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U. S. Nuclear Regulatory Commission
Document Control Desk
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Subject: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
Revision to ANO-1 Core Operating Limits Report

Dear Sir or Madam:

Arkansas Nuclear One, Unit 1 (ANO-1) Technical Specification 6.13.3.4 (Improved Technical Specification (ITS) 5.6.5.d) requires that any mid-cycle revisions to the Core Operating Limits Report (COLR) be provided to the NRC upon issuance. Attached is Revision 2 to the ANO-1 Cycle 17 COLR, issued due to ITS implementation. Revision 1 to the COLR made a correction to Figure 10 which is now included in Figure 1 of Revision 2. Since this correction was made in close proximity to the revision to support ITS, the Revision 1 changes are being issued with Revision 2. Revision 2 becomes effective with ITS on July 8, 2002. This submittal completes the reporting requirements for the referenced technical specification. Should you have any questions, please contact me.

Sincerely,

Glenn R. Ashley

Glenn R. Ashley
Manager, Licensing

GRA/nbm
Attachment

A001

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# ENTERGY OPERATIONS

ARKANSAS NUCLEAR ONE
UNIT ONE

CYCLE 17

# CORE OPERATING LIMITS REPORT

## 1.0 CORE OPERATING LIMITS

This Core Operating Limits Report for ANO-1 Cycle 17 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 reference.

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

1) 2.1.1 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, and
13) 3.9.1 Boron Concentration.

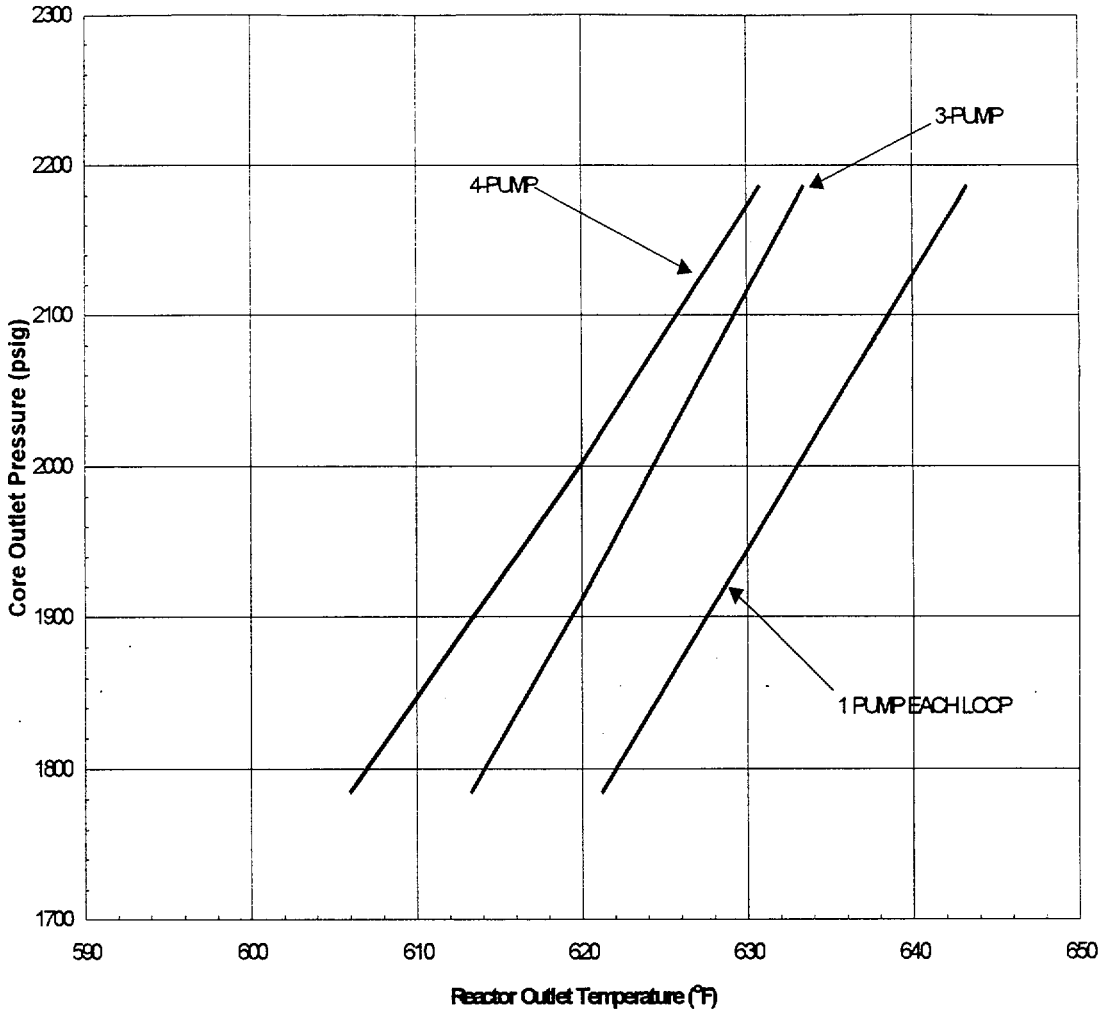
## 2.0 REFERENCES

1. "Safety Criteria and Methodology for Acceptable Cycle Reload Analysis," BAW-10179P-A, Rev. 3, Framatome Cogema Fuels, Lynchburg, Virginia, October 1999.
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.

# Table Of Contents

**Figure is referred to by**
**Technical Specification 2.1.1.3**

## Figure 1. Variable Low RCS Pressure--Temperature Protective Limits

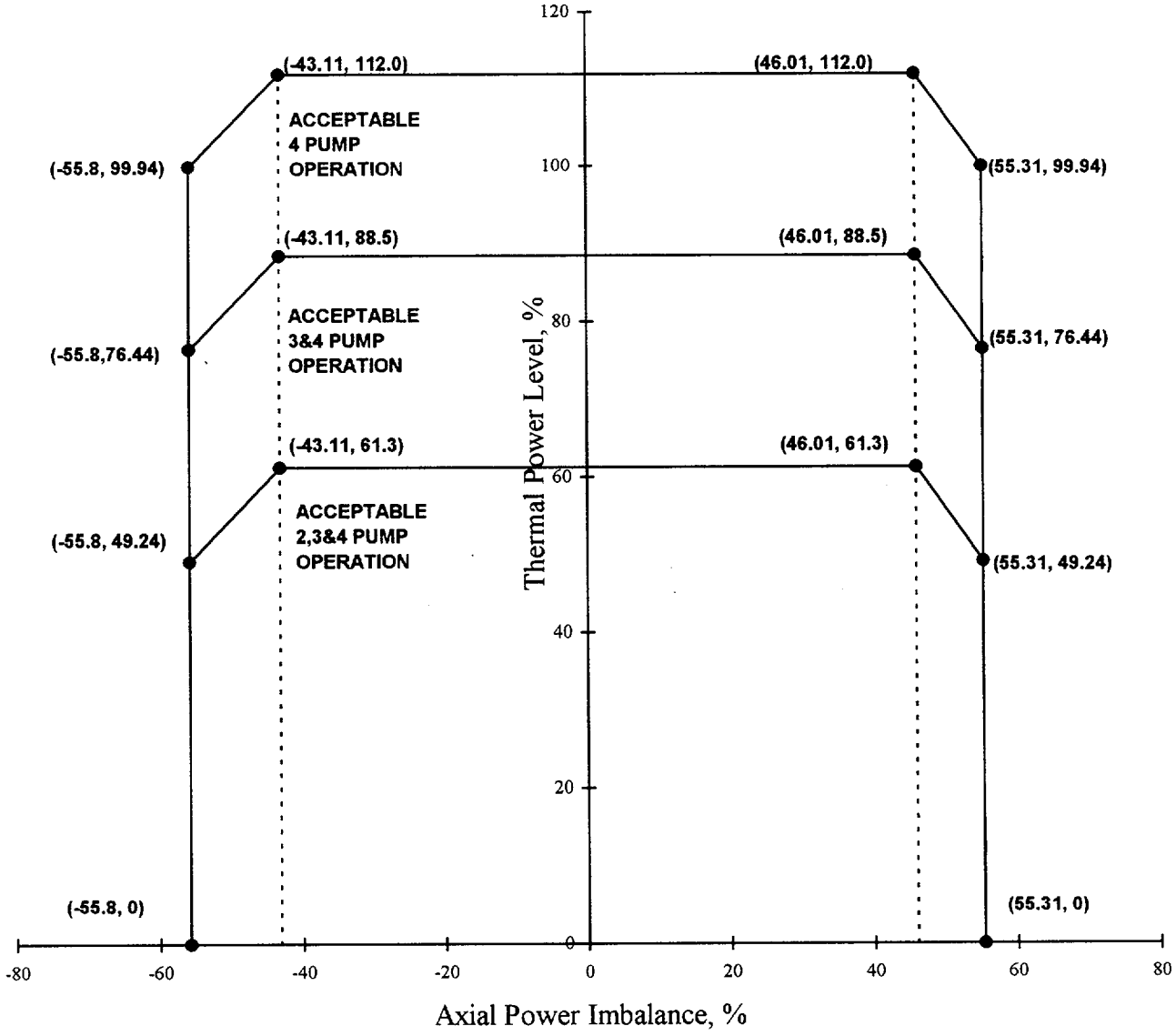



| PUMPS OPERATING (TYPE OF LIMIT) | GPM* | POWER** |
|---|---|---|
| Four Pumps (DNBR Limit) | 369,600 (100%) | 110% |
| Three Pumps (DNBR Limit) | 276,091 (74.7%) | 89% |
| One Pump in Each Loop (DNBR Limit) | 181,104 (49%) | 62.2% |

* 105% of Design Flow (2.5% UNCERTAINTY INCLUDED IN STATISTICAL DESIGN LIMIT)
**AN ADDITIONAL 2% POWER UNCERTAINTY IS INCLUDED IN STATISTICAL DESIGN LIMIT

**Figure is referred to by**
**Technical Specification 2.1.1 Bases**

## Figure 2. AXIAL POWER IMBALANCE Protective Limits (measurement system independent)



## 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

# SHUTDOWN MARGIN (SDM)

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 |

*Requires actual shutdown margin to be $\geq$ 1 %$\Delta$k/k.

