

TOLEDO EDISON COMPANY

DAVIS-BESSE UNIT 1

CYCLE 10

CORE OPERATING LIMITS REPORT

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TOLEDO EDISON

DAVIS-BESSE UNIT 1

CYCLE 10

CORE OPERATING LIMITS REPORT

1.0 Core Operating Limits

This CORE OPERATING LIMITS REPORT for DB-1 Cycle 10 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 - Δ Flux/Flow Reactor Protection System Setpoints are included in this report:

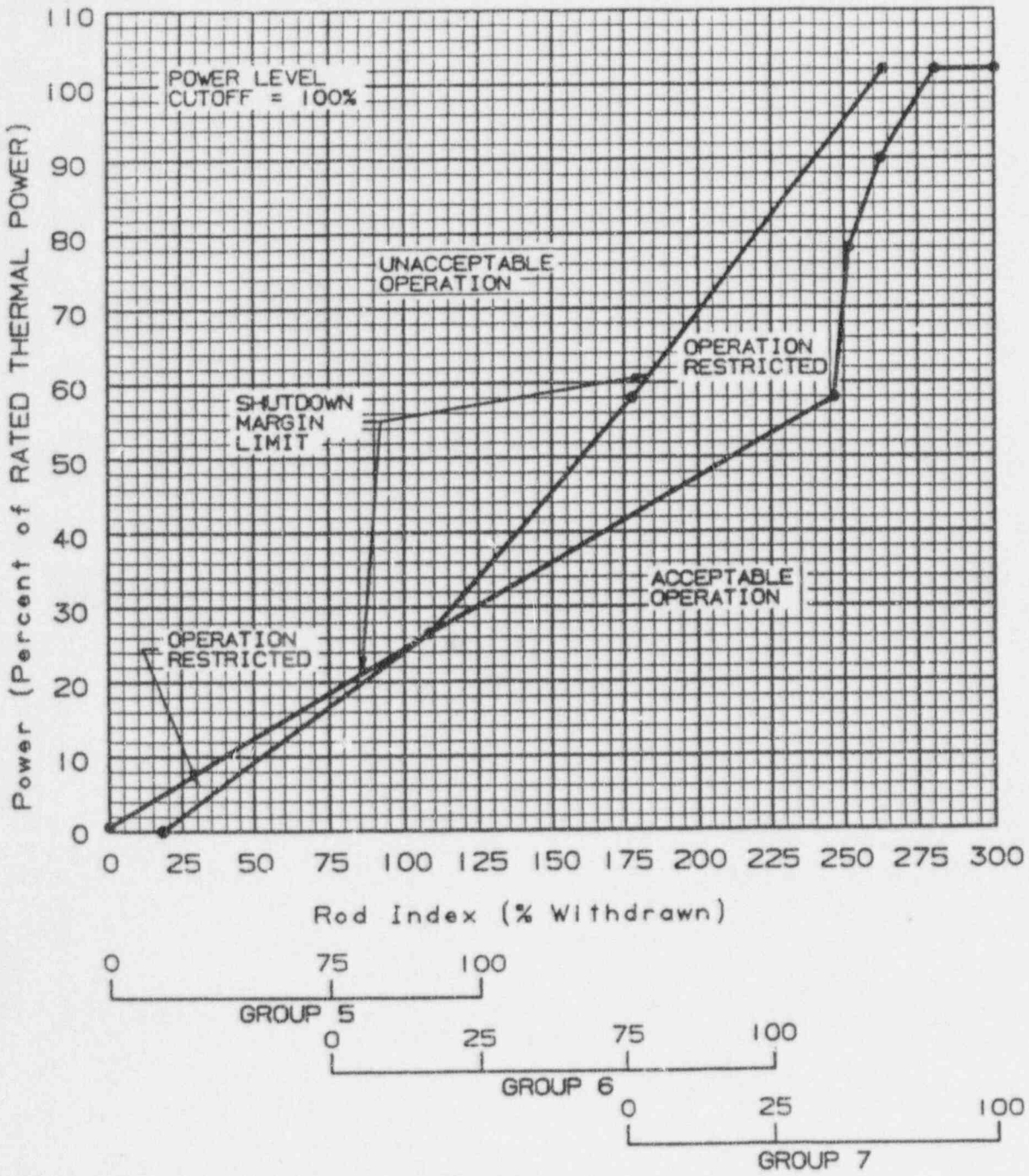
- 1) Regulating Group Position Alarm Setpoints (insertion limits) and Xenon reactivity - "power level cutoff"
- 2) Rod program group positions (Control Rod Core locations and group assignments)
- 3) Axial Power Shaping Rod Alarm Setpoints (insertion limits)
- 4) AXIAL POWER IMBALANCE Alarm Setpoints
- 5) AXIAL POWER IMBALANCE Protective Limits
- 6) Flux - Δ 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 0, "Safety Criteria and Methodology of Acceptable Cycle Reload Analysis."
- (2) BAW-2149P-A, Revision 0, "Evaluation of Replacement Rods in BWFC Fuel Assemblies."

Figure 1a Regulating Group Position Alarm Setpoints
 0 to 25+10/-0 EFPD, Four RC Pumps --
 Davis-Besse 1, Cycle 10

