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REACTIVITY CONTROL SYSTEMS

SHUTDOWN MARGIN - K_{N-1} - ANY CEA WITHDRAWN

LIMITING CONDITION FOR OPERATION

3.1.1.2

a. The SHUTDOWN MARGIN shall be greater than or equal to that shown in Figure 3.1-1A, and

b. For T_{cold} less than or equal to 500°F, K_{N-1} shall be less than 0.99.

APPLICABILITY: MODES 1, 2*, 3*, 4*, and 5* with any full-length CEA fully or partially withdrawn.

ACTION:

a. With the SHUTDOWN MARGIN less than that in Figure 3.1-1A, immediately initiate and continue boration at greater than or equal to 26 gpm to the reactor coolant system of a solution containing greater than or equal to 4000 ppm boron or equivalent until the required SHUTDOWN MARGIN is restored, and

b. With T_{cold} less than or equal to 500°F and K_{N-1} greater than or equal to 0.99, immediately vary CEA positions and/or initiate and continue boration at greater than or equal to 26 gpm to the reactor coolant system of a solution containing greater than or equal to 4000 ppm boron or equivalent until the required K_{N-1} is restored.

SURVEILLANCE REQUIREMENTS

4.1.1.2.1 With any full-length CEA fully or partially withdrawn, the SHUTDOWN MARGIN shall be determined to be greater than or equal to that in Figure 3.1.1A:

a. Within 1 hour after detection of an inoperable CEA(s) and at least once per 12 hours thereafter while the CEA(s) is inoperable. If the inoperable CEA is immovable as a result of excessive friction or mechanical interference or known to be untrippable, the above required SHUTDOWN MARGIN shall be increased by an amount at least equal to the withdrawn worth of the immovable or untrippable CEA(s).

* See Special Test Exceptions 3.10.1 and 3.10.9.

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PDR ADOCK 05000529
P PDC

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Replace with New
Figure 3.1-1A

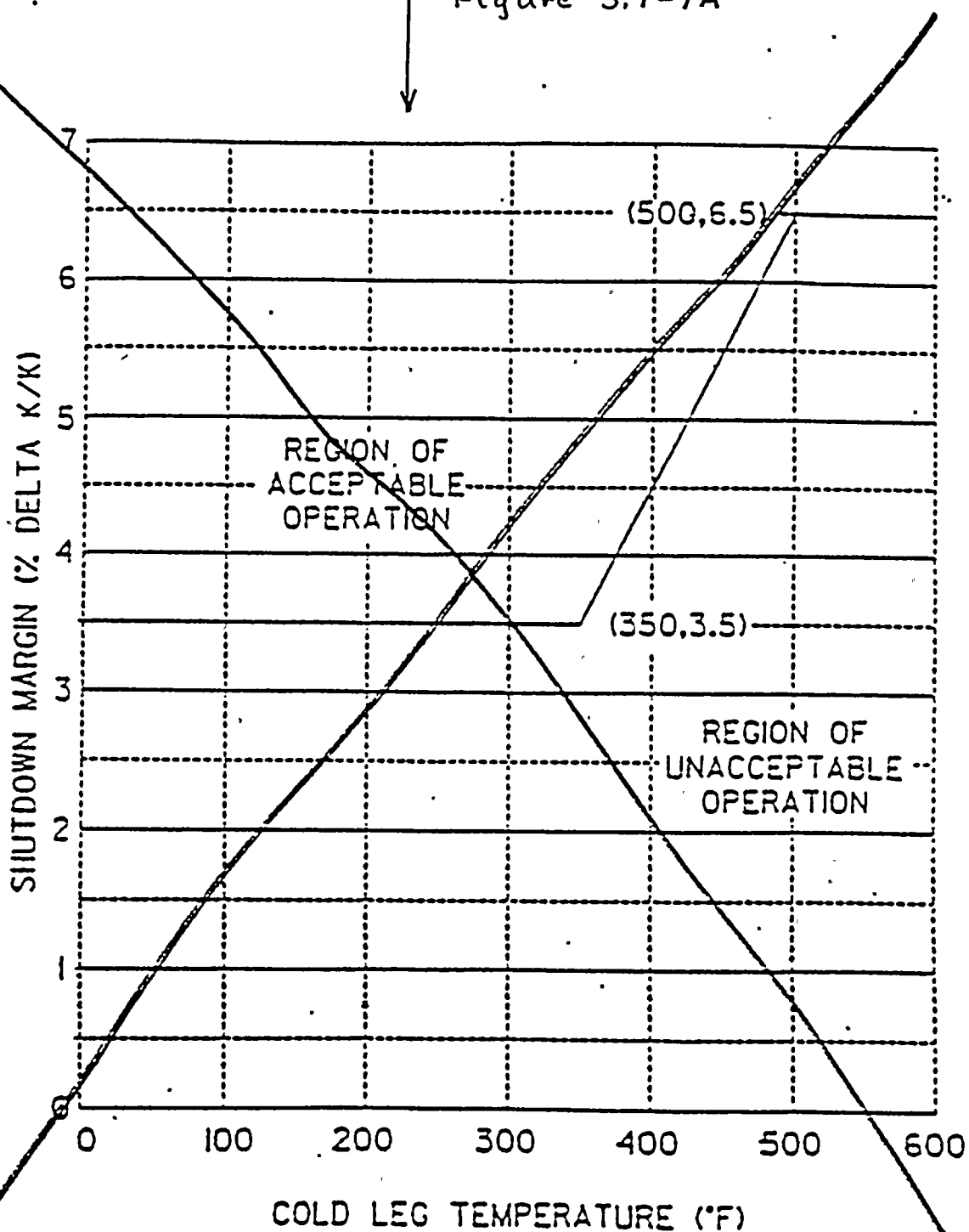


FIGURE 3.1- 1A

SHUTDOWN MARGIN VERSUS COLD LEG TEMPERATURE

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REVISED
FIGURE

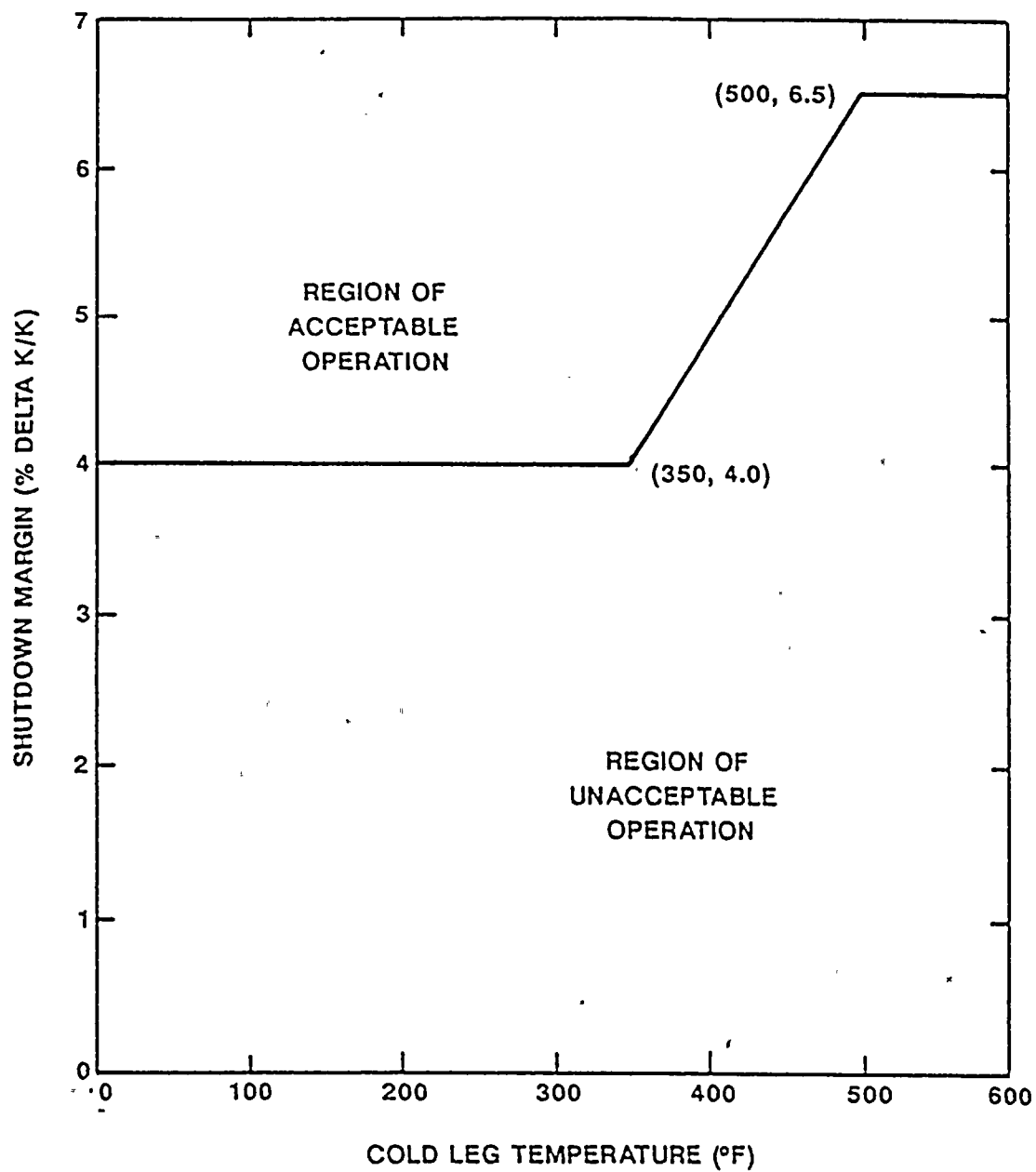


FIGURE 3.1-1A
SHUTDOWN MARGIN vs. COLD LEG TEMPERATURE



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REACTIVITY CONTROL SYSTEMSSURVEILLANCE REQUIREMENTS (Continued)

