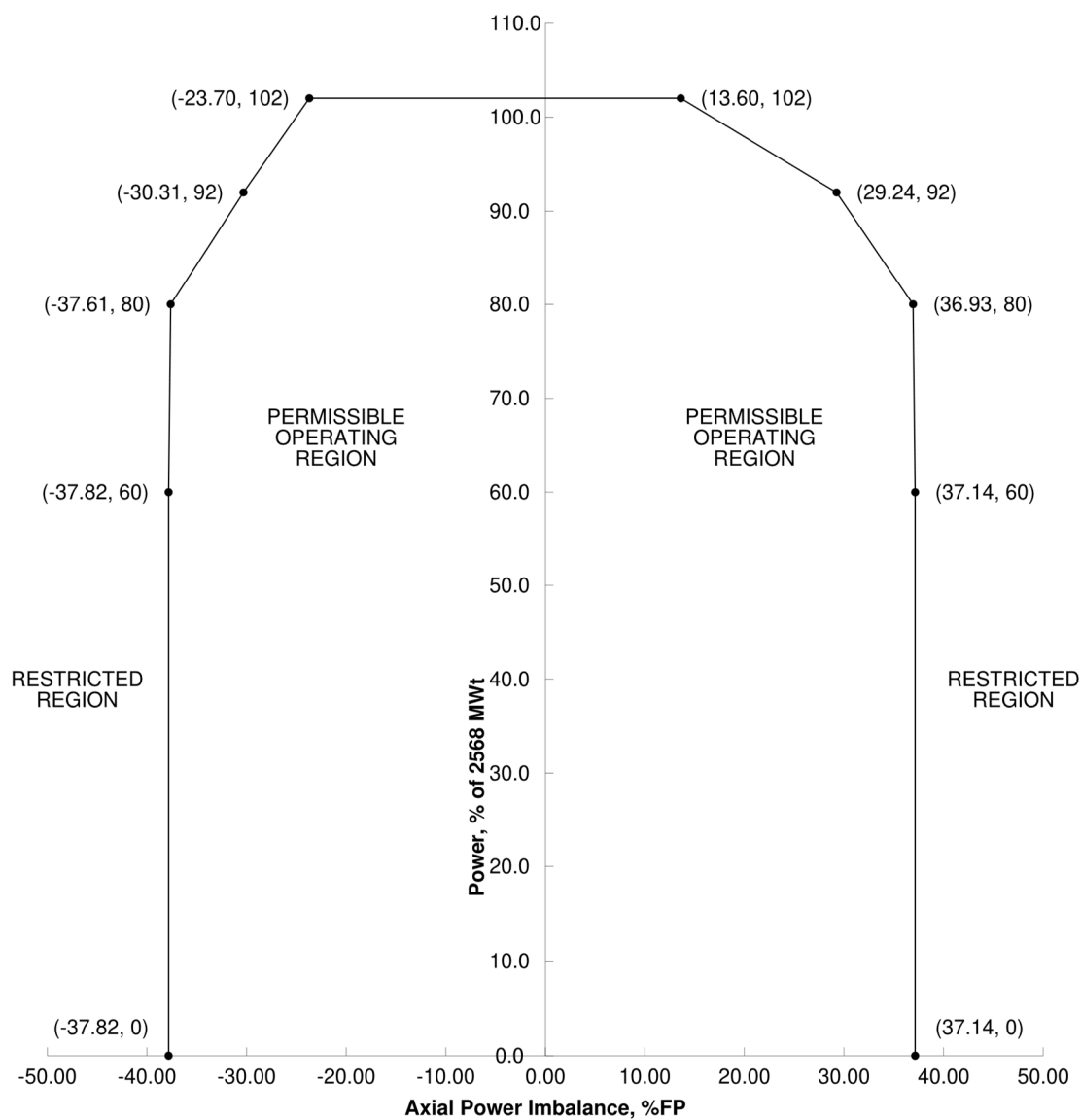
(Figure is referred to by Technical Specification 3.2.3)



OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 5-A2**AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Four-Pump Operation from 200 +10/-10 EFPD to EOC**

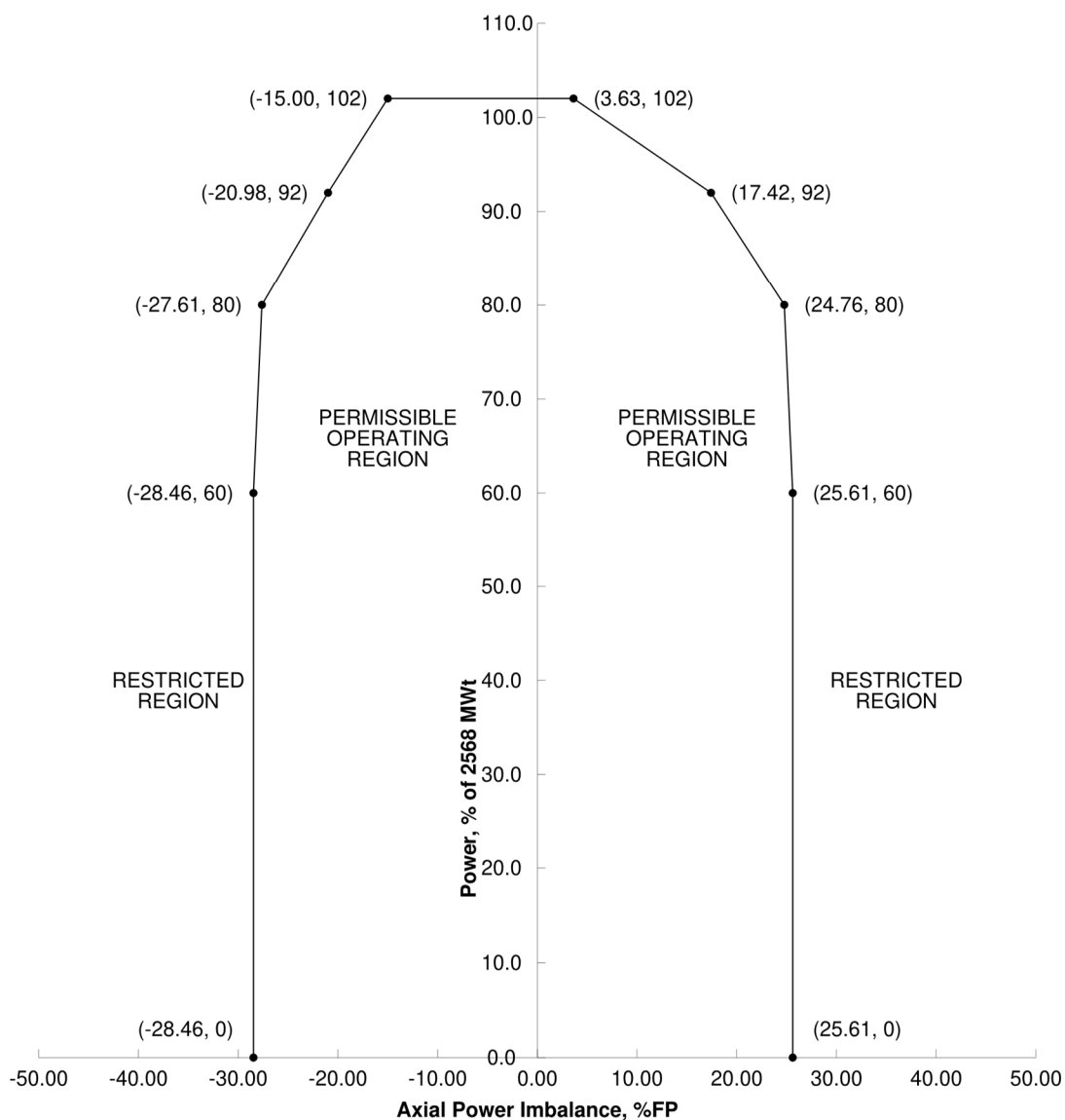
(Figure is referred to by Technical Specification 3.2.3)



OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 5-B1**AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Four-Pump Operation from 0 EFPD to 200 +10/-10 EFPD**

(Figure is referred to by Technical Specification 3.2.3)

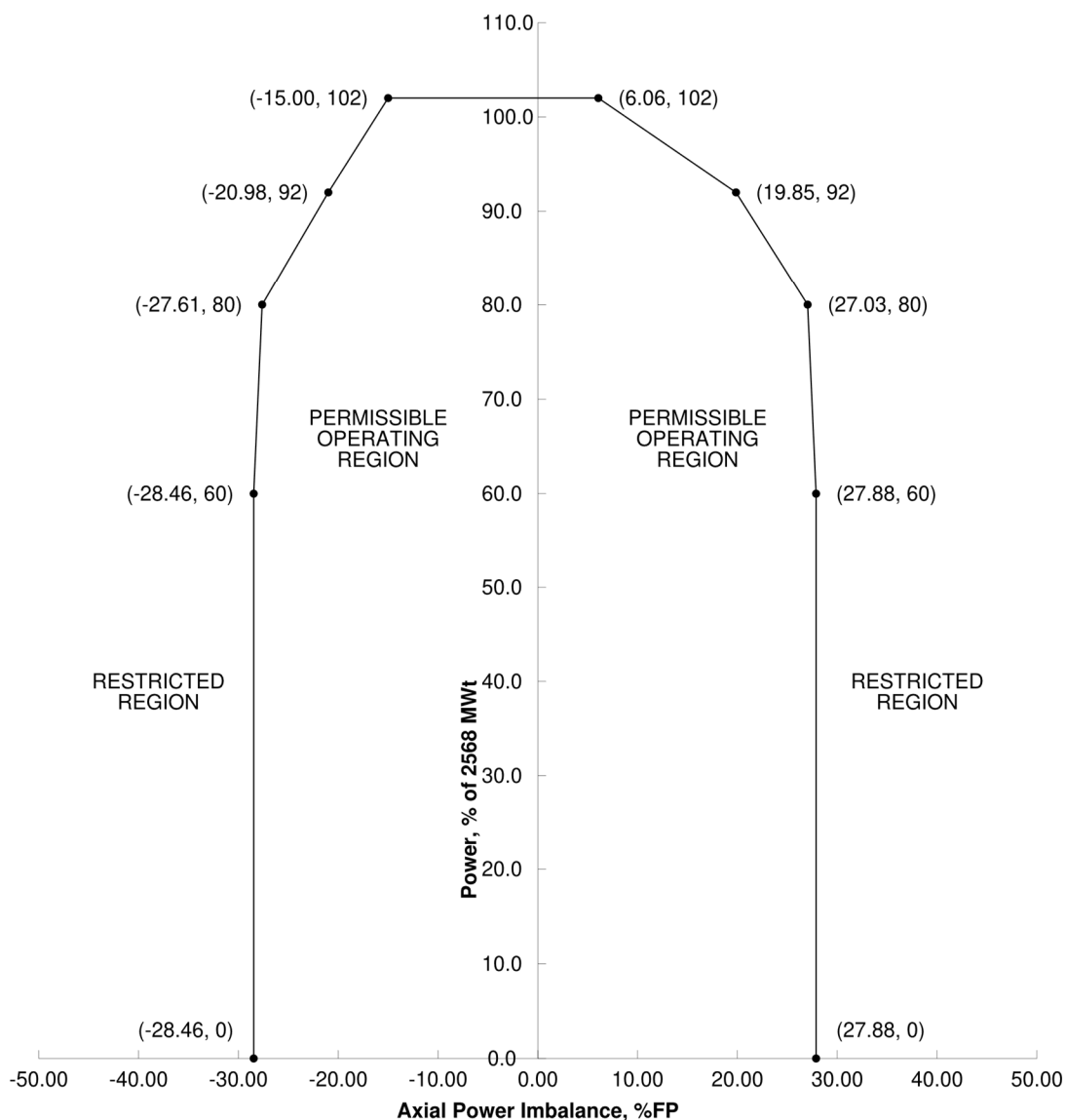


* Assumes that no individual long emitter detector affecting the minimum incore imbalance calculation exceeds 73% sensitivity depletion. The imbalance setpoints for the minimum incore system must be reduced to 2.8% FP at the earliest time-in-life this assumption is no longer valid.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 5-B2**AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Four-Pump Operation from 200 +10/-10 EFPD to EOC**

(Figure is referred to by Technical Specification 3.2.3)



* Assumes that no individual long emitter detector affecting the minimum incore imbalance calculation exceeds 73% sensitivity depletion. The imbalance setpoints for the minimum incore system must be reduced to 2.8% FP at the earliest time-in-life this assumption is no longer valid.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 5-C1**AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Four-Pump Operation
from 0 EFPD to 200 +10/-10 EFPD**

(Figure is referred to by Technical Specification 3.2.3)

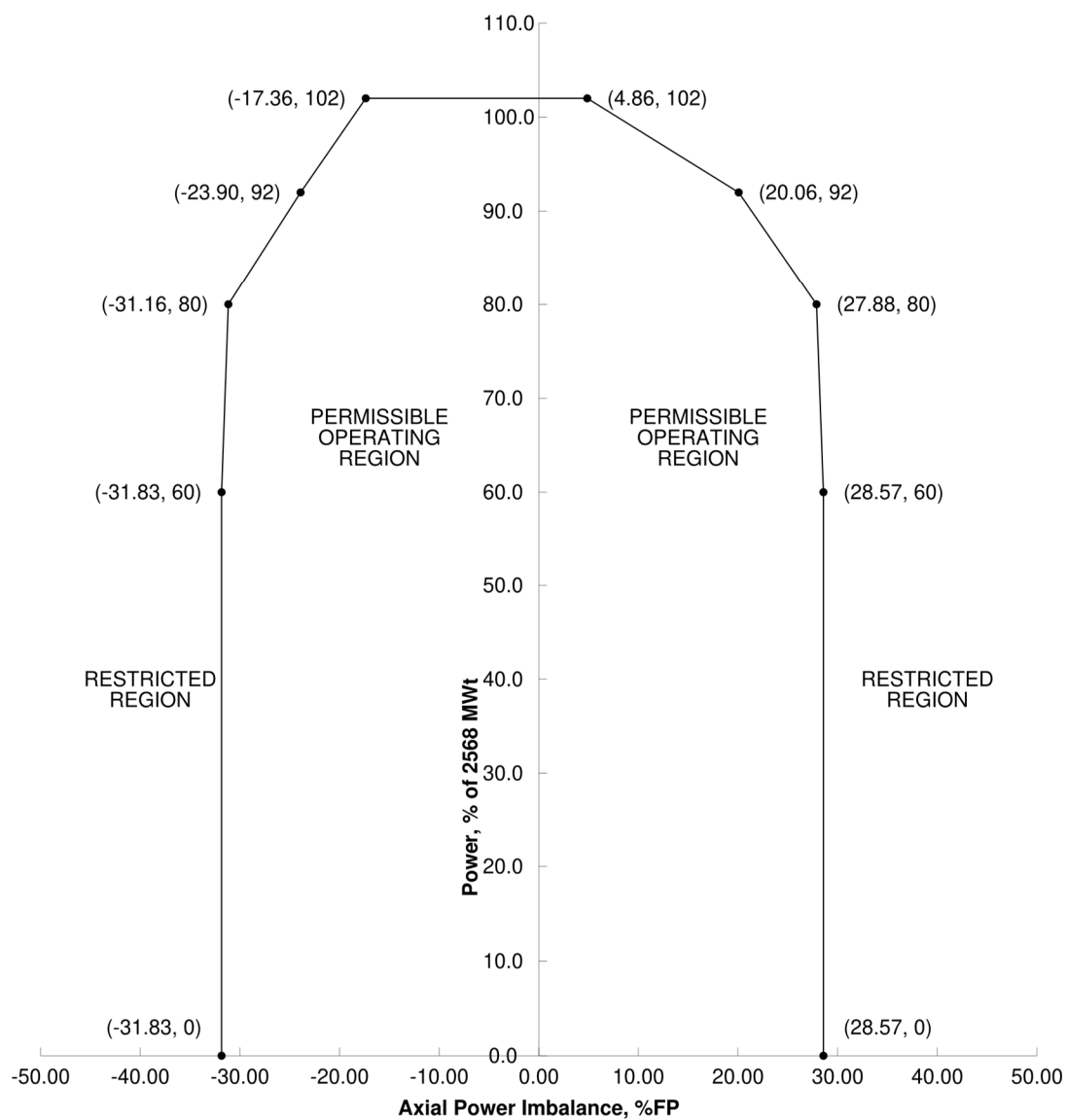
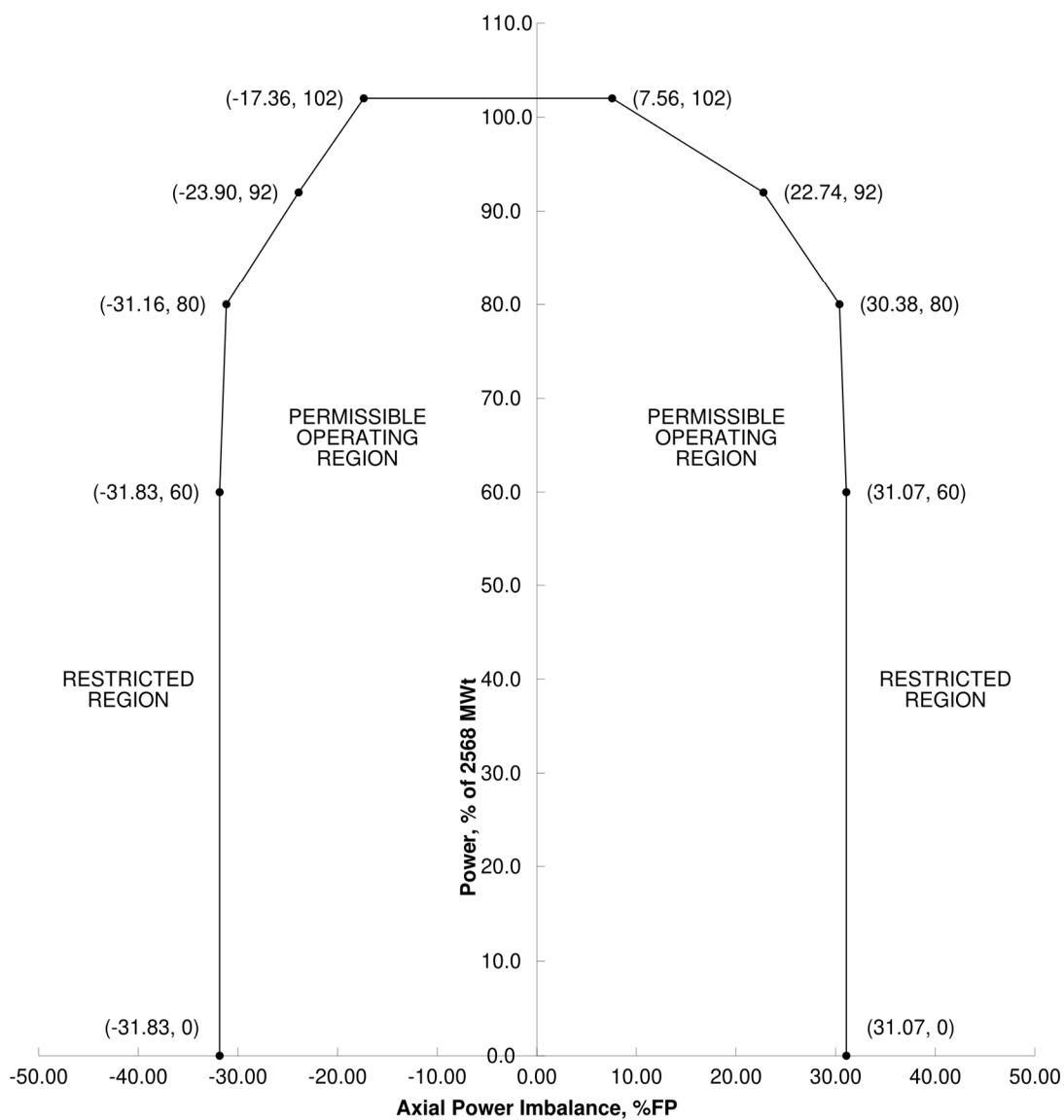
**OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.**

