Jersey Central Power & Light Company

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MEMBER OF THE General Public Utilities Corporation SYSTEM

December 14, 1973

Mr. Donald J. Skovholt
Assistant Director for Operating Reactors
Directorate of Licensing
Office of Regulation
U.S. Atomic Energy Commission
Washington, DC 20545

50-219

Dear Mr. Skovholt:

SUBJECT: FUEL DENSIFICATION
REFERENCES: (1) AEC Letter from D.J. Skovholt, 12/5/73.
(2) AEC Letter from D.J. Skovholt, 12/13/73.
(3) G.E. Topical Report, NEDO-20181, Suppl. 1.
(4) Exxon Topical Report, XN-174, Suppl. 1.

In your letters of December 5 and December 13, 1973 (References 1 & 2), you requested that we provide the necessary analyses and other relevant data for determining the consequences of densification and the effects on normal operation, anticipated transients and accidents at the Oyster Creek Nuclear Generating Station (OC) using the AEC guidance attached to those letters. The letters stated that if analyses indicate that changes in operating conditions are warranted, we should submit proposed changes to the Technical Specifications with the analyses.

References 3 & 4 have been prepared by General Electric Co. and Exxon Nuclear Co., respectively, as generic responses to your request for further analyses with regard to the consequences of fuel densification.

As a result of the above referenced analyses, and as requested in References 1 & 2, a proposed Technical Specification Change is presented in Attachment 1. This proposed Technical Specification incorporates the results of the latest analyses.

Very truly yours,

Ivan R. Finfrock, Jr.
Vice President

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Attachments

ATTACHMENT I

PROPOSED TECHNICAL SPECIFICATION CHANGE

1. Specification to be Changed

   Section 3. Limiting Condition for Operation.

2. Extent of Change

   Revise Figure 3.10.1 on Page 3.10-4.

   Revise the Section 3 Basis.

3. Change Requested

   See Revised Figure 3.10.1 attached.

   See Revised Basis attached.

BASIS:

The specification for average planar LHGR assures that the peak cladding temperature following the postulated design basis loss-of-coolant accident will not exceed the 2300°F limit specified in the Interim Acceptance Criteria (IAC) issued in June 1971 considering the postulated effects of fuel pellet densification.

The peak cladding temperature following a postulated loss-of-coolant accident is primarily a function of the average heat generation rate of all the rods of fuel assembly at any axial location and is only dependent secondarily on the rod to rod power distribution within an assembly. Since expected local variations in power distribution within a fuel assembly affect the calculated peak clad temperature by less than ±20°F relative to the peak temperature for a typical fuel design, the limit on the average linear heat generation rate is sufficient to assure that calculated temperatures are below the IAC limit.

The maximum average planar LHGR shown in Figure 3.10.1 for Type I and II fuel is the result of LOCA analyses using values of gap conductance calculated per GEGAP III (G.E. Topical Report, NEDO-20181, "A model for the Prediction of Pellet Cladding Thermal Conductance in BWR Fuel Rods") with AEC modifications ("Modified G.E. Model for Fuel Densification, December 5, 1973). The Type I curve is the same as the curve labeled "Ω" (Omega) on Figure 5-A of a report attached to a letter dated December 12, 1973 to the AEC from General Electric Company. The Type II curve is the same as the curve labeled "Ω" (Omega) on Figure 6-A of the same report. These calculations were made to determine the effect of densification on PCT following a postulated LOCA and include the results of detailed heatup calculations for the PCT at exposures up to 25,000 MWD/MT.

The maximum average planar LHGR shown in Figure 3.10.1 for Type III and IIIE fuel are the result of calucations presented in Supplement No. 1 to the Exxon Nuclear Company Topical Report, XN-174, "Densification Effects on Nuclear Boiling Water Reactor Fuel", December 1973. These calculations were made to determine the effect of fuel densification on PCT following a postulated LOCA and include the results of detailed heatup calculations for the PCT to maximum planar exposures of 25,000 MWD/MT.

The possible effects of fuel pellet densification were: (1) creep collapse of the cladding due to axial gap formation; (2) increase in the LHGR because of pellet column shortening; (3) power spikes due to axial gap formation; and (4) changes in stored energy due to increased radial gap size.

Calculations show that clad collapse is conservatively predicted not to occur during the current power operation cycle (Cycle 3). Therefore, clad collapse is not considered in the analyses. Since axial thermal expansion of the fuel pellets is greater than axial shrinkage due to densification, the analyses of peak clad temperature do not consider any change in LHGR due to pellet column shortening. Although the formation of axial gaps might produce a local power spike at one location on any one rod in a fuel assembly, the increase in local power density would be on the order of only 2% at the axial midplane. Since small local variations in power distribution have a small effect on peak clad temperature, power spikes were not considered in the analysis of loss-of-coolant accidents.

