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2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.1 SAFETY LIMITS

THERMAL POWER, Low Pressure or Low Flow

2.1.1 THERMAL POWER shall not exceed 25% of RATED THERMAL POWER with the reactor vessel steam dome pressure less than 785 psig or core flow less than 10% of rated flow.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With THERMAL POWER exceeding 25% of RATED THERMAL POWER and the reactor vessel steam dome pressure less than 785 psig or core flow less than 10% of rated flow, be in at least HOT SHUTDOWN within 2 hours and comply with the requirements of Specification 6.7.1.

THERMAL POWER, High Pressure and High Flow

2.1.2 The MINIMUM CRITICAL POWER RATIO (MCPR) shall not be less than ~~1.09~~ 1.06 during both two loop operation and 1.07 during single loop operation with the reactor vessel steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

ACTION:

With MCPR less than the above limits and the reactor vessel steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow, be in at least HOT SHUTDOWN within 2 hours and comply with the requirements of Specification 6.7.1.

REACTOR COOLANT SYSTEM PRESSURE

2.1.3 The reactor coolant system pressure, as measured in the reactor vessel steam dome, shall not exceed 1325 psig.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, 3 and 4.

ACTION:

With the reactor coolant system pressure, as measured in the reactor vessel steam dome, above 1325 psig, be in at least HOT SHUTDOWN with reactor coolant system pressure less than or equal to 1325 psig within 2 hours and comply with the requirements of Specification 6.7.1.

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2.0 INTRODUCTION

The fuel cladding, reactor pressure vessel and primary system piping are the principal barriers to the release of radioactive materials to the environs. Safety Limits are established to protect the integrity of these barriers during normal plant operations and anticipated transients. The fuel cladding integrity Safety Limit is set such that no fuel damage is calculated to occur if the limit is not violated. Because fuel damage is not directly observable, a step-back approach is used to establish a Safety Limit for the MCPR. MCPR greater than the applicable Safety Limit represents a conservative margin relative to the conditions required to maintain fuel cladding integrity. The fuel cladding is one of the physical barriers which separate the radioactive materials from the environs. The integrity of this cladding barrier is related to its relative freedom from perforations or cracking. Although some corrosion or use related cracking may occur during the life of the cladding, fission product migration from this source is incrementally cumulative and continuously measurable. Fuel cladding perforations, however, can result from thermal stresses which occur from reactor operation significantly above design conditions and the Limiting Safety System Settings. While fission product migration from cladding perforation is just as measurable as that from use related cracking, the thermally caused cladding perforations signal a threshold beyond which still greater thermal stresses may cause gross rather than incremental cladding deterioration. Therefore, the fuel cladding Safety Limit is defined with a margin to the conditions which would produce onset of transition boiling, MCPR of 1.0. These conditions represent a significant departure from the condition intended by design for planned operation.

2.1.1 THERMAL POWER, Low Pressure or Low Flow

Siemens Power SNP SNP

The ~~Advanced~~ Nuclear ~~Fuels~~ Corporation (~~ANF~~) ANFB critical power correlation is applicable to the ~~ANF~~ core. The applicable range of the ANFB correlation is for pressures above 585 psig and bundle mass flux greater than 0.25Mlbs/hr-ft^2. For low pressure and low flow conditions, a THERMAL POWER safety limit of 25% of RATED THERMAL POWER for reactor pressure below 785 psig and below 10% RATED CORE FLOW was justified for Grand Gulf cycle 1 operation based on ATLAS test data and the GEXL correlation. The use of the GEXL correlation is not valid for all critical power calculations at pressures below 785 psig or core flows less than 10% of rated flow. Therefore, the fuel cladding integrity Safety Limit was established by other means. This was done by establishing a limiting condition on core THERMAL POWER with the following basis. Since the pressure drop in the bypass region is essentially all elevation head, the core pressure drop at low power and flows will always be greater than 4.5 psi.

BASES

THERMAL POWER, Low Pressure or Low Flow (Continued)

Analyses show that with a bundle flow of 28 x 10^3 lbs/hr, bundle pressure drop is nearly independent of bundle power and has a value of 3.5 psi. Thus, the bundle flow with a 4.5 psi driving head will be greater than 28 x 10^3 lbs/hr. Full scale ATLAS test data taken at pressures from 14.7 psia to 800 psia indicate that the fuel assembly critical power at this flow is approximately 3.35 MWt. With the design peaking factors, this corresponds to a THERMAL POWER of more than 50% of RATED THERMAL POWER. Thus, a THERMAL POWER limit of 25% of RATED THERMAL POWER for reactor pressure below 785 psig is conservative. SNP Overall, because of the design thermal-hydraulic compatibility of the ~~ANF~~ fuel designs with the cycle 1 fuel, this justification and the associated low pressure and low flow limits remain applicable for future cycles of cores containing these fuel designs.

With regard to the low flow range, the core bypass region will be flooded at any flow rate greater than 10% RATED CORE FLOW. With the bypass region flooded, the associated elevation head is sufficient to assure a bundle mass flux of greater than 0.25 Mlbs/hr-ft^2 for all fuel assemblies which can approach critical heat flux. Therefore, the ANFB critical power correlation is appropriate for flows greater than 10% RATED CORE FLOW.

The low pressure range for cycle 1 was defined at 785 psig. Since the ANFB correlation is applicable at any pressure greater than 585 psig, the cycle 1 low pressure boundary of 785 psig remains valid for the ANFB correlation.

2.1.2 THERMAL POWER, High Pressure and High Flow

The onset of transition boiling results in a decrease in heat transfer from the clad, elevated clad temperature, and the possibility of clad failure. However, the existence of critical power, or boiling transition, is not a directly observable parameter in an operating reactor. Therefore, the margin to boiling transition is calculated from plant operating parameters such as core power, core flow, feedwater temperature, and core power distribution. The margin for each fuel assembly is characterized by the critical power ratio (CPR), which is the ratio of the bundle power which would produce onset of transition boiling divided by the actual bundle power. The minimum value of this ratio for any bundle in the core is the minimum critical power ratio (MCPR).

The Safety Limit MCPR assures sufficient conservatism such that, in the event of a sustained steady state operation at the MCPR safety limit, at least 99.9% of the fuel rods in the core would be expected to avoid boiling transition. The margin between calculated boiling transition (MCPR = 1.00) and the Safety Limit MCPR is based on a detailed statistical procedure which considers the uncertainties in monitoring the core operating state and includes the effects associated with channel bow. One specific uncertainty included in the safety limit is the uncertainty inherent in the ANFB critical power correlation. SNP ~~ANF~~ report ANF-524(P)(A) ~~XN-NF-524(P)~~, Rev. 2, "Advanced Nuclear Fuels Corporation Critical Power Methodology for Boiling Water Reactors," April 1989, including Supplements ~~Supplement 1~~, describes the methodology used in determining the Safety Limit MCPR.

The ANFB critical power correlation is based on a significant body of practical test data, providing a high degree of assurance that the critical power as evaluated by the correlation is within a small percentage of the actual critical power being estimated. The assumed reactor conditions used in defining the safety limit introduce conservatism into the limit because bounding radial power factors and bounding flat local peaking distributions are used to estimate the number of rods in boiling transition. Still further conservatism is induced by the tendency of the ANFB correlation to overpredict the number of rods in boiling transition. These conservatisms and the inherent accuracy of the ANFB correlation provide assurance that during sustained operation at the Safety Limit MCPR there would be essentially no transition boiling in the core.

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3/4.2 POWER DISTRIBUTION LIMITS

3/4.2.1 AVERAGE PLANAR LINEAR HEAT GENERATION RATE

LIMITING CONDITION FOR OPERATION

3.2.1 During two loop operation, all AVERAGE PLANAR LINEAR HEAT GENERATION RATES (APLHGRs) for each type of fuel as a function of AVERAGE PLANAR EXPOSURE shall not exceed the limits shown in Figure 3.2.1-1.

