November 21, 2003

Mr. Michael S. Tuckman
Executive Vice President
Duke Energy Corporation
526 South Church St
Charlotte, NC 28201-1006

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2 - REQUEST FOR ADDITIONAL INFORMATION RE: MIXED OXIDE LEAD FUEL ASSEMBLIES (TAC NOS. MB7863 AND MB7864)

Dear Mr. Tuckman:

By letter dated February 27, 2003, you submitted an application for amendments to the operating licenses for Catawba Nuclear Station, Units 1 and 2. The proposed amendments would revise the Technical Specifications to allow the use of four mixed oxide fuel assemblies at the Catawba station. The Nuclear Regulatory Commission staff has reviewed the information provided and has determined that additional information is required as identified in the Enclosure.

We discussed these questions with your staff on November 20, 2003. Your staff indicated that a response to these issues could be provided within thirty (30) days. Please contact me at (301) 415-1493, if you have any other questions on these issues.

Sincerely,

***/RA/***

Robert E. Martin, Senior Project Manager, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-413 and 50-414

Enclosure: Request for Additional Information

cc w/encl: See next page

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REQUEST FOR ADDITIONAL INFORMATION

ON APPLICATION FOR MOX LEAD TEST ASSEMBLIES

DUKE POWER COMPANY

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-413 AND 50-414

Environmental Review

1. Describe any change to the types, characteristics, or quantities of nonradiological effluents discharged to the environment as a result of the proposed change.

2. Describe any changes to liquid radioactive effluents discharged as a result of the proposed change.

3. Describe any changes to gaseous radioactive effluents discharged as a result of the proposed change.

4. Describe any change in the type or quantity of solid radioactive waste generated as a result of the proposed change.

5. What is the difference in source characteristics of mixed oxide (MOX) fuel (compared to low-enriched uranium fuel) that is considered in the accident analysis?

6. What is the expected change in occupational dose as a result of the proposed change under normal and design-basis accident (DBA) accident conditions?

7. What is the expected change in public dose as a result of the proposed change under normal and DBA accident conditions?

8. What are the performance characteristics of the packages that will be used to ship irradiated assemblies offsite?

9. What are the expected impacts of transporting the fresh MOX assemblies (to workers/drivers and to the public) under normal and accident conditions?

10. What are the expected impacts of transporting the irradiated MOX assemblies (to workers/drivers and to the public) under normal and accident conditions?

11. Provide an assessment of the occupational doses resulting from post-irradiation examinations following each cycle of irradiation of the lead test assemblies.

Radiological Consequences

1. The table below lists the parameters that the NRC staff plans to use in assessing fission gas release (isotopic gap fractions) and fission gas pressure for the lead test

assemblies (LTAs). This data is taken from Duke's submittal dated February 27, 2003, and from NUREG-1754, "A New Comparative Analysis of LWR Fuel Designs," as indicated below. The NRC staff requests that Duke complete the missing data items and confirm that the values in the table are those that have been or will be used for safety analyses and thus become part of the design basis for the LTA irradiation.

| Parameter | Value | Basis |
|---|---:|---|
| Number of fuel rods per assembly | 264 | Submittal, Table 3-1 |
| Fuel rod pitch, in. | 0.496 | Submittal, Table 3-1 |
| Cladding OD, in. | 0.374 | Submittal, Table 3-1 |
| Cladding ID, in. | 0.329 | Submittal, Table 3-1 |
| Cladding thickness, in. | 0.0225 | Submittal, Section 3.5.1 |
| Cladding material | M5 | Submittal |
| Fuel diameter, in. | 0.3225 | Submittal, Table 3-1 |
| Fuel pellet length, in. | ? 0.45 ? | NUREG-1754 |
| Fuel pellet volume reduction due to dish and chamfer, % | 1.0 | Submittal, Table 3-1 |
| Fuel pellet dish diameter, in | ? 0.158 ? | NUREG-1754 |
| Fuel pellet dish depth, in. | ? 0.0113 ? | NUREG-1754 |
| Fuel rod length, in. | 152.40 | Submittal, Table 3-1 |
| Active fuel length, in. | 144.0 | Submittal, Table 3-1 |
| Plenum length, in. | ? 10 ? | NUREG-1754 |
| Pellet initial density, % TD | 95 | Submittal, Table 3-1 |
| Pellet oxygen to metal ratio (a realistic value is preferred to a manufacturing limit) | ? | |
| Rod internal void volume, cu. in. | ? | |
| Plenum spring diameter | ? 0.3225 ? | NUREG-1754 & Table 3-1 (based on pellet diameter) |
| Plenum spring wire diameter, in. | ? 0.05 ? | NUREG-1754 |
| Turns in plenum spring | ? 28 ? | NUREG-1754 |
| Helium fill gas pressure, psi | ? 350 ? | NUREG-1754 |
| RCS pressure, psia | 2310 | Submittal, Table 3-2 |
| Reactor Power, MWt | 3411 | Submittal, Table 3-2 |