Figure 5-C2**AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Four-Pump Operation
from 200 +10/-10 EFPD to EOC**

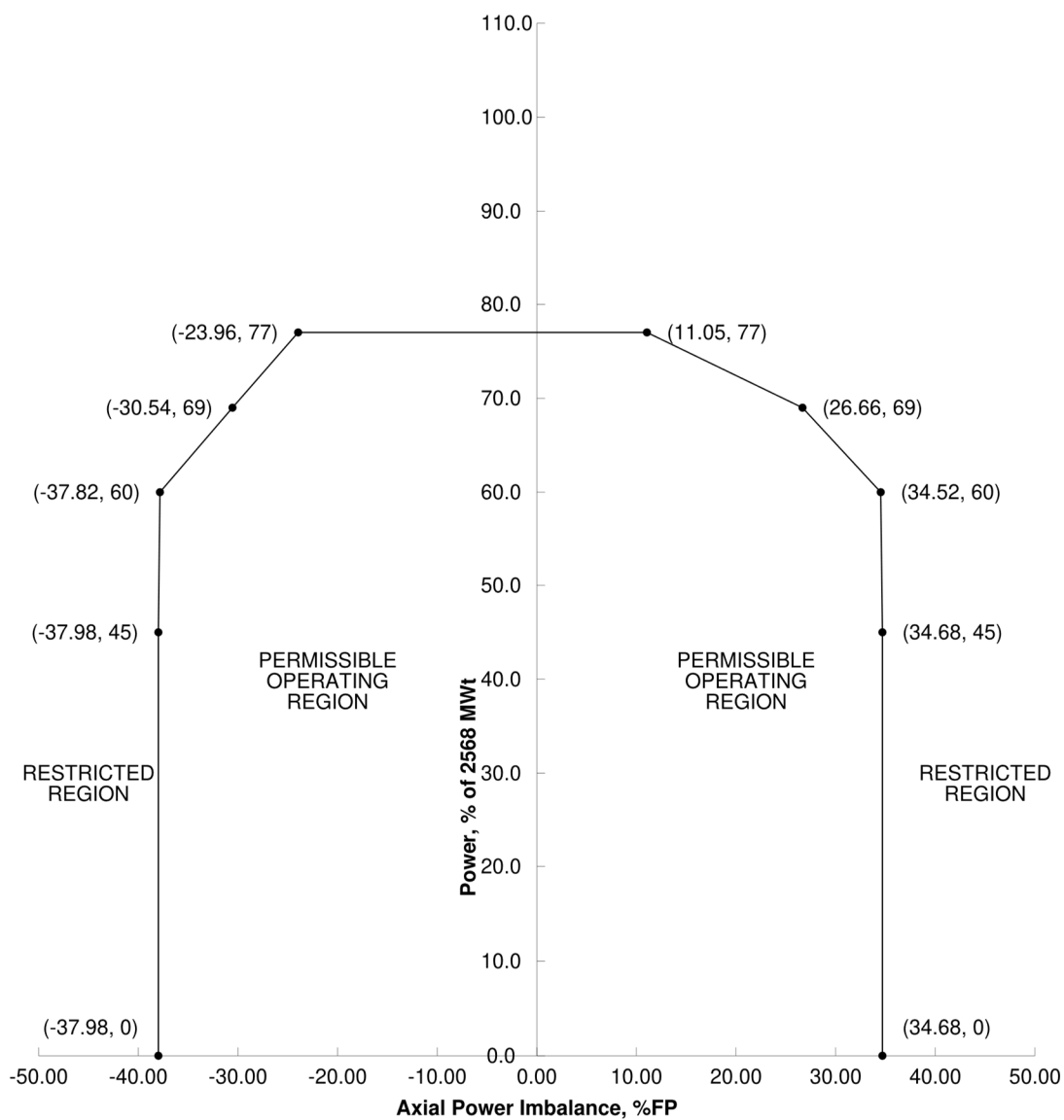
(Figure is referred to by Technical Specification 3.2.3)



OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 6-A1**AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Three-Pump Operation from 0 EFPD to 200 +10/-10 EFPD**

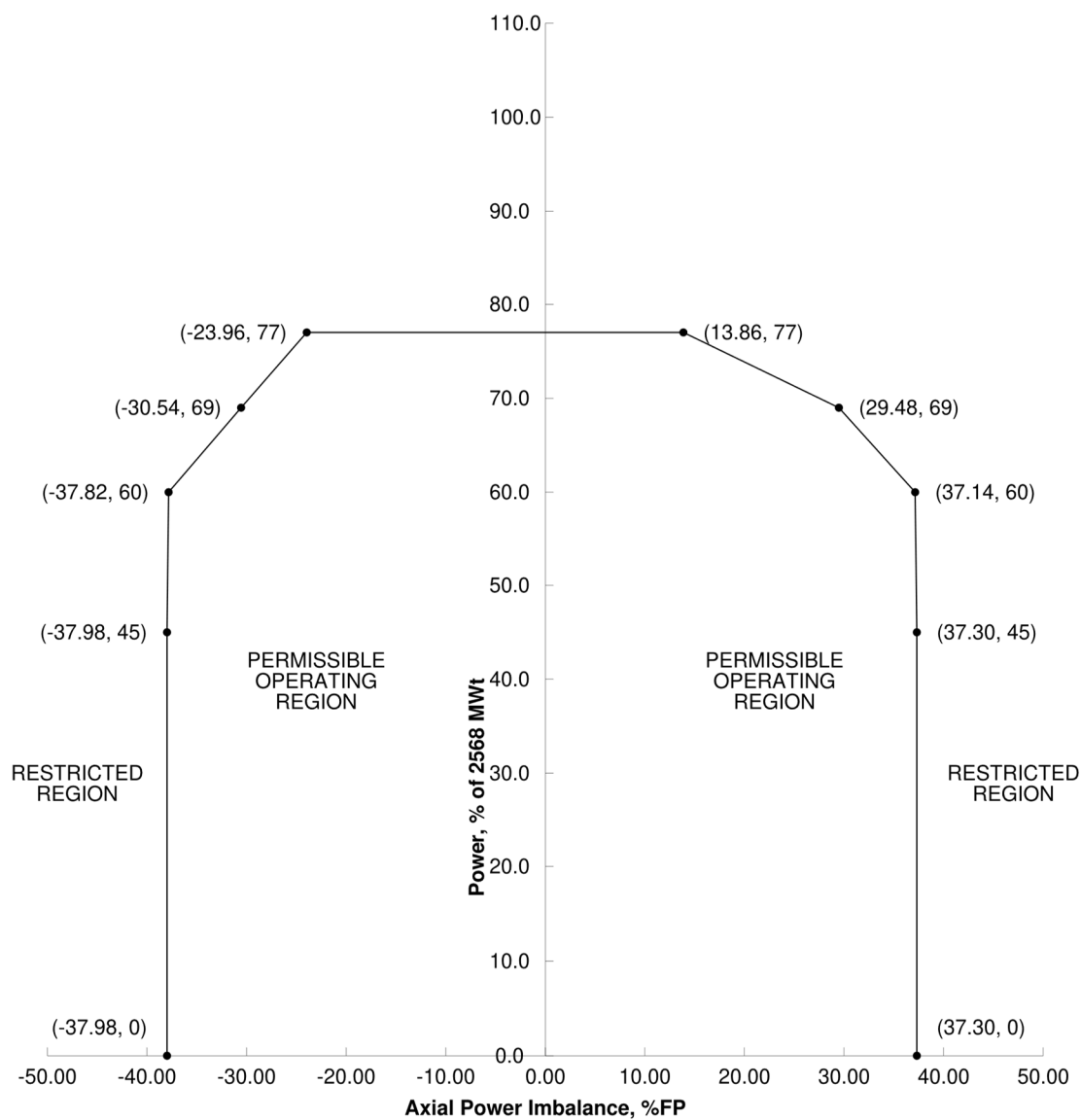
(Figure is referred to by Technical Specification 3.2.3)



OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 6-A2**AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Three-Pump Operation from 200 +10/-10 EFPD to EOC**

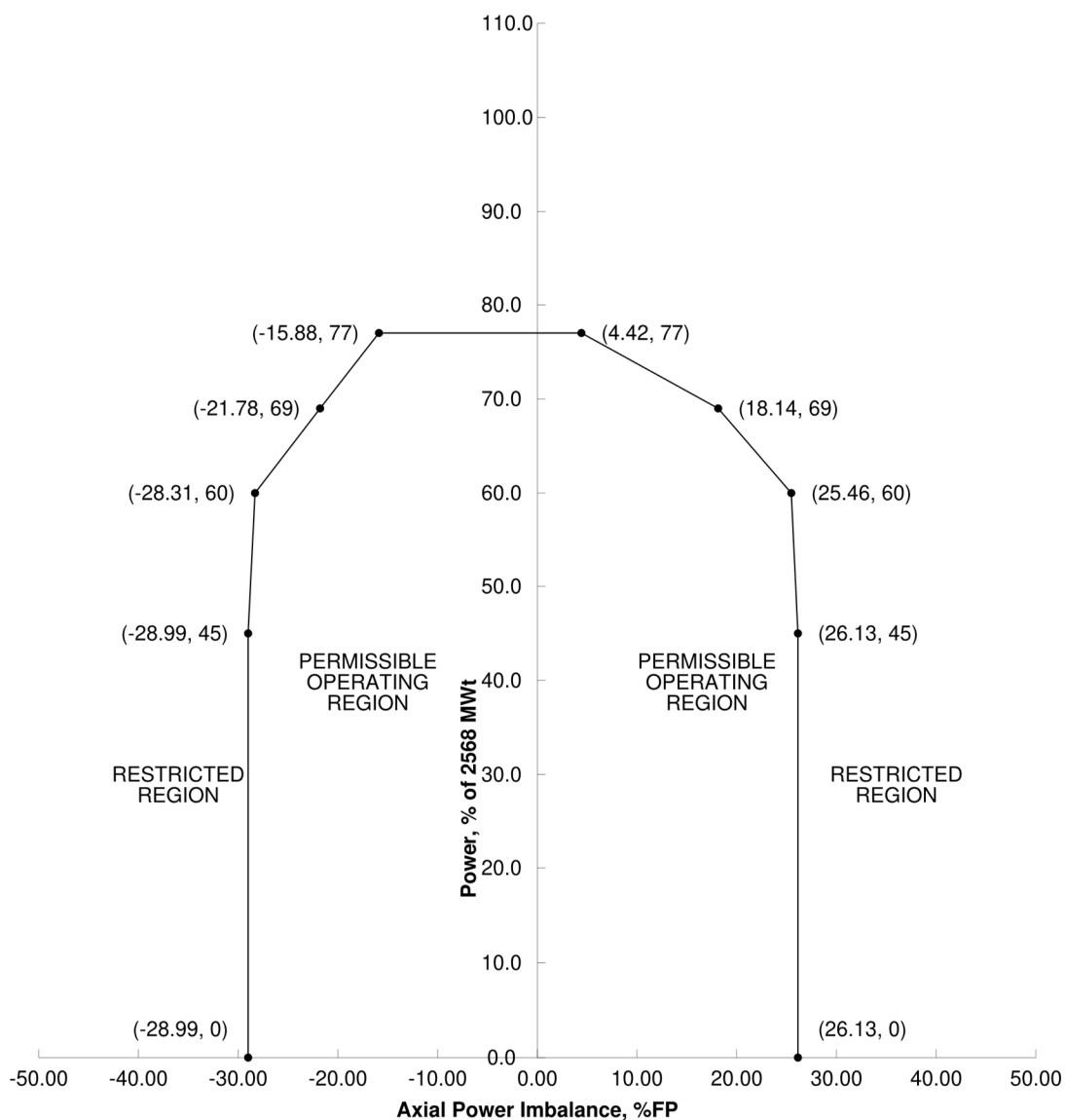
(Figure is referred to by Technical Specification 3.2.3)



OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 6-B1**AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Three-Pump Operation from 0 EFPD to 200 +10/-10 EFPD**

(Figure is referred to by Technical Specification 3.2.3)

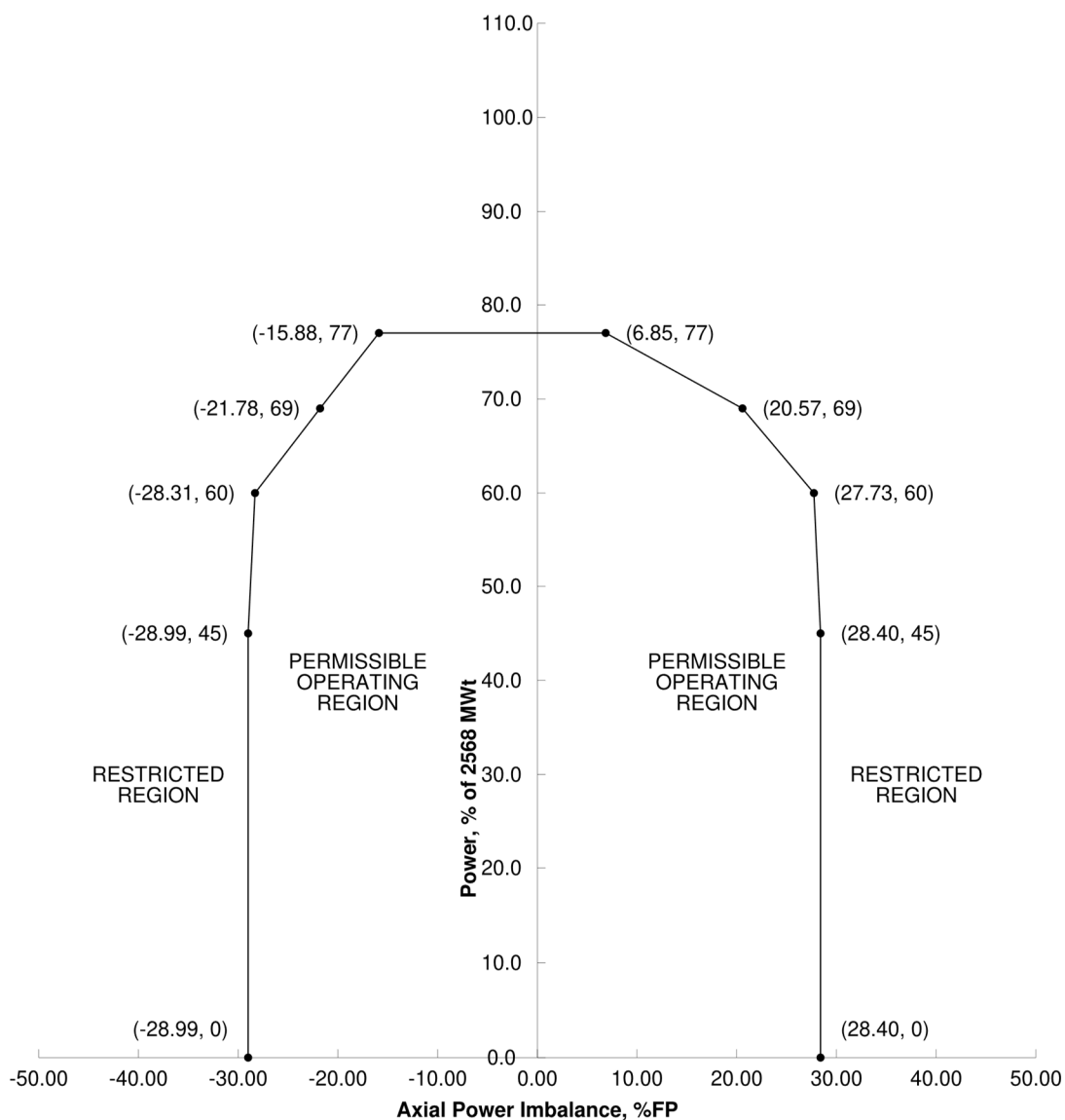


* Assumes that no individual long emitter detector affecting the minimum incore imbalance calculation exceeds 73% sensitivity depletion. The imbalance setpoints for the minimum incore system must be reduced to 2.8% FP at the earliest time-in-life this assumption is no longer valid.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 6-B2**AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Three-Pump Operation from 200 +10/-10 EFPD to EOC**