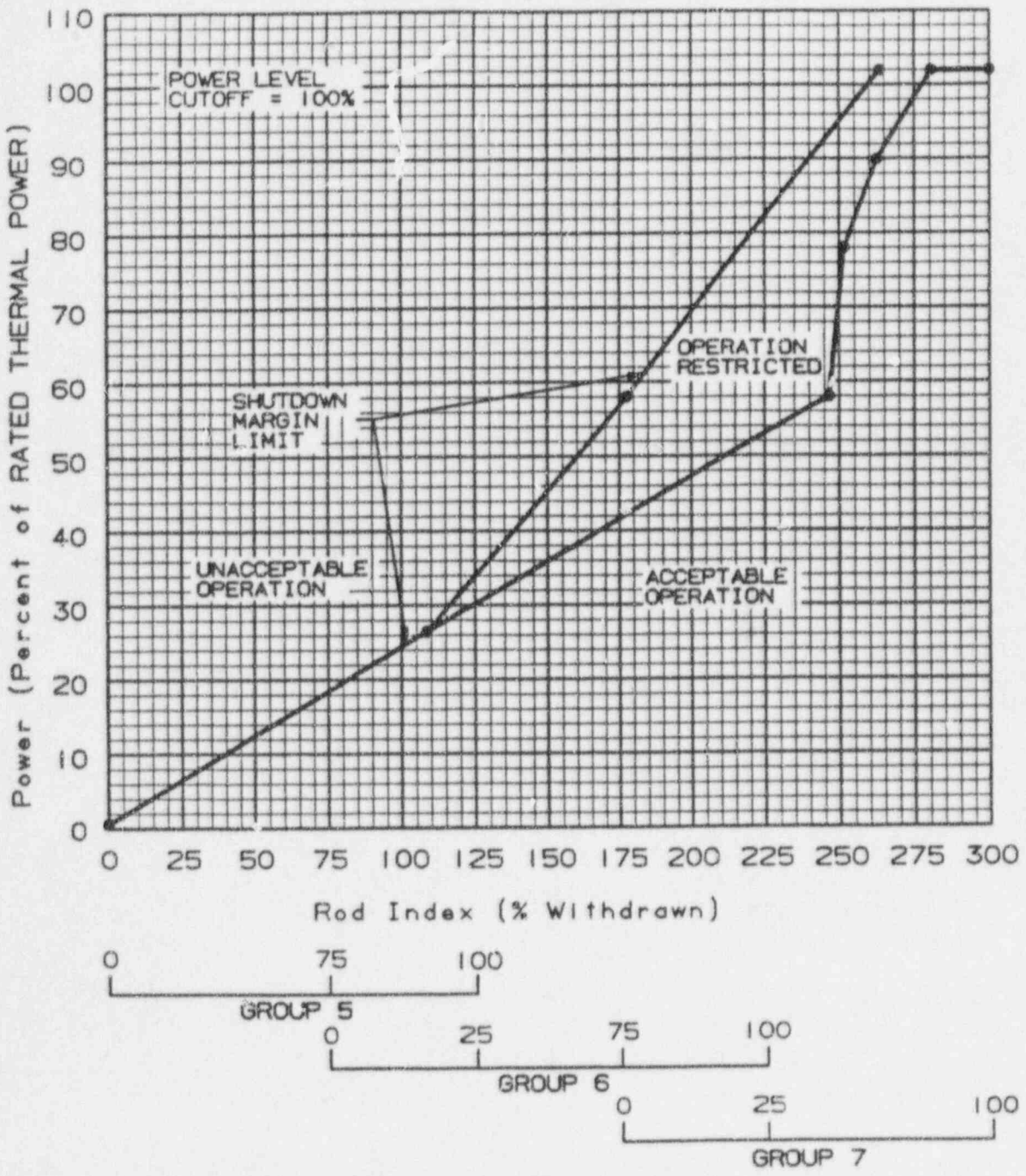
This Figure is referred
 to by Technical Specifications
 3.1.3.6 and 3.1.3.8



Note 1: A Rod Group overlap of 25±5% between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.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
 25±10/-0 to 460±10 EFPD, Four RC Pumps --
 Davis-Besse 1, Cycle 10

This Figure is referred
 to by Technical Specifications
 3.1.3.6 and 3.1.3.8

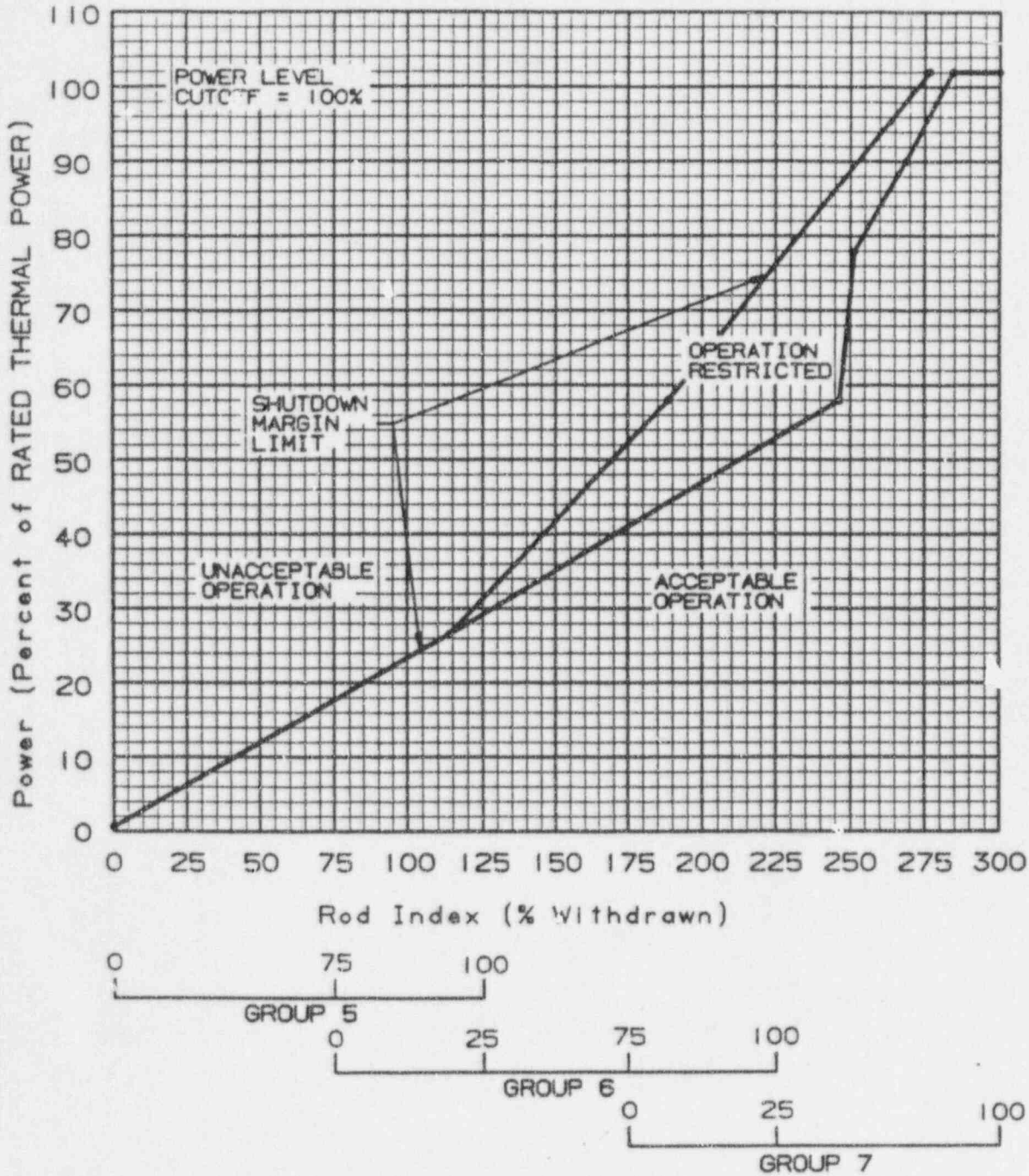


Note 1: A Rod Group overlap of 25±5% between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.

