SURVEILLANCE REQUIREMENTS (Continued)

c. Verifying that the AXIAL SHAPE INDEX is maintained within the allowable limits of Figure 3.2-2, where 100% of maximum allowable power represents the maximum THERMAL POWER allowed by the following expression:

M x N

where:

1. M is the maximum allowable THERMAL POWER level for the existing Reactor Coolant Pump combination.

2. N is the maximum allowable fraction of RATED THERMAL POWER as determined by the F^T_{xy} curve of Figure 3.2-3.

4.2.1.4 Incore Detector Monitoring System# - The incore detector monitoring system may be used for monitoring the core power distribution by verifying that the incore detector Local Power Density alarms:

a. Are adjusted to satisfy the requirements of the core power distribution map which shall be updated at least once per 31 days of accumulated operation in MODE 1.

b. Have their alarm setpoint adjusted to less than or equal to the limits shown on Figure 3.2-1 when the following factors are appropriately included in the setting of these alarms:

~~1. Flux peaking augmentation factors as shown in Figure 4.2-1,~~

1. ~~2.~~ A measurement-calculational uncertainty factor of 1.062,

2. ~~3.~~ An engineering uncertainty factor of 1.03,

3. ~~4.~~ A linear heat rate uncertainty factor of 1.01 due to axial fuel densification and thermal expansion, and

4. ~~5.~~ A THERMAL POWER measurement uncertainty factor of 1.02.

#If incore system becomes inoperable, reduce power to M x N within 4 hours and monitor linear heat rate in accordance with Specification 4.2.1.3.

