

TOLEDO EDISON COMPANY

DAVIS-BESSE UNIT 1

CYCLE 11

CORE OPERATING LIMITS REPORT

LIST OF EFFECTIVE PAGES

Page C-1 through C-24

Rev. 0

Technical Specification/COLR
Cross-Reference

Technical Specification

COLR Figure/Table

3.1.3.6 and 3.1.3.8	Figure 1a	Regulating Group Position Alarm Setpoints, 0 to 300 ±10 EFPD, Four RC Pumps
3.1.3.6 and 3.1.3.8	Figure 1b	Regulating Group Position Alarm Setpoints, 300 ±10 to 610 ±10 EFPD, Four RC Pumps
3.1.3.6 and 3.1.3.8	Figure 1c	Regulating Group Position Alarm Setpoints, after 610 ±10 EFPD, Four RC Pumps
3.1.3.6 and 3.1.3.8	Figure 1d	Regulating Group Position Alarm Setpoints, 0 to 300 ±10 EFPD, Three RC Pumps
3.1.3.6 and 3.1.3.8	Figure 1e	Regulating Group Position Alarm Setpoints, 300 ±10 to 610 ±10 EFPD, Three RC Pumps
3.1.3.6 and 3.1.3.8	Figure 1f	Regulating Group Position Alarm Setpoints, after 610 ±10 EFPD, Three RC Pumps
3.1.3.7	Figure 2	Control Rod Core Locations and Group Assignments
3.1.3.9	Figure 3	APSR Position Alarm Setpoints
3.2.1	Figure 4a	AXIAL POWER IMBALANCE Alarm Setpoints, 0 EFPD to 300 ±10 EFPD, Four RC Pumps
3.2.1	Figure 4b	AXIAL POWER IMBALANCE Alarm Setpoints, 300 ±10 EFPD to 610 ±10 EFPD, Four RC Pumps

3.2.1	Figure 4c	AXIAL POWER IMBALANCE Alarm Setpoints, after 610 ± 10 EFPD, Four RC Pumps
3.2.1	Figure 4d	AXIAL POWER IMBALANCE Alarm Setpoints, 0 EFPD to 300 ± 10 EFPD, Three RC Pumps
3.2.1	Figure 4e	AXIAL POWER IMBALANCE Alarm Setpoints, 300 ± 10 to 610 ± 10 EFPD, Three RC Pumps
3.2.1	Figure 4f	AXIAL POWER IMBALANCE Alarm Setpoints, after 610 ± 10 EFPD, Three RC Pumps
2.1.2	Figure 5	AXIAL POWER IMBALANCE Protective Limits
2.2.1	Figure 6	Flux - Δ Flux/Flow (or Power/ Imbalance/Flow) Trip Setpoints
3.2.4	Table 1	QUADRANT POWER TILT Limits
3.1.1.3c	Table 2	Negative Moderator Temperature Coefficient Limit
B2.1	Table 3	Power to Melt Limits
3.2.2	Table 4	Nuclear Heat Flux Hot Channel Factor - F_Q
3.2.3	Table 5	Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}^N$
3.2.3	Figure 7	Allowable Radial Peak for $F_{\Delta H}^N$

TOLEDO EDISON

DAVIS-BESSE UNIT 1

CYCLE 11

CORE OPERATING LIMITS REPORT

1.0 Core Operating Limits

This CORE OPERATING LIMITS REPORT for DB-1 Cycle 11 has been prepared in accordance with the requirements of Technical Specification 6.9.1.7. The core operating limits have been developed using the methodology provided in reference 2.0 (1).

The following cycle-specific core operating limits, Protective Limit and Flux \pm Flux/Flow Reactor Protection System Setpoints are included in this report:

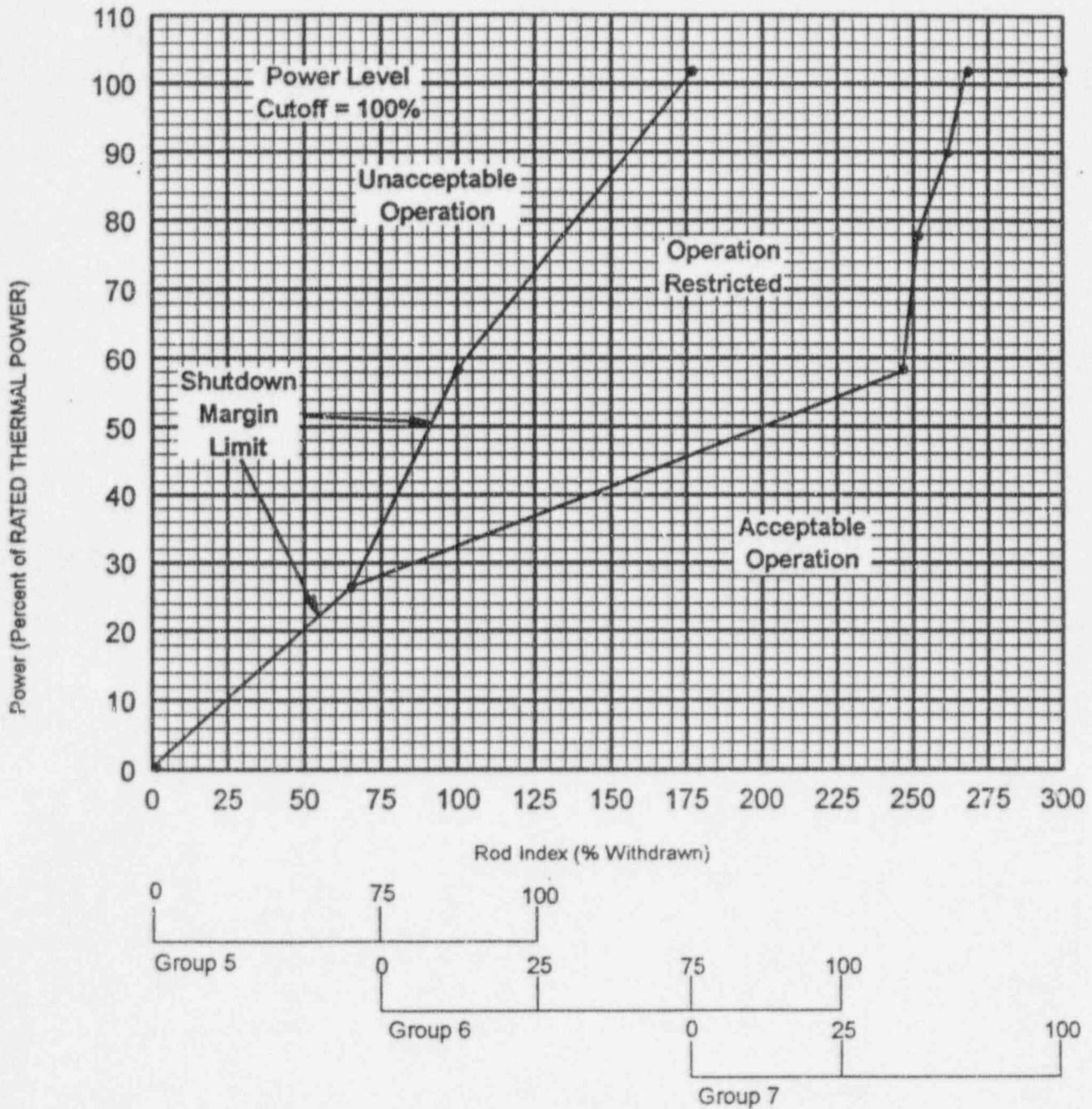
- 1) Regulating Group Position Alarm Setpoints (insertion limits) and Xenon reactivity - "power level cutoff"
- 2) Rod program group positions (Control Rod Core locations and group assignments)
- 3) Axial Power Shaping Rod Alarm Setpoints (insertion limits)
- 4) AXIAL POWER IMBALANCE Alarm Setpoints
- 5) AXIAL POWER IMBALANCE Protective Limits
- 6) Flux \pm Flux/Flow (or Power/Imbalance/Flow) Trip Setpoints
- 7) QUADRANT POWER TILT limits
- 8) Negative Moderator Temperature Coefficient limit
- 9) Nuclear Heat Flux Hot Channel Factor, F_Q and
- 10) Nuclear Enthalpy Rise Hot Channel Factor, $F_{\Delta H}^N$

2.0 References

- (1) BAW-10179P-A, Revision 1, "Safety Criteria and Methodology of Acceptable Cycle Reload Analysis."