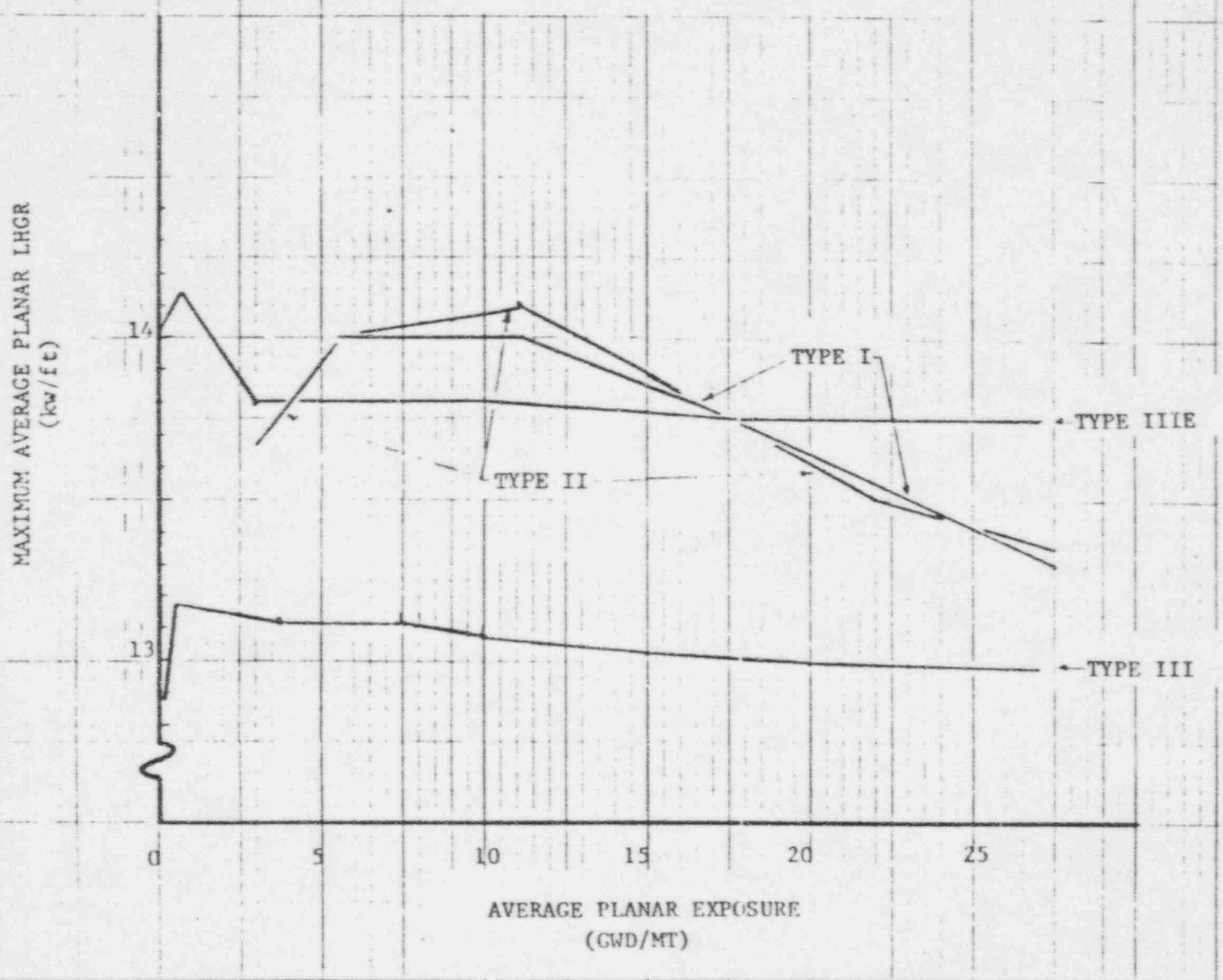
Changes in gap size affect the peak clad temperature by their effect on pellet clad thermal conductance and fuel pellet stored energy. Treatment of this effect combined with the effects of pellet cracking, relocation and subsequent gap closure are discussed in NEDO-20181 and XN-174.

Pellet-clad thermal conductance for Type I and II fuel was calculated using the GEGAP III model (NEDO-20181) and Pellet-clad thermal conductance for Type III and IIIE fuel was calculated using the GAPEXX model (XN-174).

The specification for local LHGR assures that the linear heat generation rate in any rod is less than the design linear heat generation even if fuel pellet densification is postulated. The power spike penalty specified for Type I and II fuel is based on the analysis presented in Section 3.2.1 of the G.E. Topical Report NEDM-10735 Supplement 6 and in Section I.A of Attachment 1 to Reference 11 for Type III and IIIE fuel, and assumes a linearly increasing variation in axial gaps between core bottom and top, and assures with 95% confidence that no more than one fuel rod exceeds the design linear heat generation rate due to power spiking.

FIGURE 3.10.1

MAXIMUM ALLOWABLE AVERAGE PLANAR
LINEAR HEAT GENERATION RATE



ATTACHMENT I