



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

METROPOLITAN EDISON COMPANY  
JERSEY CENTRAL POWER AND LIGHT COMPANY  
PENNSYLVANIA ELECTRIC COMPANY

DOCKET NO. 50-289

THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 39  
License No. DPR-50

1. The Nuclear Regulatory Commission (the Commission) has found that:
  - A. The application for amendment by Metropolitan Edison Company, Jersey Central Power & Light Company, and Pennsylvania Electric Company (the licensees), dated January 9, 1978, as supplemented, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application; the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

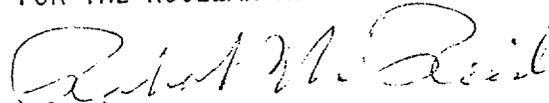
2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. DPR- 50 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 39, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Robert W. Reid, Chief  
Operating Reactors Branch #4  
Division of Operating Reactors

Attachment:  
Changes to the Technical  
Specifications

Date of Issuance:  
April 27, 1978

ATTACHMENT TO LICENSE AMENDMENT NO. 39

FACILITY OPERATING LICENSE NO. DPR-50

DOCKET NO. 50-289

The changed areas on the revised pages are shown by marginal lines.

Remove Pages

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Figure 2.1-1 thru Figure 2.1-3  
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2-6 and 2-7  
2-9  
Figure 2.3-1 and Figure 2.3-2  
3-34 and 3-34a  
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3-36 and 3-36a  
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2.3-1	Protection System Maximum Allowable Set Points
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3.1-3	Limiting Pressure Vs. Temperature Curve for 100 STD cc/Liter H <sub>2</sub> O
3.5-1	Incore Instrumentation Specification Axial Imbalance Indication
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3.5-2G	LOCA Limited Maximum Allowable Linear Heat Rate
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3.5-2J	Deleted
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4.2-1	Equipment and Piping Requiring Inservice Inspection in Accordance with Section XI of the ASME Code
4.4-1	Ring Girder Surveillance
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4.4-3	Ring Girder Surveillance Crack Pattern Chart
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6-1	Organization Chart

The curve of Figure 2.1-1 is the most restrictive of all possible reactor coolant pump-maximum thermal power combinations shown in Figure 2.1-2. The curves of Figure 2.1-3 represent the conditions at which a minimum DNBR of 1.3 is predicted at the maximum possible thermal power for the number of reactor coolant pumps in operation or the local quality at the point of minimum DNBR is equal to 22 percent, (3) whichever condition is more restrictive.

The maximum thermal power for three pump operation is 87.1 percent due to a power level trip produced by the flux-flow ratio (74.7 percent flow x 1.08 = 80.7 percent power) plus the maximum calibration and instrumentation error. The maximum thermal power for other reactor coolant pump conditions is produced in a similar manner.

Using a local quality limit of 22 percent at the point of minimum DNBR as a basis for curve 3 of Figure 2.1-3 is a conservative criterion even though the quality at the exit is higher than the quality at the point of minimum DNBR.

The DNBR as calculated by the B&W-2 correlation continually increases from the point of minimum DNBR, so that the exit DNBR is always higher and is a function of the pressure.

For each curve of Figure 2.1-3, a pressure-temperature point above and to the left of the curve would result in a DNBR greater than 1.3 or a local quality at the point of minimum DNBR less than 22 percent for that particular reactor coolant pump situation. Curve 1 is more restrictive than any other reactor coolant pump situation because any pressure/temperature point above and to the left of this curve will be above and to the left of the other curves.

#### REFERENCES

- (1) FSAR, Section 3.2.3.1.1
- (2) FSAR, Section 3.2.3.1.1.c
- (3) FSAR, Section 3.2.3.1.1.k

## 2.2 SAFETY LIMITS - REACTOR SYSTEM PRESSURE

### Applicability

Applies to the limit on reactor coolant system pressure.

### Objective

To maintain the integrity of the reactor coolant system and to prevent the release of significant amounts of fission product activity.

### Specification

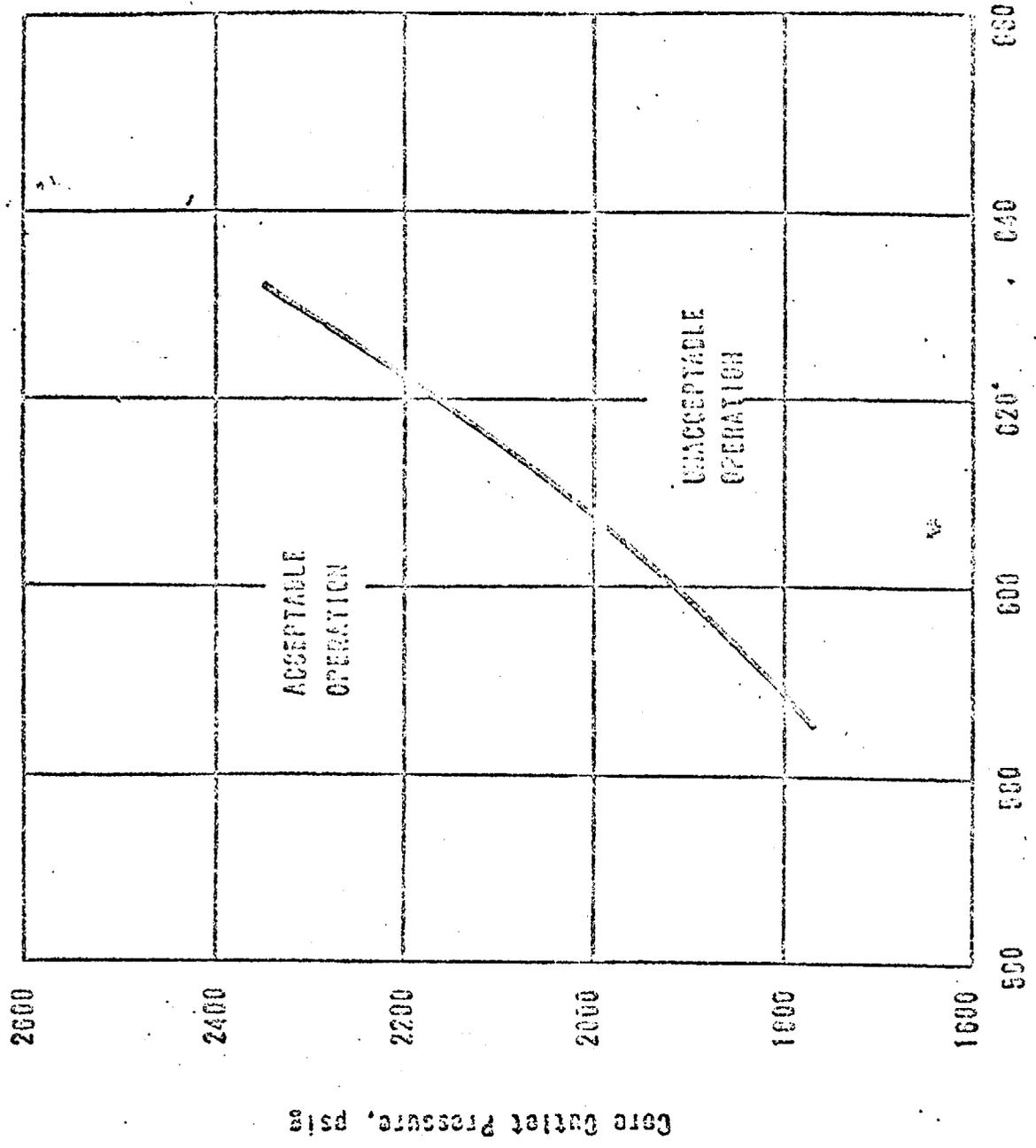
2.2.1 The reactor coolant system pressure shall not exceed 2750 psig when there are fuel assemblies in the reactor vessel.