During single loop operation, the APLHGR for each type of fuel as a function of AVERAGE PLANAR EXPOSURE shall not exceed the limit shown in Figure 3.2.1-1 multiplied by ~~0.8~~ 0.86.

APPLICABILITY: OPERATIONAL CONDITION 1, when THERMAL POWER is greater than or equal to 25% of RATED THERMAL POWER.

ACTION:

During two loop operation or single loop operation, with an APLHGR exceeding the limits of Figure 3.2.1-1 as corrected by the appropriate multiplication factor, initiate corrective action within 15 minutes and restore APLHGR to within the required limits within 2 hours or reduce THERMAL POWER to less than 25% of RATED THERMAL POWER within the next 4 hours.

SURVEILLANCE REQUIREMENTS

4.2.1 All APLHGRs shall be verified to be equal to or less than the required limits:

a. At least once per 24 hours,

b. Within 12 hours after completion of a THERMAL POWER increase of at least 15% of RATED THERMAL POWER, and

c. Initially and at least once per 12 hours when the reactor is operating with a LIMITING CONTROL ROD PATTERN for APLHGR.

d. The provisions of Specification 4.0.4 are not applicable.

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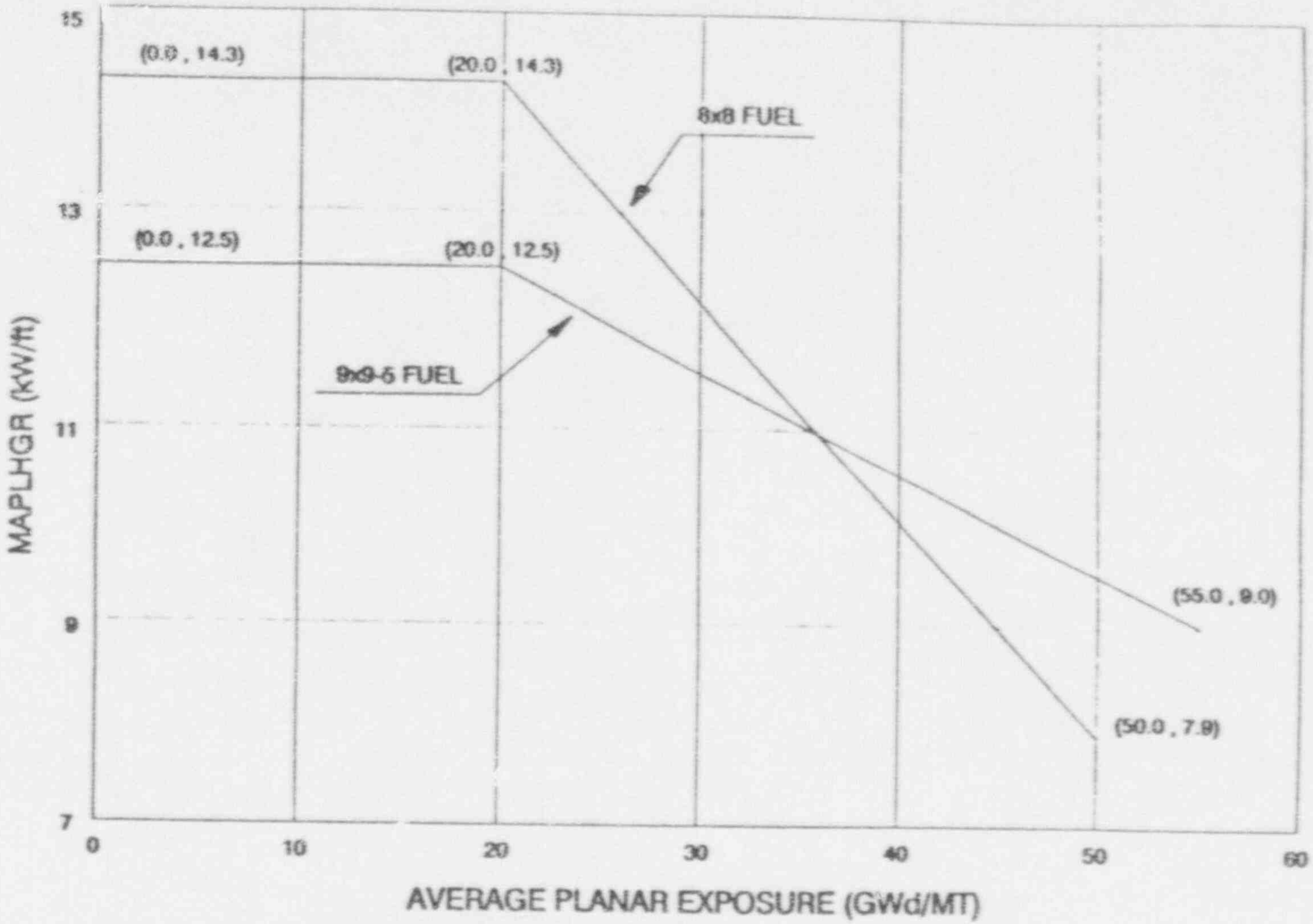

