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U.S. Nuclear Regulatory Commission
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Subject: Cycle 14 Core Operating Limits Report, Revision 0

Three Mile Island, Unit 1 (TMI Unit 1)
Facility Operating License No. DPR-50
NRC Docket No. 50-289

Pursuant to TMI Unit 1 Technical Specification Section 6.9.5.4, enclosed is a copy of the Cycle 14 Core Operating Limits Report (COLR), Revision 0. The Cycle 14 COLR, Revision 0, provides the cycle-specific limits established to support operation of Cycle 14 up to 693 Effective Full Power Days, and provides updated references. The cycle-specific core operating limits contained in this report have been determined in accordance with Technical Specification 6.9.5.

If you have any questions or require additional information, please do not hesitate to contact us.

Very truly yours,

Michael P. Gallagher

Michael P. Gallagher
Director, Licensing & Regulatory Affairs
Mid-Atlantic Regional Operating Group

Enclosure: TMI Unit 1, Cycle 14 Core Operating Limits Report, Topical Report 147, Revision 0

cc: H. J. Miller, USNRC, Administrator, Region 1
T. G. Colburn, USNRC, Senior Project Manager
J. D. Orr, USNRC, Senior Resident Inspector
File No. 95055

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AmerGen

TMI-1 Cycle 14
Core Operating Limits Report

TOPICAL REPORT 147
Rev. 0

R. Jaffa *Robert Jaffa*	10/15/2001
Author	Date
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Reviewer	Date

Design Verification Required? ☐ YES ☒ NO If yes – DV#: ____________

N/A	
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[signature]	*11/27/01*
PORC Chair	Date

AG0353 (6/00)

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ABSTRACT

This Core Operating Limits Report (COLR) has been prepared in accordance with the requirements of TMI-1 Technical Specification 6.9.5. The core operating limits were generated using the methodologies described in References 1 through 5 and were documented in References 6 through 7. The core operating limits and reactor protection system limits and setpoints in this report have been analyzed for a maximum end-of-cycle (EOC) length of 693 EFPD.

The Full Incore System (FIS) operability requirements contained within describe the number and location of Self-Powered Neutron Detector (SPND) strings that must be operable in order to monitor imbalance and quadrant tilt using the FIS.

Quadrant tilt limits for FIS, out-of-core detector [OCD] system and minimum incore system [MIS] are given in Table 1. Technical Specification requirements related to quadrant tilt, including operator actions that must be taken in the event quadrant tilt limits are exceeded, are stated in T.S. 3.5.2.4.

Rod insertion limits are provided in Figures 1 to 3 to ensure that the safety criteria for DNBR protection, LOCA kw/ft limits, shutdown margin and ejected rod worth are met. Axial Power Shaping Rod (APSR) position limits and restrictions describe how the APSRs must be operated at the end-of-cycle. Technical Specification requirements related to control rod positions, including operator actions that must be taken in the event control rod positions enter Restricted or Not Allowed Regions, are stated in T.S. 3.5.2.5.

Imbalance limits for FIS, OCD and MIS are given in Figures 4 to 6. Technical Specification requirements related to axial power imbalance, including operator actions that must be taken in the event imbalance enters the Restricted Region, are stated in T.S. 3.5.2.7.

COLR Figures 1 through 6 may have three distinctly defined regions:

1. Permissible Region
2. Restricted Region
3. Not Allowed Region (Operation in this region is not allowed)

The limiting criteria within the Restricted Region are ECCS power peaking, initial condition DNB peaking, and potential ejected rod worth. Since the probability of accidents related to these criteria is very low, especially in a twenty-four (24) hour time frame, inadvertent operation within the Restricted Region for a period not exceeding twenty-four (24) hours is allowed [T.S. 3.5.2.5.b and 3.5.2.7.e], provided that hot channel

factors are within the limits given in Tables 2 and 3. Similarly, continued operation with quadrant tilt greater than the steady-state tilt limit for a period not exceeding twenty-four (24) hours is allowed [T.S. 3.5.2.4.e] provided that hot channel factors are within the limits given in Tables 2 and 3, with the added requirement that reactor power must be reduced 2% for each 1% tilt in excess of the tilt limit [T.S. 3.5.2.4.d]. (Note that continued operation with quadrant tilt greater than the steady-state tilt limit is also permitted without hot channel factor verification as long as the alternate guidance in T.S. 3.5.2.4.e is followed).

The limiting criterion within the Not Allowed Region is the shutdown margin limit. Inadvertent operation in this region is not permitted and requires immediate action to exit the region. Acceptable control rod positions shall be attained within two (2) hours [T.S. 3.5.2.5.b.2].

Table 2 contains the total peaking hot channel factor $F_Q(Z)$ limits (i.e., ECCS power peaking limits) for core monitoring. Table 3 contains the nuclear enthalpy rise hot channel factor $F^N_{\Delta H}$ limits (i.e., initial condition DNB peaking) for core monitoring. During normal conditions, operation within quadrant tilt (Table 1), rod insertion (Figures 1-3), and imbalance (Figures 4-6) limits ensure $F_Q(Z)$ and $F^N_{\Delta H}$ limits are met. However, verification that positive margin to $F_Q(Z)$ and $F^N_{\Delta H}$ limits exists may be required during the following abnormal conditions:

- T.S. 3.5.2.2.e (operation with an inoperable rod)
- T.S. 3.5.2.4.e (operation with quadrant tilt in excess of steady-state limits)
- T.S. 3.5.2.5.b (operation with control rods in the Restricted Region)
- T.S. 3.5.2.7.d (operation with imbalance in the Restricted Region)

NAS Display 4 provides the minimum margin to $F_Q(Z)$ limits on the Thermal Limiting Condition Core Summary page and to $F^N_{\Delta H}$, limits on the Thermal Limiting Condition Hot Channel Factor page.

COLR Figure 7 indicates the LOCA limited maximum allowable linear heat rates as a function of fuel rod burnup and fuel elevation for Mark-B8V, Mark-B10/-B10P, and Mark-B12 fuel types and for the M5 lead test rods. Bounding values for monitoring these limits for the current cycle in terms of fuel batch, cycle burnup and axial detector levels are listed in Table 2. The full power linear heat rate limits are applicable for partial-power and three-pump operation since the allowable moderator temperature coefficient (MTC) as a function of power, shown on page 5 of Figure 7, is preserved by the cycle design.

COLR Figure 8 provides the Axial Power Imbalance Protective Limits (APIPL) that preserve the DNBR and Centerline Fuel Melt design criteria.

COLR Figure 9 provides the Protection System Maximum Allowable Setpoints for Axial Power Imbalance which combine the power/flow and error-adjusted axial imbalance trip setpoints that ensure the APIPL of Figure 8 are not exceeded.

Note: Figures 8 and 9 show the conservative generic limits and setpoints currently installed on the plant hardware. The cycle-specific values have been verified to be conservatively bounded by the generic values.

Enclosure 1 contains operating limits not required by TS. The core minimum DNBR and the Maximum Allowable LOCA Linear Heat Rate limits are monitored by the Process Computer Nuclear Applications Software as part of the bases of the required limits and setpoints. The minimum boron volumes and concentrations for the Boric Acid Mix Tank (BAMT) and Reclaimed Boric Acid Storage Tanks (RBAT) are the boron levels needed to achieve cold shutdown conditions throughout the cycle using these tanks.

Enclosure 2 contains the bases descriptions of the Power-to-Flow Trip Setpoint to prevent violation of DNBR criteria and the Design Nuclear Power Peaking Factors for axial flux shape ($F^N{}_Z$) and hot channel nuclear enthalpy rise ($F^N{}_{\Delta H}$) that define the reference design peaking condition in the core.

Full Incore System (FIS)
Operability Requirements

- The Full Incore System (FIS) is operable for monitoring axial power imbalance provided the number of valid Self Powered Neutron Detector (SPND) signals in any one quadrant is not less than 75% of the total number of SPNDs in the quadrant.

Quadrant	SPNDs	75%
WX	85.75	64.5
XY	99.75	75.0
YZ	89.25	67.0
ZW	89.25	67.0

- The Full Incore System (FIS) is operable for monitoring quadrant tilt provided the number of valid symmetric string individual SPND signals in any one quadrant is not less than 75% (21) of the total number of SPNDs in the quadrant (28).

Quadrant	Symmetric Strings
WX	7, 9, 32, 35
XY	5, 23, 25, 28
YZ	16, 19, 47, 50
ZW	11, 13, 39, 43

Source Doc.: B&W 86-1172640-00
Referred to by: Tech. Spec. 3.5.2.4.a and 3.5.2.7.a

APSR Position Limits

Before the end-of-cycle APSR pull maneuver is completed, the APSRs may be positioned as necessary for transient imbalance control. The APSR pull maneuver shall be completed (i.e. APSRs fully withdrawn) at 662 ±10 EFPD. Once the APSR pull maneuver has been completed, the APSRs shall not be inserted for the remainder of the fuel cycle and 0-99% WD shall be considered a "Restricted Region" as defined in the abstract section of this COLR.

Note: APSRs may be inserted during preparation for final cycle shutdown into the refueling outage after reactor power is below 20%FP.

Source Doc.: 51-5014984-00, TMI-1 Cycle 14 Verification Report

TABLE 1
Quadrant Tilt Limits

	Steady State Limit 15 < Power ≤ 60%	Steady State Limit Power > 60%	Maximum Limit Power > 15%
Full Incore System (FIS)	6.83	4.32	16.8
Minimum Incore System (MIS)	2.78	1.90	9.5

Source Doc.: BAW-2238, TMI-1 Cycle 14 Reload Report
Referred to by: Tech. Spec. 3.5.2.4

TABLE 2
Core Monitoring System Bounding Values for LOCA Limited Maximum Allowable Linear Heat Rate (kW/ft)

Batch 13K

Level	0-192 EFPD	192-274 EFPD	274-385 EFPD	385-550 EFPD	550-693 EFPD
8	15.0	15.0	15.0	13.6	12.4
7	15.3	15.2	15.0	13.6	12.4
6	15.9	15.8	15.0	13.6	12.4
5	16.4	15.8	15.0	13.6	12.4
4	16.4	15.8	15.0	13.6	12.4
3	15.9	15.8	15.0	13.6	12.4
2	15.3	15.2	15.0	13.6	12.4
1	15.0	15.0	15.0	13.6	12.4

Batch 13L

Level	0-97 EFPD	97-250 EFPD	250-400 EFPD	400-550 EFPD	550-693 EFPD
8	15.9	15.2	14.5	13.9	13.3
7	16.2	15.4	14.7	14.0	13.3
6	16.8	15.9	15.1	14.2	13.5
5	16.8	15.9	15.1	14.2	13.5
4	16.7	15.8	15.0	14.1	13.5
3	16.7	15.8	15.0	14.1	13.5
2	16.2	15.4	14.7	14.0	13.3
1	15.9	15.2	14.5	13.9	13.3

Batches 14F, 14G

Level	0-250 EFPD	250-400 EFPD	400-550 EFPD	550-650 EFPD	650-693 EFPD
8	13.8	13.6	13.3	13.0	12.8
7	13.9	13.6	13.3	13.0	12.8
6	14.1	13.8	13.4	13.0	12.8
5	14.1	13.8	13.4	13.0	12.8
4	14.1	13.7	13.3	12.9	12.8
3	14.1	13.7	13.3	12.9	12.8
2	13.9	13.6	13.3	13.0	12.8
1	13.8	13.6	13.3	13.0	12.8

Table 2 (Continued)

Batches 14C, 15A, 15B, 15C

Level	0-241 EFPD	241-400 EFPD	400-500 EFPD	500-600 EFPD	600-693 EFPD
8	15.9	15.1	14.6	14.1	13.6
7	16.2	15.3	14.7	14.2	13.7
6	16.8	15.7	15.1	14.5	13.9
5	16.8	15.7	15.1	14.5	13.9
4	16.7	15.6	15.0	14.4	13.8
3	16.7	15.6	15.0	14.4	13.8
2	16.2	15.3	14.7	14.2	13.7
1	15.9	15.1	14.6	14.1	13.6

Batch 16

Level	0-693 EFPD
8	15.9
7	16.2
6	16.8
5	16.9
4	16.8
3	16.8
2	16.2
1	15.9

The maximum linear heat rate for each CMS level, as measured with the NAS Thermal Hydraulic Package, should not be greater than the corresponding bounding value from Table 2 above. NAS Display 4, Thermal Limiting Condition Core Summary, shows the minimum margin to FQ(Z) limits for each axial level.

Notes: The LHR limits above are equivalent to the total peaking hot channel factor limits, FQ(Z), referred to in T.S. 3.5.2 by dividing the LHR limits by the product of the core average linear heat rate (5.79 kW/ft) and the current fraction of rated power.

LHR limits provided are based on nuclear source power, therefore NAS variable "FNT" must be set equal to 1.0.

Source Doc.: BAW-2238, TMI-1 Cycle 14 Reload Report

TABLE 3
LCO DNB Maximum Allowable Radial Peaking (MARP) Limits

Axial Peak	Axial Peak Elevation (Fraction of Core Height)			
	0.2	0.4	0.6	0.8
1.1	1.8246	1.8172	1.8042	1.7807
1.2	1.8760	1.8587	1.8337	1.7609
1.3	1.9193	1.8933	1.8297	1.7094
1.5	1.9598	1.8487	1.7315	1.6125
1.7	1.8416	1.7268	1.6136	1.5120
1.9	1.7089	1.6060	1.5079	1.4217

The maximum radial peak for each fuel assembly, as measured with the NAS at the elevation where the assembly axial peak occurs, should not be greater than the corresponding bounding value from Table 3 above. NAS Display 4, Thermal Limiting Condition Hot Channel Factor page, shows the minimum margin to $F^N_{\Delta H}$ limits for the fuel assemblies with the smallest (or negative) margin.