### Bases

The reactor coolant system (1) serves as a barrier to prevent radionuclides in the reactor coolant from reaching the atmosphere. In the event of a fuel cladding failure, the reactor coolant system is a barrier against the release of fission products. Establishing a system pressure limit helps to assure the integrity of the reactor coolant system. The maximum transient pressure allowable in the reactor coolant system pressure vessel under the ASME Code, Section III, is 110% of design pressure.(2) The maximum transient pressure allowable in the reactor coolant system piping, valves, and fittings under ANSI Section B31.7 is 110% of design pressure. Thus, the safety limit of 2750 psig (110% of the 2500 psig design pressure) has been established.(2) The maximum settings for the reactor high pressure trip (2405 psig) and the pressurizer code safety valves (2500 psig) (2) have been established for Cycle 4 in accordance with ASME Boiler and Pressure Vessel Code, Section III, Article 9, Winter, 1968 to assure that the reactor coolant system pressure safety limit is not exceeded. The initial hydrostatic test was conducted at 3125 psig (125% of design pressure) to verify the integrity of the reactor coolant system. Additional assurance that the reactor coolant system pressure does not exceed the safety limit is provided by setting the pressurizer automatic relief valve at 2255 psig. (4)

### References

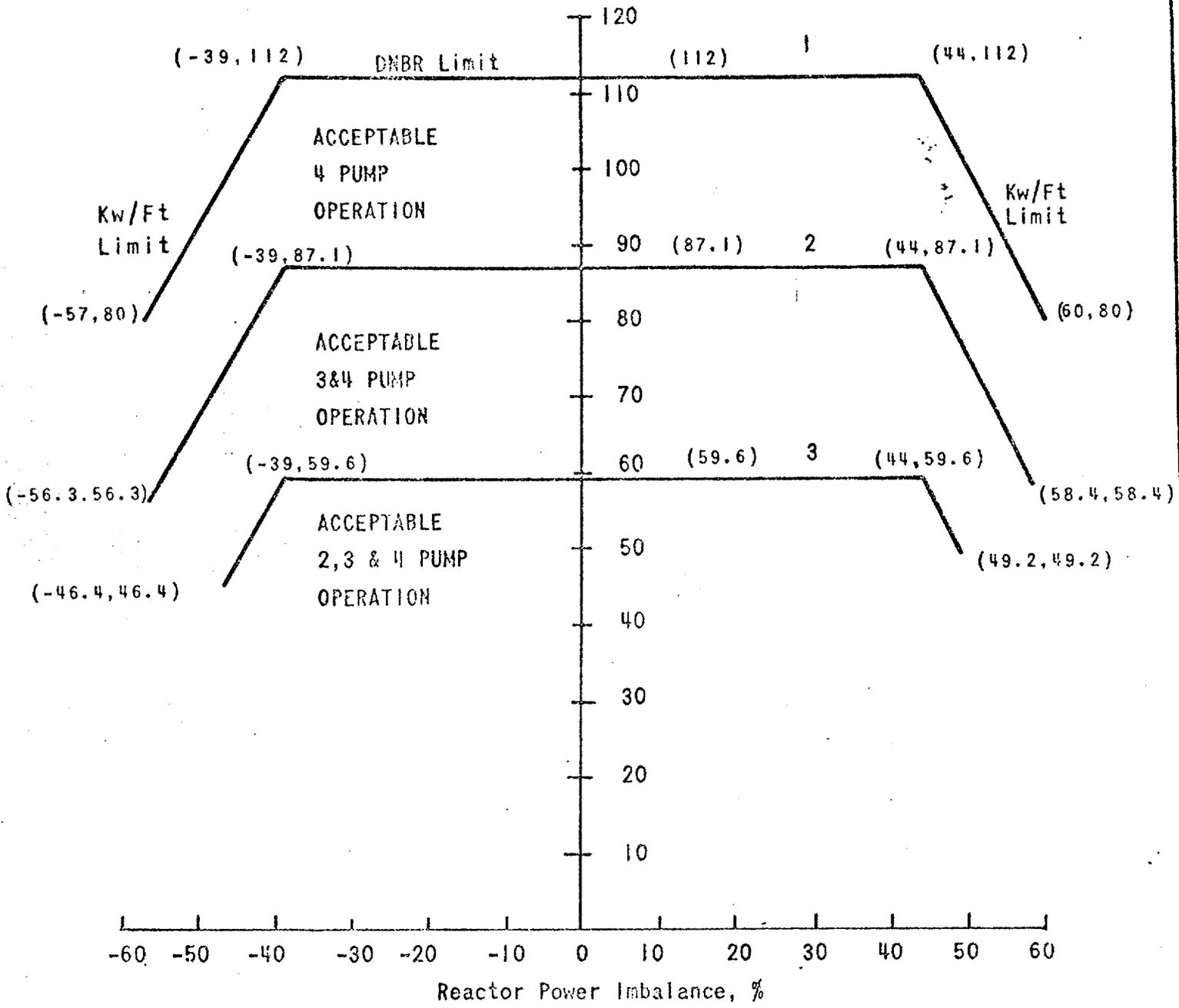
- (1) FSAR, Section 4
- (2) FSAR, Section 4.3.10.1
- (3) FSAR, Section 4.2.4
- (4) FSAR, Table 4-1