- b. When in MODE 1 or MODE 2 with k_{eff} greater than or equal to 1.0, at least once per 12 hours by verifying that CEA group withdrawal is within the Transient Insertion Limits of Specification 3.1.3.6.
- c. When in MODE 2 with k_{eff} less than 1.0, within 4 hours prior to achieving reactor criticality by verifying that predicted critical CEA position is within the limits of Specification 3.1.3.6.
- d. Prior to initial operation above 5% RATED THERMAL POWER after each fuel loading, by consideration of the factors of e. below, with the CEA groups at the Transient Insertion Limits of Specification 3.1.3.6.
- e. When in MODE 3, 4, or 5, at least once per 24 hours by consideration of at least the following factors:
 - 1. Reactor Coolant System boron concentration,
 - 2. CEA position
 - 3. Reactor Coolant System average temperature,
 - 4. Fuel burnup based on gross thermal energy generation,
 - 5. Xenon concentration, and
 - 6. Samarium concentration.

4.1.1.2.2 When in MODE 3, 4, or 5, with any full-length CEA fully or partially withdrawn, and T_{cold} less than or equal to 500°F, K_{N-1} shall be determined to be less than 0.99 at least once per 24 hours by consideration of at least the following factors.

- 1. Reactor Coolant System boron concentration,
- 2. CEA position,
- 3. Reactor Coolant System average temperature
- 4. Fuel burnup based on gross thermal energy generation.
- 5. Xenon concentration, and
- 6. Samarium concentration.

4.1.1.2.3 The overall core reactivity balance shall be compared to predicted values to demonstrate agreement within $\pm 1.0\%$ delta k/k at least once per 31 Effective Full Power Days (EFPD). This comparison shall consider at least those factors stated in Specification 4.1.1.2.1.e or 4.1.1.2.2. The predicted reactivity values shall be adjusted (normalized) to correspond to the actual core conditions prior to exceeding a fuel burnup of 60 EFPD after each fuel loading.

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BORON DILUTION ALARMSLIMITING CONDITION FOR OPERATION

3.1.2.7 Both startup channel high neutron flux alarms shall be OPERABLE.

APPLICABILITY: ~~MODES 3*, 4, 5, and 6.~~

ACTION:

- a. With one startup channel high neutron flux alarm inoperable:
 1. Determine the RCS boron concentration when entering MODE 3, 4, 5, or 6 or at the time the alarm is determined to be inoperable. From that time, the RCS boron concentration shall be determined at the applicable monitoring frequency in Tables 3.1-1 through 3.1-5 by either boronmeter or RCS sampling**.
- b. With both startup channel high neutron flux alarms inoperable:
 1. Determine the RCS boron concentration by either boronmeter and RCS sampling** or by independent collection and analysis of two RCS samples when entering Mode 3, 4, or 5 or at the time both alarms are determined to be inoperable. From that time, the RCS boron concentration shall be determined at the applicable monitoring frequency in Tables 3.1-1 through 3.1-5, as applicable, by either boronmeter and RCS sampling** or by collection and analysis of two independent RCS samples. If redundant determination of RCS boron concentration cannot be accomplished immediately, suspend all operations involving CORE ALTERATIONS or positive reactivity changes until the method for determining and confirming RCS boron concentration is restored.
 2. When in MODE 5 with the RCS level below the centerline of the hotleg or MODE 6, suspend all operations involving CORE ALTERATIONS or positive reactivity changes until at least one startup channel high neutron flux alarm is restored to OPERABLE status.
- c. The provisions of Specification 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS

4.1.2.7 Each startup channel high neutron flux alarm shall be demonstrated OPERABLE by performance of:

*Within 1 hour after the neutron flux is within the startup range following a reactor shutdown.

**With one or more reactor coolant pumps (RCP) operating the sample should be obtained from the hot leg. With no RCP operating, the sample should be obtained from the discharge line of the low pressure safety injection (LPSI) pump operating in the shutdown cooling mode.

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SURVEILLANCE REQUIREMENTS (Continued)

a. A CHANNEL CHECK:

1. At least once per 12 hours.
2. When initially setting setpoints at the following times:
 - a) One hour after a reactor trip.
 - b) After a controlled reactor shutdown: Within 1 hour after the neutron flux is within the startup range in MODE 3.

b. A CHANNEL FUNCTIONAL TEST every 31 days of cumulative operation during shutdown.

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TABLE 3.1-2

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON DILUTION
DETECTION AS A FUNCTION OF OPERATING CHARGING PUMPS AND PLANT
OPERATIONAL MODES FOR $0.98 > K_{eff} > 0.97$

OPERATIONAL MODE	Number of Operating Charging Pumps			
	0	1	2	3
3	12 hours	2.5 hours 2.0	1 hour 0.5	0.5 hours ONA
4 not on SCS	12 hours	2.5 hours	1 hour	0.5 hours
5 not on SCS	8 hours	2.5 hours	1 hour	0.5 hours
4 & 5 on SCS	8 hours	0.5 hours	ONA	ONA

Notes: SCS = Shutdown Cooling System
ONA = Operation not allowed

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TABLE 3.1-3

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON DILUTION
DETECTION AS A FUNCTION OF OPERATING CHARGING PUMPS
AND PLANT OPERATIONAL MODES FOR $0.97 \geq K_{eff} > 0.96$

OPERATIONAL MODE	Number of Operating Charging Pumps			
	0	1	2	3
3	12 hours	3.5 hours	1.5 hours	1 0.5 hour
4 not on SCS	12 hours	3.5 hours	1.5 hours	1 hour
5 not on SCS	8 hours	3.5 hours	1.5 hours	1 hour
4 & 5 on SCS	8 hours	1 hour	0.5 hours	ONA

Notes: SCS = Shutdown Cooling System
 ONA = Operation not allowed

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TABLE 3.1-5.

REQUIRED MONITORING FREQUENCIES FOR BACKUP BORON DILUTION
DETECTION AS A FUNCTION OF OPERATING CHARGING PUMPS.
AND PLANT OPERATIONAL MODES FOR $K_{eff} \leq 0.95$

OPERATIONAL MODE	<u>Number of Operating Charging Pumps</u>			
	0	1	2	3
3	12 hours	6 hours	3 2.5 hours	1.5 hours
4 not on SCS	12 hours	6 hours	3 hours	1.5 hours
5 not on SCS	8 hours	6 hours	3 hours	1.5 hours
4 & 5 on SCS	8 hours	2 hours	1 hour	0.5 hours
6	24 hours	8 hours	4 hours	2 hours

Note: SCS = Shutdown Cooling System



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3/4.1 REACTIVITY CONTROL SYSTEMS

BASES

3/4.1.1 DEBORATION CONTROL

3/4.1.1.1 and 3/4.1.1.2 SHUTDOWN MARGIN and K_{N-1}

The function of SHUTDOWN MARGIN is to ensure that the reactor remains subcritical following a design basis accident or anticipated operational occurrence. The function of K_{N-1} is to maintain sufficient subcriticality to preclude inadvertent criticality following ejection of a single control element assembly (CEA). During operation in MODES 1 and 2, with k_{eff} greater than or equal to 1.0, the transient insertion limits of Specification 3.1.3.6 ensure that sufficient SHUTDOWN MARGIN is available.

SHUTDOWN MARGIN is the amount by which the core is subcritical, or would be subcritical immediately following a reactor trip, considering a single malfunction resulting in the highest worth CEA failing to insert. K_{N-1} is a measure of the core's reactivity, considering a single malfunction resulting in the highest worth inserted CEA being ejected.

SHUTDOWN MARGIN requirements vary throughout the core life as a function of fuel depletion and reactor coolant system (RCS) cold leg temperature (T_{cold}). The most restrictive condition occurs at EOL, with T_{cold} at no-load operating temperature, and is associated with a postulated steam line break accident and the resulting uncontrolled RCS cooldown. In the analysis of this accident, the specified SHUTDOWN MARGIN is required to control the reactivity transient and ensure that the fuel performance and offsite dose criteria are satisfied. As (initial) T_{cold} decreases, the potential RCS cooldown and the resulting reactivity transient are less severe and, therefore, the required SHUTDOWN MARGIN also decreases. Below T_{cold} of about 210°F, the inadvertent deboration event becomes limiting with respect to the SHUTDOWN MARGIN requirements. Below 210°F, the specified SHUTDOWN MARGIN ensures that sufficient time for operator actions exists between the initial indication of the deboration and the total loss of shutdown margin. Accordingly, with at least one CEA partially or fully withdrawn, the SHUTDOWN MARGIN requirements are based upon these limiting conditions.

Additional events considered in establishing requirements on SHUTDOWN MARGIN that are not limiting with respect to the Specification limits are single CEA withdrawal and startup of an inactive reactor coolant pump.