Note: The LCO DNB Maximum Allowable Radial Peaking (MARP) limits above are equivalent to nuclear enthalpy rise hot channel factor limits, $F^N_{\Delta H}$, referred to in T.S. 3.5.2 by using the following conversion:

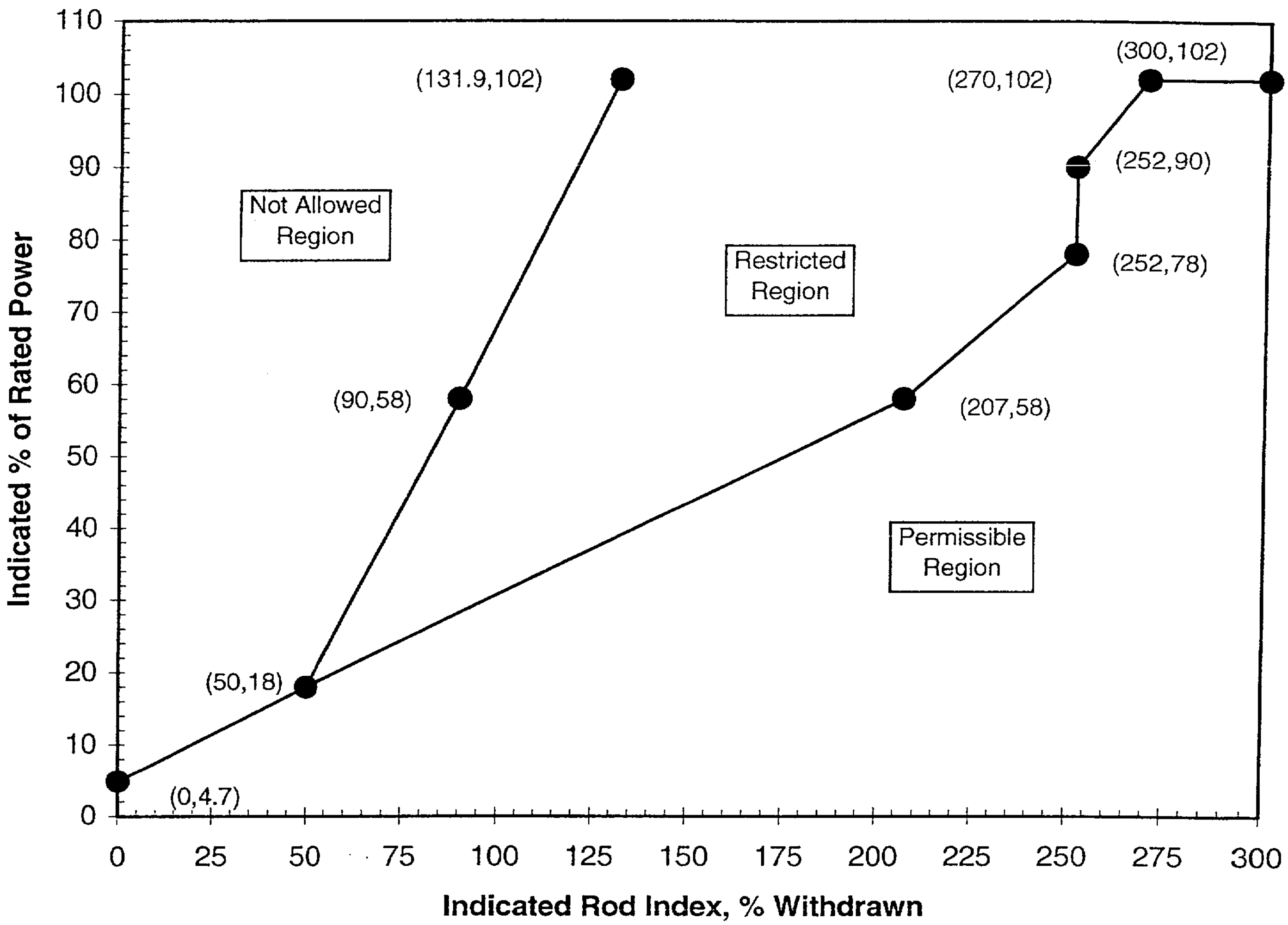
$F^N_{\Delta H}$ limit = (LCO DNB MARP) * [1 + 0.3 * (1 – P/P_m)]

where: P = Current fraction of power and,
P_m = power adjustment factor for RC Pump combination (1.0 for 4 pump, 0.75 for 3 pump)

These limits are applicable to all fuel in the core for 3 and 4 RC pump operation.

Source: BAW-2238, TMI-1 Cycle 14 Reload Report

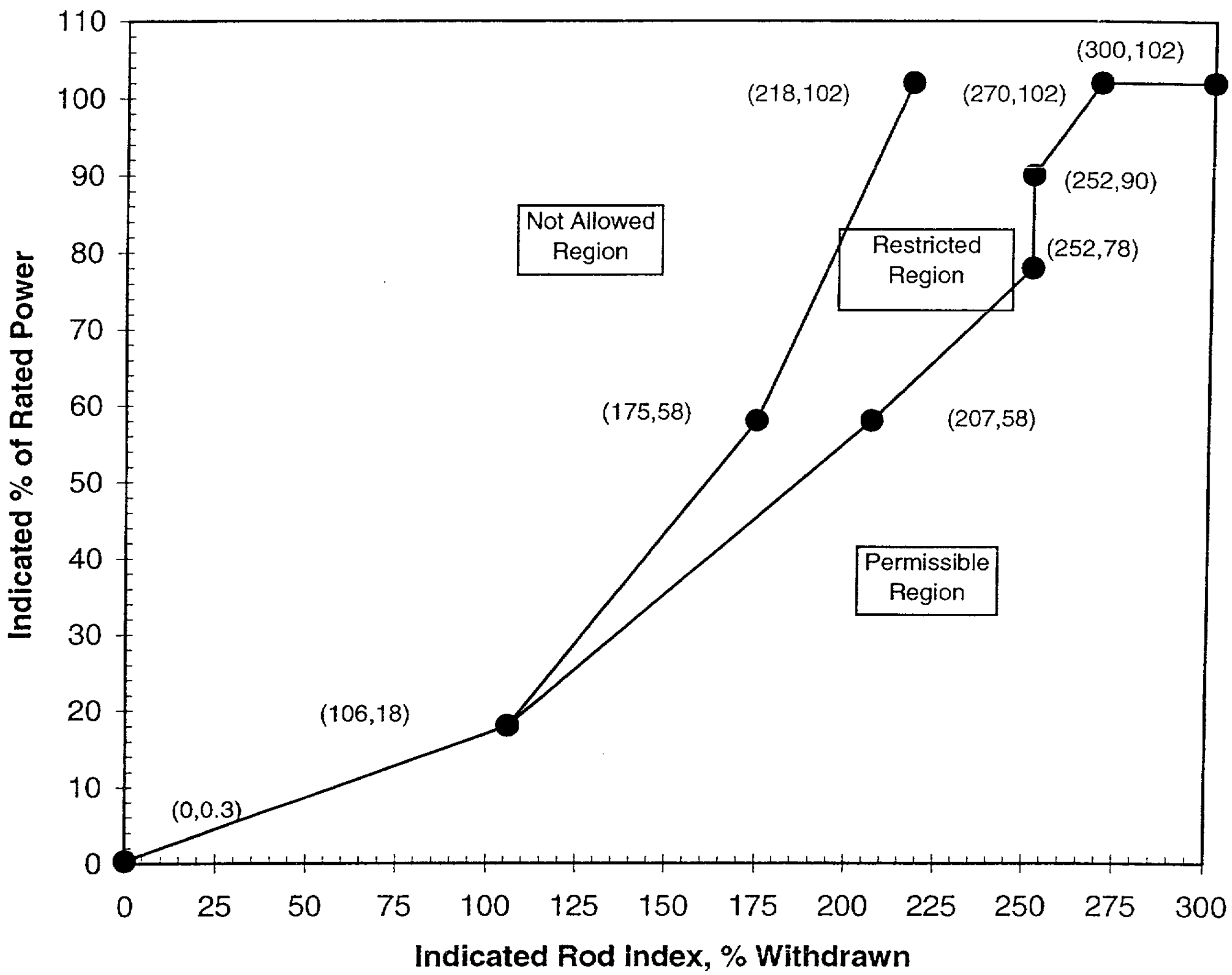
Figure 1 (Page 1 of 2)
Error Adjusted Rod Insertion Limits
(0 to 400 ±10 EFPD; 4 Pump Operation)



A Rod group overlap of 25 ±5% between sequential groups 5 and 6, and 6 and 7 shall be maintained.

This figure is referred to by
TS 3.5.2.5.b & 3.5.2.4.e.3

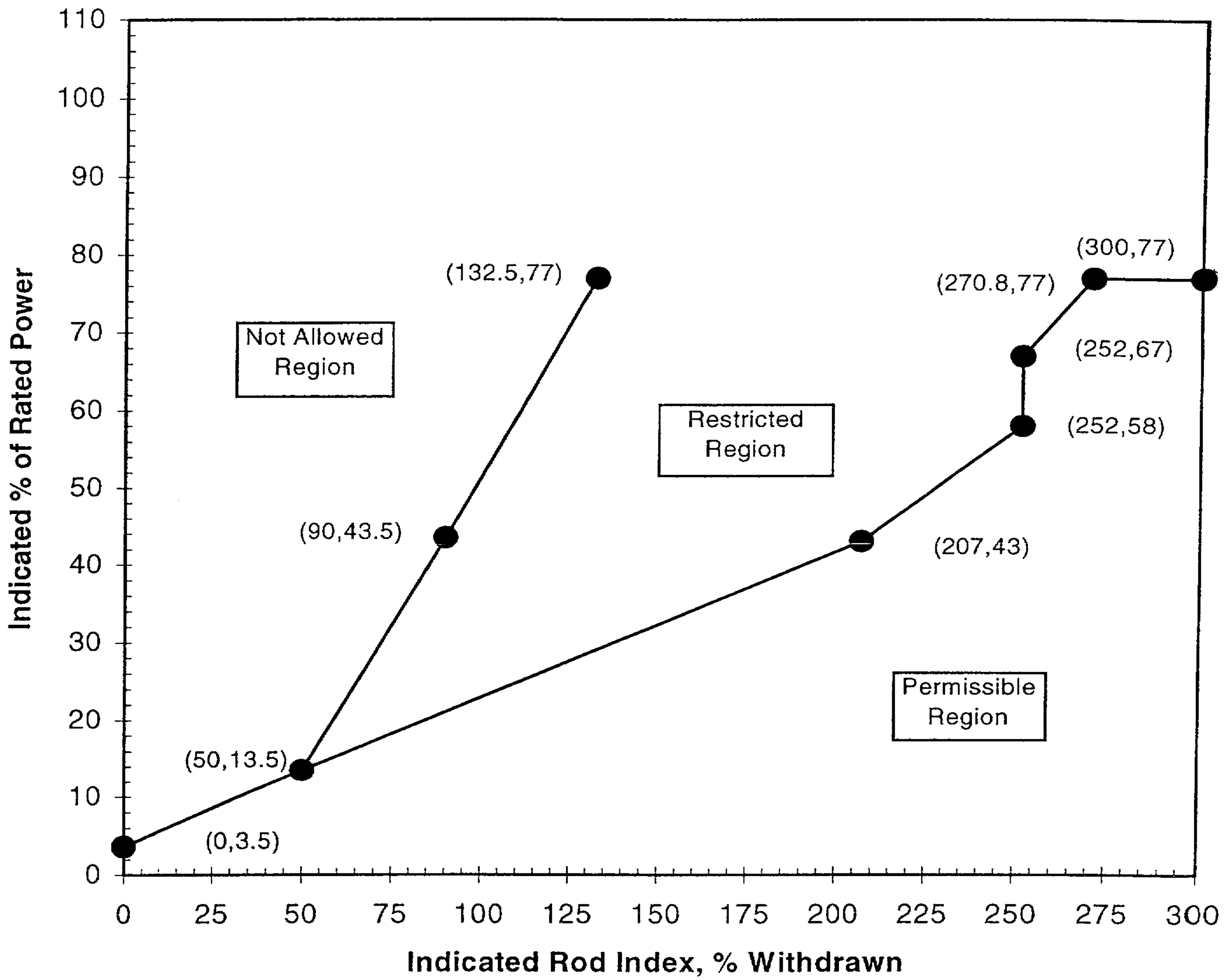
Figure 1 (Page 2 of 2)
Error Adjusted Rod Insertion Limits
(400 ±10 EFPD to EOC; 4 Pump Operation)



A Rod group overlap of 25 ±5% between sequential groups 5 and 6, and 6 and 7 shall be maintained.