Reactor Outlet Temperature, F

UNIT-1, UNIT 1, CYCLE 4  
 CORE PROTECTION SAFETY LIMIT  
 Figure 2.1-1

Thermal Power Level, %

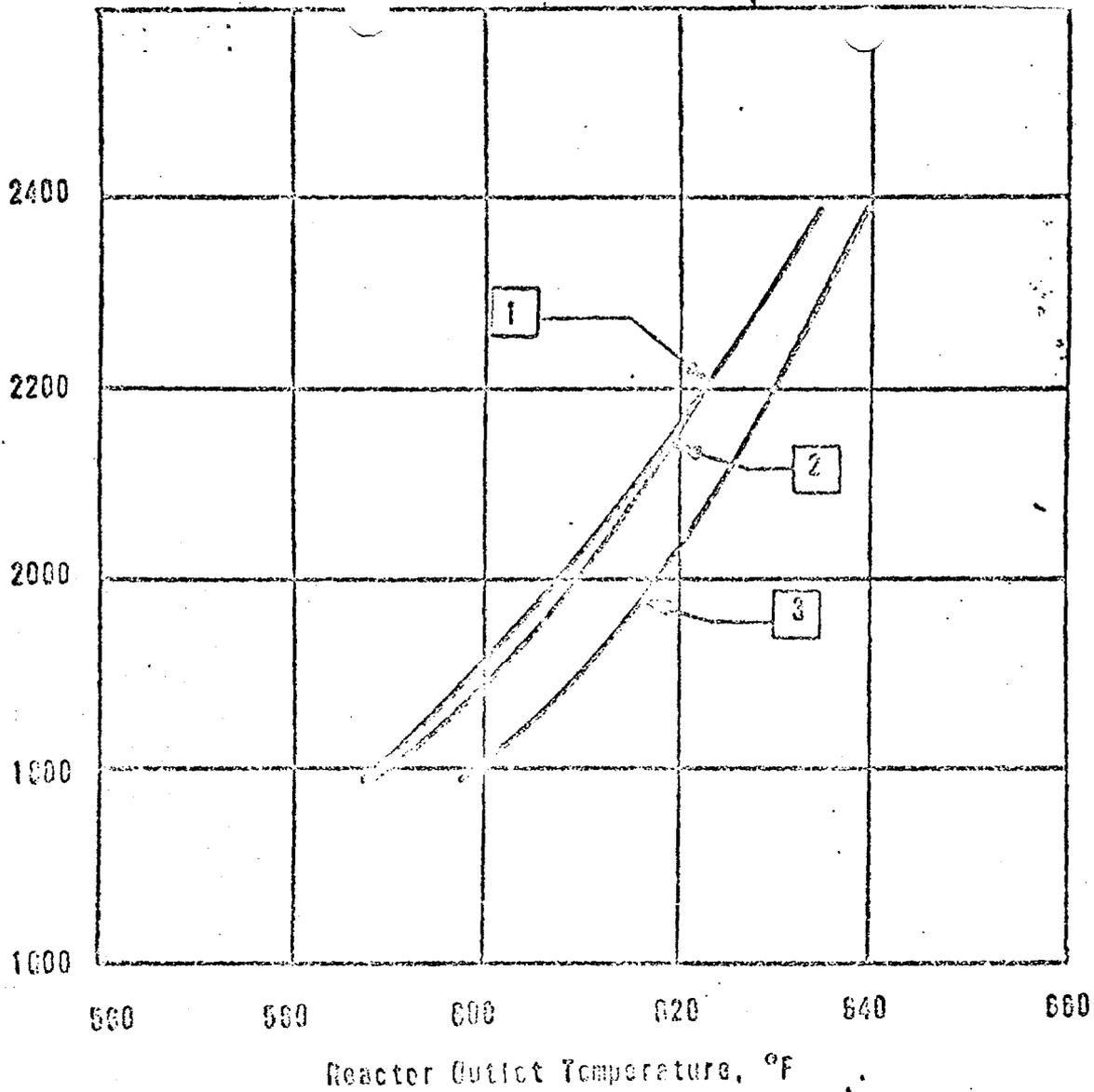


Curve	Reactor Coolant Flow (lb/hr)
1	$139.8 \times 10^6$
2	$104.5 \times 10^6$
3	$68.8 \times 10^6$

CORE PROTECTION SAFETY LIMITS  
TMI-1, CYCLE 4

Figure 2.1-2

Core Outlet Pressure, psig



REACTOR COOLANT FLOW

CURVE	(LBS/HR)	POWER	PUMPS OPERATING (TYPE OF LIMIT)
1	$139.8 \times 10^6$ (100%)*	112%	Four Pumps (DNBR Limit)
2	$104.5 \times 10^6$ (74.7%)	87.1	Three Pumps (DNBR Limit)
3	$60.6 \times 10^6$ (43.2%)	59.6	One Pump in Each Loop (Quality Limit)

\*108.5% of Cycle 1 Design Flow

YU-1, UNIT 1, CYCLE 4  
CORE PROTECTION SAFETY BASES

Figure 2.1-3

The power level trip set point produced by the power-to-flow ratio provides both high power level and low flow protection in the event the reactor power level increases or the reactor coolant flow rate decreases. The power level trip set point produced by the power to flow ratio provides overpower DNB protection for all modes of pump operation. For every flow rate there is a maximum permissible power level, and for every power level there is a minimum permissible low flow rate. Typical power level and low flow rate combinations for the pump situations of Table 2.3-1 are as follows:

1. Trip would occur when four reactor coolant pumps are operating if power is 108 percent and reactor flow rate is 100 percent, or flow rate is 92.5 percent and power level is 100 percent.
2. Trip would occur when three reactor coolant pumps are operating if power is 80.7 percent and reactor flow rate is 74.7 percent or flow rate is 69.4 percent and power level is 75 percent.
3. Trip would occur when one reactor coolant pump is operating in each loop (total of two pumps operating) if the power is 53.1 percent and reactor flow rate is 49.1 percent or flow rate is 45.3 percent and the power level is 49 percent.

The flux/flow ratios account for the maximum calibration and instrumentation errors and the maximum variation from the average value of the RC flow signal in such a manner that the reactor protective system receives a conservative indication of the RC flow.

No penalty in reactor coolant flow through the core was taken for an open core vent valve because of the core vent valve surveillance program during each refueling outage.

For safety analysis calculations the maximum calibration and instrumentation errors for the power level were used.

The power-imbalance boundaries are established in order to prevent reactor thermal limits from being exceeded. These thermal limits are either power peaking Kw/ft limits or DNBR limits. The reactor power imbalance (power in the top half of the core minus power in the bottom half of core) reduces the power level trip produced by the power-to-flow ratio so that the boundaries of Figure 2.3-2 are produced. The power-to-flow ratio reduces the power level trip and associated reactor power/reactor power-imbalance boundaries by 1.08 percent for a one percent flow reduction.

#### b. Pump monitors

The redundant pump monitors prevent the minimum core DNBR from decreasing below 1.3 by tripping the reactor due to the loss of reactor coolant pump(s). The pump monitors also restrict the power level for the number of pumps in operation.

c. Reactor coolant system pressure

During a startup accident from low power or a slow rod withdrawal from high power, the system high pressure trip set point is reached before the nuclear overpower trip set point. The trip setting limit shown in Figure 2.3-1 for high reactor coolant system pressure has been established to maintain the system pressure below the safety limit (2750 psig) for any design transient. Due to calibration and instrument errors, the safety analysis assumed a 45 psi pressure error in the high reactor coolant system pressure trip setting.

The low pressure (1800 psig) and variable low pressure (11.75 Tout - 5103) trip setpoint shown in Figure 2.3-1 have been established to maintain the DNB ratio greater than or equal to 1.3 for those design accidents that result in a pressure reduction (3, 4).

Due to the calibration and instrumentation errors, the safety analysis used a variable low reactor coolant system pressure trip value of (11.75 Tout - 5143) and a low pressure trip value of 1770 psig.

d. Coolant outlet temperature

The high reactor coolant outlet temperature trip setting limit (619 F) shown in Figure 2.3-1 has been established to prevent excessive core coolant temperatures in the operating range.

The calibrated range of the temperature channels of the RPS is 520 to 620 F. The trip setpoint of the channel is 619 F. Under the worst case environment, power supply perturbations, and drift, the accuracy of the trip string is 1%. This accuracy was arrived at by summing the worst case accuracies of each module. This is a conservative method of error analysis since the normal procedure is to use the root mean square method.

Therefore, it is assured that a trip will occur at a value no higher than 620 F even under worst case conditions. The safety analysis used a high temperature trip set point of 620 F.

The calibrated range of the channel is that portion of the span of indication which has been qualified with regard to drift, linearity, repeatability, etc. This does not imply that the equipment is restricted to operation within the calibrated range. Additional testing has demonstrated that in fact, the temperature channel is fully operational approximately 10% above the calibrated range.

Since it has been established that the channel will trip at a value of RC outlet temperature no higher than 620 F even in the worst case, and since the channel is fully operational approximately 10% above the calibrated range and exhibits no hysteresis or foldover characteristics, it is concluded that the instrument design is acceptable.

e. Reactor building pressure

The high reactor building pressure trip setting limit (4 psig) provides positive assurance that a reactor trip will occur in the unlikely event of a steam line failure in the reactor building or a loss-of-coolant accident, even in the absence of a low reactor coolant system pressure trip.