(Figure is referred to by Technical Specification 3.2.3)

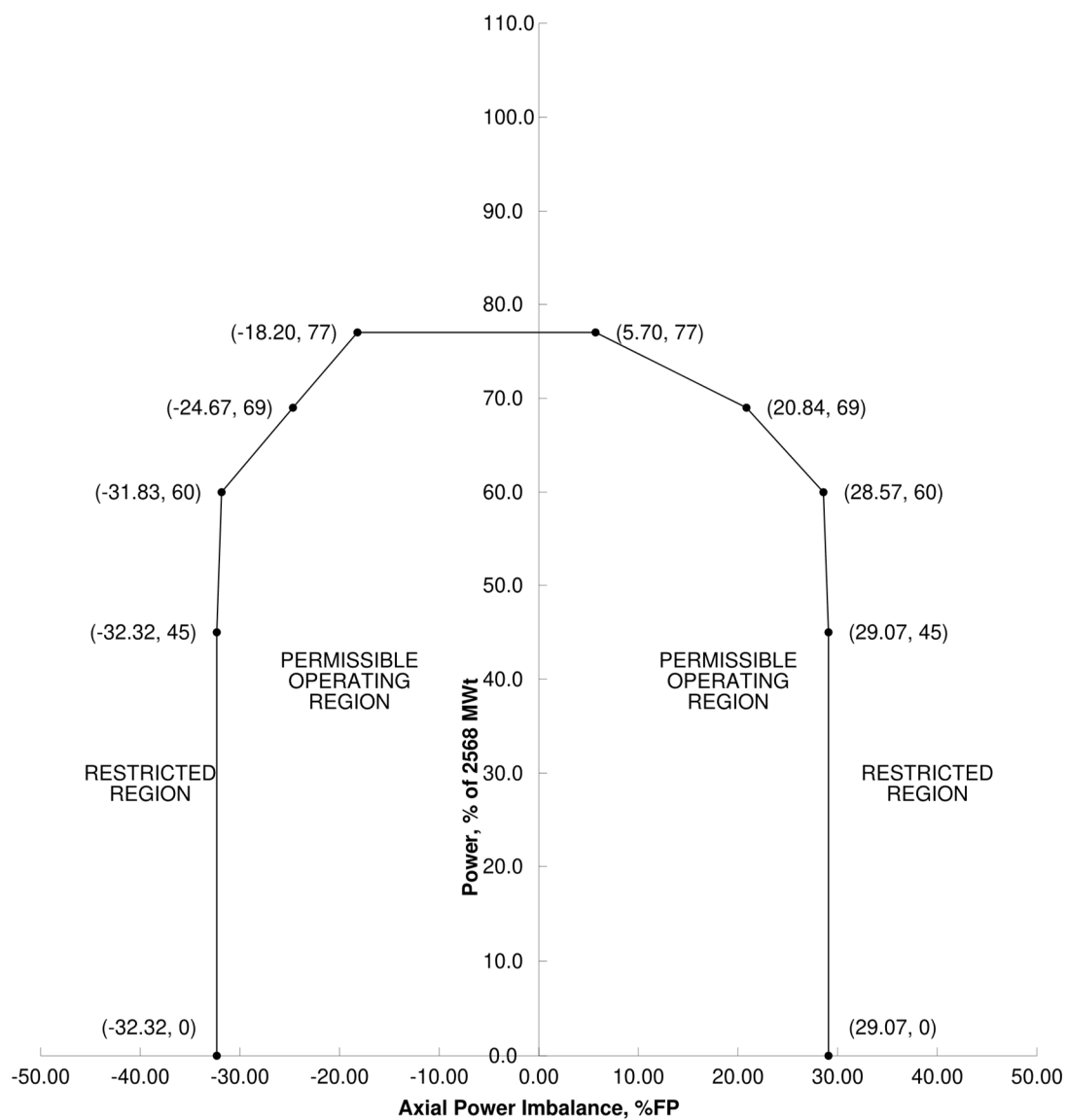


* Assumes that no individual long emitter detector affecting the minimum incore imbalance calculation exceeds 73% sensitivity depletion. The imbalance setpoints for the minimum incore system must be reduced to 2.8% FP at the earliest time-in-life this assumption is no longer valid.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 6-C1**AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Three-Pump Operation
from 0 EFPD to 200 +10/-10 EFPD**

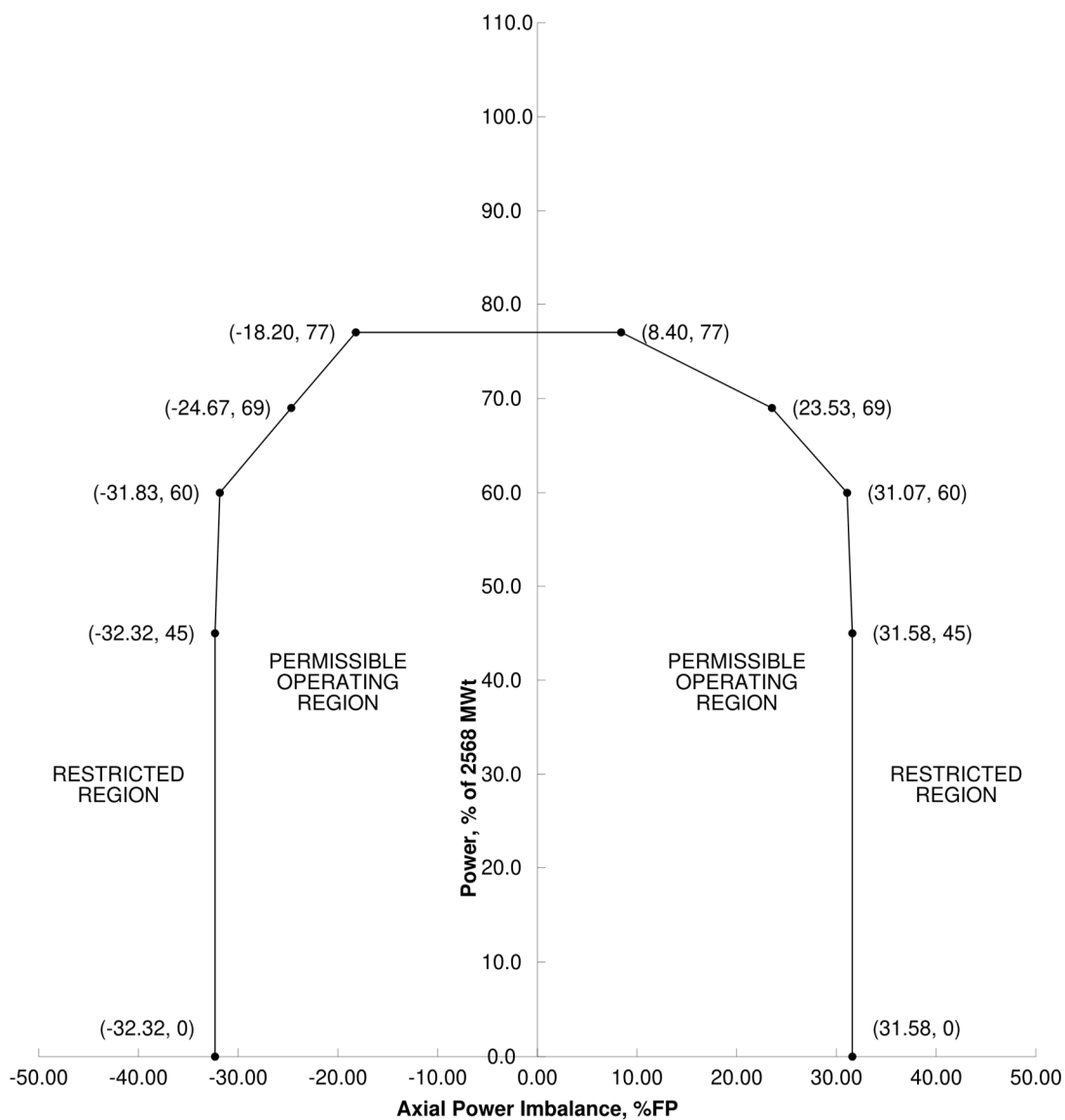
(Figure is referred to by Technical Specification 3.2.3)



OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 6-C2**AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Three-Pump Operation from 200 +10/-10 EFPD to EOC**

(Figure is referred to by Technical Specification 3.2.3)



OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Quadrant Power Tilt Limits And Setpoints

(Limits are referred to by Technical Specification 3.2.4)

From 0 EFPD to EOC

<u>Measurement System</u>	<u>Steady State Value (%)</u>		<u>Maximum Value (%)</u>
	<u>≤ 60 % FP</u>	<u>> 60 % FP</u>	
Full In-core Detector System Setpoint	6.83	4.53	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.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 7A**LOCA Linear Heat Rate Limits for Mark-B-HTP Fuel**

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

Allowable LOCA LHR Limits			
Core Elevation, ft	LHR Limit for 0 MWd/mtU, kW/ft	LHR Limit for 28,000 MWd/mtU, kW/ft	LHR Limit for 62,000 MWd/mtU, kW/ft
0.000	16.60	16.60	12.30
2.506	17.50	17.50	13.00
4.264	17.50	17.50	13.00
6.021	17.30	17.30	13.00
7.779	17.50	17.50	13.00
9.536	17.30	17.30	13.00
11.000	15.30	15.30	12.50
12.000	14.50	14.50	12.30

Note:

The LOCA LHR limits may be linearly interpolated as a function of burnup between 0 MWd/mtU and 28,000 MWd/mtU, between 28,000 MWd/mtU and 62,000 MWd/mtU, and as a function of core elevation.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 7B**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 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	2.04426	1.4	0.01	2.94000	1.7	0.01	3.20469
	0.14	2.04515		0.14	2.94000		0.14	3.20469
	0.20	2.04535		0.20	2.93545		0.20	3.15423
	0.30	2.04551		0.30	2.84715		0.30	3.08083
	0.40	2.04470		0.40	2.76077		0.40	2.98064
	0.50	2.04437		0.50	2.66671		0.50	2.89369
	0.60	2.04415		0.60	2.55808		0.60	2.78037
	0.70	2.04400		0.70	2.46508		0.70	2.68552
	0.80	2.04329		0.80	2.34973		0.80	2.56207
	0.89	2.00109		0.89	2.27714		0.89	2.49021
	0.99	1.90427		0.99	2.18525		0.99	2.39515
1.2	0.01	2.33088	1.5	0.01	3.08066	1.8	0.01	3.24949
	0.14	2.33287		0.14	3.08066		0.14	3.24949
	0.20	2.33339		0.20	3.03513		0.20	3.20303
	0.30	2.33352		0.30	2.93856		0.30	3.13047
	0.40	2.33338		0.40	2.84115		0.40	3.04037
	0.50	2.33285		0.50	2.75216		0.50	2.95027
	0.60	2.33232		0.60	2.63946		0.60	2.84225
	0.70	2.26721		0.70	2.54429		0.70	2.74696
	0.80	2.16931		0.80	2.42655		0.80	2.62489
	0.89	2.10460		0.89	2.35382		0.89	2.55373
	0.99	2.00767		0.99	2.26040		0.99	2.45882
1.3	0.01	2.64464	1.6	0.01	3.14861	1.9	0.01	3.28611
	0.14	2.64863		0.14	3.14861		0.14	3.28611
	0.20	2.64909		0.20	3.09918		0.20	3.24461
	0.30	2.64997		0.30	3.01573		0.30	3.17163
	0.40	2.64949		0.40	2.91490		0.40	3.08589
	0.50	2.56272		0.50	2.82718		0.50	3.00025
	0.60	2.46600		0.60	2.71210		0.60	2.89826
	0.70	2.37484		0.70	2.61653		0.70	2.80288
	0.80	2.26452		0.80	2.49634		0.80	2.68386
	0.89	2.19471		0.89	2.42370		0.89	2.61261
	0.99	2.09988		0.99	2.32955		0.99	2.51792

Notes

- The values above are not error corrected.
- 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.
- 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:

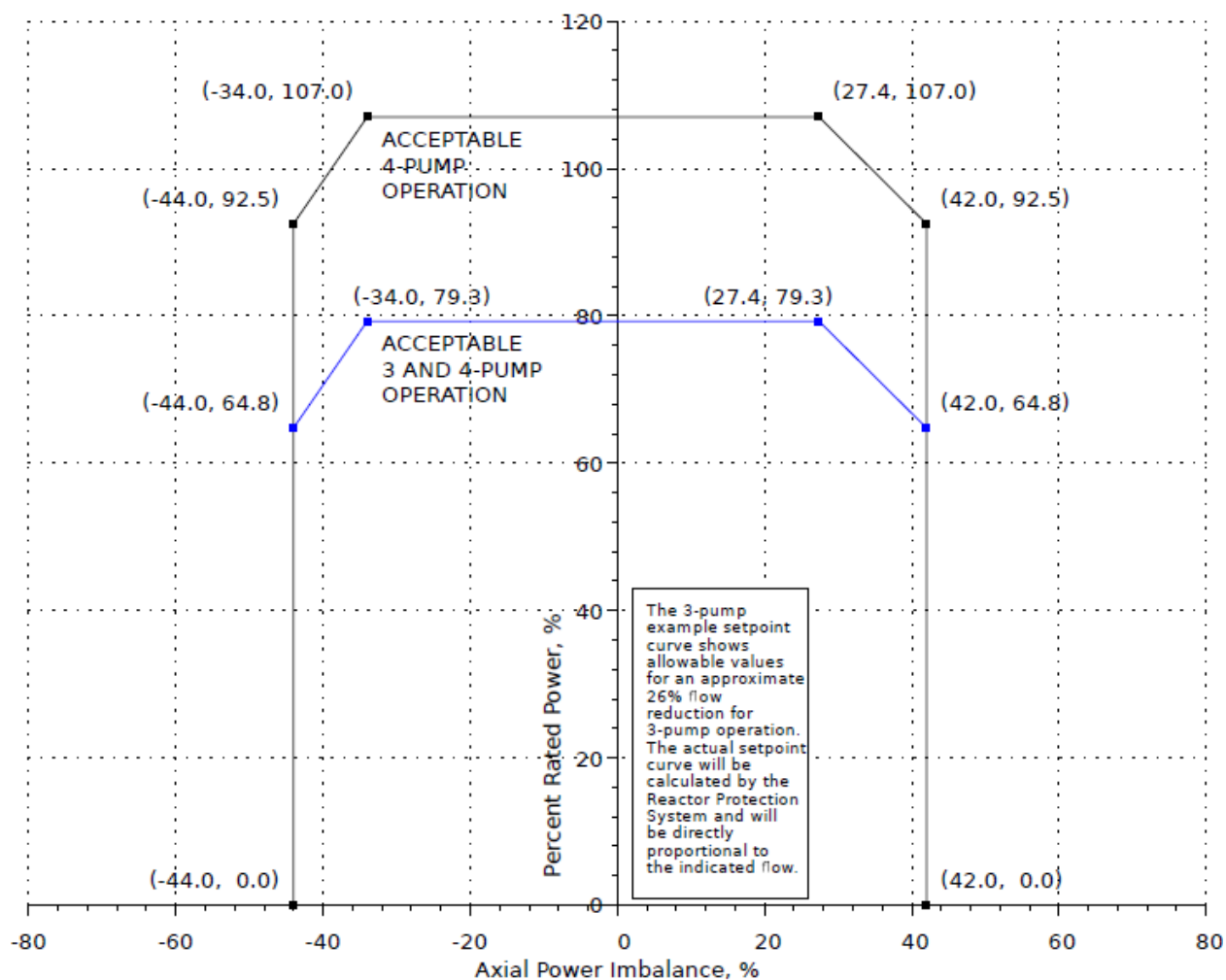
	$P/P_m = 1.00$	$P/P_m < 1.00$
MAP Multiplier	1.0	$1 + 0.3(1 - P/P_m)$

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

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 8**Reactor Protection System Maximum Allowable Setpoints for Axial Power Imbalance**

(Figure is referred to by Technical Specification 3.3.1 and Technical Specification Bases 2.1.1)

