UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

April 3, 1973

Docket No. 50-219

Jersey Central Power & Light Company
ATTN: Mr. R. H. Sims, Vice President
Madison Avenue at Punch Bowl Road
Morristown, New Jersey 07960

Gentlemen:

In the course of our review of your submittals dated January 18, 1973, and February 22, 1973, which describe the Cycle 3 core loading for the Oyster Creek reactor, we find that we require additional information. During a meeting in our offices on March 21, 1973, your staff and the fuel supplier, EXXON Nuclear, made a presentation concerning fuel densification and its effects on normal operation and the loss of coolant accident analysis, the XN-1 critical heat flux correlation, and the Quality Assurance Program. At this meeting it was agreed that the information discussed at the meeting would be submitted formally for our evaluation. Attachment A to this letter identifies this information. Attachment B contains additional questions that have resulted from our continuing review of your Facility Change Request No. 4 and the documents referred to in that submittal. Attachment C is a copy of the letter and questions which we sent to General Electric Company in regards to their generic report on fuel densification NEDM-10735 and is for your information. In your responses to our questions, please include information for all the fuel in the Cycle 3 core; that is, both the GE fuel and the EXXON fuel.

Your response to this request for additional information should be provided to us for review by April 16, 1973. Otherwise, we may not be able to complete our review to authorize operation by completion of your refueling outage.

Sincerely,

Robert J. Schemel

Robert J. Schemel, Chief
Operating Reactors Branch #1
Directorate of Licensing

Enclosures: see next page

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Enclosures:
1. Attachment A
2. Attachment B
3. Attachment C

cc w/enclosures:
GPU Service Corporation
ATTN: Mr. Thomas M. Crimmins, Jr.
Safety & Licensing Manager
260 Cherry Hill Road
Parsippany, New Jersey 07054

George F. Trowbridge, Esquire
Shaw, Pittman, Potts, Trowbridge
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910 - 17th Street, N. W.
Washington, D. C. 20006

ATTACHMENT A

ADDITIONAL INFORMATION REQUIRED

1. Resubmit Fig. 9 of Facility Change Request No. 4 without credit for gas pressure build up.

2. Submit for the record the input data for creep collapse calculations for each fuel type (types I, II, and III-E).

3. Describe the results of the γ scan measurements on Oyster Creek spent fuel.

4. The details regarding the Exxon power spike model are to be provided. Special attention will be given to the following two questions:

   (a) Can the results of out-of-pile scans be used without penalty for the prediction of gap under operating conditions?

   (b) What interpretation is needed to apply the results of measurements made on spent Oyster Creek GE fuel, to other fuel, like Exxon fuel?

5. Analyses and data on gap closure effects due to pellet cracking are to be provided. The response should include answers to the following two questions: (1) how many data points are available which are within the range of the Oyster Creek fuel design and operating conditions; (2) how this information is used to predict the stored heat content of the fuel at operating conditions?

6. A detailed description of the core average zirc-water reaction calculation performed for the postulated LOCA.

7. A parametric study of peak cladding temperature following a postulated LOCA with various gap conductance values. The gap conductance should be varied from 200 to 1000 Btu/hr-ft^2-F.

8. For the quality range where the XN-1 correlation predicts higher CHF than the Bench-Levy limit lines, a comparison of the XN-1 correlation and data available in the open literature will be provided.

9. Justification of the use of the XN-1 correlation for bundles with non-uniform axial power [illegible].

10. Copies of all slides shown at the March 21 meeting including those at the QA meeting.

(e) Surface finishing (centerless grinding, none or what)?

(f) Properties measurements:

(1) Density - technique and statistical distribution for batches.

(2) Microstructure - macro or micro

(3) Diameter measurements - statistical distribution for batches.

(4) O/M values for sintered product

(5) List chemical impurity specifications for fuel

(g) How are individual enrichments kept separate during processing?

6. Standard Fuel Loading Process. Please provide the following information for all types of fuel including GE fuel as well as Exxon fuel.

(a) Is pellet stack laid out and checked prior to loading?

(b) Nature of spacers and holddown springs?

(c) Nature of checking first end plug and second end plug welds for porosity and leak tightness?

(d) Time and pressure if an autoclave process is used?

(e) Orientation check of the hydride formation in Zircaloy.

(f) Coding system for finished rods - does it reflect enrichment level?

7. Resintering Tests for Fuel (GE and Exxon)

(a) ave resintering trials been performed and what are the results for time at temperature?

8. Irradiation Results (GE and Exxon)

(a) Are there density measurements on irradiated fuel to give the upperbound for densification?

(b) Is there data showing fuel column lengths variations with initial density, burnup, or linear heat rate?