TABLE 2.3-1(6)

## REACTOR PROTECTION SYSTEM TRIP SETTING LIMITS

	Four Reactor Coolant Pumps Operating (Nominal Operating Power - 100%)	Three Reactor Coolant Pumps Operating (Nominal Operating Power - 75%)	One Reactor Coolant Pump Operating in Each Loop (Nominal Operating Power - 49%)	Shutdown Bypass
1. Nuclear power, Max. % of rated power	105.5	105.5	105.5	5.0 (3)
2. Nuclear Power based on flow (2) and imbalance max. of rated power	1.08 times flow minus reduction due to imbalance(s)	1.08 times flow minus reduction due to imbalance(s)	1.08 times flow minus reduction due to imbalance(s)	Bypassed
3. Nuclear power based (5) on pump monitors, max. % of rated power	NA	NA	91%	Bypassed
4. High reactor coolant system pressure, psig, max.	2405 (7)	2405 (7)	2405 (7)	1720 (4)
5. Low reactor coolant system pressure, psig min.	1800	1800	1800	Bypassed
6. Variable low reactor coolant system pressure psig, min.	(11.75 Tout-5103) (1)	(11.75 Tout-5103) (1)	(11.75 Tout-5103) (1)	Bypassed
7. Reactor coolant temp. F., Max.	619	619	619	619
8. High Reactor Building pressure, psig, max.	4	4	4	4

(1) Tout is in degrees Fahrenheit (F)

(2) Reactor coolant system flow, %

(3) Administratively controlled reduction set only during reactor shutdown

(4) Automatically set when other segments of the RPS (as specified) are bypassed

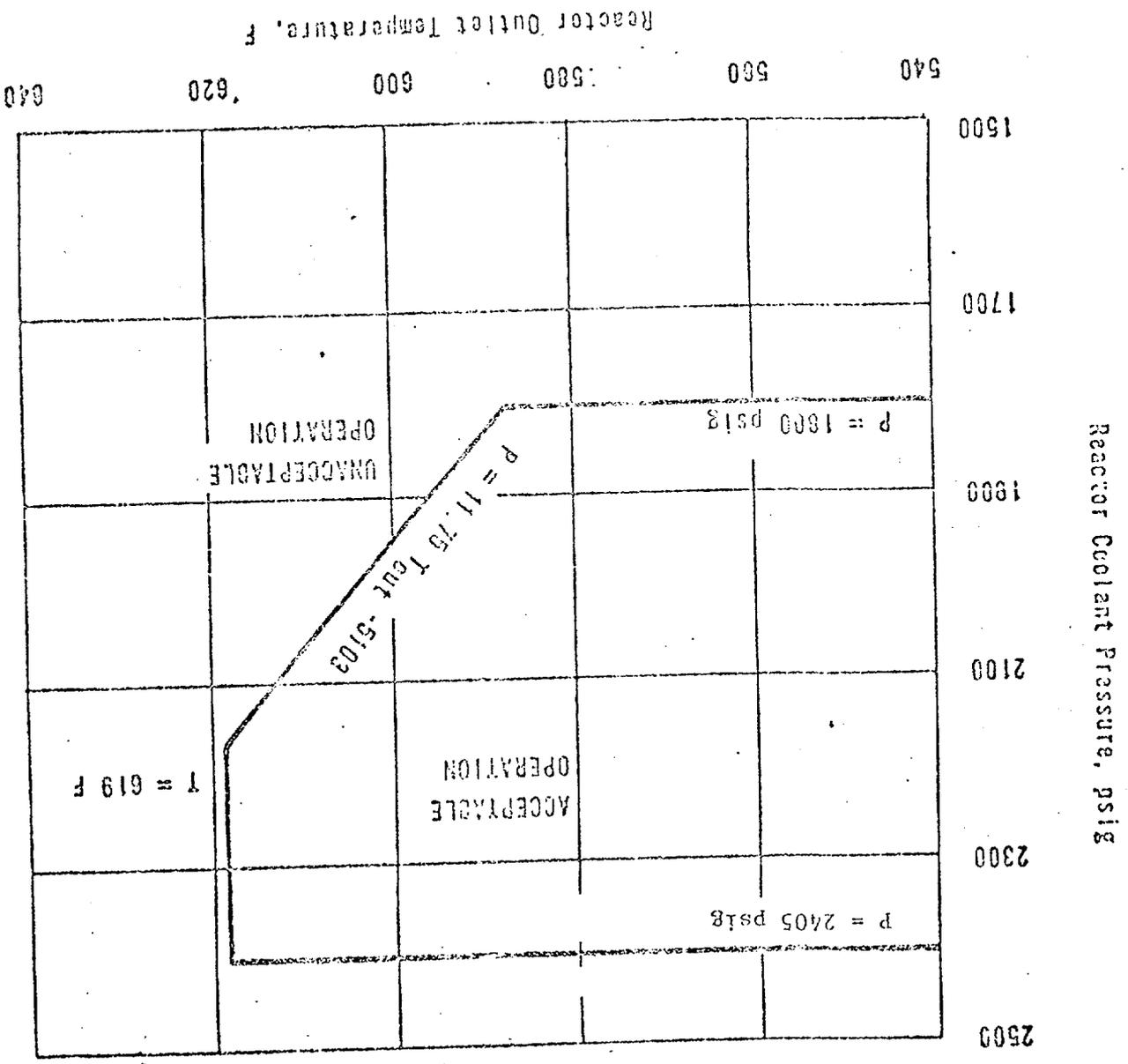
(5) The pump monitors also produce a trip on: (a) loss of two reactor coolant pumps in one reactor coolant loop, and  
(b) loss of one or two reactor coolant pumps during two-pump operation

(6) Trip settings limits are setting limits on the set point side of the protection system bistable comparators

(7) These limits applicable for operation in Cycle 4 only.