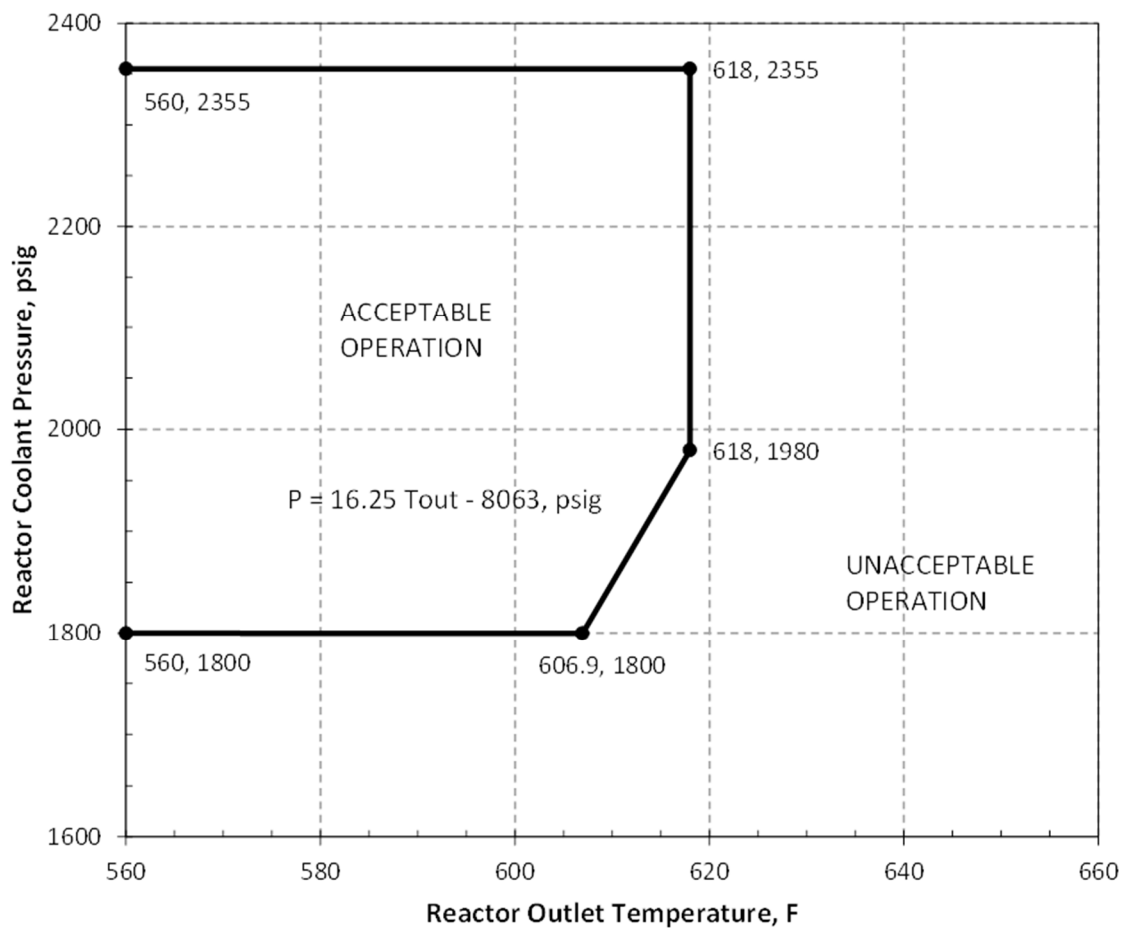


	Flux / Flow Setpoint (% Power / % Flow)
Four Pump Operation	1.07
Three Pump Operation	1.07

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

Figure 9**Reactor Protection System Variable Low Pressure Temperature Envelope Setpoints**

(Figure is referred to by Technical Specification 3.3.1)



OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

RCS Pressure, Temperature, and Flow DNB Surveillance Limits

(Limit is referred to by Technical Specification 3.4.1)

	Four-Pump Operation	Three-Pump Operation
Minimum RCS Hot Leg Pressure (psig) ^{Note 1}	2082.2	2081.2 ^{Note 4} 2120.4 ^{Note 5}
Maximum RCS Hot Leg Temperature (°F) ^{Note 2}	602.6	602.9
Minimum RCS Total Flow (Mlb _m /hr) ^{Note 3}	143.36 ^{Note 6} 138.01 ^{Note 8}	106.46 ^{Note 7} 102.45 ^{Note 8}

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 $T_{cold} = 580$ °F.

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.

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

OPERATION IN MODES 1, 2, 3, 4 AND 5 IS PROHIBITED.**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 the End of Cycle 32 (EOC-32) EFPD is:

EOC-32 EFPD	Refueling Boron (ppm) ¹
478	2217
480	2213
485	2203
490	2193
493	2187
≥499	2181

¹The Refueling Boron may be linearly interpolated as a function of EOC-32 EFPD between 478 and 499 EFPD.

LAST PAGE

Enclosure 2

1CAN102501

ANO-1 Cycle 33 Core Operating Limits Report (COLR) Revision 1

(31 pages)

ENTERGY OPERATIONS

ARKANSAS NUCLEAR ONE
UNIT ONE

CYCLE 33

CORE OPERATING LIMITS REPORT

1.0 CORE OPERATING LIMITS

This Core Operating Limits Report for ANO-1 Cycle 33 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. 9, Framatome ANP, Inc., Lynchburg, Virginia, November 2017
2. "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
3. Framatome Document, "Transmittal of ANO-1 Cycle 33 Limits and Setpoints," FS1-0079307-1.0
4. Framatome Document, "Transmittal of ANO-1 Cycle 33 Core Loading Plan," FS1-0078298-2.0
5. "IC (Initial Condition) DNB RCS Protection Criteria," CALC-96-E-0023-02, Rev. 7
6. Framatome Document, "Transmittal of ANO-1 Generic Reload Technical Document," FS1-0071774-1.0, CALC-ANO1-NE-23-00005
7. Framatome Document, "Transmittal of ANO-1 Cycle 33 Refueling Boron Confirmation," FS1-0081238-1.0
8. Framatome Document, "Transmittal of ANO-1 Cycle 33 Reload Report and COLR," FS1-0080078-5.0, CALC-ANO1-NE-25-00002
9. Framatome Document, "Transmittal of ANO-1 Cycle 33 Reload Technical Document," FS1-0079847-1.0, CALC-ANO1-NE-25-00001

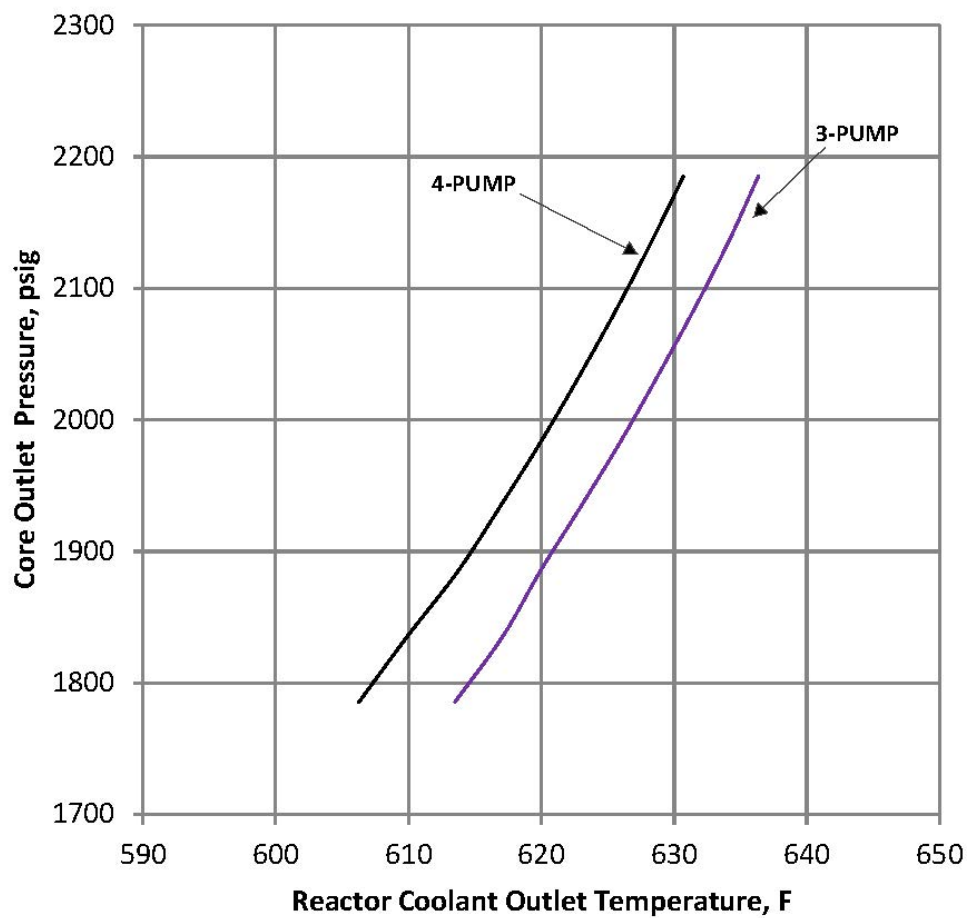
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FIGURE 1**Variable Low RCS Pressure – Temperature Protective Limits**

(Figure is referred to by Technical Specification 2.1.1.3)



<u>PUMPS OPERATING (TYPE OF LIMIT)</u>	<u>GPM*</u>	<u>POWER**</u>
FOUR PUMPS (DNBR LIMIT)	383,680 (100%)	110%
THREE PUMPS (DNBR LIMIT)	284,307 (74.1%)	89%

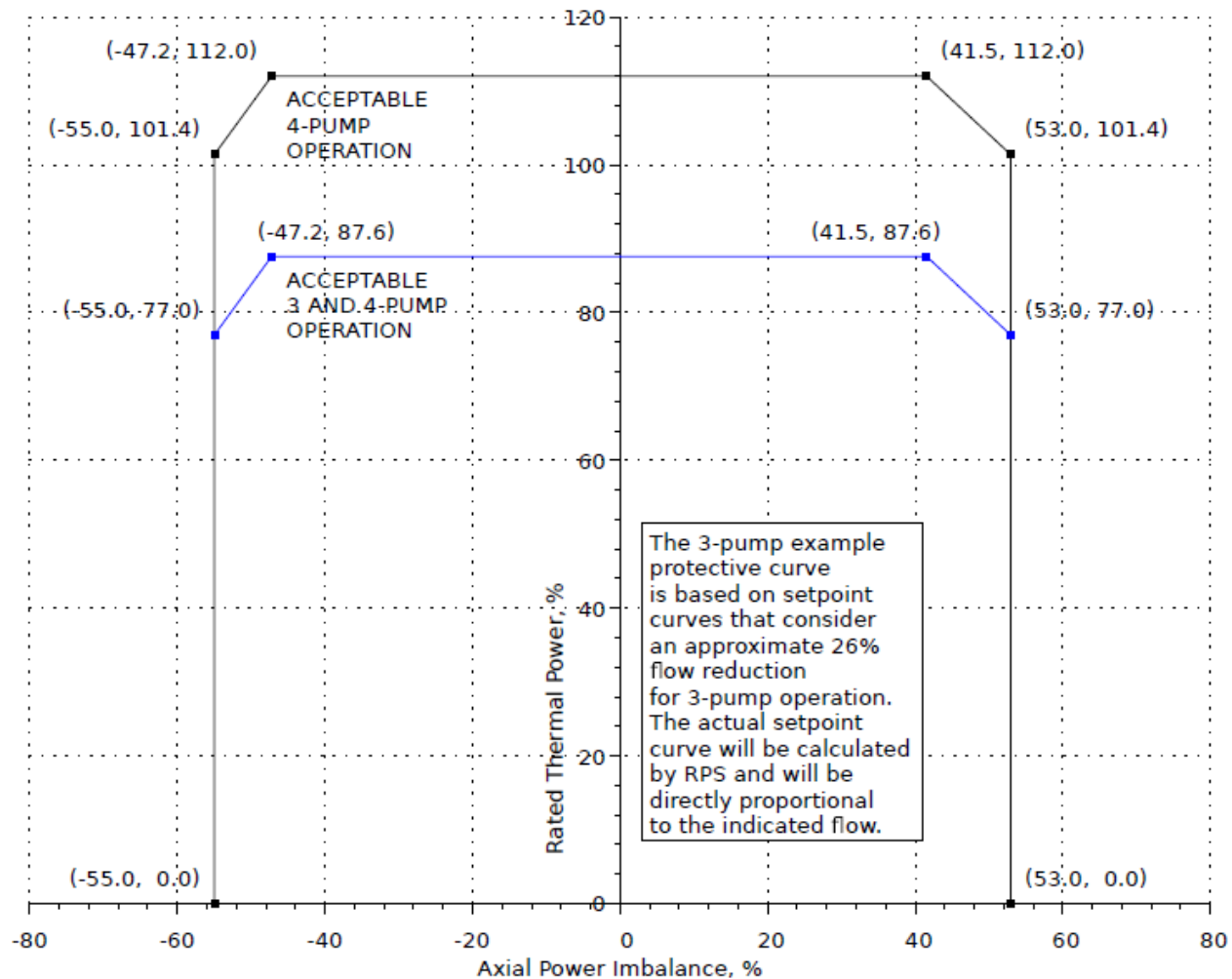
* 109% OF DESIGN FLOW (2.5% UNCERTAINTY INCLUDED IN STATISTICAL DESIGN LIMIT)

** 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.

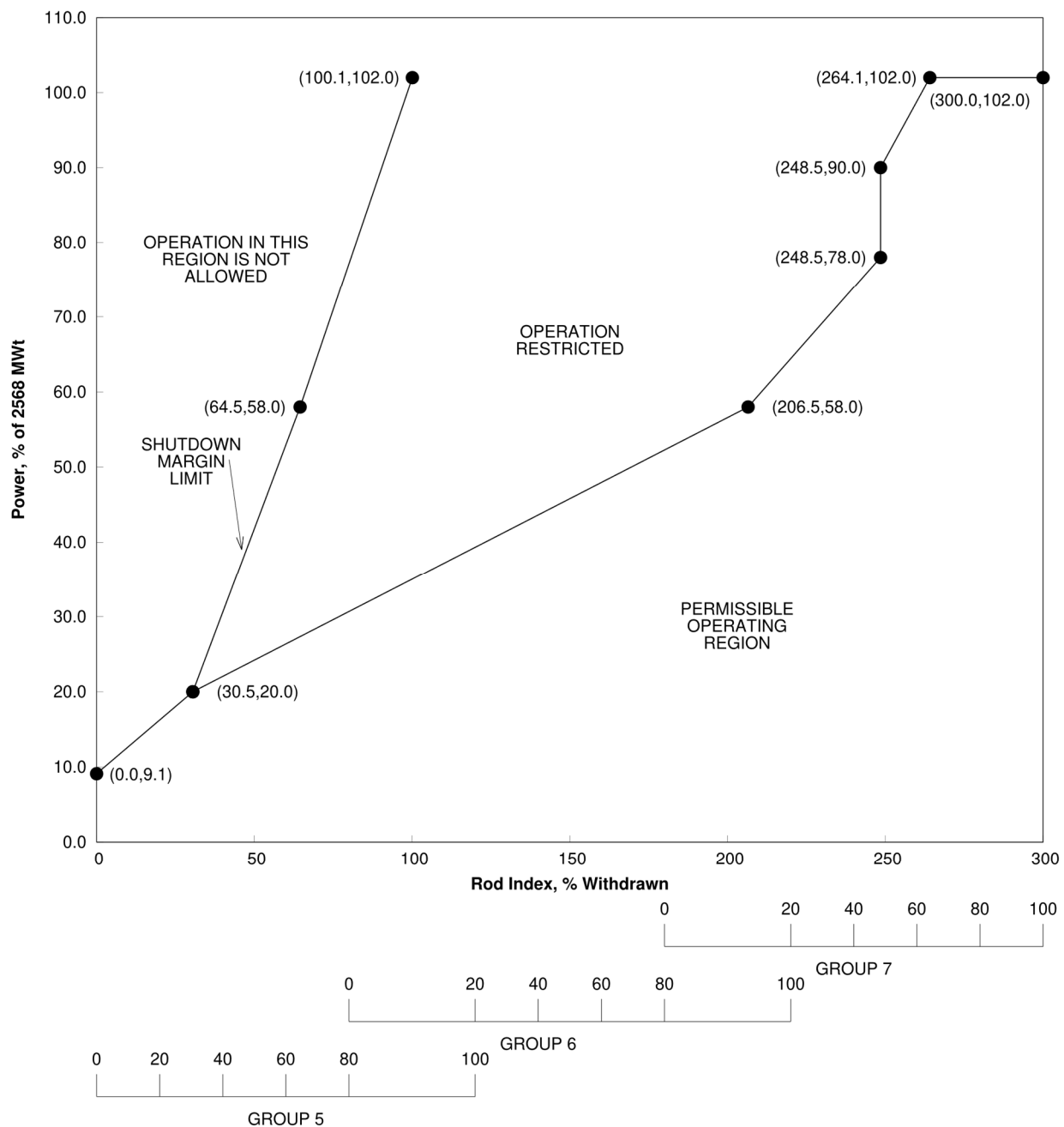
APPLICABILITY	REQUIRED SHUTDOWN MARGIN	TECHNICAL SPECIFICATION REFERENCE
MODE 1*	$\geq 1\ \% \Delta k/k$	3.1.4, 3.1.5
MODE 2*	$\geq 1\ \% \Delta k/k$	3.1.4, 3.1.5, 3.3.9
MODE 3	$\geq 1\ \% \Delta k/k$	3.1.1, 3.3.9
MODE 4	$\geq 1\ \% \Delta k/k$	3.1.1, 3.3.9
MODE 5	$\geq 1\ \% \Delta k/k$	3.1.1, 3.3.9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

* The required Shutdown Margin capability of $1\ \% \Delta k/k$ in MODE 1 and MODE 2 is preserved by the Regulating Rod Insertion Limits specified in Figures 3-A&B, and 4-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 $\geq 1\ \% \Delta k/k$.

