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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 76 TO FACILITY OPERATING LICENSE NO. NPF-41,

AMENDMENT NO. 62 TO FACILITY OPERATING LICENSE NO. NPF-51,

AND AMENDMENT NO. 48 TO FACILITY OPERATING LICENSE NO. NPF-74

ARIZONA PUBLIC SERVICE COMPANY, ET AL.

PALO VERDE NUCLEAR GENERATING STATION, UNIT NOS. 1, 2, AND 3

DOCKET NOS. STN 50-528, STN 50-529, AND STN 50-530

1.0 BACKGROUND

In a letter of March 30, 1993 (Ref. 1), Arizona Public Service Company (APS) requested U.S. Nuclear Regulatory Commission (NRC) review of Supplement 1-P to Enclosure 1-P to LD-82-054, "System 80™ Inlet Flow Distribution." Enclosure 1P to LD-82-054, "Statistical Combination of Uncertainties - of System Parameter Uncertainties in Thermal Margin Analyses for System 80™," is used to calculate the departure from nucleate boiling ratio (DNBR) for Palo Verde Nuclear Generating Station (PVNGS) units. This method has been reviewed and approved by the NRC.

Supplement 1-P to Enclosure 1P to LD-82-054 describes a revised System 80™ core inlet flow distribution for use with ABB-CE Statistical Combination of Uncertainties (SCU) methodology for assessing core thermal margin. The revised core inlet flow distribution and the associated uncertainties are the result of re-evaluating the System 80™ reactor flow model data. The re-evaluation treats the core inlet flow distribution data in a statistical manner, as opposed to the deterministic method currently used. The objective of the revised methodology is to reduce conservatism in the current deterministic approach to gain additional calculated core thermal margin.

The report summarizes the current deterministic method of treating the core inlet flow data as an introduction to the revised methodology. The geometric features of the core lower support structure are described in relation to their possible impacts on core inlet flow distribution. Based on these features, the core inlet plane is regionalized to account for potential differences in inlet flow rates. The System 80™ flow model data is then used to determine the core inlet flow factors and their uncertainties for the core inlet regions. A statistical test is applied to the resulting core inlet flow factors to support the hypothesis that the selected regions have separate, distinct core inlet flow factors.

2.0 INTRODUCTION

By letter dated January 20, 1994 (Ref. 2), the Arizona Public Service Company (APS or the licensee) submitted a request for changes to the Technical Specifications (TS) for the Palo Verde Nuclear Generating Station, Units 1, 2, and 3 (Appendix A to Facility Operating License Nos. NPF-41, NPF-51, and NPF-74, respectively). The Arizona Public Service Company submitted this request on behalf of itself, the Salt River Project Agricultural Improvement and Power District, Southern California Edison Company, El Paso Electric Company, Public Service Company of New Mexico, Los Angeles Department of Water and Power, and Southern California Public Power Authority. The proposed changes would increase the DNBR limit from 1.24 to 1.30 to accommodate the uncertainties in core inlet flow distribution. The proposed amendment also adds the analytical method supplement entitled "System 80™ Inlet Flow Distribution" to the list of methods used to determine core operating limits.

3.0 EVALUATION

APS currently uses a deterministic method to account for the inlet flow distribution and associated uncertainties in thermal margin analysis. The revised approach applied to determine the System 80™ core inlet flow distribution is to identify regional flow factors based on the assumption that the inlet flow for groups of assemblies is determined by some common relationship to the upstream flow geometry. It consists of the following steps:

- Define geometric features in the reactor vessel which influence the core inlet flow distribution.
- Examine the core inlet flow distribution data to identify regions which have similar inlet flow factors, and categorize those regions.
- Determine the mean inlet flow factor and standard deviation of the flow factors for each region.
- Test the null hypothesis that the mean inlet flow factor values for two regions are from the same population. If that hypothesis can be rejected at a significance level of 5% for an equal-tails test, assume that the mean flow factors for the two regions are distinct values.
- Repeat the test pairwise for each of the regions that have been identified.