Figure 1a Regulating Group Position Alarm Setpoints
0 to 300±10 EFPD, Four RC Pumps –
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specifications 3.1.3.6 and 3.1.3.8

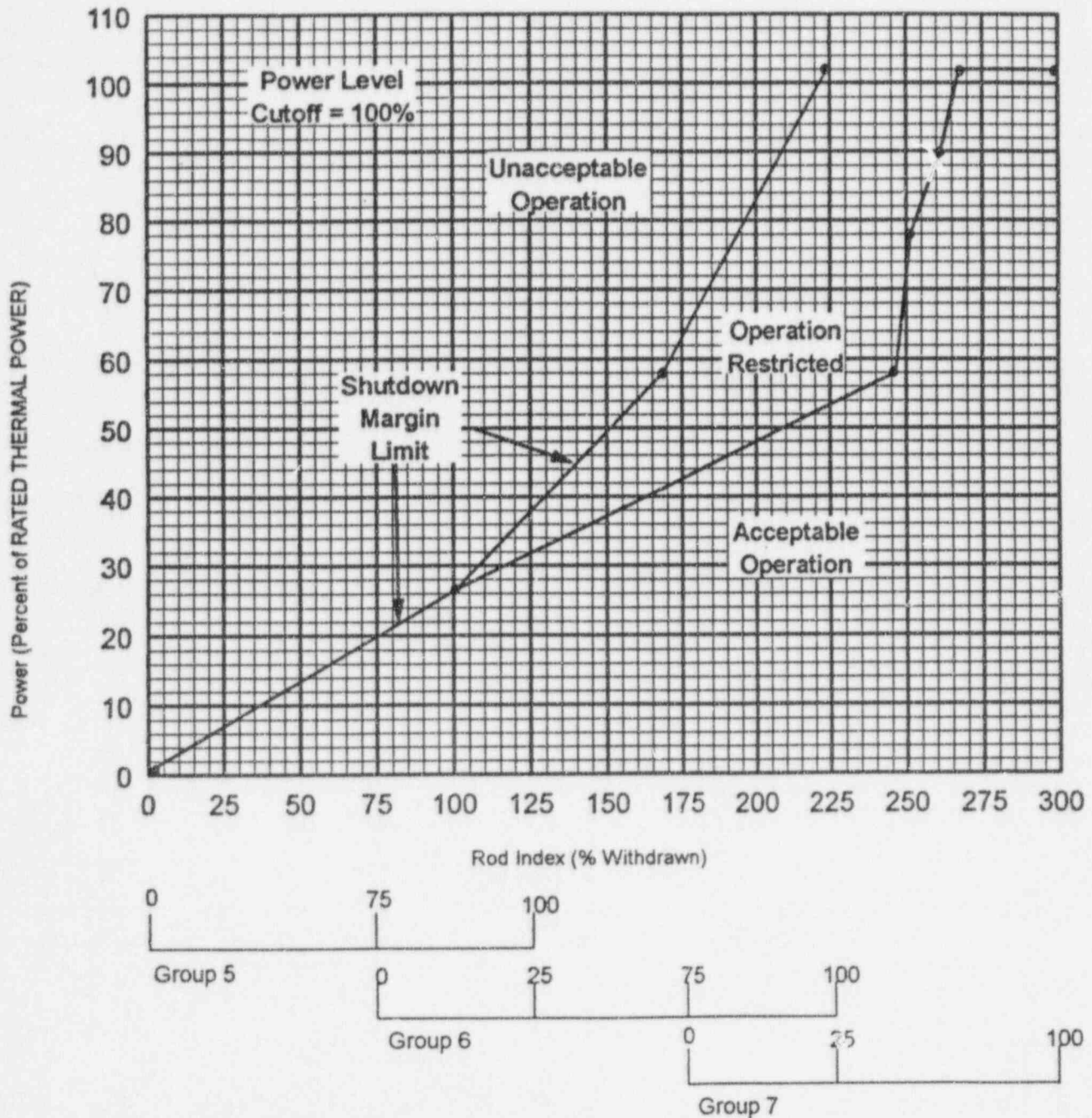


Note 1: A Rod Group overlap of 25±5% between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained

Note 2: Instrument error is accounted for in these setpoints.

Figure 1b Regulating Group Position Alarm Setpoints
300 \pm 10 to 610 \pm 10 EFPD, Four RC Pumps --
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specifications 3.1.3.6 and 3.1.3.8

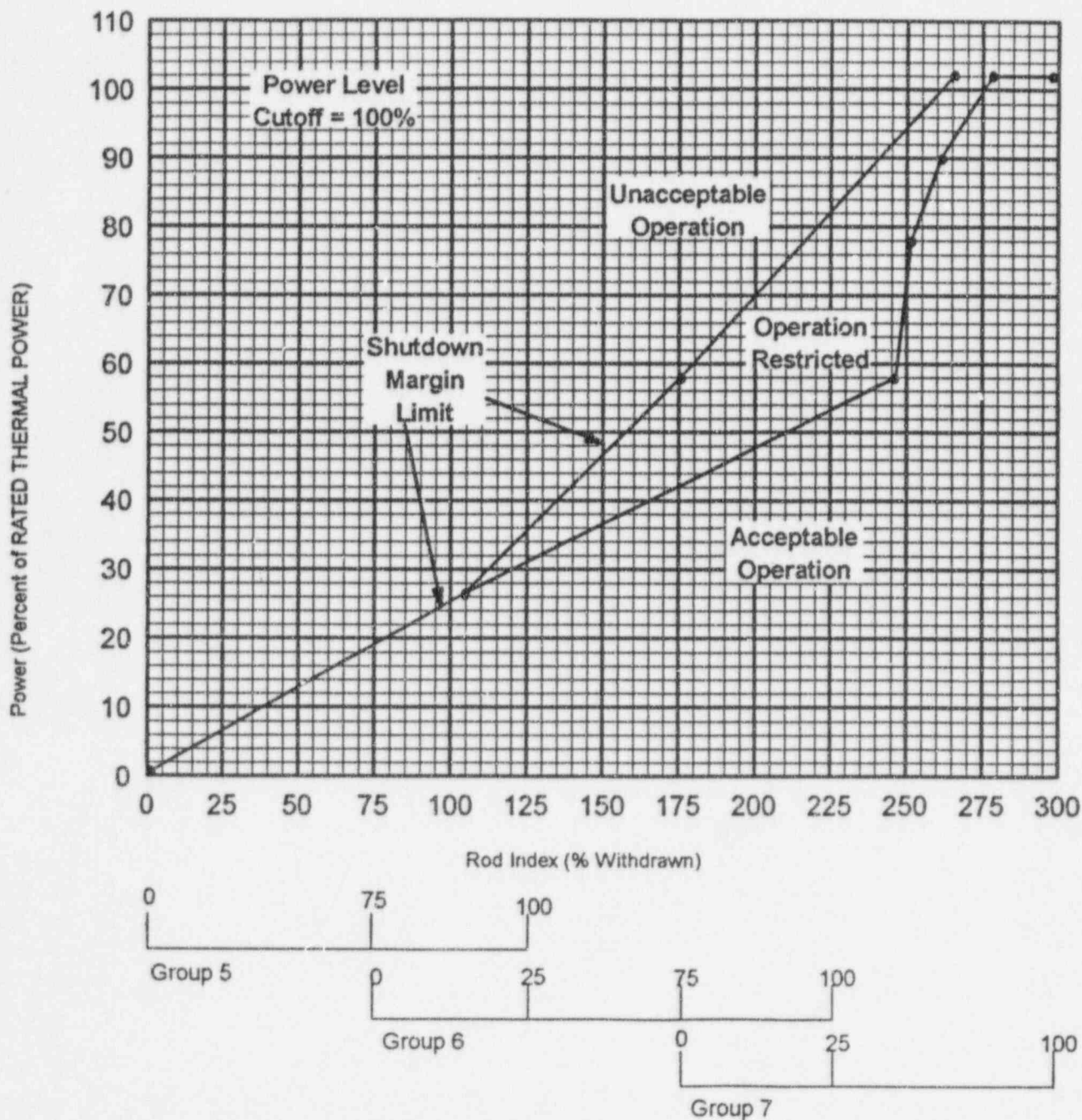


Note 1: A Rod Group overlap of 25 \pm 5% between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.

Note 2: Instrument error is accounted for in these setpoints.

Figure 1c Regulating Group Position Alarm Setpoints
After 610±10 EFPD, Four RC Pumps --
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specifications 3.1.3.6 and 3.1.3.8

