July 1, 1998

Mr. William R. McCollum
Vice President, Oconee Site
Duke Energy Corporation
P. O. Box 1439
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SUBJECT: REQUEST FOR ADDITIONAL INFORMATION - APPENDIX D, "OCONEE PLANT SPECIFIC DATA, MARK-B11 FUEL, APPLICATION OF BWU-Z CHF CORRELATION TO MARK-B11 MIXING VANE SPACER GRID FUEL DESIGN," TO DPC-NE-2005P, "DUKE POWER COMPANY THERMAL-HYDRAULIC STATISTICAL CORE DESIGN METHODOLOGY" (TAC NOS. 98660, 98661, AND 98662)

Dear Mr. McCollum:

By letter dated April 22, 1997, Duke Energy Corporation transmitted the subject topical report, Appendix D to DPC-NE-2005P, for staff review. In order to complete its review, the NRC staff has determined that additional information is needed. The staff's request for additional information is enclosed.

Sincerely,

ORIGINAL SIGNED BY:

David E. LaBarge, Senior Project Manager
Project Directorate II-2
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

Enclosure: Request for Additional Information

cc w/encl: See next page

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Enclosure: Request for Additional Information

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Request for Additional Information
Review of Duke Topical Report DPC-NE-2005P,
Appendix D, "Oconee Plant Specific Data, Mark-B11 Fuel,
and Application of BWU-Z CHF Correlation to Mark-B11
Mixing Vane Spacer Grid Fuel Design"
to DPC-NE-2005P, "Duke Power Company
Thermal-hydraulic Statistical Core Design Methodology"

1. The safety evaluation report (SER) for DPC-NE-2005P-A requires that in all applications of the statistical core design methodology, the uncertainties and distributions used in the analysis will be justified on a plant-specific basis. This has not been done in Appendix D, which presents plant-specific data for Oconee with Mark-B11 fuel. Comparing Table D-4 of Appendix D with Table A-2 of Appendix A (which contains the approved uncertainties and distributions for the Oconee units with Mark-B10 fuel), there are four major changes, none of which are explained adequately. Specifically:

(a) The core flow uncertainty has been increased from ±2.0 percent design (with standard deviation ±1.0 percent design) to ±4.2 percent design (with standard deviation ±2.1 percent design). The report says simply that the value was increased "to ensure that it is bounding." Bounding in what way? How was this determined? It appears to be an arbitrary adjustment to what should be a real indicator of the uncertainty in the measured core flow. What is the justification for this change?

(b) Table A-2 includes the parameter Fq" (local heat flux hot channel flow (HCF)), which is an uncertainty to account for the decrease in departure from nuclear boiling ratio (DNBR) at the point of minimum DNBR due to engineering tolerances. It also accounts for flux depression at a spacer grid, and has a value of +2.08 percent (with standard deviation +1.26 percent). This parameter has been omitted from Table D-4. What is the justification for this change?

(c) Table A-2 includes the parameter Fq (rod power HCF), which is an uncertainty to account for rod power increases due to manufacturing tolerances. This parameter also includes the uncertainty in calculating the pin peak from the assembly radial peak, and has a value of +2.27 percent (with standard deviation +1.38 percent) for Mark-B10 fuel. In Table D-4, this parameter has the value +2.40 percent (with standard deviation +1.46 percent) for Mark-B11 fuel. How was this uncertainty determined, and why is it larger for Mark-B11 fuel than for Mark-B10 fuel?

(d) The HCF area uncertainty is reported as -3.00 percent in Table D-4, unchanged from the value in Table A-2 for Mark-B10 fuel, even though there are significant differences in the assembly geometry of Mark-B11 fuel. In addition, the value reported for the parameter Fq indicates that there are significant differences in the manufacturing tolerances for the fuel rods in Mark-B11 fuel, which would seem to imply that there should also be significant differences in the flow channel geometry variations. What is the justification for using the value of -3.00 percent for this parameter?

