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U. S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

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

Subject: Cycle 16 Core Operating Limits Report, COLR TMI 1, Revision 2

Pursuant to TMI Unit 1 Technical Specification Section 6.9.5.4, enclosed is a copy of the Cycle 16 Core Operating Limits Report, COLR TMI 1, Revision 2. The Cycle 16 Core Operating Limits Report, COLR TMI 1, Revision 2, provides the cycle-specific limits established to support operation of Cycle 16 up to 705 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.

Since the Cycle 16 Core Operating Limits Report, COLR TMI 1, Revision 1 has been replaced by the enclosed Cycle 16 Core Operating Limits Report, COLR TMI 1, Revision 2 prior to startup of the new operating cycle, the Cycle 16 Core Operating Limits Report, COLR TMI 1, Revision 1 has not been submitted to the NRC.

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

Respectfully,

Pamela B. Cowan

Pamela B. Cowan
Director - Licensing & Regulatory Affairs
AmerGen Energy Company, LLC

Enclosure: TMI-1 Cycle 16 Core Operating Limits Report, COLR TMI 1, Revision 2

cc: S. J. Collins, USNRC, Administrator, Region I
F. E. Saba, USNRC, Project Manager, TMI Unit 1
D. M. Kern, USNRC, Senior Resident Inspector, TMI Unit 1
File No. 95055

ENCLOSURE

CYCLE 16 CORE OPERATING LIMITS REPORT

COLR TMI 1, REVISION 2

AmerGen

TMI-1 Cycle 16
Core Operating Limits Report

COLR TMI 1
Rev. 2

R. Jaffa	Preparer	11/11/05 Date
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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 and 2 and were documented in Reference 3. 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 705 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 during the 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 8. 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 8 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 4-8) 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)

Display 4 of the Core Monitoring System 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 9 indicates the LOCA limited maximum allowable linear heat rates as a function of fuel rod burnup and fuel elevation for Mark-B10 and Mark-B12 fuel types. Bounding values for monitoring these limits for the current cycle in terms of fuel batch, fuel rod burnup and core elevation 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 3 of Figure 9, is preserved by the cycle design.

> Note: Figures 10 and 11 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.

COLR Figure 10 provides the Axial Power Imbalance Protective Limits (APIPL) that preserve the DNBR and Centerline Fuel Melt design criteria.

COLR Figure 11 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 10 are not exceeded.

Enclosure 1 contains operating limits not required by TS. The Maximum Allowable Local Linear Heat Rate limits are monitored by the Process Computer core monitoring system 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

The Axial Power Shaping Rods (APSRs) shall be inserted at the initial startup following fuel reload and may be positioned as necessary during the Power Imbalance Detector Correlation (PIDC) test. The APSRs shall be withdrawn from the core before exceeding 4 EFPD and prior to thermal power escalation above 80% RTP. Once the APSR pull maneuver has been completed, the APSRs shall not be inserted for the remainder of the fuel cycle during normal operation and 0-99% WD shall be considered a "Restricted Region" as defined in the abstract section of this COLR.

Note: Periodic movement of the APSRs to verify their operability required by Technical Specification 4.7.1 is allowed provided that the APSRs are returned to the fully withdrawn position each time the verification is completed.

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

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**	**4.53**	**16.8**
Minimum Incore System (MIS)	**2.78**	**1.90**	**9.5**

Note: If the Full Incore System (FIS) is inoperable, FIS tilt limits are applicable to the Out-of-Core (OCD) Detector System following the guidance in 1203-7, Hand Calculations for Quadrant Power Tilt and Core Power Imbalance.

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 [a])

UO_2 LOCA Limits

Batch 13N

Core Elevation (feet)	0 MWd/mtU	40,000 MWd/mtU	62,000 MWd/mtU
0.000	15.9	15.9	12.8
2.506	16.8	16.8	12.8
4.264	16.8	16.8	12.8
6.021	17.0	17.0	12.8
7.779	16.8	16.8	12.8
9.536	16.8	16.8	12.8
12.000	15.9	15.9	12.8

Batch 16 & 17

Core Elevation (feet)	0 MWd/mtU	40,000 MWd/mtU	62,000 MWd/mtU
0.000	15.9	15.9	12.4
2.506	16.8	16.8	12.4
4.264	16.8	16.8	12.4
6.021	17.0	17.0	12.4
7.779	17.0	17.0	12.4
9.536	16.8	16.8	12.4
12.000	15.9	15.9	12.4

Batch 18[b]

Core Elevation (feet)	0 MWd/mtU	40,000 MWd/mtU	62,000 MWd/mtU
0.000	15.7	15.7	12.2
2.506	16.6	16.6	12.2
4.264	16.6	16.6	12.2
6.021	17.0	17.0	12.4
7.779	17.0	17.0	12.4
9.536	16.8	16.8	12.4
12.000	15.9	15.9	12.4

[a] Linear interpolation for allowable linear heat rate limits between specified burnup points and core elevation points is valid for these tables.

[b] The kW/ft limits were reduced by 0.2 kW/ft from 0 to 4.264 feet based on compliance with SER to BAW-10192-A.

Note: LHR limits provided are based on nuclear source power.

Table 2 (Continued)

Gadolinia Fuel LOCA Limits

Batch 16 2 w/o Gd

Core Elevation (feet)	0 MWd/mtU	40,000 MWd/mtU	62,000 MWd/mtU
0.000	15.1	15.1	12.0
2.506	15.9	15.9	12.0
4.264	15.9	15.9	12.0
6.021	16.1	16.1	12.0
7.779	16.1	16.1	12.0
9.536	15.9	15.9	12.0
12.000	15.1	15.1	12.0

Batch 17 3 w/o Gd

Core Elevation (feet)	0 MWd/mtU	40,000 MWd/mtU	62,000 MWd/mtU
0.000	14.4	14.4	11.7
2.506	15.2	15.2	11.7
4.264	15.2	15.2	11.7
6.021	15.4	15.4	11.7
7.779	15.4	15.4	11.7
9.536	15.2	15.2	11.7
12.000	14.4	14.4	11.7

Batch 17 8 w/o Gd

Core Elevation (feet)	0 MWd/mtU	40,000 MWd/mtU	62,000 MWd/mtU
0.000	13.5	13.5	11.0
2.506	14.2	14.2	11.0
4.264	14.2	14.2	11.0
6.021	14.4	14.4	11.0
7.779	14.4	14.4	11.0
9.536	14.2	14.2	11.0
12.000	13.5	13.5	11.0

[a] Linear interpolation for allowable linear heat rate limits between specified burnup points and core elevation points is valid for these tables.

Note: LHR limits provided are based on nuclear source power.

Table 2 (Continued)

Gadolinia Fuel LOCA Limits

Batch 18 2 w/o Gd(b)

Core Elevation (feet)	0 MWd/mtU	40,000 MWd/mtU	62,000 MWd/mtU
0.000	14.9	14.9	11.8
2.506	15.7	15.7	11.8
4.264	15.7	15.7	11.8
6.021	16.1	16.1	12.0
7.779	16.1	16.1	12.0
9.536	15.9	15.9	12.0
12.000	15.1	15.1	12.0

Batch 18 3 w/o Gd(b)

Core Elevation (feet)	0 MWd/mtU	40,000 MWd/mtU	62,000 MWd/mtU
0.000	14.2	14.2	11.5
2.506	15.0	15.0	11.5
4.264	15.0	15.0	11.5
6.021	15.4	15.4	11.7
7.779	15.4	15.4	11.7
9.536	15.2	15.2	11.7
12.000	14.4	14.4	11.7

Batch 18 8 w/o Gd(b)

Core Elevation (feet)	0 MWd/mtU	40,000 MWd/mtU	62,000 MWd/mtU
0.000	13.3	13.3	10.8
2.506	14.0	14.0	10.8
4.264	14.0	14.0	10.8
6.021	14.4	14.4	11.0
7.779	14.4	14.4	11.0
9.536	14.2	14.2	11.0
12.000	13.5	13.5	11.0

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

(b) The kW/ft limits were reduced by 0.2 kW/ft from 0 to 4.264 feet based on compliance with SER to BAW-10192-A.

Note: LHR limits provided are based on nuclear source power.

Table 2 (Continued)

The maximum linear heat rate for each CMS level, as measured with the FIDMS Thermal Hydraulic Package, should not be greater than the corresponding bounding value from Table 2 above. FIDMS 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 (5.71 kW/ft) and the current fraction of rated power.