**Figure is referred to by**
**Technical Specification 3.2.1**

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

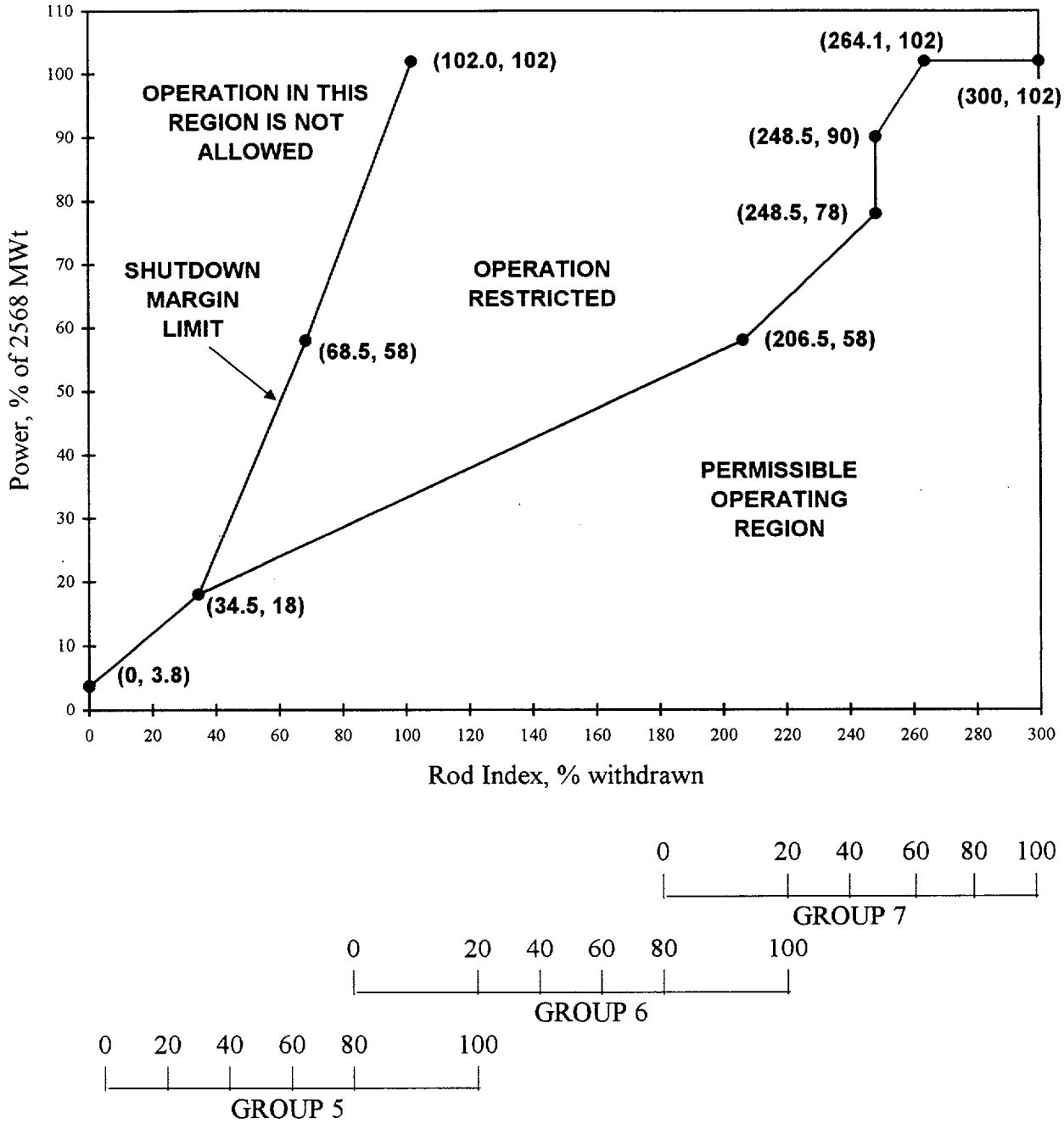


**Figure is referred to by**
**Technical Specification 3.2.1**

## Figure 3-B. Regulating Rod Insertion Limits for Four-Pump Operation From 200 ± 10 EFPD to EOC

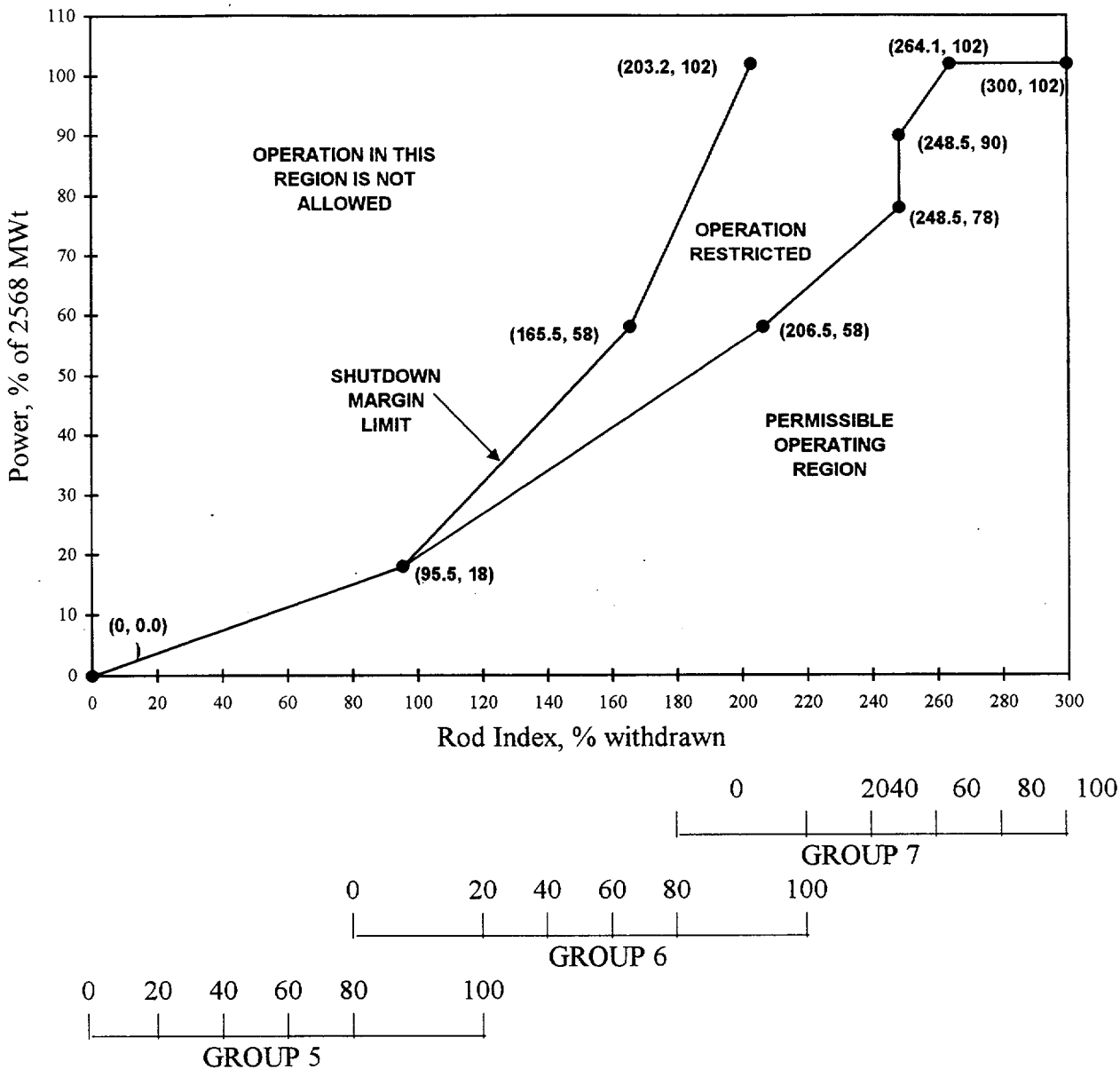


**Figure is referred to by**
**Technical Specification 3.2.1**

## Figure 4-A. Regulating Rod Insertion Limits for Three-Pump Operation From 0 to 200 ± 10 EFPD

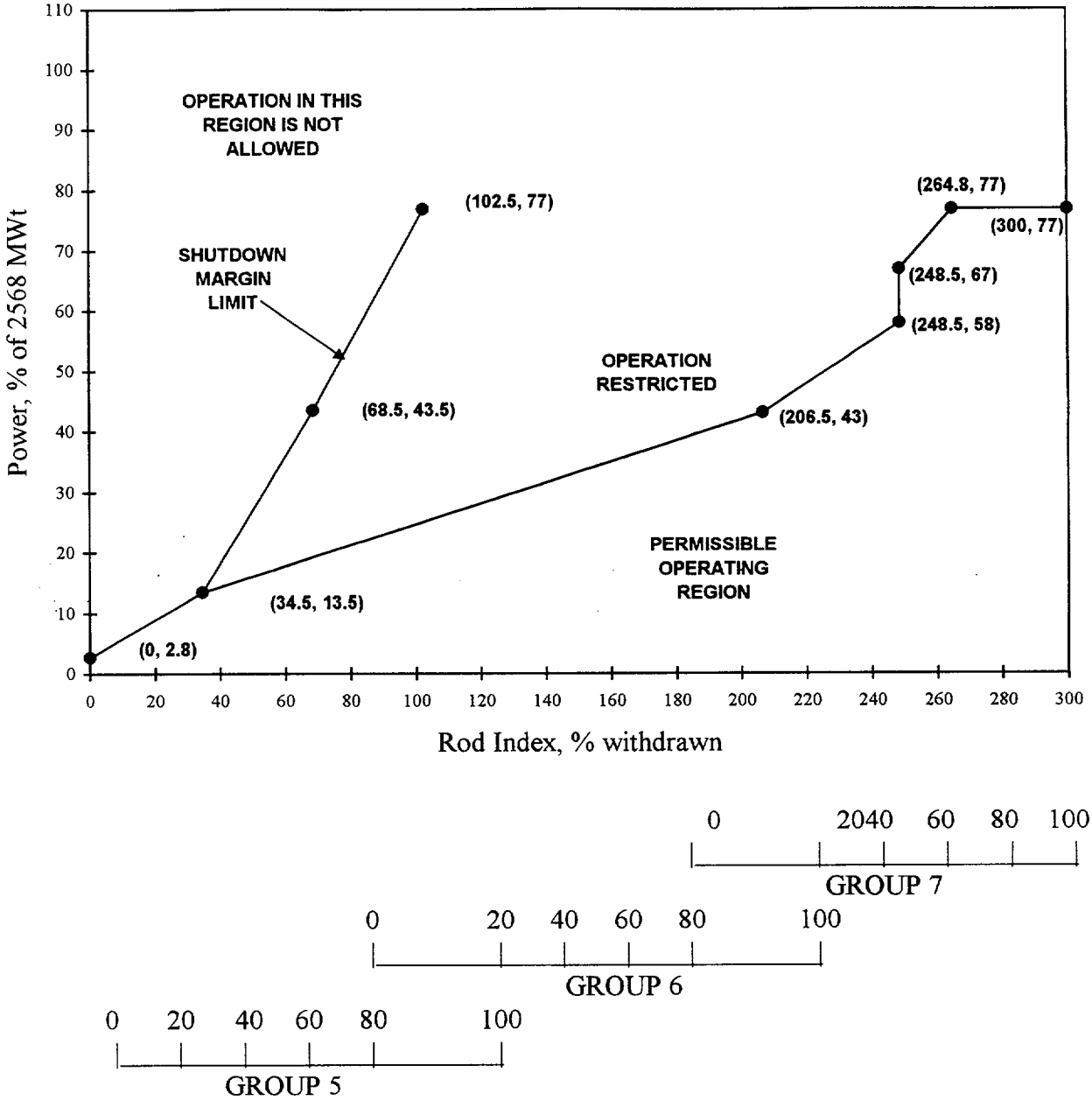