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

Figure 1c Regulating Group Position Alarm Setpoints
 After 460 ± 10 EFPD, Four RC Pumps --
 Davis-Besse 1, Cycle 10

This Figure is referred
 to by Technical Specifications
 3.1.3.6 and 3.1.3.8

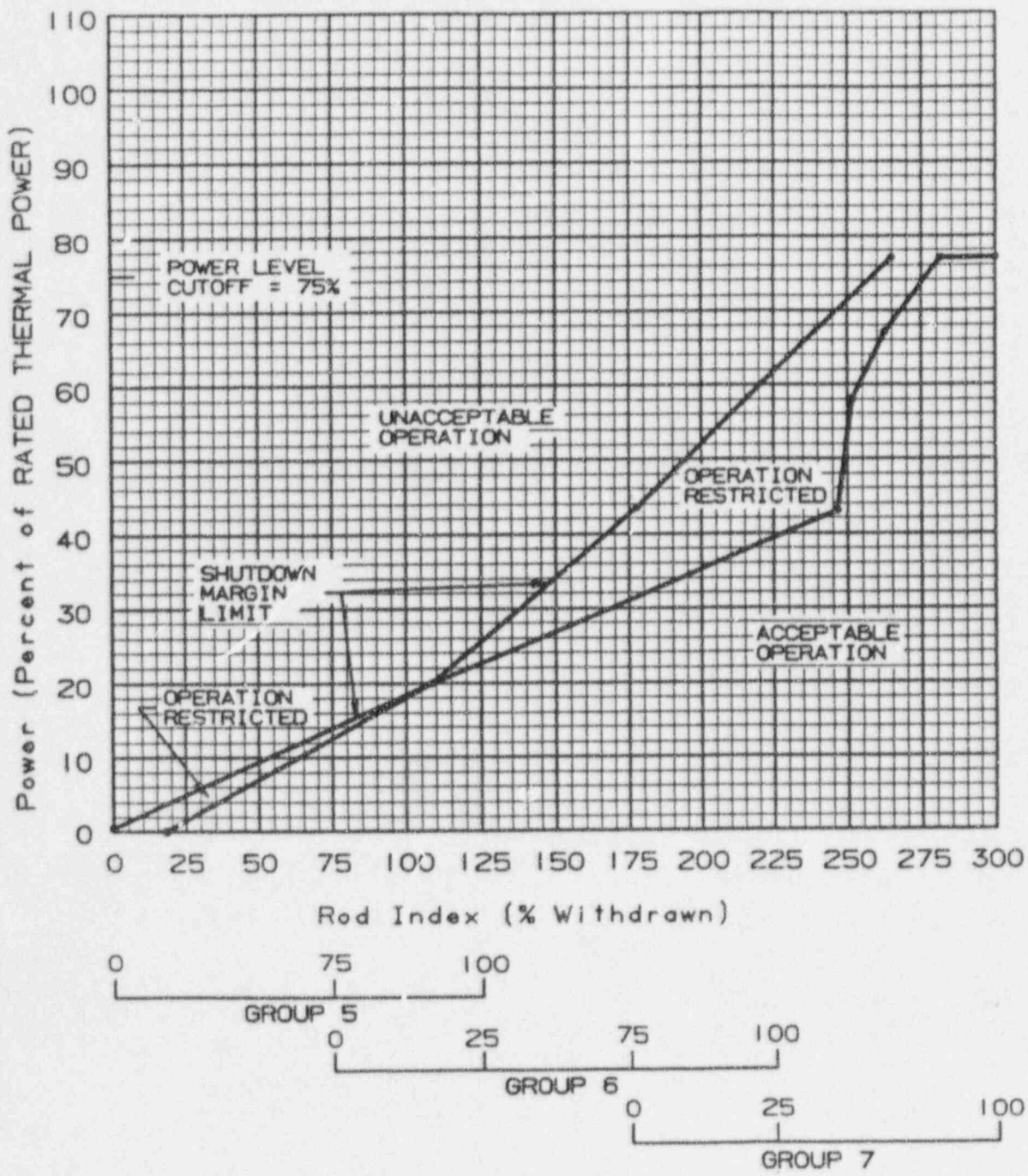


Note 1: A Rod Group overlap of $25 \pm 5\%$ between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.

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

Figure 1d Regulating Group Position Alarm Setpoints :
 0 to 25+10/-0 EFPD, Three RC Pumps --
 Davis-Besse 1, Cycle 10