This figure is referred to by
TS 3.5.2.5.b & 3.5.2.4.e.3

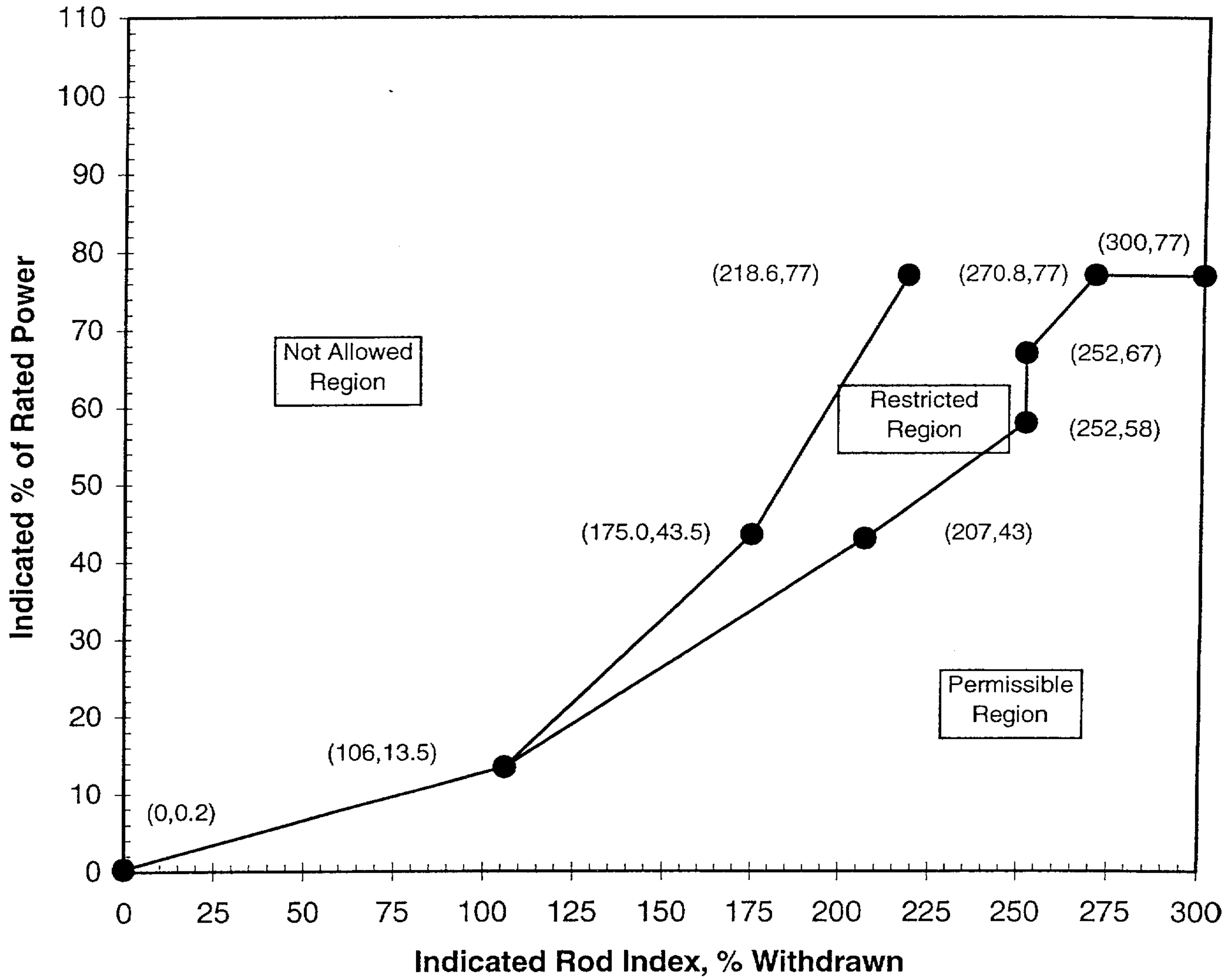
Figure 2 (Page 1 of 2)
Error Adjusted Rod Insertion Limits
(0 to 400 ±10 EFPD; 3 Pump Operation)



A Rod group overlap of 25 ±5% between sequential groups 5 and 6, and 6 and 7 shall be maintained.

This figure is referred to by
TS 3.5.2.5.b & 3.5.2.4.e.3

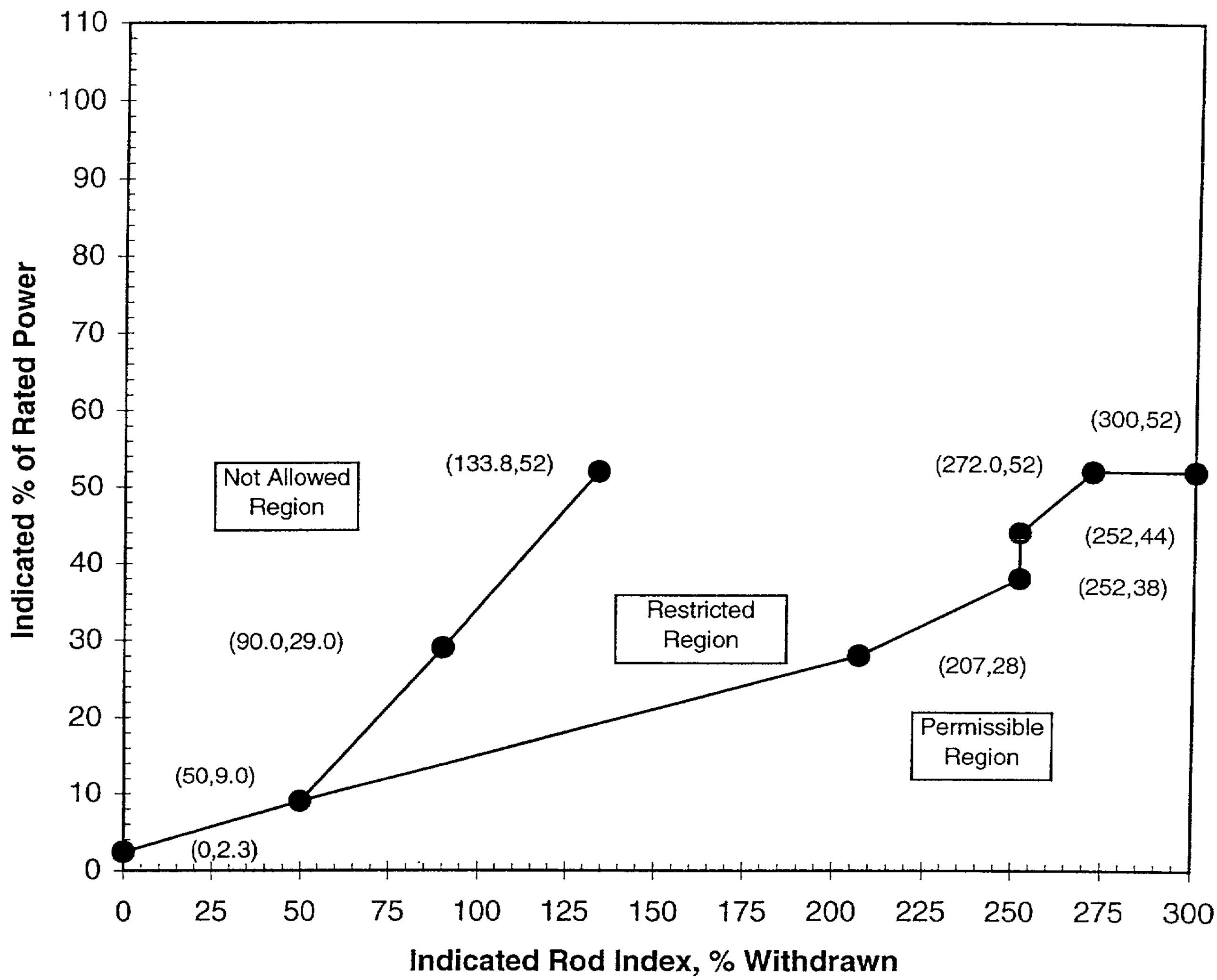
Figure 2 (Page 2 of 2)
Error Adjusted Rod Insertion Limits
(400 ±10 EFPD to EOC; 3 Pump Operation)



A Rod group overlap of 25 ±5% between sequential groups 5 and 6, and 6 and 7 shall be maintained.

This figure is referred to by TS 3.5.2.5.b & 3.5.2.4.e.3

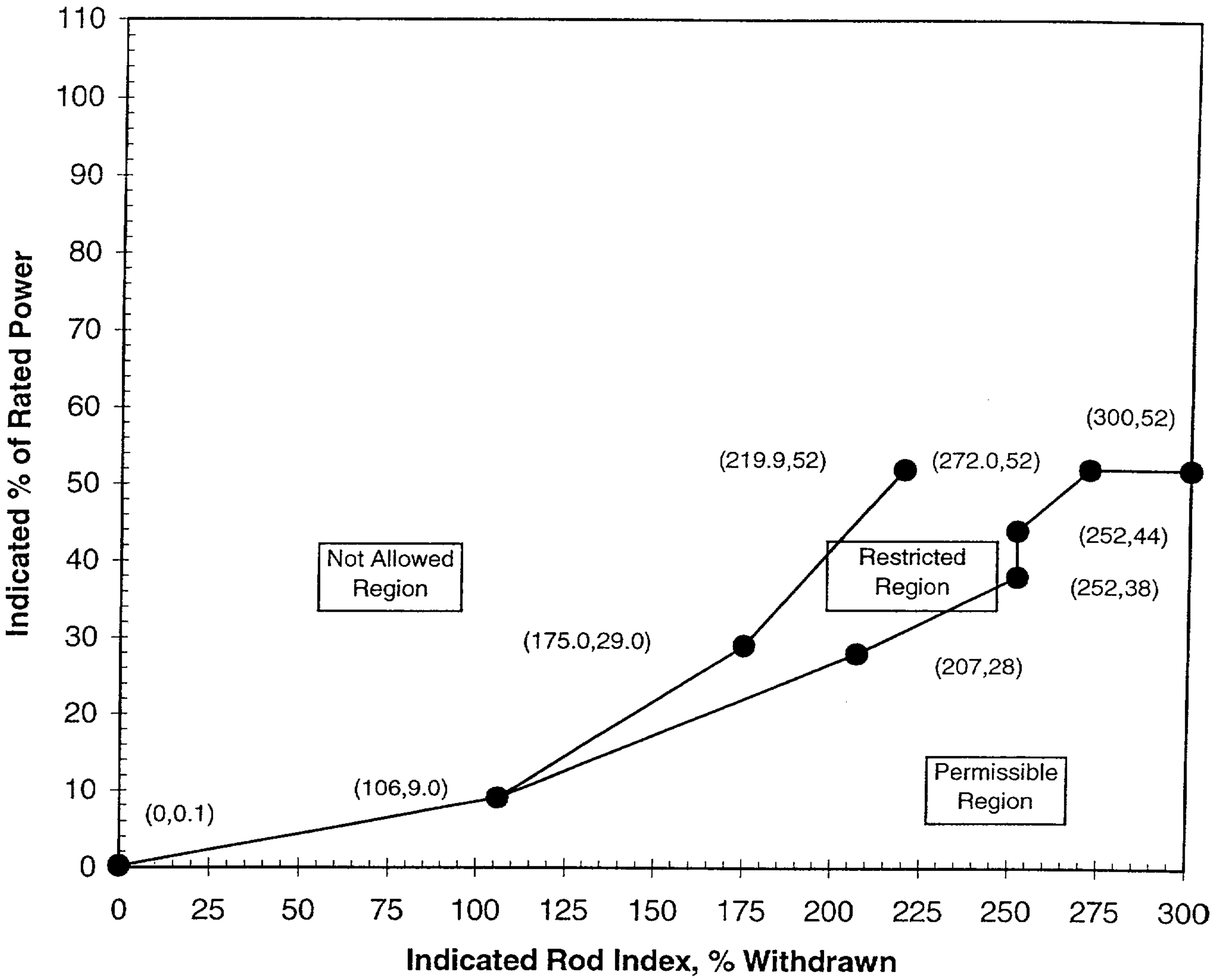
Figure 3 (Page 1 of 2)
Error Adjusted Rod Insertion Limits
(0 to 400 ±10 EFPD; 2 Pump Operation)



A Rod group overlap of 25 ±5% between sequential groups 5 and 6, and 6 and 7 shall be maintained.