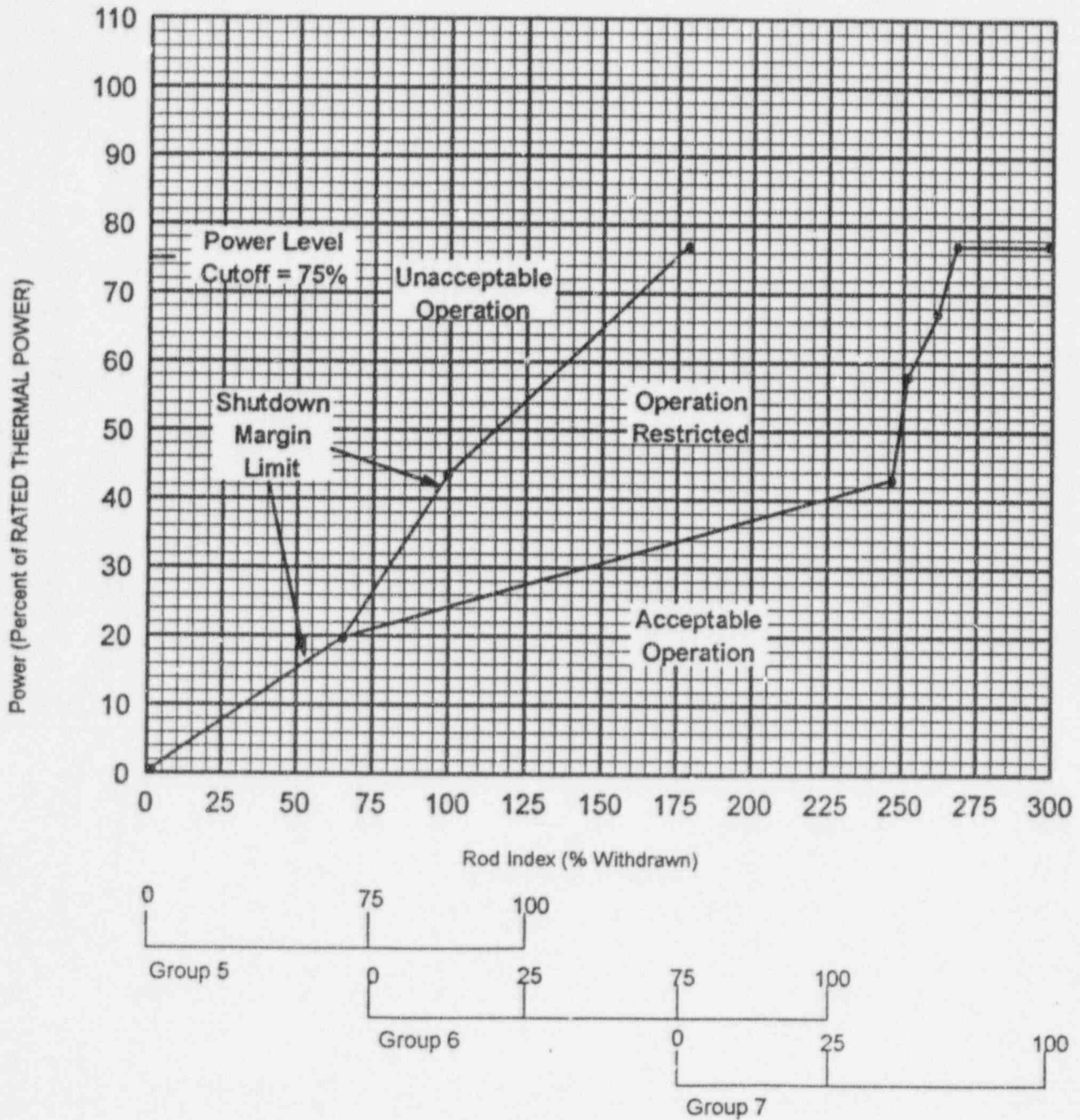


Note 1: A Rod Group overlap of 25±5% between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.

Note 2: Instrument error is accounted for in these setpoints.

Figure 1d Regulating Group Position Alarm Setpoints
0 to 300±10 EFPD, Three RC Pumps –
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specifications 3.1.3.6 and 3.1.3.8

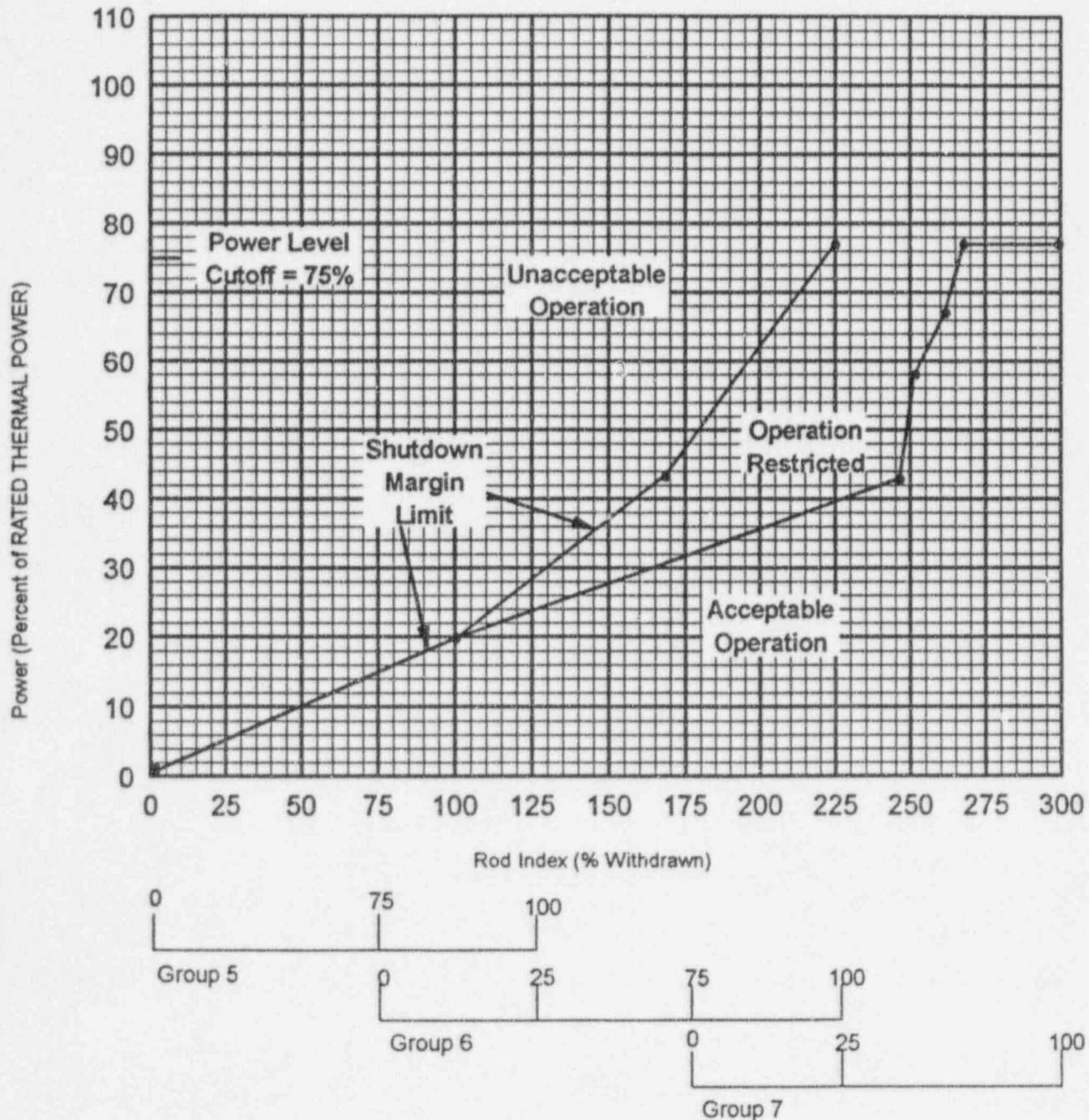


Note 1: A Rod Group overlap of 25±5% between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.

Note 2: Instrument error is accounted for in these setpoints.

Figure 1e Regulating Group Position Alarm Setpoints
300 \pm 10 to 610 \pm 10 EFPD, Three RC Pumps --
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specifications 3.1.3.6 and 3.1.3.8

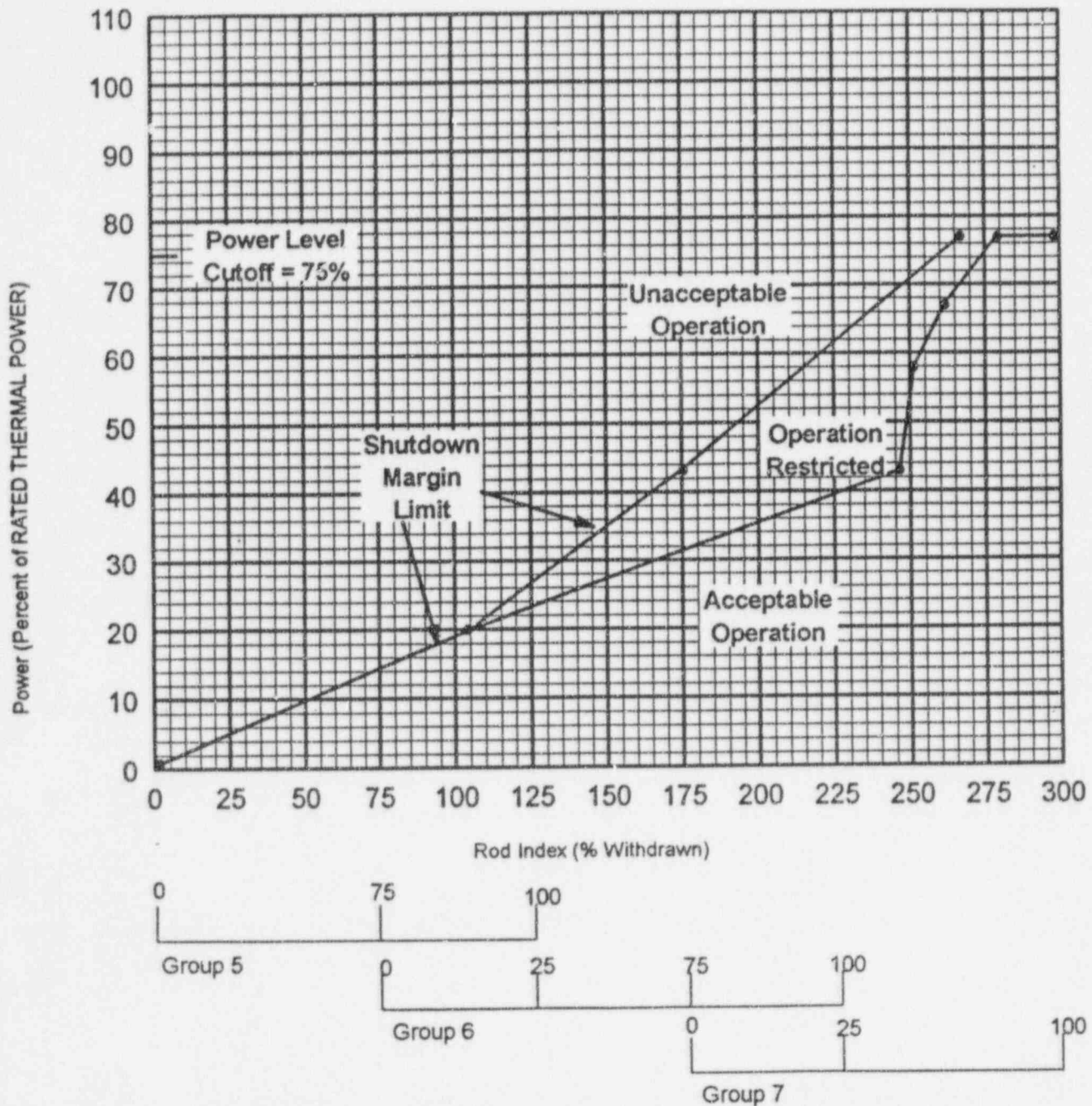


Note 1: A Rod Group overlap of 25 \pm 5% between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.