This Figure is referred
 to by Technical Specifications
 3.1.3.6 and 3.1.3.8

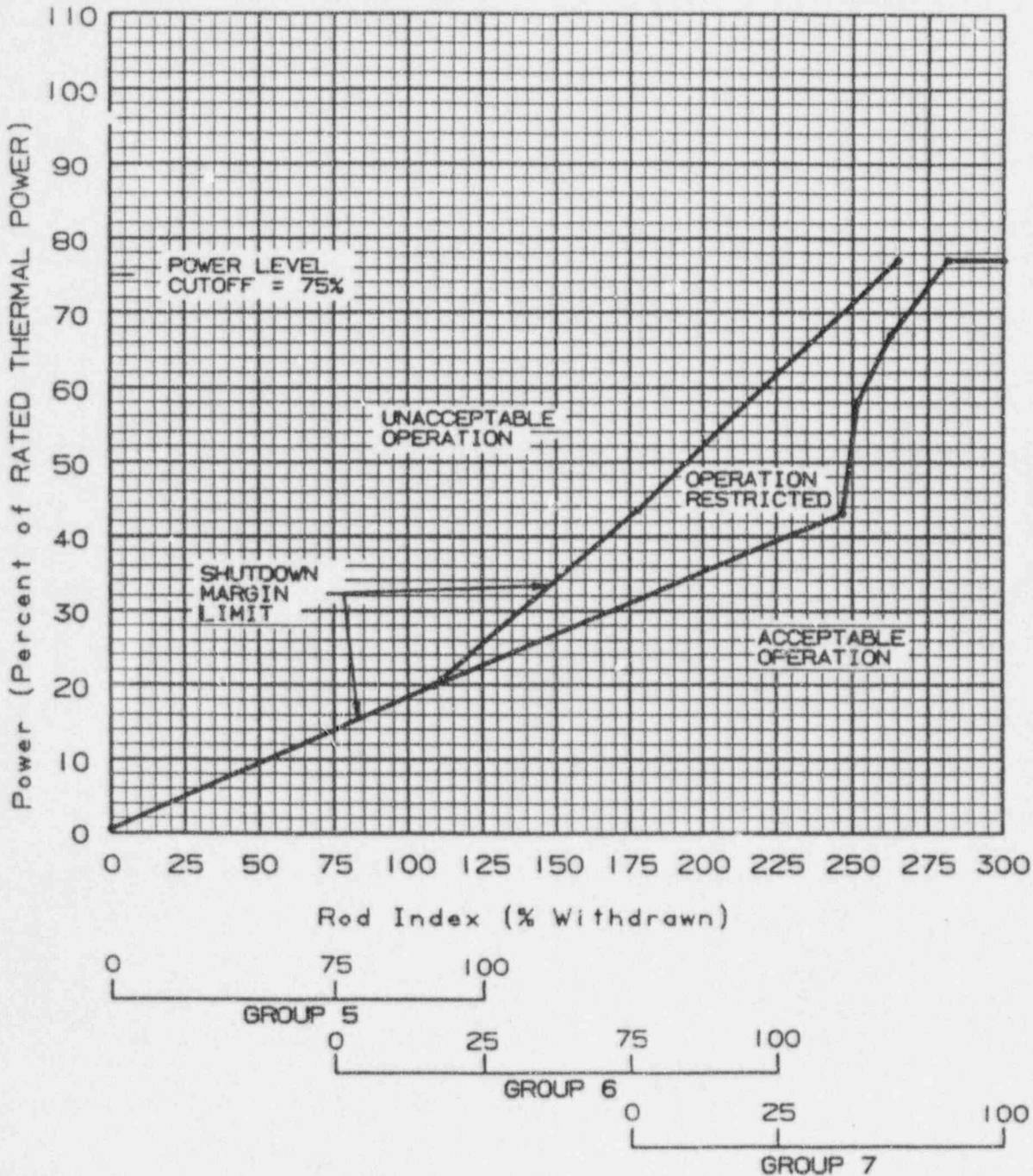


Note 1: A Rod Group overlap of 25±5% between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.

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

Figure 1e Regulating Group Position Alarm Setpoints
 25±10/-0 to 460±10 EFPD, Three RC Pumps --
 Davis-Besse 1, Cycle 10

This Figure is referred
 to by Technical Specifications
 3.1.3.6 and 3.1.3.8

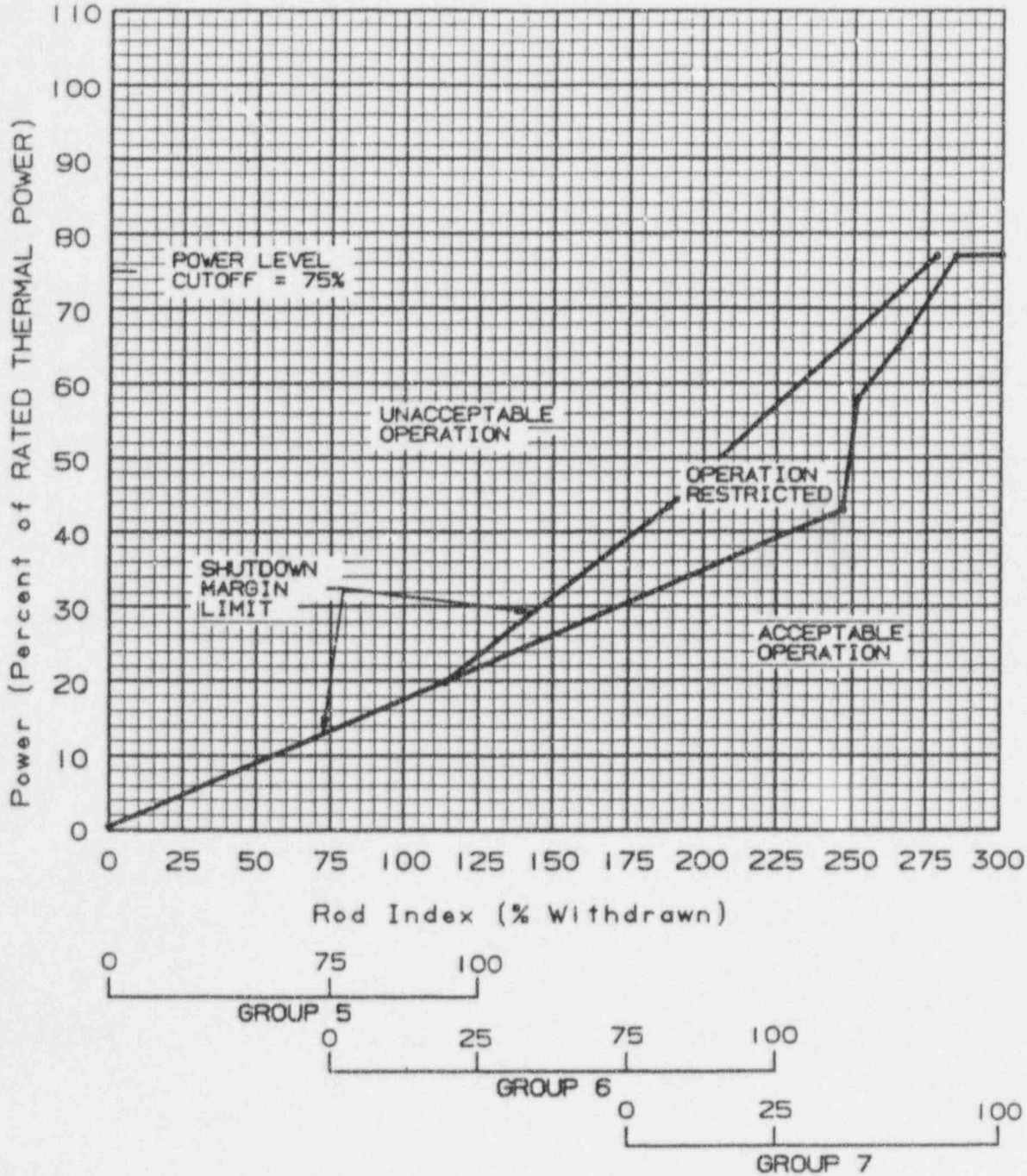


Note 1: A Rod Group overlap of 25±5% between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.