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

	Axial Peak Elevation (Fraction of Core Height)			
Axial Peak	**0.2**	**0.4**	**0.6**	**0.8**
1.1	1.9672	1.9607	1.9489	1.9206
1.2	2.0312	2.0162	1.9922	1.8995
1.3	2.0857	2.0625	1.9786	1.8412
1.5	2.1091	1.9760	1.8378	1.7103
1.7	1.9522	1.8285	1.7060	1.5963
1.9	1.8011	1.6959	1.5905	1.4944

The maximum radial peak for each fuel assembly, as measured with the Core Monitoring System (CMS)at the elevation where the assembly axial peak occurs, should not be greater than the corresponding bounding value from Table 3 above. CMS 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.

Notes: 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:

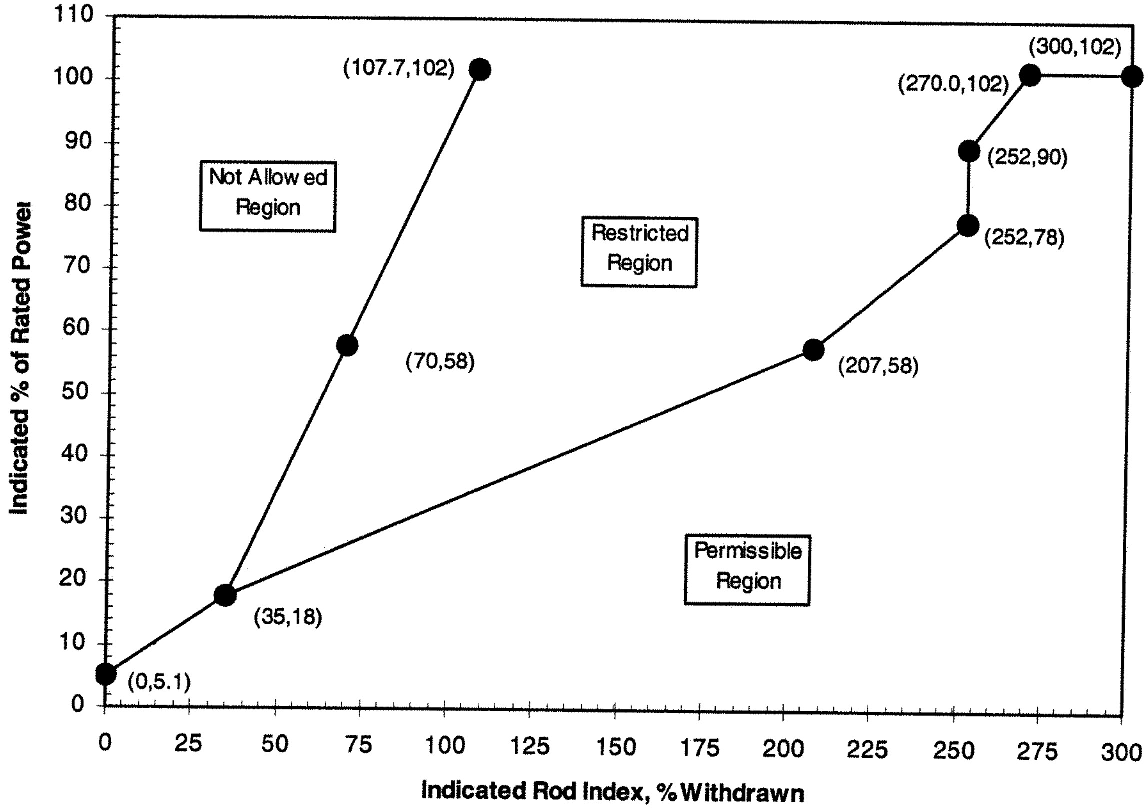
$F^N_{\Delta H}$ limit = (LCO DNB MARP) * [1 + 0.3 * (1 – P/P_m)]

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.

These limits have been increased to reflect the 3.8% peaking uncertainty treated by Statistical Core Design (SCD) methodology.

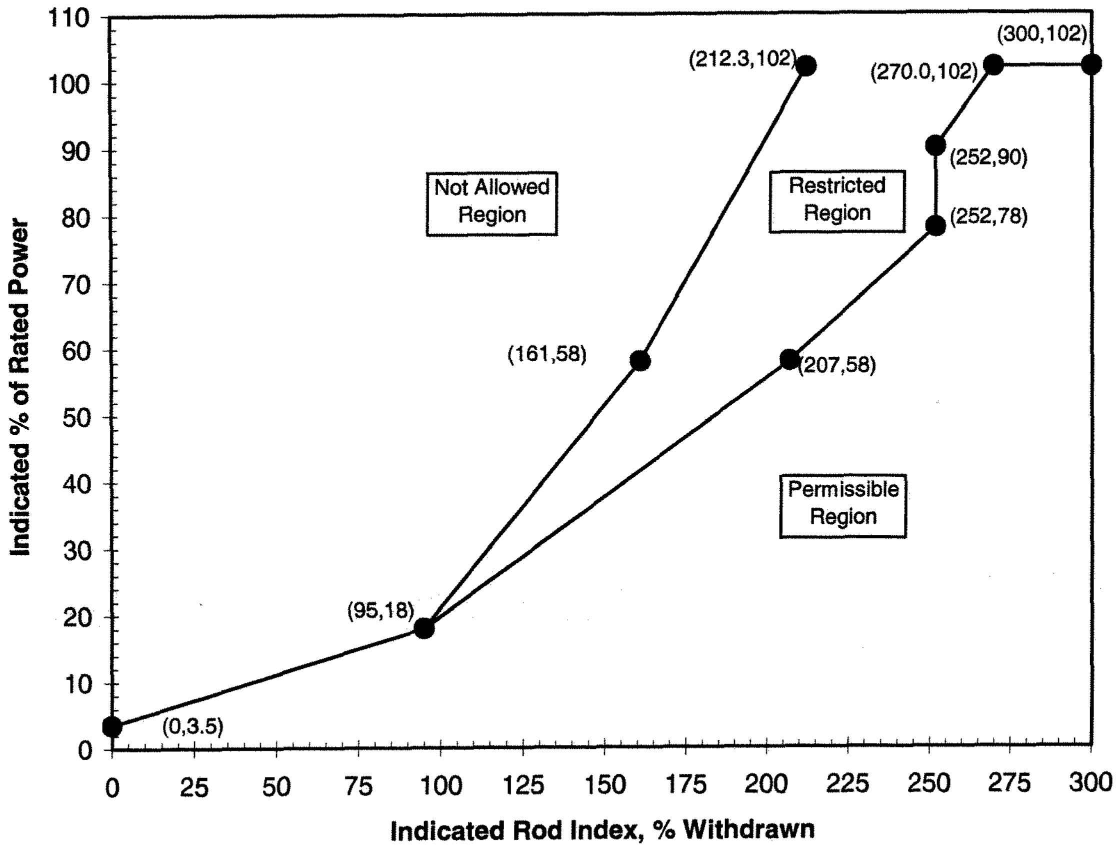
Figure 1 (Page 1 of 2)
Error Adjusted Rod Insertion Limits
(0 to 400 ±10 EFPD; 4 Pump Operation)