**Figure is referred to by**
**Technical Specification 3.2.1**

## Figure 4-B. Regulating Rod Insertion Limits for Three-Pump Operation From 200 ± 10 EFPD to EOC

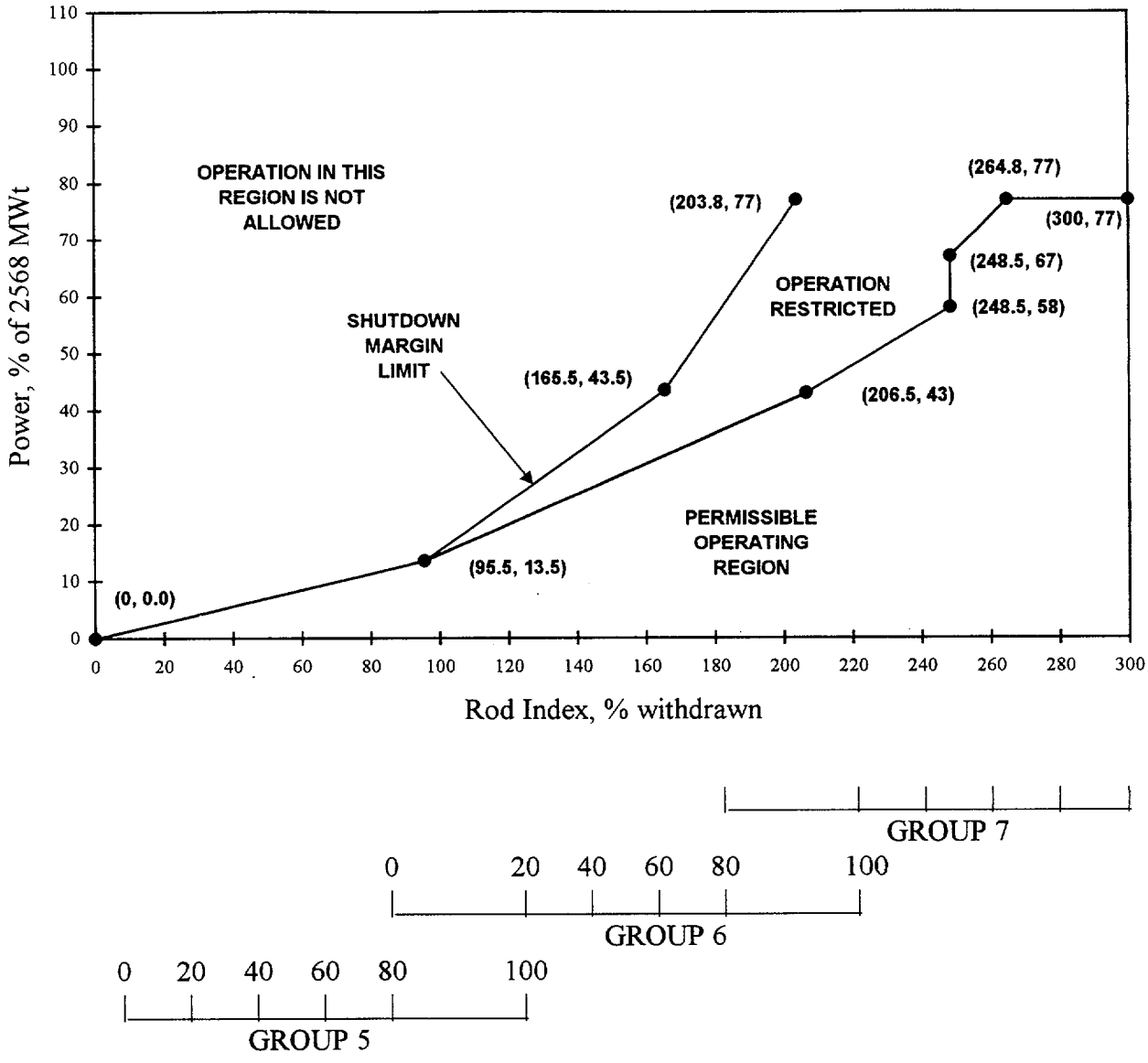


**Figure is referred to by**
**Technical Specification 3.2.1**

## Figure 5-A. Regulating Rod Insertion Limits for Two-Pump Operation From 0 to 200 ± 10 EFPD

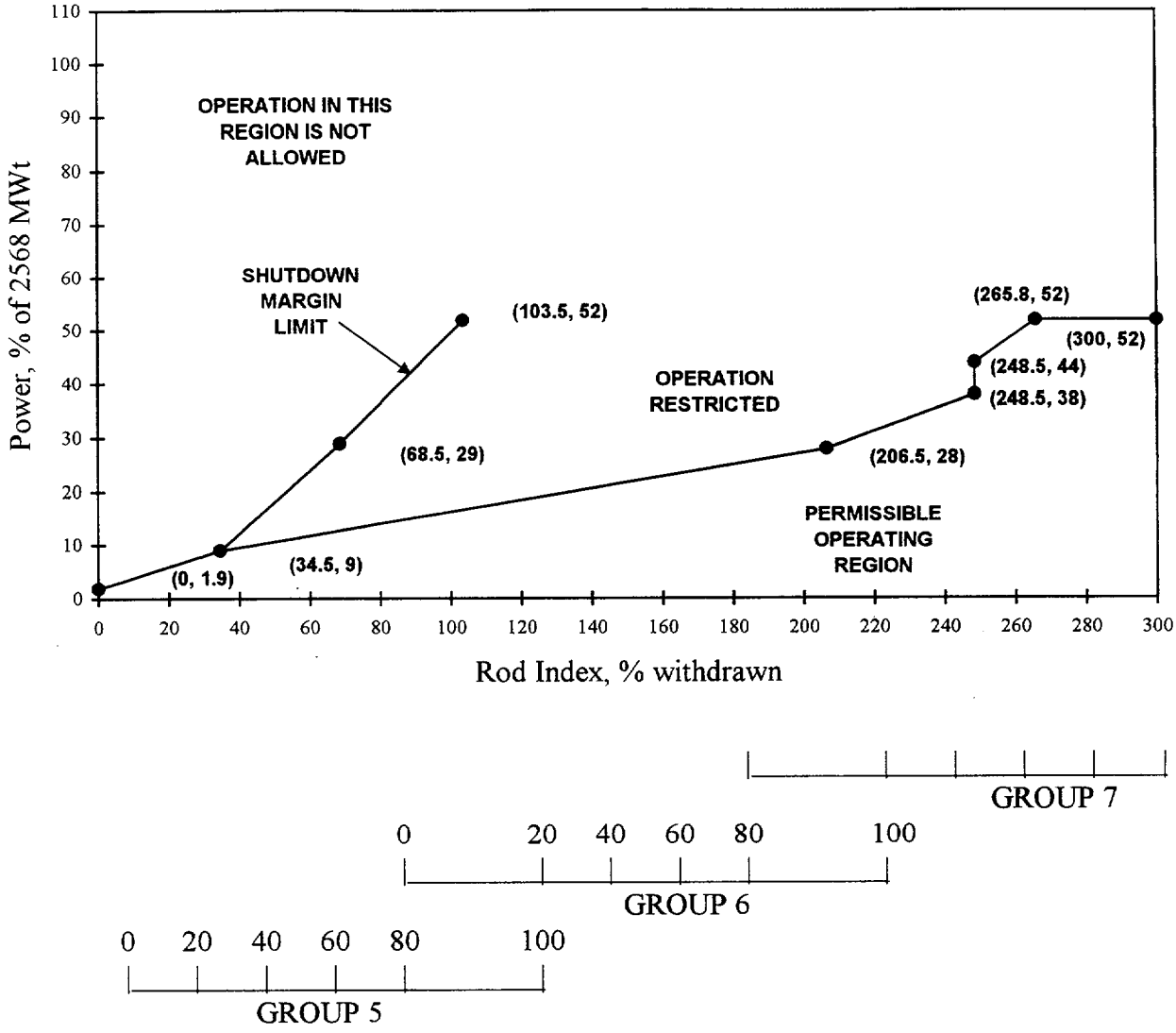
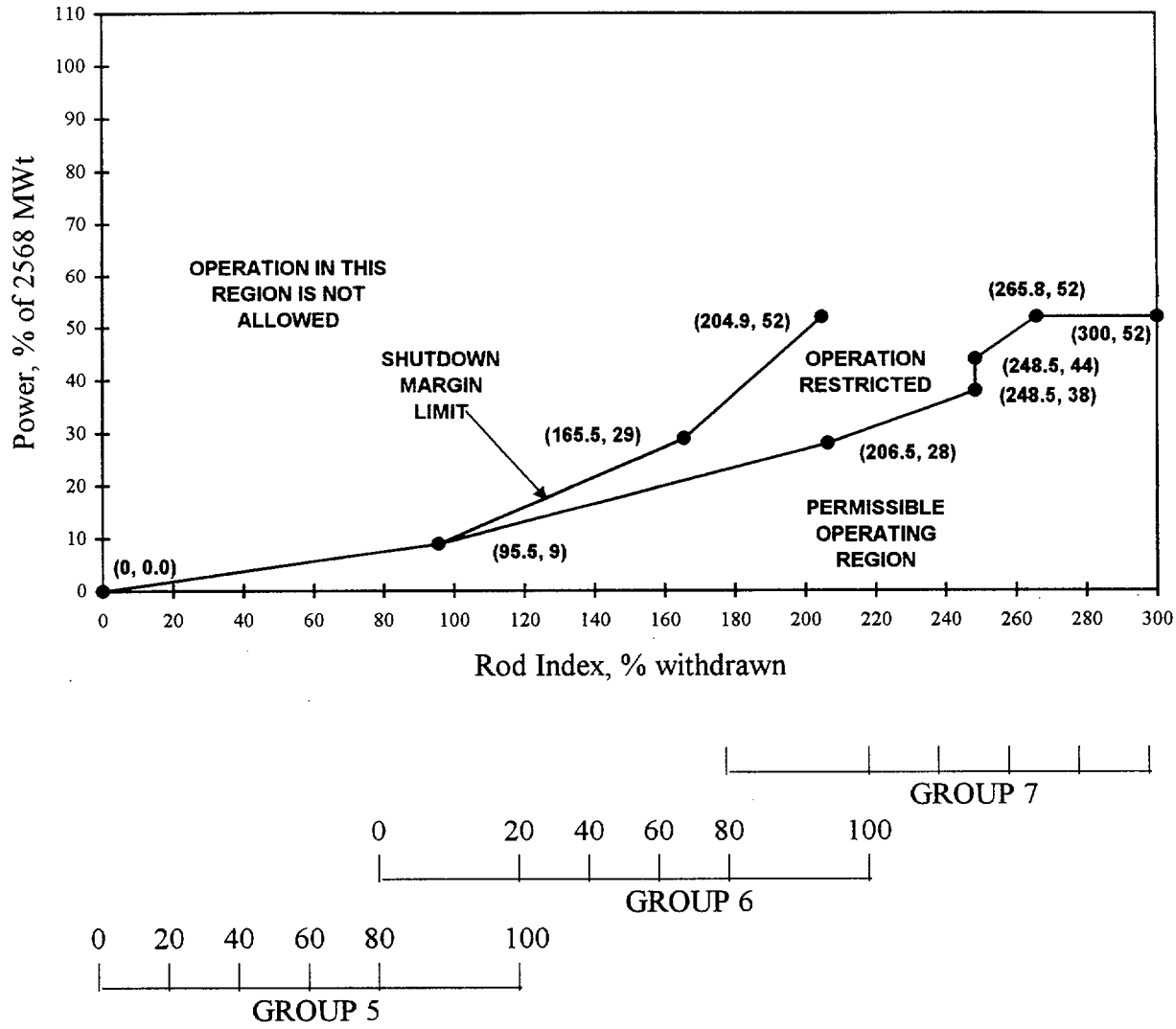