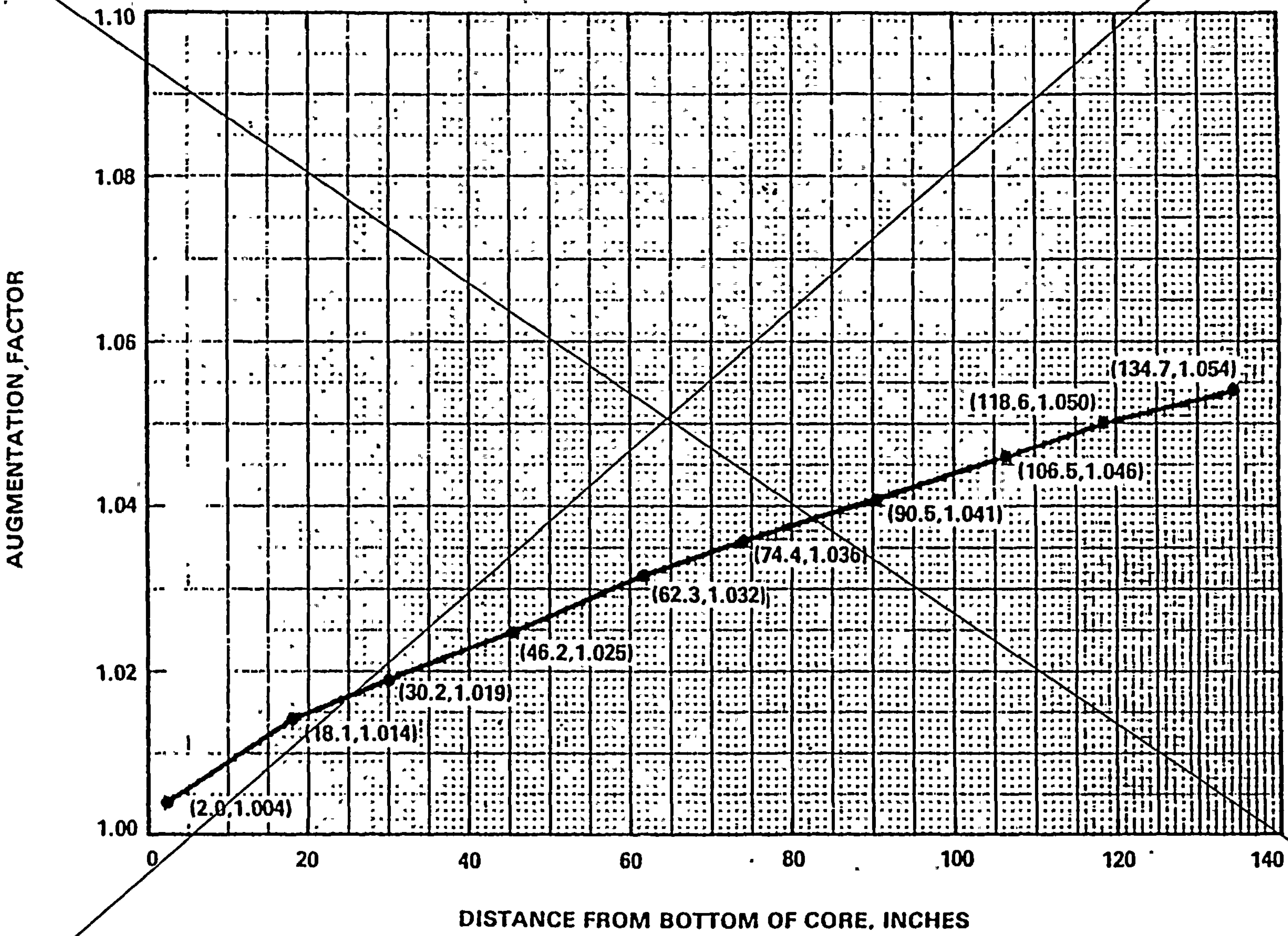

Figure 4.2-1
Augmentation factors vs distance from bottom of core

Delete

3/4.2 POWER DISTRIBUTION LIMITS

BASES

3/4.2.1 LINEAR HEAT RATE

The limitation on linear heat rate ensures that in the event of a LOCA, the peak temperature of the fuel cladding will not exceed 2200°F.

Either of the two core power distribution monitoring systems, the Excore Detector Monitoring System and the Incore Detector Monitoring System, provides adequate monitoring of the core power distribution and are capable of verifying that the linear heat rate does not exceed its limits. The Excore Detector Monitoring System performs this function by continuously monitoring the AXIAL SHAPE INDEX with the OPERABLE quadrant symmetric excore neutron flux detectors and verifying that the AXIAL SHAPE INDEX is maintained within the allowable limits of Figure 3.2-2. In conjunction with the use of the excore monitoring system and in establishing the AXIAL SHAPE INDEX limits, the following assumptions are made: (1) the CEA insertion limits of Specifications 3.1.3.5 and 3.1.3.6 are satisfied, (2) ~~the flux peaking augmentation factors are as shown in Figure 4.2-1, (3)~~ the AZIMUTHAL POWER TILT restrictions of Specification 3.2.4 are satisfied, and ~~(4)~~ (3) the TOTAL PLANAR RADIAL PEAKING FACTOR does not exceed the limits of Specification 3.2.2.

The Incore Detector Monitoring System continuously provides a direct measure of the peaking factors and the alarms which have been established for the individual incore detector segments ensure that the peak linear heat rates will be maintained within the allowable limits of Figure 3.2-1. The setpoints for these alarms include allowances, set in the conservative directions, for (1) ~~flux peaking augmentation factors as shown in Figure 4.2-1, (2)~~ a measurement-calculational uncertainty factor of 1.062, ~~(3)~~ (2) an engineering uncertainty factor of 1.03, ~~(4)~~ (3) an allowance of 1.01 for axial fuel densification and thermal expansion, and ~~(5)~~ (4) a THERMAL POWER measurement uncertainty factor of 1.02.