| | | |
|---|---|---|
| Coolant Flow, lb/ft$^2$-hr | ? 2.55E6 ? | NUREG-1754 |
| Coolant inlet temperature, °F | 555 | Submittal, Table 3-2 |
| Coolant outlet temperature, °F | 616 | Submittal, Table 3-2 |
| Channel temperature rise, °F *(for the limiting LTA)* | ? | |
| Temperature at which pellets were sintered, °F | ? 2911 ? | NUREG-1754 |
| Limit on pellet density increase, %TD | ? 0.9 ? | NUREG-1754 |
| Limit on pellet swelling, % | ? 5 ? | NUREG-1754 |
| Fuel surface roughness, in. | ? 3E-5 ? | NUREG-1754 |
| Cladding ID surface roughness, in. | ? 2E-5 ? | NUREG-1754 |
| Initial crud thickness, in. | ? 0 ? | NUREG-1754 |
| Lattice geometry | 17 x 17 | Submittal |
| Maximum fuel rod burnup, MWD/MThm | 50,000 | Submittal, Table 3-1 |
| Heavy metal loading per assembly, kg | 462.6 | Submittal, Table 3-1 |
| Hot pin and hot assembly radial peaking factors* | 1.60 | Submittal, Table 3-1 |
| Highest allowable total peaking for MOX fuel assembly ($F_Q$)* | 2.4 | Submittal, Table 3-1 |
| Core axial peaking factor* | 1.50 | Submittal, table 3-1 |
| ** See question #2 below.* | | |
| Nominal average Pu concentration, weight percent Pu, in a radially zoned fuel assembly containing pellets with nominal Pu concentration<br><br>(4.37 x TD = 4.15 w/o-% fissile) | 4.37<br><br>4.94 (176 rods)<br>3.35 (76 rods)<br>2.40 (12 rods) | Submittal, Section 3.2<br><br>Submittal, Section 3.2 & Fig. A3-6<br>Submittal, Section 3.2 & Fig. A3-6<br>Submittal, Section 3.2 & Fig. A3-6 |

| | | |
|---|---|---|
| Unirradiated isotopic composition, % of base element | | Table Q3(a)-2 Ltr dtd 11/3/2003 |
| Pu-238 | 0.025 | |
| Pu-239 | 92.5 | |
| Pu-240 | 6.925 | |
| Pu-241 | 0.5 | |
| Pu-242 | 0.05 | |
| U-235 | 0.25 | |
| U-234 | 0.0017 | |
| U-236 | 0.0012 | |
| U-238 | 99.741 | |

2. Please provide projected power histories for the LTAs. These would typically tabulate or plot peak rod average power, kW/ft, versus time (days) since start of irradiation (or versus average burnup, MWD/MThm). If a projected power history specifically for the LTAs is not available, please provide the average kW/ft data and the appropriate peaking factors.

3. Please provide the axial power profile expected in the LTAs. These would typically tabulate or plot normalized power versus height.

4. In the response to Question 3(f) in Duke's letter dated November 3, 2003, Duke identified that the SCALE/SAS2H code suite was used to establish the source term used in the safety analyses. Please provide a listing of the SAS2H input data file(s) for the case(s) that generated the fuel assembly inventory used in the fuel handling accident shown in Table Q3(f)-1. The NRC staff is particularly interested in the SAS2H case that would have generated the MOX fuel cross-section library used in the safety analysis work.

Definitions:

| | |
|---|---|
| in. | inches |
| TD | Theoretical Density |
| psi | pressure, pounds per square inch |
| psia | pounds per square inch absolute |
| MWt | Megawatts thermal |
| $lb/ft^2$ - hr | pounds/square foot - hour |
| °F | degrees Farenheit |
| % | percent |
| MWD/MThm | Megawatt days/Metric ton heavy metal |
| kg | kilogram |
| Pu | Plutonium |
| kW/ft | kilowatts/foot |

Catawba Nuclear Station

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