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

March 4, 1981

Docket Nos. 50-368
and 50-313

Mr. William Cavanaugh, III
Vice President Generation and Construction
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P. O. Box 51
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Dear Mr. Cavanaugh:

We have reviewed the report "Qualification of Reactor Physics Methods for Application to Pressurized Water Reactors of the Middle South Utilities System" submitted with your letter dated September 19, 1980. We find that we need the additional information requested in the enclosure in order to complete our review.

We understand that the first application of these physics methods will not be to the ANO-2 Cycle 2 Spring 1981 startup as discussed in your September 12, 1980 letter. Accordingly we do not consider that matters identified in the review of this report necessarily require resolution to support the ANO-2 Cycle 2 startup. We request that you identify a schedule for your response to the enclosed questions and an identification of your first planned application of this report to ANO-1 and/or ANO-2.

Sincerely,

Robert A. Clark

Robert A. Clark, Chief
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Division of Licensing

Enclosure: As stated

cc: See next page

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FEB 24 1981

REQUEST FOR ADDITIONAL INFORMATION
QUALIFICATION OF REACTOR PHYSICS METHODS FOR APPLICATION TO PRESSURIZED WATER REACTORS OF THE MIDDLE SOUTH UTILITIES SYSTEM

REPORT NO. MSS-NA1-P
(TACS 42982)

Review of the applicant's submittal dated September 19, 1980 on the "Qualification of Reactor Physics Methods for Application to Pressurized Water Reactors of the Middle South Utilities System" MSS-NA1-P, showed that more information is required in order for us to complete the review. The subject report deals with the determination of calculational uncertainties and the resultant reliability factors associated with the reactor physics model. There are three PWRs to which this methodology will be applied.

In particular the subject report gives an overview of the calculational model and the determination of the model uncertainty and reliability. The model then is applied to reactor operations and to safety evaluations. The reactor operations includes startup physics tests and power distribution measurements. The safety evaluation includes nuclear heat flux and enthalpy rise hot channel factors, rod worths, shut down margin and reactivity coefficients. The report contains two parts referring respectively to ANO-1 Unit 1 and Unit 2 benchmarking.

A number of specific questions have been brought forth in the review and the following additional information is required:

1. In the expression for σ^2_{OBV} the total observed uncertainty (p. 3-5) the independence of the calculated uncertainties for rod worth σ_R and the boron coefficient σ_B has not been established. Note that both quantities are calculated using PDQ-07. What is the basis for the assumption of σ_R and σ_B independence?

2. On p. 3-10 and 3-11 it is stated that NAI "performed an evaluation of the comparisons of measured and calculated ITC's... The resulting data base..." Does this paragraph mean that some "data conditioning" or "data selection" was performed? Give more details on the data evaluations referred to above.

3. One Kewaunee comparison for the isothermal temperature coefficient (-7.2 pcm/°F) has been deleted and the deletion was justified on the basis that the value is four standard deviations from the Kewaunee mean using the pooled estimates of the variance.

   (a) Measurement cannot be rejected on the basis of statistical arguments;

   (b) at this point the poolability of the data has not been established; and

   (c) the value is only about two deviations from the Kewaunee mean using the Kewaunee estimate of the variance.

Discuss the suspected measurement error. How would this value affect the reliability factor if it was left in the pooled data?

4. The Isothermal Temperature Coefficient data base listed in Table 3.5(a) includes comparisons from Kewaunee, Beaver Valley, ANO-1 and ANO-2. These plants represent a Westinghouse 2-Loop, Westinghouse 3-Loop, B&W, and Combustion plants respectively. Address the issue of data poolability in view of the plant design diversity.

5. The presence of a boron dependent bias in the pooled data for the isothermal temperature coefficient appears to indicate that spectral effects are not being fully accounted for by the calculational model or calculational procedures (Section 3.2, P. 3-10). Has this point been investigated before the bias factor was absorbed in the calculational methodology?

6. On p. 3-11 using the data of Table 3.5(b) a statistical equivalency test is performed on Kewaunee and ANO-1 data. Given that the ANO-1 has only two entries, comment on the validity of such a statistical test.

7. In view of the lack of measurements, demonstrate that a 10% reliability factor for the Doppler coefficient is conservative (Section 3.3, p. 3-16).