Figure 3-A**Regulating Rod Insertion Limits for Four-Pump Operation From 0 to 200 ± 10 EFPD**

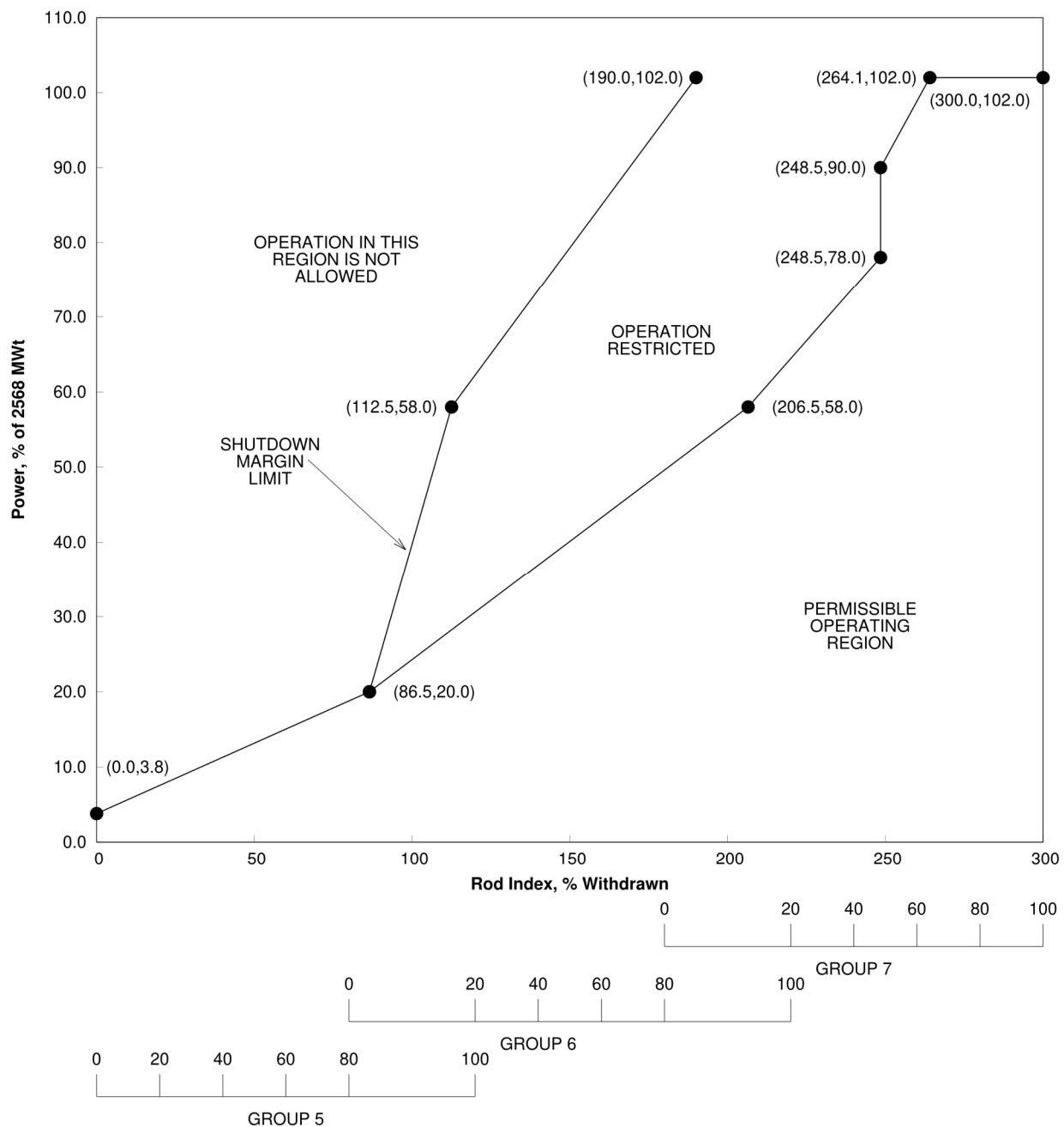
(Figure is referred to by Technical Specification 3.2.1)



Operating rod group overlap in the above figure is $20\% \pm 5\%$ 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**

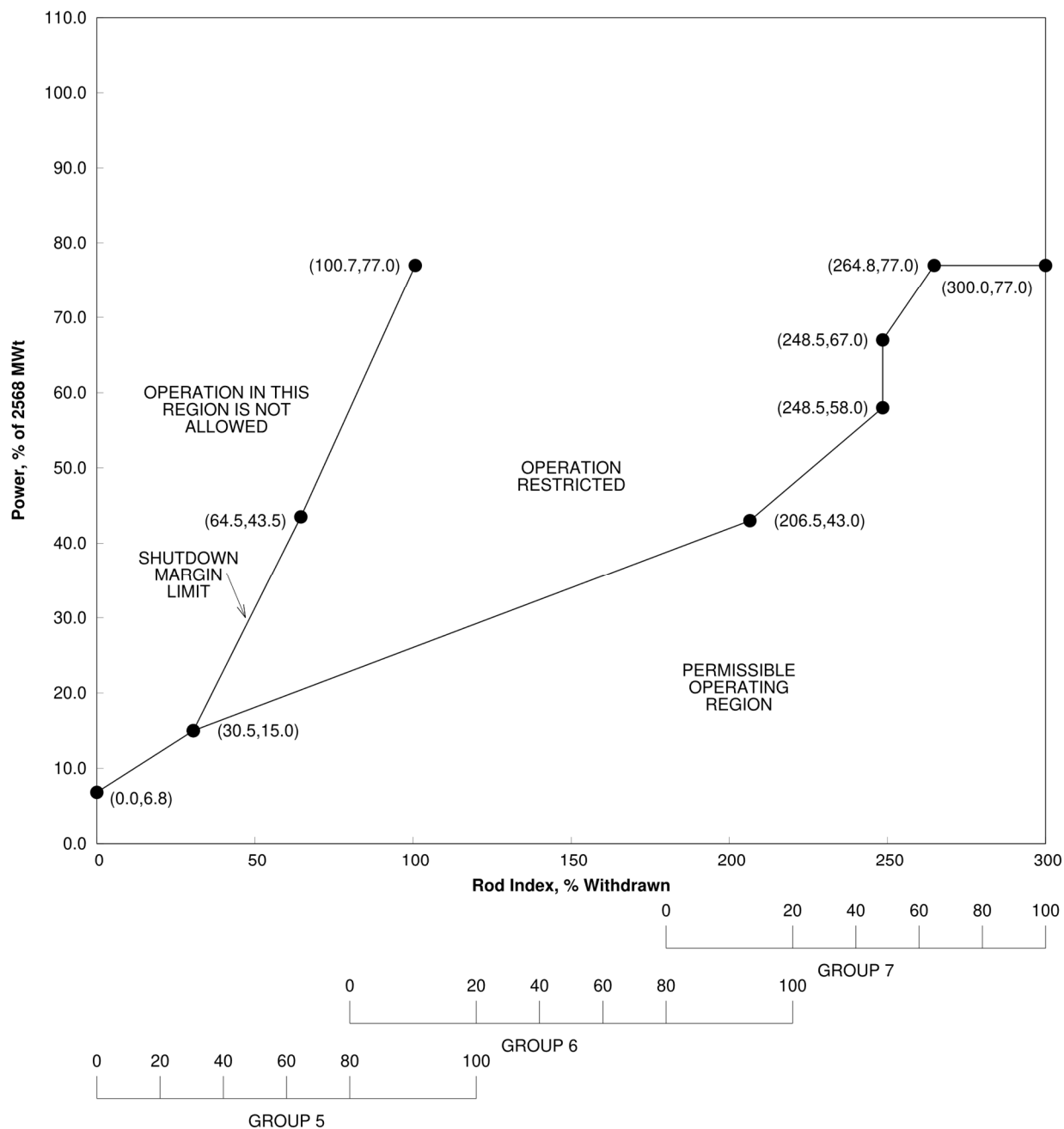
(Figure is referred to by Technical Specification 3.2.1)



Operating rod group overlap of Groups 5, 6, 7 in the above figure is $20\% \pm 5\%$ 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**

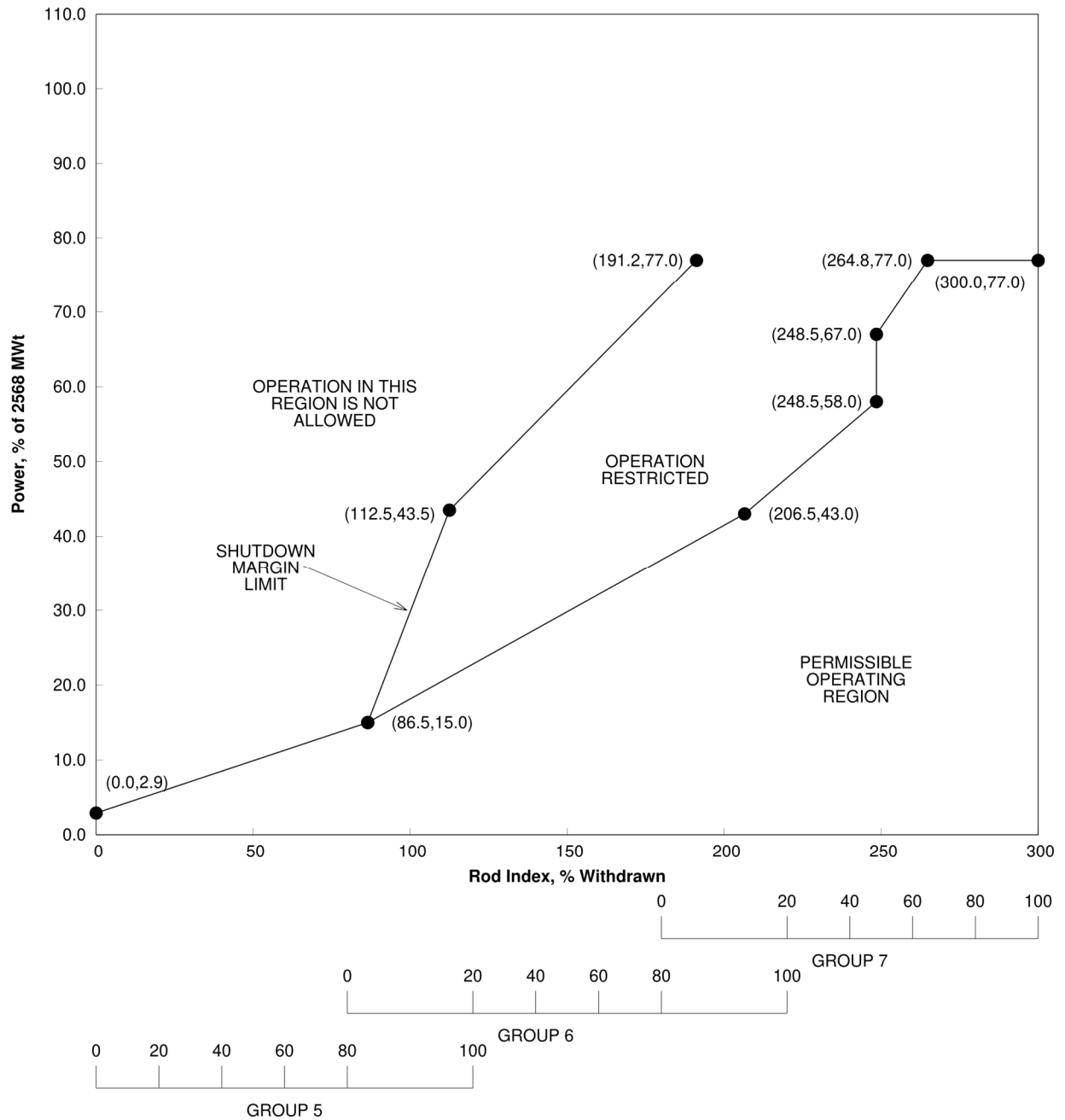
(Figure is referred to by Technical Specification 3.2.1)



Operating rod group overlap of Groups 5, 6, 7 in the above figure is $20\% \pm 5\%$ 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 of Groups 5, 6, 7 in the above figure is $20\% \pm 5\%$ between two sequential groups, except for physics tests.

AXIAL POWER SHAPING RODS (APSR) INSERTION LIMITS

(Limits are referred to by Technical Specification 3.2.2)

Up to 454 ± 10 EFPD, the APSRs may be positioned as necessary for transient imbalance control; however, the APSRs shall be fully withdrawn by 464 EFPD. After the APSRs withdrawal at 454 ± 10 EFPD, the APSRs shall not be reinserted, except during the end-of-cycle shutdown when the reactor power is equal to, or less than, 30 % FP.

Figure 5-A1**AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Four-Pump Operation from 0 EFPD to 200 +10/-10 EFPD**

(Figure is referred to by Technical Specification 3.2.3)

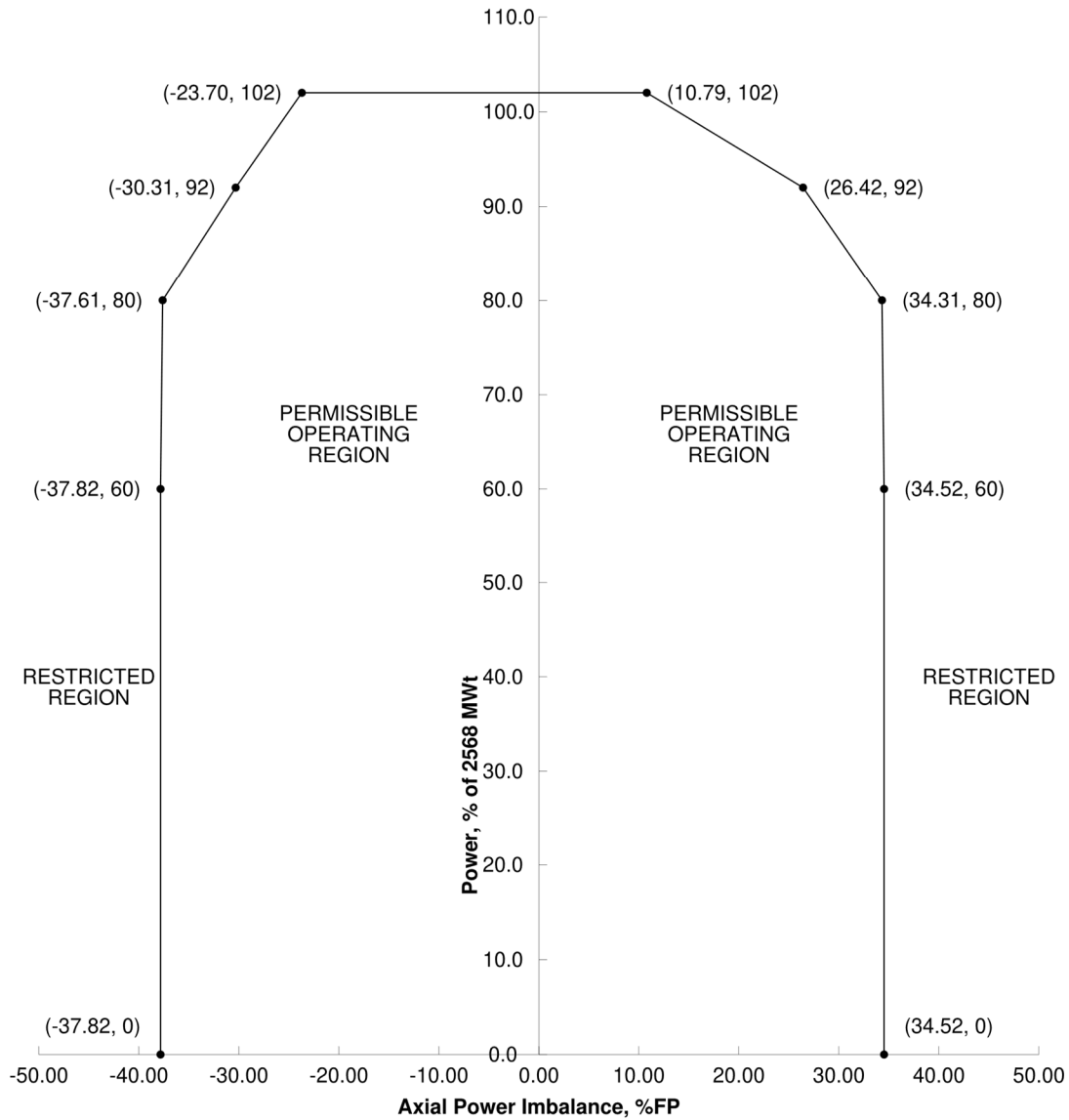


Figure 5-A2

**AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Four-Pump
Operation from 200 +10/-10 EFPD to EOC**

(Figure is referred to by Technical Specification 3.2.3)