FIGURE 3.2.1-1 MAPLHGR vs AVERAGE PLANAR EXPOSURE ~~FOR ANF FUEL~~

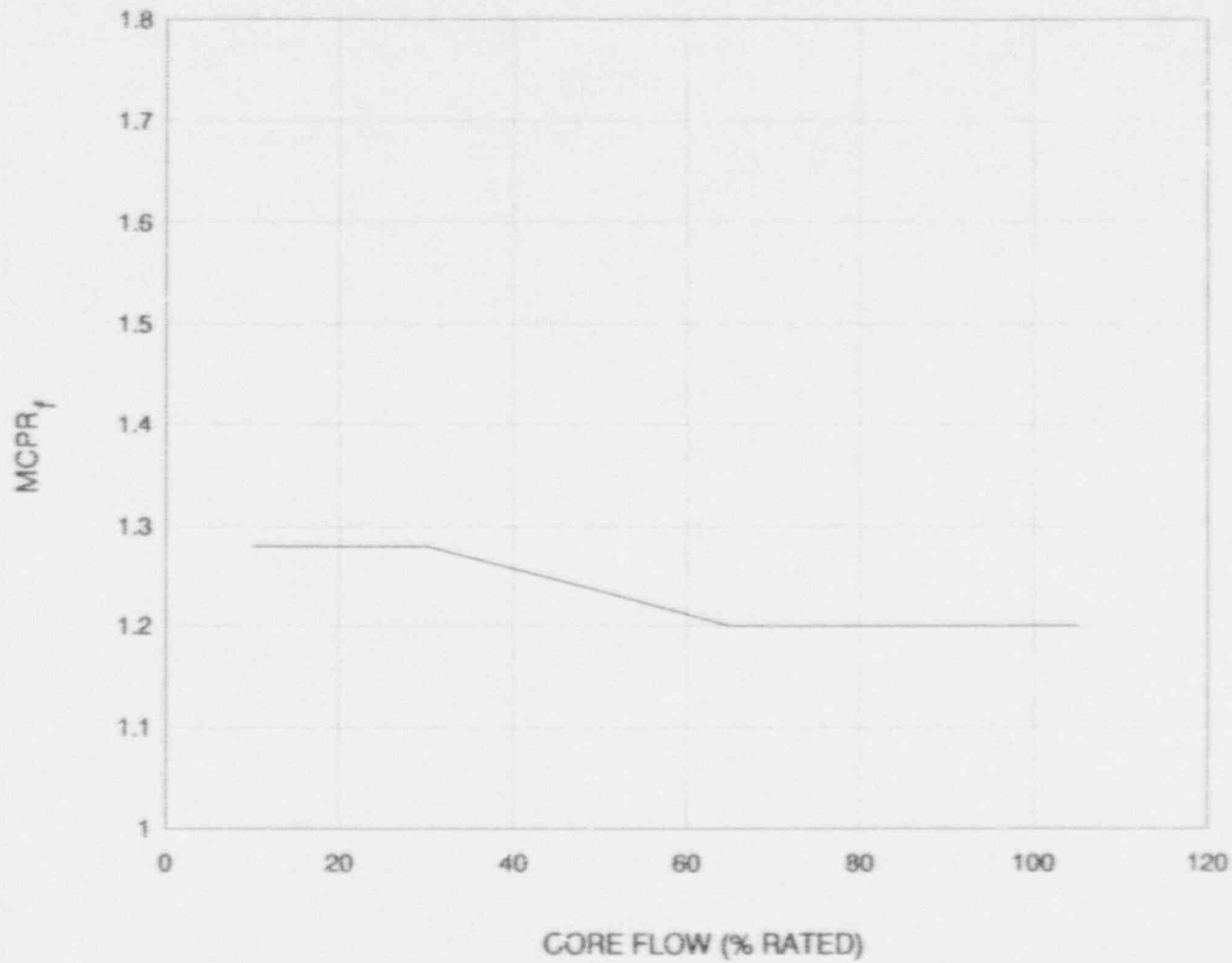

FIGURE 3.2.3-1 $MCPR_f$

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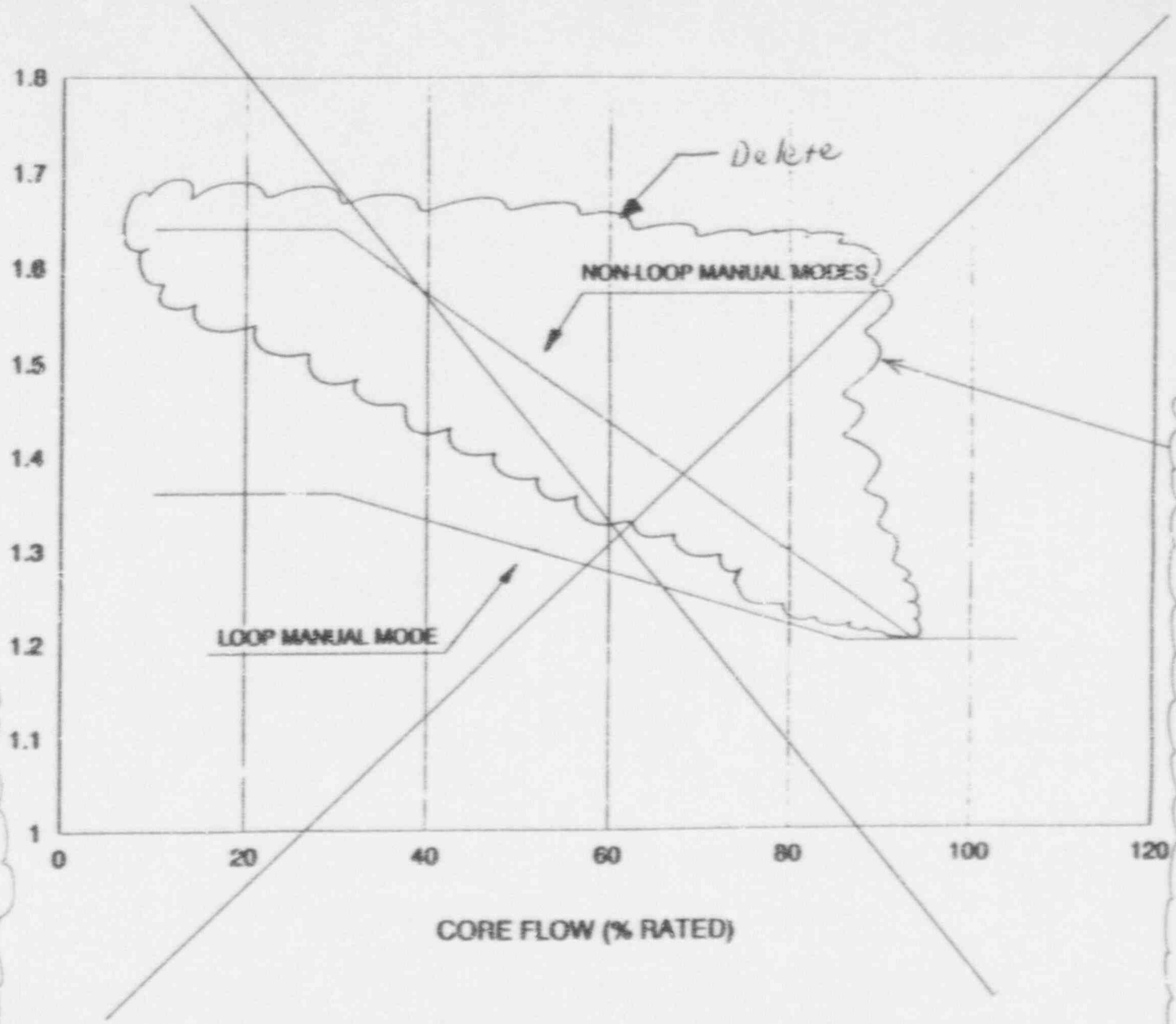

FIGURE 3.2.3-1 $MCPR_f$

Replace with new Figure 3.2.3-1.

Proposed changes to this figure were previously submitted by GNRO-91/00071.

