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

Docket No. 50-219

JUN 13 1973

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

Gentlemen:

By letter dated April 4, 1973, you submitted Amendment 72 to the Application for Operating License for Oyster Creek Nuclear Generating Station that requested authorization to receive, possess and store up to 1,000 kilograms of contained plutonium 239 and 241 and to use up to 10 kilograms in connection with four PuO_2-UO_2 lead assemblies. In support of the use of the mixed oxide fuel, you also submitted Supplement No. 2 to Facility Change Request No. 4 that presented the safety, transient and accident analyses for a mixed oxide core. You requested these authorizations be promptly reviewed and approved since the four lead mixed oxide fuel assemblies had to be shipped from the fuel manufacturer and loading was to commence in mid-April 1973 and be completed in May 1973.

We reviewed the above submittals but did not have sufficient time to complete our evaluation in order to meet your refueling schedule. Also we find that we would require additional information in order for us to complete an evaluation of the use of any significant amount of mixed oxide fuel assemblies in the Oyster Creek reactor. A preliminary list of questions is enclosed as Attachment A to this letter. Information in response to these questions should be included in any future application for the use of mixed oxide fuel in the Oyster Creek reactor in order to facilitate our review and a timely submittal would be required in order for us to meet your refueling schedule.

Since Cycle 3 operation has already commenced, as authorized by our letter dated May 25, 1973, we do not intend to take any action in regard to Amendment 72 or Supplement 2 to Facility Change Request No. 4, which

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we interpreted to apply to Cycle 3 operation, until further application by you for any intended use of mixed oxide fuel.

Sincerely,

Donald J. Skovholt
Assistant Director for
Operating Reactors
Directorate of Licensing

Enclosure:
Attachment A

cc: w/enclosure
George F. Trowbridge, Esquire
Shaw, Pittman, Potts, Trowbridge & Madden
910 - 17th Street, N. W.
Washington, D. C. 20006

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

ATTACHMENT A

1. Provide the expected PuO_2 particle size distribution.

2. Provide details of the neutron spectrum calculations for mixed oxide cells; include

   (a) agglomeration effects of the PuO_2 particles,
   (b) assumed fission spectrum,
   (c) microscopic cross section data source,
   (d) slowing down and thermal group structure,
   (e) thermal neutron scattering kernel,
   (f) resonance overlap effects.

   Are your fine structure constants normalized to experimental predictions or are they obtained from original (e.g., ENDF/B) data?

3. Discuss how the neutron spectrum calculational model predicts experimental data for:

   (a) control rod worths in mixed oxide lattices,
   (b) rod-to-rod and bundle-to-bundle power distributions in regions containing control rods, burnable poisons, and/or water slots,
   (c) temperature coefficient calculations throughout fuel lifetime,
   (d) integral absorption cross section measurements.

4. Calculate the effect of PuO_2 particle size and Pu enrichment on the Doppler coefficient. Provide details of the calculational model.

5. Discuss the change of PuO_2 particle agglomeration during a reactor transient. Provide the resulting reactivity changes and details of the calculational model employed.

6. Provide the initial loadings of all Pu isotopes.

7. For the pertinent mixed oxide fuel composition, provide the time history of:

   (a) transuranium isotope concentrations,
   (b) saturating fission product poisons,
   (c) nonsaturating lumped fission product poisons,
   (d) fuel temperature coefficient of reactivity,
   (e) moderator temperature coefficient of reactivity.

   Compare the above with the values for UO_2 core.

8. Compare your burnup calculational model with existing experimental data.

9. Provide details and justification for the shutdown decay heat curve employed for the mixed oxide assemblies.

10. Compare the effects of densification of mixed oxide fuels with those of UO_2 fuels; specifically, compare local flux peaking, gap conductance, and fuel diameter and length changes. What lattice configuration of UO_2 and mixed oxide rods provides the worst situation for fuel densification?

11. Compare the calculated axial and radial peaking factors for type IIIE and type IV fuel configurations. Provide comparative core and fuel assembly power distributions and assumed burnup for the "worst case" power distributions for LOCA, control rod drop accident, and control rod withdrawal error.

12. The K_∞ of the cold clean type IV core is significantly different from the type IIIE core value. What effect does this have on control rod worths and sequencing?

13. For the rod drop accident:

    (a) Compare the shape of the scram reactivity vs time curves with those of cycle 3, type IIIE, and type IV fuels;

    (b) Compare the shape of the reactivity insertion rate due to the dropped rod for the above core loadings;

    (c) For an assumed peak pellet energy deposition of 280 cal/gm, compare the expected number of fuel pins at 170 cal/gm for the UO_2 and mixed oxide cores;

    (d) Compare the effects of PuO_2 particle agglomeration and distribution on the 280 cal/gm fuel energy design limit;

    (e) Extend Figure 7 of Supplement 2 to Facility Change Request No. 4 to include the entire range of dropped rod worths.

14. Describe, in detail, the process used to fabricate the mixed oxide fuels; are the fuels fabricated by mechanical blending of PuO_2 and UO_2, coprecipitated in aqueous solution, or some other method? Details regarding batch sizes, temperatures, product characteristics, etc., are requested. Discuss in detail:

    (a) Receiving and storing of nuclear materials (solutions, oxide powders, sintered pellets, process scrap, fuel rods, and fuel assemblies.