Note 2: Instrument error is accounted for in these setpoints.

Figure 1f Regulating Group Position Alarm Setpoints
After 610 ± 10 EFPD, Three RC Pumps --
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specifications 3.1.3.6 and 3.1.3.8

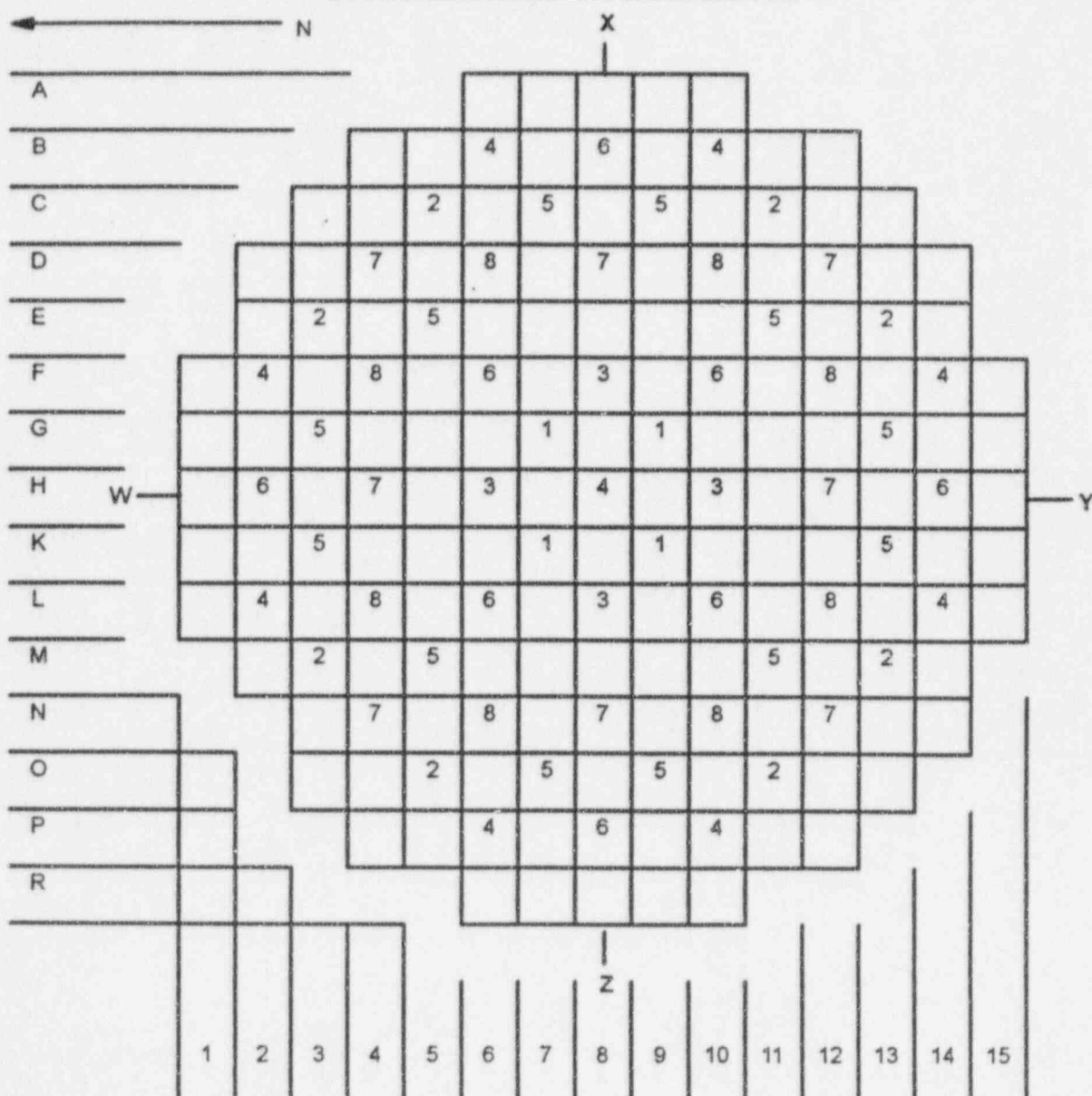


Note 1: A Rod Group overlap of $25 \pm 5\%$ between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.

Note 2: Instrument error is accounted for in these setpoints.

Figure 2 Control Rod Core Locations
and Group Assignments
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specifications 3.1.3.7



X Group Number

Group	No. of Rods	Function
1	4	Safety
2	8	Safety
3	4	Safety
4	9	Safety
5	12	Control
6	8	Control
7	8	Control
8	8	APSRs
Total	61	

Figure 3 APSR Position Alarm Setpoints

This Figure is referred to by Technical
Specification 3.1.3.9

Before APSR Pull - 0 EFPD to 610 +/- 10 EFPD,
Three or Four RC pumps operation*

Lower Setpoint: 0 %WD

Upper Setpoint: 100 %WD

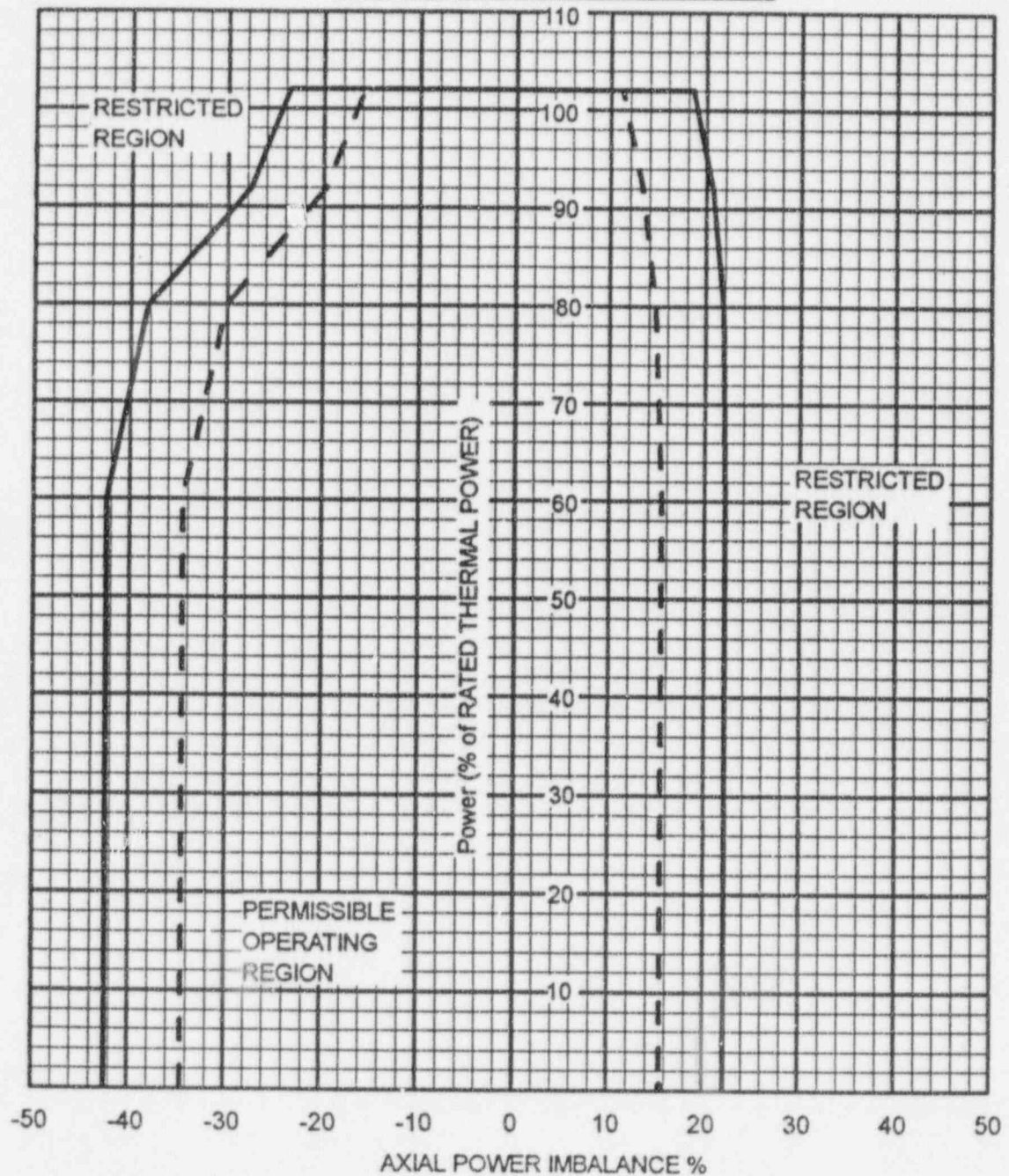
After APSR Pull - 610 +/- 10 EFPD to End-of-Cycle
Three or Four RC pumps operation*

Insertion Prohibited per Tech Spec 3.1.3.9

* Power restricted to 77% for 3 pump operation

Figure 4 a AXIAL POWER IMBALANCE Alarm Setpoints
0 to 300+10 EFPD, Four RC Pumps –
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specification 3.2.1