K_{N-1} requirements vary with the amount of positive reactivity that would be introduced assuming the CEA with the highest inserted worth ejects from the core. In the analysis of the CEA ejection event, the K_{N-1} requirement ensures that the radially averaged enthalpy acceptance criterion is satisfied, considering power redistribution effects. Above T_{cold} of 500°F, Doppler reactivity feedback is sufficient to preclude the need for a specific K_{N-1} requirement. With all CEAs fully inserted, K_{N-1} and SHUTDOWN MARGIN requirements are equivalent in terms of minimum acceptable core boron concentration.

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REACTIVITY CONTROL SYSTEMSBASESSHUTDOWN MARGIN and K_{N-1} (continued)

Other technical specifications that reference the Specifications on SHUTDOWN MARGIN or K_{N-1} are: 3/4.1.2, BORATION SYSTEMS, 3/4.1.3, MOVABLE CONTROL ASSEMBLIES, 3/4.9.1, REFUELING OPERATIONS-BORON CONCENTRATION, 3/4.10.1, SHUTDOWN MARGIN AND K_{N-1} - CEA WORTH TESTS, and 3/4.10.9, SHUTDOWN MARGIN AND K_{N-1} - CEDMS TESTING.

3/4.1.1.3 MODERATOR TEMPERATURE COEFFICIENT (MTC)

The limitations on moderator temperature coefficient (MTC) are provided to ensure that the assumptions used in the accident and the transient analysis remain valid through each fuel cycle. The surveillance requirements for measurement of the MTC during each fuel cycle are adequate to confirm the MTC value since this coefficient changes slowly due principally to the reduction in RCS boron concentration associated with fuel burnup. The confirmation that the measured MTC value is within its limit provides assurances that the coefficient will be maintained within acceptable values throughout each fuel cycle.

3/4.1.1.4 MINIMUM TEMPERATURE FOR CRITICALITY

This specification ensures that the reactor will not be made critical with the Reactor Coolant System cold leg temperature less than 552°F. This limitation is required to ensure (1) the moderator temperature coefficient is within its analyzed temperature range, (2) the protective instrumentation is within its normal operating range, and (3) consistency with the FSAR safety analysis.

POWER DISTRIBUTION LIMITS

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3/4.2.4 DNBR MARGIN

LIMITING CONDITION FOR OPERATION

3.2.4 The DNBR margin shall be maintained by one of the following methods:

- a. Maintaining COLSS calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR (when COLSS is in service, and either one or both CEACs are operable); or
- b. Maintaining COLSS calculated core power less than or equal to COLSS calculated core power operating limit based on DNBR decreased by the allowance shown in Figure 3.2-1 (when COLSS is in service and neither CEAC is operable); or
- c. Operating within the region of acceptable operation of Figure 3.2-2 using any operable CPC channel (when COLSS is out of service and either one or both CEACs are operable); or
- d. Operating within the region of acceptable operation of Figure 3.2-2A using any operable CPC channel (when COLSS is out of service and neither CEAC is operable).

APPLICABILITY: MODE 1 above 20% of RATED THERMAL POWER.

ACTION:

With the DNBR not being maintained:

1. As indicated by COLSS calculated core power exceeding the appropriate COLSS calculated power operating limit; or
2. With COLSS out of service, operation outside the region of acceptable operation of Figure 3.2-2 or 3.2-2A, as applicable;

within 15 minutes initiate corrective action to increase the DNBR to within the limits and either:

- a. Restore the DNBR to within its limits within 1 hour, or
- b. Reduce THERMAL POWER to less than or equal to 20% of RATED THERMAL POWER within the next 6 hours.

SURVEILLANCE REQUIREMENTS

4.2.4.1 The provisions of Specification 4.0.4 are not applicable.

4.2.4.2 The DNBR shall be determined to be within its limits when THERMAL POWER is above 20% of RATED THERMAL POWER by continuously monitoring the core power distribution with the Core Operating Limit Supervisory System (COLSS) or, with the COLSS out of service, by verifying at least once per 2 hours that the DNBR, as indicated on any OPERABLE DNBR channel, is within the limit shown on Figure 3.2-2 or Figure 3.2-2A.

4.2.4.3 At least once per 31 days, the COLSS Margin Alarm shall be verified to actuate at a THERMAL POWER level less than or equal to the core power operating limit based on DNBR.

COLSS OUT OF SERVICE DNER LIMIT LINE

Replace with
New Figure 3.2-2

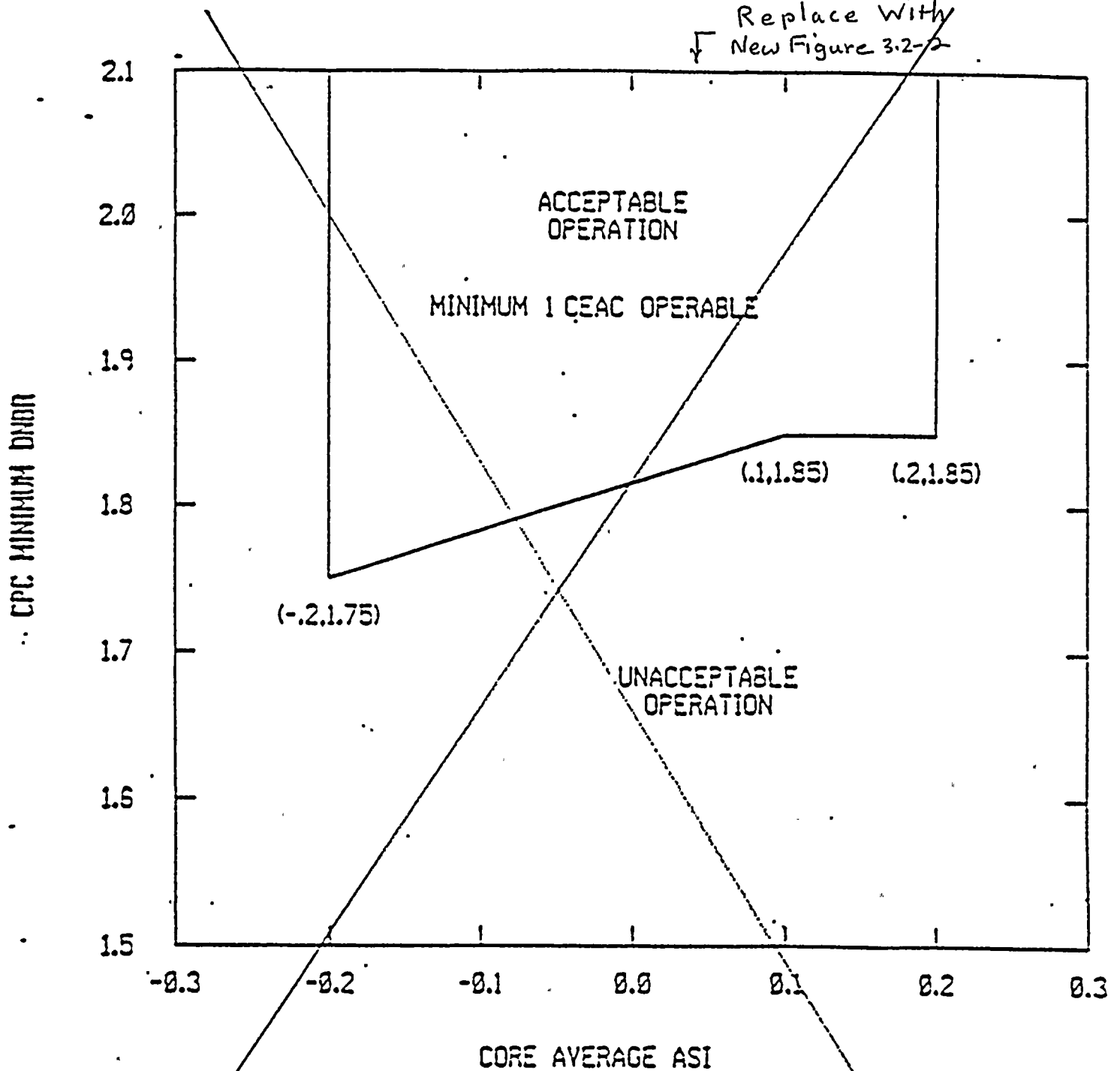


FIGURE 3.2-2

DNER MARGIN OPERATING LIMIT BASED ON CORE PROTECTION CALCULATORS
(COLSS OUT OF SERVICE, CEACs OPERABLE)



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COLSS OUT OF SERVICE DNBR LIMIT LINE