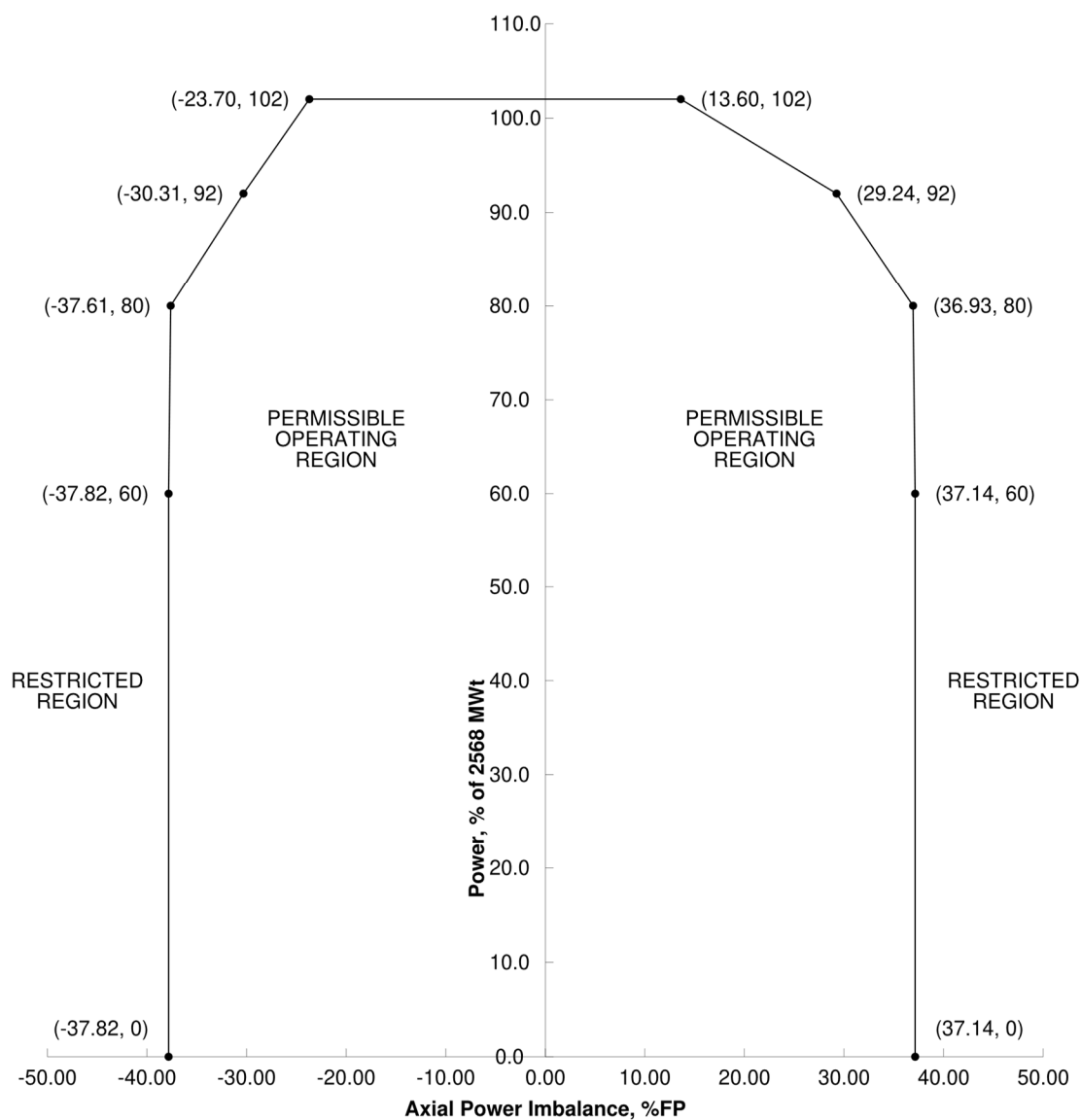
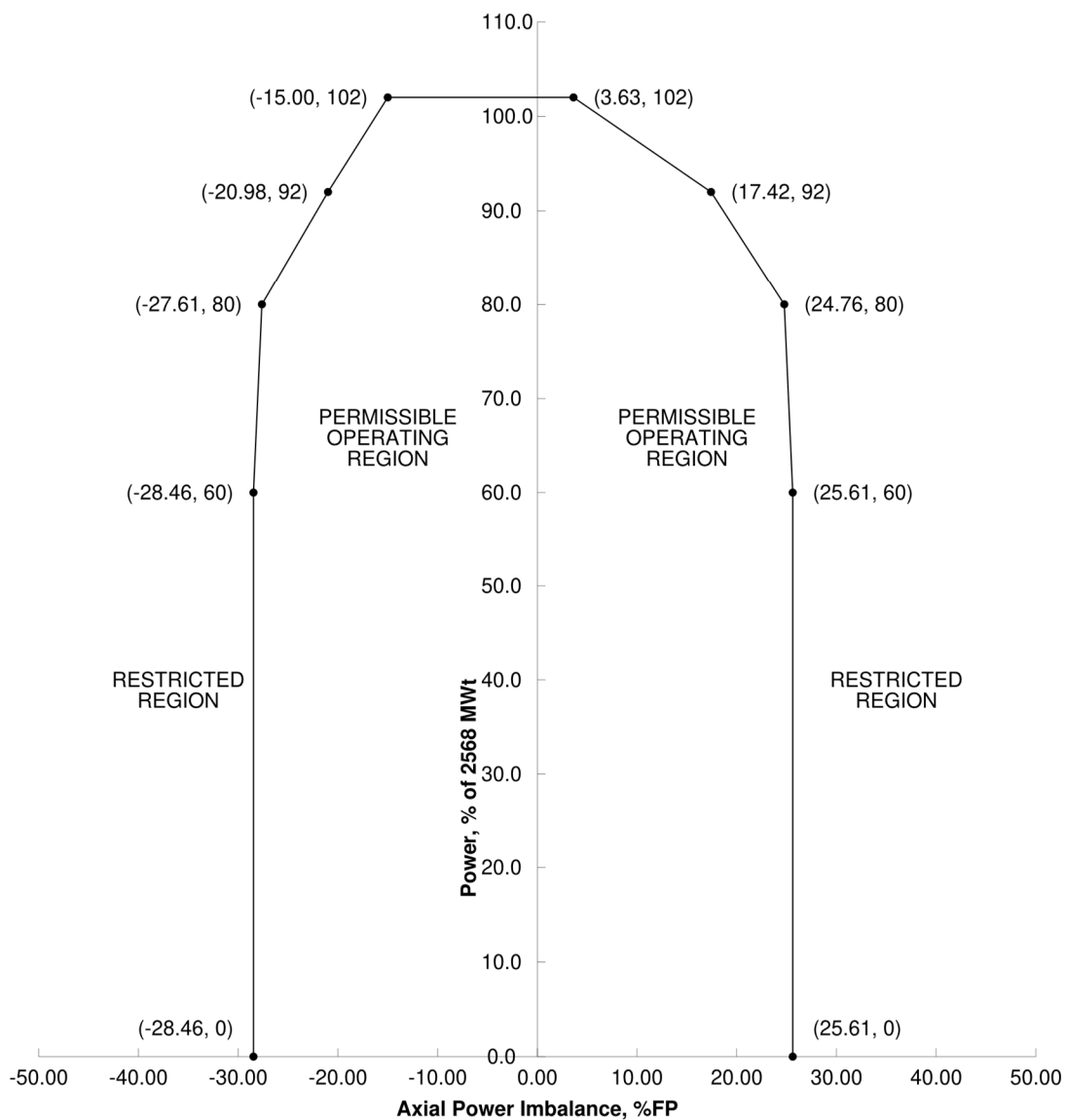


Figure 5-B1

**AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Four-Pump
Operation from 0 EFPD to 200 +10/-10 EFPD**

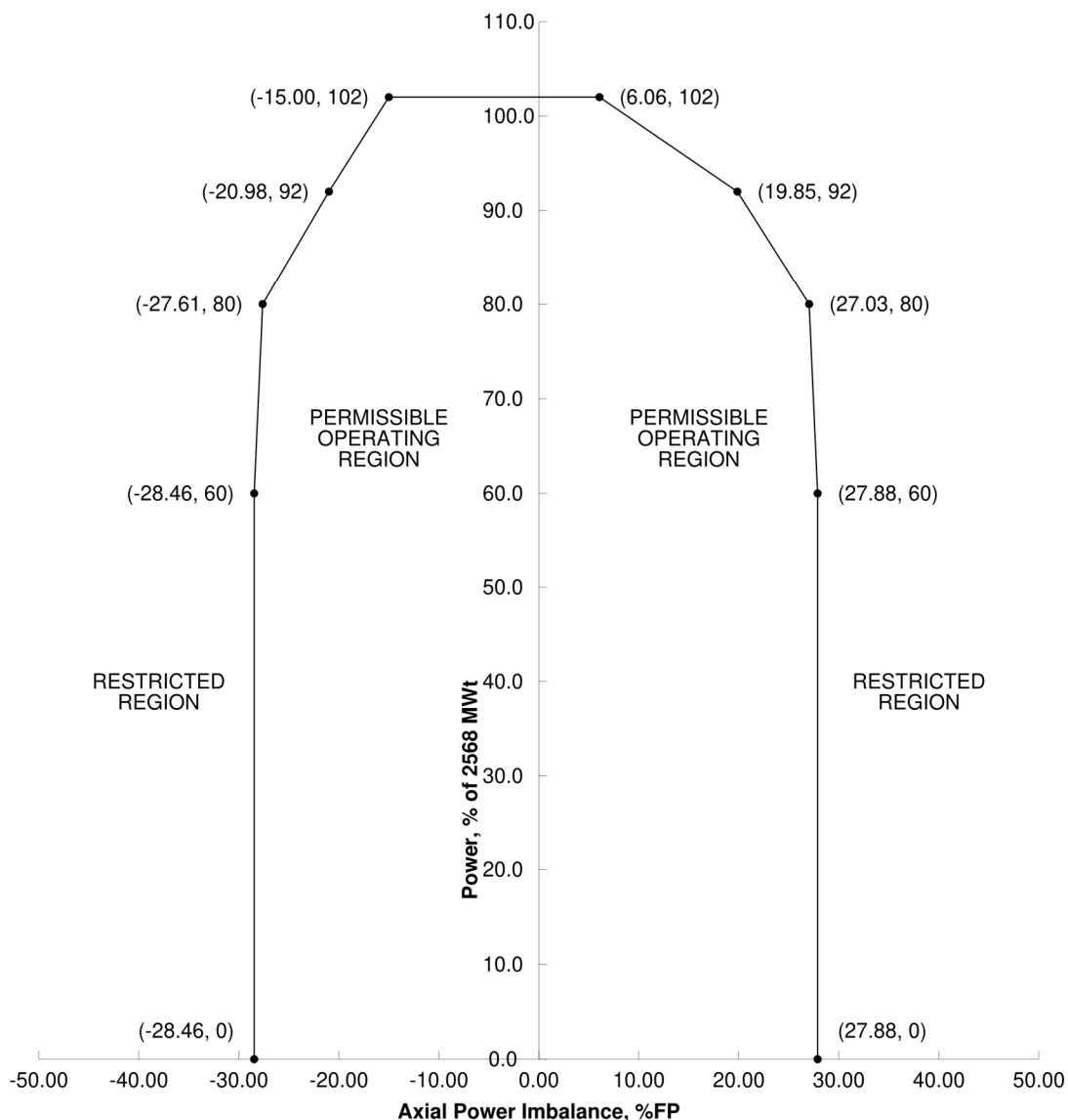
(Figure is referred to by Technical Specification 3.2.3)



* Assumes that no individual long emitter detector affecting the minimum incore imbalance calculation exceeds 73% sensitivity depletion. The imbalance setpoints for the minimum incore system must be reduced to 2.8% FP at the earliest time-in-life this assumption is no longer valid.

Figure 5-B2**AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Four-Pump Operation from 200 +10/-10 EFPD to EOC**

(Figure is referred to by Technical Specification 3.2.3)



* Assumes that no individual long emitter detector affecting the minimum incore imbalance calculation exceeds 73% sensitivity depletion. The imbalance setpoints for the minimum incore system must be reduced to 2.8% FP at the earliest time-in-life this assumption is no longer valid.

Figure 5-C1

**AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Four-Pump Operation
from 0 EFPD to 200 +10/-10 EFPD**

(Figure is referred to by Technical Specification 3.2.3)

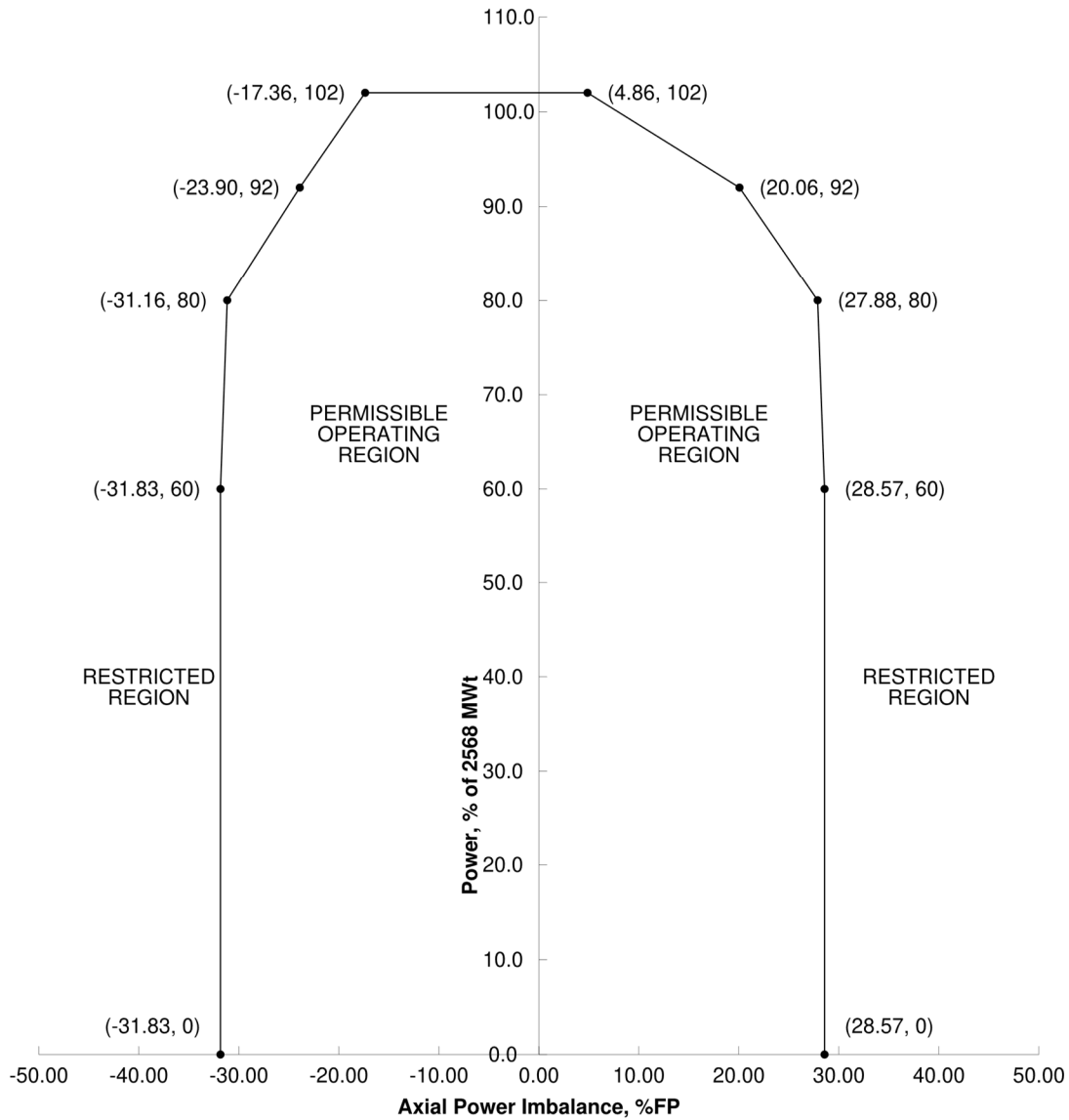


Figure 5-C2

**AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Four-Pump Operation
from 200 +10/-10 EFPD to EOC**

(Figure is referred to by Technical Specification 3.2.3)

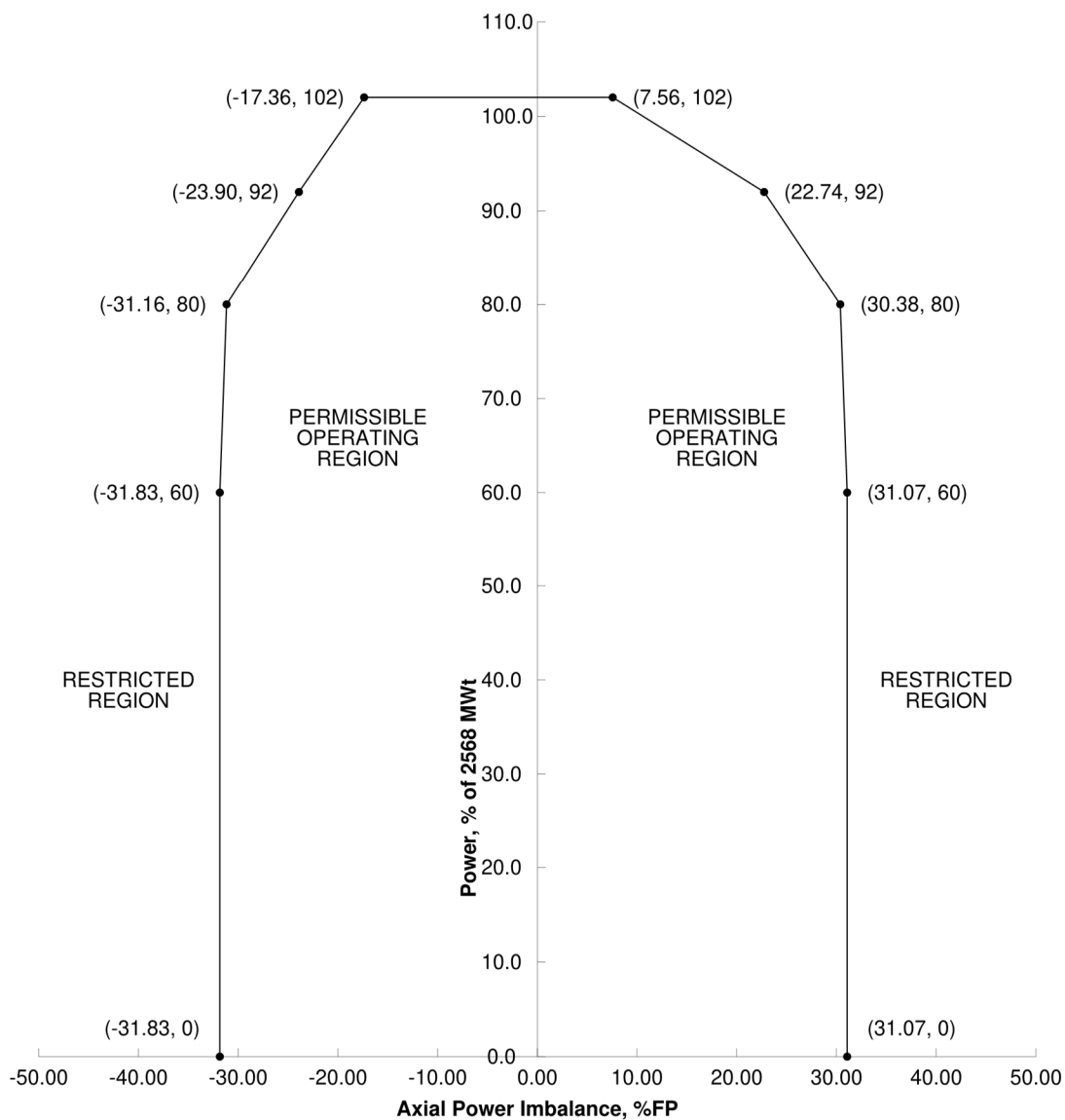


Figure 6-A1

AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Three-Pump Operation from 0 EFPD to 200 +10/-10 EFPD