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

Figure 1f Regulating Group Position Alarm Setpoints:
 After 460 ± 10 EFPD, Three RC Pumps --
 Davis-Besse 1, Cycle 10

This Figure is referred
 to by Technical Specifications
 3.1.3.6 and 3.1.3.8

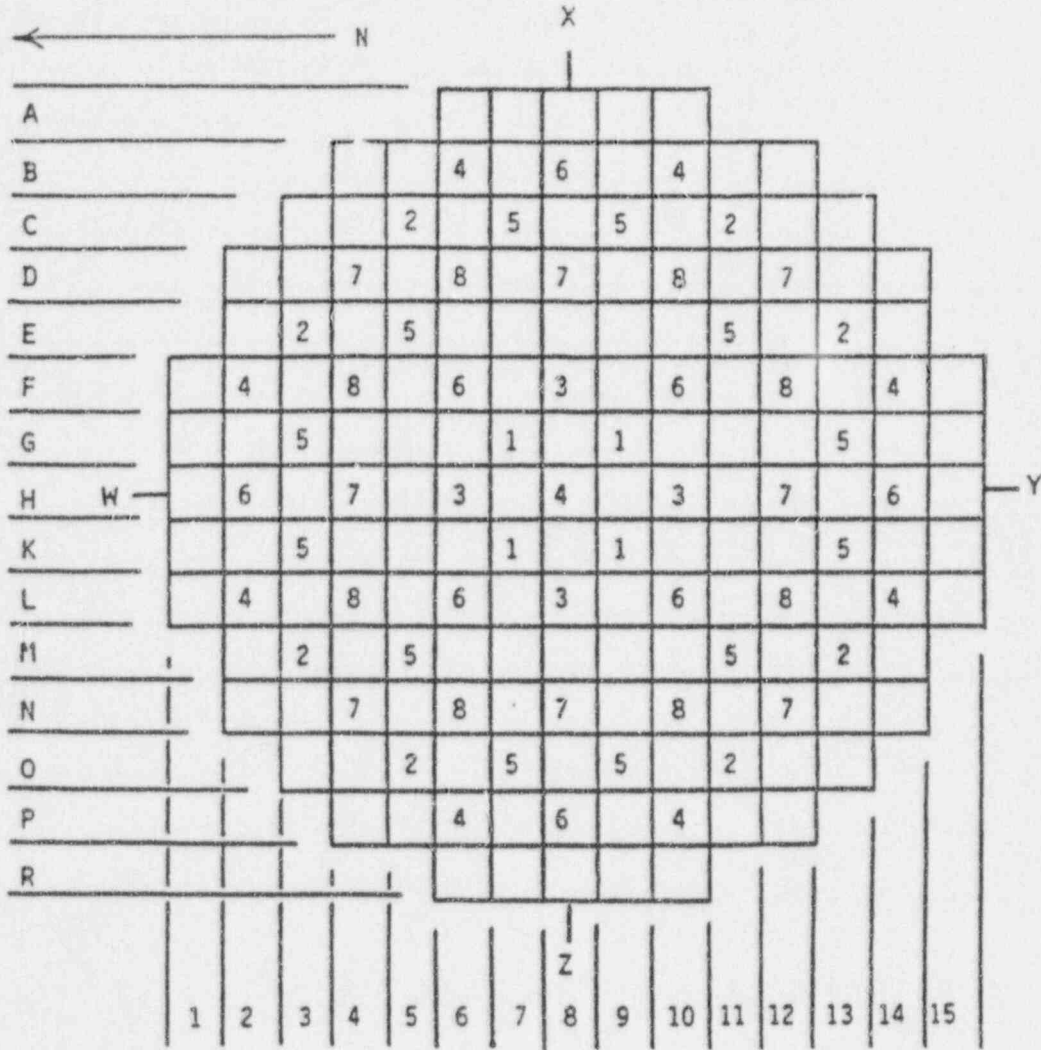


Note 1: A Rod Group overlap of $25 \pm 5\%$ between sequential withdrawn groups 5 and 6, and 6 and 7, shall be maintained.

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

Figure 2 Control Rod Core Locations and Group Assignments
 Davis-Besse 1, Cycle 10

This Figure is referred to by Technical Specification 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 460 +/- 10 EFPD,
Three or Four RC pumps operation*

Lower Setpoint: 0 %WD

Upper Setpoint: 100 %WD

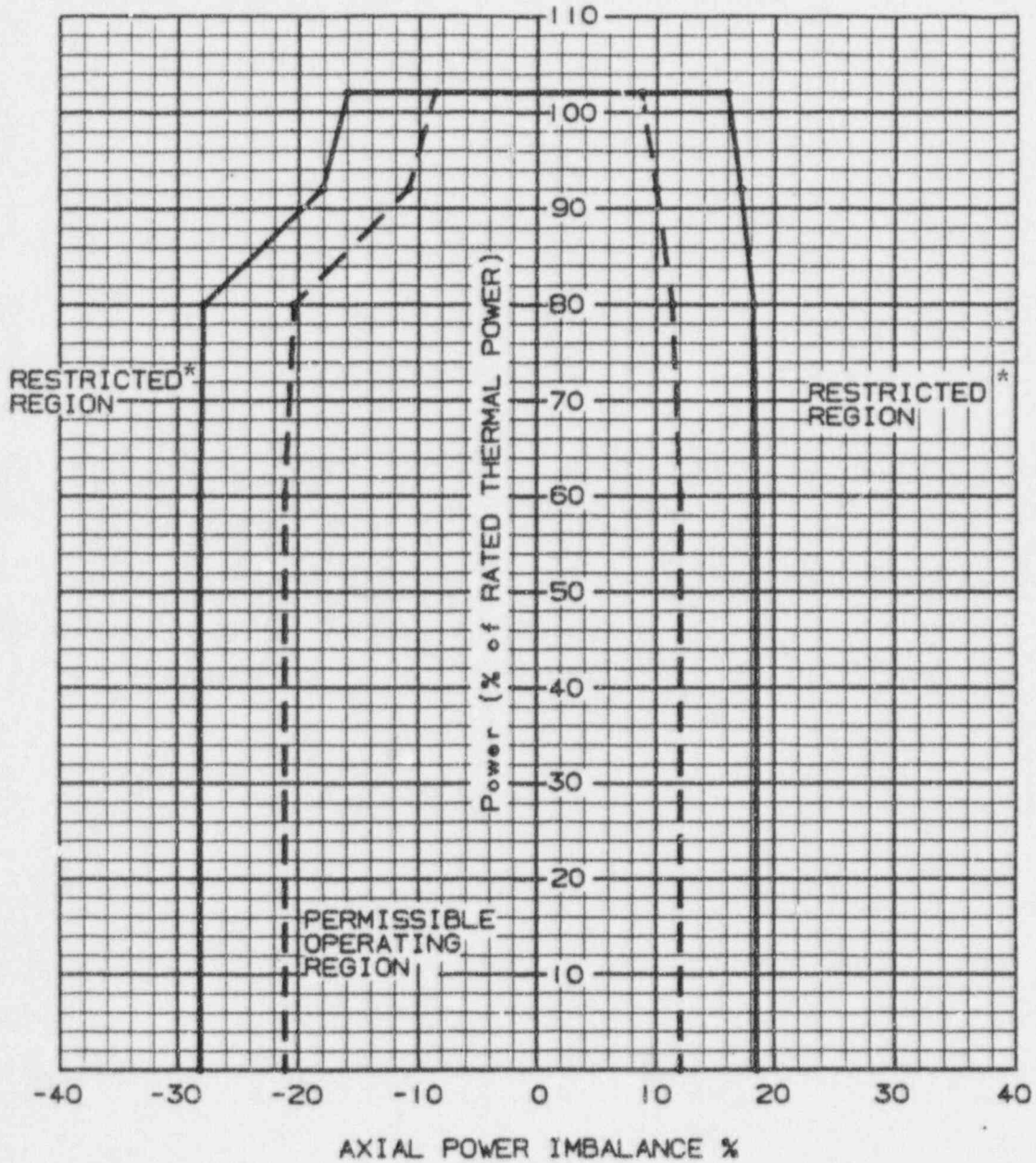
After APSR Pull - 460 +/- 10 EFPD to End-of-Cycle
Three or Four RC pumps operation*