Revised
Figure

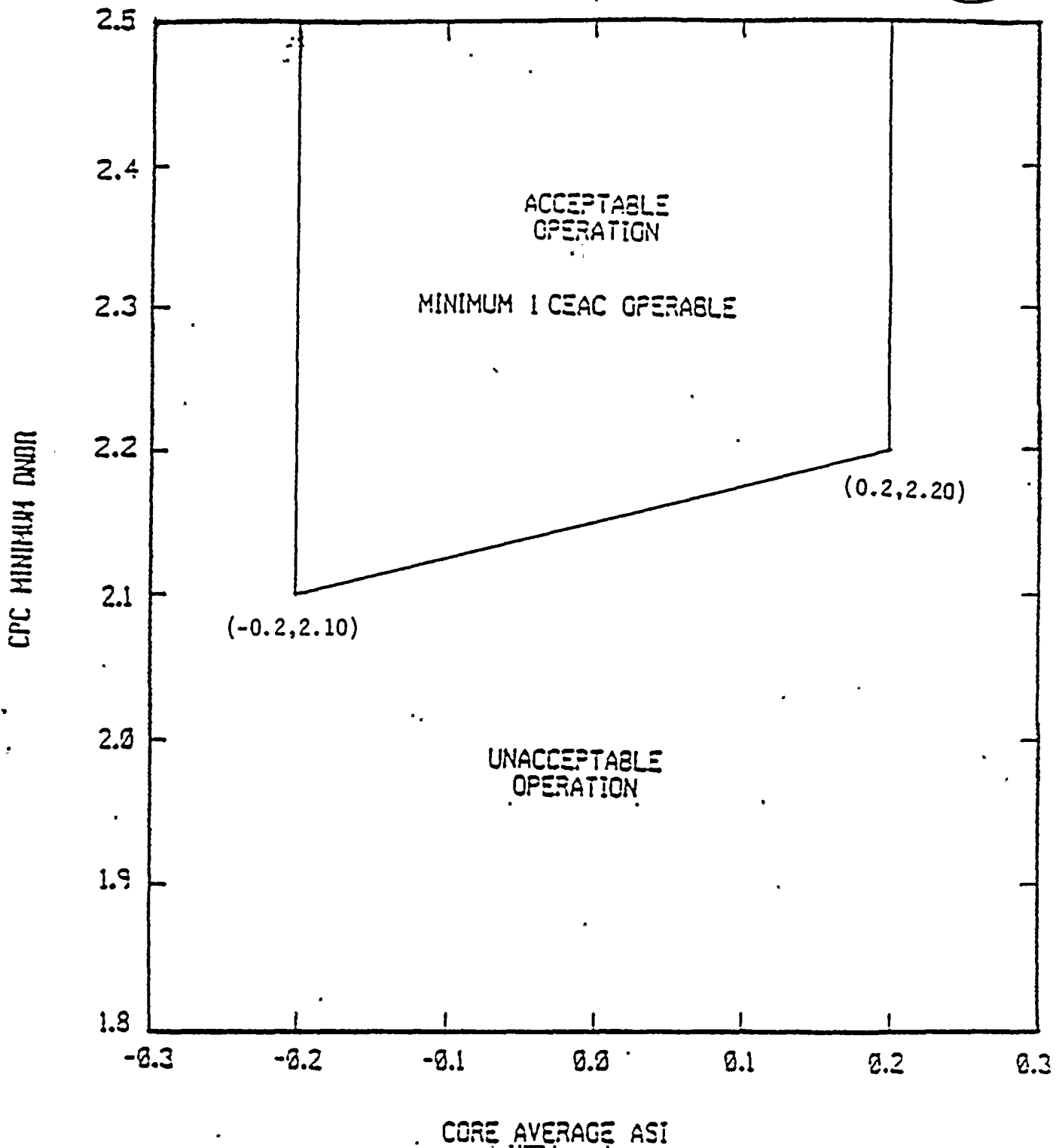


FIGURE 3.2-2 CEACs

DNBR MARGIN OPERATING LIMIT BASED ON CORE PROTECTION CALCULATORS
(COLSS OUT OF SERVICE, CEACs OPERABLE)

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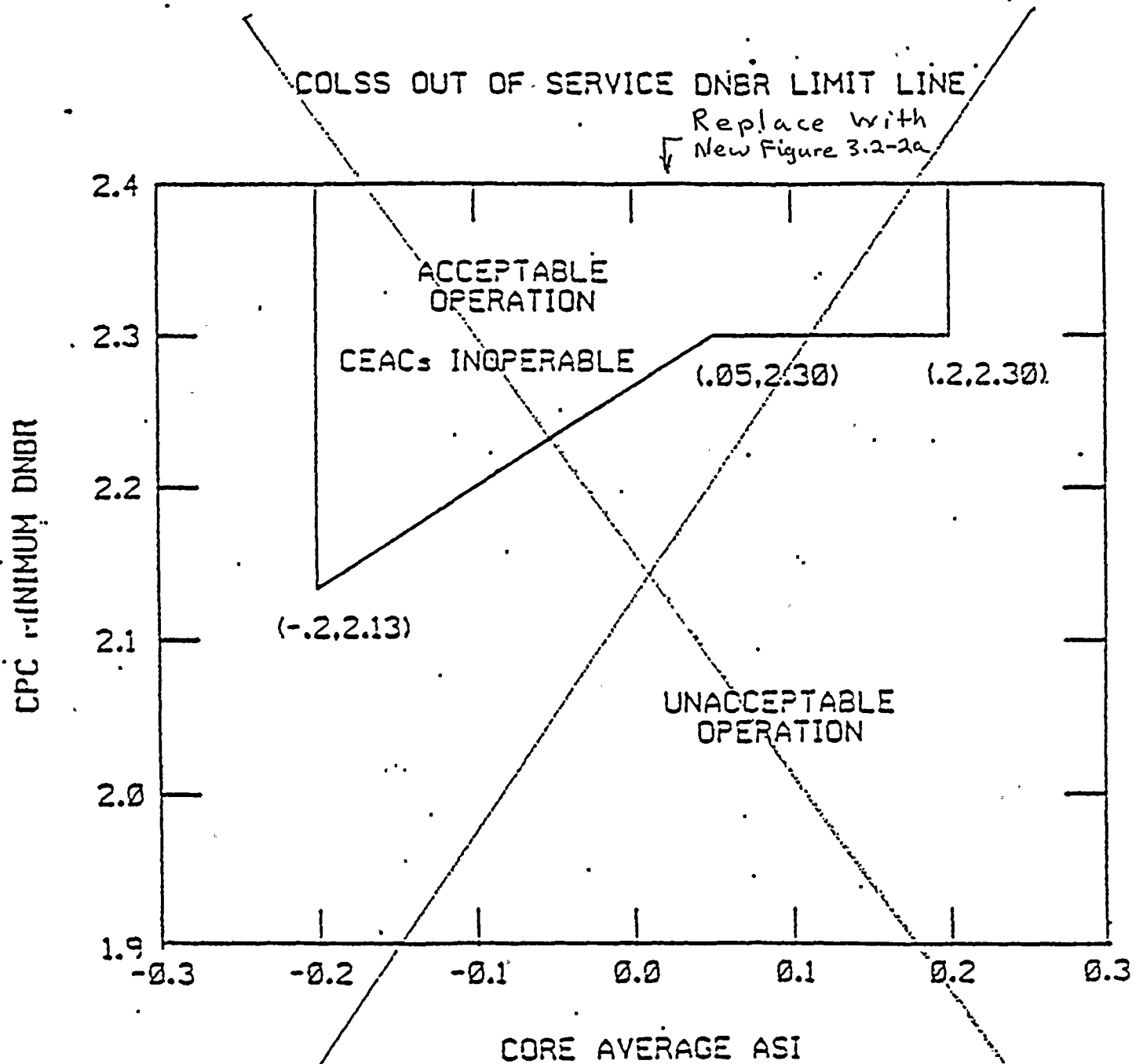


FIGURE 3.2-2A

DNBR MARGIN OPERATING LIMIT BASED ON CORE PROTECTION CALCULATORS
(COLSS OUT OF SERVICE, CEACs INOPERABLE)