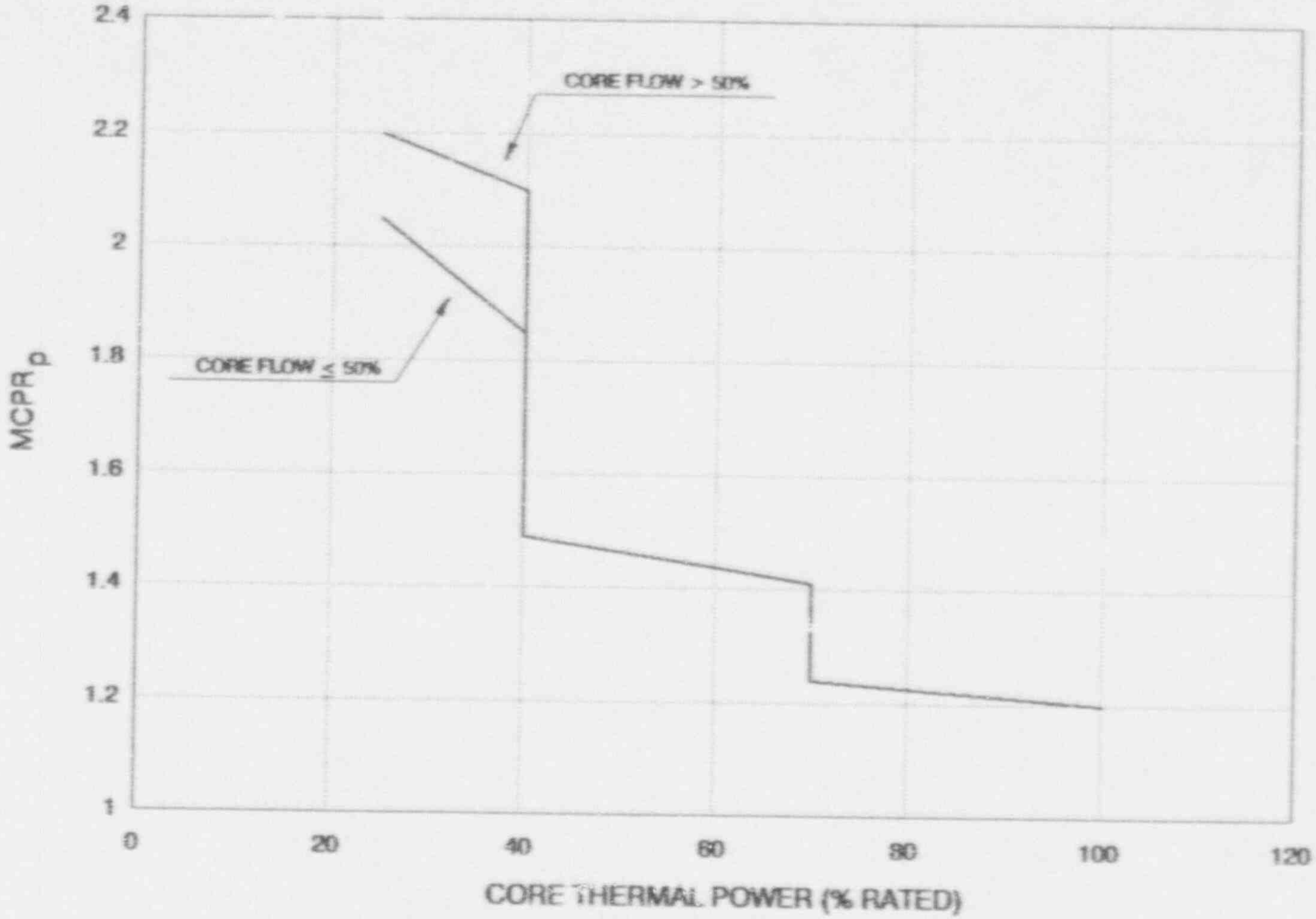

FIGURE 3.2.3-2 $MCPR_p$

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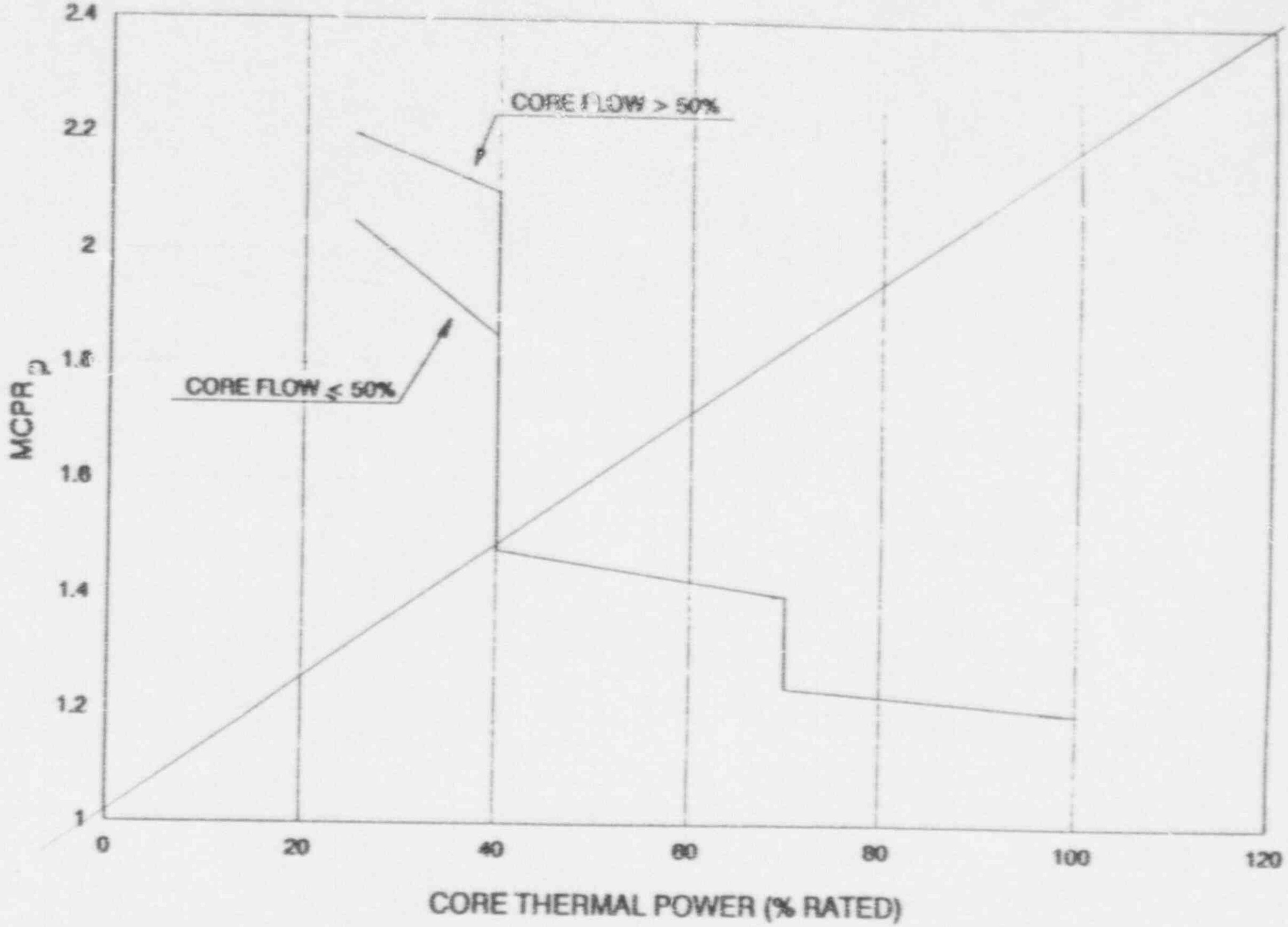

FIGURE 3.2.3-2 $MCPR_p$

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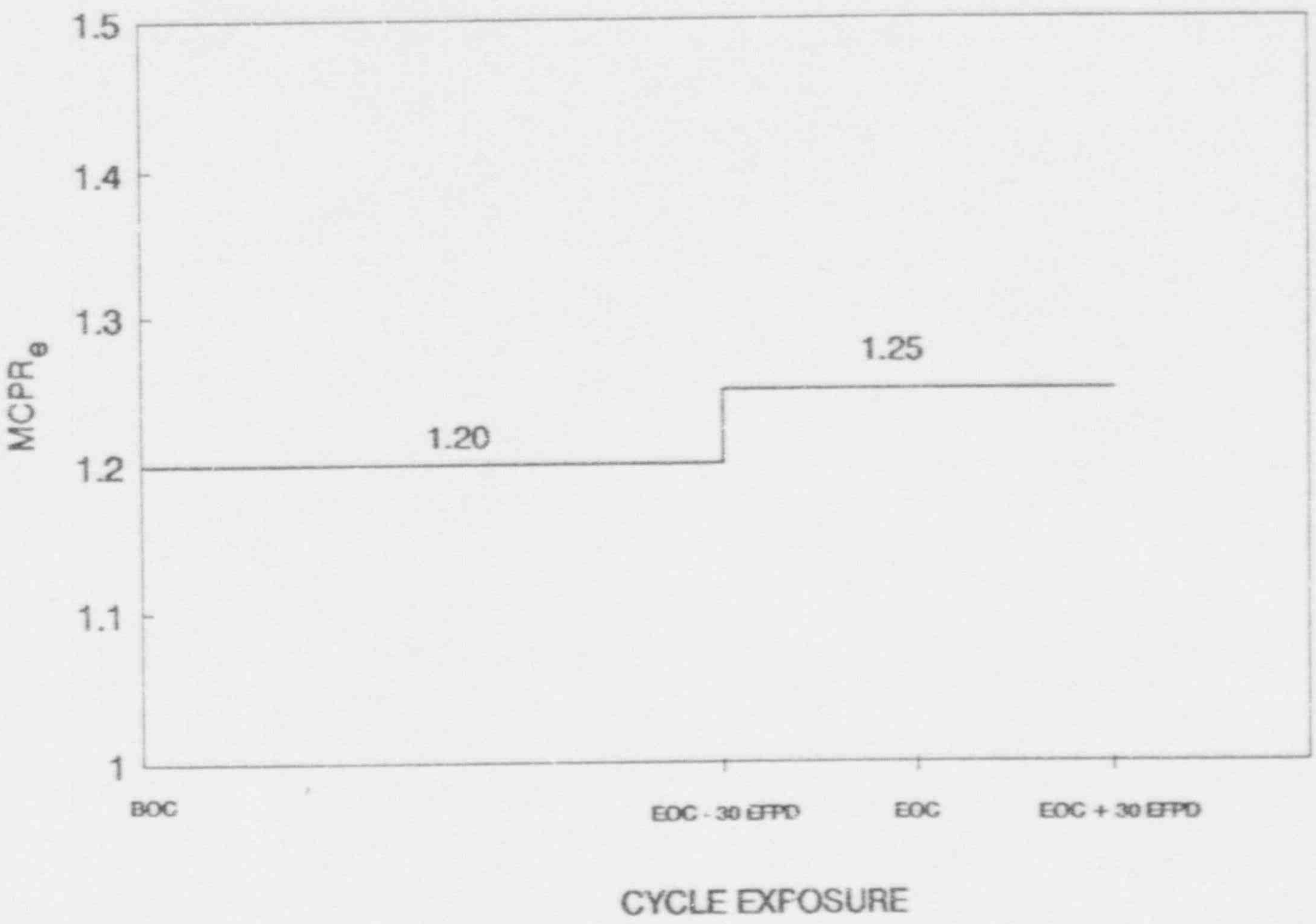

