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

Duke Power Company
ATTN: Mr. William O. Parker, Jr.
Vice President - Steam Production
422 South Church Street
P. O. Box 2178
Charlotte, North Carolina 28242

Gentlemen:

By letter dated January 13, 1977, you submitted a reevaluation of the ECCS cooling performance for Oconee Units 1, 2 and 3 in response to our December 6, 1976 letter. Our evaluation of your submittal is contained as an enclosure to this letter.

Based on our review, we conclude that your January 13, 1977 submittal satisfies the requests contained in our December 6, 1976 letter. We concluded in a February 13, 1977 letter from S. A. Varga (NRC) to K. E. Suhrke (B&W) that the revised nucleate boiling lockout logic results in a model which is wholly in conformance with 10 CFR 50 Appendix K. We find that the application of this model is appropriate for the Oconee Units.

Sincerely,

/s/

A. Schwencer, Chief
Operating Reactors Branch #1
Division of Operating Reactors

Enclosure:
Safety Evaluation

cc w/enclosure:
See next page

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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Sincerely,

A. Schwencer, Chief
Operating Reactors Branch #1
Division of Operating Reactors

Enclosure:
Safety Evaluation

cc w/enclosure:
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cc: Mr. William L. Porter
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REVISED ECCS EVALUATION MODEL

OCONEE NUCLEAR STATION UNITS 1, 2 AND 3

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

Introduction

By letter dated December 6, 1976, the NRC requested a reevaluation of the ECCS performance for Oconee Units 1, 2 and 3 (Reference 1) from Duke Power Company (licensee). The NRC request was based on the finding that the post-Critical Heat Flux (CHF) heat transfer calculation of the Babcock and Wilcox (B&W) THETA 6F computer code may not be consistent with the requirements of Code of Federal Regulations Title 10 Part 50, Appendix K (10 CFR 50, Appendix K). B&W modified the THETA 6F code and submitted the revised version in generic reports (References 3 and 4). The reports have been reviewed and approved by the NRC (Reference 5). By letter dated January 13, 1977 (Reference 2) the licensee presented the reevaluation of the ECCS performance in the Oconee plant referencing the revised B&W model.

Discussion

The calculation of the local heat transfer subsequent to the occurrence of CHF as performed in THETA 6F was not consistent with the requirements of 10 CFR 50 Appendix K, Section I.C.4.e. That section stated: "After CHF is first predicted at an axial fuel rod location during blowdown, the calculation shall not use nucleate boiling heat transfer correlations at that location subsequently during blowdown even if the calculated fluid and surface conditions would apparently justify the reestablishment of nucleate boiling." B&W proposed an alternate post-CHF heat transfer model and performed an ECCS reevaluation which satisfies these criteria (References 3 and 4). The change of the model included both revisions to the post-CHF heat transfer mode selection logic and elimination of the post-CHF return to nucleate boiling.

Post-CHF Heat Transfer Mode Selection Logic

Examination of the original THETA 6F heat transfer model selection logic showed that the comparison of transition boiling heat flux to nucleate boiling heat flux was not made. The corrected logic restricts transition

boiling heat fluxes to values less than those calculated with the pre-CHF correlations such that if the transition boiling heat flux is greater than that calculated with the pre-CHF correlations, the heat flux is determined by a film boiling correlation which conservatively increases the cladding temperature. This change of the model meets the requirements of 10 CFR 50, Appendix K.

The licensee and B&W have provided comparative calculations with the previous model and the proposed heat transfer selection logic for generic 177 fuel assembly plants with lowered loops in references 2 and 4, respectively. The calculations showed an increase in peak cladding temperature for the proposed model over that for the previous model. For a 8.55 ft^2 double-ended, pump discharge break with C_D = 1.0, the increase was 12°F for a plant with the lowered loop design which is the same as the Oconee Units 1, 2 and 3 design. Larger increases result for lower power or smaller break cases but no significant change is observed for the worst break case cited above.

Return to Nucleate Boiling Lockout

The revised nucleate boiling lockout model, as proposed by B&W, was developed to specifically provide for compliance with Appendix K requirements for post-CHF heat transfer. This model provides the necessary restriction on the heat transfer logic in conformance with section 1.C.4.e of 10 CFR 50, Appendix K. Use of the modified code logic results in a discontinuity in the heat transfer coefficient when the nucleate boiling heat transfer coefficient is exceeded. Application of the lower film boiling heat transfer coefficient reduces the surface cooling and tends to raise the clad surface temperature back into the transition boiling correlation regime, resulting in some oscillation between transition boiling and film boiling heat transfer. Results of calculations with the revised return to nucleate boiling logic demonstrate that the new model results in minor differences in clad temperature compared to calculations with the previous model. The peak cladding temperature calculated by the revised model is less than 20°F above the original value.

Since data indicate that heat transfer condition characteristic of nucleate boiling continue through the early blowdown flow reversal, the much lower heat transfer obtained by the use of film boiling in the nucleate boiling regime tends to overpredict the cladding temperature during the initial period of blowdown. Its use in combination with the correlation for the transient period between CHF and the establishment of stable film boiling is correspondingly conservative with respect to available experimental data on heat transfer during this period. Therefore, we conclude that the blowdown heat transfer logic results

in a model which is consistent with the post-CHF heat transfer requirements of 10 CFR 50, Appendix K. Consideration of the entire LOCA transient indicates that the overall effect of the model change on peak clad temperature is minimal.

Conclusions

After reviewing the submitted information the staff finds that the B&W revisions to the ECCS evaluation model described in References 3 and 4 produce only negligibly small changes in peak cladding temperature. On the basis of this finding the staff concludes that Oconee Nuclear Station's Technical Specifications remain valid and the plant meets the requirements set forth by 10 CFR 50, Appendix K.

Date: May 27, 1977

References

(1) Letter from A. Schwencer (NRC) to William O. Parker, Jr., (Duke Power Company), dated December 6, 1976.

(2) Letter from William O. Parker, Jr. (Duke Power Company) to Benard C. Rusche (NRC), dated January 13, 1977.

(3) Letter from K. E. Suhrke (B&W) to S. A. Varga (NRC), dated December 20, 1976.

(4) Letter from K. E. Suhrke (B&W) to S. A. Varga (NRC), dated January 24, 1977.

(5) Letter from S. A. Varga (NRC) to K. E. Suhrke (B&W), "B&W ECCS Evaluation Model," dated February 13, 1977.

References

(1) Letter from A. Schwencer (NRC) to William O. Parker, Jr., (Duke Power Company), dated December 6, 1976.

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