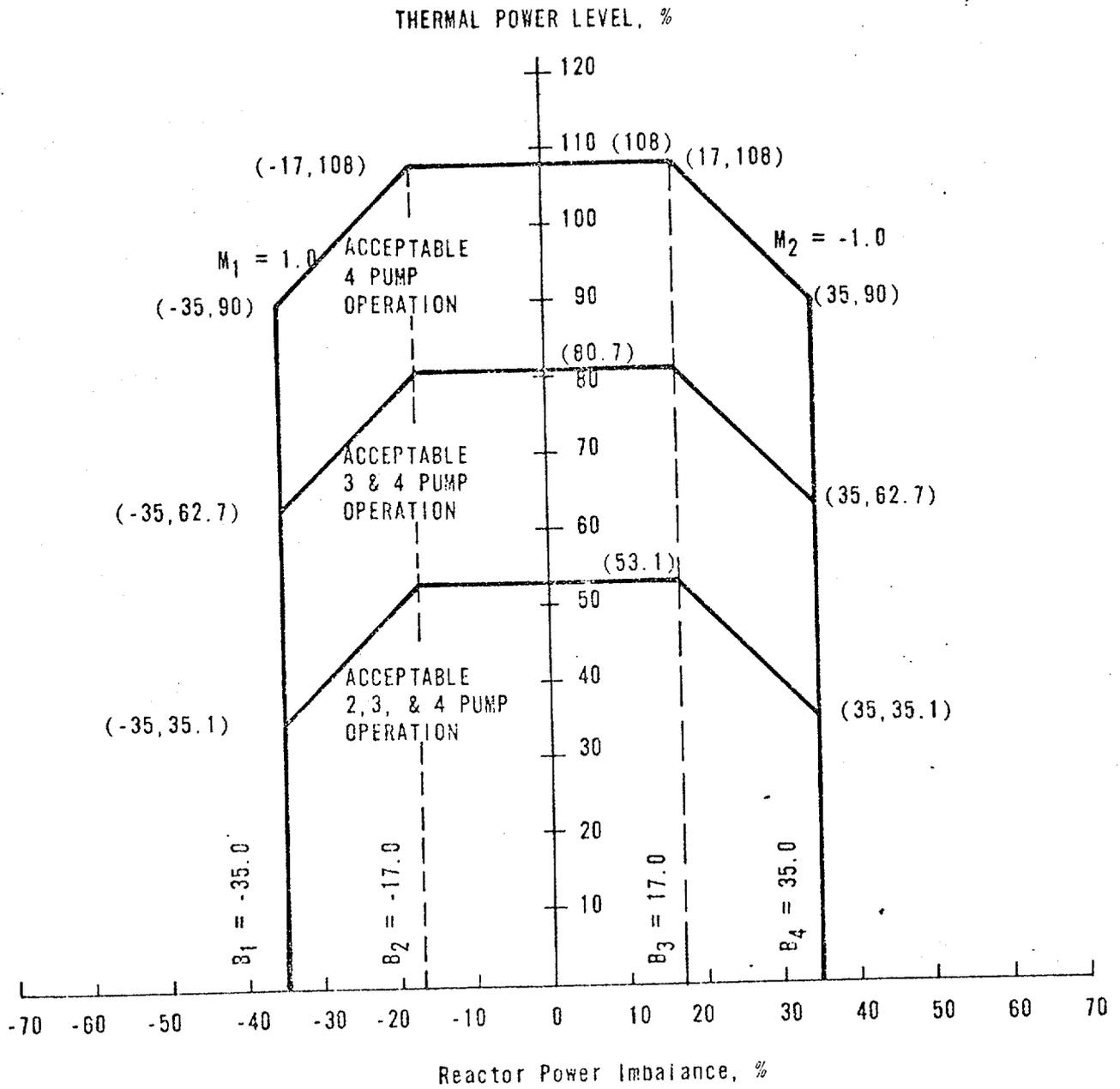
Figure 2.3-1

TH-1, UNIT 1, CYCLE 4  
PROTECTION SYSTEM MAXIMUM  
ALLOWABLE SET POINTS



Reactor Outlet Temperature, F

Reactor Coolant Pressure, psig



PROTECTION SYSTEM MAXIMUM ALLOWABLE  
 SETPOINTS FOR REACTOR POWER IMBALANCE  
 TMI-1, CYCLE 4

Figure 2.3-2

- f. If a control rod in the regulating or axial power shaping groups is declared inoperable per Specification 4.7.1.2., operation may continue provided the rods in the group are positioned such that the rod that was declared inoperable is maintained within allowable group average position limits of Specification 4.7.1.2.
- g. If the inoperable rod in Paragraph "e" above is in groups 5, 6, 7, or 8, the other rods in the group may be trimmed to the same position. Normal operation of 100 percent of the thermal power allowable for the reactor coolant pump combination may then continue provided that the rod that was declared inoperable is maintained within allowable group average position limits in 3.5.2.5.

3.5.2.3 The worth of single inserted control rods during criticality are limited by the restrictions of Specification 3.1.3.5 and the Control Rod Position Limits defined in Specification 3.5.2.5.

3.5.2.4 Quadrant tilt:

- a. Except for physics tests the quadrant tilt shall not exceed +4.01% as determined using the full incore detector system.
- b. When the full incore detector system is not available and except for physics tests quadrant tilt shall not exceed +2.82% as determined using the minimum incore detector system.
- c. When neither incore detector system above is available and except for physics tests quadrant tilt shall not exceed +2.04% as determined using the power range channels displayed on the console for each quadrant (out of core detector system).
- d. Except for physics tests if quadrant tilt exceeds the tilt limit power shall be reduced immediately to below the power level cutoff (see Figures 3.5-2A, and 3.5-2B. Moreover, the power level cutoff value shall be reduced 2 percent for each 1 percent tilt in excess of the tilt limit. For less than four pump operation, thermal power shall be reduced 2 percent of the thermal power allowable for the reactor coolant pump combination for each 1 percent tilt in excess of the tilt limit.
- e. Within a period of 4 hours, the quadrant power tilt shall be reduced to less than the tilt limit except for physics tests, or the following adjustments in setpoints and limits shall be made:
  - 1. The protection system reactor power/imbalance envelope trip setpoints shall be reduced 2 percent in power for each 1 percent tilt.

2. The control rod group withdrawal limits (Figures 3.5-2A, 3.5-2B, 3.5-2C, 3.5-2D, and 3.5-2H, shall be reduced 2 percent in power for each 1 percent tilt in excess of the tilt limit.
  3. The operational imbalance limits (Figure 3.5-2E, and 3.5-2F) shall be reduced 2 percent in power for each 1 percent tilt in excess of the tilt limit.
- f. Except for physics or diagnostic testing, if quadrant tilt is in excess of +27.10% determined using the full incore detector system (FIT), or +25.91% determined using the minimum incore detector system (MIT) if the FIT is not available, or +23.04% determined using the out of core detector system (OCT) when neither the FIT nor MIT are available, the reactor will be placed in the hot shutdown condition. Diagnostic testing during power operation with a quadrant tilt is permitted provided that the thermal power allowable is restricted as stated in 3.5.2.4.d above.
- g. Quadrant tilt shall be monitored on a minimum frequency of once every two hours during power operation above 15 percent of rated power.

### 3.4.2.5 Control Rod Positions

- a. Operating rod group overlap shall not exceed 25 percent  $\pm$ 5 percent, between two sequential groups except for physics tests.
- b. Position limits are specified for regulating and axial power shaping control rods. Except for physics tests or exercising control rods, the regulating control rod insertion/withdrawal limits are specified on Figures 3.5-2A, and 3.5-2B for four pump operation and Figures 3.5-2C and 3.5-2D three or two pump operation. Also excepting physics tests or exercising control rods, the axial power shaping control rod insertion/withdrawal limits are specified on Figure 3.5-2H. If any of these control rod position limits are exceeded, corrective measures shall be taken immediately to achieve an acceptable control rod position. Acceptable control rod positions shall be attained within four hours.
- c. Except for physics tests, power shall not be increased above the power level cutoff of 92 percent of rated thermal power unless one of the following conditions is satisfied:
  1. Xenon reactivity never deviated more than 10 percent from the equilibrium value for operation at 100 percent of rated thermal power.
  2. Xenon reactivity deviated more than 10 percent and is now within 10 percent of the equilibrium value for operation at 100 percent of rated thermal power and asymptotically approaching stability.
  3. Except for Xenon free startup (when 3.5.2.5.c.2 applies) the reactor has operated within a range of 87 to 92 percent of rated thermal power for a period exceeding 2 hours in the soluble poison control mode.
- d. Core imbalance shall be monitored on a minimum frequency of once every two hours during power operation above 40 percent of rated power. Except for physics tests, corrective measures (reduction of imbalance by APSR movements and/or reduction in reactor power) shall be taken to maintain operation within the envelope defined by Figures 3.5-2E, and 3.5-2F. If the imbalance is not within the envelope defined by Figures 3.5-2E, and 3.5-2F corrective measures shall be taken to achieve an acceptable imbalance. If an acceptable imbalance is not achieved within four hours, reactor power shall be reduced until imbalance limits are met.
- e. Safety rod limits are given in 3.1.3.5.

3.5.2.6 The control rod drive patch panels shall be locked at all times with limited access to be authorized by the superintendent.

- 3.5.2.7 A power map shall be taken at intervals not to exceed 30 effective full power days using the incore instrumentation detection system to verify the power distribution is within the limits shown in Figure 3.5-2G.

#### Bases

The power-imbalance envelope defined in Figures 3.5-2E, and 3.5-2F is based on LOCA analyses which have defined the maximum linear heat rate (see Figure 3.5-2G) such that the maximum clad temperature will not exceed the Final Acceptance Criteria (2200F). Operation outside of the power imbalance envelope alone does not constitute a situation that would cause the Final Acceptance Criteria to be exceeded should a LOCA occur. The power imbalance envelope represents the boundary of operation limited by the Final Acceptance Criteria only if the control rods are at the withdrawal/insertion limits as defined by Figures 3.5-2A, 3.5-2B, 3.5-2C, 3.5-2D, 3.5-2H, and if quadrant tilt is at the limit. Additional conservatism is introduced by application of:

- a. Nuclear uncertainty factors
- b. Thermal calibration uncertainty
- c. Fuel densification effects
- d. Hot rod manufacturing tolerance factors
- e. Postulated fuel rod bow effects

The Rod index versus Allowable Power curves of Figures 3.5-2A, 3.5-2B, 3.5-2C, 3.5-2D, and 3.5-2H describe three regions. These three regions are:

1. Permissible operating Region
2. Restricted Regions
3. Prohibited Region (Operation in this region is not allowed)

NOTE: Inadvertent operation within the Restricted Region for a period of four hours is not considered a violation of a limiting condition for operation. The limiting criteria within the Restricted Region are potential ejected rod worth and ECCS power peaking and since the probability of these accidents is very low especially in a 4 hour time frame, inadvertent operation within the Restricted Region for a period of 4 hours is allowed.