FIGURE 3.2.3-3 MCPR$_e$

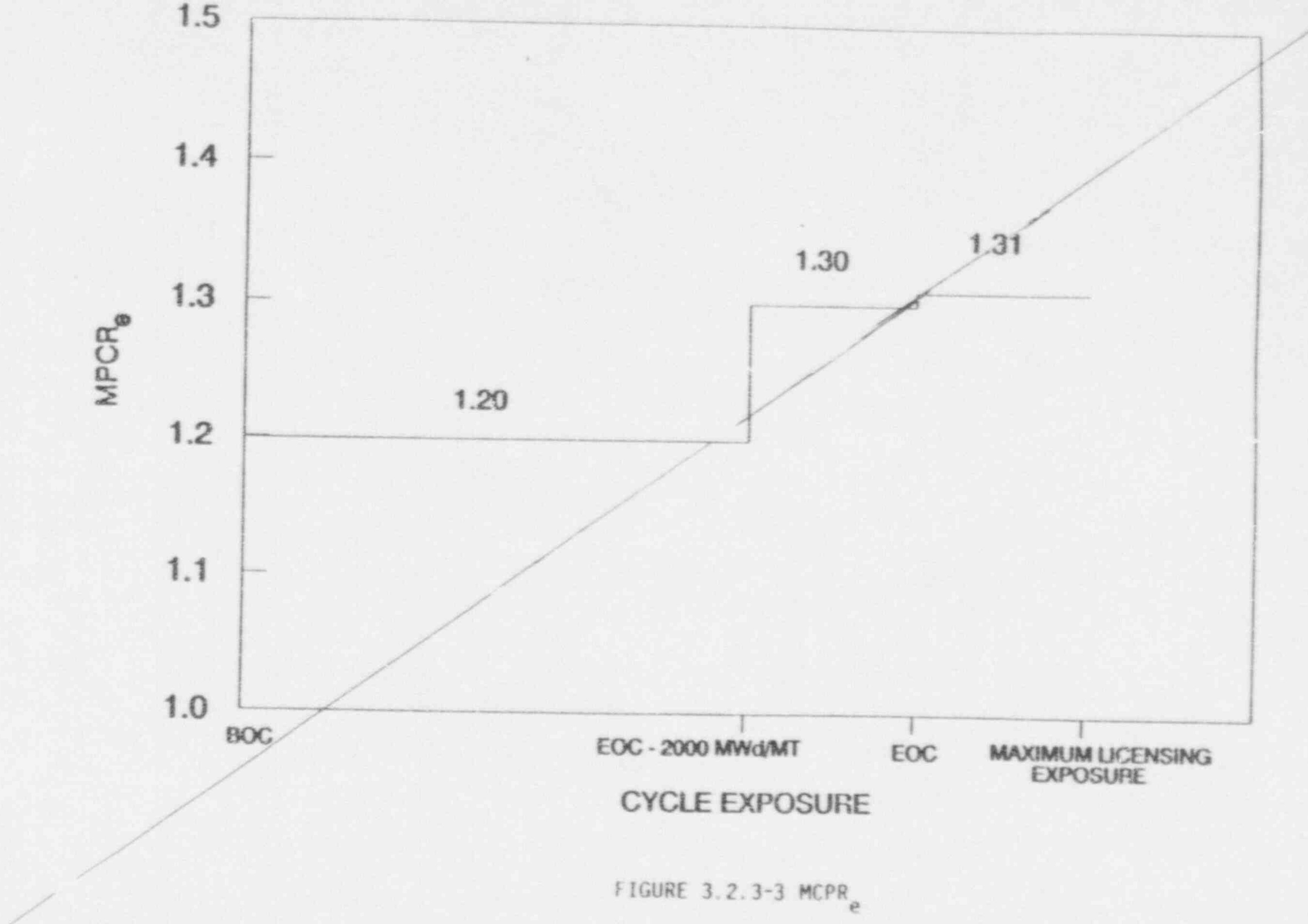

FIGURE 3.2.3-3 $MCPR_e$

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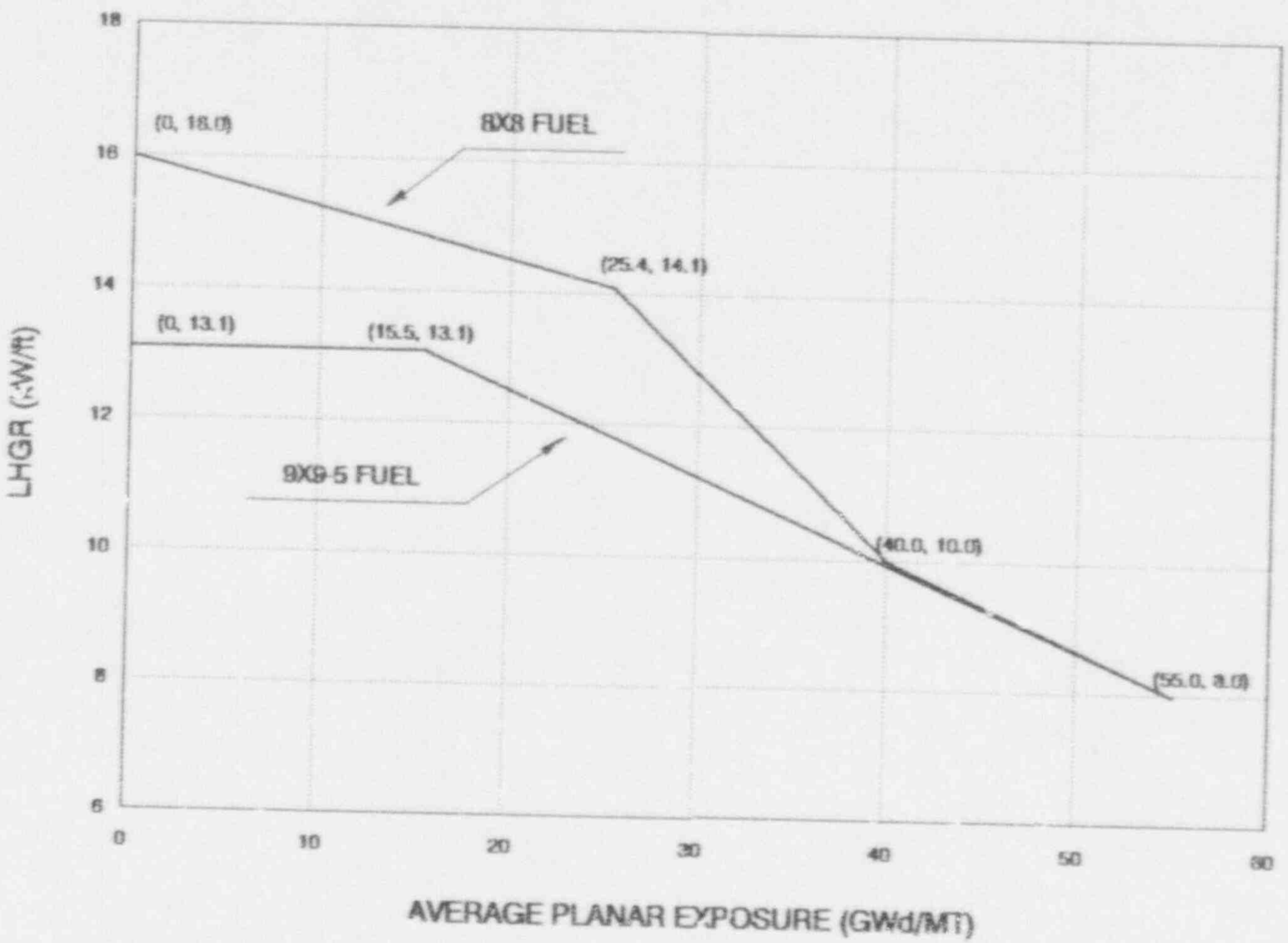

FIGURE 3.2.4-1 LHGR vs AVERAGE PLANAR EXPOSURE

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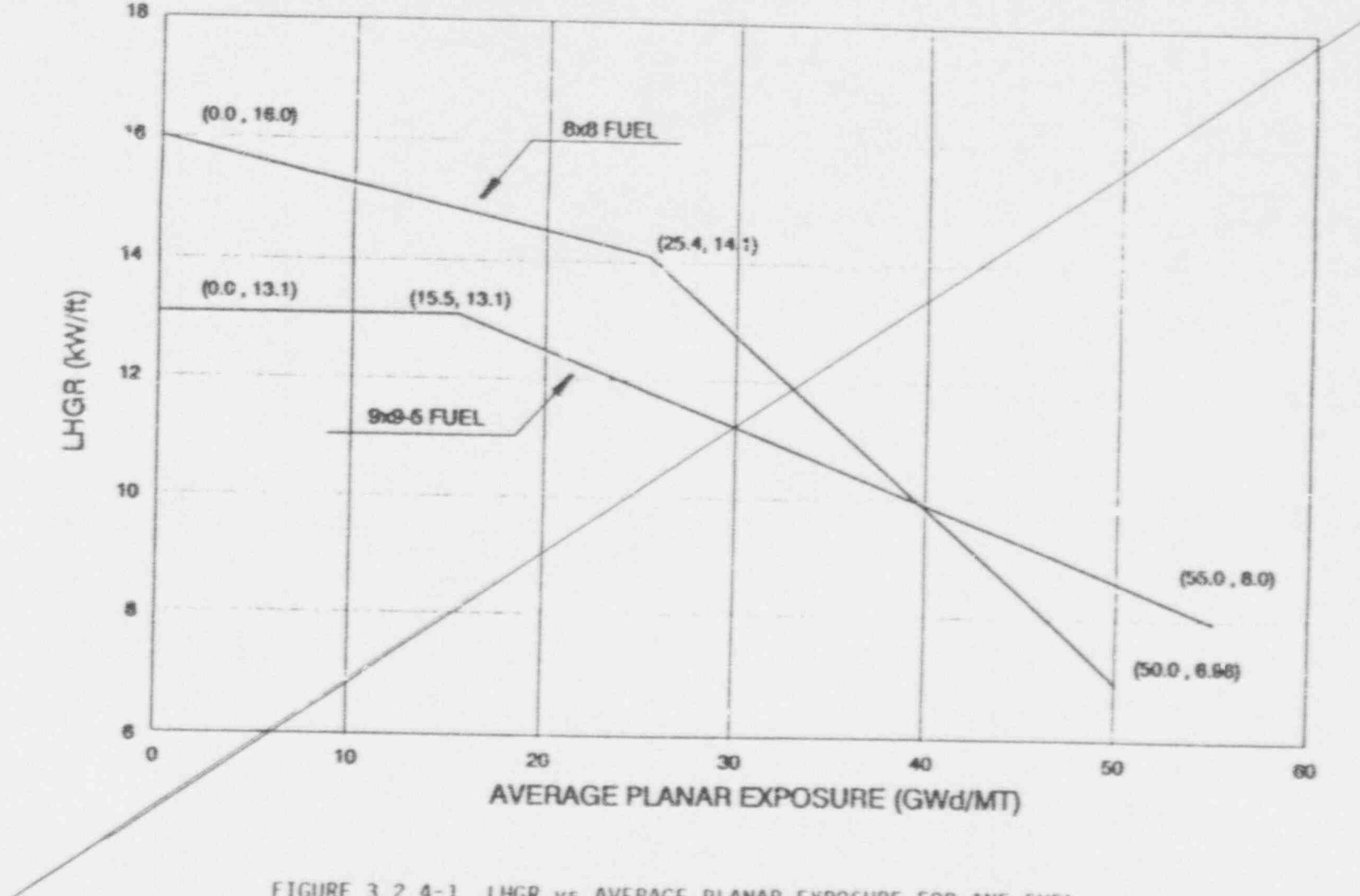