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

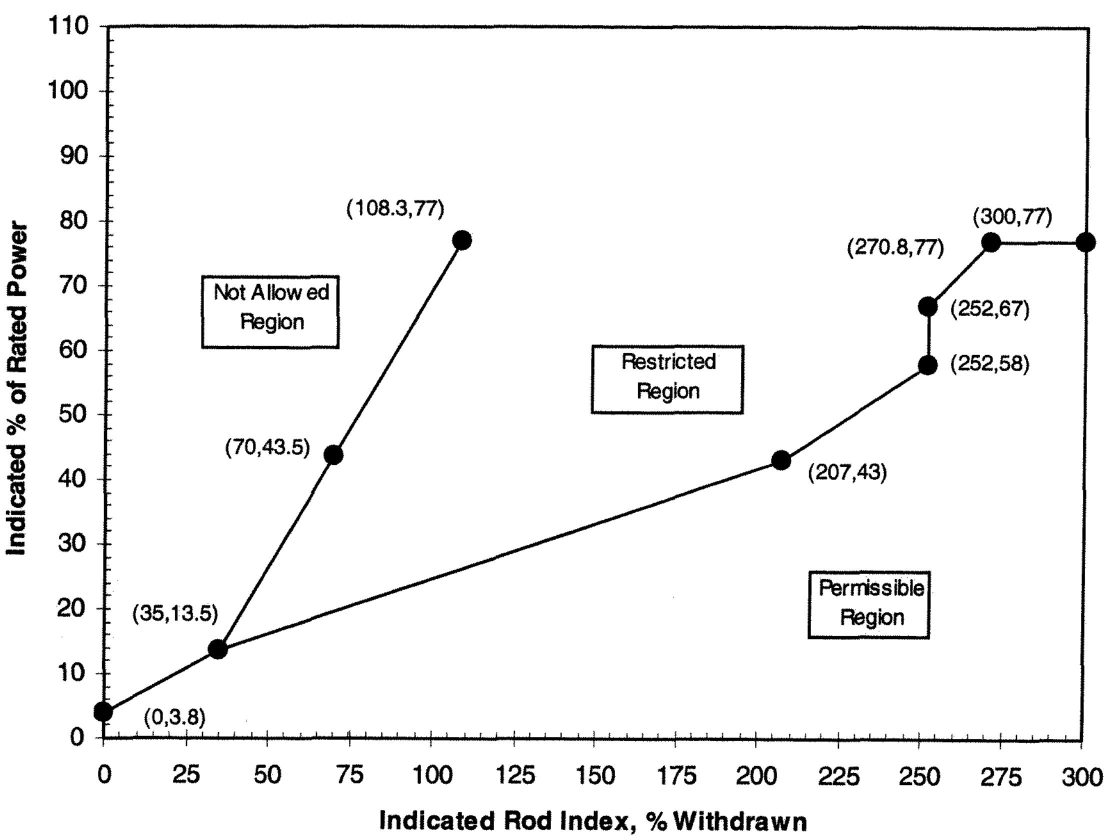
Figure 1 (Page 2 of 2)
Error Adjusted Rod Insertion Limits
(400 ±10 EFPD to EOC; 4 Pump Operation)



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

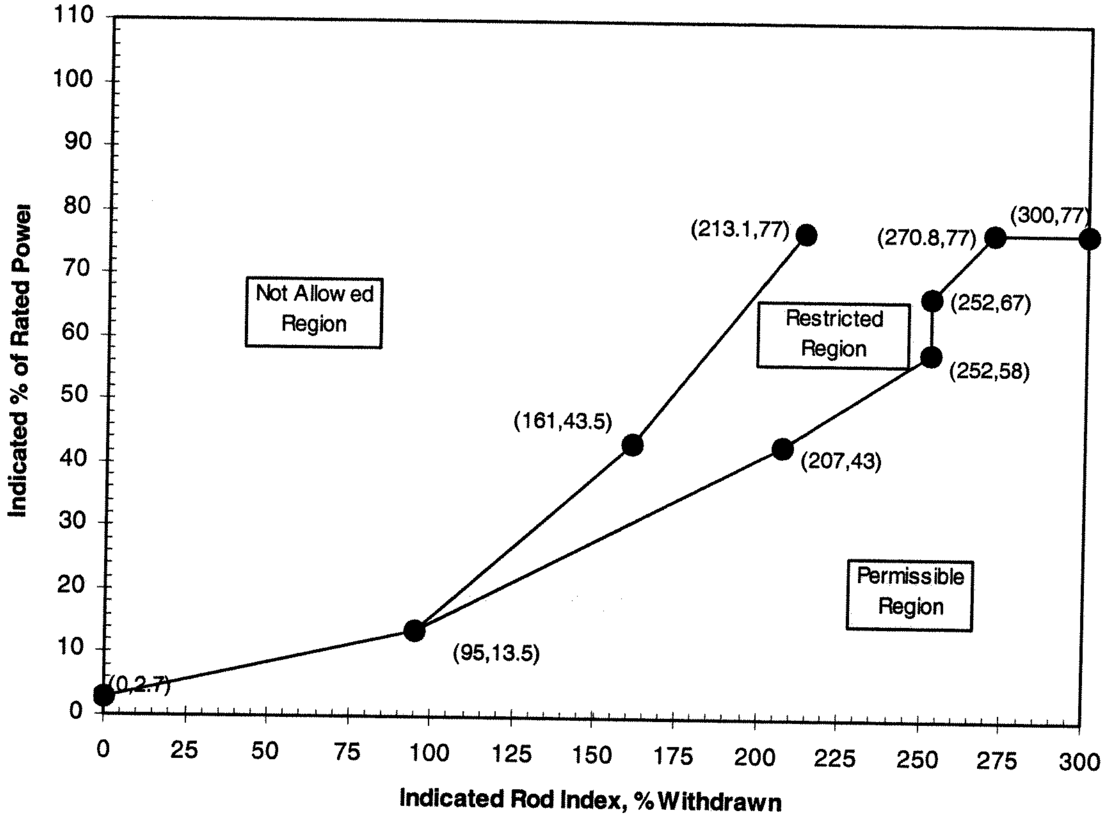
Figure 2 (Page 1 of 2)
Error Adjusted Rod Insertion Limits
(0 to 400 ±10 EFPD; 3 Pump Operation)



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

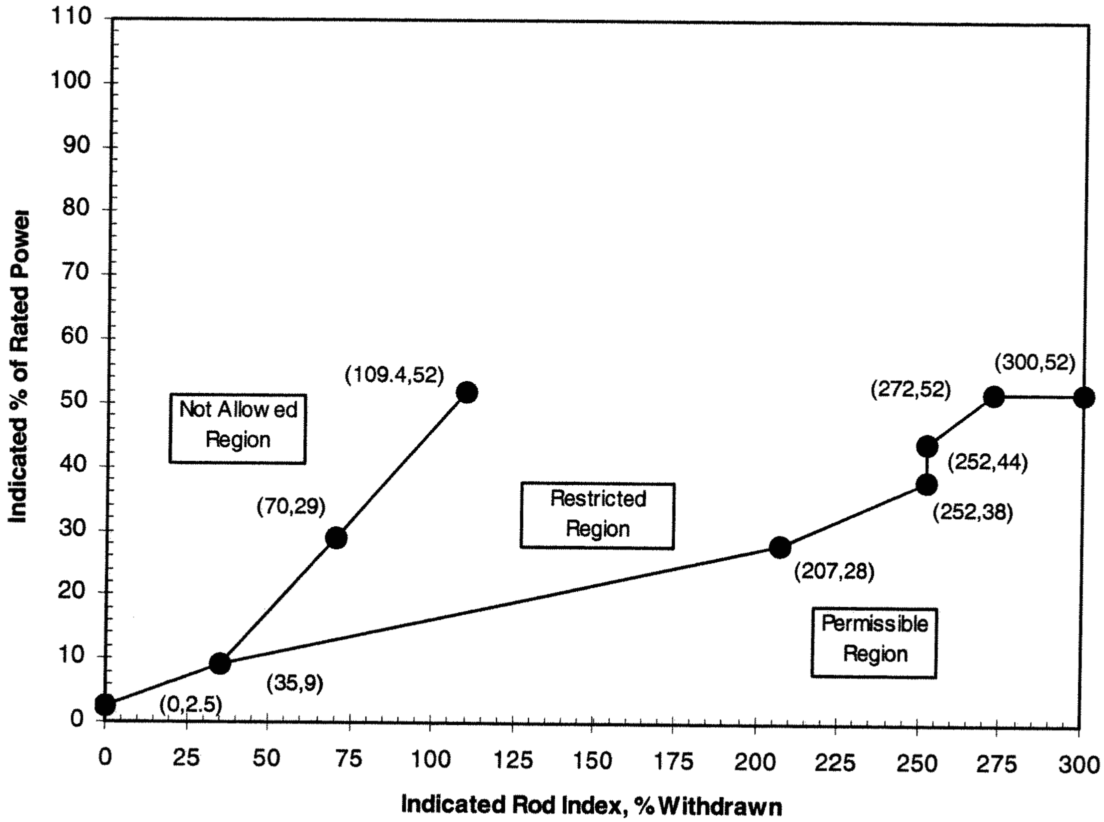
Figure 2 (Page 2 of 2)
Error Adjusted Rod Insertion Limits
(400 ±10 EFPD to EOC; 3 Pump Operation)



A Rod group overlap of 25 ±5% betw een 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

