



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF THE NUCLEAR REACTOR REGULATION

TOPICAL REPORT DPC-NE-3000-P, REVISION 1

"THERMAL-HYDRAULIC TRANSIENT ANALYSIS METHODOLOGY"

DUKE POWER COMPANY, ET AL.

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

DOCKET NOS. 50-369, 50-370, 50-413, 50-414

50-269, 50-270, AND 50-287

1.0 INTRODUCTION AND BACKGROUND

By letter dated August 9, 1994, Duke Power Company (DPC or licensee) submitted a revision to the DPC Topical Report DPC-NE-3000-P, "Thermal-Hydraulic Transient Analysis Methodology," dated June 1994 (Reference 1) for NRC staff review and approval. The report describes changes to the DPC thermal-hydraulic transient analysis methodology that are due to: (1) the steam generator replacement for Catawba Unit 1 and McGuire Units 1 and 2, (2) changes to the methodology previously documented in DPC-NE-3000-P, and (3) corrections of typographical errors. Supplemental information was submitted in a letter dated September 12, 1995.

The subject report was submitted on August 9, 1994, and was identified by DPC as Revision 3 to the original DPC-NE-3000 report that was submitted by letter from H. B. Tucker to the NRC on September 29, 1987. The original report, following approvals for the Catawba, McGuire, and Oconee stations, was issued by DPC in its approved form by letter from M. S. Tuckman, DPC, to the NRC dated August 8, 1995, wherein it was identified as DPC-NE-3000-PA with no revision number. Accordingly, since the revisions in the August 9, 1994, report are beyond the scope of the original report, DPC's letter of September 12, 1995, renames the August 9, 1994, report as Revision 1 to DPC-NE-3000-P. Therefore, the August 9, 1994, report will be referred to, hereafter, as Revision 1 to the original DPC-NE-3000-P report.

In Revision 1 of the Topical Report DPC-NE-3000, DPC documents revisions to the currently approved thermal-hydraulic transient analysis methodology for Oconee, McGuire and Catawba stations (Reference 2). The revisions reflect changes due to the proposed replacement of the steam generators for McGuire

Units 1 and 2 and Catawba Unit 1 and methodology changes. Corrections of typographical errors are also included. Additional information was provided in Reference 3.

The currently approved methodology (Reference 2) for non-LOCA transient safety analysis is based upon the use of the RETRAN-02 and the VIPRE-01 computer codes for the McGuire, Catawba and Oconee stations. In Revision 1, only the RETRAN portion of the methodology was revised. The stated objective of the subject revision of the Topical Report is for DPC to demonstrate acceptability of changes in the analysis methodology for the Oconee, McGuire and Catawba plants.

This review is focused upon determining acceptability of the revised RETRAN plant models and their impact on previously approved analysis.

2.0 SUMMARY OF REPORT REVISIONS

The licensee incorporated, in Revision 1 of DPC-NE-3000, new sections describing Babcock and Wilcox's (B&W's) feeding steam generator (FSG), which is expected to replace the existing Westinghouse preheater steam generators (PSG) at the McGuire Units 1 and 2 and Catawba Unit 1 nuclear stations. Necessary modifications to associated components such as steamline and feedwater lines were also made.

There are minor modifications to the RETRAN methodology including the treatment of phase separation in some volumes and pressurizer modeling. Setpoint changes were incorporated into the description of the respective components and control systems. A description of the General Transport model to simulate boron transport (its use was approved in connection with the steamline break analysis in DPC-NE-3001 (Reference 4) was also added to the report for completeness. In addition, DPC corrected numerous typographical errors and made some editorial changes, which are of minimal technical significance.

3.0 EVALUATION

Revisions incorporated into the submittal can be categorized into three classes: (1) modeling upgrades and incorporation of a new steam generator model; (2) setpoint changes due to revised Technical Specifications; (3) non-technical correction to the text. Revisions to the approved RETRAN transient analysis methodology and their acceptability are discussed. Minor changes of a non-technical nature are not discussed, since these changes have no technical impact and are acceptable.

3.1 Revisions to RETRAN Models

These model revisions resulted from consolidation of modifications made due to (i) proposed steam generator replacements, (ii) better understanding gained through sensitivity studies performed since the original review, and (iii) plant Technical Specification changes.

3.1.1 Editorial Changes

The RETRAN General Transport model is used to simulate boron transport in the steamline break analysis. The model description is added to the Topical Report for completeness. The use of this model for steamline break was reviewed and approved in DPC-NE-3001.

3.1.2 Setpoint Changes

There are many setpoint changes used in the RETRAN control systems documented in this revision due to revised Technical Specifications. DPC will use setpoints which have been approved by the NRC.

3.1.3 Revised RETRAN Plant Models

Modeling upgrades were made in the (1) pressurizer model, (2) two-phase modeling, and (3) feeding steam generator (FSG) model. The addition of the FSG model and changes necessitated in associated components were also presented in this revision.

3.2 Description and Qualification of Revised Models

Pressurizer Model

The pressurizer vessel model was modified to include heat conductors using the local conditions heat transfer model. The pressurizer level is computed in the RETRAN control system whose modeling simulates the actual plant function.

Phase Separation

The bubble-rise model was used to simulate the two-phase separation in components where two-phase liquid is expected. The bubble rise velocity and gradient are specified. This option is specified instead of the homogeneous equilibrium model in the primary system volumes stated in the revision. As long as the primary system remains subcooled, the option is not activated. However, in the event that subcooling is lost, with the exception of the pressurizer, DPC should submit justification to the staff that use of this option is appropriate and will result in conservative predictions.

Steam Generator Replacement

The description of the B&W FSG is provided. Due to the design differences, the FSG nodalization is slightly different from the pre-heater SG nodalization. Although there is no transient data to qualify the adequacy of the nodalization, DPC provided a comparison of RETRAN-computed SG mass and level with the vendor-computed data and obtained good agreement. Similarly, DPC provided a comparison of RETRAN-computed RCS hot and cold leg temperatures given a specified RCS flow and steamline pressure with the vendor predictions. The comparison indicated that the heat transfer of the FSG was predicted well with the RETRAN model. Based upon these comparisons, it was concluded that the feeding SG nodalization and model are acceptable.

4.0 CONCLUSION AND LIMITATIONS

The DPC Topical Report DPC-NE-3000, Revision 1, and the DPC responses to NRC requests for additional information were reviewed.

The licensee's revised RETRAN models for the McGuire, Catawba and Oconee stations are acceptable for applications to 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 set forth in the SERs on DPC-NE-3001 and DPC-NE-3002 (References 4 and 5). Furthermore, acceptability does not remove limitations and restrictions set forth in the SER on the original DPC-NE-3000 for those issues not impacted by the subject revision.

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Date: December 27, 1995

REFERENCES

1. Letter from H. B. Tucker (DPC) to NRC, Attachment "DPC-NE-3000 Revision 3" August 9, 1994.
2. DPC-NE-3000, "Thermal-Hydraulic Transient Analysis Methodology" original version July 1987, the approved version (DPC-NE-3000PA dated August 1994) submitted by letter from M. S. Tuckman, DPC, to NRC, dated August 8, 1995.
3. Letter from M. S. Tuckman (DPC) to NRC, "Request for Additional Information Relative to DPC-NE-3000P, Revision 1; Responses to Questions" September 12, 1995.
4. DPC-NE-3001P, "Duke Power Company Multidimensional Reactor Transients and Safety Analysis Physics Parameters Methodology," January 1990.
5. DPC-NE-3002, "FSAR Chapter 15 System Transient Analysis Methodology" Revision 1, November 1994.