FIGURE 3.2.4-1 LHGR vs AVERAGE PLANAR EXPOSURE FOR ANF FUEL

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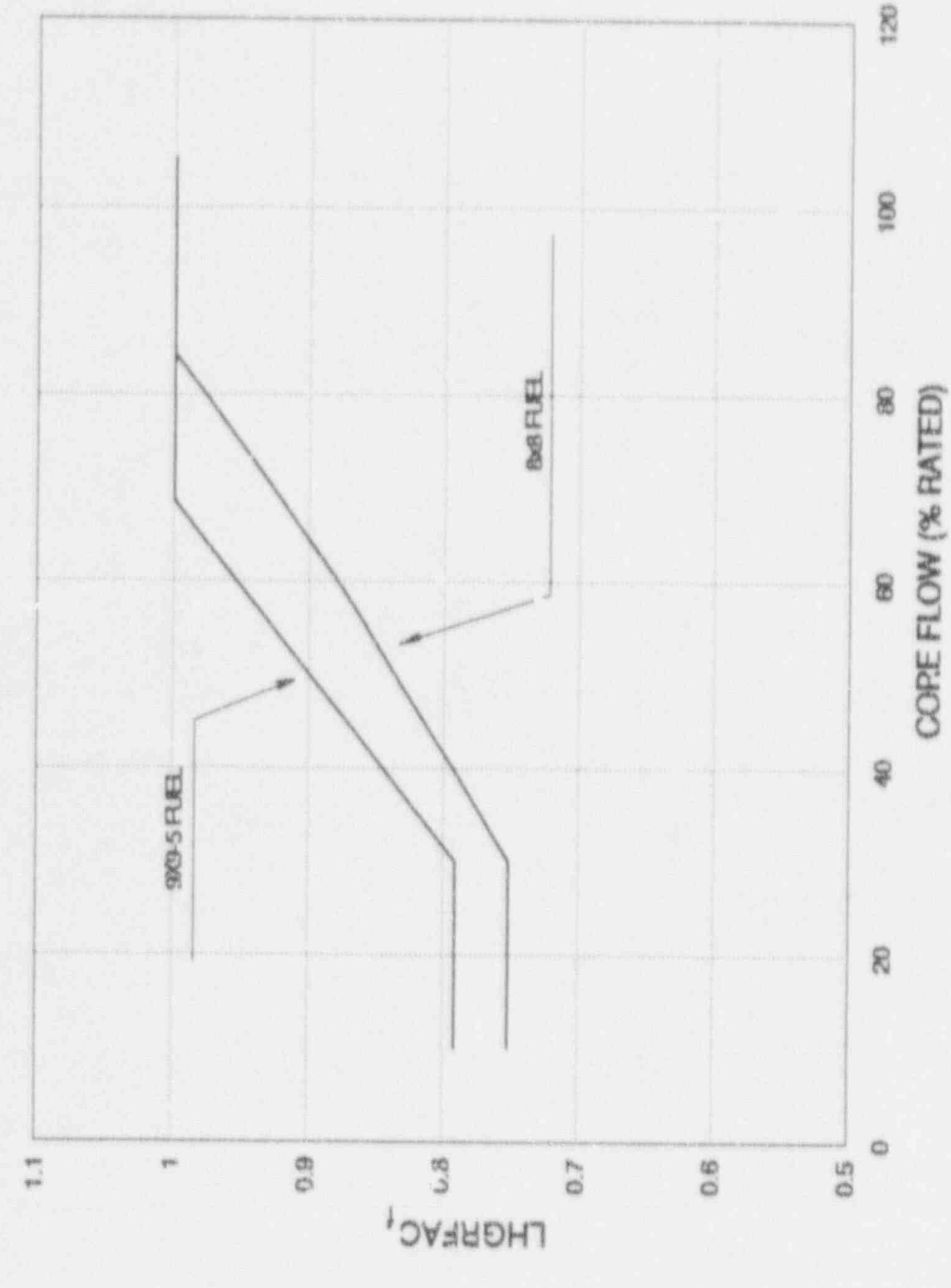

FIGURE 3.2.4-2 LHGRFAC$_f$

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Proposed changes to this figure were previously submitted by GNRO-91/00071.