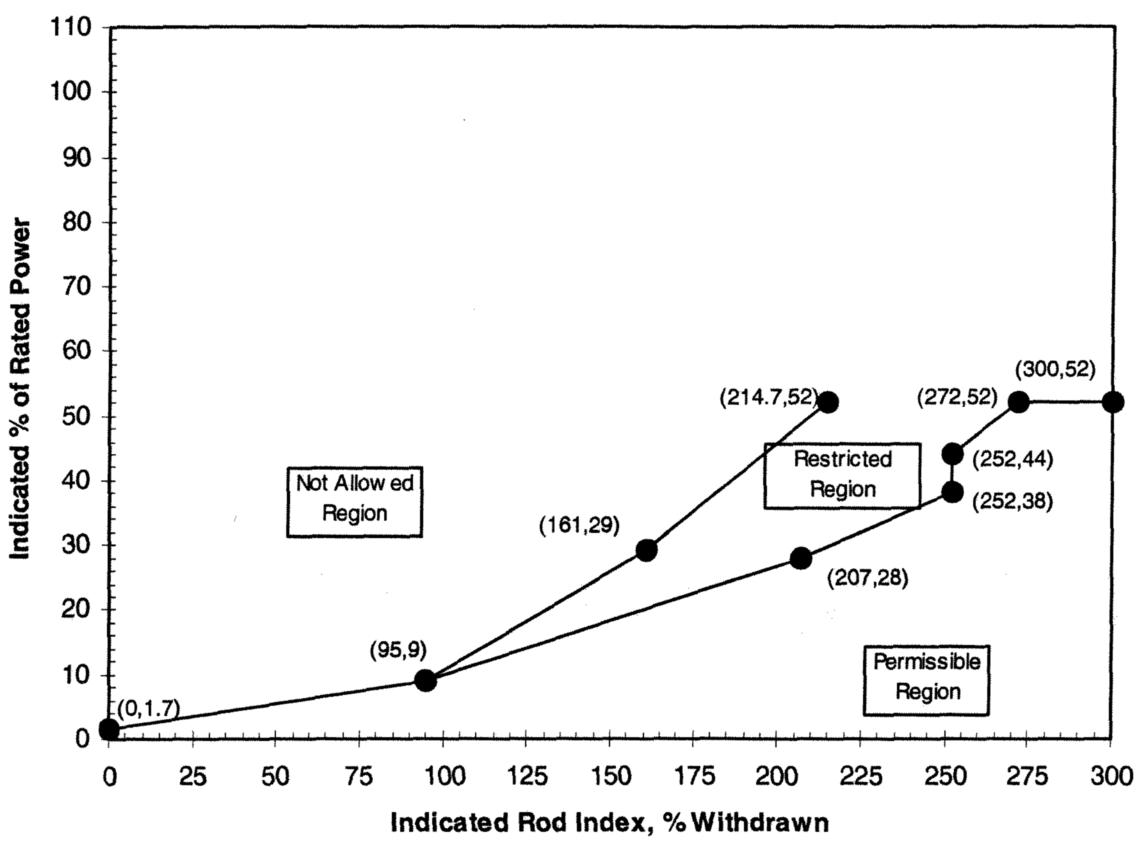
Figure 3 (Page 1 of 2)
Error Adjusted Rod Insertion Limits
(0 to 400 ±10 EFPD; 2 Pump Operation)



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
Full Incore System Error Adjusted 4 Pump Imbalance Limits
(0 EFPD to EOC)

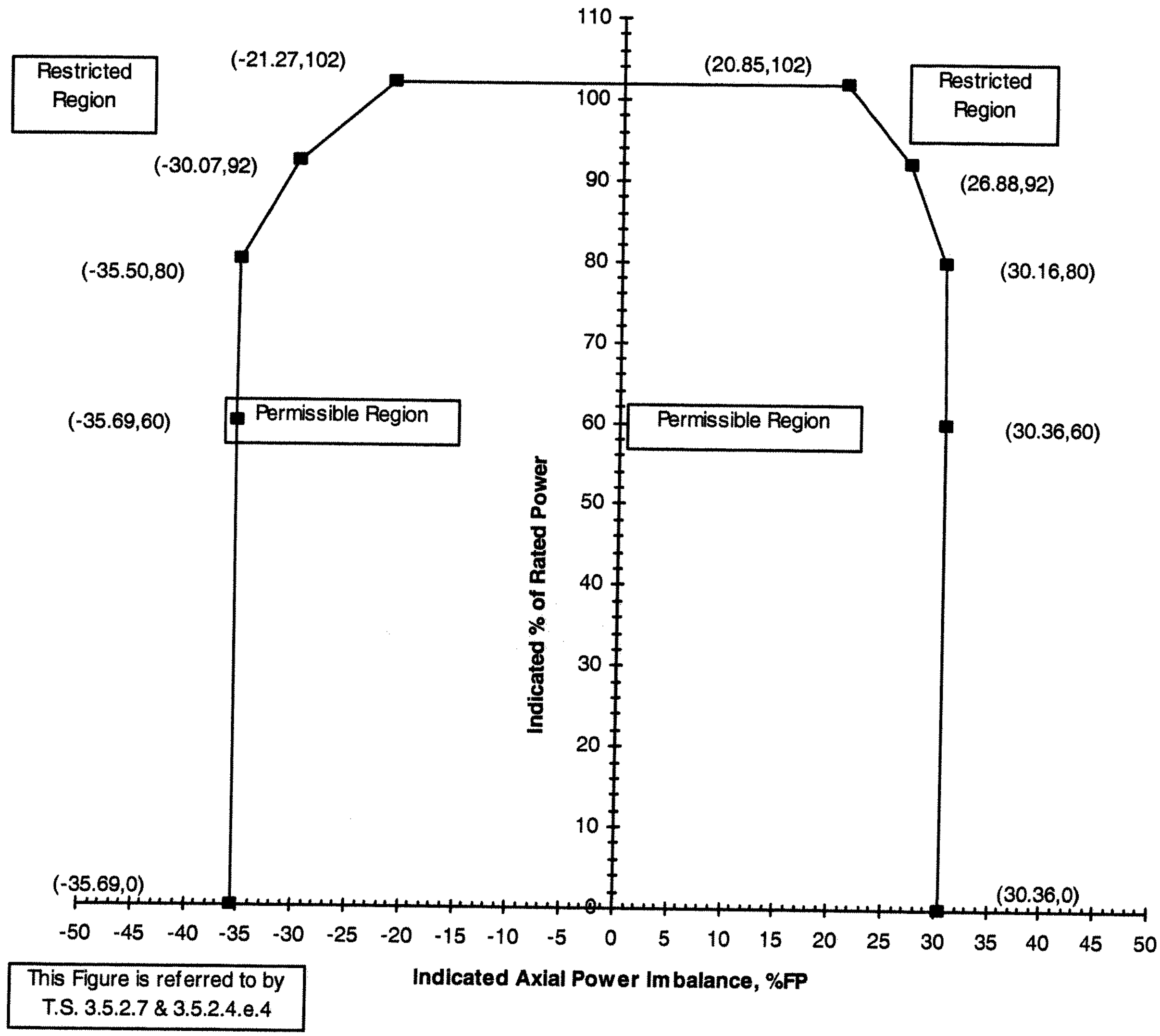


Figure 5
Full Incore System Error Adjusted 3 Pump Imbalance Limits
(0 EFPD to EOC)