This figure is referred to by
TS 3.5.2.5.b & 3.5.2.4.e.3

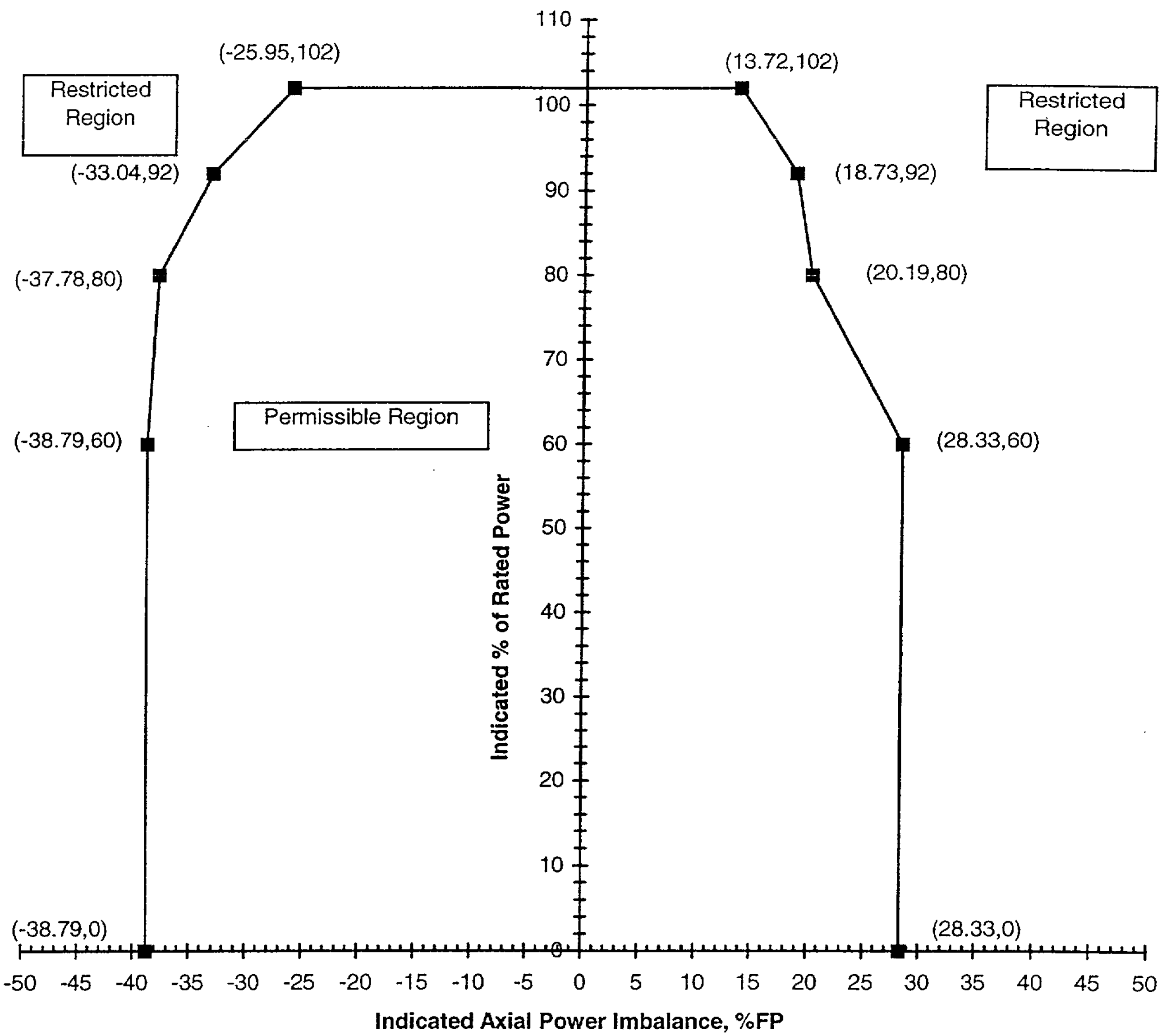
Figure 3 (Page 2 of 2)
Error Adjusted Rod Insertion Limits
(400 ±10 EFPD to EOC; 2 Pump Operation)



A Rod group overlap of 25 ±5% between sequential groups 5 and 6, and 6 and 7 shall be maintained.

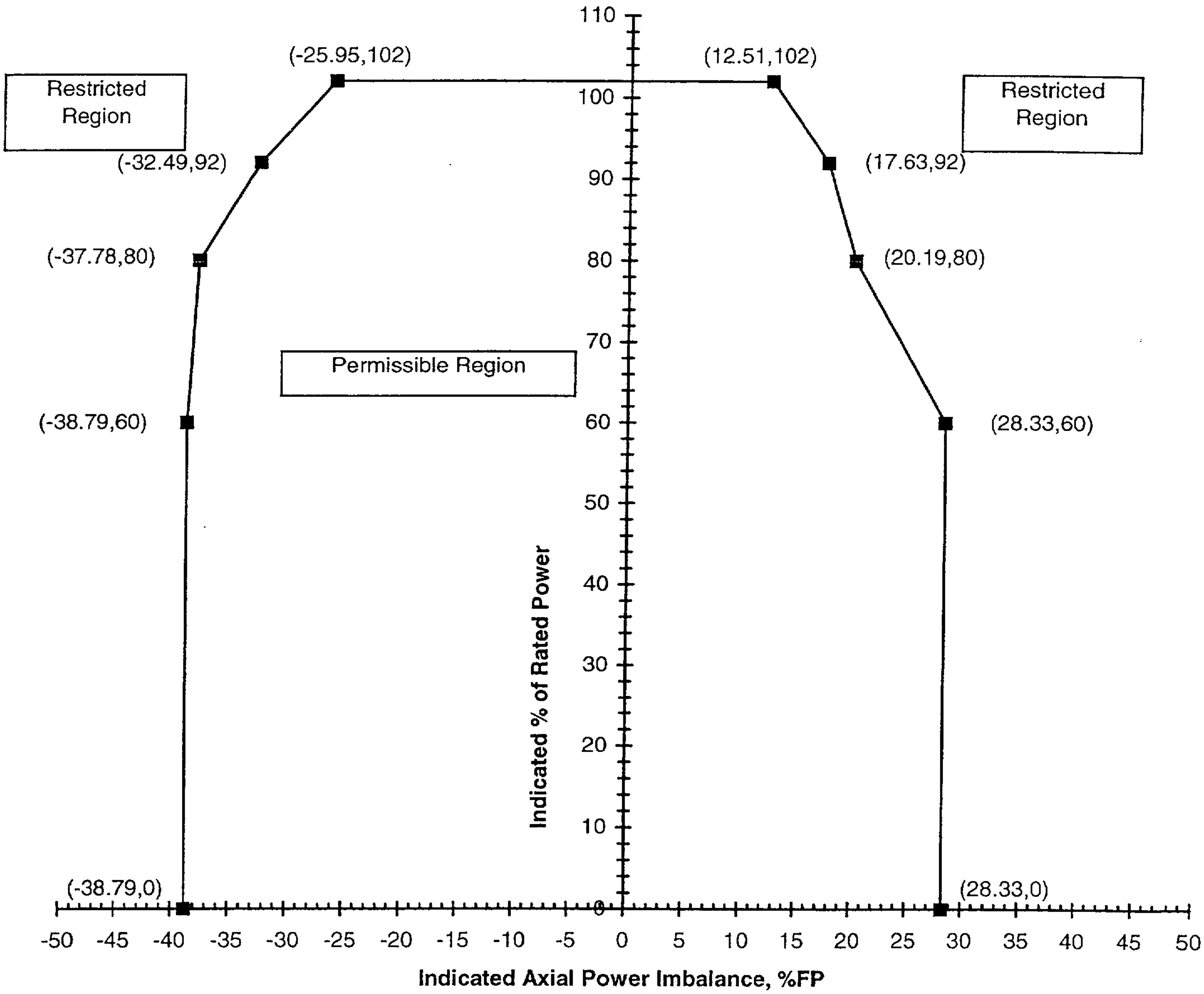
This figure is referred to by
TS 3.5.2.5.b & 3.5.2.4.e.3

Figure 4 (Page 1 of 3)
Full Incore System Error Adjusted Imbalance Limits
(0 to 100 ±10 EFPD)



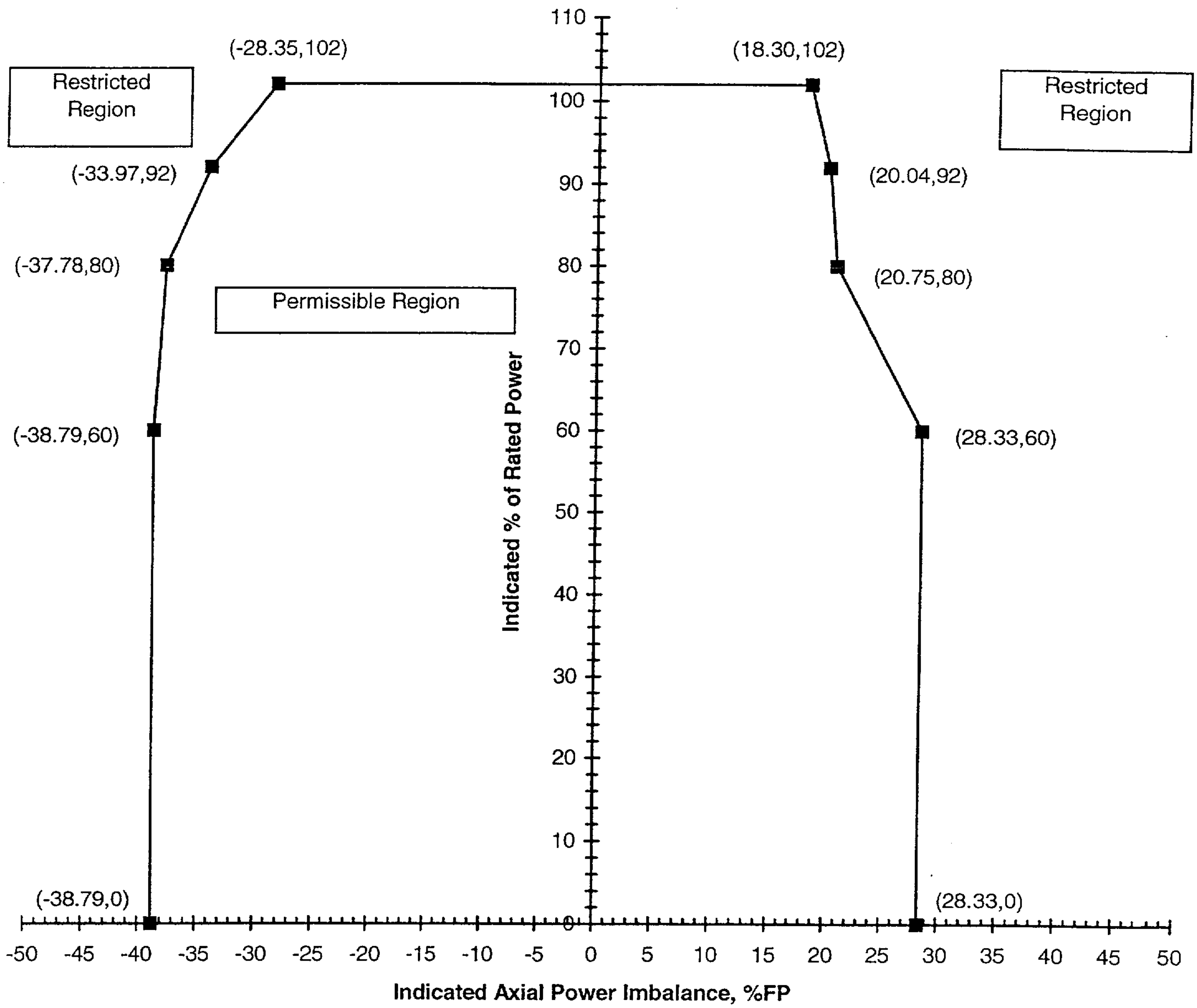
This Figure is referred to by
T.S. 3.5.2.7 & 3.5.2.4.e.4

Figure 4 (Page 2 of 3)
Full Incore System Error Adjusted Imbalance Limits
(100 ±10 to 657 ±10 EFPD)



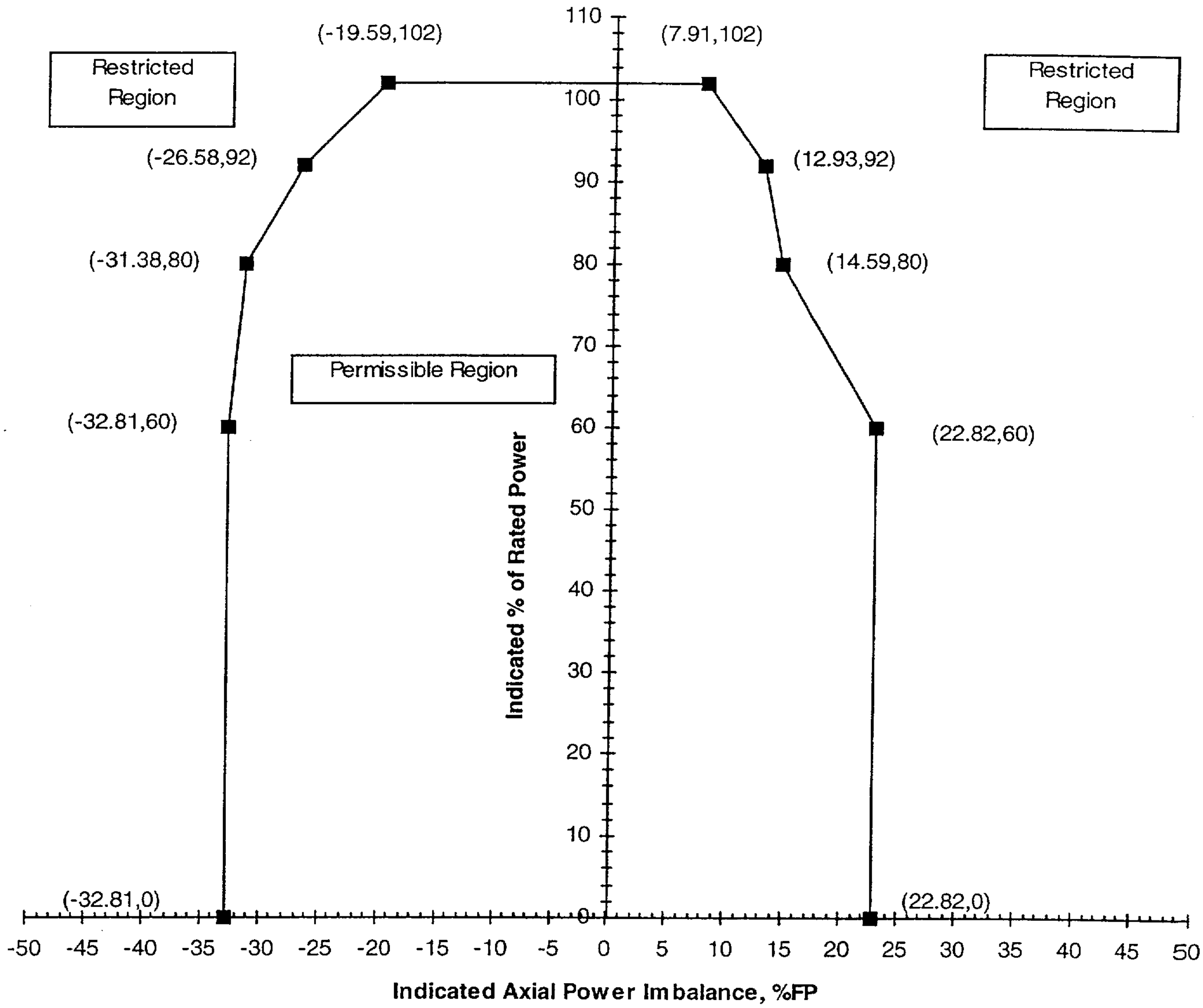
This Figure is referred to by
T.S. 3.5.2.7 & 3.5.2.4.e.4