3/4.2.2, 3/4.2.3 and 3/4.2.4 TOTAL PLANAR AND INTEGRATED RADIAL PEAKING FACTORS - F_{xy}^T AND F_r^T AND AXIMUTHAL POWER TILT - T_q

The limitations on F_{xy}^T and T_q are provided to ensure that the assumptions used in the analysis for establishing the Linear Heat Rate and Local Power Density - High LCOs and LSSS setpoints remain valid during operation at the various allowable CEA group insertion limits. The limitations on F_r^T and T_q are provided to ensure that the assumptions used in the analysis establishing the DNB Margin LCO, the Thermal Margin/Low Pressure LSSS setpoints remain valid during operation at the various allowable CEA group insertion limits. If F_{xy}^T, F_r^T or T_q exceed their basic limitations, operation may continue under the additional restrictions imposed by the ACTION statements since these additional restrictions provide adequate provisions to assure that the

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ATTACHMENT 2

SAFETY EVALUATION

Introduction

The proposed change to the St. Lucie Unit 2 Technical Specifications is to discontinue the use of Nuclear Flux Peaking Augmentation Factors. Augmentation factors are used at present in establishing setpoints for the peak linear heat generation rate alarm. The changes, which are detailed in Attachment 1, modify part 4.2.1.4 of the Linear Heat Rate Technical Specification and the associated Technical Specification Bases. Figure 4.2.1, which specifies the value of the augmentation factor versus height in the core, is also presented in Attachment 1 and is proposed for deletion by this Technical Specification change.

The purpose for which the Nuclear Flux Peaking Augmentation Factor was originally developed was to provide margin for increased flux peaks which could result from the formation of interpellet gaps in the fuel pellet column and the subsequent local creepdown of the fuel cladding. The augmentation factor is defined as the ratio of the local flux with increased peaks due to interpellet gaps to the local flux in the absence of interpellet gaps. Analysis of fuel performance data such as that in Reference 1 is the basis for determining appropriate sizes and spatial distributions of the gaps used in the calculation of these fluxes.

The proposed change is based on the performance of fuel rods of modern design as compared to the performance of fuel rods of older design for which the flux peaking augmentation factors were originally developed.

As noted in References 2 and 3, Baltimore Gas and Electric Company has received NRC approval to modify the linear heat rate technical specifications for their Calvert Cliffs Units 1 and 2 based on considerations similar to those noted in this evaluation.

Discussion

The purpose of using augmentation factors has been to provide margin for flux peaks which would result from the formation of gaps between fuel pellets and subsequent cladding collapse. Uranium fuel is a strong neutron absorber and a gap in the fuel column will cause a localized flux peak. This peak causes an increase in the reaction rate for the neighboring fuel pellets. If the gaps are larger than about 0.5", then clad collapse can occur over the voided region. Cladding collapse will increase the flux peak in the voided region because it increases the moderator present in the area of the peak. The mechanisms leading to the formation of these gaps and cladding collapse which were present in old fuel designs have been eliminated in modern fuel designs.

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Due to the material properties of UO_2, fuel pellets suffer from irradiation-induced densification. This densification is caused by the reduction of porosity and subsequent shrinkage of UO_2. This is most important in the low-density ($\leq$ 92% theoretical density) UO_2 used in old fuel designs. Modern fuel designs utilize UO_2 that is closer to the maximum theoretical density. This material has less porosity and is incapable of significant shrinkage. Fuel pellets used in old designs would densify by as much as 3% of the theoretical density. Industry-wide, increased pellet sintering temperatures and sintering time have led to a significant decrease in densification. Modern fuel pellets are considered non-densifying (they densify less than 0.5% T.D.). The main impact of fuel pellet shrinkage is the associated reduction in the fuel column height.

In old fuel designs, the fuel rods were not prepressurized. These rods were subjected to greater pressure differences across the cladding which caused cladding ovality and creepdown to begin at relatively low exposure. As the deformation of the cladding continued, the cladding would begin to make contact with the fuel pellets. This resulted in the immobilization of fuel pellets. Because this was occurring before the fuel densification and shrinkage were complete, axial gaps would form below the immobilized pellets as the remainder of the column continued to settle.

Because modern fuel rods are prepressurized, the pressure differential across the cladding is reduced. This delays the onset of cladding deformation so that pellet-to-cladding contact does not immobilize fuel pellets until after most of the fuel column shrinkage is completed. Since the total amount of column shinkage is significantly reduced in modern fuel, and because most of the shrinkage occurs before cladding deformation causes pellet immobilization, the possibility of forming large axial gaps in the fuel is eliminated. The absence of any large axial gaps also prevents clad collapse and the associated flux peaks.