8. Referring to Figures 3.4-3.6 and Table 3.6 on the isotopic comparisons it is not clear whether or not the applicant performed the indicated calculations, hence, demonstrating his capability of using the EPRI-CELL, CPM and the ARMP codes. Did the applicant perform the calculations indicated on Figures 3.4-3.6?

9. What adjustments were made to the EPRI-CELL code to match CPM? (Section 3.4, p. 3-17)?

10. Uncertainties in the spatial nuclide inventory calculation involve uncertainties in the local inventory computation as well as uncertainties in the computation of the spatial burnup distribution (Section 3.4, p. 3-17; Section 4.3, p. 4-5). The uncertainty in the local inventory computation has been dealt with in Section 3.4. Establish the uncertainty in the computation of the spatial burnup distribution.

11. Uncertainty (b) in the calculation of the spatial nuclide inventory (Section 3.5, pp. 3-22 and 3-24) is only partially addressed in Section 3.4. What is the value of the uncertainty in the spatial nuclide inventory when the uncertainty in the spatial burnup distribution is accounted for?

12. What are the one-sided tolerance factors used when relating the uncertainties in B and ℓ to the corresponding reliability factors? (Section 3.5, pp. 3-24 and p. 3-25)

13. It is stated on p. 3-26 for the power distribution uncertainty as measured by the Rh self powered detectors that "the signals from these detectors are corrected by the on-site process computer... These corrected signals, or reaction rates..."

    (a) Usually the process computer will process the Rh detector signals in a manner which will account for detector sensitivity, depletion, leakage etc.

    (b) The process computer will determine a quantity which represents the reaction rate.

    In view of the above comments, explain whether further corrections to the Rh signals have been applied and what corrections were they?

14. The reaction rate to power density conversion factors are calculated for each assembly as a function of exposure using a 2D PDQ model. In view of the discussion of power distribution reliability factors presented in Section 3.7, p. 3-109, how are axial effects for these factors accounted for?

15. Axial power shapes are shown at locations D10, B8, and R4 (Figures 3.12 through 3.38). Explain why no distributions are shown for central or near central locations. Show some axial power shapes of central locations and describe the normalization to plant measurements and PDQ.

16. On page 3-32 it appears that "the simulation errors" are due to (a) input errors and (b) approximations in the representation of a given state point. Describe in detail the errors implied by the term "simulation error".

17. How are errors associated with asymmetries (e.g. asymmetric fuel burnup distributions) accounted for in the model uncertainty analysis and in the core monitoring system uncertainties? (p. 3-34)

18. In view of the systematic pattern of errors shown in Tables 3-10, 3-11, and 3-12, how is detector intercalibration maintained? Is there a cycle or exposure dependent method used in correcting possible drifts away from intercalibration, and if so, please describe it.

19. It is stated on p. 3-37 and 3-38 that hardware problems in Cycle 1 led to the elimination of Cycle 1 data from inclusion in estimating an axial level dependent mean difference for ANO-1 (Table 3-18, Figure 3.40, p. 3-85, 86). This suggests that there should be a large uncertainty in the bias. With respect to the data included in Table 18, on what basis is it concluded that the differences between Cycle 1, Cycle 2, and Cycle 3 are due to hardware problems and how is it insured that they are specific only to Cycle 1?

20. What is the mechanism or phenomena responsible for the axially varying reliability factor (RF)? Why does ANO-1 require an axially varying RF, while ANO-2 does not? Is the axial variation cycle dependent?

21. Discuss the effects caused by the nodal code albedo selection, calibration errors and crud buildup on the axial dependence of the reliability factor.

22. With regard to the pooling of statistics, the discussion on the application of the Barlett Test is not clear in the light of Figures 3.40 and 3.41. Discuss the basis for pooling the statistics in Tables 3-13 to 3-17 in view of the fact that the data failed the Barlett Test. Supply curves similar to Figure 3.41, separately for cycles 1, 2, and 3.

23. The large differences in the statistics between Cycle 1 on one hand and Cycle 2 and 3 on the other suggest that they are being drawn from different populations. Justify, therefore, the use of a one-sided tolerance factor corresponding to over 1300 data points of 1.71 (p 3-110).

24. In the equation on page 4-4, what one-sided tolerance factor will be used with the uncertainty fraction? Does the (ANO-2) 2.2% uncertainty fraction include the uncertainties resulting from the extrapolation to unmonitored locations and other Process Computer approximations not accounted for in the model error? What is the uncertainty factor to be used in F_Q?