**Figure is referred to by**
**Technical Specification 3.2.1**

## Figure 5-B. Regulating Rod Insertion Limits for Two-Pump Operation From 200 ± 10 EFPD to EOC



## LIMITS ARE REFERRED TO BY TECHNICAL SPECIFICATION 3.2.2

## AXIAL POWER SHAPING RODS (APSR) Insertion Limits

Up to 480 ± 10 EFPD, the APSRs may be positioned as necessary for transient imbalance control, however, the APSRs shall be fully withdrawn by 490 EFPD. After the APSR withdrawal at 480 ± 10 EFPD, the APSRs shall not be reinserted.

**Figure is referred to by**
**Technical Specification 3.2.3**

## Figure 6-A. AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Four-Pump Operation

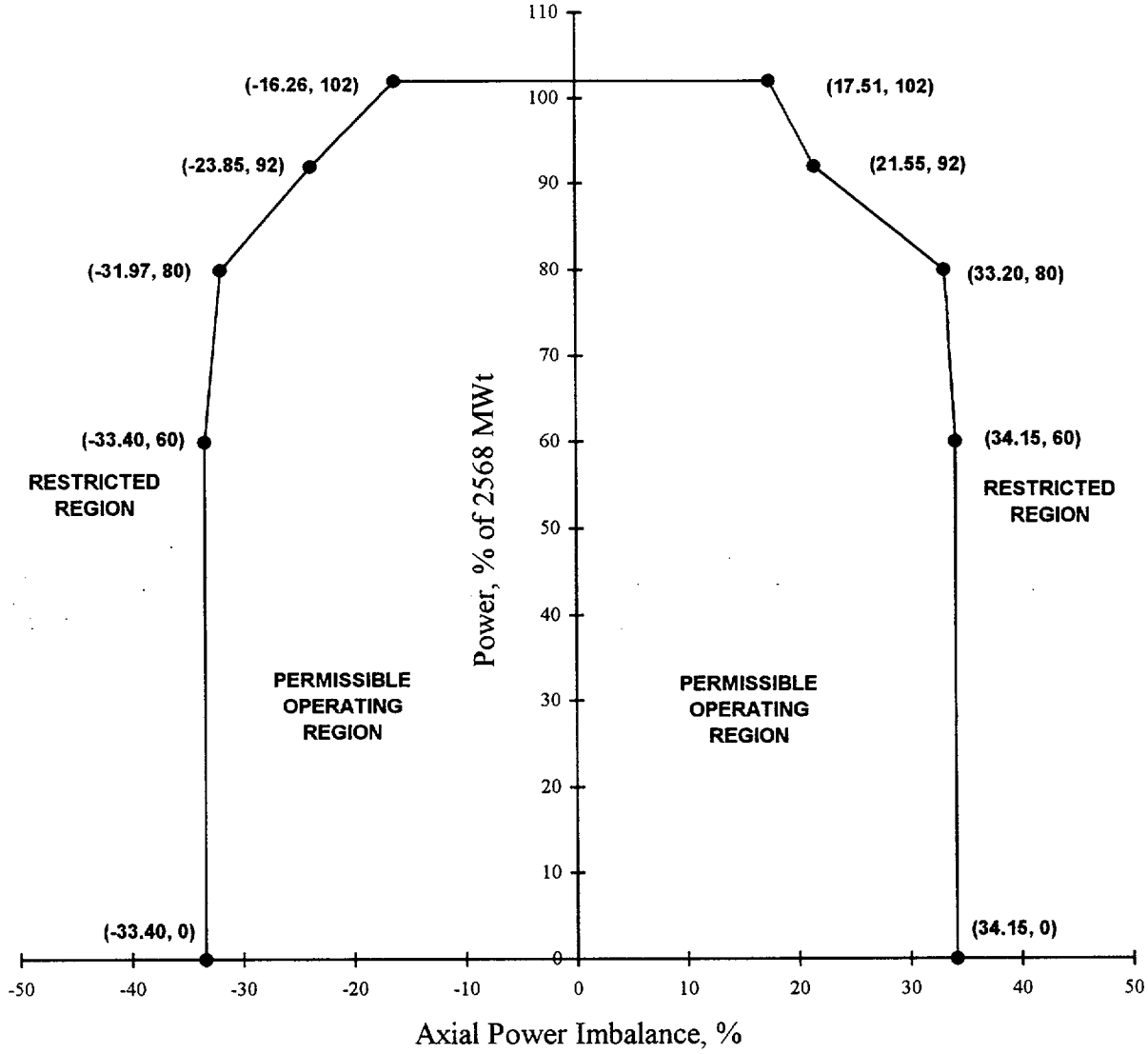
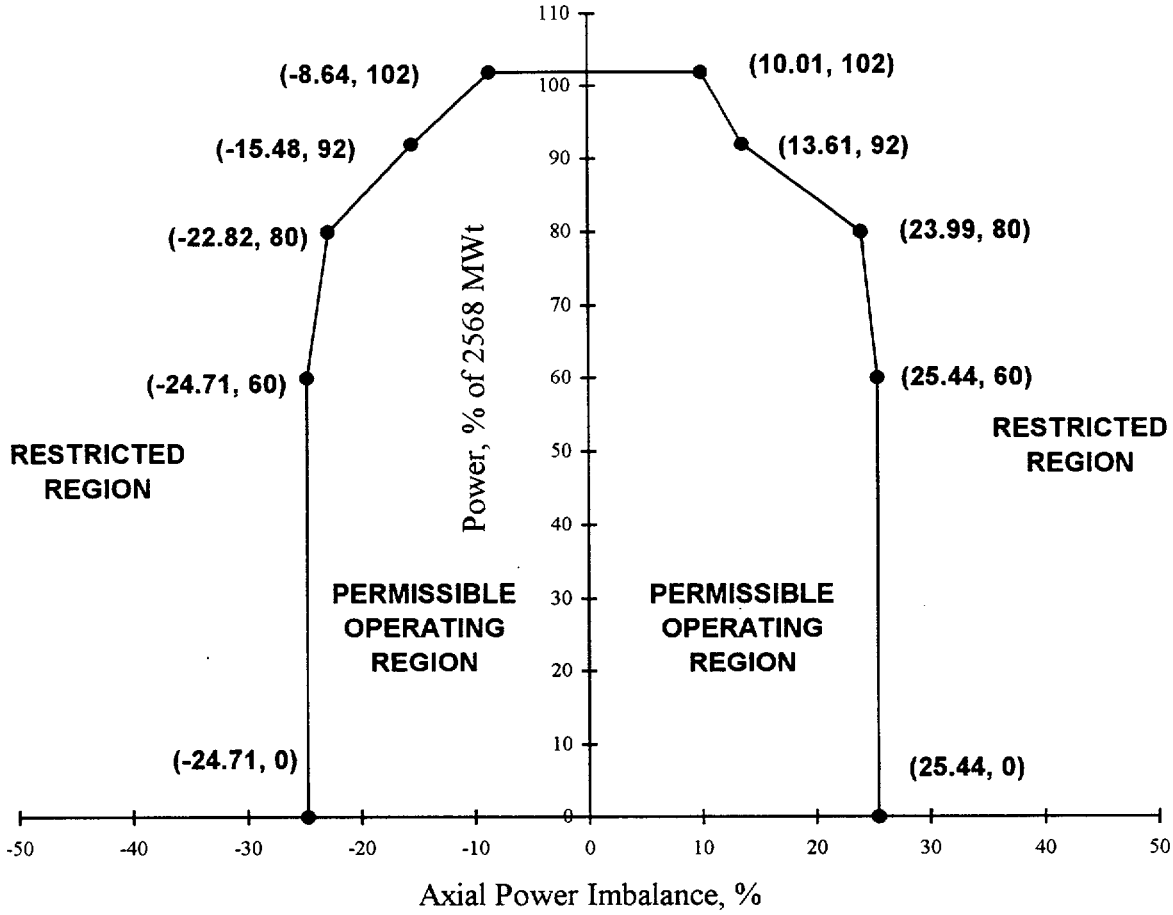


**Figure is referred to by**
**Technical Specification 3.2.3**

## Figure 6-B. AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Four-Pump Operation




* Assumes that no individual short emitter detector affecting the minimum in-core imbalance calculation exceeds 60% sensitivity depletion, and that no individual long emitter detector exceeds 73% sensitivity depletion, or both. The imbalance setpoints for the minimum in-core system must be reduced by 2.80 %FP at the earliest time-in-life that this assumption is no longer valid.