LEGEND

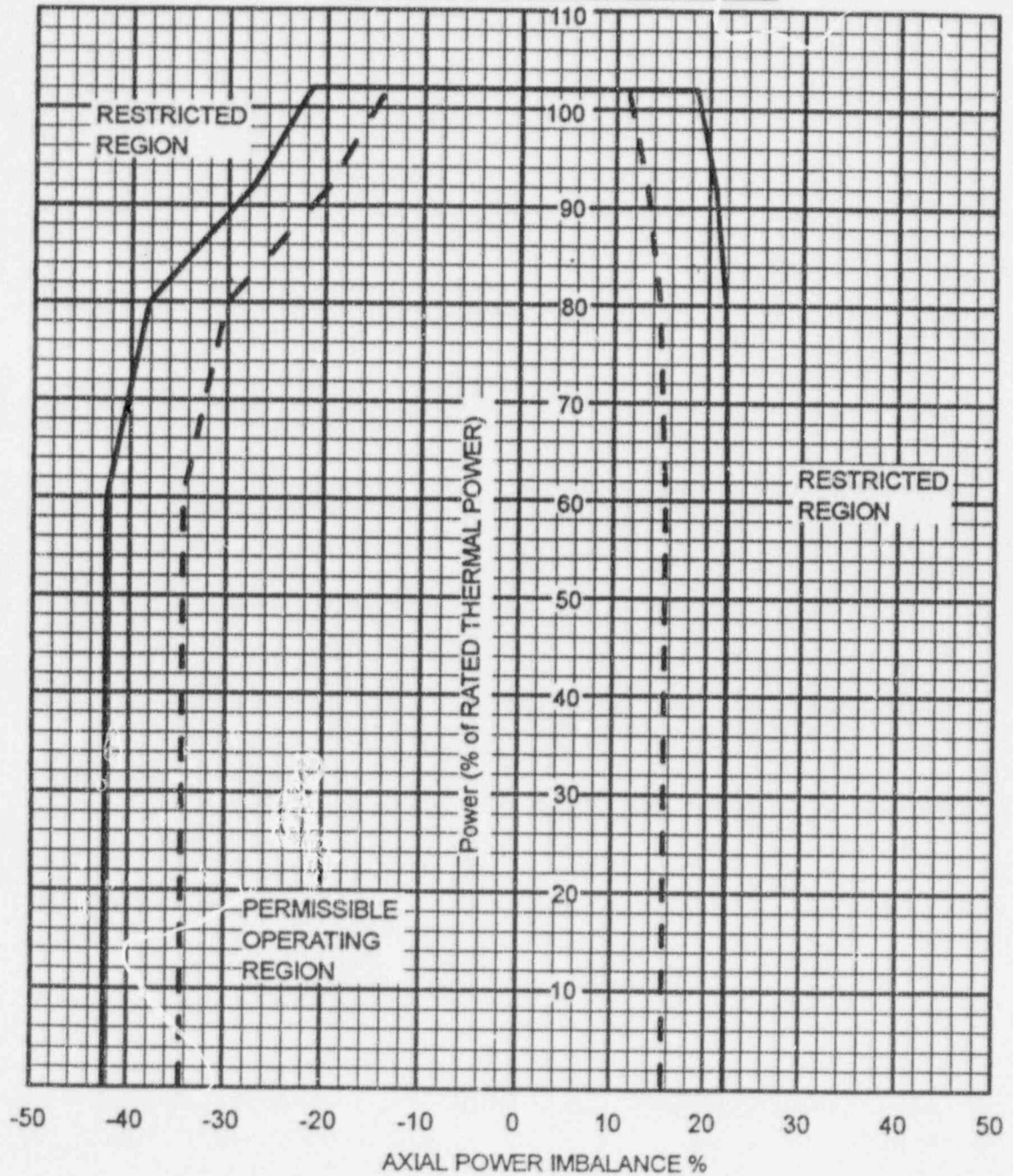
FULL INCORE

EXCORE

Note 1: Instrument error is accounted for in these setpoints

Figure 4b AXIAL POWER IMBALANCE Alarm Setpoints
300±10 to 610±10 EFPD, Four RC Pumps --
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specification 3.2.1



LEGEND

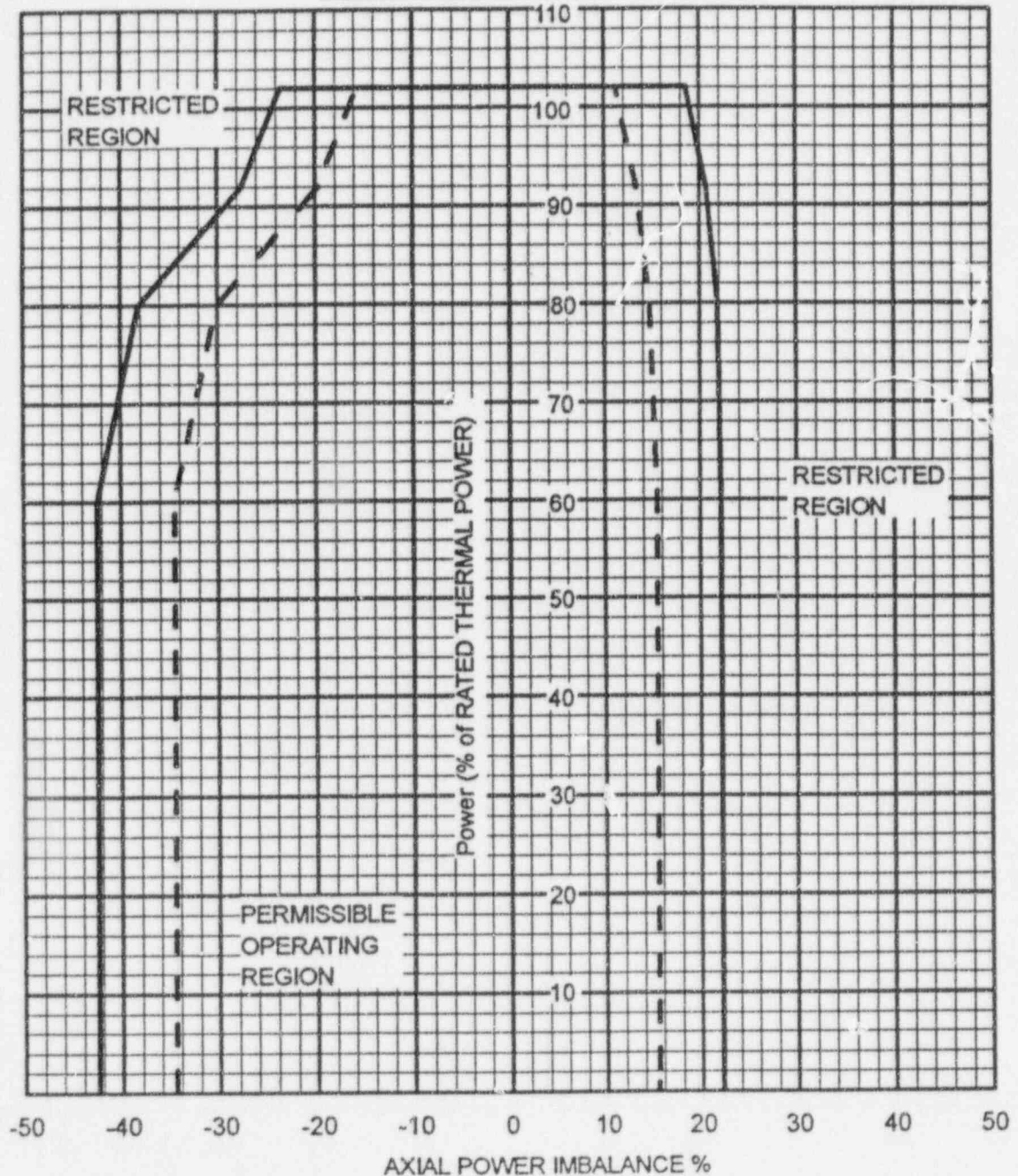
FULL INCORE

EXCORE

Note 1: Instrument error is accounted for in these setpoints

Figure 4c AXIAL POWER IMBALANCE Alarm Setpoints
After 610±10 EFPD, Four RC Pumps –
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specification 3.2.1