(Figure is referred to by Technical Specification 3.2.3)

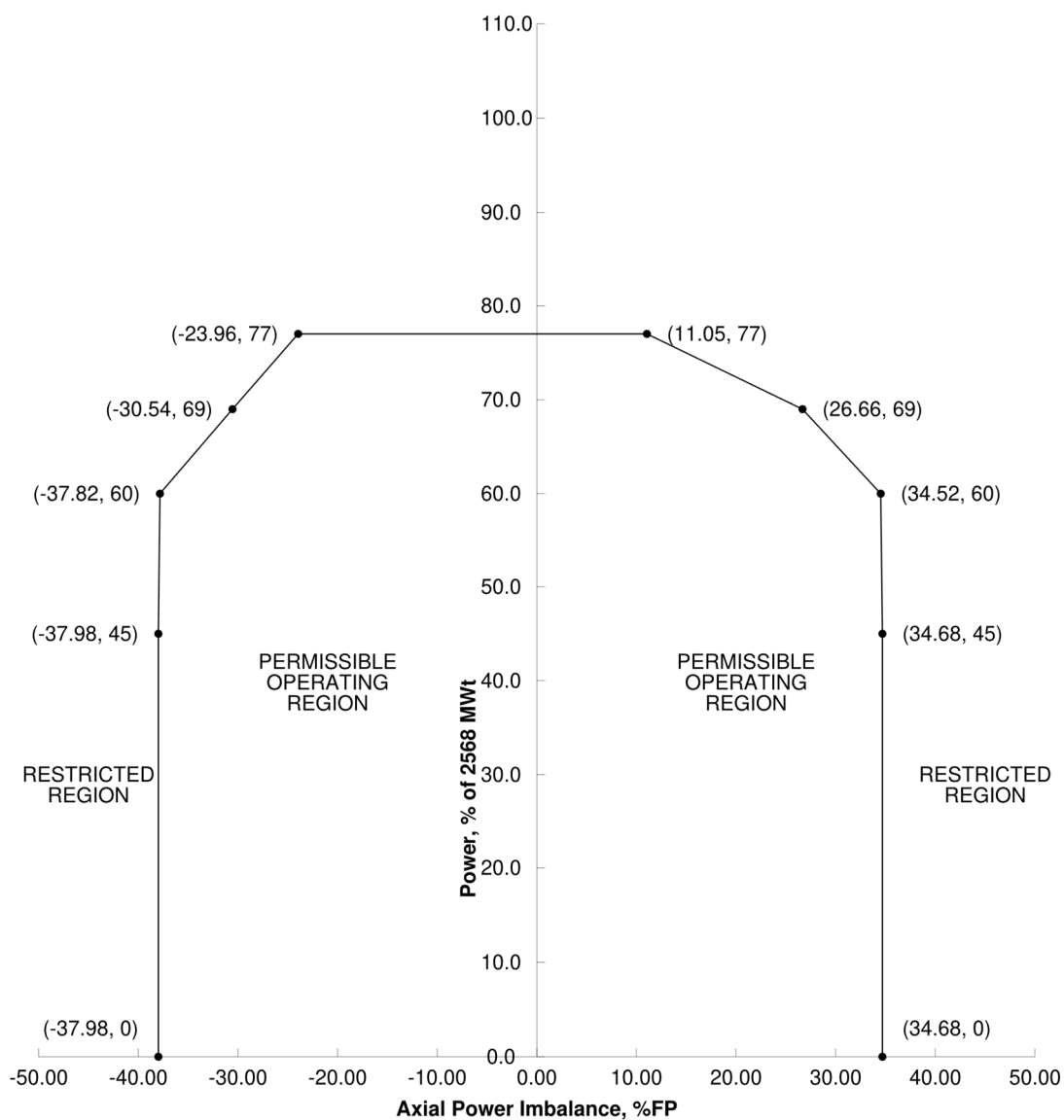


Figure 6-A2**AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Three-Pump Operation from 200 +10/-10 EFPD to EOC**

(Figure is referred to by Technical Specification 3.2.3)

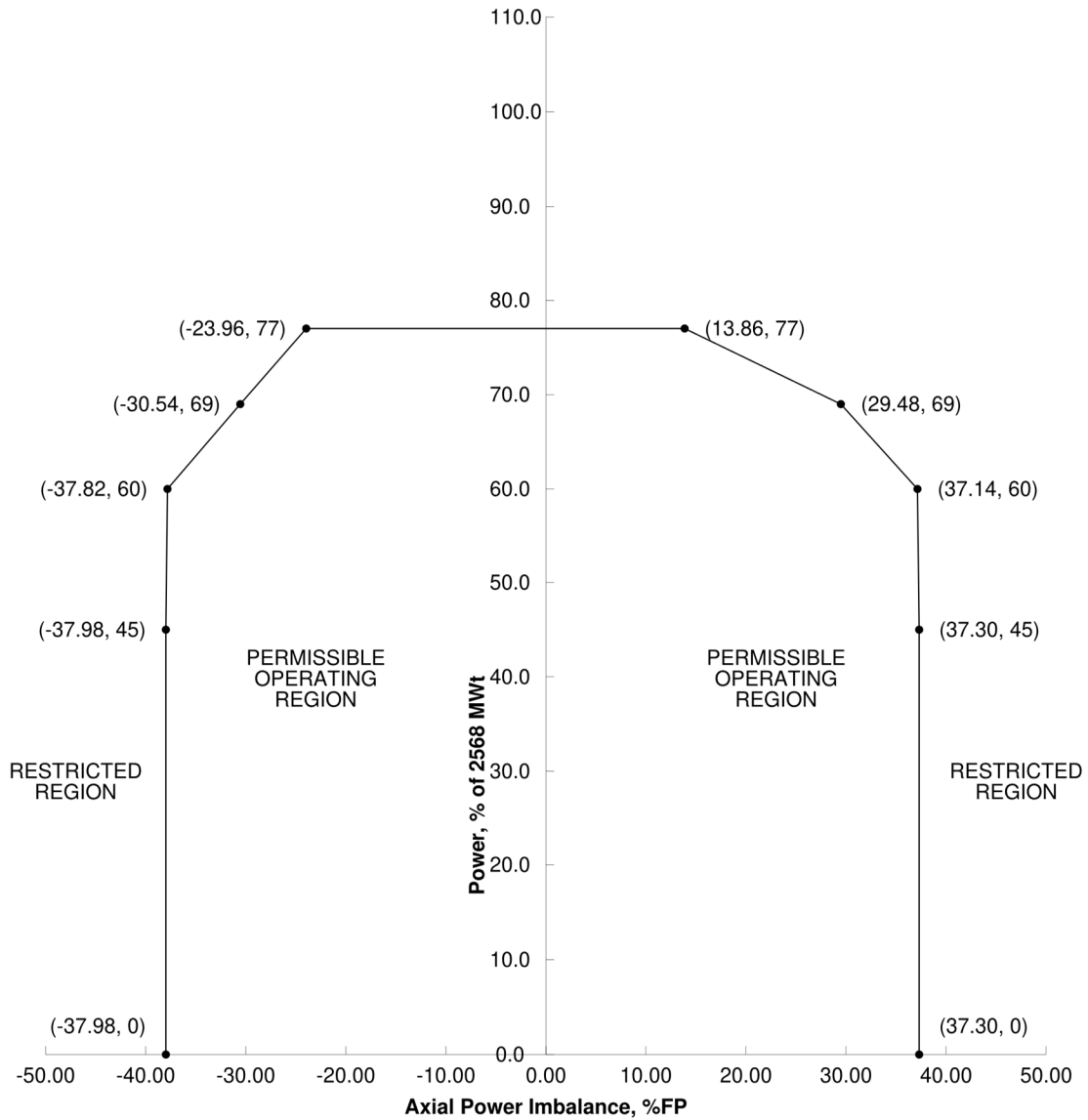
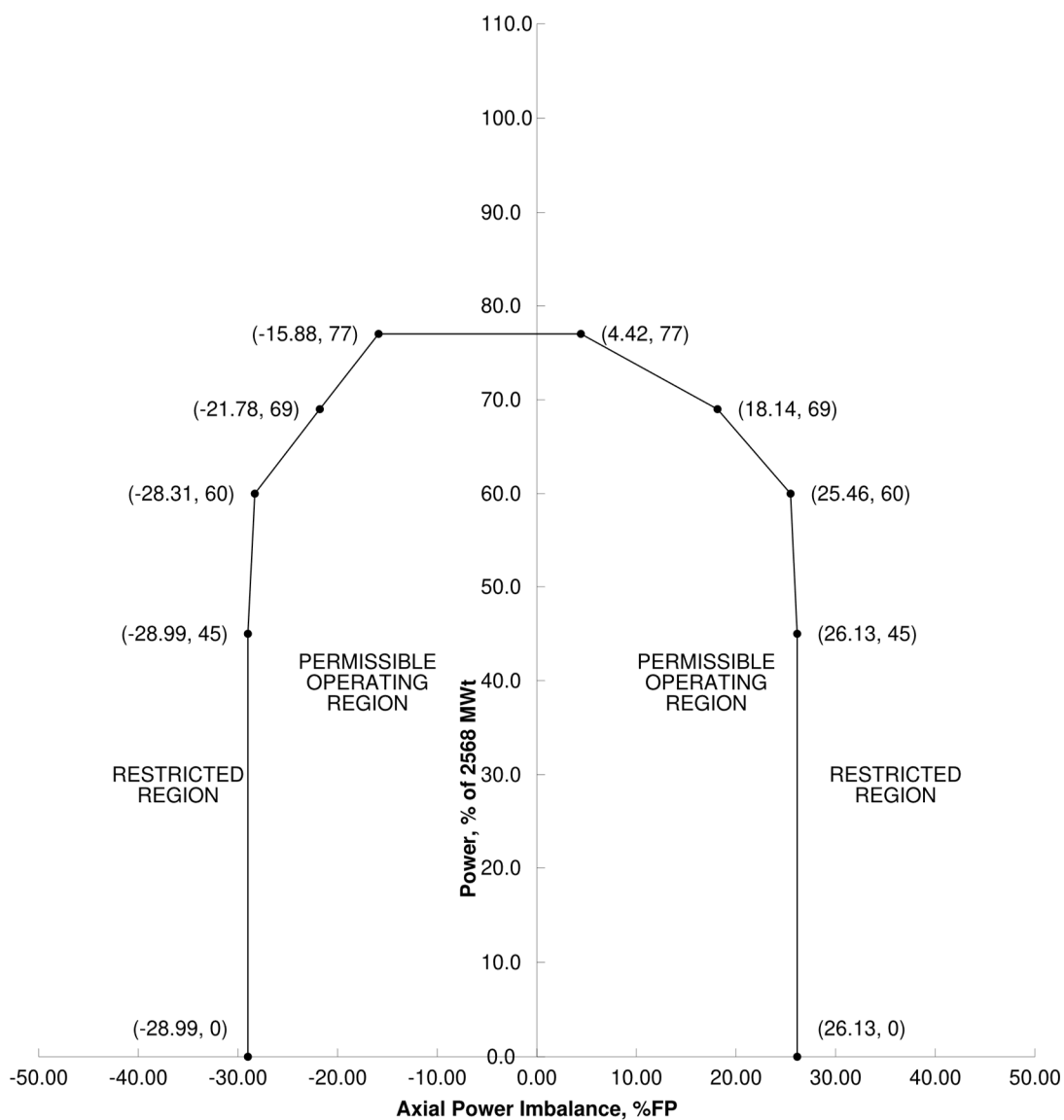


Figure 6-B1

AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Three-Pump Operation from 0 EFPD to 200 +10/-10 EFPD

(Figure is referred to by Technical Specification 3.2.3)

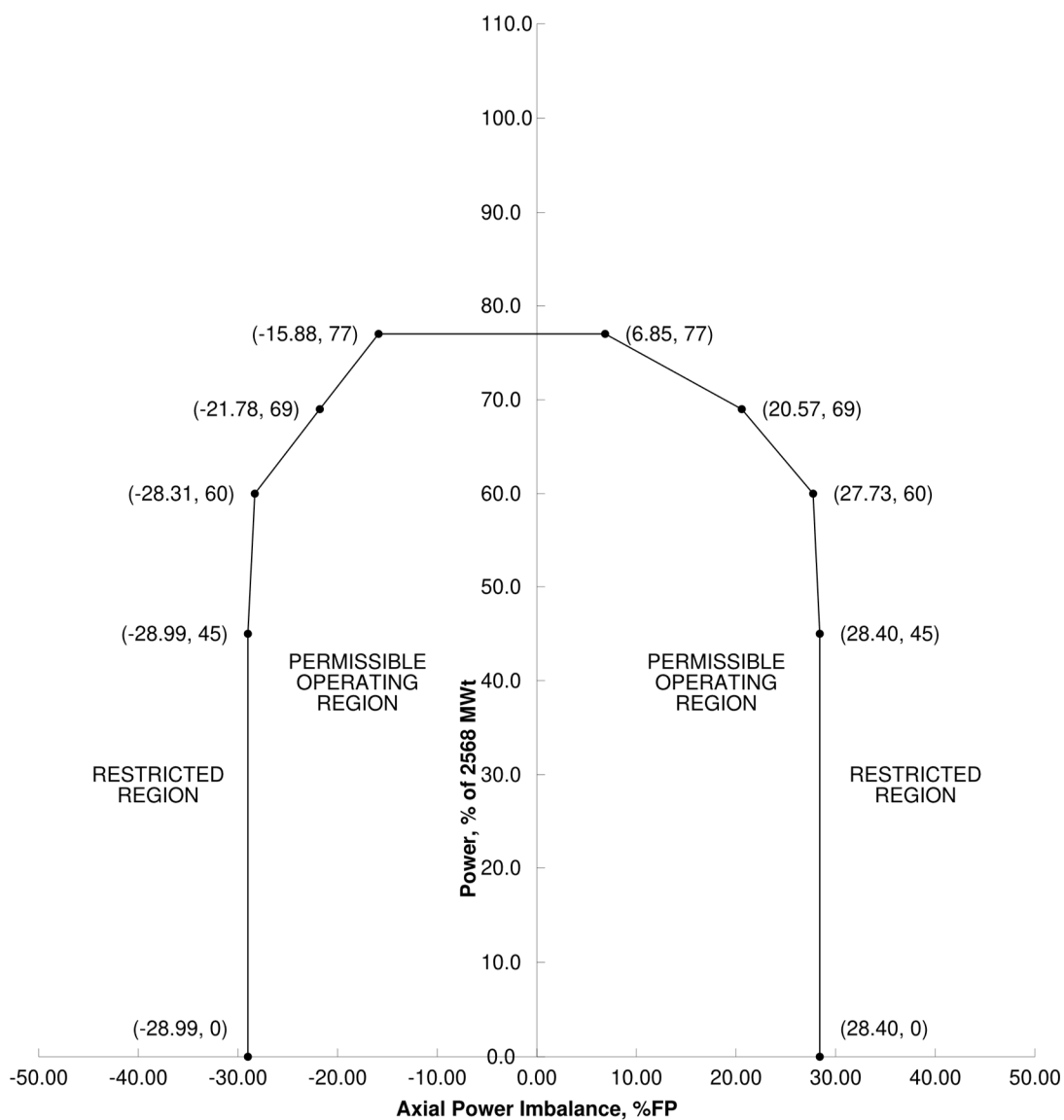


* Assumes that no individual long emitter detector affecting the minimum incore imbalance calculation exceeds 73% sensitivity depletion. The imbalance setpoints for the minimum incore system must be reduced to 2.8% FP at the earliest time-in-life this assumption is no longer valid.

Figure 6-B2

AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Three-Pump Operation from 200 +10/-10 EFPD to EOC

(Figure is referred to by Technical Specification 3.2.3)



* Assumes that no individual long emitter detector affecting the minimum incore imbalance calculation exceeds 73% sensitivity depletion. The imbalance setpoints for the minimum incore system must be reduced to 2.8% FP at the earliest time-in-life this assumption is no longer valid.