Insertion Prohibited per Tech Spec 3.1.3.9

* Power restricted to 77% for 3 pump operation

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

This Figure is referred
 to by Technical Specification
 3.2.1



LEGEND

 FULL INCORE

 EXCORE

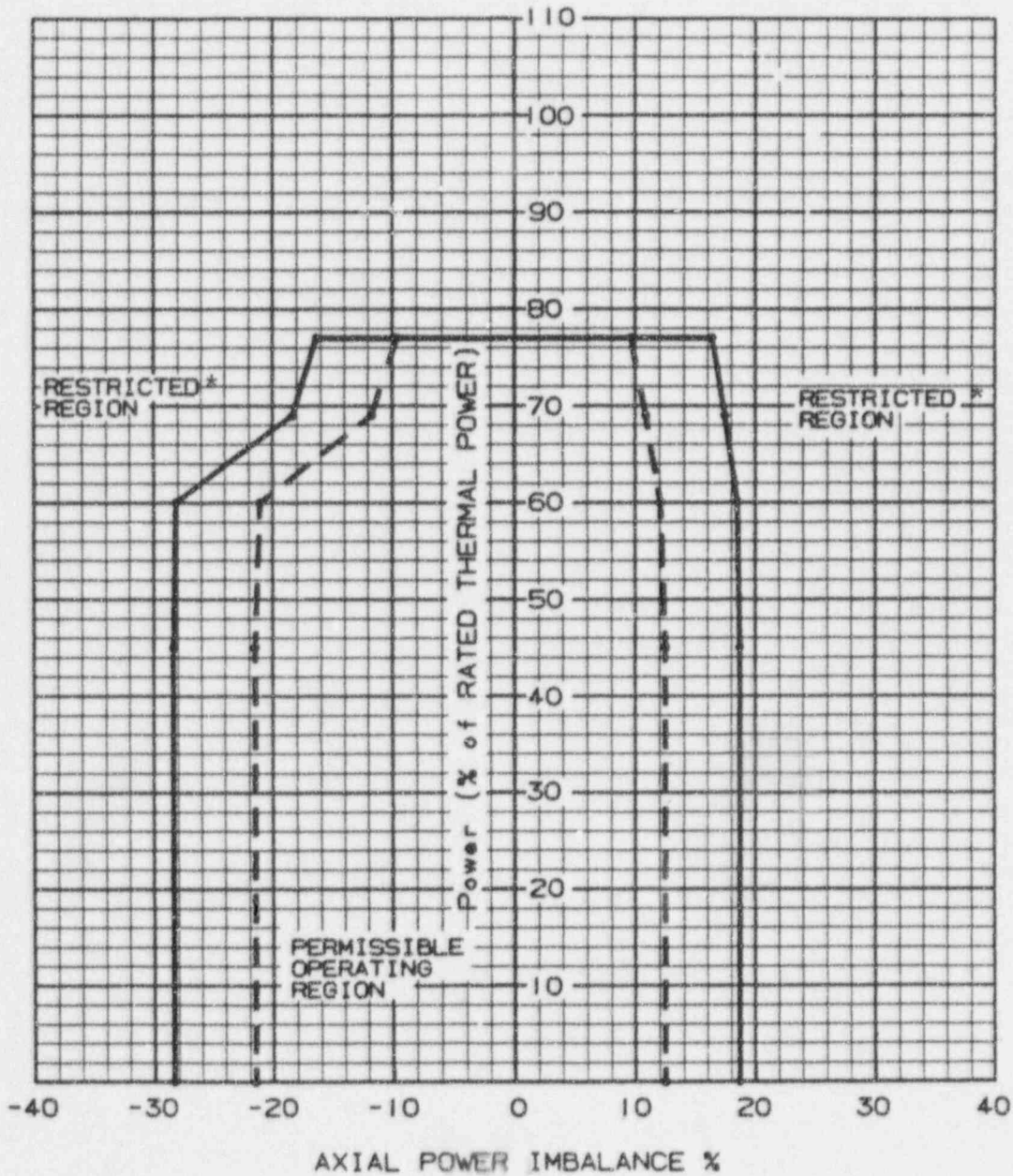
*Based on measurement system

Note 1: Instrument error is accounted for in these setpoints.

Figure 4b

AXIAL POWER IMBALANCE Alarm Setpoints
 0 EFPD to EOC, Three RC Pumps --
 Davis-Besse 1, Cycle 10