Using this approach, six different regions each with its own mean value and standard deviation for inlet flow factors are identified in Table 3-2 (Ref. 1). The licensee's report concludes that these revised flow factors along with the sample standard deviations of the flow factors are a valid set to be used for future System 80™ thermal margin licensing analyses.

For the System 80™ plants, the current SCU methodology treats the core inlet flow distribution in a deterministic manner. As a result of the reassessment of the System 80™ core inlet flow distribution, the core inlet flow distribution and its associated uncertainties will be treated in a statistical manner.

The system parameter SCU methodology consists of developing a minimum departure from nucleate boiling ratio (MDNBR) response surface which provides the functional relationship between the dependent variable, MDNBR, and the independent system parameter variable. The response surface is used to combine the probability density functions (PDFs) or the uncertainties associated with each of the independent variables into a resultant DNB PDF. The DNB PDF is then used to determine the MDNBR value at the 95% probability and 95% confidence levels.

The 95/95 SCU MDNBR limit is used in conjunction with a best estimate thermal margin model to assess margin to the DNBR limit.

With respect to the System 80™ SCU methodology described in NUREG-0852, Supplement 2 (Ref. 3), the revised core inlet flow distribution approach will involve the following changes:

- The sensitivity of DNBR with respect to inlet flow factor will be determined for the limiting assembly and adjacent assemblies. These sensitivities will then be used with the appropriate inlet flow factor uncertainties to calculate an overall root-sum-square system parameter uncertainty, using the method presented in Section 5.3 of "Statistical Combination of Uncertainties, Combination of System Parameter Uncertainties in Thermal Margin Analyses for Arkansas Nuclear One Unit 2" (Ref. 4).

- This approach will yield an increased MDNBR limit which will include allowances for uncertainties in hot assembly and adjacent assembly inlet flow. The increase in MDNBR limit can be accommodated directly by increasing the limit, or by applying a thermal margin penalty.

APS has proposed (Ref. 2) to increase the MDNBR limit from 1.24 to 1.30 to accommodate the uncertainties in the core inlet flow distribution.

Reference 1 has proposed a set of factors to construct a best estimate core thermal margin model. Uncertainties in inlet flow to the hot assembly and adjacent assemblies can be accounted for statistically by either increasing DNBR or applying a thermal margin penalty using approved SCU methods. Uncertainties in inlet flow have been treated statistically, using these methods (Ref. 4) and have been previously approved by the staff for other Combustion Engineering plants.

The licensee has proposed to implement the uncertainties associated with core inlet flow distribution by increasing the MDNBR from 1.24 to 1.30. The basis for this increase is provided in References 2 and 5. This has been reviewed

by the staff and is acceptable for use in Palo Verde Units 1, 2, and 3. The staff finds the technical specification changes proposed in Reference 2 to be acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Arizona State official was notified of the proposed issuance of the amendments. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and change surveillance requirements. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding (59 FR 12358). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

1. Letter from W. F. Conway (APS) to Document Control Desk (NRC), "Supplement 1-P to Enclosure 1-P to LD-82-054," March 30, 1993.

2. Letter from W. F. Conway (APS) to Document Control Desk (NRC), "Proposed Amendment to Technical Specification Sections 2.1.1.1, 2.2.1, and 6.9.1.10," January 20, 1994.

3. NUREG-0852, Supplement 2, CESSAR System 80™ SSER 2, September 1983.

4. "Statistical Combination of Uncertainties, Combination of System Parameter Uncertainties in Thermal Margin Analyses for Arkansas Nuclear One Unit 2," CEN-139(P), November 1980.

5. "Presentation to NRC on Impact of Improved Inlet Flow Distribution on the CPCS," CEN-424(v)-P, October 1993.

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Date: May 26, 1994