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NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TOPICAL REPORT DPC-NE-3000-PA, REVISION 2

"THERMAL-HYDRAULIC TRANSIENT ANALYSIS METHODOLOGY"

DUKE ENERGY CORPORATION

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

DOCKET NOS. 50-269, 50-270, AND 50-287

1.0 INTRODUCTION AND BACKGROUND

By letter dated December 23, 1997, Duke Energy Corporation (the licensee) submitted a revision to topical Report DPC-NE-3000-PA, Revision 1, "Thermal-Hydraulic Transient Analysis Methodology," dated December 1997 (Reference 1) for NRC staff review and approval. The report describes changes to the thermal-hydraulic transient analysis methodology that are due to: (1) simulation model revision to reflect the new Mk-B11 fuel assembly design; (2) application of the new critical heat flux correlation (BWU-Z with the Mk-B11V multiplier); and (3) several RETRAN model improvements.

The topical report DPC-NE-3000-PA, Revision 1, was submitted for staff review on August 8, 1995, (Reference 2), and approved by the staff on December 27, 1995, for reference for the Catawba, McGuire, and Oconee Nuclear Stations. Revision 1 included changes to the methodology due to the steam generator replacement for Catawba Unit 1, and McGuire Units 1 and 2, and correction of typographical errors.

This review is focused upon determining acceptability of the revised fuel assembly design, application of the new critical heat flux correlation, and RETRAN model improvements.

2.0 SUMMARY OF REPORT REVISIONS

The licensee incorporated in Revision 2 of DPC-NE-3000, a new Appendix A describing how the Mk-B11 fuel assembly will be simulated with the RETRAN-02 and VIPRE-01 models, text revisions which describe changes to the Oconee RETRAN models made to support the Updated Final Safety Analysis Report Chapter 15 analyses, and minor model revisions to the Catawba and McGuire RETRAN models that are identical to the Oconee revisions.

Appendix A of Revision 2 also discusses the use of the BWU-Z form of the BWU critical heat flux correlation with the Mk-B11V multiplier approved by the NRC for use in Mk-B11 fuel analysis.

3.0 EVALUATION

The Mk-B11 fuel assembly has smaller diameter fuel pins and mixing vane grids than the current fuel assembly design. Four lead test assemblies began operation in Oconee Unit 2, Cycle 16 in May 1996.

3.1 Mk-B11 Fuel Assembly

The Mk-B11 fuel assembly consists of a 15 by 15 array containing 208 fuel rods, 16 control rod guide tubes, one incore instrument guide tube, one nonmixing vane grid type grid spacer, and five mixing vane type grid spacers. The fuel pins are smaller in diameter than the current fuel design. The fuel design was previously reviewed and approved (Reference 3).

The VIPRE bulk void model has been modified to use the Zuber-Findlay model only when the void fraction is below 85 percent. When the void fraction is above 85 percent, the Armand or Smith bulk void fraction model will be used. The difference in use of these models will result in a change in minimum DNBR of 0.1 percent, an insignificant change. Four Mk-B11 lead fuel assemblies have been in operation in Oconee Unit 2 since May 1996.

The staff finds the revisions for the Mk-B11 fuel assembly acceptable.

3.2 Critical Heat Flux Correlation

The staff has reviewed and approved the BWU-Z form of the BWU critical heat flux correlation with the Mk-B11V multiplier for application to the Mk-B11 fuel assembly design (Reference 3). Duke will use the correlation within the range of applicability:

Pressure, psia	400 to 2465
Mass velocity, 10^6 lbm/hr-ft^2	0.36 to 3.55
Quality, percent	less than 74

Use of the BWU-Z form of the BWU critical heat flux correlation with the Mk-B11V multiplier is acceptable, as approved in Reference 3.

3.3 RETRAN Model Revisions

The RETRAN modeling was revised in the following areas:

Structural conductors - included metal heat sources previously excluded.

Process variable indications - correct circuit indications previously excluded, and extend indications where required.

Phase separation - apply the non-equilibrium bubble rise model for a more realistic pressure response when voiding has occurred.

Steady-state initialization - more accurately initialize steady-state conditions.

General transport model - general transport model added to an intermediate RETRAN version used to track soluble boron.

Reactor protection system functions - additional control system trip added to trip logic.

The revisions noted are applying previously approved code models and are acceptable.

4.0 CONCLUSIONS AND LIMITATIONS

The licensee's revision incorporating the Mk-B11 fuel assembly design, BWUZ critical heat flux correlation with the Mk-B11V multiplier, and RETRAN model revisions are acceptable for applications to non-loss-of-coolant accident (non-LOCA) transient and safety analysis.

Acceptability of the use of the proposed revisions in non-LOCA transients safety analysis remains subject to the limitations that were previously described in the safety evaluations for DPC-NE-3001 and DPC-NE-3002. Furthermore, acceptability does not remove limitations and restrictions previously described in the safety evaluation related to the original DPC-NE-3000 Topical Report for those issues not impacted by the subject revision.

Licensees who reference this topical report are expected to submit documentation describing how they comply with these safety evaluation conditions as part of their applications to use the topical report.

REFERENCES

1. Letter M. S. Tuckman (Duke Energy Corporation) to NRC, Attachment "DPC-NE-3000-PA, Revision 2," December 23, 1997.

2. DPC-NE-3000, "Thermal-Hydraulic Transient Analysis Methodology" original version July 1987, the approved version (DPC-NE-3000-PA dated August 1994) submitted by letter from M. S. Tuckman (Duke Energy Corporation) to NRC, August 8, 1995.

3. The BWU Critical Heat Flux Correlations Applications to the Mk-B11 and Mk-BW17 MSM Designs, Addendum 1 to BAW-10199P-A, Babcock and Wilcox, Lynchburg, Virginia, September 1996.

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