**Figure is referred to by**
**Technical Specification 3.2.3**

## Figure 6-C. AXIAL POWER IMBALANCE Setpoints for Excore Conditions for Four-Pump Operation

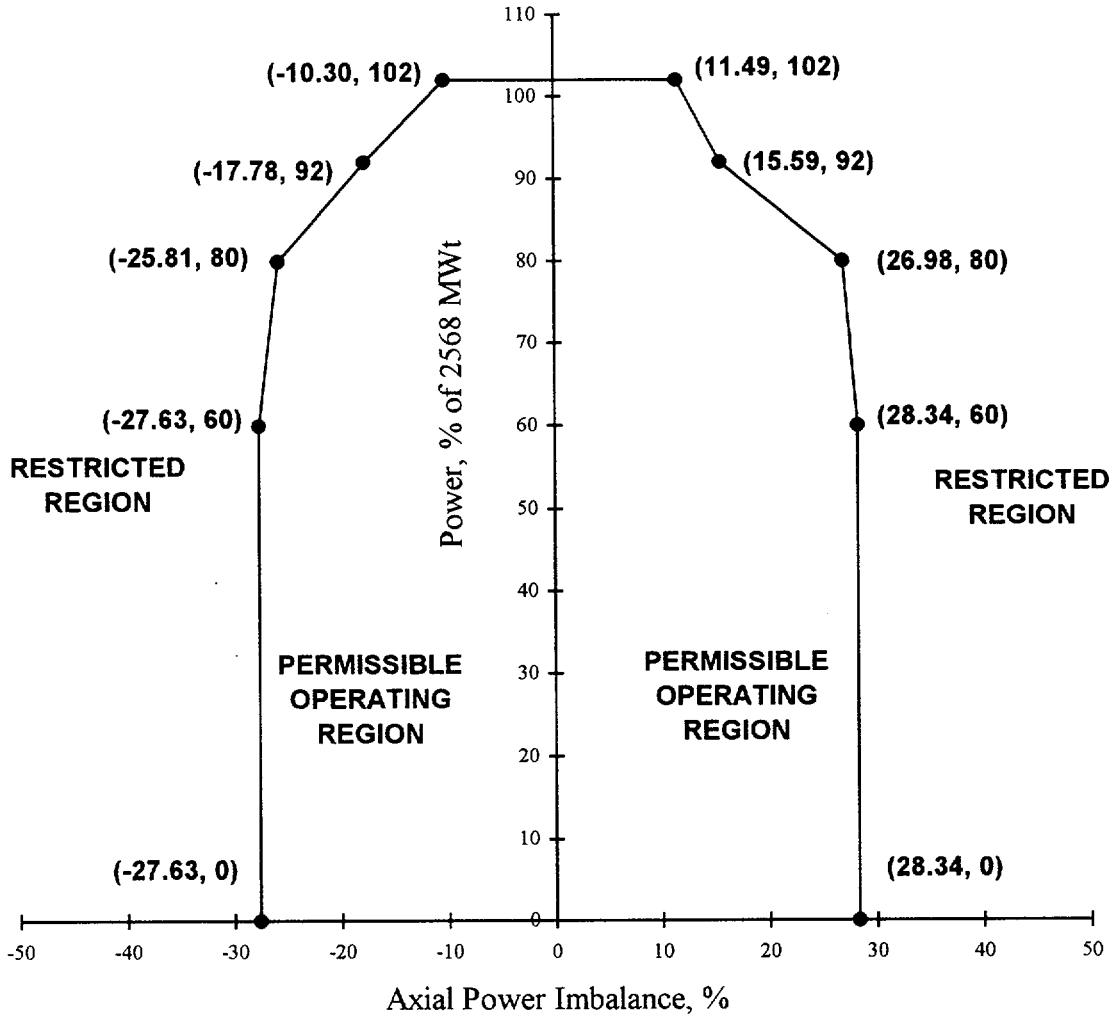


**Figure is referred to by**
**Technical Specification 3.2.3**

## Figure 7-A. AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Three-Pump Operation

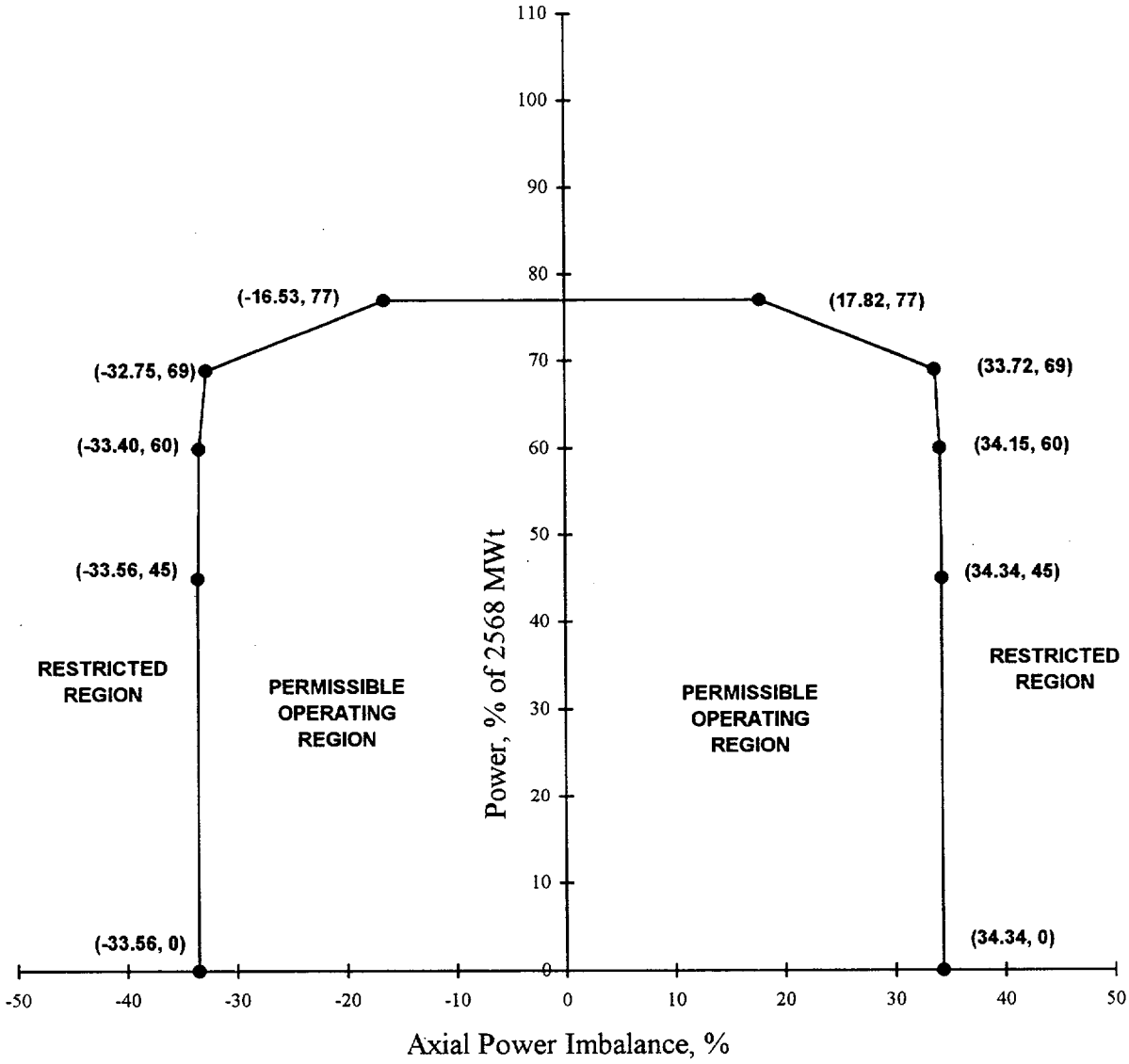
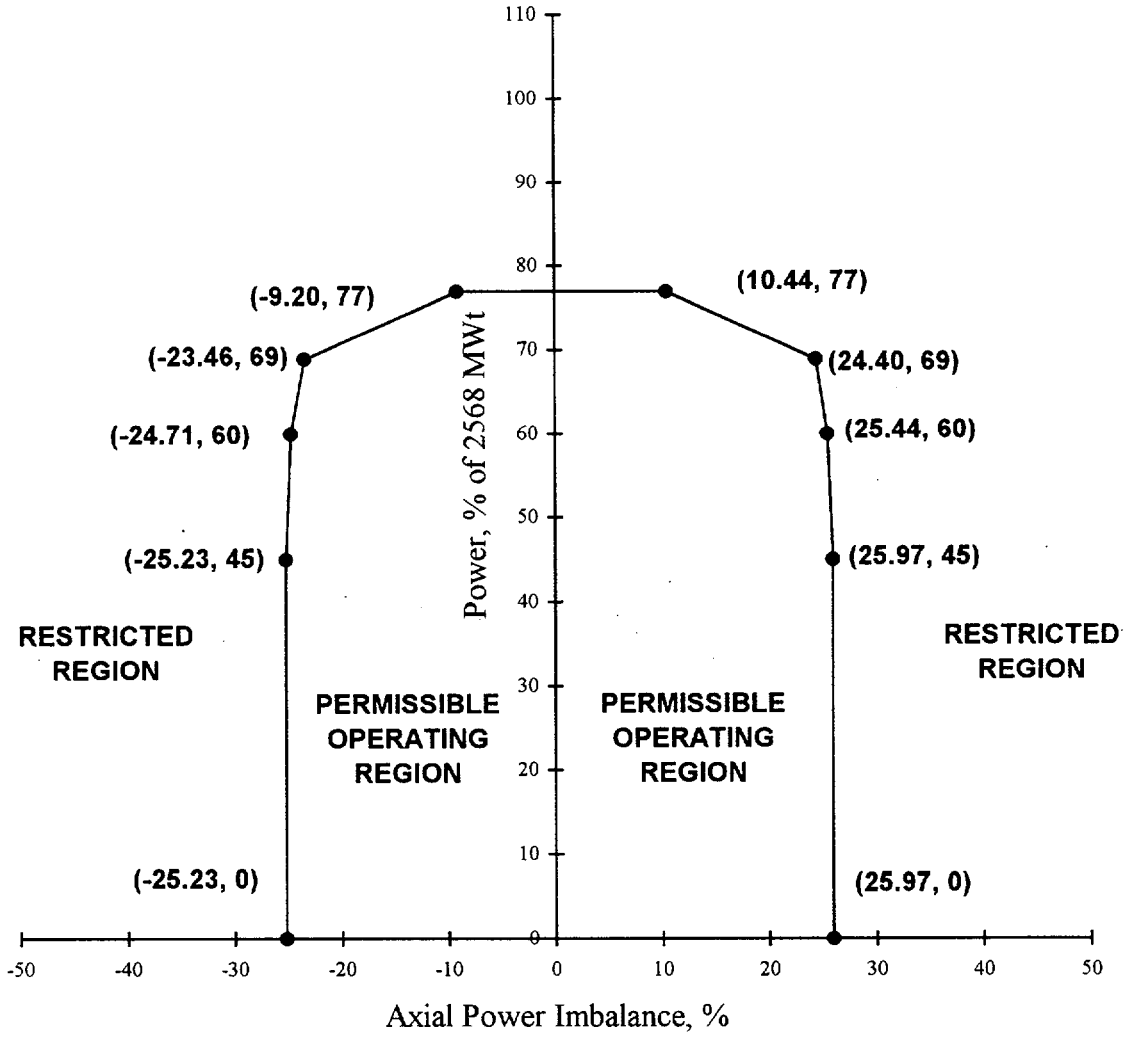


**Figure is referred to by**
**Technical Specification 3.2.3**

## Figure 7-B. AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Three-Pump Operation




* Assumes that no individual short emitter detector affecting the minimum in-core imbalance calculation exceeds 60% sensitivity depletion, and that no individual long emitter detector exceeds 73% sensitivity depletion, or both. The imbalance setpoints for the minimum in-core system must be reduced by 2.80 %FP at the earliest time-in-life that this assumption is no longer valid.