The 25±5 percent overlap between successive control rod groups is allowed since the worth of a rod is lower at the upper and lower part of the stroke. Control rods are arranged in groups or banks defined as follows:

<u>Group</u>	<u>Function</u>
1	Safety
2	Safety
3	Safety
4	Safety
5	Regulating
6	Regulating
7	Regulating (Xenon transient override)
8	APSR (axial power shaping bank)

Control rod groups are withdrawn in sequence beginning with group 1. Groups 5, 6 and 7 are overlapped 25 percent. The normal position at power is for group 7 to be partially inserted.

The rod position limits are based on the most limiting of the following three criteria: ECCS power peaking, shutdown margin, and potential ejected rod worth. As discussed above, compliance with the ECCS power peaking criterion is ensured by the rod position limits. The minimum available rod worth, consistent with the rod position limits, provides for achieving hot shutdown by reactor trip at any time, assuming the highest worth control rod that is withdrawn remains in the full out position (1). The rod position limits also ensure that inserted rod groups will not contain single rod worths greater than: 0.65%  $\Delta k/k$  at rated power. These values have been shown to be safe by the safety analysis (2) of the hypothetical rod ejection accident. A maximum single inserted control rod worth of 1.0%  $\Delta k/k$  is allowed by the rod position limits at hot zero power. A single inserted control rod worth 1.0%  $\Delta k/k$  at beginning of life, hot, zero power would result in a lower transient peak thermal power and, therefore, less severe environmental consequences than 0.65%  $\Delta k/k$  ejected rod worth at rated power.

The plant computer will scan for tilt and imbalance and will satisfy the technical specification requirements. If the computer is out of service, than manual calculation for tilt above 15 percent power and imbalance above 40 percent power must be performed at least every two hours until the computer is returned to service.

The quadrant power tilt limits set forth in Specification 3.5.2.4 have been established within the thermal analysis design base using an actual core tilt of +4.92% which is equivalent to a +4.01% tilt measured with the full incore instrumentation with measurement uncertainties included.

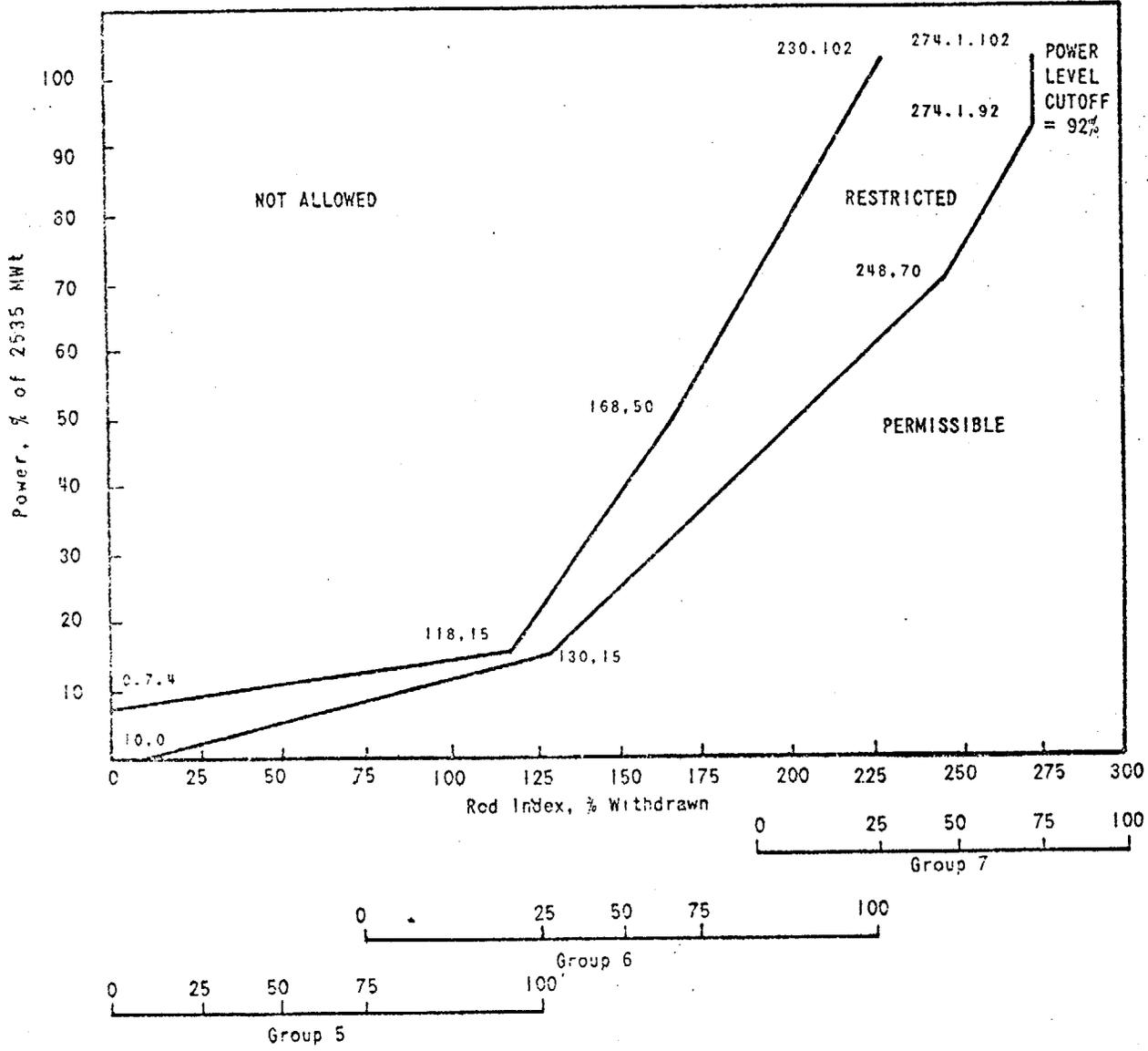
During the physics testing program, the high flux trip setpoints are administratively set as follows to assure an additional safety margin is provided:

<u>Test Power</u>	<u>Trip Setpoint</u>
0	<5%
15	50%
40	50%
50	60%
75	85%
>75	105.5%