LEGEND

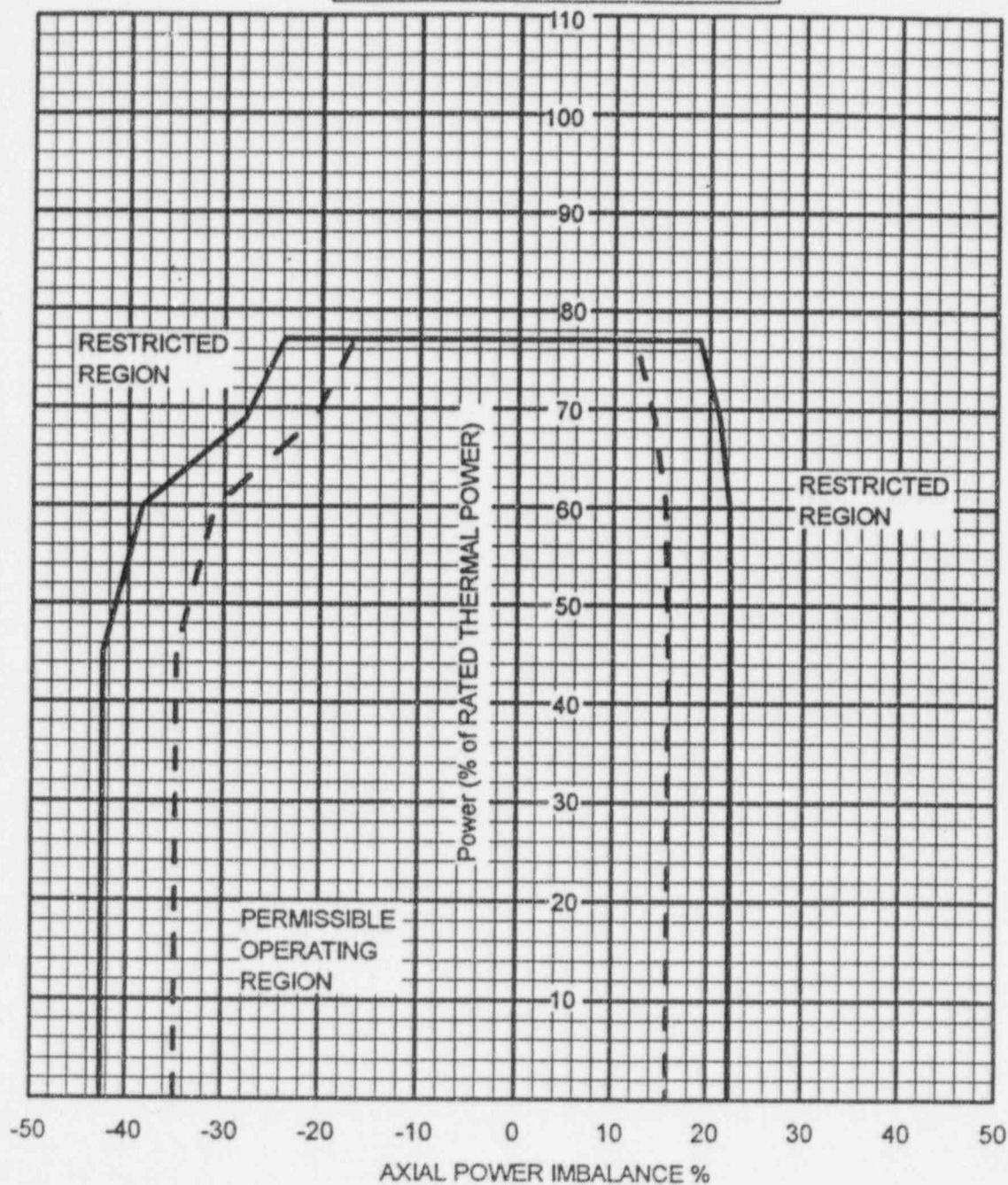
FULL INCORE

EXCORE

Note 1: Instrument error is accounted for in these setpoints

Figure 4d AXIAL POWER IMBALANCE Alarm Setpoints
0 to 300±10 EFPD, Three RC Pumps –
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specification 3.2.1



LEGEND

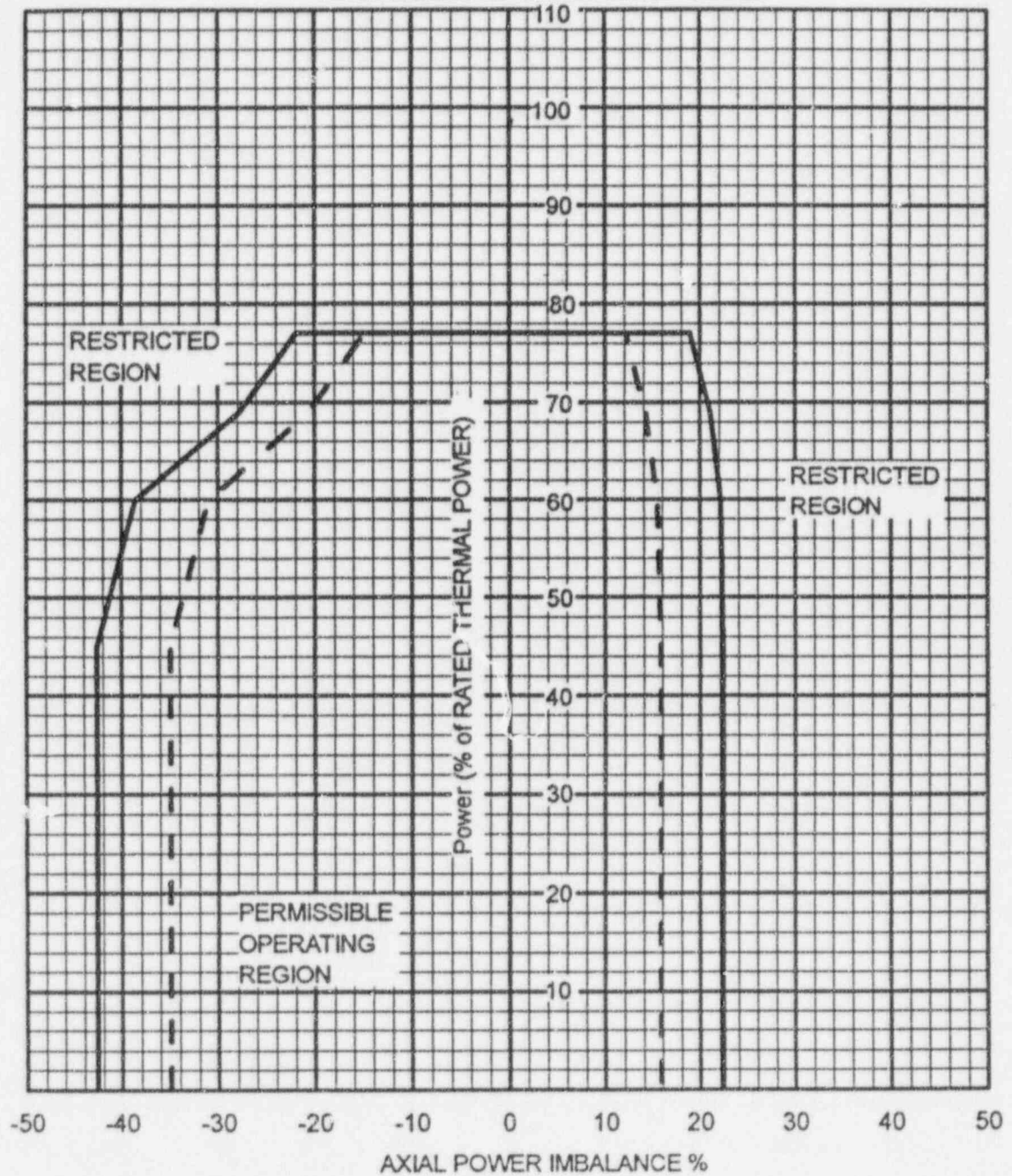
FULL INCORE

EXCORE

Note 1: Instrument error is accounted for in these setpoints

Figure 4e AXIAL POWER IMBALANCE Alarm Setpoints
300 \pm 10 to 610 \pm 10 EFPD, Three RC Pumps --
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specification 3.2.1



LEGEND

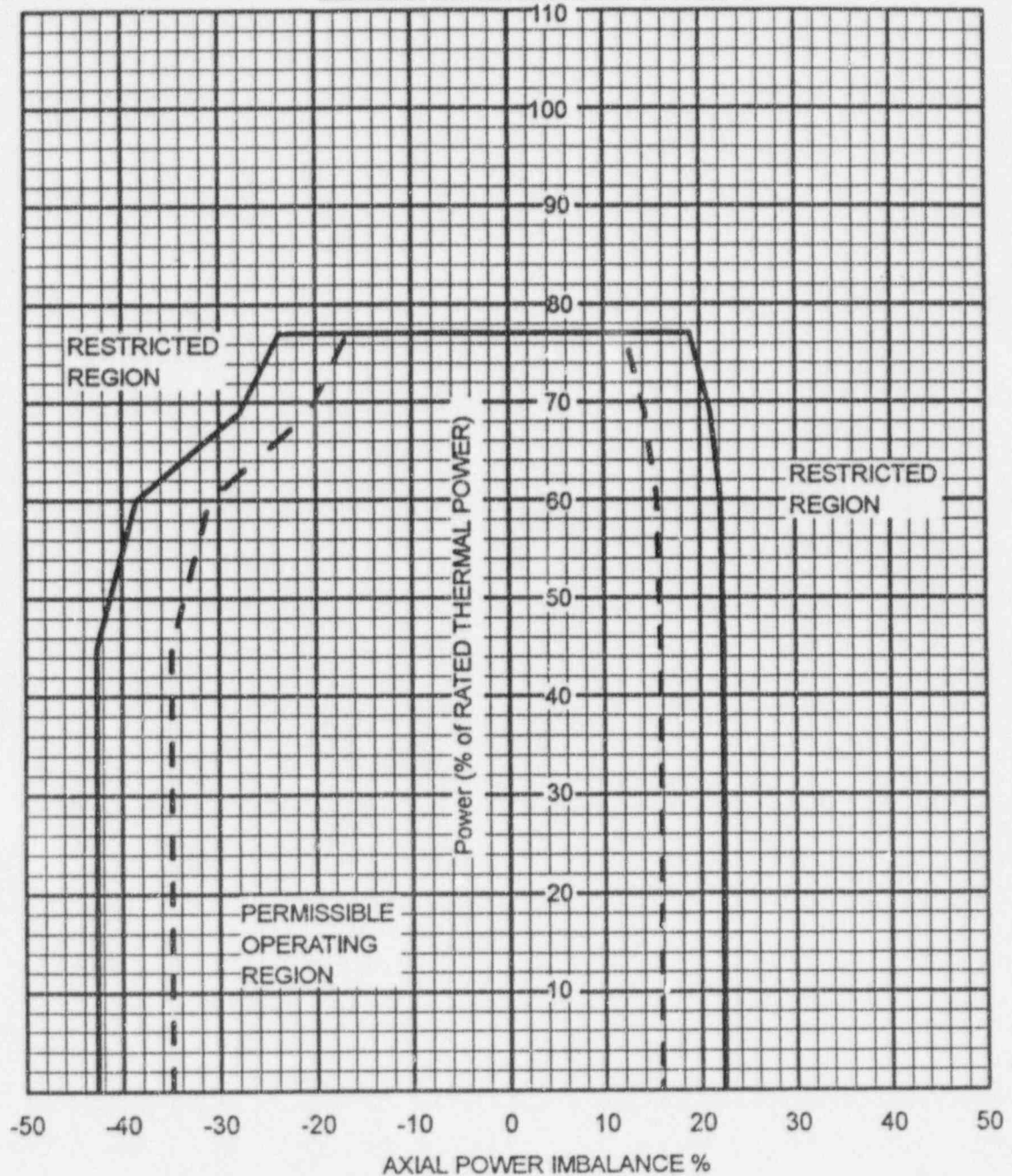
FULL INCORE

EXCORE

Note 1: Instrument error is accounted for in these setpoints

Figure 4f AXIAL POWER IMBALANCE Alarm Setpoints
After 610±10 EFPD, Three RC Pumps --
Davis-Besse 1, Cycle 11