This Figure is referred
 to by Technical Specification
 3.2.1



LEGEND

FULL INCORE

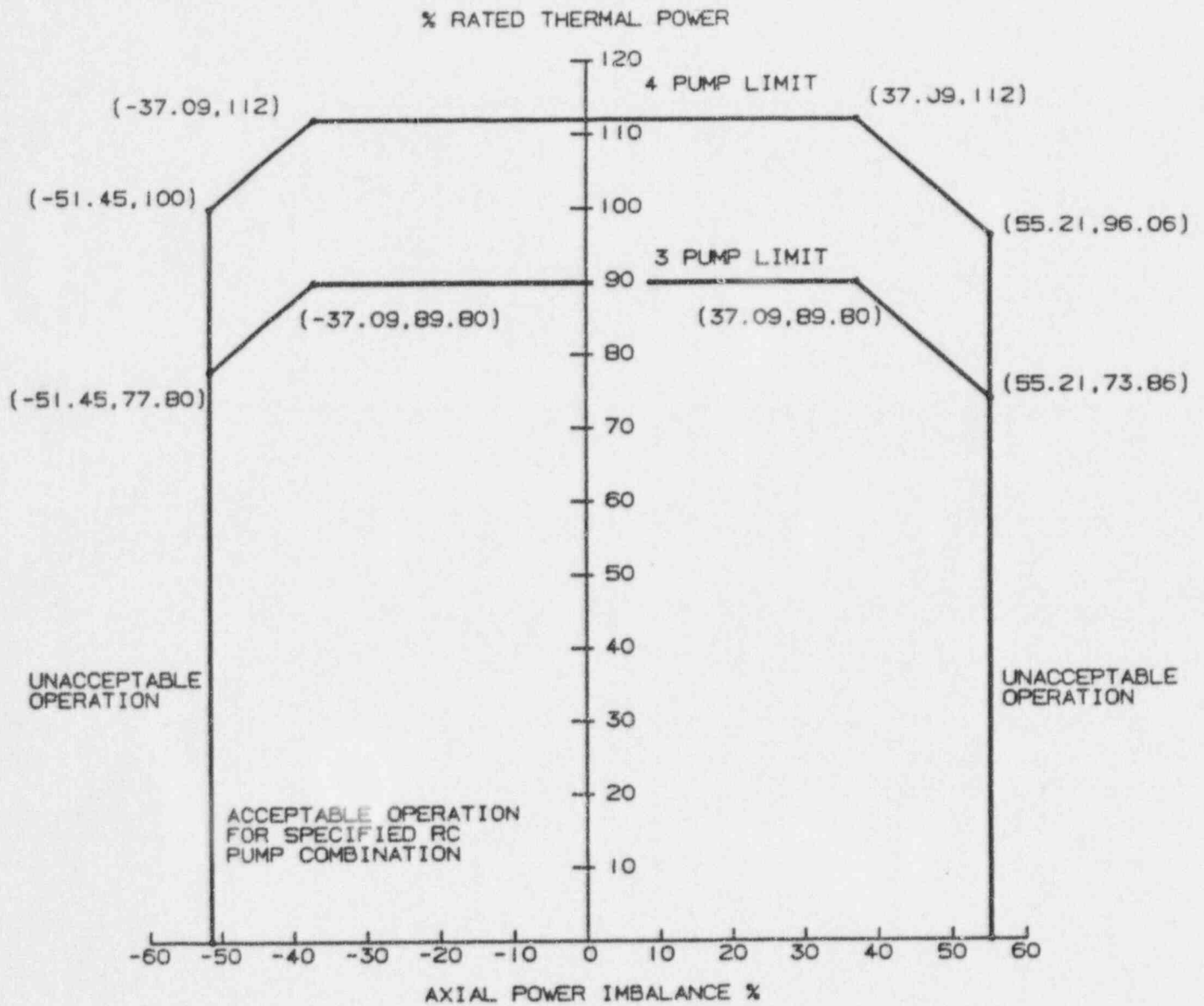
EXCORE

*Based on measurement system

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



<u>Pumps Operating</u>	<u>Reactor Coolant Flow, gpm</u>	<u>Required Measured Flow to Ensure Compliance, gpm</u>
4	380,000	339,500
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

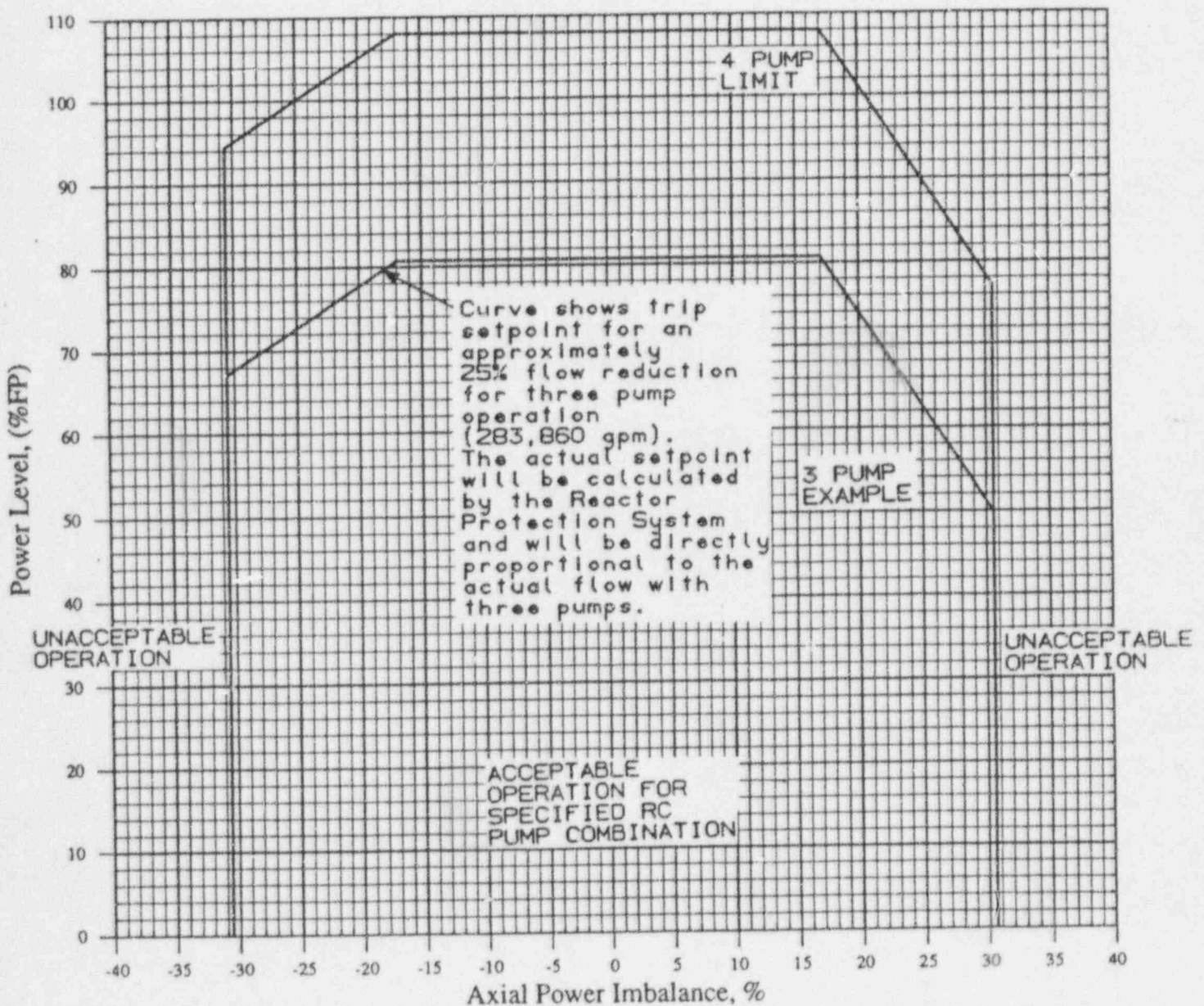


Table 1 QUADRANT POWER TILT Limits

This Table is referred
to by Technical Specification
3.2.4

QUADRANT POWER TILT as measured by:	Steady-state Limit for THERMAL POWER ≤ 60% (%)	Steady-state Limit for THERMAL POWER > 60% (%)	Transient Limit (%)	Maximum Limit (%)
Symmetrical Incore detector system	6.8	4.4	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) -3.73 X 10⁻⁴ Δk/k/°F