**Figure is referred to by**
**Technical Specification 3.2.3**

## Figure 7-C. AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Three-Pump Operation

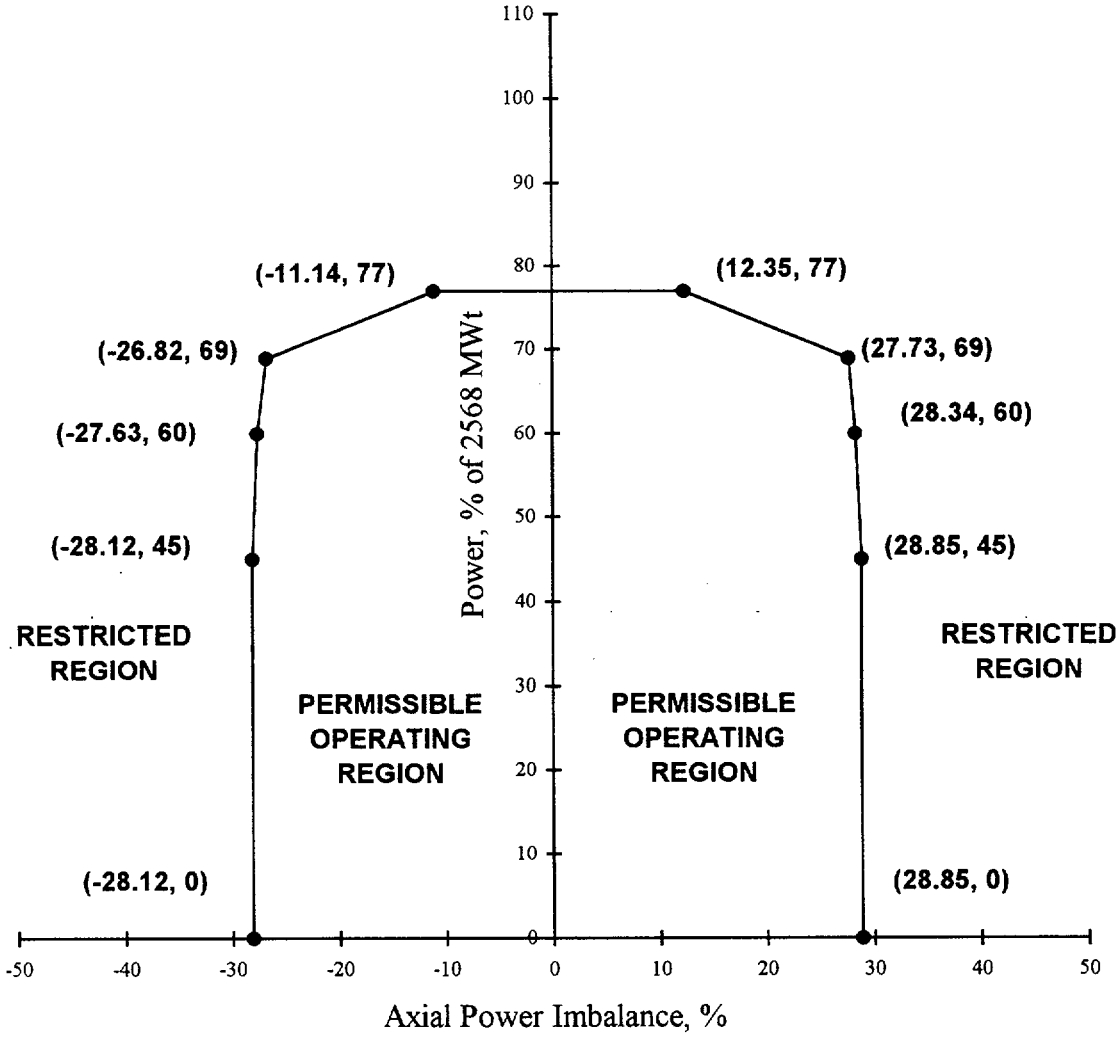


**Figure is referred to by**
**Technical Specification 3.2.3**

## Figure 8-A. AXIAL POWER IMBALANCE Setpoints for Full In-Core Conditions for Two-Pump Operation

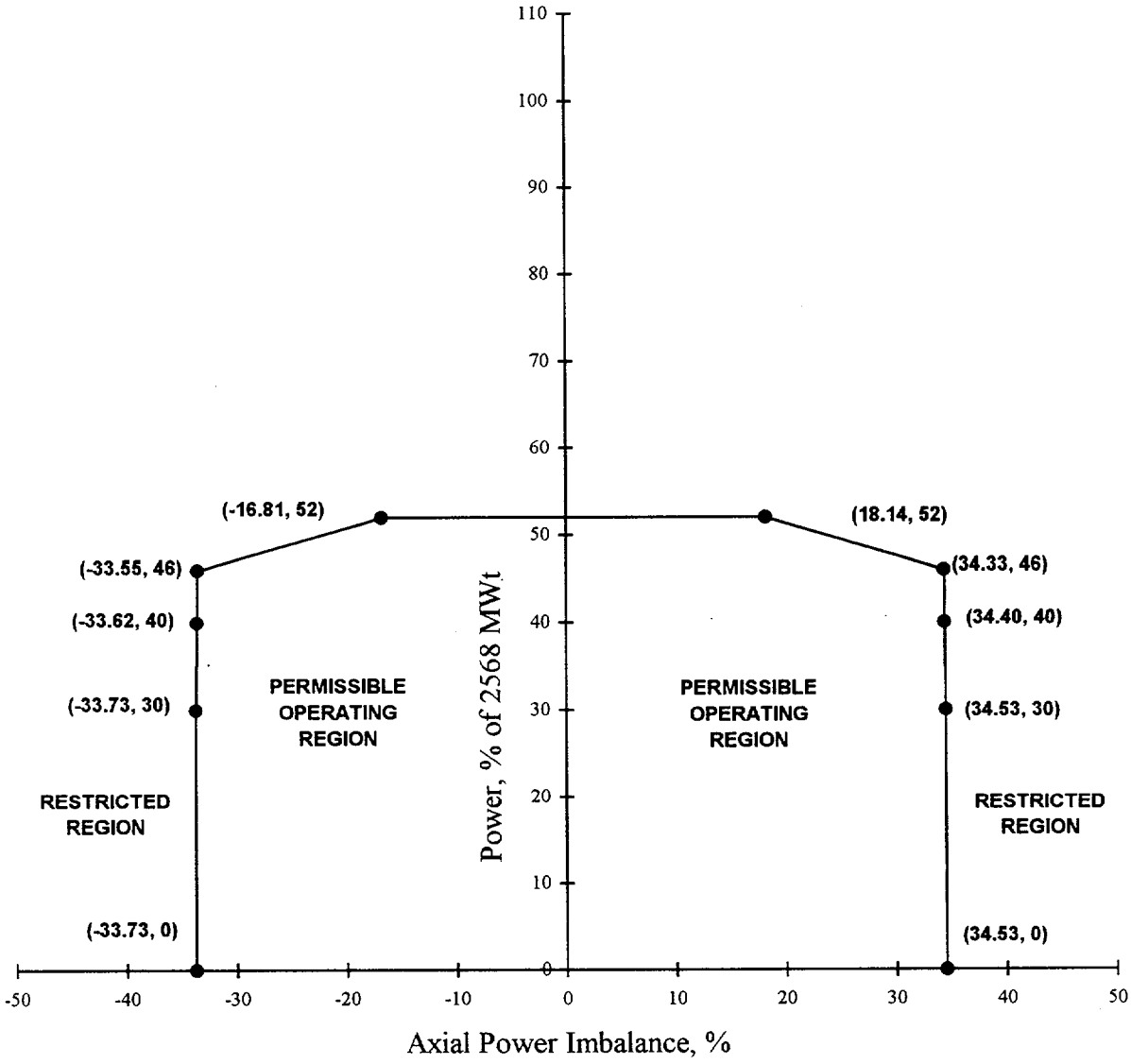
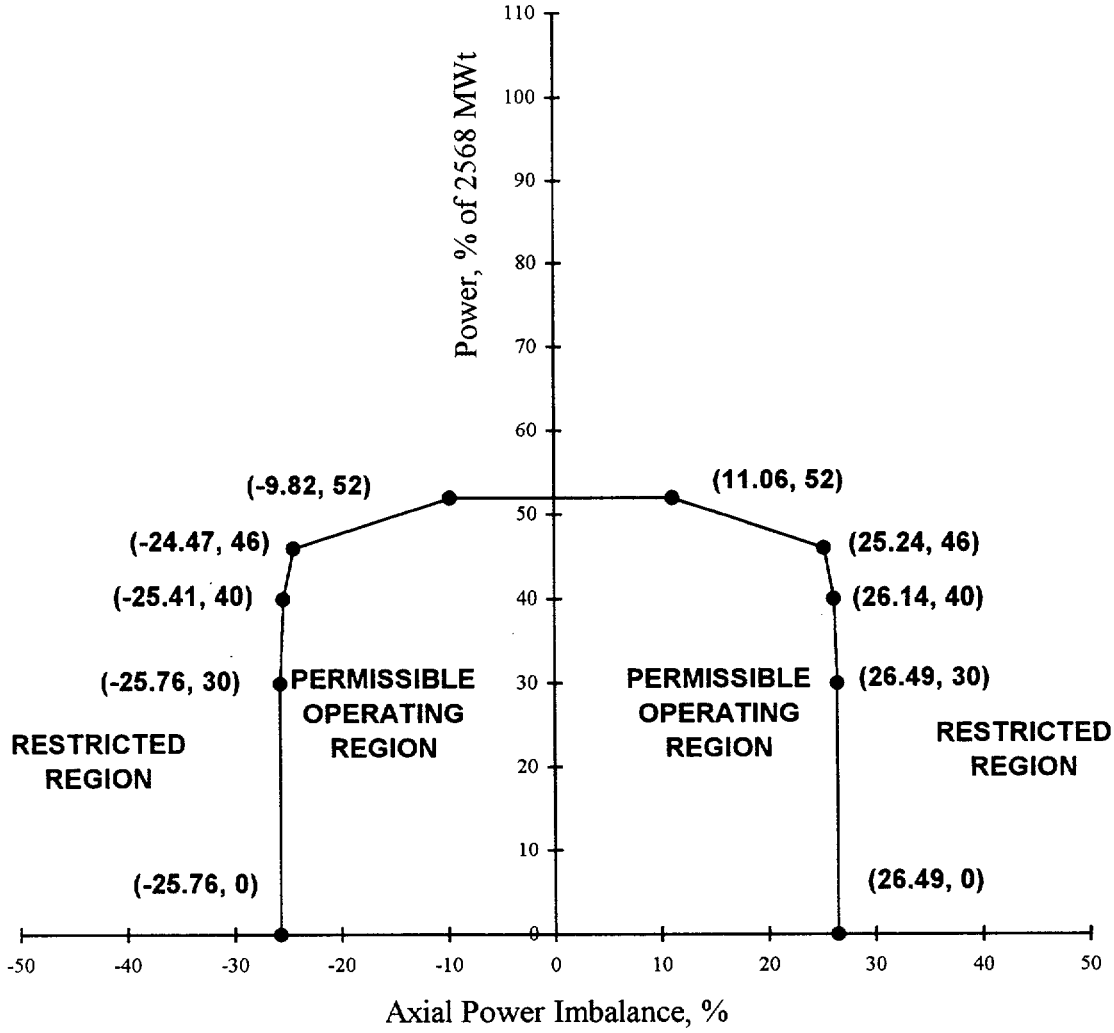