Figure 4 (Page 3 of 3)
Full Incore System Error Adjusted Imbalance Limits
(657 ±10 EFPD to EOC)



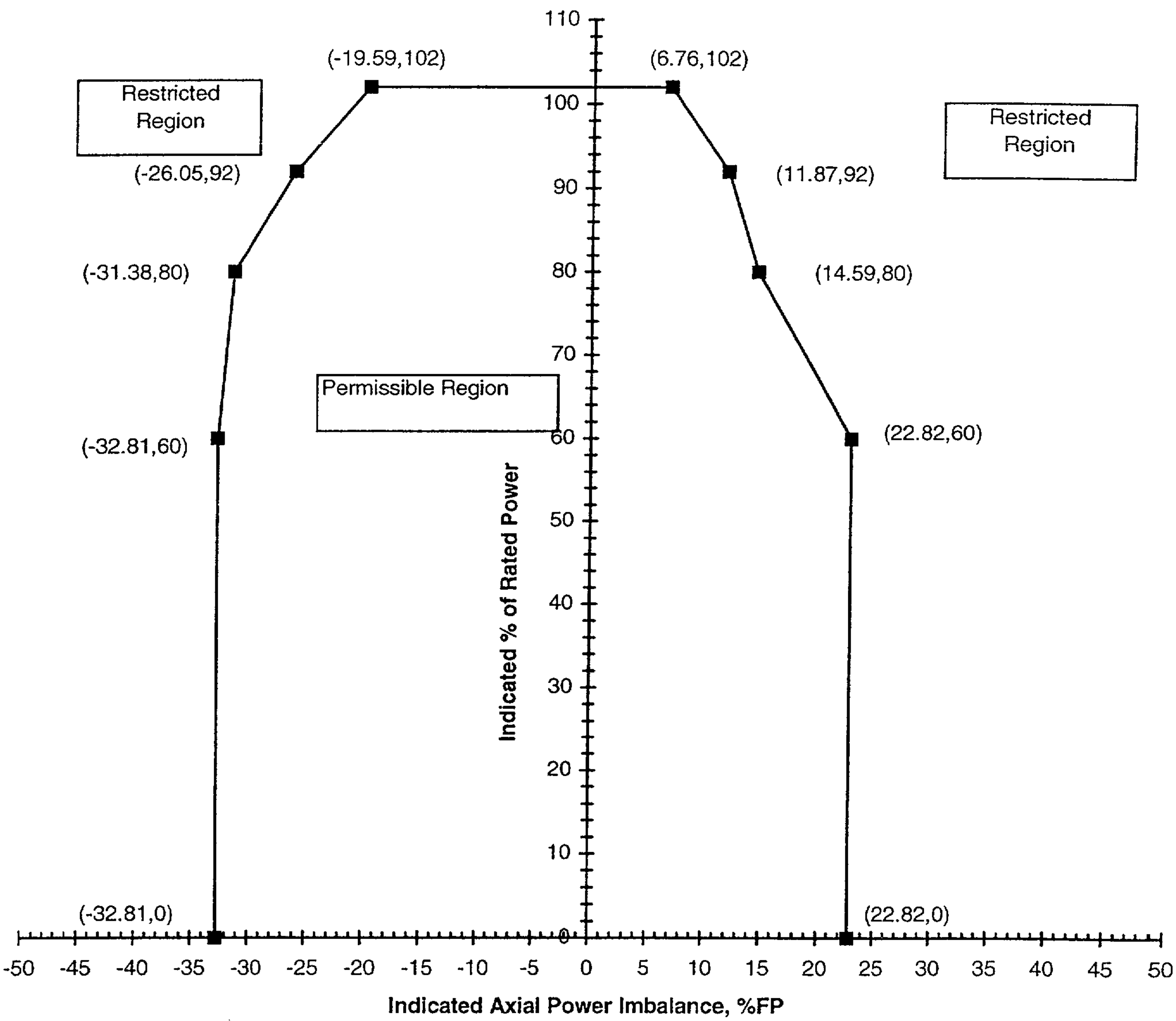
This Figure is referred to by
T.S. 3.5.2.7 & 3.5.2.4.e.4

Figure 5 (Page 1 of 3)
Out-of-Core Detector System Error Adjusted Imbalance Limits
(0 to 100 ±10 EFPD)



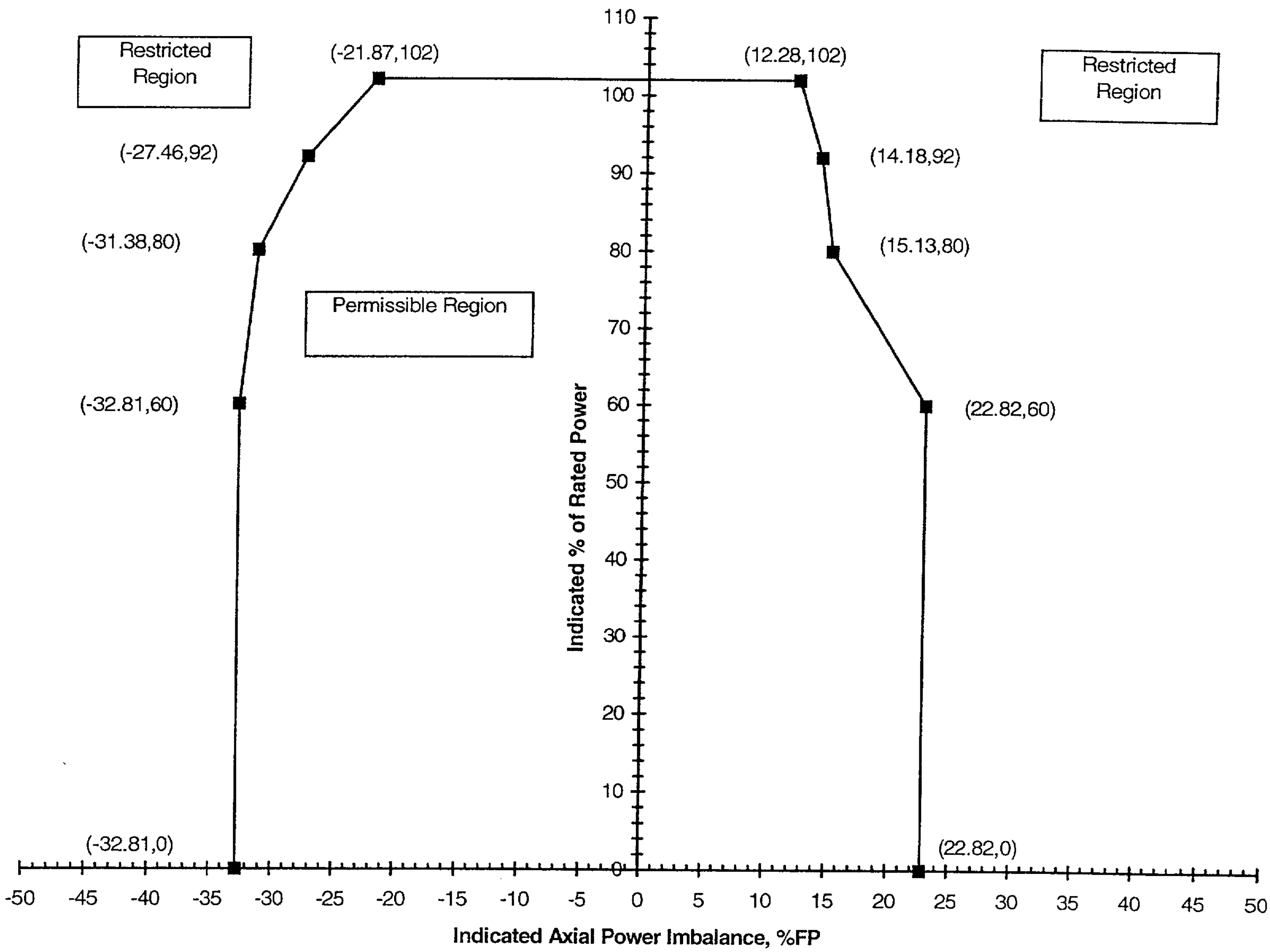
This Figure is referred to by
T.S. 3.5.2.7 & 3.5.2.4.e.4

Figure 5 (Page 2 of 3)
Out-of-Core Detector System Error Adjusted Imbalance Limits
(100 ±10 to 657 ±10 EFPD)



This Figure is referred to by
T.S. 3.5.2.7 & 3.5.2.4.e.4

Figure 5 (Page 3 of 3)
Out-of-Core Detector System Error Adjusted Imbalance Limits
(657 ±10 EFPD to EOC)