REFERENCES

- (1) FSAR, Section 3.2.2.1.2
- (2) FSAE, Section 14.2.2.2

Amendment No. 17, 29, 39

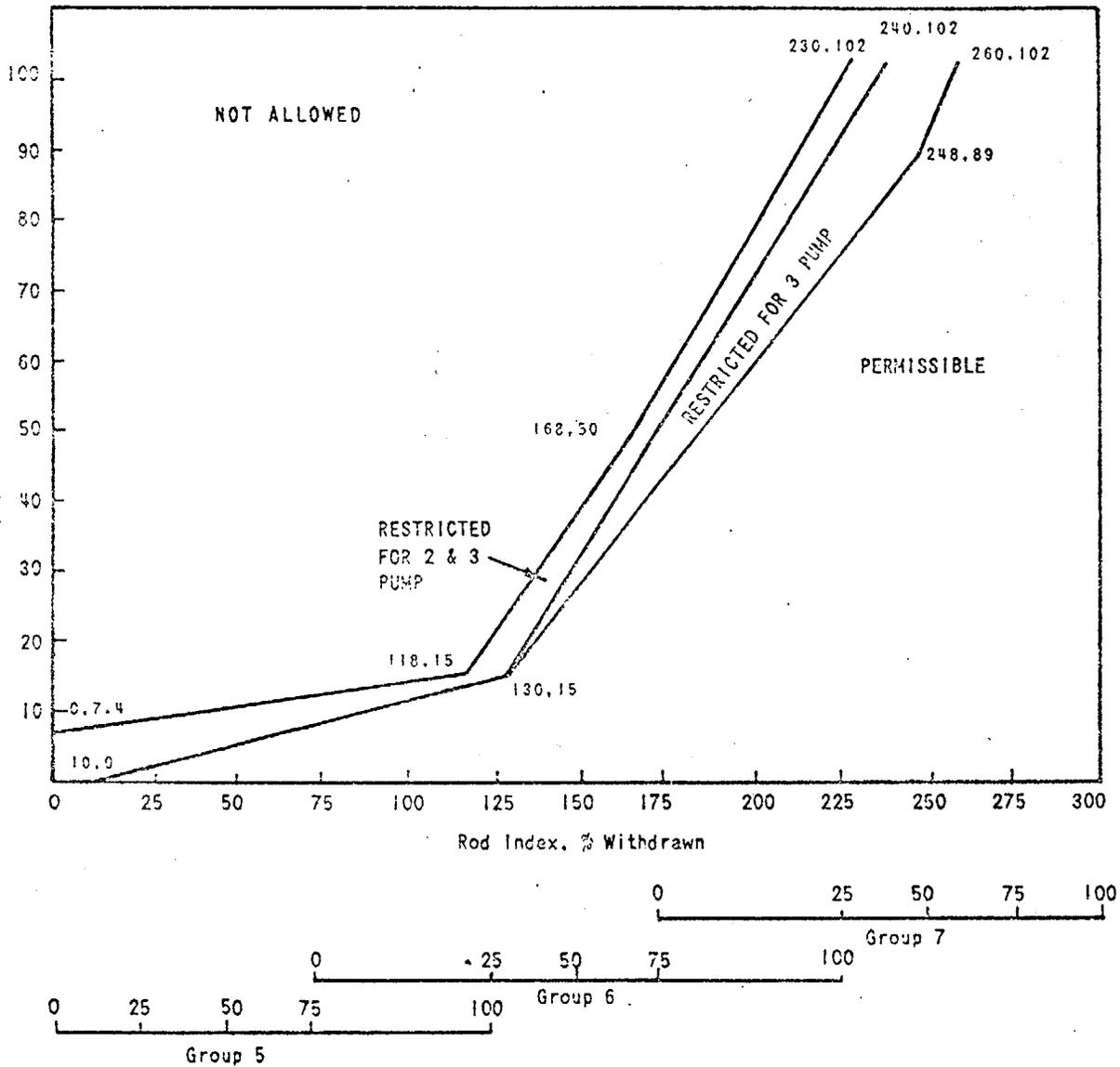


ROD POSITION LIMITS FOR 4 PUMP OPERATION FROM 0 TO 125 ± 5 EFDP TMI, CYCLE 4

Figure 3.5-2A

Reserved for Figure 3.5-2B

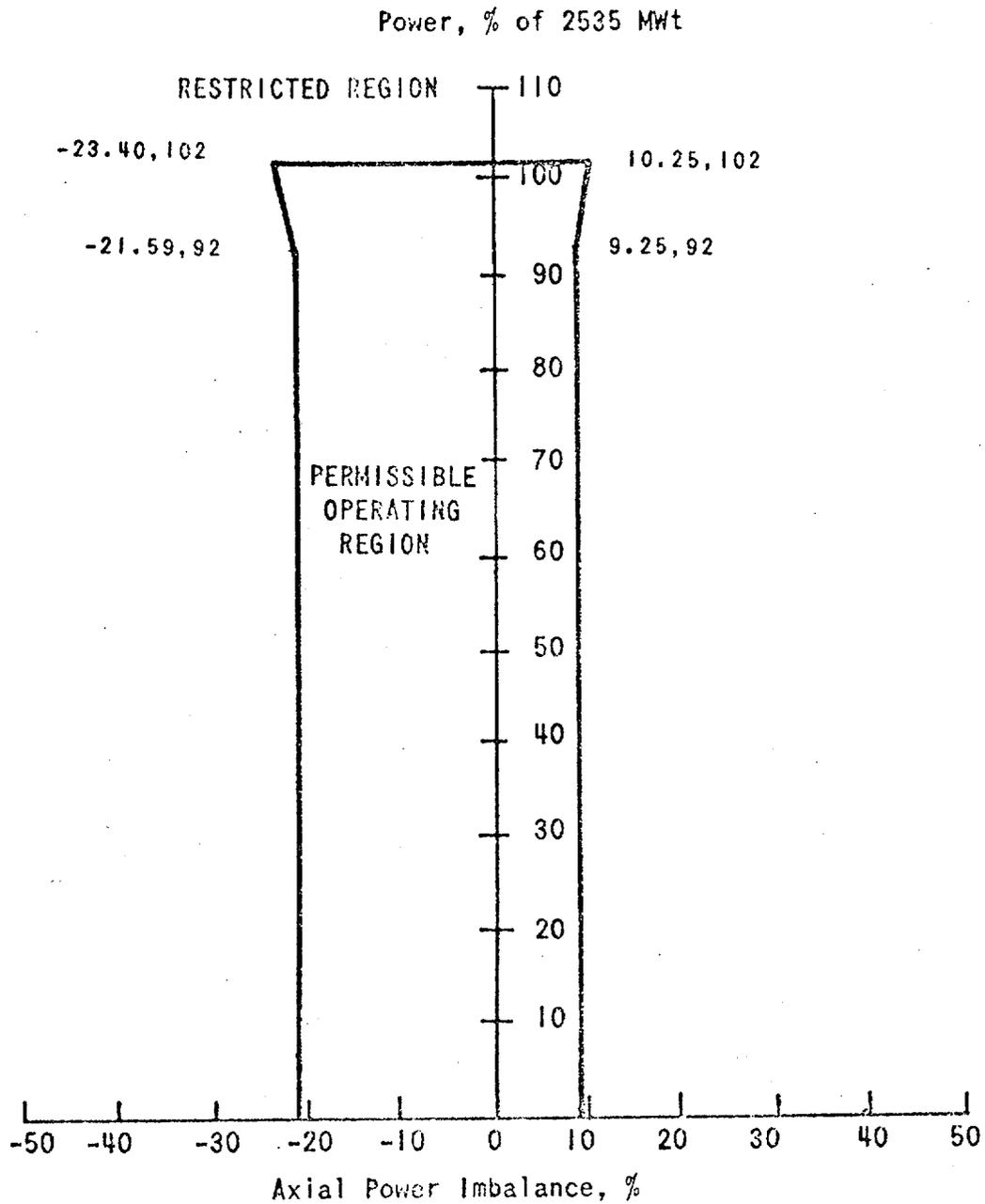
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ROD POSITION LIMITS FOR 2 & 3 PUMP  
OPERATION FROM 0 TO 125 ± 5 EFPD  
TMI, CYCLE 4