COLSS OUT OF SERVICE DNR LIMIT LINE

Revised
Figure

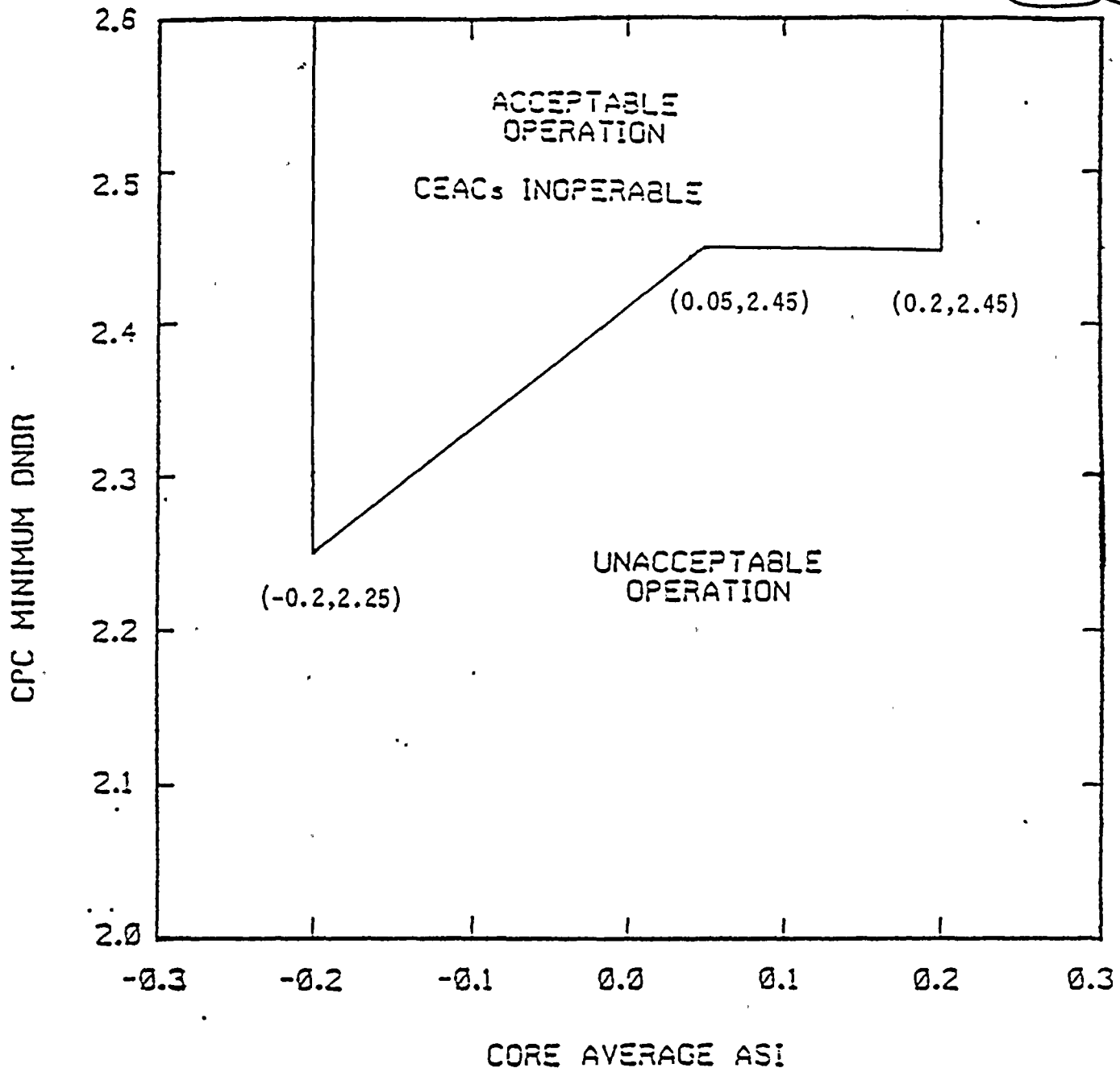


FIGURE 3.2-2a

DNR MARGIN OPERATING LIMIT BASED ON CORE PROTECTION CALCULATORS
(COLSS OUT OF SERVICE, CEACs INOPERABLE)

POWER DISTRIBUTION LIMITS

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BASESAZIMUTHAL POWER TILT - T_g (Continued)

$P_{\text{tilt}}/P_{\text{untilt}}$ is the ratio of the power at a core location in the presence of a tilt to the power at that location with no tilt.

The AZIMUTHAL POWER TILT allowance used in the CPCs is defined as the value of CPC addressable constant TR-1.0.

3/4.2.4 DNBR MARGIN

The limitation on DNBR as a function of AXIAL SHAPE INDEX represents a conservative envelope of operating conditions consistent with the safety analysis assumptions and which have been analytically demonstrated adequate to maintain an acceptable minimum DNBR throughout all anticipated operational occurrences. Operation of the core with a DNBR at or above this limit provides assurance that an acceptable minimum DNBR will be maintained in the event of a loss of flow transient.

Either of the two core power distribution monitoring systems, the Core Operating Limit Supervisory System (COLSS) and the DNBR channels in the Core Protection Calculators (CPCs), provide adequate monitoring of the core power distribution and are capable of verifying that the DNBR does not violate its limits. The COLSS performs this function by continuously monitoring the core power distribution and calculating a core operating limit corresponding to the allowable minimum DNBR. The COLSS calculation of core power operating limit based on DNBR includes appropriate penalty factors which provide, with a 95/95 probability/confidence level, that the core power limits calculated by COLSS (based on the minimum DNBR Limit) is conservative with respect to the actual core power limit. These penalty factors are determined from the uncertainties associated with planar radial peaking measurement, engineering heat flux, state parameter measurement, software algorithm modelling, computer processing, rod bow, and core power measurement.

Parameters required to maintain the margin to DNB and total core power are also monitored by the CPCs. Therefore, in the event that the COLSS is not being used, operation within the limits of Figures 3.2-2 and 3.2-2A can be maintained by utilizing a predetermined DNBR as a function of AXIAL SHAPE INDEX and by monitoring the CPC trip channels. The above listed uncertainty and penalty factors are also included in the CPCs which assume a minimum core power of 20% of RATED THERMAL POWER. The 20% RATED THERMAL POWER threshold is due to the neutron flux detector system being less accurate below 20% core power. Core noise level at low power is too large to obtain usable detector readings.

A DNBR penalty factor has been included in the COLSS and CPC DNBR calculations to accommodate the effects of rod bow. The amount of rod bow in each assembly is dependent upon the average burnup experienced by that assembly. Fuel assemblies that incur higher average burnup will experience a greater magnitude of rod bow. Conversely, lower burnup assemblies will experience less rod bow. In design calculations, the penalty for each batch required to compensate for rod bow is determined from a batch's maximum average assembly burnup applied to the batch's maximum integrated planar-radial power peak. A single net penalty for COLSS and CPC is then determined from the penalties associated with each batch, accounting for the offsetting margins due to the lower radial power peaks in the higher burnup batches.

REGULATING CEA INSERTION LIMITS

LIMITING CONDITION FOR OPERATION

3.1.3.6 The regulating CEA groups shall be limited to the withdrawal sequence, and to the insertion limits## shown on Figure 3.1-3** when the COLSS is in service or shown on Figure 3.1-4** when the COLSS is not in service. The CEA insertion between the Long Term Steady State Insertion Limits and the Transient Insertion Limits is restricted to:

- a. Less than or equal to 4 hours per 24 hour interval,
- b. Less than or equal to 5 Effective Full Power Days per 30 Effective Full Power Day interval, and
- c. Less than or equal to 14 Effective Full Power Days per 18 Effective Full Power Months.

APPLICABILITY: MODES 1* and 2*#.

ACTION:

- a. With the regulating CEA groups inserted beyond the Transient Insertion Limits, except for surveillance testing pursuant to Specification 4.1.3.1.2, within 2 hours either:
 1. Restore the regulating CEA groups to within the limits, or
 2. Reduce THERMAL POWER to less than or equal to that fraction of RATED THERMAL POWER which is allowed by the CEA group position using Figures 3.1-3 or 3.1-4.
- b. With the regulating CEA groups inserted between the Long Term Steady State Insertion Limits and the Transient Insertion Limits for intervals greater than 4 hours per 24 hour interval, operation may proceed provided either:
 1. The Short Term Steady State Insertion Limits of Figure 3.1-3 or Figure 3.1-4 are not exceeded, or
 2. Any subsequent increase in THERMAL POWER is restricted to less than or equal to 5% of RATED THERMAL POWER per hour.

*See Special Test Exceptions 3.10.2 and 3.10.4.

#With K_{eff} greater than or equal to 1.

**CEAs are fully withdrawn in accordance with Figure 3.1-3 or Figure 3.1-4 when withdrawn to at least 144.75 inches.

##A reactor power cutback will cause either (Case 1) Regulating Group 5 or Regulating Group 4 and 5 to be dropped with no sequential insertion of additional Regulating Groups (Groups 1, 2, 3, and 4) or (Case 2) Regulating Group 5 or Regulating Group 4 and 5 to be dropped with all or part of the remaining Regulating Groups (Groups 1, 2, 3, and 4) being sequentially inserted. In either case, the Transient Insertion Limit and the withdrawal sequence of Figure 3.1-3 or Figure 3.1-4 can be exceeded for up to 2 hours.

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ACTION: (Continued)

- c. With the regulating CEA groups inserted between the Long Term Steady State Insertion Limits and the Transient Insertion Limits for intervals greater than 5 EFPD per 30 EFPD interval or greater than 14 EFPD per 18 Effective Full Power Months, either:
1. Restore the regulating groups to within the Long Term Steady State Insertion Limits within 2 hours, or
 2. Be in at least HOT STANDBY within 6 hours.

SURVEILLANCE REQUIREMENTS

4.1.3.6 The position of each regulating CEA group shall be determined to be within the Transient Insertion Limits at least once per 12 hours except during time intervals when the PDIL Auctioneer Alarm Circuit is inoperable, then verify the individual CEA positions at least once per 4 hours. The accumulated times during which the regulating CEA groups are inserted beyond the Long Term Steady State Insertion Limits but within the Transient Insertion Limits shall be determined at least once per 24 hours.