Table 3 Power to Melt Limits

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

	<u>Batch 9A</u>	<u>Batch 9D</u>	<u>Batch 10B</u>	<u>Batch 11</u>	<u>Batch 12</u>
Fuel Assembly Type	Mark-B8A	Mark-B8A	Mark-B8A	Mark-B8B	Mark-B10AZL
Minimum linear heat rate to melt, kW/ft	20.5	20.5	20.5	22.3	22.3

Table 4 Nuclear Heat Flux Hot Channel Factor - F₀

This Table is referred
to by Technical Specification
3.2.2

Heat Flux Hot Channel Factor F₀

F₀ shall be limited by the following relationships:

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

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

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

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

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

P = ratio of THERMAL POWER/RATED THERMAL POWER

Bu = Fuel Burnup (Mwd/mtU)

Batch 9A (Mark-B8A) LHR^{ALLOW} kW/ft

<u>Axial Segment</u>	<u>Less than 24,500 Mwd/mtU</u>	<u>After 24,500 Mwd/mtU</u>
1	12.8	9.6
2	15.1	11.3
3	15.7	12.0
4	15.7	12.0
5	16.4	12.0
6	17.0	12.0
7	16.2	11.4
8	13.6	9.6

Table 4, continued

Batches 9D and 10B (Mark-B8A) LHR^{ALLOW} kW/ft

<u>Axial Segment</u>	<u>After 24,500 MWd/mtU</u>
1	9.6
2	11.3
3	12.0
4	12.0
5	12.0
6	12.0
7	11.4
8	9.6

Batch 11B (Mark-B8B) LHR^{ALLOW} kW/ft

<u>Axial Segment</u>	<u>After 20,000 MWd/mtU</u>
1	12.9
2	15.3
3	16.2
4	16.2
5	16.2
6	16.6
7	16.2
8	13.6

Batch 12 (Mark-B10AZL) LHR^{ALLOW} kW/ft

<u>Axial Segment</u>	<u>Less Than 20,000 MWd/mtU</u>	<u>After 20,000 MWd/mtU</u>
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

Table 5 Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}^N$

This Table is referred
 to by Technical Specification
 3.2.3

Enthalpy Rise Hot Channel Factor $F_{\Delta H}^N$

$$F_{\Delta H}^N \leq \text{ARP} [1 + 0.3(1 - P/P_m)]$$

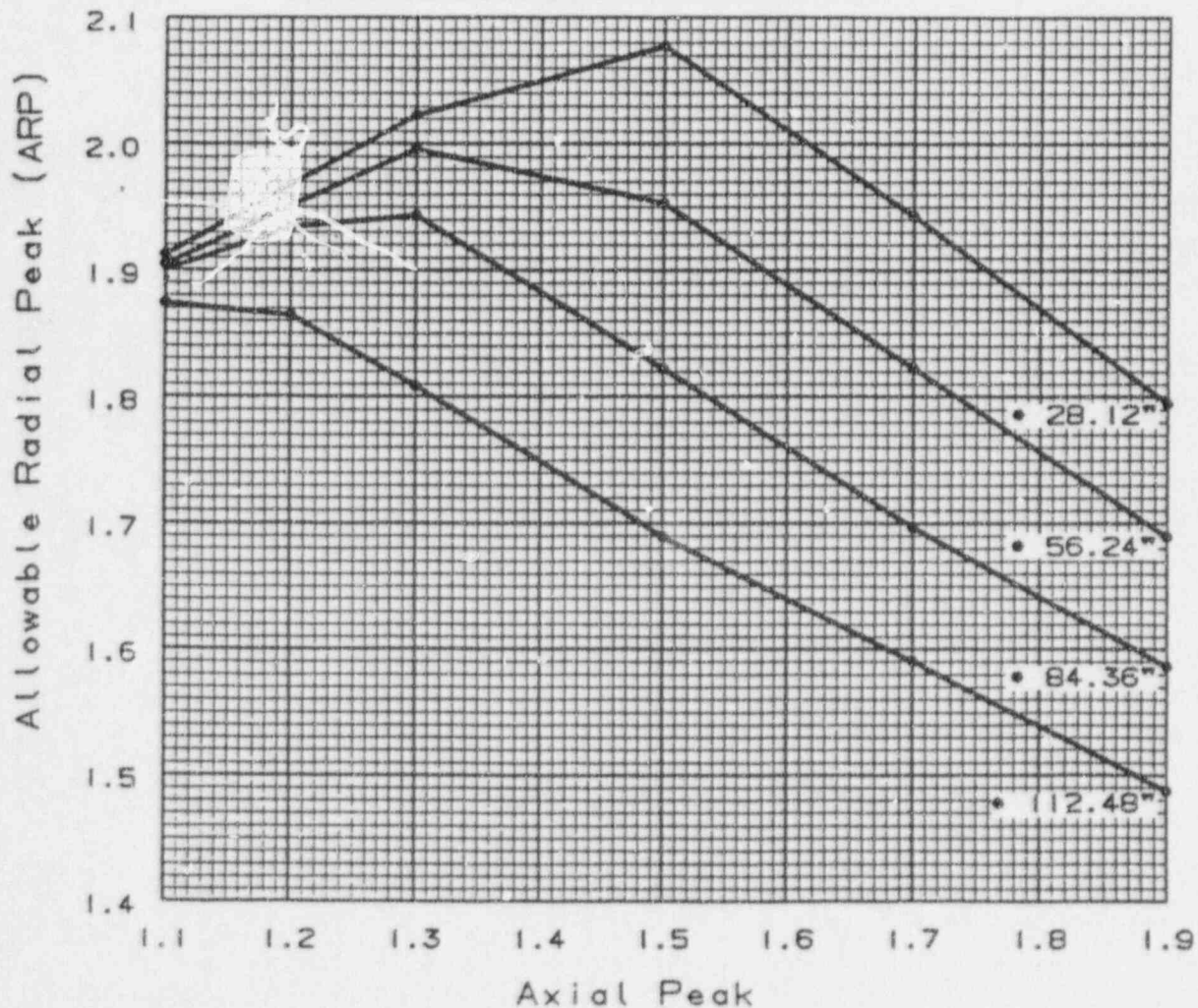
ARP = Allowable Radial Peak, see Figure

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

$P_m = 1.0$ for 4-RCP operation

$P_m = 0.75$ for 3-RCP operation

Figure 7 Allowable Radial Peak for $F_{\Delta H}^N$



* 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.