(b) Conversion of Pu-nitrate solution to PuO_2 or PuO_2 - UO_2 mixed-oxide powders or sol-gel mixtures.

(c) Powder processing (calcining, hydrogen reduction, screening, ball milling, blending, prepressing, granulating, and binder or lubricant addition).

(d) Powder Properties - what is the mean particle diameter, particle size distribution, and specific surface of the powder? How do these vary from batch to batch? Provide chemical analyses including O/M, sorbed gases, metallic and non-metallic impurities.

(e) Pressing Parameters - what pressures were used? What type dies and punches? What were the green pellet densities (mean values and standard deviations)?

(f) Sintering Parameters - provide a complete description of the sintering cycle, including heating rates, soak times, and cooling rates. What were the furnace atmospheres (include approximate concentration of impurities).

(g) Surface Finishing - what methods were used to finish the pellets and to what specifications?

(h) Resintering Parameters - are the pellets reheated? To what heating cycle? Cite reasons for choice of temperatures, times, and atmospheres.

(i) Inspection - what procedures were used to inspect the pellets and what bases for acceptance or rejection were used?

15. Pellet Characterization - What were the fuel pellet specifications for dimensions, density, Pu content, Pu isotopic composition, Pu homogeneity, O/M, H or gas content, impurity limits, and microstructure? Specifically include information on:

(a) Mean immersion and geometric densities, standard deviations and minimum densities.

(b) Microstructure - What were the average grain sizes, grain size distributions, pore morphology and location, and axial and radial distributions of grain size and porosity in the fuel pellets (if not uniform). Provide sample photo-micrographs of typical (or atypical) pellets; show both etched and as-polished microstructures.

(c) Dimensions - Provide statistical distributions. What were the minimum dimensions? Provide a drawing or sketch illustrating the end configuration of the pellets.

(d) Chemical Properties - What were the O/M ratios, impurities (metallic & non-metallic) and specifications for the sintered pellets? (See question 26.)

16. Describe, in detail, the fuel element assembly, receiving, packaging and shipping. What special handling techniques or processing procedures are used in the fabrication or use of Pu fuel assemblies?

17. How might Pu-redistribution during irradiation affect densification and thermal performance of the fuel? How do the PuO_2 additions affect fission product migration?

18. What differences in fission gas release are there with mixed-oxide thermal reactor fuels as compared to UO_2? (See question 26.)

19. What effects will the PuO_2 additions have on material properties such as melting point, thermal conductivity, thermal expansion, etc., as fabricated and as a function of burn-up to end-of-life? (See question 21.)

20. Describe the design and results of any tests for determining the relative densification, swelling, and fission product retention of mixed oxide fuel and UO_2 fuel.

21. Provide a detailed description of your gap conductance and fuel temperature calculation technique for the mixed oxides for the PuO_2 contents intended. Include a description of all models used such as thermal expansion, fission gas release, fuel thermal conductivity, etc. Give references for all models used.

22. Using the model described in request no. 21, compare calculated gap conductances and/or fuel temperatures with experimental data in the same range of parameters as the fuel of interest.

23. Provide calculations of gap conductance and fuel temperatures as a function of time and burnup. Resolve the gap conductance into components for contributions through the gas, solid-solid contact and radiation. Also present hot gap size, fuel pellet diameter and conductivity of gas mixture as a function of time. Provide the following input data needed for GAPCON for gap conductance calculations:

(a) diameter of pellet

(b) ID & OD of clad

(c) enrichment of fuel

(d) density of fuel (% theoretical)

(e) plenum volume

(f) active fuel pellet length

(g) sorbed gas content (cc/gram)

(h) surface roughness of clad and fuel

(i) coolant temperature and pressure

(j) film coefficient between cladding and coolant

(k) initial fill gas pressure and composition

24. Provide a calculation of the maximum axial compressive stresses in a fuel pellet during full power operation. Include in this calculation the pellet-to-pellet contact areas and the compressive loads (spring and pellet weights) assumed.

25. Of gas released from the mixed oxide fuels, what is the assumed (or measured) composition (both sorbed and fission gas)? Provide a comparison of the gas mixture thermal conductivity model with experimental data (or a reference which contains this comparison).

26. What methods are used to ensure Pu micro-homogenity in the fuel pellets? Are representative mixed-oxide fuel pellets examined for adequate PuO_2 homogenity?

27. Describe all fuel fabrication procedures used to lower the incidence of hydride-caused failures of the zircaloy cladding.

28. Discuss the differences in radiation levels for new and spent fuel associated with mixed oxides as compared to UO_2 in particular, the neutron radiations. What precautionary procedures are taken in fabricating these fuels, beyond the usual for UO_2? Discuss the effects of light element impurities on neutron yield; compare calculations with experimental data.

29. Discuss the restructuring phenomena in mixed-oxide fuel as compared to UO_2. What effect does restructuring have on Pu distribution? How is Pu - re-distribution affected by stoichiometry?

30. Discuss compatibility of zircaloy-clad with mixed-oxide fuel. Include a discussion of the O/M ratio effects with burnup on fuel-clad compatibility.

31. Describe any effects that the mixed oxide core might have on the scram reactivity vs time curve for all transient analysis cases, such as turbine trip with and without bypass.