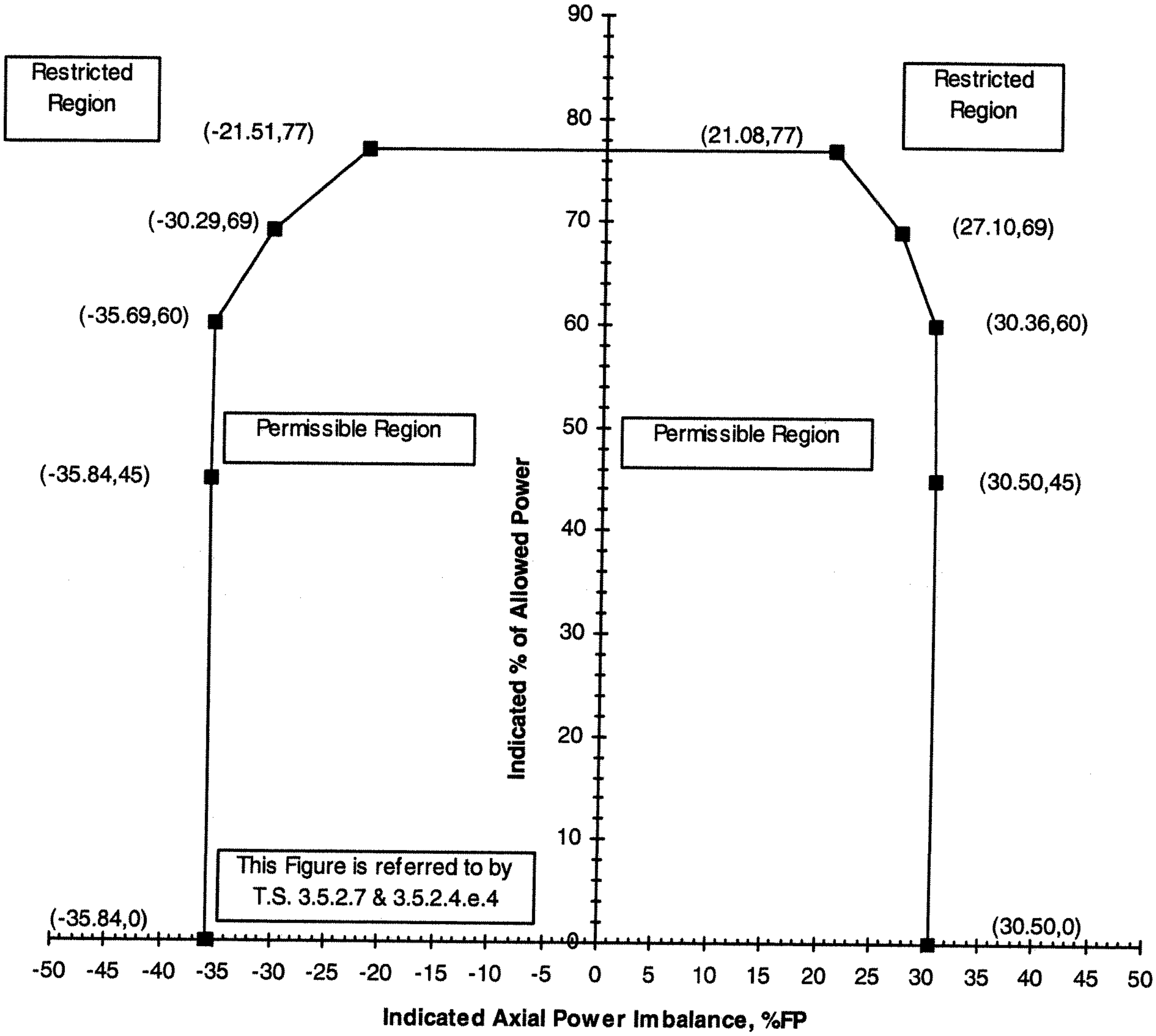


Figure 6
Full Incore System Error Adjusted 2 Pump Imbalance Limits
(0 EFPD to EOC)

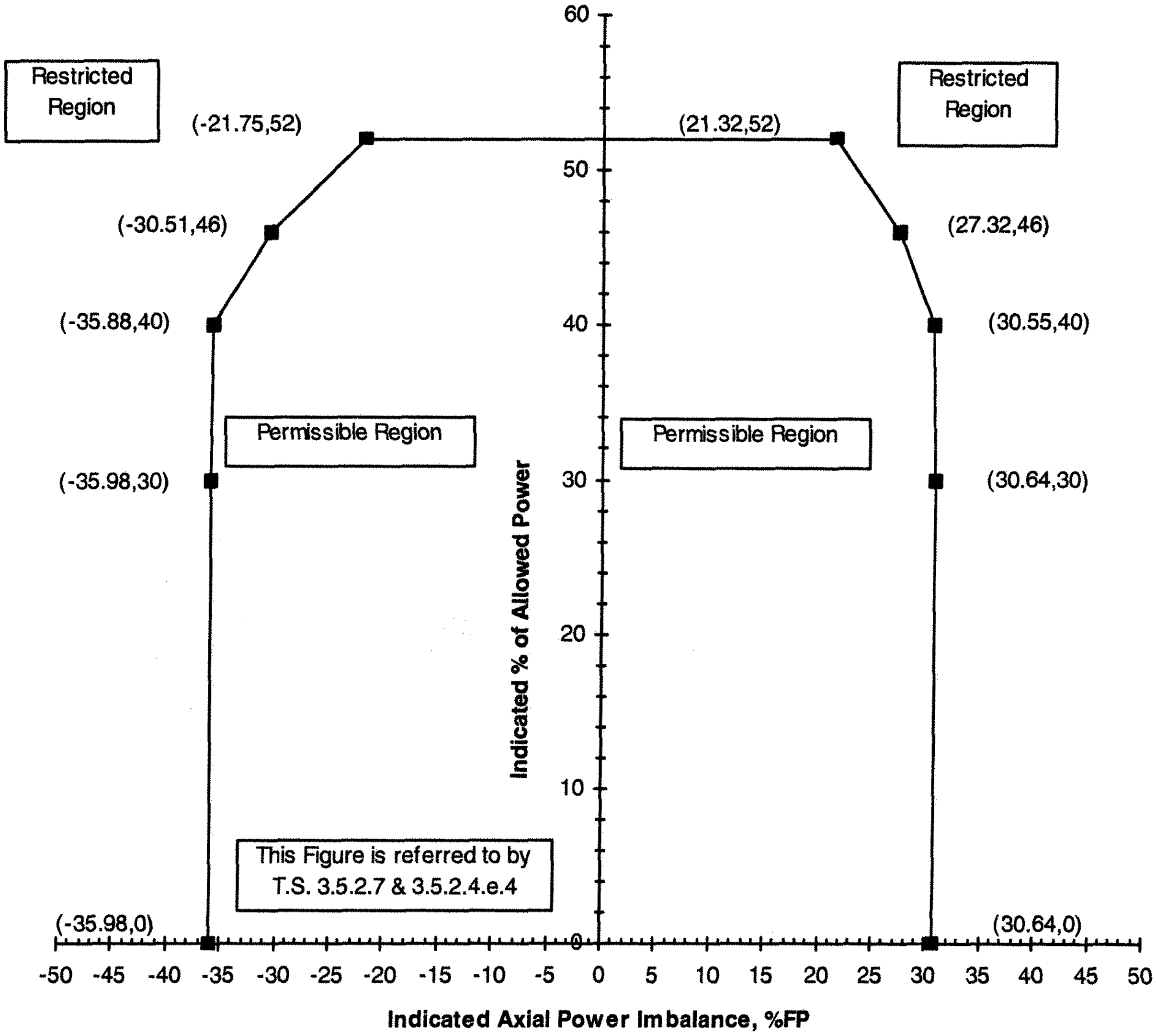
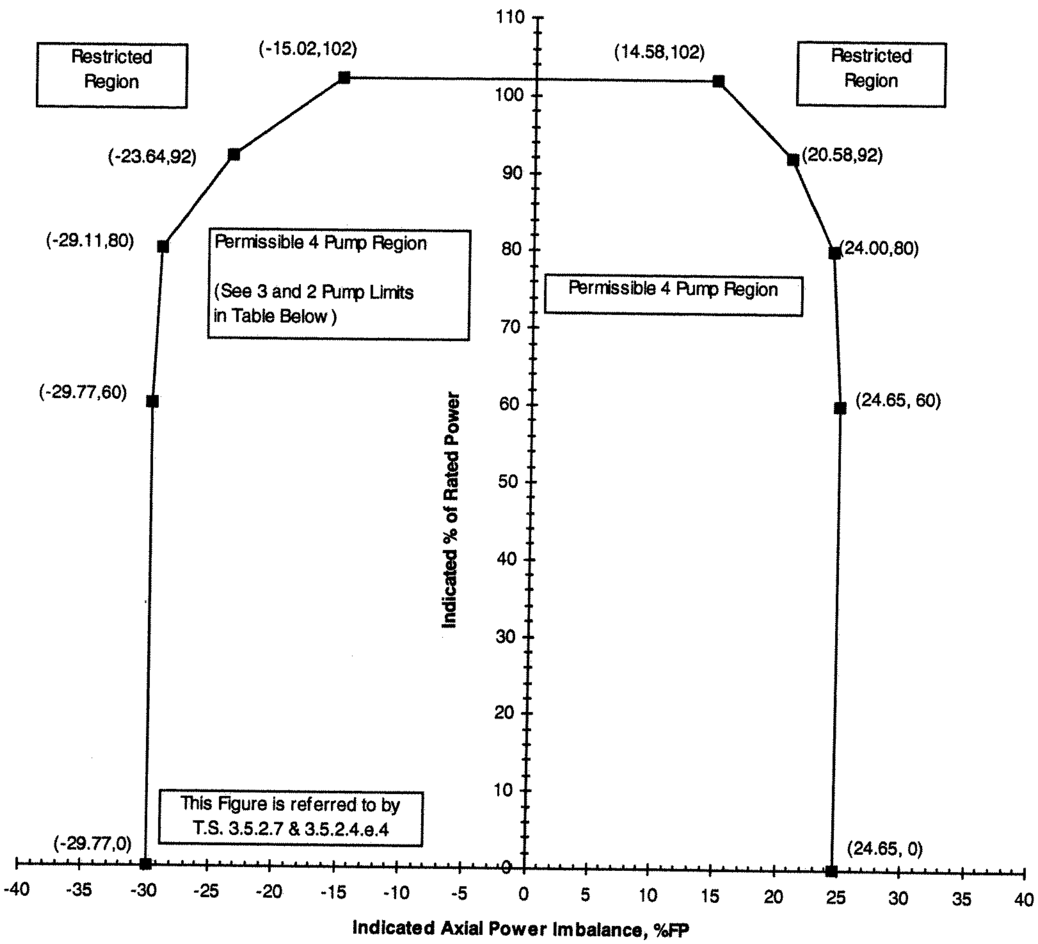