Replace with New

Figure 3.1-3

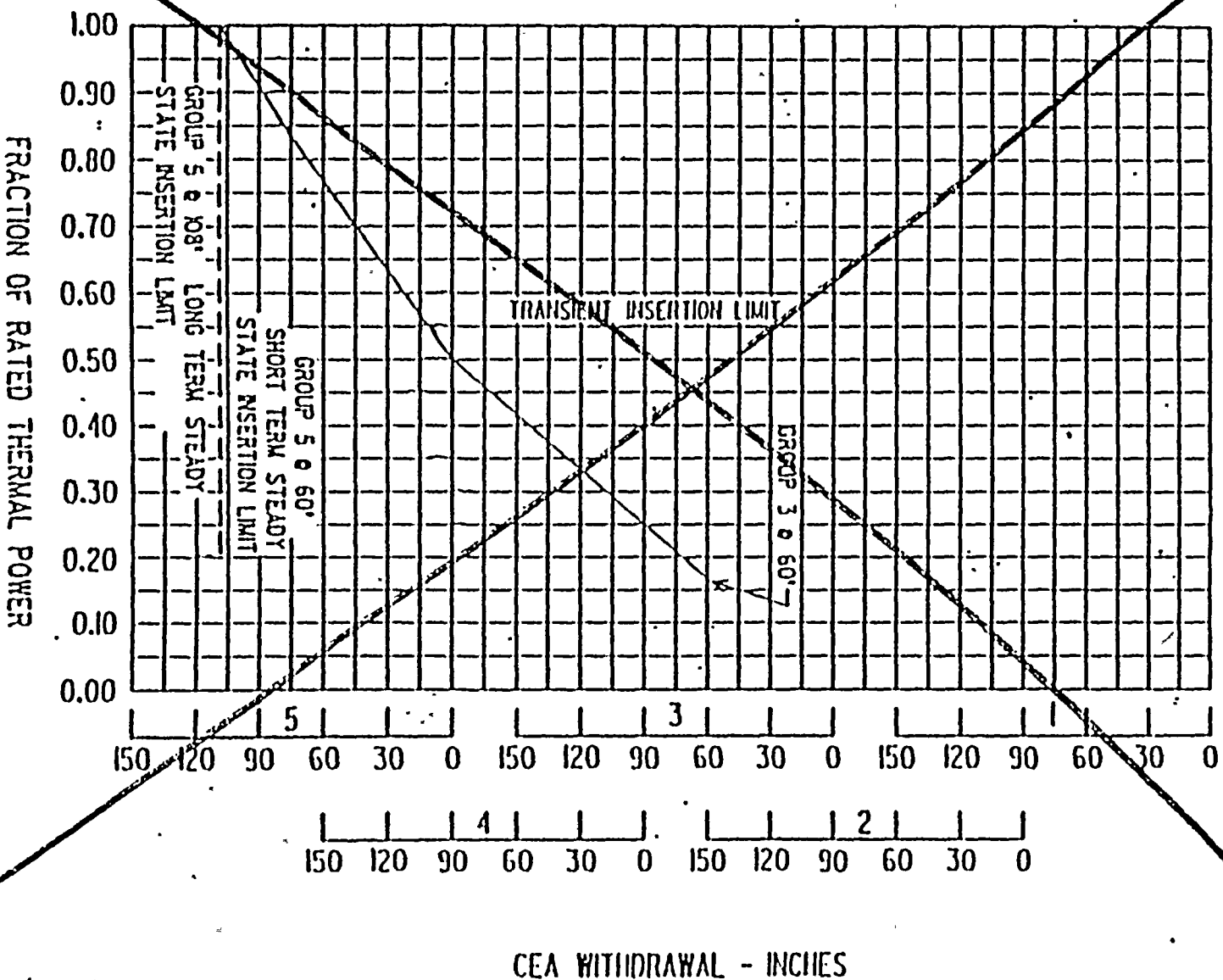
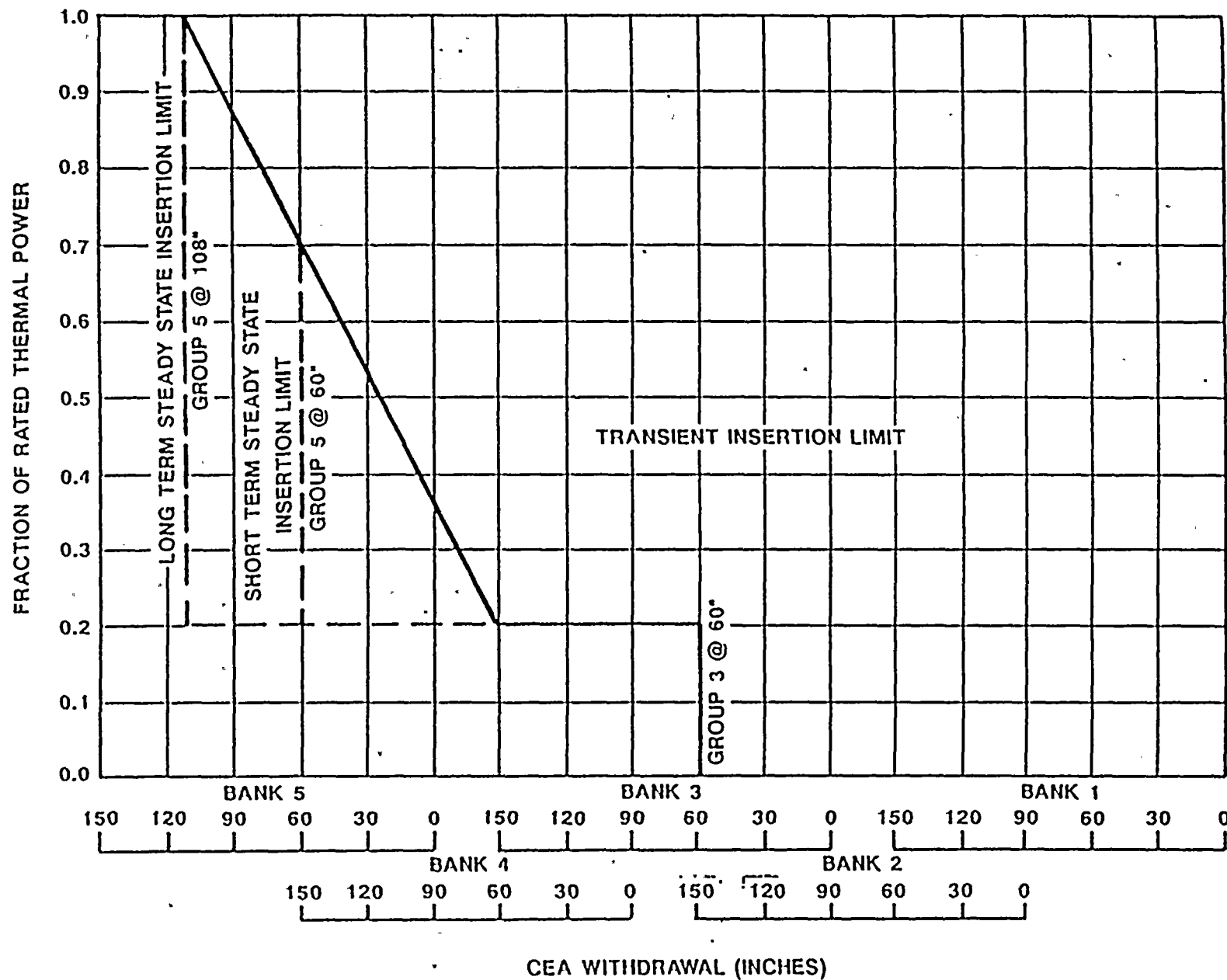


FIGURE 3.1-3

CEA INSERTION LIMITS VS THERMAL POWER
(COLSS IN SERVICE)

FIGURE 3.1-3
CEA INSERTION LIMITS vs. THERMAL POWER
(COLSS IN SERVICE)