Enclosure

2. The description of how transition cores will be treated is unclear. Please provide additional information, addressing the following points:

   (a) What is a "transition core penalty," and how is it determined?

   (b) The local pressure drop differences between the Mark-B10 and Mark-B11 fuel assemblies mean that the local assembly flow distributions may be very different in a mixed core, due to differences in inter-assembly crossflow patterns. The departure from nucleate boiling (DNB) behavior of a mixed core may, therefore, be significantly different from that of a full core of Mark-B11 fuel only. Justify the assumption that the BWU-Z CHF correlation can be applied to Mark-B11 fuel in a core containing both Mark-B10 and Mark-B11 fuel.

   (c) Two options are described (see p. D-7) that will be used to "conservatively compensate" for the transition core penalty. The report states that they will be applied "as necessary" to determine the DNB effect of a transition core. What are the criteria for selecting one or the other of the two options? How will it be determined that the selected option is "conservative" for a given transition core?

   (d) One option of the two described on p. D-7 is to explicitly apply a penalty to the Mark-B11 fuel generic peaking limit based on a full Mark-B11 core. What is this penalty? How is it determined? How will it be determined that the penalty adequately accounts for the effects of a mixed core on DNB behavior?

3. Table D-2 (p. D-14) claims a pressure range of 400 to 2465 psia for the BWU-Z correlation with the Mark-B11V multiplier. The database supporting this form of the correlation includes tests only over the pressure range 695 to 2425 psia. In addition, there is a distinct nonconservative bias evident in the correlation's predictions with decreasing pressure (see Figure D-3, p. D-11). The BWU-Z correlation for Mark-BW17 fuel (as documented in BAW-10199-A) has a demonstrated bias with decreasing pressure, and the SER for this correlation specifies a separate design limit DNBR of 1.59 for pressures below 700 psia. If the BWU-Z correlation with the Mark-B11V multiplier is to be applied to conditions where the pressure is below 700 psia, what value will be used for the design limit DNBR and how will it be determined?

4. The SER for DPC-NE-2005P-A requires that the selected state points for an application of the SCD methodology shall be justified to be appropriate, on a plant-specific basis. Documentation of this justification in Appendix D consists only of the statement on p. D-1, "...state point ranges were selected to bound the unit and cycle-specific values of the Oconee Station." However, the document also notes that the values of the key parameter ranges used to define the state points (in Table D-6, p. D-21) are "based on the currently analyzed state points," and further notes that "ranges are subject to change based on future state point conditions." The procedure and justification for selecting state points is unclear, and additional information is needed. Specifically, please provide a more detailed description of how the state points are selected for the Oconee plant-specific data, with particular attention to how bounding values are to be determined for the B11 and mixed B10/B11 cores.

5. The calculations with the VIPRE-01 code using the BWU-Z correlation form for B11 fuel show essentially the same results as the those obtained with LYNX over the correlation's database (as documented in Addendum 1 of BAW-10199). However, the BWU-Z correlation as modified for analysis of B11 fuel has not yet been approved by the staff, and the topical report describing this correlation, Addendum 1 of BAW-10199, is still being reviewed. This means that the design limit DNBR for the parameter ranges stated in Table D-2 may not be the final approved value or range of applicability. Specifically, the database for the form of the correlation spans a pressure range of 700 to 2400 psia, not the 400 to 2400 psia range stated in Table D-2. Also, the plot in Figure D-3 (see p. D-11) shows a distinct nonconservative bias with decreasing pressure (which is identical to the trend shown for the correlation in the Addendum 1 submittal). There is also a nonconservative bias with increasing power, clearly shown by the plot of measured versus predicted Critical Heat Flux (CHF) in Figure D-1. What would be the effect on the thermal hydraulic statistical core design analysis for Oconee if the DNBR design limit of the CHF correlation for B11 fuel were to be increased, or if the range of applicability of the correlation were to be limited to pressures of 700 to 2400 psia?