December 16, 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 November 3, 2003, you provided additional information for your application that was submitted on February 27, 2003 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 in your letter dated November 3, 2003 and has determined that additional information is required as identified in the Enclosure.

We discussed these questions with your staff on December 11, 2003. Your staff indicated that a response to these issues could be provided by January 30, 2004. 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

## Materials Engineering

Section 3.6.1 of Attachment 3 to the Duke Power (licensee or Duke) letter dated February 27, 2003, indicates that the fast flux impacting the reactor vessel will be virtually identical to that for a reactor core consisting entirely of low enriched uranium (LEU) fuel. The licensee states that the Reactor Vessel Integrity Program will manage the reduction in fracture toughness of the reactor vessel beltline region so that the function of the vessel is maintained. The licensee states that the existing pressure-temperature curves in the Catawba Technical Specifications will remain valid with the use of four mixed oxide (MOX) lead test assemblies.

The Nuclear Regulatory Commission (NRC) staff requests that the licensee identify the capsules, dosimetry, capsule withdrawal schedule, and projected neutron fluence for the capsules that will be in the vessel during the period of time that the MOX lead test assembly fuel will be utilized. The test results from the reactor vessel material samples should be compared to the results predicted using Regulatory Guide (RG) 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," and dosimetry should be evaluated in accordance with RG 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." Provide a basis for concluding that there is no change required in the withdrawal schedule for the capsules in the vessel during the period of time that MOX lead test assembly fuel will be utilized.

## Radiological Consequences

By letter dated February 27, 2003, Duke requested a license amendment related to the use of four MOX lead test assemblies. The NRC staff requested additional information (RAI) by letter dated July 25, 2003, and Duke responded to that RAI on November 3, 2003. In reviewing the responses to the radiological consequences questions, the NRC staff has identified some areas where additional clarification or information is required to enable the staff to make its requisite safety findings.

1. With regard to Footnote 3 to Table Q12-3 (cited in the response to RAI Question 3), Section 4.5 of RG 1.195, "Methods and Assumptions for Evaluating Radiological Consequences of Design Basis Accidents at Light-Water Nuclear Power Plants," does state that 50 rem thyroid may be used as the acceptance criterion. However, Section B of the guide states: "The guidance contained in this regulatory guide will supersede corresponding radiological analysis assumptions provided in other regulatory guides when used in conjunction with guidance that is in Regulatory Guide 1.196, 'Control Room Habitability at Light-Water Nuclear Power Reactors.'" Please provide a

commitment to the guidance of RG 1.196, identifying proposed alternatives to the guidance, if any, that are proposed by Duke.

2. Table Q3(a)-1 states that the control room X/Q value from Reference Q3(a)-1 is "increased" to a value of 1.04E-3 seconds/cubic meters (sec/$m^3$) for unit vent releases. The citation to Reference Q3(a)-1 appears to be in error. The NRC staff believes that the most recently approved value for this parameter is 1.74E-3 sec/$m^3$ (See Catawba Amendments 198 and 191 dated April 23, 2002). Please resolve this apparent difference in values. If the 1.04E-3 sec/$m^3$ value is a newly calculated value, please provide a revised response to RAI Question 3.c.

3. In response to RAI Question 3.b on Page 93, Duke indicates that a loss-of-coolant accident (LOCA) is the most restrictive accident and its thyroid dose is more restrictive than its whole body dose. Please explain whether control room dose was considered in this conclusion and, if not, how this omission would impact this conclusion.

4. A sentence in the last paragraph on page 94 states that: "Included in these tables is an evaluation of the results for the Catawba AST [accident source term] LOCA including MOX lead assemblies." That sentence could imply that the NRC staff is currently reviewing an analysis of a LOCA with AST and MOX lead assemblies for Catawba. This would be in error since Duke did not address MOX fuel in the AST amendment currently under review. Please clarify.

5. The NRC staff finds the response to RAI Question 3.g. to be inadequate. This question asked for a justification for the continued use of the gap fractions in Table 3 of RG 1.183, "Alternative Radiological Source Terms For Evaluating Design Basis accidents At Nuclear Power Reactors." Duke responded to the NRC staff's question by proposing to increase the Table 3 values (except alkali metals) by a multiplier of 1.5 without an adequate explanation of why the Table 3 values, adjusted by the multiplier, would reasonably bound the expected gap fractions for weapons-grade MOX assemblies with burnups to 60 Gigawatt days/Metric ton heavy metal (GWd/MThm). Duke is requested to provide the NRC staff with a basis for concluding that this multiplier is acceptable for all isotopic groups, including alkali metal, for weapons-grade MOX.

   The NRC staff believes that the discussion provided in the response could be considered to provide qualitative support for Duke's conclusions regarding LOCA release fractions for the gap phase, but it does not establish the adequacy of the gap fraction multiplier for use with Table 3 for non-LOCA events. The expert panel identified in Duke's response was impaneled by the NRC in 2001 to address (1) whether or not the data in NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants," would apply to high burnup LEU fuel; (2) and to reactors using mixed oxide fuel. The panel reviewed available data and made recommendations for changes to the NUREG-1465 release phase fractions. Duke attempted to use the insights of the expert panel to address the adequacy of the Table 3 values as stated in the following paragraph from page 106 of Duke's November 3, 2003, response:

   > Since [Regulatory Guide 1.183] Table 3 is based upon expert panel work which was published in [NUREG-1465] and the panel saw similarities in gap release rates between LEU and MOX fuel, it could be inferred that the gap release rates

> in [Regulatory Guide 1.183] Table 3 should also be valid for MOX fuel gap releases.

However, (1) the data in Table 3 were not derived from NUREG-1465. These data were generated by the NRC staff in recognition of the fact that the core average gap release fractions in NUREG-1465 were inappropriate for use with non-LOCA events since the gap fraction of many assemblies in the core could exceed the core average value; (2) the expert panel's deliberations were limited to LOCAs and other severe accidents involving a substantial portion of the core, since this was the direction given to the panel; (3) section 3.4.2 of the panel report tabulated the MOX fuel characteristics considered by the panel. This included a maximum burnup on an assembly basis of approximately 46 Gigawatt days/ton (GWd/t). Duke has requested MOX lead test assembly (LTA) burnups to 60 Gwd/t; and (4) the panel's conclusions are not directly applicable to a comparison of an LEU assembly and a MOX assembly since the panel considered core-average releases from the LEU core and core-average releases from the core containing 40 percent MOX assemblies.

6. In the response to Question 3.g, Duke provided a graph of fission gas data for European reactor-grade MOX fuel and LEU fuel. With regard to this graph, please provide the following information:

    a. An explanation of the data sets represented on this graph. For example, what fuel configurations are included, what plutonium concentrations, what LEU enrichments, PWR/BWR/MAGNOX/etc. How were the data obtained?

    b. Was the linear heat generation rate for these assemblies comparable to what Duke proposes for the MOX LTAs?

    c. How do the data showing a nearly vertical rise in the MOX fission gas release (FGR) that occurs about 43,000 MWd/MThm support Duke's planned burnup to 60,000 MWd/MThm?

    d. Taking the four highest MOX data points at about 43,000 MWd/MThm, the MOX FGR values range from 4.5 to 7, implying an uncertainty of nearly 50 percent at this burnup. How is this uncertainty addressed?

Catawba Nuclear Station

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