This Figure is referred to by Technical
Specification 3.2.1



LEGEND

FULL INCORE

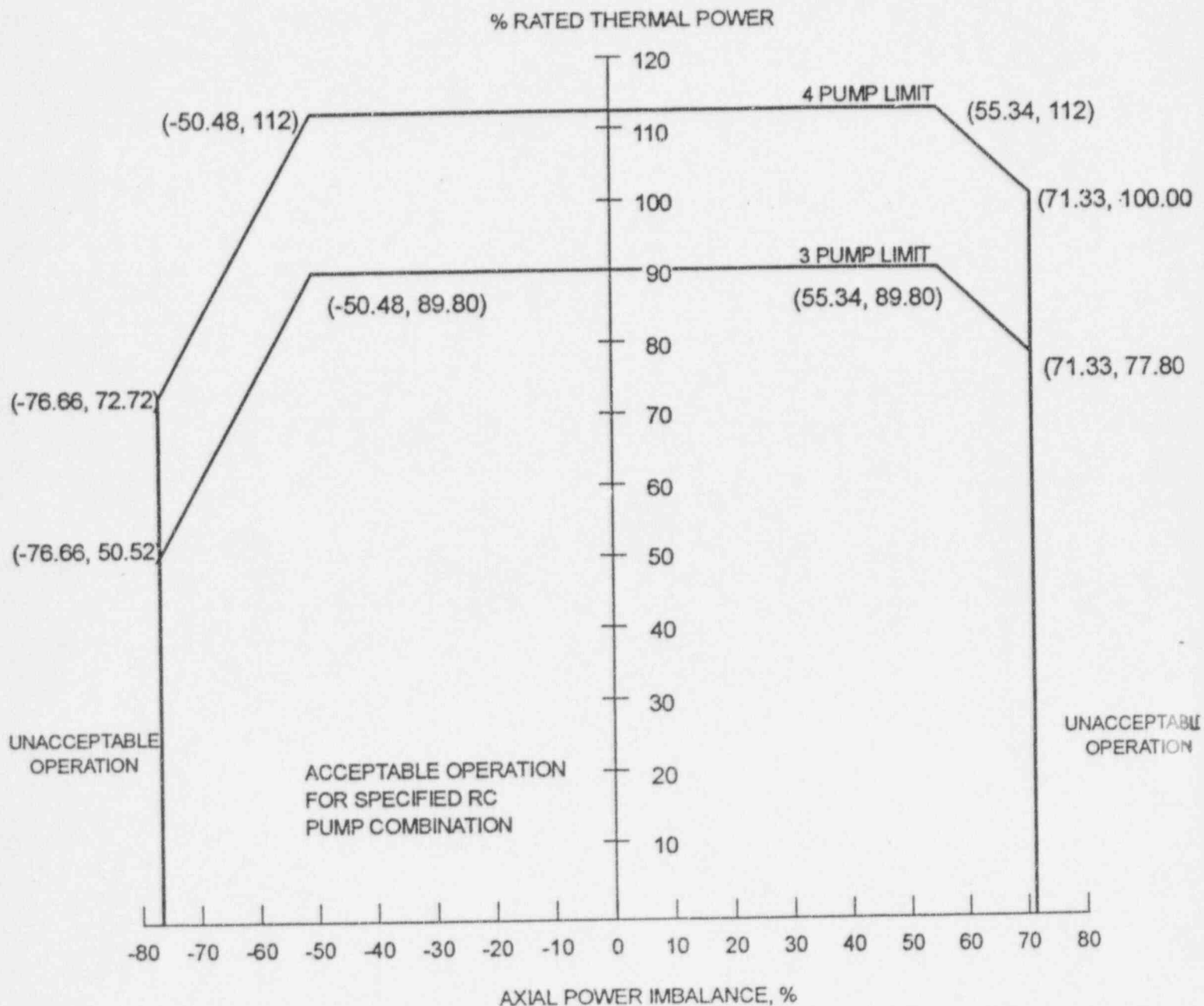
EXCORE

Note 1: Instrument error is accounted for in these setpoints

Figure 5

AXIAL POWER IMBALANCE Protective Limits

This Figure is referred to by Technical Specification 2.1.2



Pumps Operating	Reactor Coolant Flow, gpm	Required Measured Flow to Ensure Compliance, gpm
4	380,000	389,500
3	283,860	290,957

Figure 6 Flux-- Δ Flux/Flow (or Power/Imbalance/Flow)
Trip Setpoints

This Figure is referred
to by Technical Specification
2.2.1

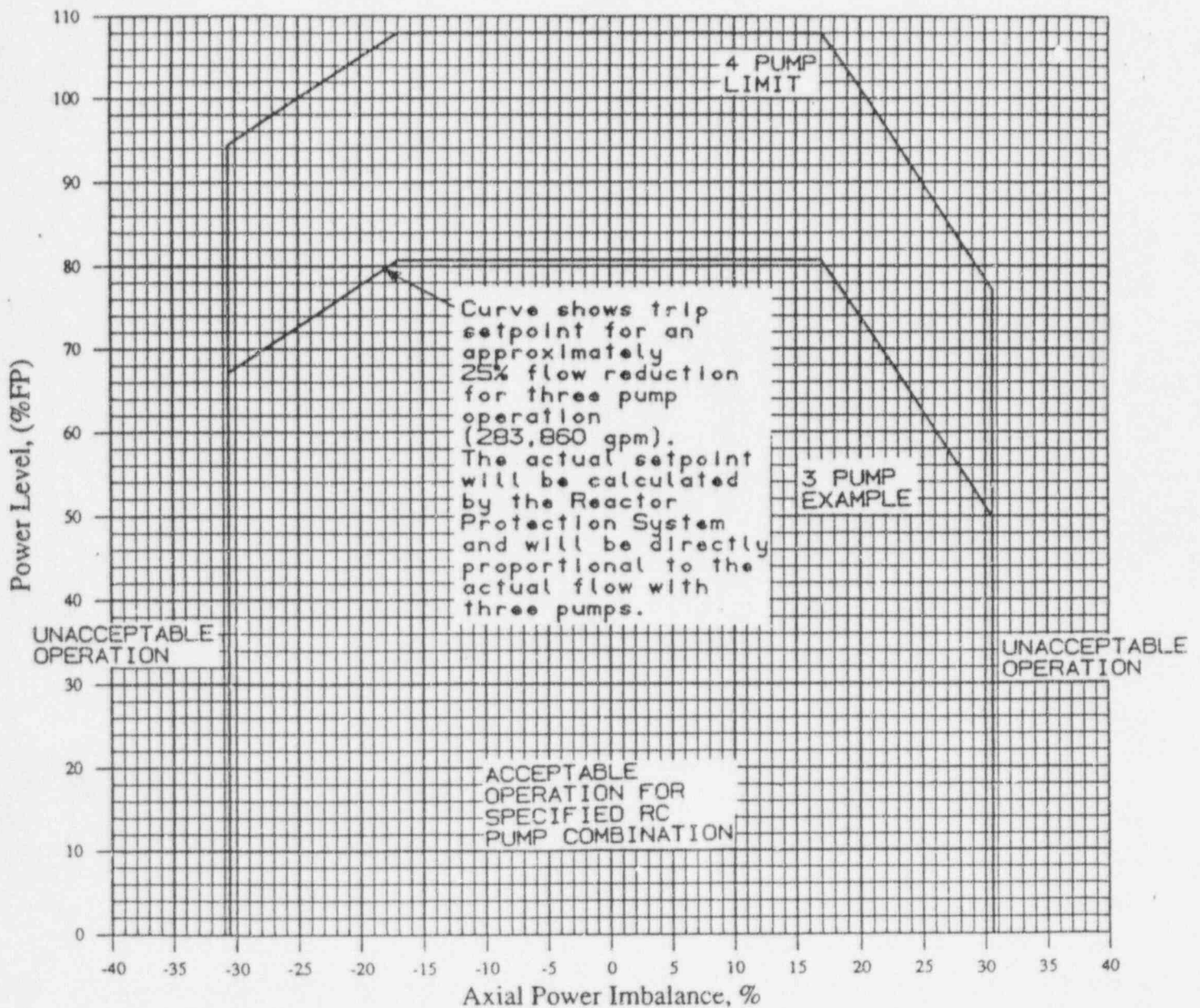


Table 1 QUADRANT POWER TILT Limits

This Table is referred
to by Technical Specification
3.2.4

QUADRANT POWER TILT as measured by:	Steady-state Limit for THERMAL POWER \leq 60% (%)	Steady-state Limit for THERMAL POWER $>$ 60% (%)	Transient Limit (%)	Maximum Limit (%)
Symmetrical Incore detector system	6.8	4.1	10.03	20.0