Figure 7
Out-of-Core Detector System Error Adjusted Imbalance Limits (0 EFPD to EOC)



Out-of-Core Detector System Error Adjusted Imbalance Limits (0 EFPD to EOC) for 3 and 2 Pump Operation

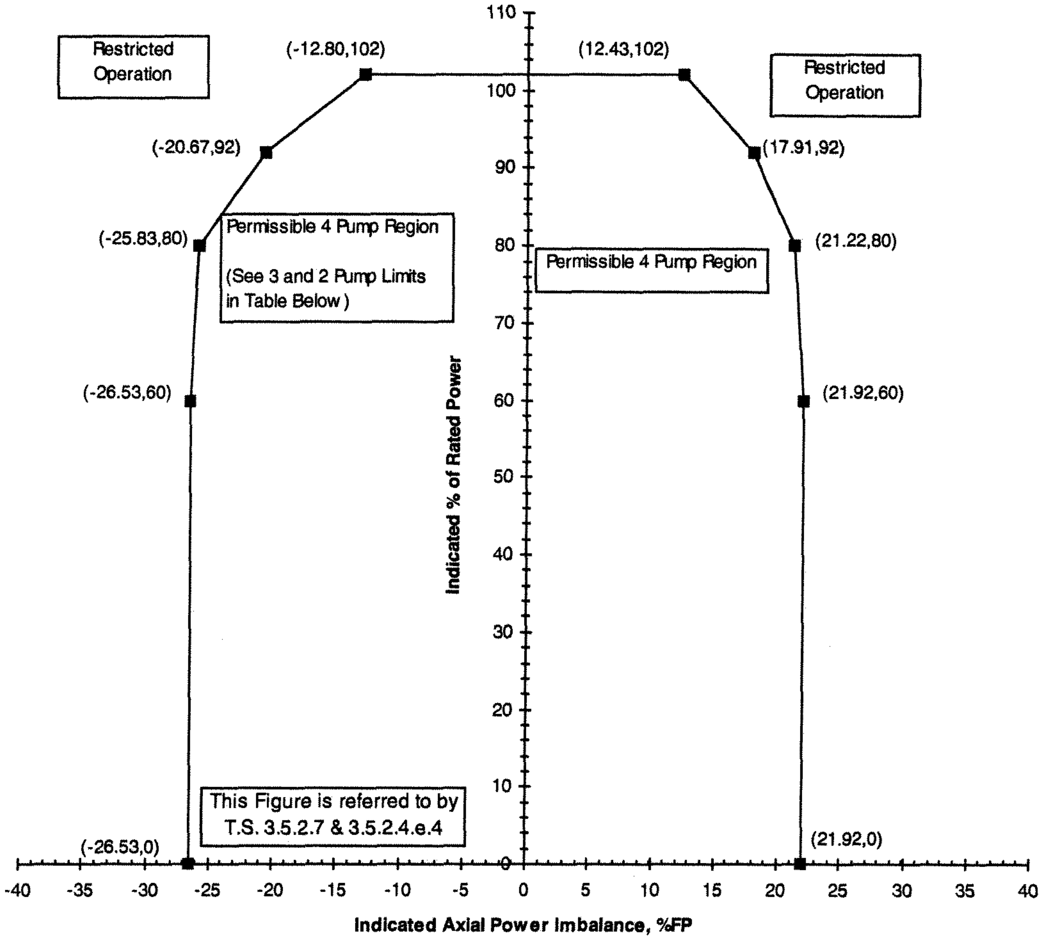
3 Pump Operation

Power (%FP)	Neg. Imb. (%FP)	Pos. Imb. (%FP)
77	-15.83	15.39
69	-24.40	21.33
60	-29.77	24.65
45	-30.25	25.12
0	-30.25	25.12

2 Pump Operation

Power (%FP)	Neg. Imb. (%FP)	Pos. Imb. (%FP)
52	-16.63	16.18
46	-25.14	22.06
40	-30.41	25.28
30	-30.73	25.58
0	-30.73	25.58

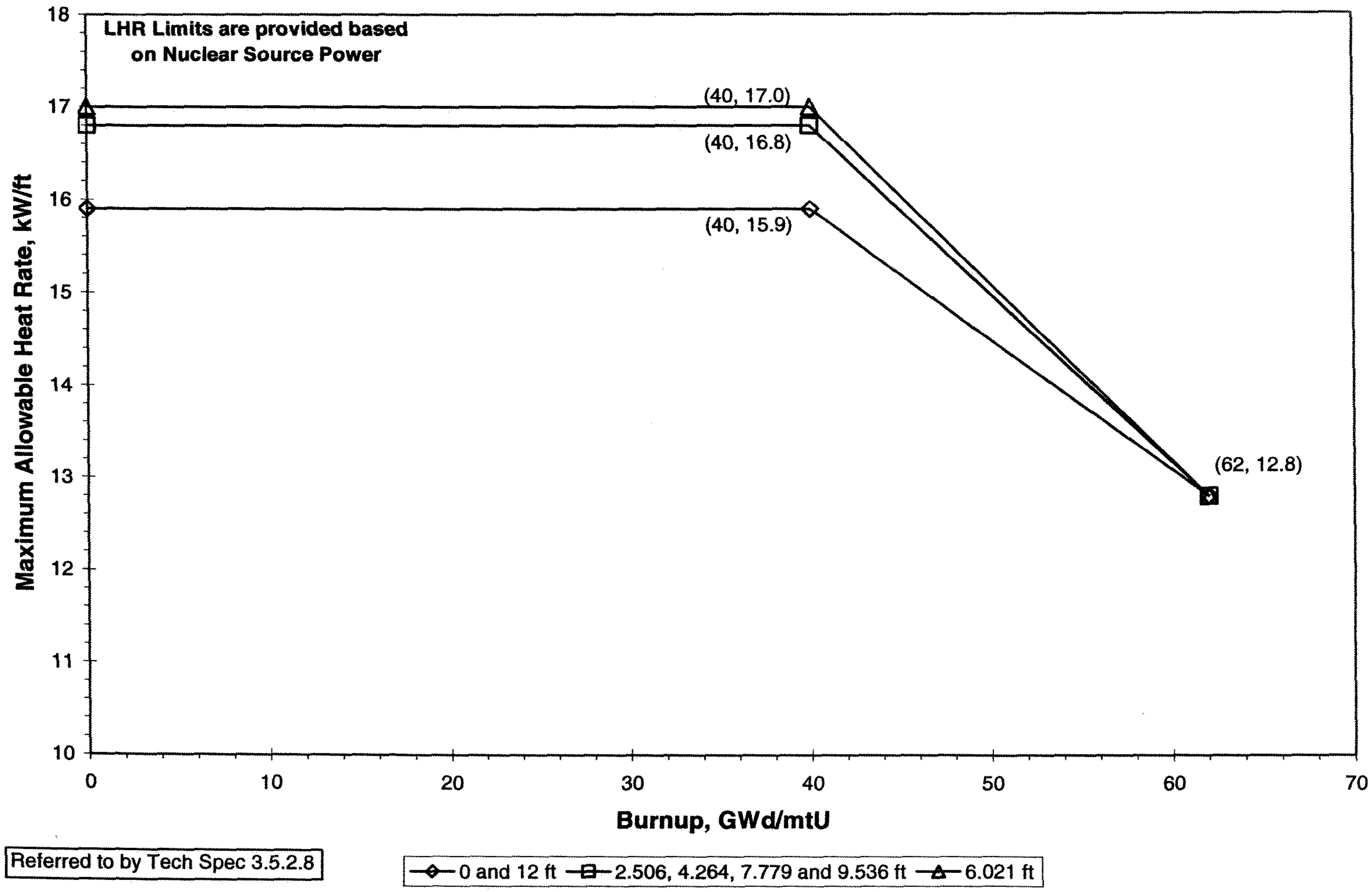
Figure 8
Minimum Incore System Error Adjusted Imbalance Limits (0 EFPD to EOC)