ATTACHMENT B

QUESTIONS TO JERSEY CENTRAL ON FUEL DENSIFICATION

1. Provide either an analytical model for calculating gap conductance or a conservative value of gap conductance for beginning of cycle LOCA calculations. Your model should assume that the fuel densifies immediately upon startup of power range operation and should be verified using experimental data. If the value of gap conductance is based solely on experimental results, submit detailed information describing the experiments and an error analysis indicating the uncertainty inherent in the data and indicating the confidence level of the selected gap coefficient. If the data was obtained on fuel, different from the Oyster Creek fuel, (for example due to differences in pellet manufacturing processes), indicate all differences and justify the interpretation of the data for this application.

2. Provide detailed information derived from analytical or experimental analyses on the exposure and linear heat rate dependence of gap conductance. Estimate the exposure when gap conductance attains its minimum value.

3. Provide the following information for each fuel type:

   (a) sorbed gas content in cc (STP) / gm of fuel

   (b) gas plenum volume

   (c) fuel and cladding surface roughness

   (d) heat transfer coefficient from coolant to clad

4. Some of the fuel rods contain Gadolinium Oxide as a burnable poison. Describe the effects of Gadolinium Oxide (a) on flux depression within a fuel pin; (b) on thermal properties of the fuel; and (c) on densification of the fuel. How did you account for these effects in the safety evaluation of the Oyster Creek fuel?

5. What is the standard fuel fabrication procedure for Oyster Creek fuel? Please provide this information for all types of fuel including both, the GE fuel and the Exxon fuel.

   (a) Type of powder prepared [ADU]?

   (b) Sterotex or other binder additions, what kind and how much?

   (c) Pressing parameters, either psi or green densities?

   (d) Sintering parameters - time, temperature, atmosphere.

9. Please describe all of the differences between your MOXXY code and the MOXY code as it is described in IN-139^

10. Perform a study of peak cladding temperature following LOCA as a function of core power level. The power range should vary from 70 percent to 100 percent of nominal power. This study should use a gap coefficient of 400 Btu/hr-ft^{2}F.

11. NEDM-10735 indicates that U-235 deficiency in initially low density pellets offsets the increase in heat generation rate due to the increased densification effect of a low density pellet. Justify this assumption for the Oyster Creek fuel.

12. Describe the thermal expansion model discussed on page 38 of NEDM-10735 and present the experimental data used to verify the model.

13. Provide power spike sensitivity calculations including the case where the maximum theoretical gap size is calculated from the nominal initial density and an assumed final density of 96.5% theoretical. An appropriate increase in the maximum gap size must be made to account for irradiation induced growth of the fuel rod cladding.

14. Perform an error analysis on the uncertainty involved in the measurement and reduction of the data given in Tables 6, 9, and 10 of NEDM-10735.

15. How many fuel rods were examined for creep collapse and at what burnup? Did you measure at various elevations the diameter of your exposed fuel rods in the vicinity of observed large gaps? If so, please submit the results of such measurements and your interpretation of these data.

16. Describe in more detail the instability criteria, i.e.,

    (a) What is the significance of your present specific ovality limit? Is there experimental data to support such a limit?

    (b) Present information comparing the relative importance of using for a failure criterion,

        i. Ovality Limit

        ii. Plastic Hinge Formation

        iii. Strain Limit

        iv. Elastic Instability (Buckling)

    (c) Was numerical instability encountered after the ovality limit, or did you fail to obtain an infinite slope in the ovality vs. time curve?

17. Provide examples of quantitative computer results (Colapx) for cases when there is a temperature gradient across the cladding, and when there is no gradient in order that the sensitivity to a gradient can be evaluated. Provide experimental verification as available for the two cases.

18. Discuss in detail the selection of a specific time as the transition to gap formation.

19. Discuss the geometrical parameters used in the examples in report JN-72-23.

    (a) Why was an initial ovality of .003 inch used? If this was a measured value, provide the sample population mean, standard deviation and confidence level.

    (b) Similarly provide the mean value, standard deviation and confidence level for the clad thickness and outside diameter.

20. Provide the following sensitivity studies on cladding collapse using the Colapx Code:

    (a) Initial Ovality (Especially for when ovality is initially zero).

    (b) Clad Thickness

    (c) Differential pressure

    (d) Clad temperature

    (e) Flux

21. Provide a detailed description of the calculation method and example computer results for the variation of internal pressure.

22. Thermal axial cladding ratcheting was cited. Discuss the calculation of axial strain in detail and show how the result is incorporated into the overall stress and strain summary (i.e., such as the specified strain limit).

23. Explain why the ovality vs. time curve in JN-72-23 for the Ginna example has the [illegible] as expected, however the Yankee Rowe example does not.

24. Demonstrate that as a limiting case when there is no creep, the Colapx results agree with Timoshenko's elastic solution.

25. Provide the results of any controlled experimental data which verifies Colapx predictions.

26. Provide any experimental data that may be used to confirm the Oyster Creek calculations indicating integrity up to the time stated.

27. Give a comparison of Colapx with N. Hoff's results. REF: Hoff, N. T., Jahsman, W. F., and Nachbar, W., "A Study of Creep Collapse of a Long Circular Cylindrical Shell Under Uniform External Pressure." Journal of the Aerospace Sciences, Vol. 26, No. 10, pp. 663-674.