Replace with
New Figure 3.1-4

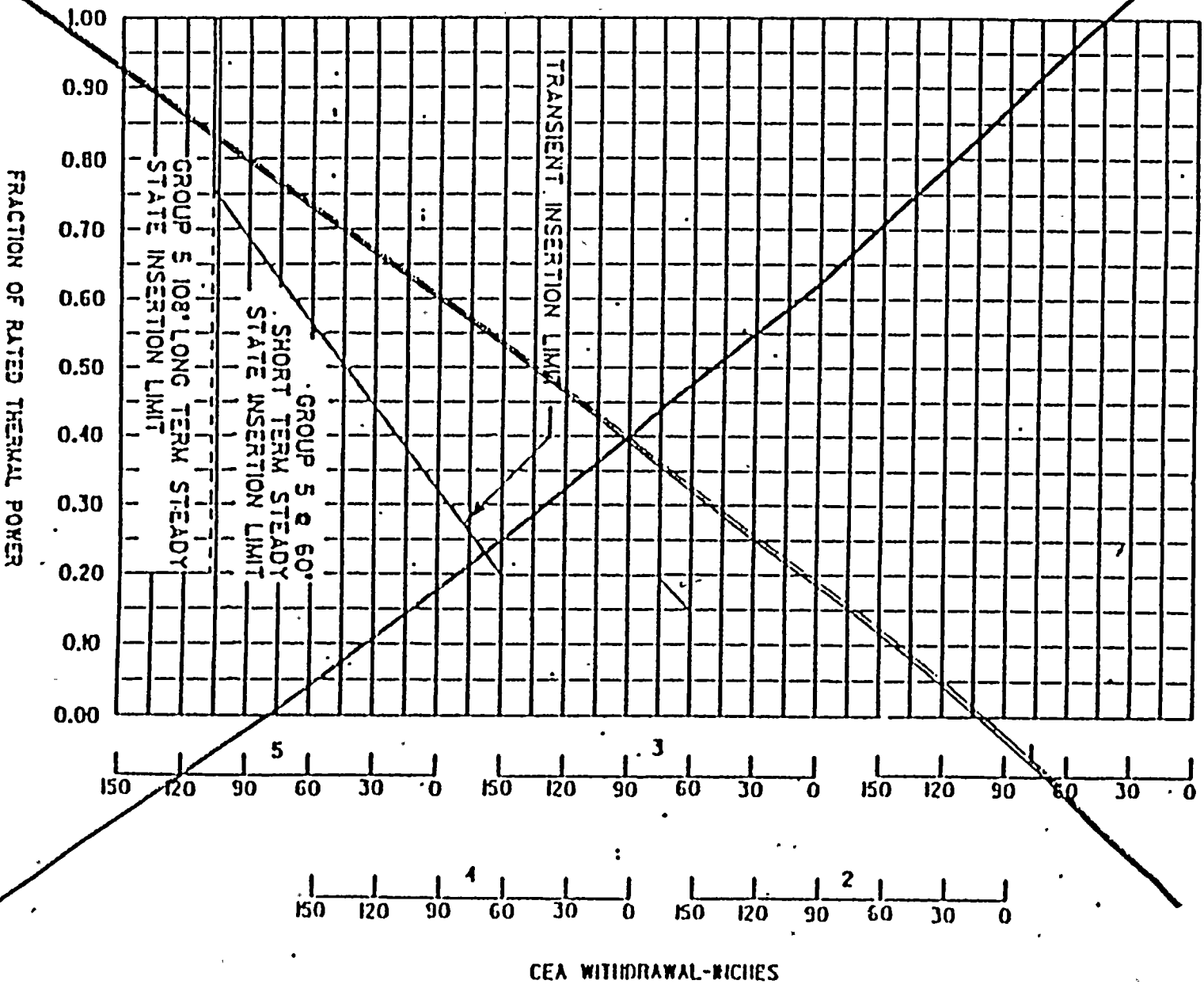
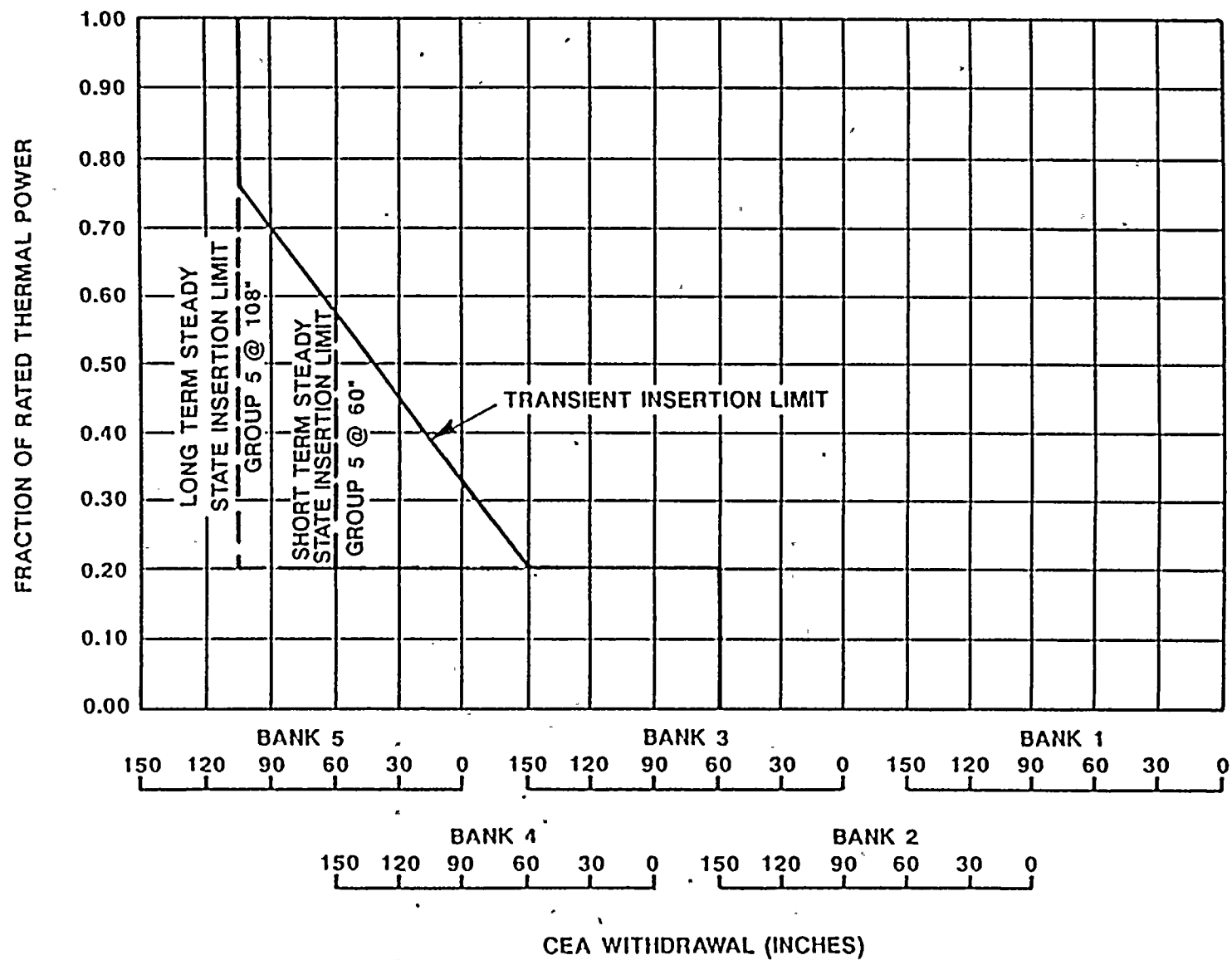


FIGURE 3.1-4

CEA INSERTION LIMITS VS THERMAL POWER
(COLDS OUT OF SERVICE)

FIGURE 3.1-4
CEA INSERTION LIMITS vs. THERMAL POWER
(COLSS OUT OF SERVICE)



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REACTIVITY CONTROL SYSTEMS

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BASES

3/4.1.3 MOVABLE CONTROL ASSEMBLIES

The specifications of this section ensure that (1) acceptable power distribution limits are maintained, (2) the minimum SHUTDOWN MARGIN is maintained, and (3) the potential effects of CEA misalignments are limited to acceptable levels.

The ACTION statements which permit limited variations from the basic requirements are accompanied by additional restrictions which ensure that the original design criteria are met.

The ACTION statements applicable to a stuck or untrippable CEA, to two or more inoperable CEAs, and to a large misalignment (greater than or equal to 19 inches) of two or more CEAs, require a prompt shutdown of the reactor since either of these conditions may be indicative of a possible loss of mechanical functional capability of the CEAs and in the event of a stuck or untrippable CEA, the loss of SHUTDOWN MARGIN.

For small misalignments (less than 19 inches) of the CEAs, there is (1) a small effect on the time-dependent long-term power distributions relative to those used in generating LCOs and LSSS setpoints, (2) a small effect on the available SHUTDOWN MARGIN, and (3) a small effect on the ejected CEA worth used in the safety analysis. Therefore, the ACTION statement associated with small misalignments of CEAs permits a 1-hour time interval during which attempts may be made to restore the CEA to within its alignment requirements. The 1-hour time limit is sufficient to (1) identify causes of a misaligned CEA, (2) take appropriate corrective action to realign the CEAs, and (3) minimize the effects of xenon redistribution.

The CPCs provide protection to the core in the event of a large misalignment (greater than or equal to 19 inches) of a CEA by applying appropriate penalty factors to the calculation to account for the misaligned CEA. However, this misalignment would cause distortion of the core power distribution. This distribution may, in turn, have a significant effect on (1) the available SHUTDOWN MARGIN, (2) the time-dependent long-term power distributions relative to those used in generating LCOs and LSSS setpoints, and (3) the ejected CEA worth used in the safety analysis. Therefore, the ACTION statement associated with the large misalignment of a CEA requires a prompt realignment of the misaligned CEA.

The ACTION statements applicable to misaligned or inoperable CEAs include requirements to align the OPERABLE CEAs in a given group with the inoperable CEA. Conformance with these alignment requirements bring the core, within a short period of time, to a configuration consistent with that assumed in generating LCO and LSSS setpoints. However, extended operation with CEAs significantly inserted in the core may lead to perturbations in (1) local burnup, (2) peaking factors, and (3) available SHUTDOWN MARGIN which are more adverse than the conditions assumed to exist in the safety analyses and LCO.

REACTIVITY CONTROL SYSTEMS

BASES

MOVABLE CONTROL ASSEMBLIES (Continued)

and LSSS setpoints determination. Therefore, time limits have been imposed on operation with inoperable CEAs to preclude such adverse conditions from developing.

Operability of at least two CEA position indicator channels is required to determine CEA positions and thereby ensure compliance with the CEA alignment and insertion limits. The CEA "Full In" and "Full Out" limits provide an additional independent means for determining the CEA positions when the CEAs are at either their fully inserted or fully withdrawn positions. Therefore, the ACTION statements applicable to inoperable CEA position indicators permit continued operations when the positions of CEAs with inoperable position indicators can be verified by the "Full In" or "Full Out" limits.

CEA positions and OPERABILITY of the CEA position indicators are required to be verified on a nominal basis of once per 12 hours with more frequent verifications required if an automatic monitoring channel is inoperable. These verification frequencies are adequate for assuring that the applicable LCOs are satisfied.

The maximum CEA drop time restriction is consistent with the assumed CEA drop time used in the safety analyses. Measurement with T_{cold} greater than or equal to 552°F and with all reactor coolant pumps operating ensures that the measured drop times will be representative of insertion times experienced during a reactor trip at operating conditions.

Several design steps were employed to accommodate the possible CEA guide tube wear which could arise from CEA vibrations when fully withdrawn. Specifically, a programmed insertion schedule will be used to cycle the CEAs between the full out position ("FULL OUT" LIMIT) and 3.0 inches inserted over the fuel cycle. This cycling will distribute the possible guide tube wear over a larger area, thus minimizing any effects. To accommodate this programmed insertion schedule, the fully withdrawn position was redefined, in some cases, to be 144.75 inches or greater.