Combustion Engineering (CE) has evaluated the factors that cause the formation of gaps and cladding collapse and has concluded that, for fuel designed by CE, significant gaps and cladding collapse will not occur. CE examined fuel supplied to several utilities to verify these conclusions. Because of these results, no flux peaking augmentation factors are required for fuel designed by CE. The justification for this position is presented in Reference 1. No new data has been developed which would require changes to the conclusions presented in Reference 1.

The fuel used at St. Lucie Unit 2 is provided by CE. The manufacturing process for the fuel rods used in Unit 2 is the same as that which was used in the fuel rods for which CE demonstrated the formation of no interpellet gaps.

The safety analyses for St. Lucie Unit 2 have been performed in a manner to support the elimination of the augmentation factor. The calculations were either run without the augmentation factors or, if the augmentation factors were used, they were included in a way that would enhance the conservatism of analytical results. The removal of the augmentation factors will not cause the results of any analysis to exceed design acceptance criteria.

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Attachment 2 (con't)

References

1. EPRI NP-3966-CCM, "CEPAN Method of Analyzing Creep Collapse of Oval Cladding Volume 5: Evaluation of Interpellet Gap Formation and Clad Collapse in Modern PWR Fuel Rods", April 1985

2. Letter, A. E. Lundvall, Jr. to J. R. Miller (Chief Operating Reactors Branch #3), "Calvert Cliffs Nuclear Power Plant Unit Nos. 1 & 2, Docket Nos. 50-317 & 50-318, Request for Amendment, " December 31, 1984.

3. "Safety Evaluation By the Office of Nuclear Reactor Regulation Related to Amendment No. 104 to Facility Operating License No. DPR-53, Baltimore Gas & Electric Company Calvert Cliffs Nuclear Power Plant Unit No. 1 Docket No. 50-317."

ATTACHMENT 3

DETERMINATION OF NO SIGNIFICANT HAZARDS CONSIDERATION

The standards used to arrive at a determination that a request for amendment involves no significant hazards consideration are included in the Commission's regulations, 10 CFR 50.92, which states that no significant hazards considerations are involved if the operation of the facility in accordance with the proposed amendment would not (1) involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) create the possiblity of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety. Each standard is discussed as follows:

(1) Operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously evaluated.

The change incorporates a model refinement reflecting present fuel designs and does not adversely affect accident initiating events or consequences. The consequences of removing the augmentation factors have already been evaluated because current safety analyses do take credit for the reduction in linear heat rate imposed by augmentation factors. Removal of the augmentation factors will not cause the results of any analysis to exceed design acceptance criteria.

(2) Use of the modified specification would not create the possiblity of a new or different kind of accident from any accident previously evaluated.

No new accident initiators are created by the incorporation of the model refinements. This change will not result in any change in the operating mode of the plant. The deficiencies in fuel design which necessitated the original implementation of augmentation factors have been corrected so that these factors are no longer necessary to ensure adequate fuel performance.

(3) Use of the modified specification would not involve a significant reduction in a margin of safety.

The margin of safety is the difference between the peak linear heat generation rate Limiting Condition for Operation (LCO) and the Specified Acceptable Fuel Design Limit (SAFDL). Augmentation factors were included in the determination of the peak linear heat generation rate LCO and SAFDL in a conservative manner. Since these limits are conservative, neither the LCO nor the SAFDL will be changed by this modification to the Technical Specifications. Elimination of augmentation factors will not reduce the margin of safety between the peak linear heat generation rate LCO and SAFDL.

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Attachment 3 (con't)

Based on the above, we have determined that the amendment request does not (1) involve a significant increase in the probability or consequences of an accident previously evaluated, (2) create the probability of a new or different kind of accident from any accident previously evaluated, or (3) involve a significant reduction in a margin of safety; and therefore does not involve a significant hazards consideration.