This Figure is referred to by
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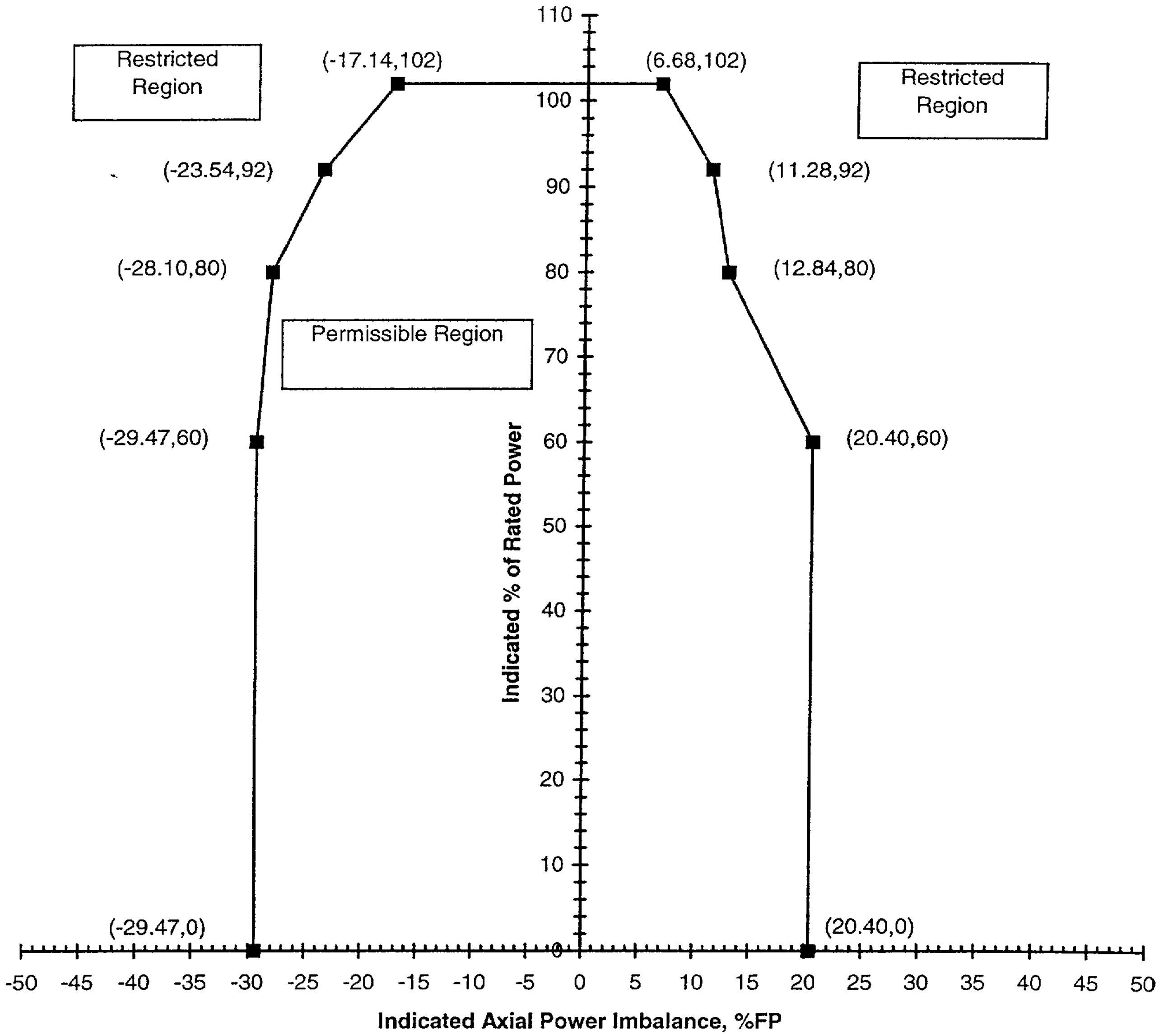
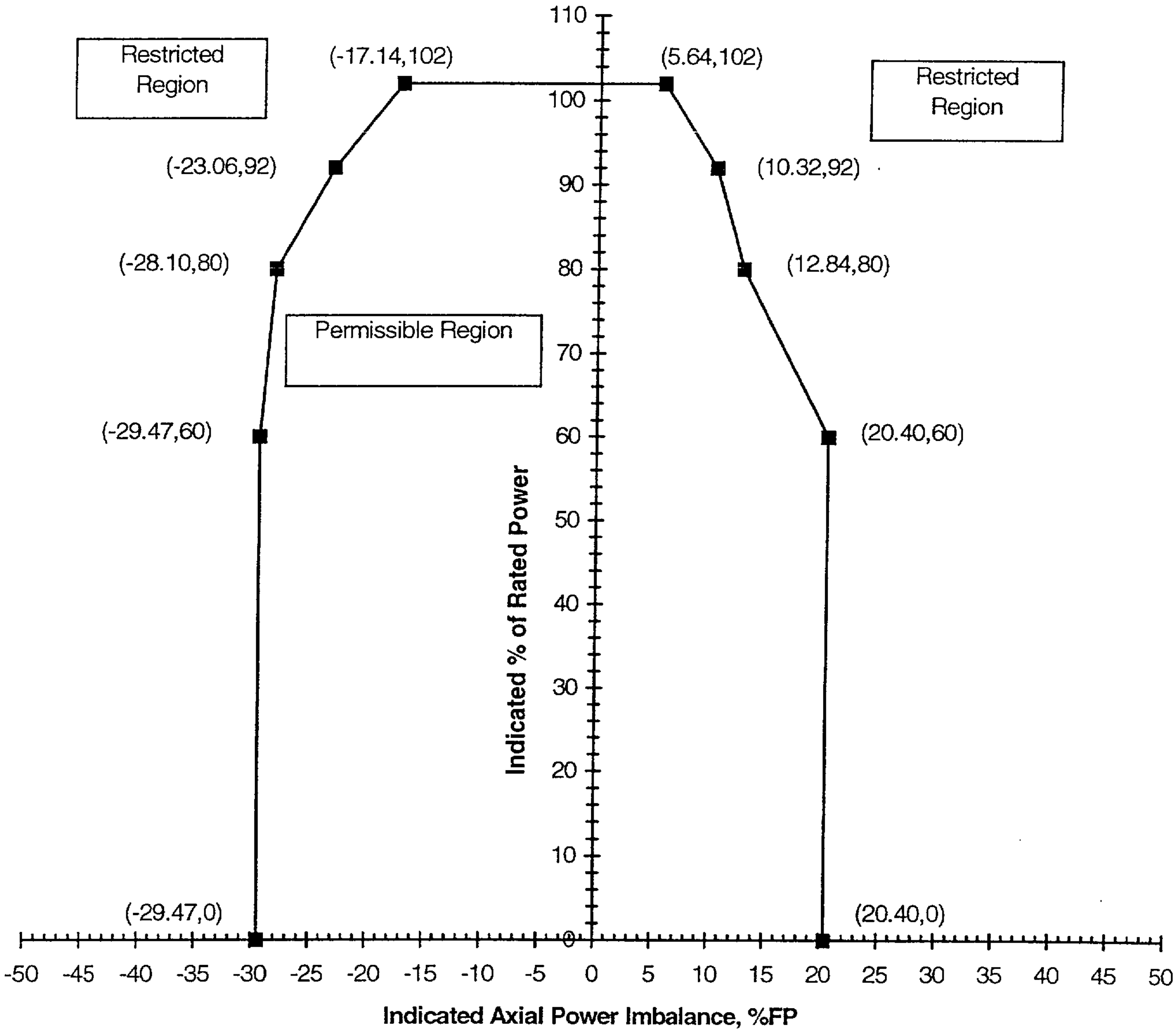
Figure 6 (Page 1 of 3)
Minimum Incore System Error Adjusted Imbalance Limits
(0 to 100 ±10 EFPD)



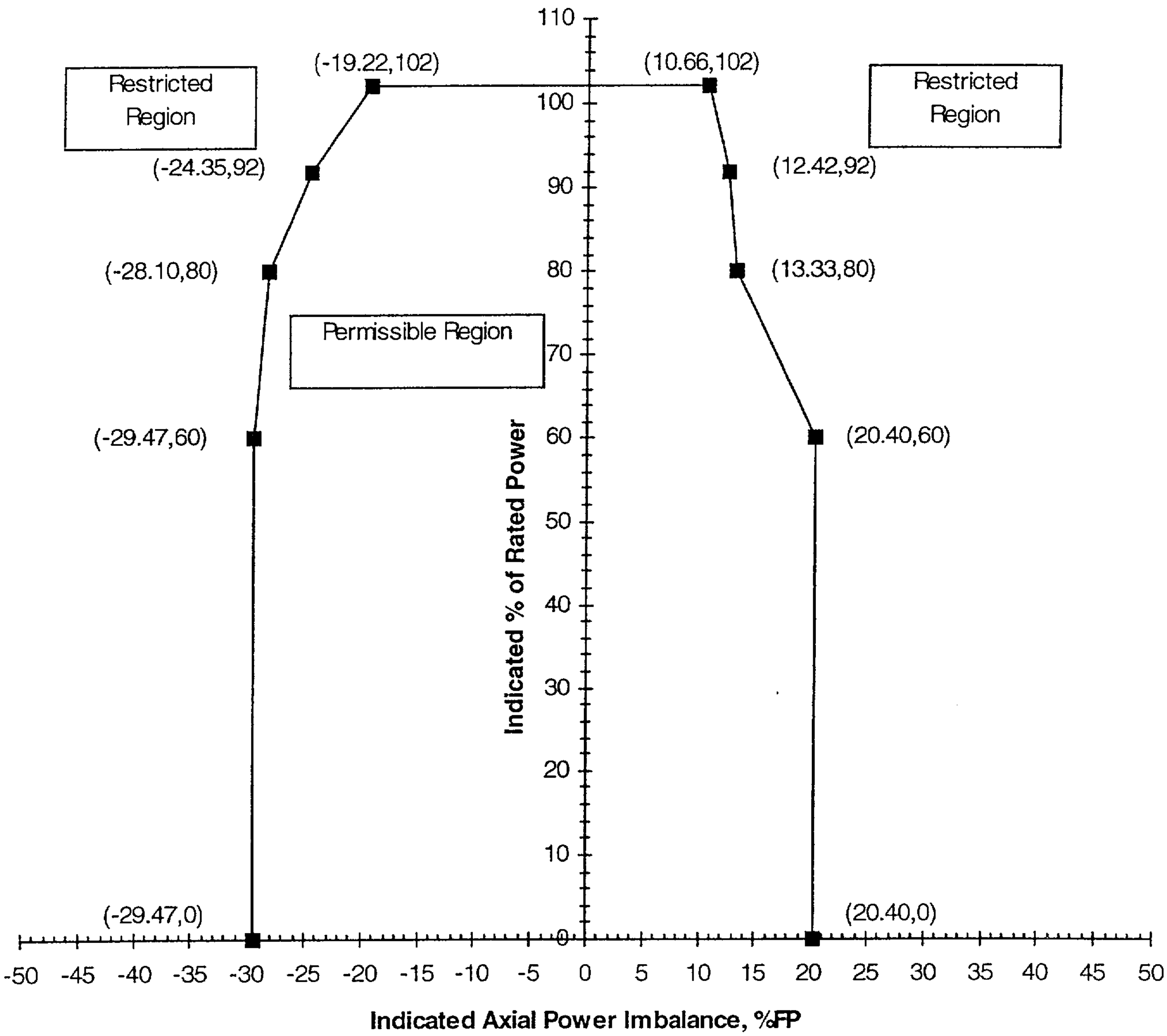
This Figure is referred to by
T.S. 3.5.2.7 & 3.5.2.4.e.4

Figure 6 (Page 2 of 3)
Minimum Incore System Error Adjusted Imbalance Limits
(100 ±10 to 657 ±10 EFPD)



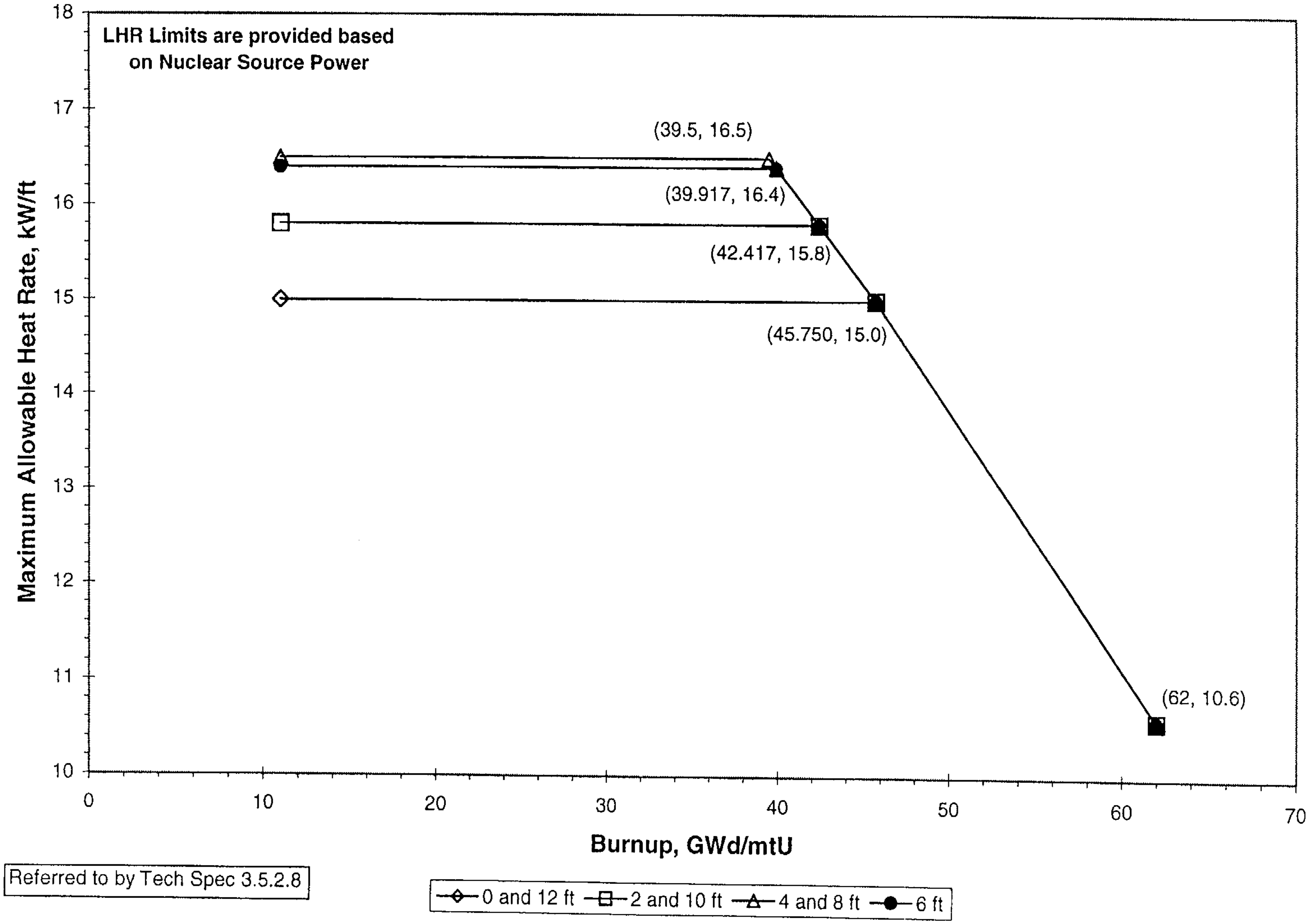
This Figure is referred to by
T.S. 3.5.2.7 & 3.5.2.4.e.4

Figure 6 (Page 3 of 3)
Minimum Incore System Error Adjusted Imbalance Limits
(657 ±10 EFPD to EOC)