The establishment of LSSS and LCOs requires that the expected long- and short-term behavior of the radial peaking factors be determined. The long-term behavior relates to the variation of the steady-state radial peaking factors with core burnup and is affected by the amount of CEA insertion assumed, the portion of a burnup cycle over which such insertion is assumed and the expected power level variation throughout the cycle. The short-term behavior relates to transient perturbations to the steady-state radial peaks due to radial xenon redistribution. The magnitudes of such perturbations depend upon the expected use of the CEAs during anticipated power reductions

BASESMOVABLE CONTROL ASSEMBLIES (Continued)

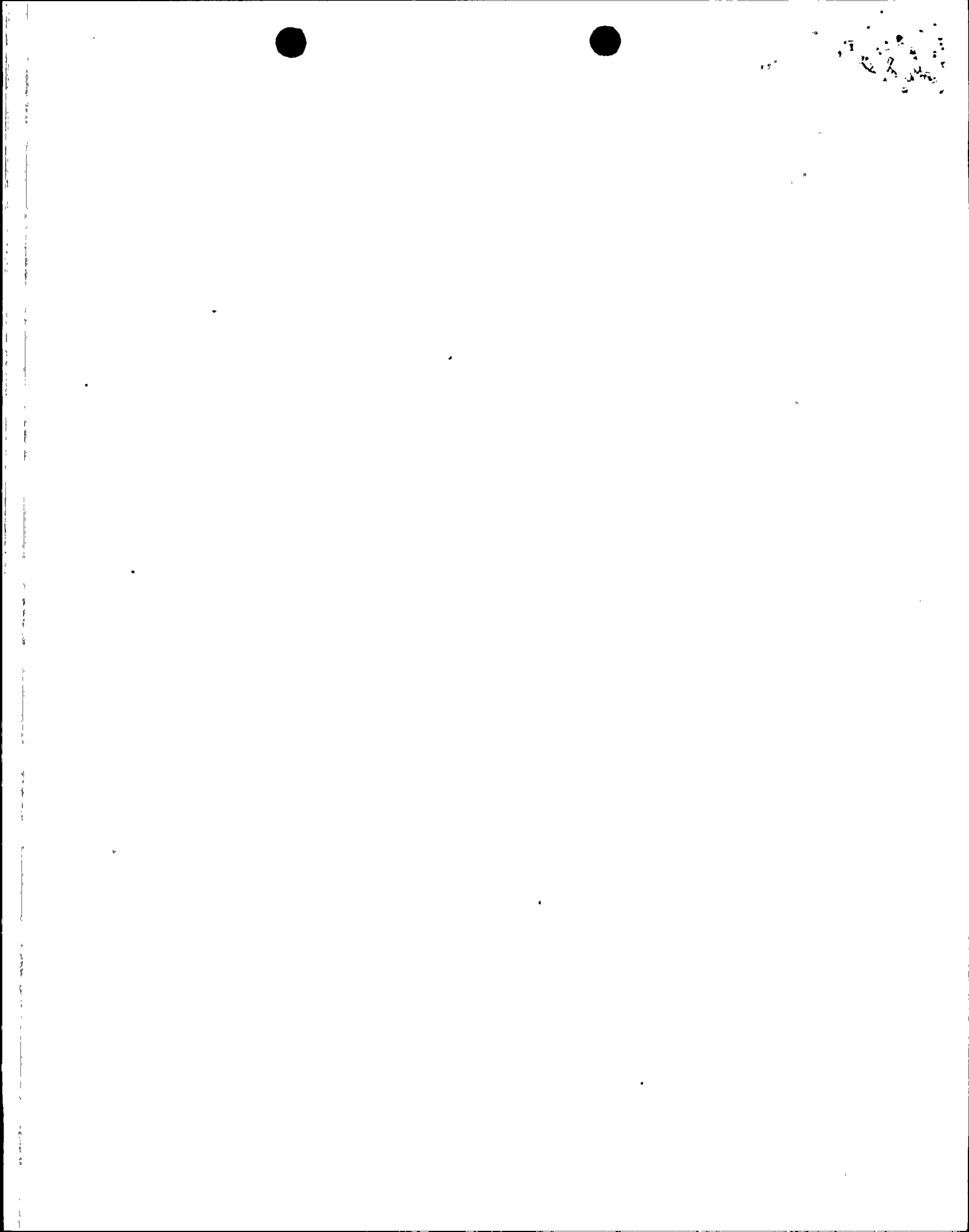
and load maneuvering. Analyses are performed based on the expected mode of operation of the NSSS (base load maneuvering, etc.) and from these analyses CEA insertions are determined and a consistent set of radial peaking factors defined. The Long Term Steady State and Short Term Insertion Limits are determined based upon the assumed mode of operation used in the analyses and provide a means of preserving the assumptions on CEA insertions used. The limits specified serve to limit the behavior of the radial peaking factors within the bounds determined from analysis. The actions specified serve to limit the extent of radial xenon redistribution effects to those accommodated in the analyses. The Long and Short Term Insertion Limits of Specifications 3.1.3.6 and 3.1.3.7 are specified for the plant which has been designed for primarily base loaded operation but which has the ability to accommodate a limited amount of load maneuvering.

The Transient Insertion Limits of Specifications 3.1.3.6 and 3.1.3.7 the Shutdown CEA Insertion Limits of Specification 3.1.3.5 ensure that (1) the minimum SHUTDOWN MARGIN is maintained, and (2) the potential effects of a CEA ejection accident are limited to acceptable levels. Long-term operation at the Transient Insertion Limits is not permitted since such operation could have effects on the core power distribution which could invalidate assumptions used to determine the behavior of the radial peaking factors.

The PVNGS CPC and COLSS systems are responsible for the safety and monitoring functions, respectively, of the reactor core. COLSS monitors the DNB Power Operating Limit (POL) and various operating parameters to help the operator maintain plant operation within the limiting conditions for operation (LCO). Operating within the LCO guarantees that in the event of an Anticipated Operational Occurrence (AOO), the CPCs will provide a reactor trip in time to prevent unacceptable fuel damage.

The COLSS reserves the Required Overpower Margin (ROPM) to account for the Loss of Flow (LOF) and CEA misoperation transients. When the COLSS is Out of Service (COOS), the monitoring function is performed via the CPC calculation of DNBR in conjunction with Technical Specification COOS Limit Lines (Figures 3.2-2 and 3.2-2A) which restricts the reactor power sufficiently to preserve the ROMP.

The reduction of the CEA deviation penalties in accordance with the CEAC (Control Element Assembly Calculator) sensitivity reduction program has been performed. This task involved setting many of the inward single CEA deviation penalty factors to 1.0. An inward CEA deviation event in effect would not be accompanied by the application of the CEA deviation penalty in either the CPC DNB and LHR (Linear Heat Rate) calculations for those CEAs with the reduced penalty factors. The protection for an inward CEA deviation event is thus accounted for separately.



BASESMOVABLE CONTROL ASSEMBLIES (Continued)

If an inward CEA deviation event occurs, the current CPC algorithm applies two penalty factors to each of the DNB and LHR calculations. The first, a static penalty factor, is applied upon detection of the event. The second, a xenon redistribution penalty, is applied linearly as a function of time after the CEA drop. The expected margin degradation for the inward CEA deviation event for which the penalty factor has been reduced is accounted for in two ways. The ROM reserved in COLSS is used to account for some of the margin degradation. Further, a power reduction in accordance with the curve in Figure 3.1-2A is required. In addition, the part length CEA maneuvering is restricted in accordance with Figure 3.1-5 to justify reduction of the PLR deviation penalty factors.

The technical specification permits plant operation if both CEACs are considered inoperable for safety purposes after this period.

POWER DISTRIBUTION LIMITS

3/4.2.7 AXIAL SHAPE INDEX

LIMITING CONDITION FOR OPERATION

3.2.7 The core average AXIAL SHAPE INDEX (ASI) shall be maintained within the following limits:

- a. COLSS OPERABLE

$$\frac{-0.23}{-0.27} \leq \text{ASI} \leq \frac{0.23}{0.27}$$
- b. COLSS OUT OF SERVICE (CPC)

$$-0.20 \leq \text{ASI} \leq +0.20$$

APPLICABILITY: MODE 1 above 20% of RATED THERMAL POWER*.

ACTION:

With the core average AXIAL SHAPE INDEX outside its above limits, restore the core average ASI to within its limit within 2 hours or reduce THERMAL POWER to less than 20% of RATED THERMAL POWER within the next 4 hours.

SURVEILLANCE REQUIREMENTS

4.2.7 The core average AXIAL SHAPE INDEX shall be determined to be within its limit at least once per 12 hours using the COLSS or any OPERABLE Core Protection Calculator channel.

* See Special Test Exception 3.10.2.

Figure 6

POWER DISTRIBUTION LIMITS

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BASES3/4.2.5 RCS FLOW RATE

This specification is provided to ensure that the actual RCS total flow rate is maintained at or above the minimum value used in the safety analyses. The minimum value used in the safety analyses is 95% of the design flow rate (164.0×10^6 lbm/hr) or 155.8×10^6 lbm/hr. The actual RCS flow rate is determined by direct measurement and an uncertainty associated with that measurement is considered when comparing actual RCS flow rate to the minimum required value of 155.8×10^6 lbm/hr.

3/4.2.6 REACTOR COOLANT COLD LEG TEMPERATURE

This specification is provided to ensure that the actual value of reactor coolant cold leg temperature is maintained within the range of values used in the safety analyses.

3/4.2.7 AXIAL SHAPE INDEX

This specification is provided to ensure that the actual value of the core average AXIAL SHAPE INDEX is maintained within the range of values used in the safety analyses.

3/4.2.8 PRESSURIZER PRESSURE

This specification is provided to ensure that the actual value of pressurizer pressure is maintained within the range of values used in the safety analyses.