**Figure is referred to by**
**Technical Specification 3.2.3**

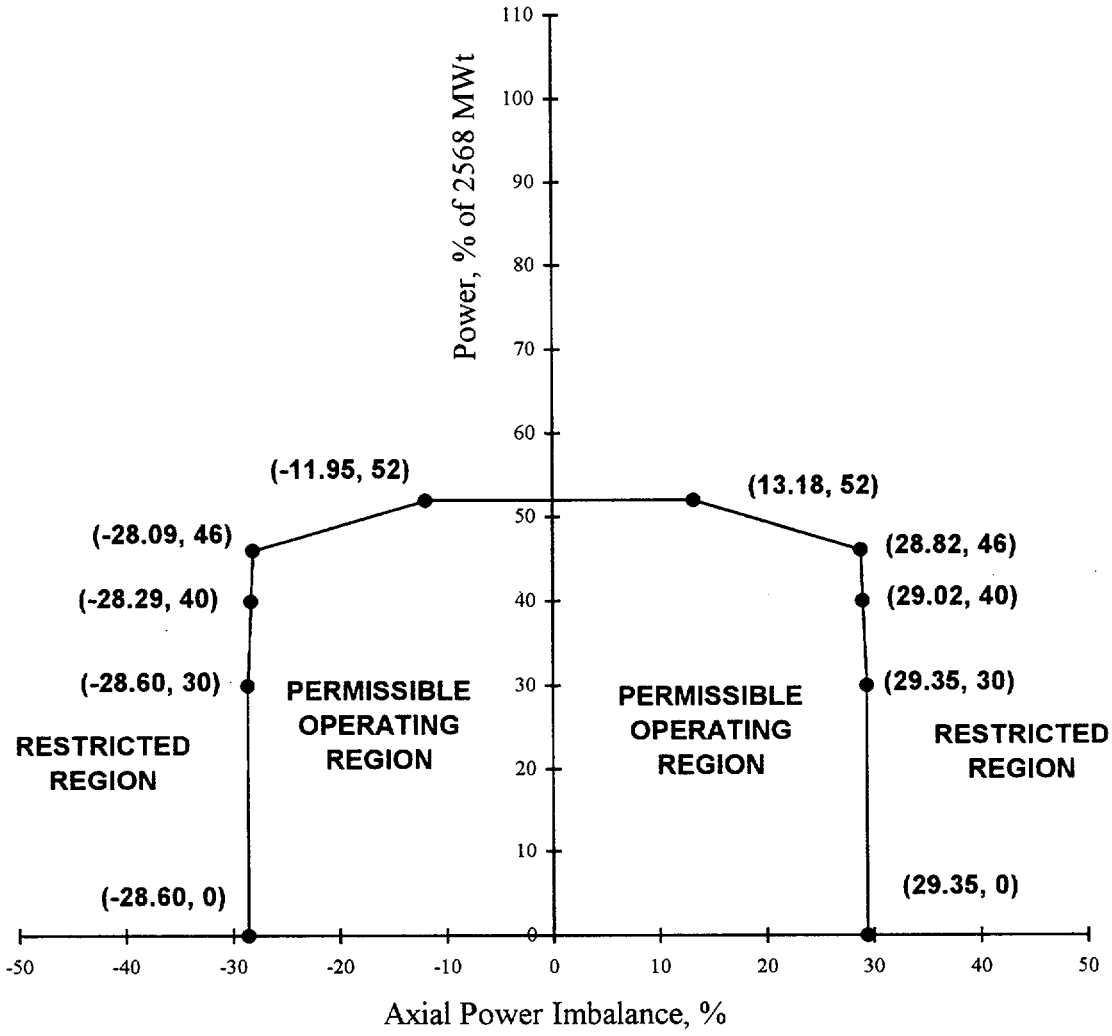
## Figure 8-B. AXIAL POWER IMBALANCE Setpoints for Minimum In-Core Conditions* for Two-Pump Operation




* Assumes that no individual short emitter detector affecting the minimum in-core imbalance calculation exceeds 60% sensitivity depletion, and that no individual long emitter detector exceeds 73% sensitivity depletion, or both. The imbalance setpoints for the minimum in-core system must be reduced by 2.80 %FP at the earliest time-in-life that this assumption is no longer valid.

**Figure is referred to by**
**Technical Specification 3.2.3**

## Figure 8-C. AXIAL POWER IMBALANCE Setpoints for Ex-Core Conditions for Two-Pump Operation



# LIMITS ARE REFERRED TO BY TECHNICAL SPECIFICATION 3.2.4

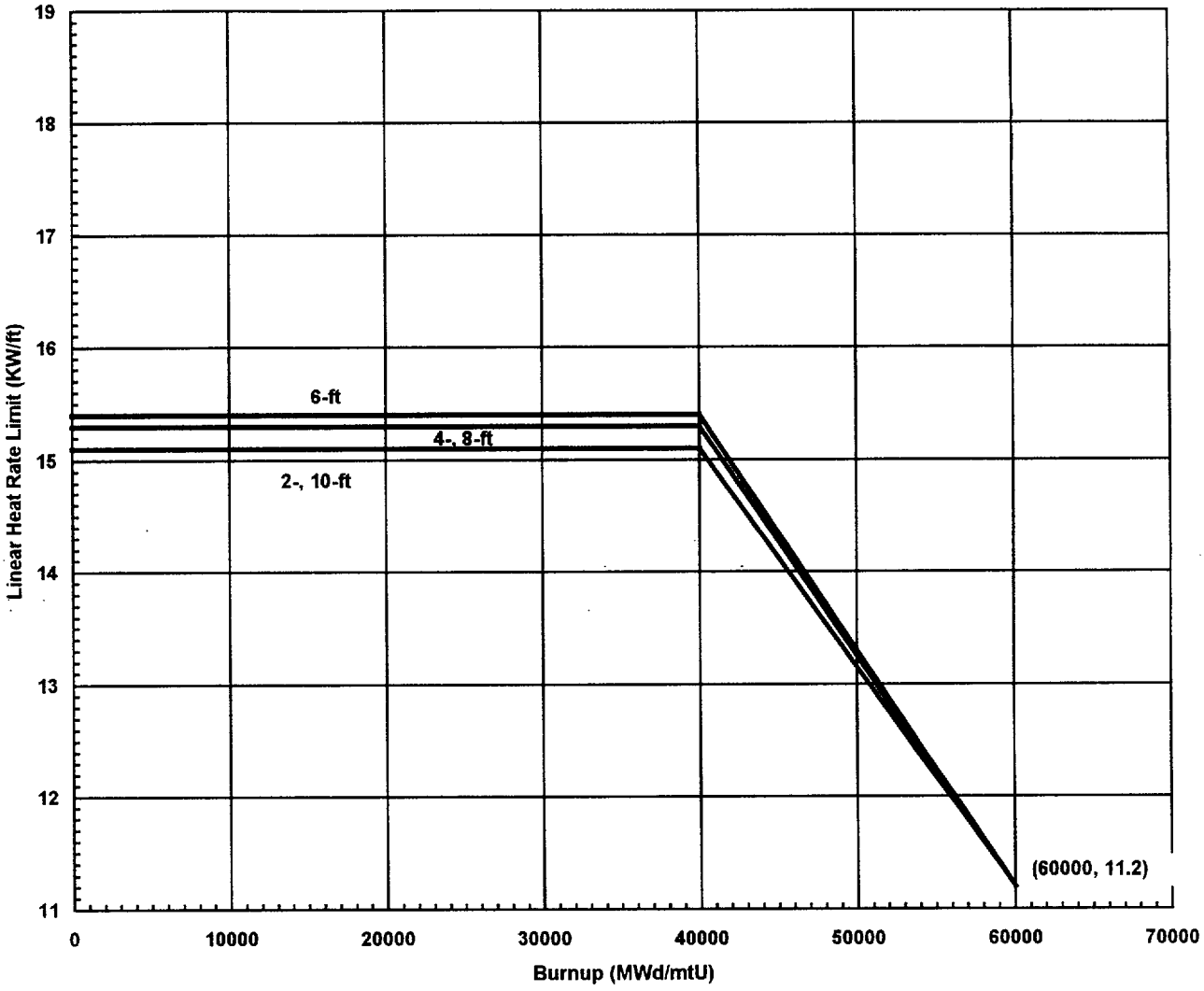
## Quadrant Power Tilt Limits And Setpoints

| Measurement System | From 0 EFPD to EOC Steady State Value (%) | | Maximum Value (%) |
|---|---|---|---|
| | ≤60 % RTP | >60 % RTP | |
| Full In-core Detector System Setpoint | 6.83 | 4.44 | 25.0 |
| Minimum In-core Detector System Setpoint | 2.78* | 1.90* | 25.0 |
| Ex-core Power Range NI Channel Setpoint | 4.05 | 1.96 | 25.0 |
| Measurement System Independent Limit | 7.50 | 4.92 | 25.0 |

* 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 is referred to by**
**Technical Specification 3.1.8 and 3.2.5**

## Figure 9. LOCA Linear Heat Rate Limits



# LIMIT IS REFERRED TO BY TECHNICAL SPECIFICATION 3.1.8 and 3.2.5

## DNB Power Peaking Factors

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.

| | | Total Peak | |
|---|---|---|---|
| **Axial Peak** | **Axial Peak Location X/L** | **4 - Pump Operation** | **3 - Pump Operation** |
| 1.1 | 0.2 | 2.028 | 2.028 |
| 1.1 | 0.4 | 2.021 | 2.021 |
| 1.1 | 0.6 | 2.008 | 2.008 |
| 1.1 | 0.8 | 1.985 | 1.985 |
| 1.3 | 0.2 | 2.515 | 2.515 |
| 1.3 | 0.4 | 2.486 | 2.486 |
| 1.3 | 0.6 | 2.411 | 2.411 |
| 1.3 | 0.8 | 2.252 | 2.252 |
| 1.5 | 0.2 | 2.973 | 2.973 |
| 1.5 | 0.4 | 2.786 | 2.786 |
| 1.5 | 0.6 | 2.596 | 2.596 |
| 1.5 | 0.8 | 2.422 | 2.422 |
| 1.7 | 0.2 | 3.117 | 3.117 |
| 1.7 | 0.4 | 2.921 | 2.921 |
| 1.7 | 0.6 | 2.727 | 2.727 |
| 1.7 | 0.8 | 2.560 | 2.560 |
| 1.9 | 0.2 | 3.237 | 3.237 |
| 1.9 | 0.4 | 3.024 | 3.024 |
| 1.9 | 0.6 | 2.841 | 2.841 |
| 1.9 | 0.8 | 2.675 | 2.675 |

Note - the values above have not been error corrected.