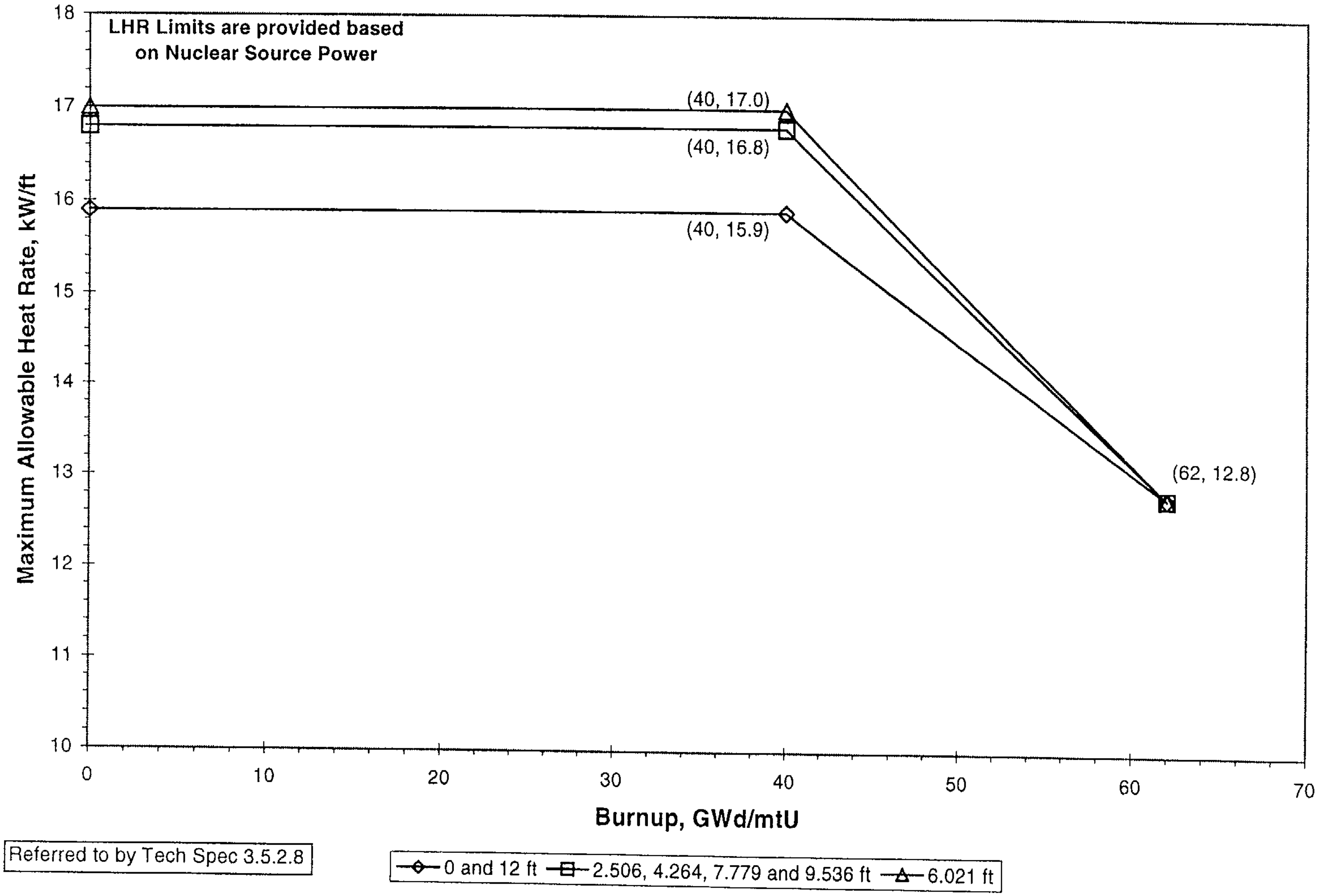
This Figure is referred to by
T.S. 3.5.2.7 & 3.5.2.4.e.4

Figure 7 (Page 1 of 5)
LOCA Limited Maximum Allowable Linear Heat Rates
Mark-B8V Fuel Assemblies



Referred to by Tech Spec 3.5.2.8

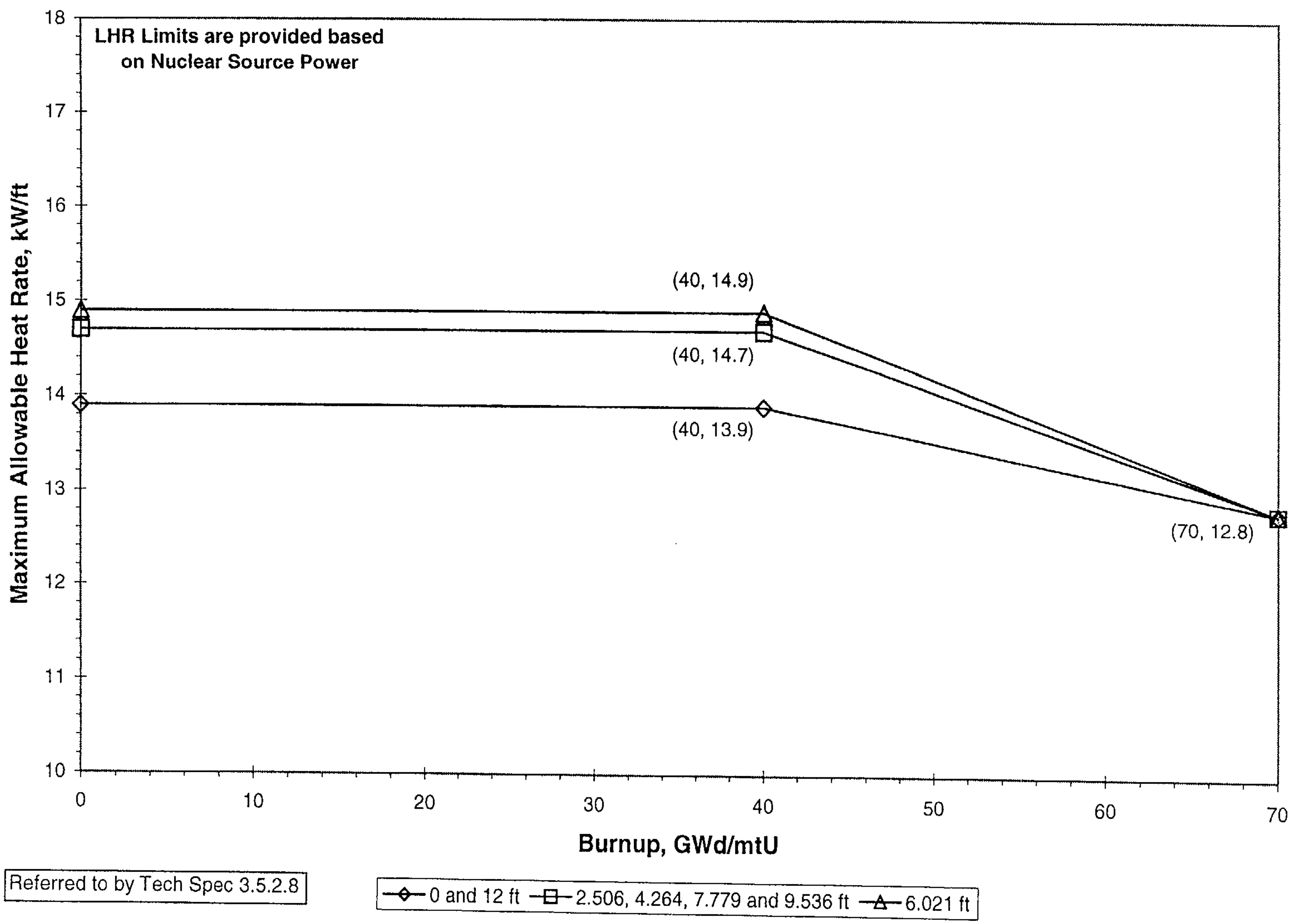
Figure 7 (Page 2 of 5)
LOCA Limited Maximum Allowable Linear Heat Rates
Mark-B10 and Mark-B10P Fuel Assemblies



Referred to by Tech Spec 3.5.2.8

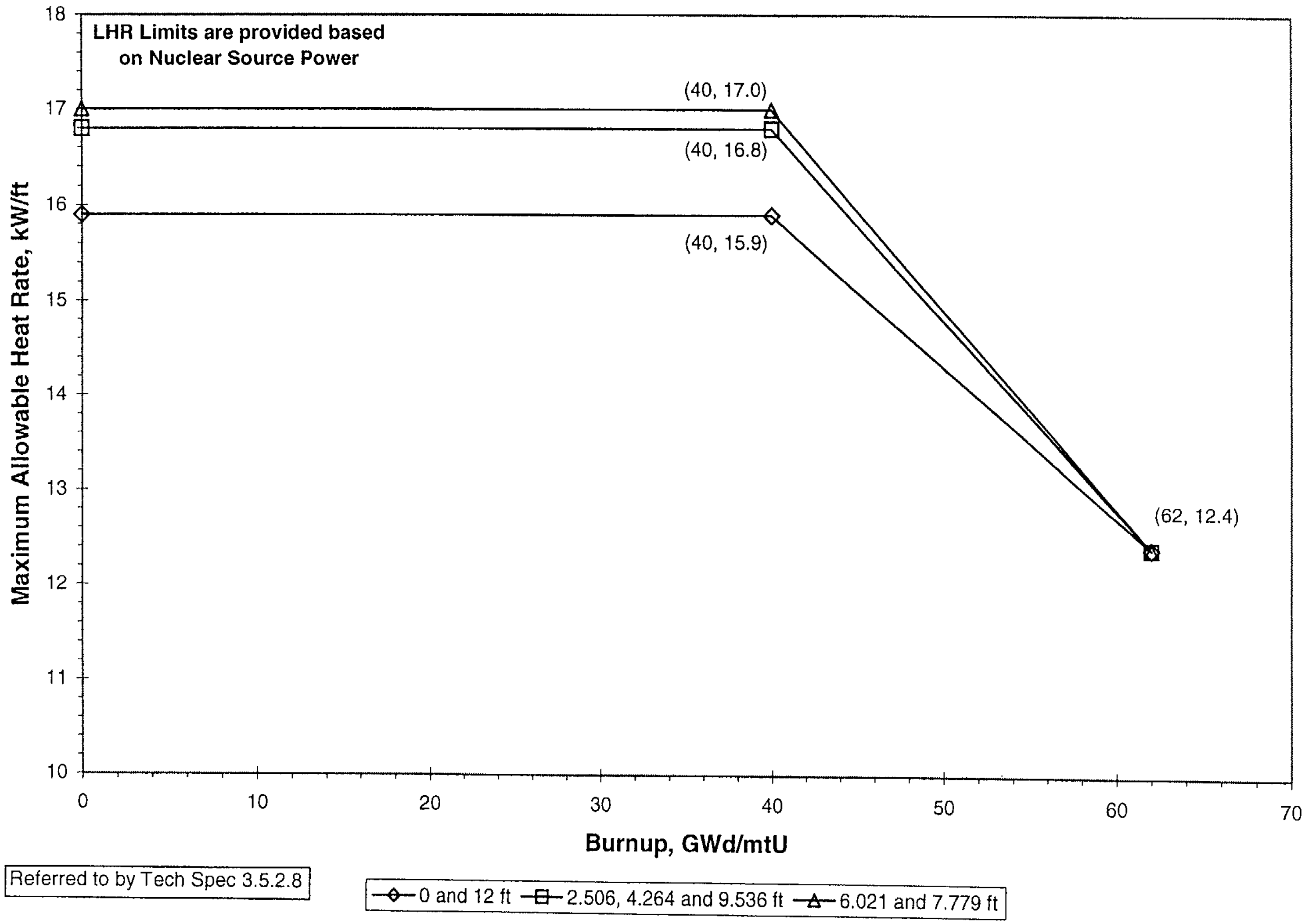
Note: The MALHR of 16.8 kW/ft at the 7.779 ft. elevation is administrative. A limit of 17.3 kW/ft is acceptable providing cycle-specific evaluation of PCT.

Figure 7 (Page 3 of 5)
LOCA Limited Maximum Allowable Linear Heat Rates
Mark-B10 Fuel Assemblies with M5™-Clad High Burnup Test Pins



Referred to by Tech Spec 3.5.2.8

Figure 7 (Page 4 of 5)
LOCA Limited Maximum Allowable Linear Heat Rates
Mark-B12 Fuel Assemblies