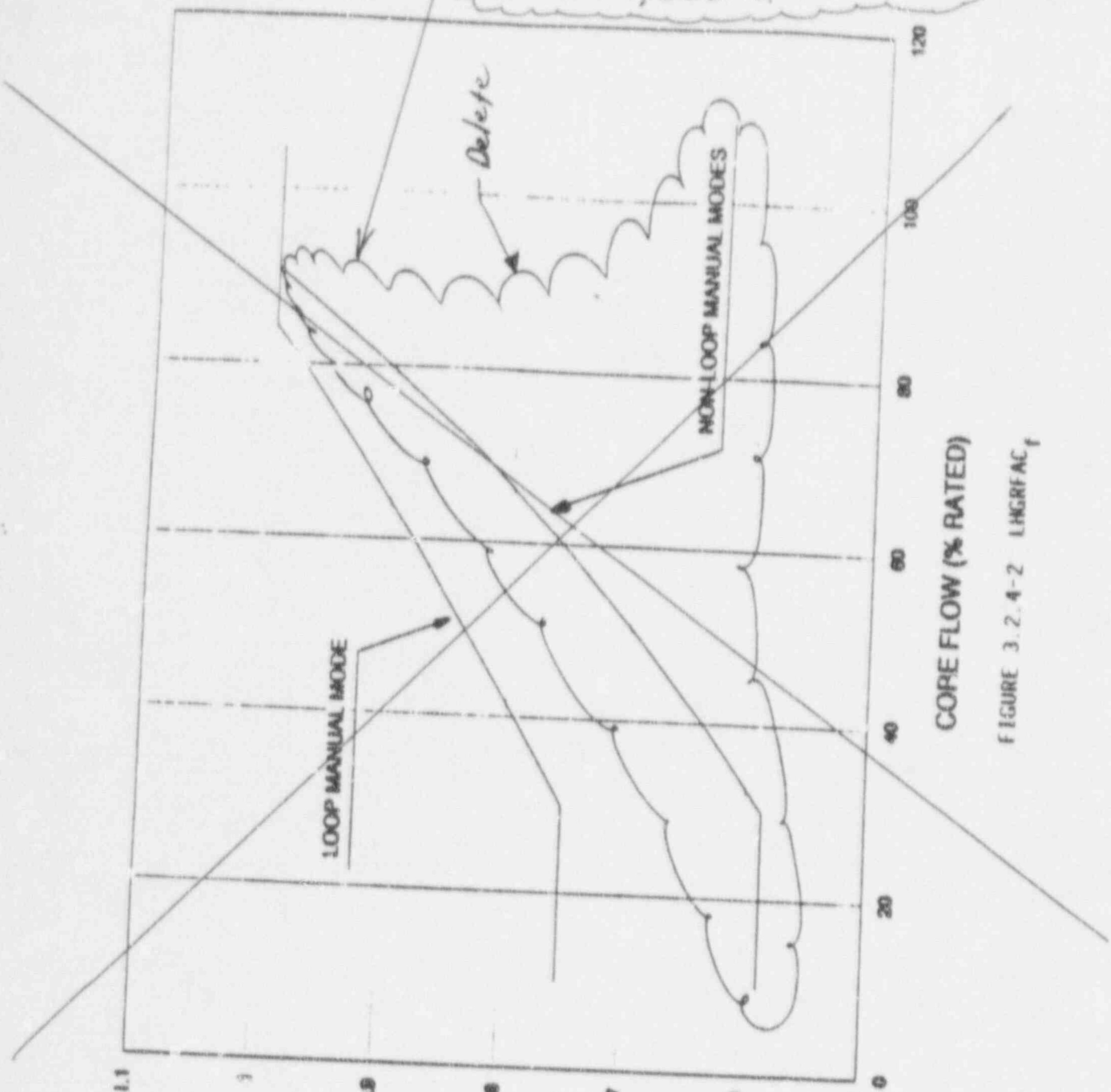

FIGURE 3.2.4-2 LHGRFAC$_f$

Replace with new Figure 3.2.4-2

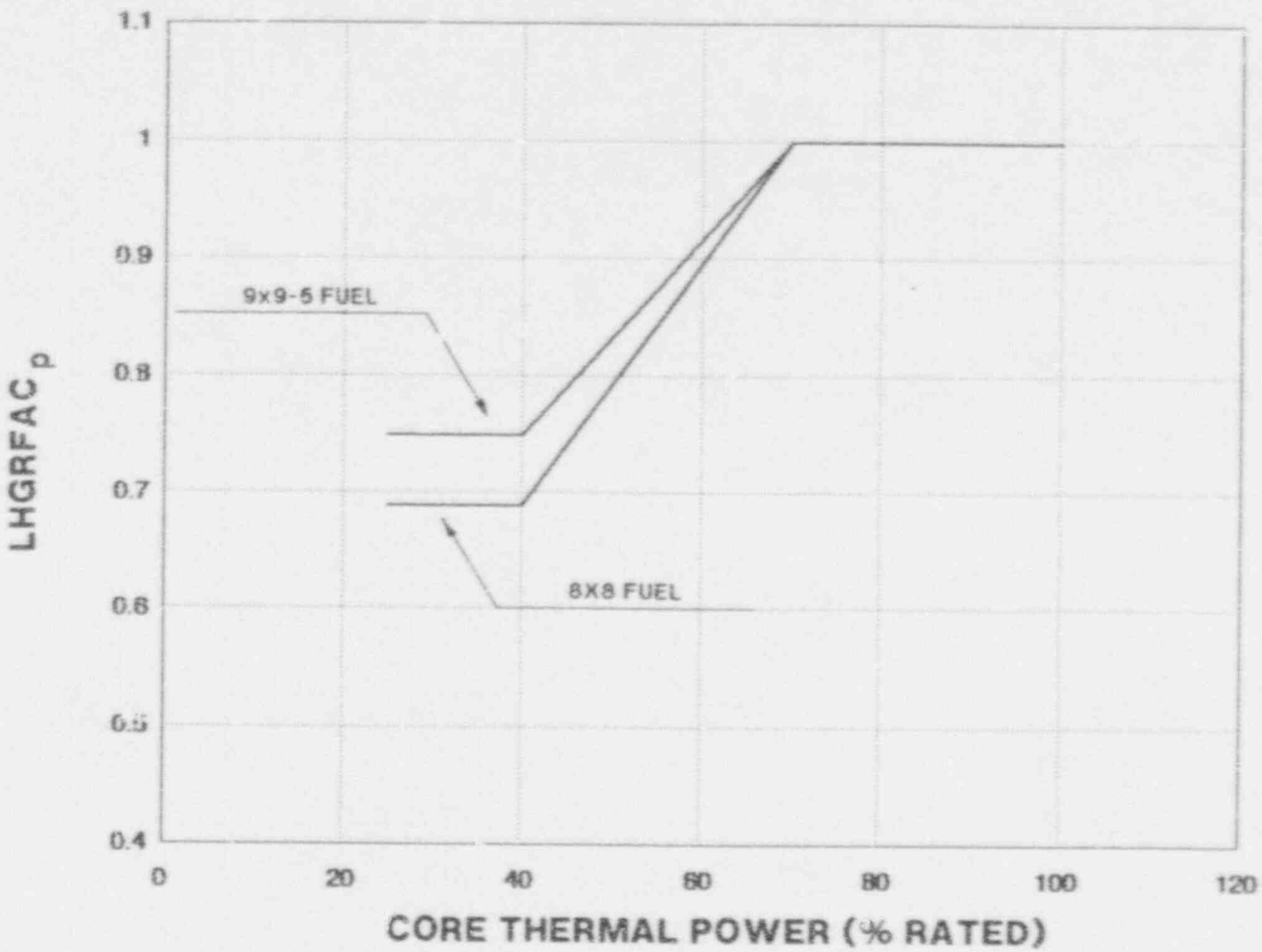

FIGURE 3.2.4-3 LHGRFAC$_p$

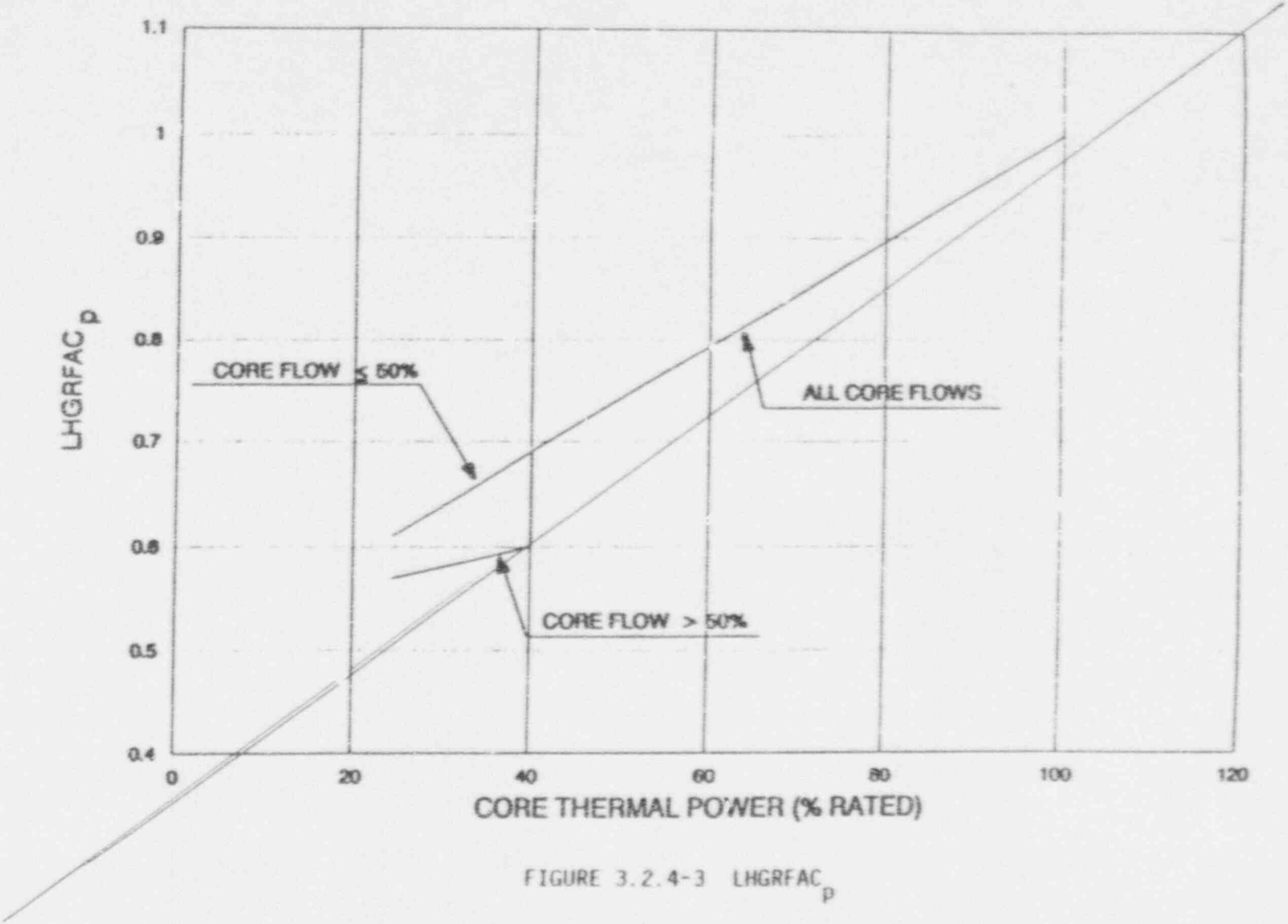

FIGURE 3.2.4-3 LHGRFAC$_p$

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3/4.2 POWER DISTRIBUTION LIMITS

BASES

The specifications of this section assure that the peak cladding temperature following the postulated design basis loss-of-coolant accident will not exceed the 2200°F limit specified in 10 CFR 50.46.

3/4.2.1 AVERAGE PLANAR LINEAR HEAT GENERATION RATE

This specification assures that the peak cladding temperature following the postulated design basis loss-of-coolant accident will not exceed the limit specified in 10 CFR 50.46.

The peak cladding temperature (PCT) following a postulated loss-of-coolant accident is primarily a function of the average heat generation rate of all the rods of a fuel assembly at any axial location and is dependent only secondarily on the rod to rod power distribution within an assembly. The Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) limits of Figure 3.2.1-1 are applicable to two loop operation.

For single-loop operation, a MAPLHGR limit corresponding to the product of the MAPLHGR, Figure 3.2.1-1, and ~~0.8~~ 0.86 can be conservatively used to ensure that the PCT for single loop operation is bounded by the PCT for two loop operation.

The daily requirement for calculating APLHGR when THERMAL POWER is greater than or equal to 25% of RATED THERMAL POWER is sufficient since power distribution shifts are very slow when there have not been significant power or control