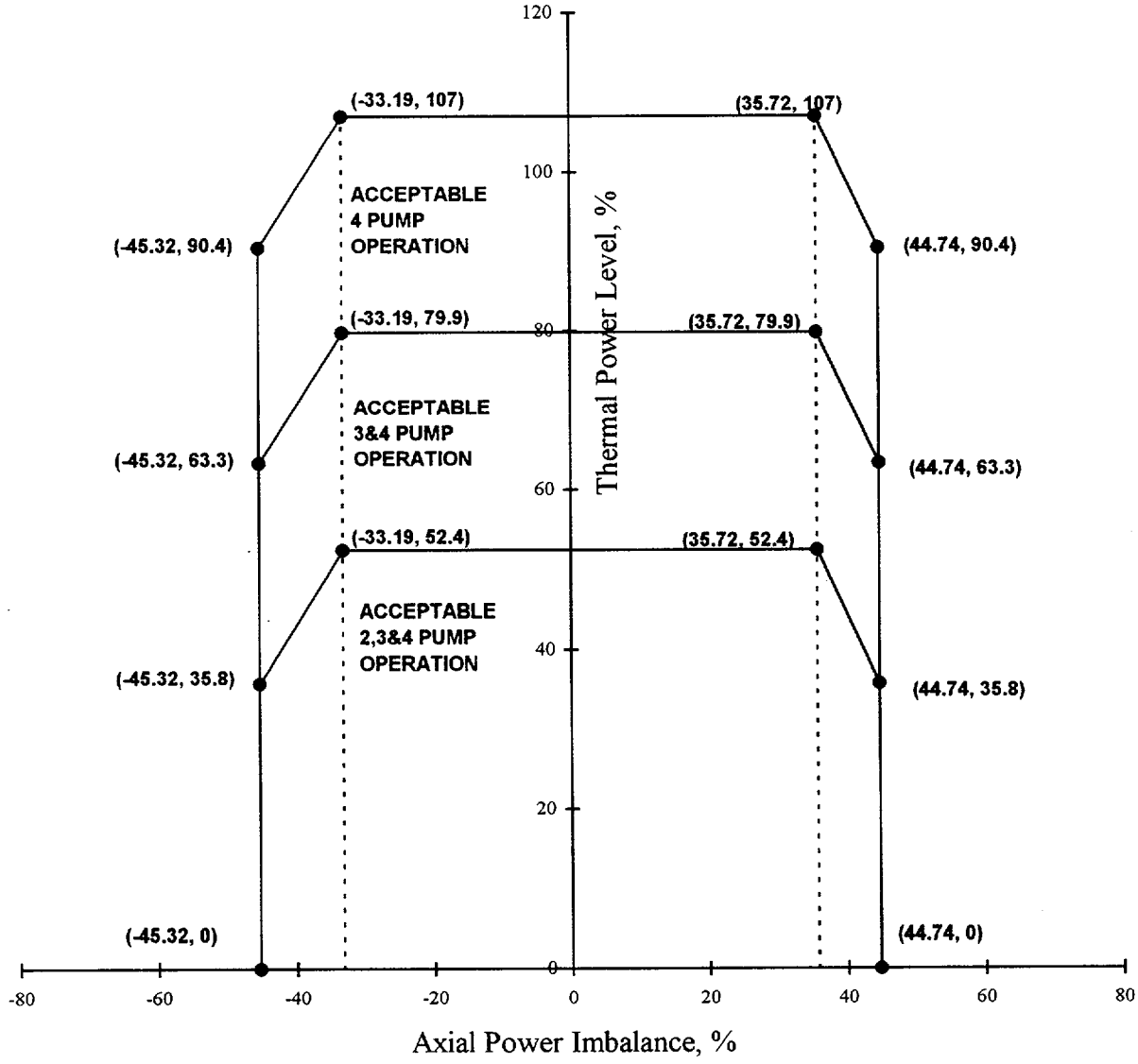
The present T-H methodology allows for an increase in the design radial-local peak for power levels under 100% full power. The equations defining the multipliers are as follows:

| | $P/P_m = 1.00$ | $P/P_m < 1.00$ |
|---|---|---|
| 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 is referred to by**
**Technical Specification 2.1.1.1, 2.1.1.2, and 3.3.1**

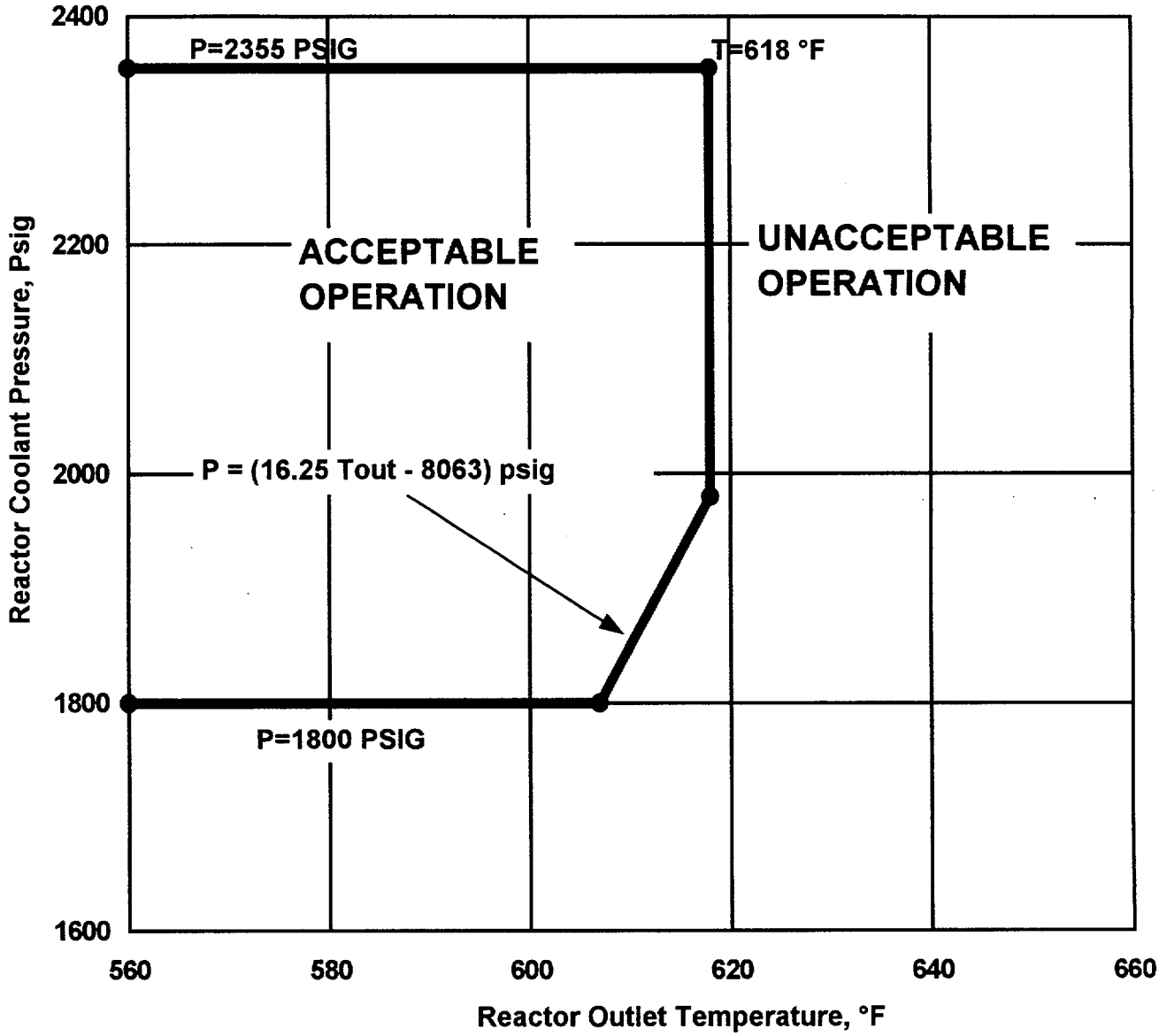
**Figure 10. Reactor Protection System Maximum Allowable Setpoints for Axial Power Imbalance**




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

**Figure is referred to by
Technical Specification 3.3.1**

**Figure 11. Reactor Protection System Variable Low Pressure Temperature Envelope Setpoints**



# LIMIT IS REFERRED TO BY TECHNICAL SPECIFICATION 3.4.1

## RCS Pressure, Temperature, and Flow DNB Surveillance Limits

| | Four-Pump Operation | Three-Pump Operation | Two-Pump Operation |
|---|---|---|---|
| Minimum RCS Hot Leg Pressure (psig) Note 1 | 2065.7 | 2063.9 Note 4<br>2100.9 Note 5 | 2099.1 |
| Maximum RCS Hot Leg Temperature (°F) Note 2 | 603.45 | 603.55 | 604.00 |
| Minimum RCS Total Flow ($Mlb_m/hr$) Note 3 | 138.10 Note 6<br>132.96 Note 9 | 103.36 Note 7<br>99.50 Note 9 | 68.06 Note 8<br>65.48 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 $T_{cold}$ = 555.79°F.

Note 7 -- For $T_{cold}$ = 555.69°F.

Note 8 -- For $T_{cold}$ = 555.31°F.

Note 9 -- For $T_{cold}$ = 580°F.

# LIMIT IS REFERRED TO BY TECHNICAL SPECIFICATION 3.4.4

## RCS Loops – Mode 1 and Mode 2

| | 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.

# LIMIT IS REFERRED TO BY TECHNICAL SPECIFICATION 3.9.1

## Refueling Boron Concentration

The minimum required boron concentration (which includes uncertainties) for use during refueling is:

**2517 ppm**