Minimum Incore System Error Adjusted Imbalance Limits (0 EFPD to EOC)
for 3 and 2 Pump Operation

Power (%FP)	Neg. Imb. (%FP)	Pos. Imb. (%FP)	Power (%FP)	Neg. Imb. (%FP)	Pos. Imb. (%FP)
3 Pump Operation			2 Pump Operation		
77	-13.67	13.30	52	-14.35	14.18
69	-21.47	18.72	46	-22.08	19.52
60	-26.38	21.92	40	-27.08	22.62
45	-27.06	22.45	30	-27.58	22.97
0	-27.06	22.45	0	-27.58	22.97

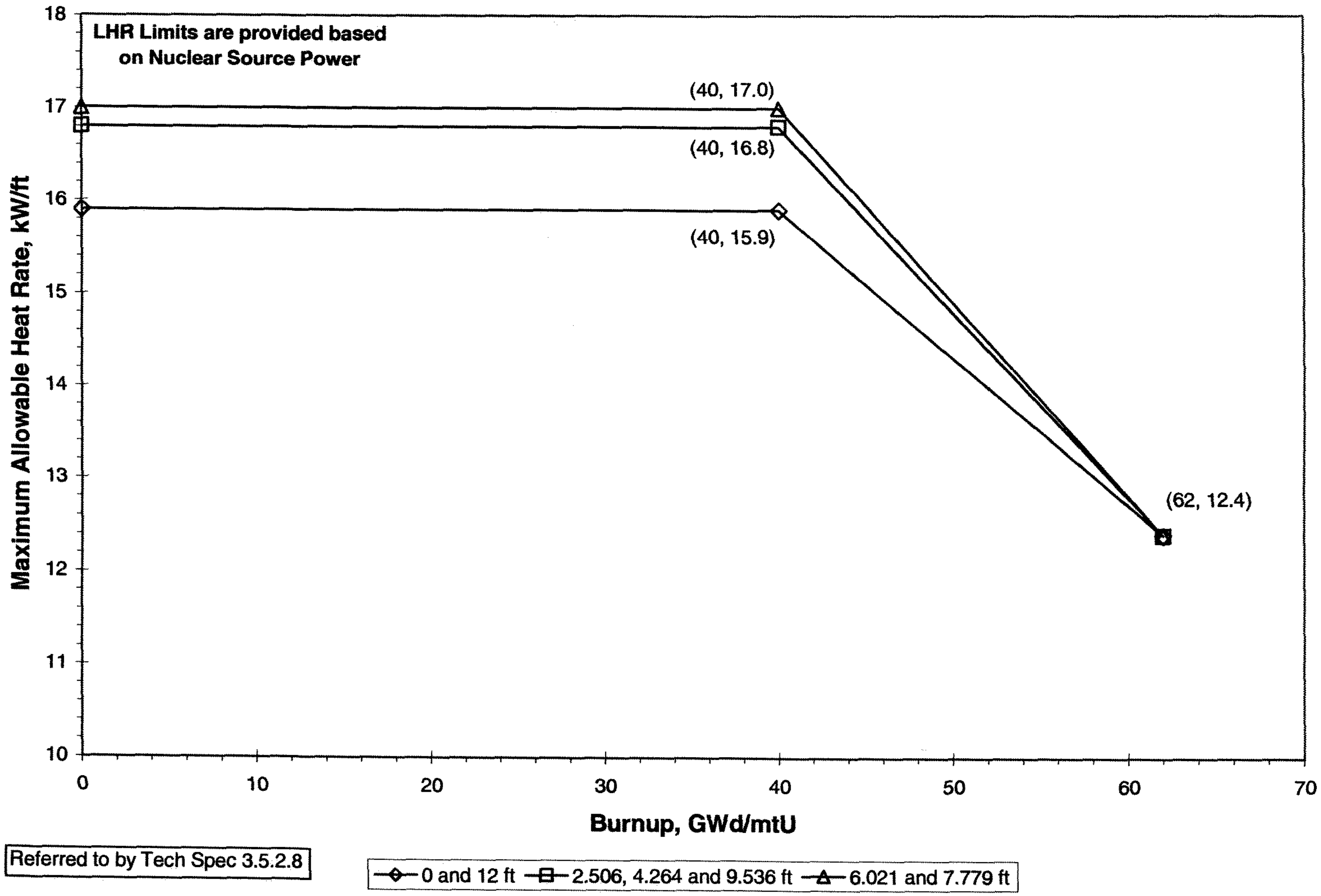
Figure 9 (Page 1 of 3)
LOCA Limited Maximum Allowable Linear Heat Rates
Mark-B10 Fuel Assemblies (UO_2 Fuel Rods)



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 9 (Page 2 of 3)
LOCA Limited Maximum Allowable Linear Heat Rates
Mark-B12 Fuel Assemblies (UO_2 Fuel Rods)