Referred to by Tech Spec 3.5.2.8

Figure 7 (Page 5 of 5)
MTC Limit vs. Power Level

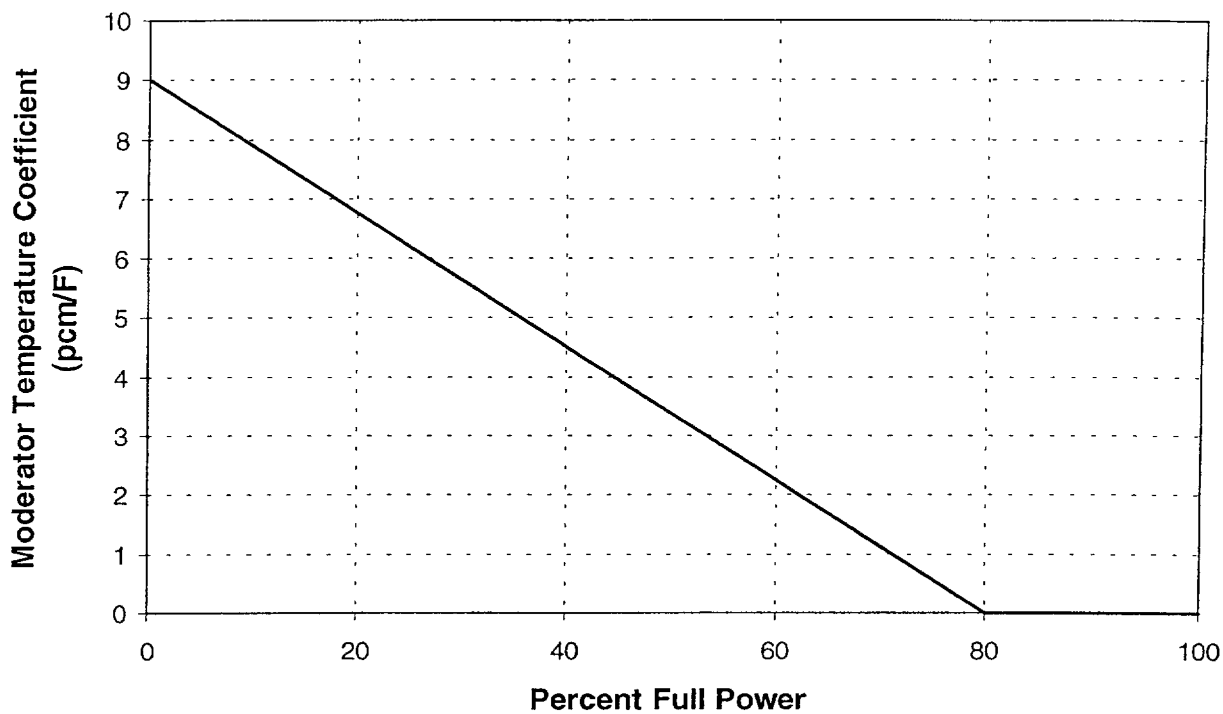
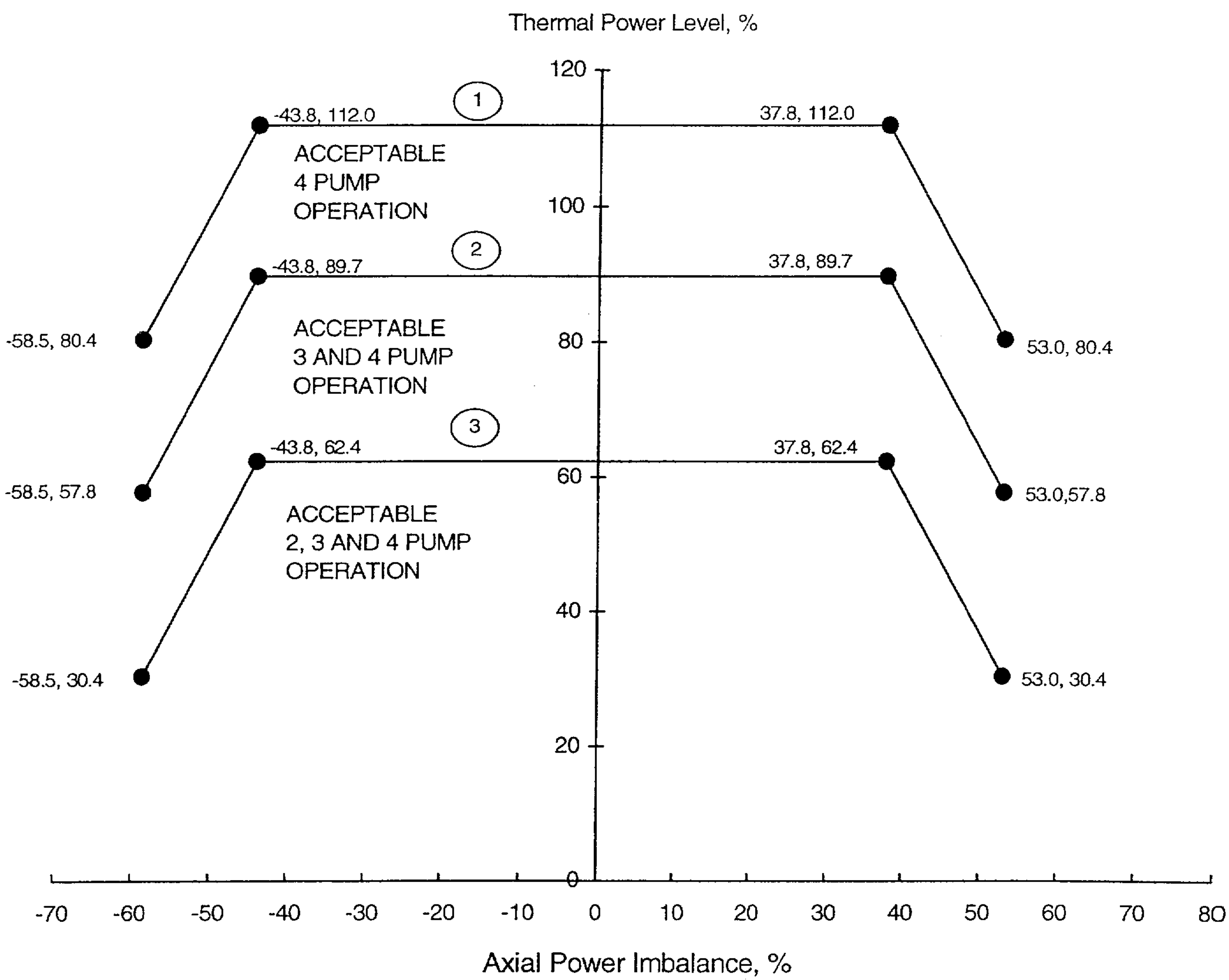
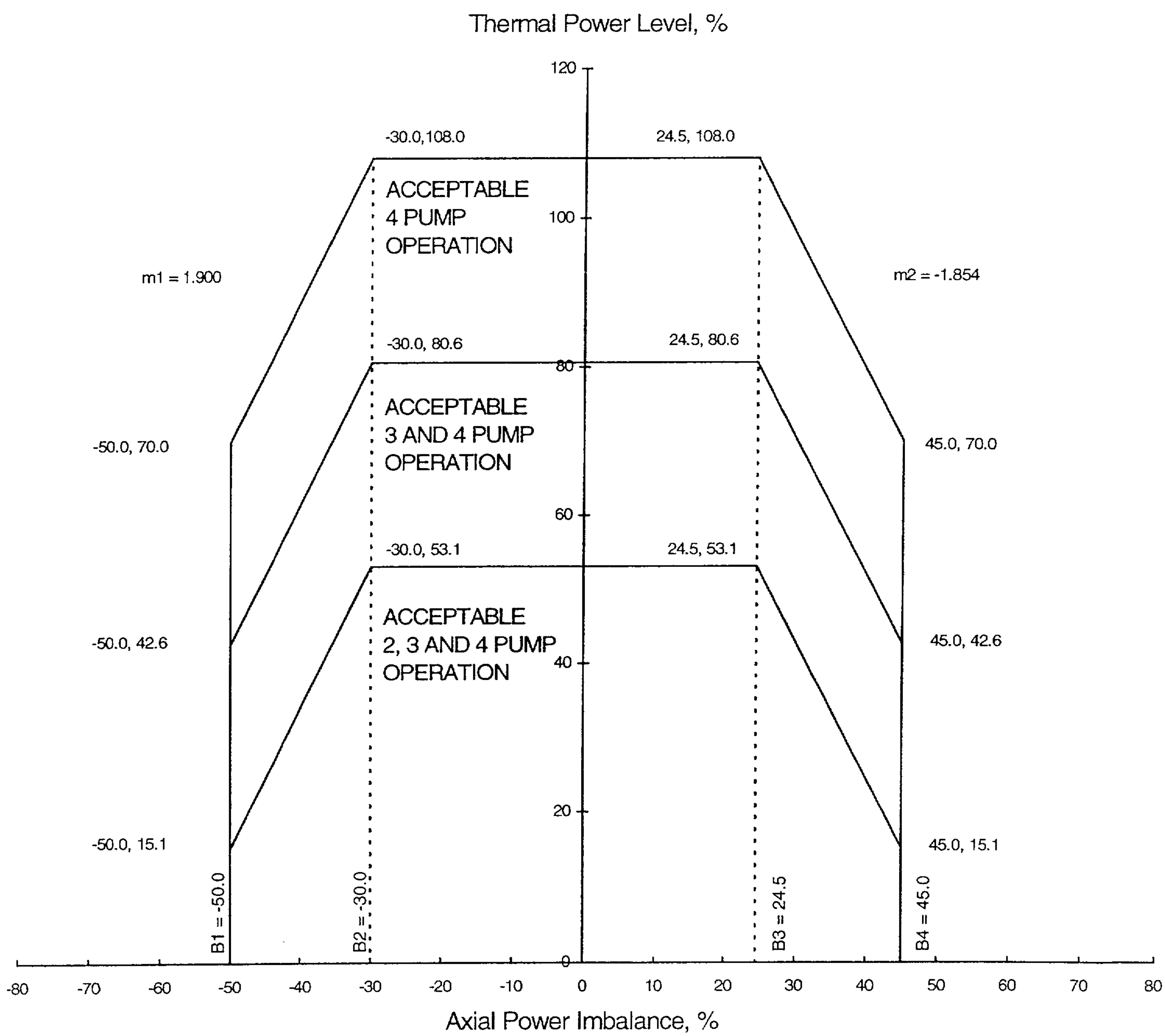


Figure 8
Axial Power Imbalance Protective Limits



CURVE	EXPECTED MINIMUM REACTOR COOLANT FLOW (lb/hr)
1	138.52×10^6
2	103.74×10^6
3	68.47×10^6

Figure 9
Reactor Protection System Maximum Allowable Setpoints
for Axial Power Imbalance



REFERENCES:

1. BAW-10179P-A, Rev. 4, "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses," August 2001.

2. FRA-ANP Doc. No 86-1172640-00, "Detector Lifetime Extension Final Report for TMI-1," September 1988.

3. BAW-10103A, Rev. 3, "ECCS Analysis of B&W's 177-FA Lowered Loop NSS," July 1977.

4. BAW-1915P-A, "Bounding Analytical Assessment of NUREG-0630 Models on LOCA kw/ft Limits with Use of FLECSET," November 1988.

5. BAW-10104P-A, Rev. 5, "B&W ECCS Evaluation Model," November 1988.

6. BAW-2388, "Three Mile Island Unit 1 Cycle 14 Reload Report," June 2001.

7. FRA-ANP Doc. 51-5014984-00, "TMI-1 Cycle 14 Verification Report," October 9, 2001.

Enclosure 1

Operating Limits Not Required by Technical Specifications

1. Core Minimum DNBR Operating Limit

(Reference: BAW-2250)

The core minimum DNBR value as measured with the NAS Thermal Hydraulic Package (Display 1 or 4) should not be less than 2.02 (102% ICDNBR).

2. Maximum Allowable Local Linear Heat Rate Limits

(Reference: T.S. 2.1 Bases)

The maximum allowable local linear heat rate limit is the minimum LHR that will cause centerline fuel melt in the rod. This limit is the basis for the imbalance portions of the Axial Power Imbalance Protective Limits and Setpoints in Figures 8 and 9 of the COLR, respectively. The limit is fuel design-specific; the value for the most limiting fuel design in the current core is used for monitoring as given below:

- FRA-ANP Mark-B8V

  LHR to melt = 20.5 kW/ft

3. Alternate Minimum Boron Requirements for Cold Shutdown

(References: T.S. 3.3.1.1.a, T.S. 3.3. Bases, FSAR 9.2.1.2)

- The BWST is required by Technical Specifications 3.3.1.1.a to be available as a source of borated water to meet ECCS LOCA criteria. The T.S. 3.3.1.1.a requirements also ensure that there is a sufficient source of borated water available to bring the reactor to cold shutdown under normal operating conditions. Although not required by T.S., other sources of borated water can be used in lieu of the BWST for the purpose of achieving cold shutdown under normal operating conditions.

  The minimum boron level needed in the BAMT or RBATs to achieve cold shutdown conditions throughout the cycle is the equivalent of at least 798 ft^3 of 12,500 ppm boron. There is no T.S. requirement to maintain these tanks at this level.

Enclosure 2

DNBR-Related Bases Descriptions

1. Power-to-Flow Trip Setpoints

The nuclear overpower trip setpoint based on RCS flow (power/flow or flux/flow trip) for the current cycle is 1.08. This setpoint applies to four-, three- and two-pump operation as described in T.S. Table 2.3-1 and Figure 9 of the COLR.

The power/flow trip, in combination with the axial power imbalance trip, provides steady-state DNB protection for the Axial Power Imbalance Protective Limit (Figure 8). A reactor trip is initiated when the core power, axial power peaking and reactor coolant flow conditions indicate an approach to the DNBR limit. The power/flow trip also provides transient protection for loss of reactor coolant flow events, such as loss of one RC pump from a four RC pump operating condition and a locked rotor accident.

Power level and reactor flow rate combinations for four-, three- and two-pump operating conditions are as follows:

1. Trip would occur when four reactor coolant pumps are operating if power level is 108 percent and flow rate is 100 percent, or power level is 100 percent and flow rate is 92.5 percent.

2. Trip would occur when three reactor coolant pumps are operating if power level is 80.6 percent and flow rate is 74.7 percent or power level is 75 percent and flow rate is 69.4 percent.

3. Trip would occur when one reactor coolant pump is operating in each loop (total of two pumps operating) if power level is 53.1 percent and flow rate is 49.2 percent or power level is 49 percent and flow rate is 45.4 percent.

The power level trip and associated reactor power/axial power imbalance boundaries are reduced by the power-to-flow ratio as a percent (1.08 percent) for each one percent flow reduction.

2. Design Nuclear Power Peaking Factors

(Reference: T.S. 2.1 Bases)

The design nuclear power peaking factors given below define the reference design peaking condition in the core for operation at the maximum overpower. These peaking factors serve as the basis for the pressure/temperature core protection safety limits and the power-to-flow limit that prevent cladding failure due to DNB overheating.

- Nuclear Enthalpy Rise Hot Channel Factor (Radial-Local Peaking Factor), $F^N_{\Delta H}$
- $F^N_{\Delta H} = 1.714$

- Axial Flux Shape Peaking Factor, F^N_Z

  $F^N_Z = 1.65$ (cosine with tails)

- Total Nuclear Power Peaking Factor, F^N_q

- $F^N_q = F^N_{\Delta H} \times F^N_Z$

  $F^N_q = 2.828$