Table 2 Negative Moderator Temperature Coefficient Limit

This Table is referred
to by Technical Specification
3.1.1.3c

Negative Moderator Temperature
Coefficient Limit
(at RATED THERMAL POWER)

$-4 \times 10^{-4} \Delta k/k/F$

Table 3 Power to Melt Limits

This Table is referred
to by Technical Specification
Bases B2.1

	<u>Batch 9E</u>	<u>Batch 11C/11A</u>	<u>Batch 12B</u>	<u>Batch 13A/13B</u>
Fuel Assembly Type	Mark-B8A	Mark-B8B	Mark-B10AZL	Mark-B10A
Minimum linear heat rate to melt, kW/ft	20.5	22.3	22.3	22.3

Table 4 Nuclear Heat Flux Hot Channel Factor - F_0

This Table is referred
to by Technical Specification
3.2.2

Heat Flux Hot Channel Factor F_0

F_0 shall be limited by the following relationships:

$$F_0 \leq \text{LHR}^{\text{ALLOW}}(\text{Bu}) / [\text{LHR}^{\text{AVG}} * P] \quad (\text{for } P \leq 1.0)$$

$\text{LHR}^{\text{ALLOW}}(\text{Bu})$: See the Tables below

$\text{LHR}^{\text{AVG}} = 6.139 \text{ kW/ft}$ for Mark-B8A fuel

$\text{LHR}^{\text{AVG}} = 6.253 \text{ kW/ft}$ for Mark-B8B fuel

$\text{LHR}^{\text{AVG}} = 6.253 \text{ kW/ft}$ for Mark-B10AZL fuel

$\text{LHR}^{\text{AVG}} = 6.253 \text{ kW/ft}$ for Mark-B10A fuel

P = ratio of THERMAL POWER/RATED THERMAL POWER

Bu = Fuel Burnup (MWd/mtU)

Batch 9E (Mark-B8A) $\text{LHR}^{\text{ALLOW}}$ kW/ft^(a)

Axial Segment	24,500	60,000
	MWd/mtU	MWd/mtU
1	12.8	8.4
2	15.2	9.9
3	15.7	10.5
4	15.8	10.5
5	16.4	10.5
6	17.0	10.5
7	16.2	10.0
8	13.6	8.4

Batch 11A (Mark-B8B) $\text{LHR}^{\text{ALLOW}}$ kW/ft^(a)

Axial Segment	Less than	47,016	47,557	49,180	55,000	60,000
	40,000	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU
1	12.9	12.4	12.4	12.4	10.2	10.0
2	15.3	14.7	14.7	14.6	12.1	11.8
3	16.2	15.6	15.6	15.5	12.8	12.5
4	16.2	15.6	15.6	15.5	12.8	12.5
5	16.2	15.6	15.6	15.5	12.8	12.5
6	16.6	16.0	16.0	15.5	12.8	12.5
7	16.2	15.6	15.4	14.7	12.2	11.9
8	13.6	13.1	12.9	12.4	10.2	10.0

Table 4 Nuclear Heat Flux Hot Channel Factor - F_0

Batch 11C (Mark-B8B) LHR^{ALLOW} kW/ft ^(a)						
Axial Segment	Less than 40,000	47,016	47,557	49,180	55,000	60,000
	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU
1	12.9	12.4	12.4	12.4	10.2	10.0
2	15.3	14.7	14.7	14.6	12.1	11.8
3	16.2	15.6	15.6	15.5	12.8	12.5
4	16.2	15.6	15.6	15.5	12.8	12.5
5	16.2	15.6	15.6	15.5	12.8	12.5
6	16.6	16.0	16.0	15.5	12.8	12.5
7	16.2	15.6	15.4	14.7	12.2	11.9
8	13.6	13.1	12.9	12.4	10.2	10.0

Batch 12B (Mark-B10AZL) LHR^{ALLOW} kW/ft ^(a)						
Axial Segment	Less than 40,000	47,016	47,557	49,180	55,000	60,000
	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU	MWd/mtU
1	12.9	12.4	12.4	12.4	10.2	10.0
2	15.3	14.7	14.7	14.6	12.1	11.8
3	16.2	15.6	15.6	15.5	12.8	12.5
4	16.2	15.6	15.6	15.5	12.8	12.5
5	16.2	15.6	15.6	15.5	12.8	12.5
6	16.6	16.0	16.0	15.5	12.8	12.5
7	16.2	15.6	15.4	14.7	12.2	11.9
8	13.6	13.1	12.9	12.4	10.2	10.0

Batches 13 A & B (Mark-B10A) LHR^{ALLOW} kW/ft ^(a)		
Axial Segment	Less than 20,000	35,000
	MWd/mtU	MWd/mtU
1	13.6	12.9
2	16.0	15.3
3	17.2	16.2
4	17.5	16.2
5	17.5	16.2
6	17.8	16.6
7	17.4	16.2
8	14.6	13.6

(a) Linear interpolation for allowable linear heat rate between specified burnup points is valid for these tables.

Table 5 Nuclear Enthalpy Rise Hot Channel Factor - F_{EH}^H

This Table is referred
to by Technical Specification
3.2.3

Enthalpy Rise Hot Channel Factor F_{EH}^H

$$F_{EH}^H \leq ARP [1 + 0.3(1 - P/P_s)]$$

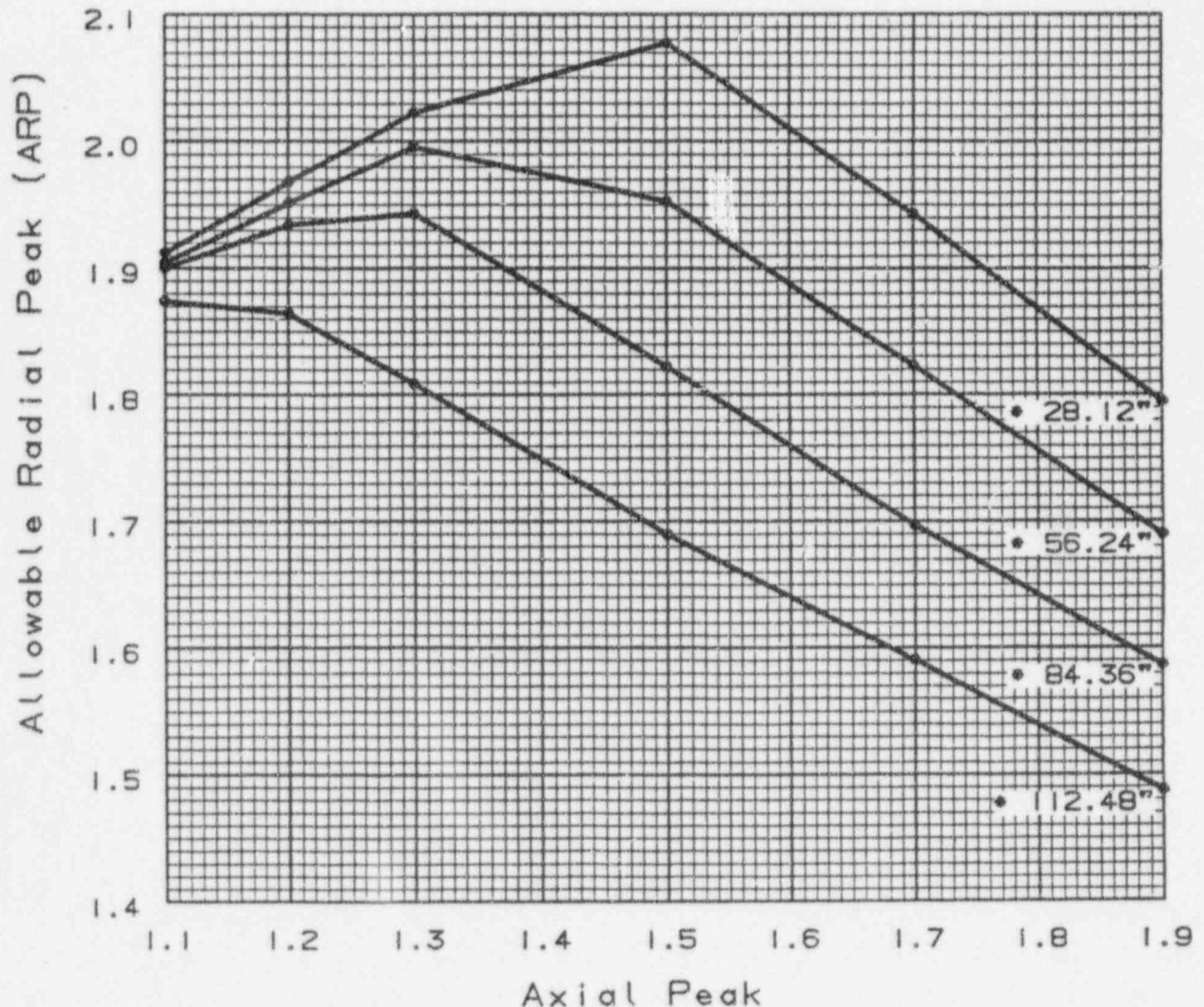
ARP = Allowable Radial Peak, see Figure

P = THERMAL POWER/RATED THERMAL POWER and $P \leq 1.0$

$P_s = 1.0$ for 4-RCP operation

$P_s = 0.75$ for 3-RCP operation

Figure 7 Allowable Radial Peak for F_{EH}^H



* Based on an active core height of 140.6 inches. Linear interpolation and extrapolation above 112.48 inches are acceptable. For axial heights <28.12 inches, the value at 28.12 inches will be used.