Referred to by Tech Spec 3.5.2.8

Figure 9 (Page 3 of 3)
MTC Limit vs. Power Level

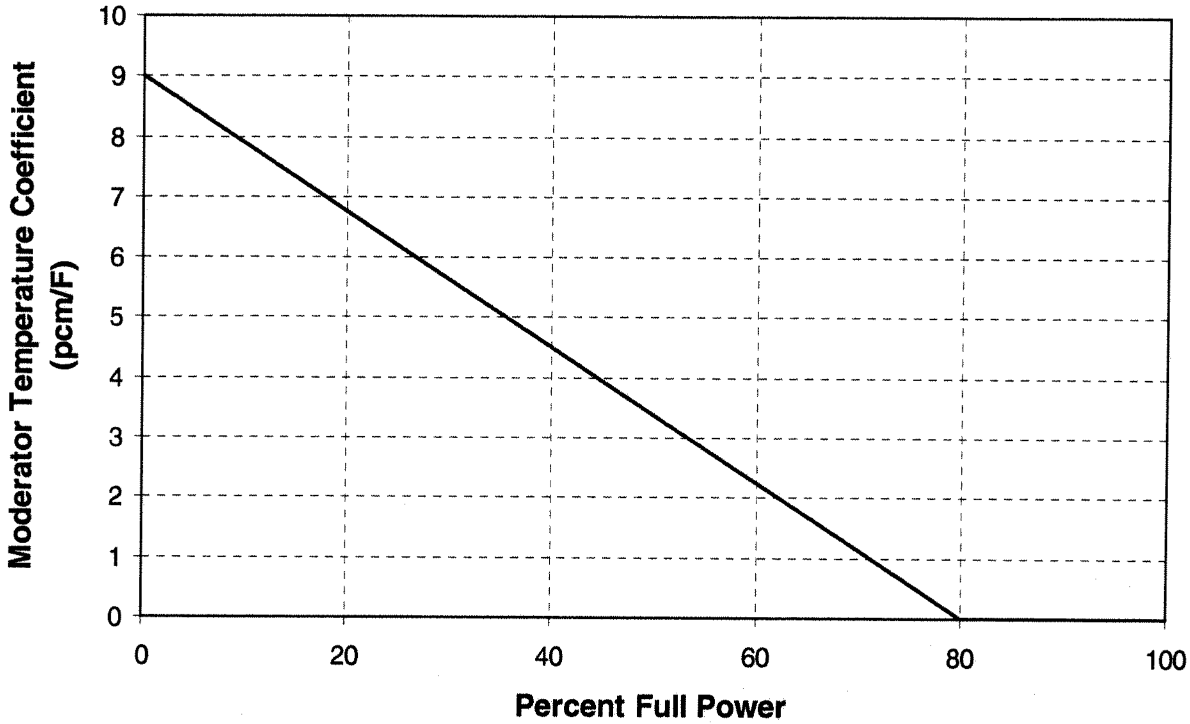
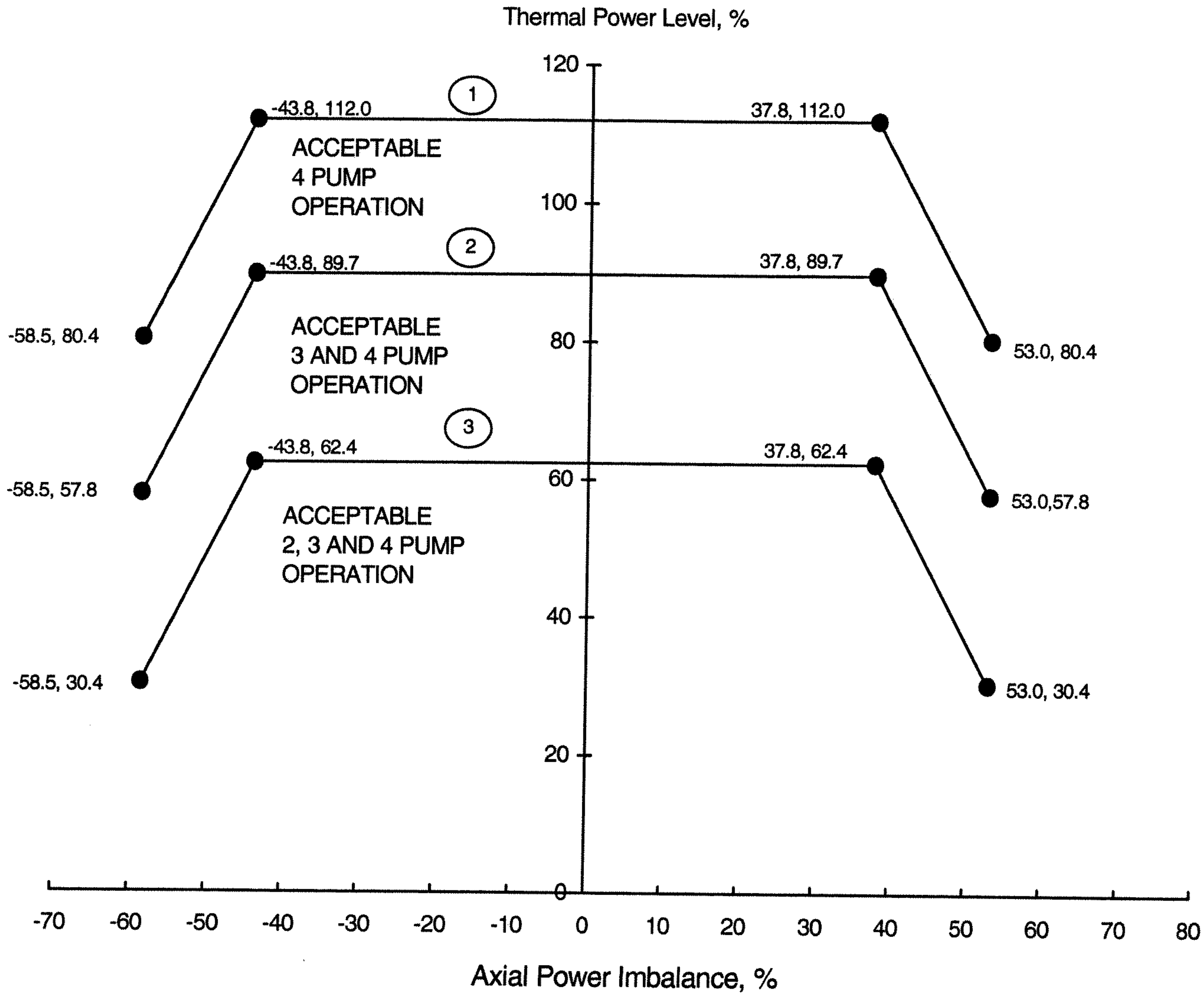
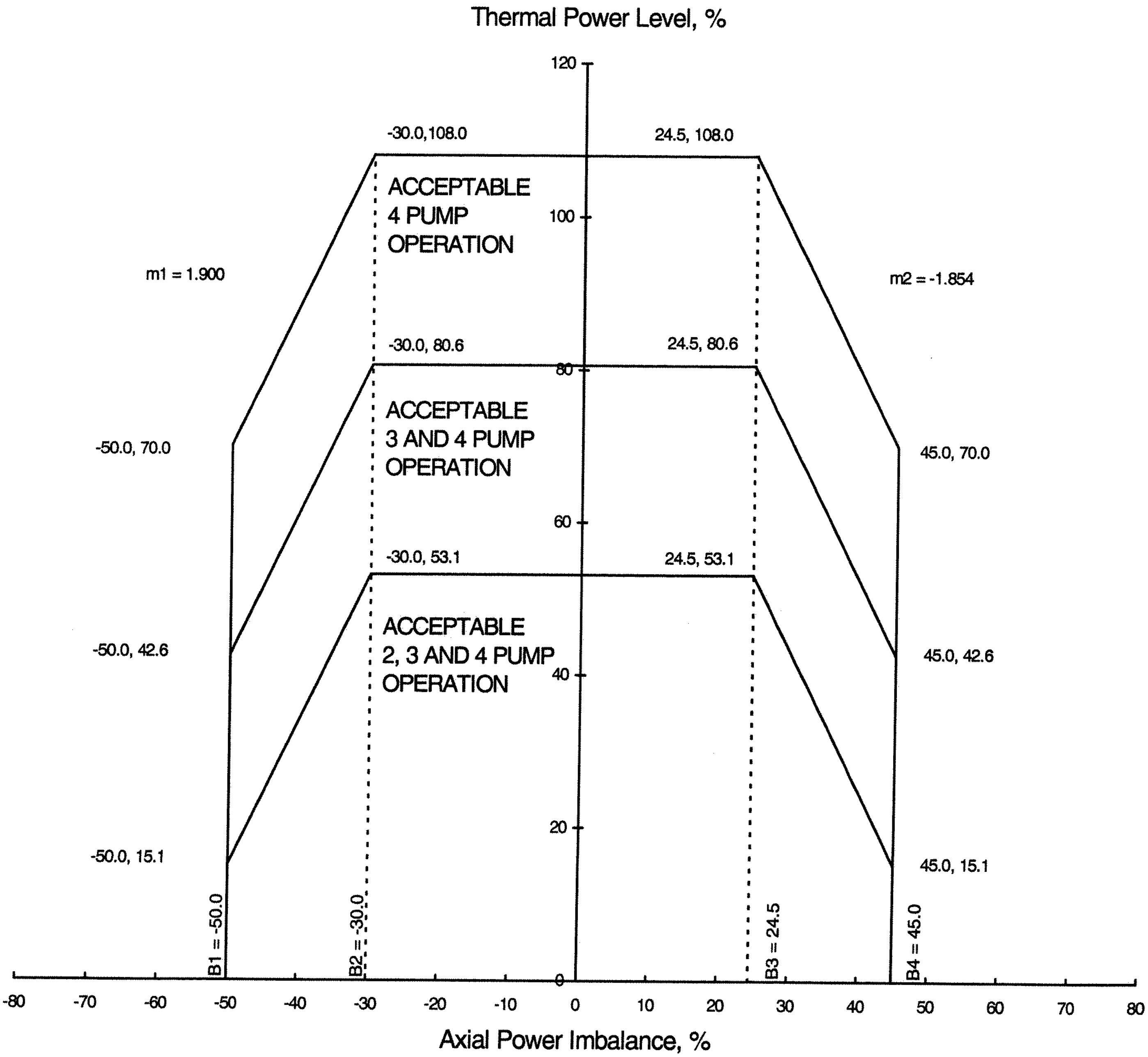


Figure 10
Axial Power Imbalance Protective Limits



CURVE	EXPECTED MINIMUM REACTOR COOLANT FLOW (lb/hr)
1	137.77×10^6
2	103.22×10^6
3	67.90×10^6

Figure 11
Reactor Protection System Maximum Allowable Setpoints for Axial Power Imbalance



REFERENCES:

1. BAW-10179P-A, Rev. 5, "Safety Criteria and Methodology for Acceptable Cycle Reload Analyses," December 2004.

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

3. BAW-2491, Rev. 2, "Three Mile Island Unit 1 Cycle 16 Reload Report," November 2005.

Enclosure 1

Operating Limits Not Required by Technical Specifications

1. 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-B10 / Mark-B12

  LHR to melt = 21.9 kW/ft

2. 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 ft3 of 12,500 ppm boron. There is no T.S. requirement to maintain these tanks at this level, however out-of-service time for the tanks should be minimized. The design bases for these tanks are described in FSAR Section 9.2.1.2.

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), $F^N_{\Delta H}$

  $F^N_{\Delta H}$ = 1.80

- 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 = 2.97