Figure 6-C1

**AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Three-Pump Operation
from 0 EFPD to 200 +10/-10 EFPD**

(Figure is referred to by Technical Specification 3.2.3)

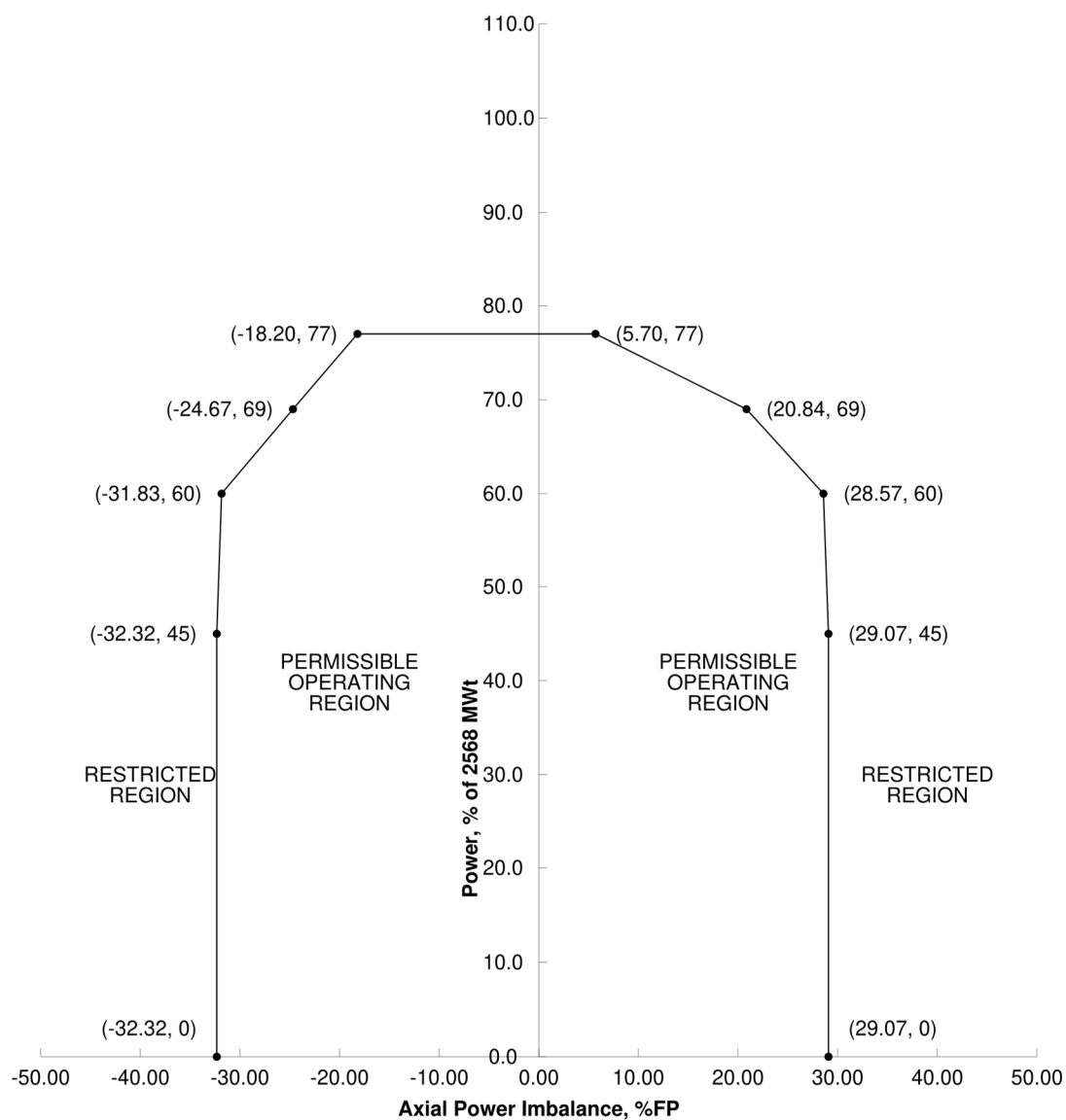
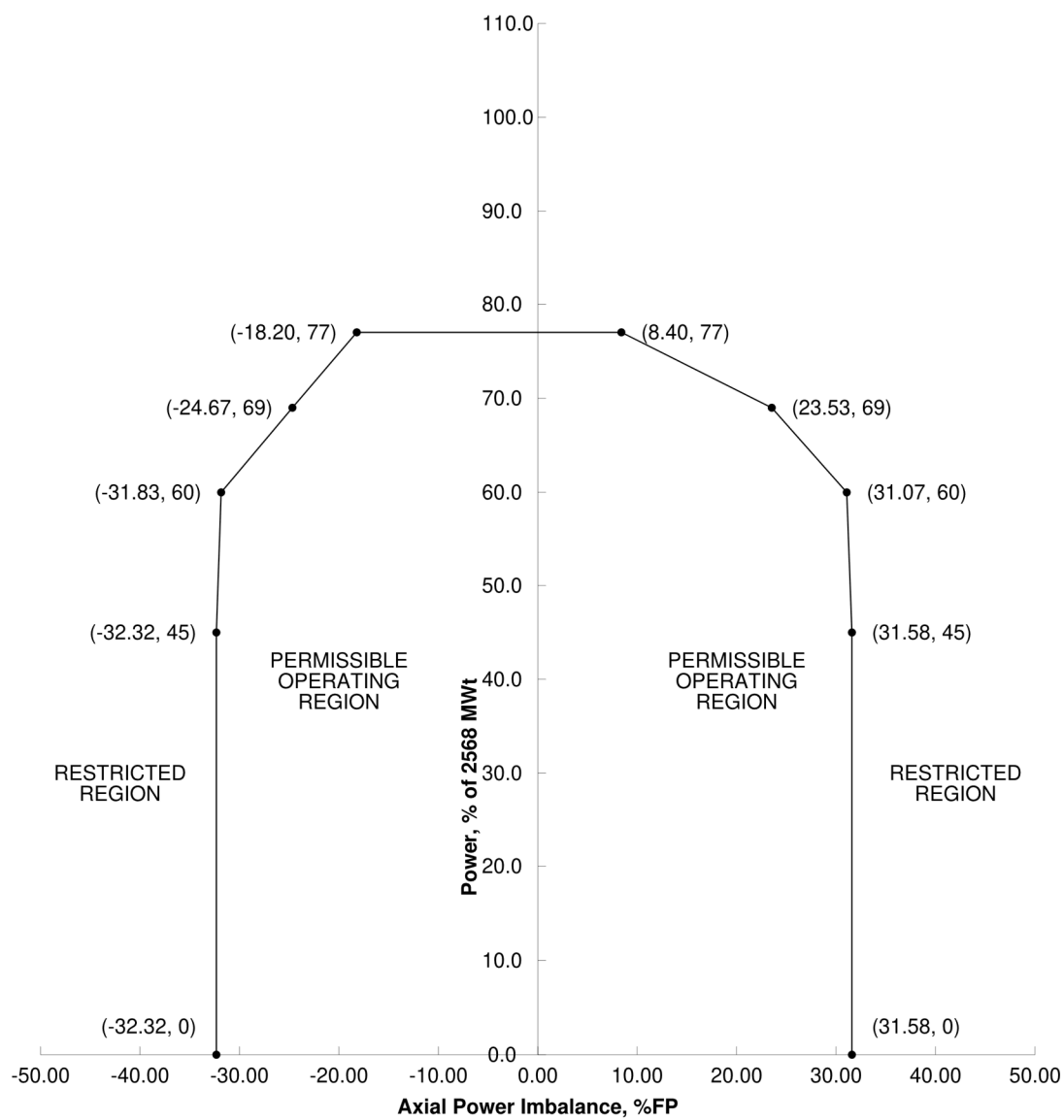


Figure 6-C2

**AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Three-Pump Operation
from 200 +10/-10 EFPD 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

<u>Measurement System</u>	<u>Steady State Value (%)</u>		<u>Maximum Value (%)</u>
	<u>$\leq 60\% \text{ FP}$</u>	<u>$> 60\% \text{ FP}$</u>	
Full In-core Detector System Setpoint	6.83	4.53	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 $> 60\% \text{ FP}$) and to 2.19% (power levels $\leq 60\% \text{ FP}$) at the earliest time-in-life that this assumption is no longer valid.

Figure 7A**LOCA Linear Heat Rate Limits for Mark-B-HTP Fuel**

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

Allowable LOCA LHR Limits			
Core Elevation, ft	LHR Limit for 0 MWd/mtU, kW/ft	LHR Limit for 28,000 MWd/mtU, kW/ft	LHR Limit for 62,000 MWd/mtU, kW/ft
0.000	16.60	16.60	12.30
2.506	17.50	17.50	13.00
4.264	17.50	17.50	13.00
6.021	17.30	17.30	13.00
7.779	17.50	17.50	13.00
9.536	17.30	17.30	13.00
11.000	15.30	15.30	12.50
12.000	14.50	14.50	12.30

Note:

The LOCA LHR limits may be linearly interpolated as a function of burnup between 0 MWd/mtU and 28,000 MWd/mtU, between 28,000 MWd/mtU and 62,000 MWd/mtU, and as a function of core elevation.

Figure 7B

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 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	2.04426	1.4	0.01	2.94000	1.7	0.01	3.20469
	0.14	2.04515		0.14	2.94000		0.14	3.20469
	0.20	2.04535		0.20	2.93545		0.20	3.15423
	0.30	2.04551		0.30	2.84715		0.30	3.08083
	0.40	2.04470		0.40	2.76077		0.40	2.98064
	0.50	2.04437		0.50	2.66671		0.50	2.89369
	0.60	2.04415		0.60	2.55808		0.60	2.78037
	0.70	2.04400		0.70	2.46508		0.70	2.68552
	0.80	2.04329		0.80	2.34973		0.80	2.56207
	0.89	2.00109		0.89	2.27714		0.89	2.49021
	0.99	1.90427		0.99	2.18525		0.99	2.39515
1.2	0.01	2.33088	1.5	0.01	3.08066	1.8	0.01	3.24949
	0.14	2.33287		0.14	3.08066		0.14	3.24949
	0.20	2.33339		0.20	3.03513		0.20	3.20303
	0.30	2.33352		0.30	2.93856		0.30	3.13047
	0.40	2.33338		0.40	2.84115		0.40	3.04037
	0.50	2.33285		0.50	2.75216		0.50	2.95027
	0.60	2.33232		0.60	2.63946		0.60	2.84225
	0.70	2.26721		0.70	2.54429		0.70	2.74696
	0.80	2.16931		0.80	2.42655		0.80	2.62489
	0.89	2.10460		0.89	2.35382		0.89	2.55373
	0.99	2.00767		0.99	2.26040		0.99	2.45882
1.3	0.01	2.64464	1.6	0.01	3.14861	1.9	0.01	3.28611
	0.14	2.64863		0.14	3.14861		0.14	3.28611
	0.20	2.64909		0.20	3.09918		0.20	3.24461
	0.30	2.64997		0.30	3.01573		0.30	3.17163
	0.40	2.64949		0.40	2.91490		0.40	3.08589
	0.50	2.56272		0.50	2.82718		0.50	3.00025
	0.60	2.46600		0.60	2.71210		0.60	2.89826
	0.70	2.37484		0.70	2.61653		0.70	2.80288
	0.80	2.26452		0.80	2.49634		0.80	2.68386
	0.89	2.19471		0.89	2.42370		0.89	2.61261
	0.99	2.09988		0.99	2.32955		0.99	2.51792

Notes

- The values above are not error corrected.
- 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.
- 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:

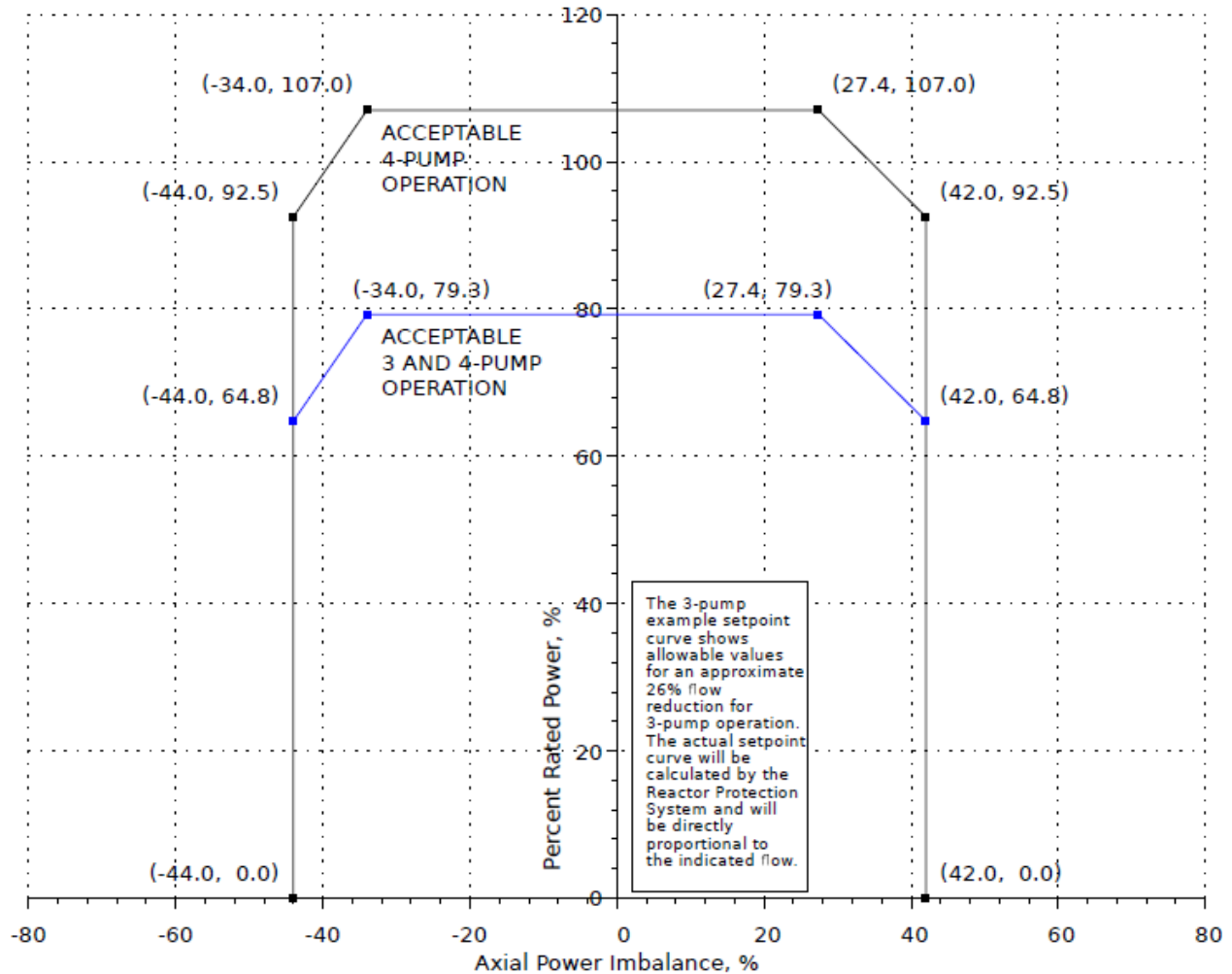
	$P/P_m = 1.00$	$P/P_m < 1.00$
MAP Multiplier	1.0	$1 + 0.3(1 - P/P_m)$

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

Figure 8

Reactor Protection System Maximum Allowable Setpoints for Axial Power Imbalance

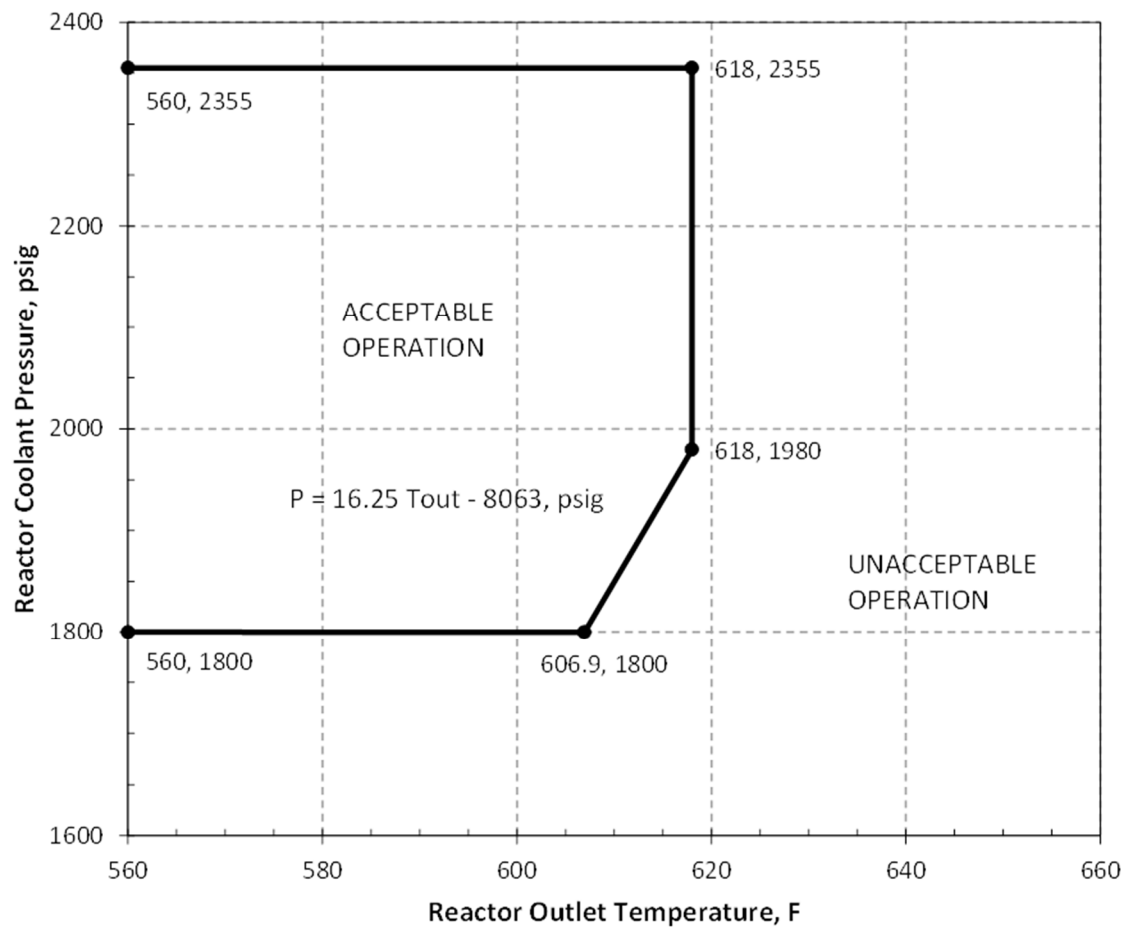
(Figure is referred to by Technical Specification 3.3.1 and Technical Specification Bases 2.1.1)



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

Figure 9**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
Minimum RCS Hot Leg Pressure (psig) ^{Note 1}	2082.2	2081.2 ^{Note 4} 2120.4 ^{Note 5}
Maximum RCS Hot Leg Temperature (°F) ^{Note 2}	602.6	602.9
Minimum RCS Total Flow (Mlb _m /hr) ^{Note 3}	143.36 ^{Note 6} 138.01 ^{Note 8}	106.46 ^{Note 7} 102.45 ^{Note 8}

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 $T_{cold} = 580$ °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

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 the End of Cycle 32 (EOC-32) EFPD is:

EOC-32 EFPD	Refueling Boron (ppm) ¹
478	2217
480	2213
485	2203
490	2193
493	2187
≥499	2181

¹The Refueling Boron may be linearly interpolated as a function of EOC-32 EFPD between 478 and 499 EFPD.

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