Figure 3.5-2C

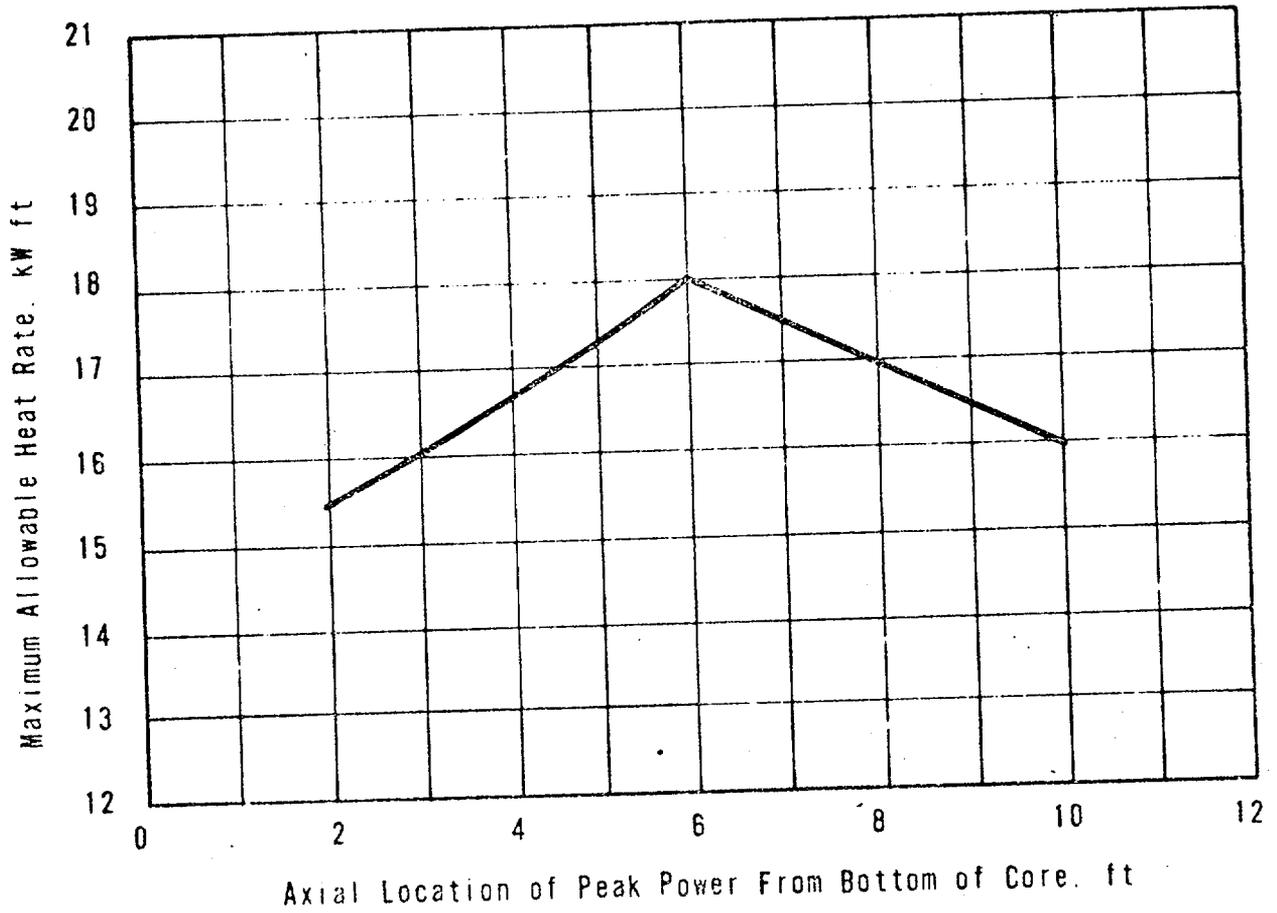
Reserved for Figure 3.5-2D



POWER IMBALANCE ENVELOPE FOR OPERATION  
FROM 0 TO 125 ± 5 EFPD  
TMI-1, CYCLE 4

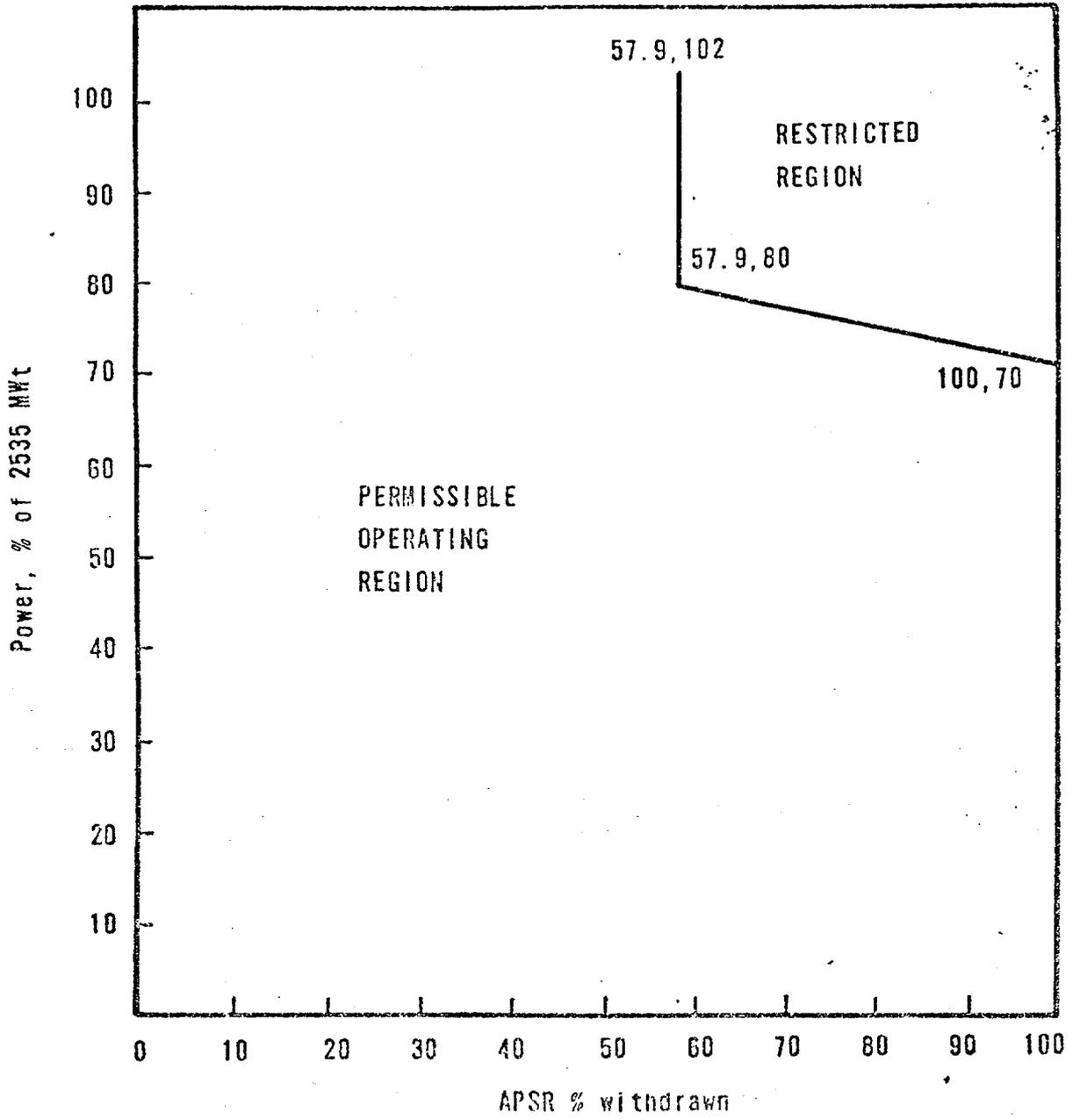
Figure 3.5-2E

Reserved for Figure 3.5-2F



LOCA LIMITED MAXIMUM ALLOWABLE  
 LINEAR HEAT RATE - TMI-1, CYCLE 4

Figure 3.5-2G



APSR POSITION LIMITS FOR  
 OPERATION FROM 0 TO 265 ± 15 EFPO  
 TMI-1, CYCLE 4

Figure 3.5-2N