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

April 23, 1981

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U.S. NUCLEAR REGULATORY COMMISSION

Docket No. 50-368

Mr. William Cavanaugh, III
Senior Vice President
Energy Supply Department
Arkansas Power & Light Company
P. O. Box 551
Little Rock, Arkansas 72203

Dear Mr. Cavanaugh:

The staff, using technical assistance resources provided by the Battelle Pacific Northwest Laboratories, has reviewed your December 1, 1980 submittal of CEN-139, "Statistical Combination of Uncertainties" in support of the ANO-2 Cycle 2 reload and has identified a need for additional information as set forth in the enclosure. These questions are numbered sequentially to earlier questions on the ANO-2 Reload which were transmitted to you by our letter of April 1, 1981.

Please contact us if you have questions regarding the items noted in the enclosure.

Sincerely,

Robert A. Clark

Robert A. Clark, Chief
Operating Reactors Branch #3
Division of Licensing

Enclosure:
As stated

cc: See next page

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cc:

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QUESTIONS ON ANO-2 CYCLE 2 RELOAD

Thermal Hydraulics Section
Core Performance Branch, DSI

The following first round questions, endorsed by NRC for the Arkansas Nuclear One, Unit 2 (ANO-2) reload, were prepared by our technical assistance contractor, the Pacific Northwest Laboratories of Battelle. These questions are on the ANO-2 report, CEN-139(A)-P, "Statistical Combination of Uncertainties," dated November 1980. CEN-139(A)-P is similar in content to the Calvert Cliffs report, CEN-124(B)-P, "Statistical Combination of Uncertainties," Part 2, January 1980 except for plant specific items. Questions on CEN-124(B)-P were sent previously and are referenced in these new questions for ANO-2 because of their relevancy.

492.38 Is there a typographical error in the fifth paragraph of Section 3.0? The statement "system parameters define the operational state of the reactor...." must be incorrect.

492.39 Many of the questions we asked as a result of our initial review of CEN-124(B)-P, Part 2, had to do with the [illegible]olution of state parameters. The answers to the questions clar[illegible]ed many of the points, but some do remain, namely:

(a) Question 3 refers to pp. 3-3 to 3-5 and the discussion of how the most adverse state parameters are derived from the information in Tables 3-3, 3-10, and 3-7. The response to the question helps to clarify the procedures used, but it does not quite address the central problem that caused the question to be raised in the first place. We would, therefore, like to rephrase the question as follows:

On p. 3-5, in Section 3.1.5, the report states that magnitude and impact of a specific system parameter uncertainty on MDNBR exceed those of the other system parameters. Therefore the ASI and T_{in} which tend to maximize MDNBR sensitivity to this parameter are used to generate the response surface. The discussion in Sections 3.2 through 3.8 does not explain how it was determined that this uncertainty was the most important of the system parameters affecting MDNBR. Please clarify.

(b) From Table 3-4 on p. 3-22 of CEN-124(B)-P, Part 2, it appears that the enthalpy rise factor effects on MDNBR are very sensitive to the axial shape index. The largest ASI which produces the largest percent change in MDNBR at nominal operating conditions is identified. But this ASI value is not used in Table 3-5, which determines the operating conditions (pressure, inlet temperature, and percent design flow rate) at which MDNBR is most sensitive to enthalpy rise factor effects. Please explain the logic behind this.

(c) In Section 3.1.1, page 3-3 of the ANO report it is stated that MDNBR is a smoothly varying function of the state parameters. However, the data presented in Tables 3-2, page 3-16, do not support that conclusion. This can be seen if you plot the data in Table 3-2. MDNBR for both the advantageous and adverse perturbations changes very rapidly as ASI changes from 0.317 to 0.337.

The behavior of MDNBR in this region makes your selection of the most adverse ASI questionable. Hypothetical values of MDNBR evaluated at points intermediate between those given in the report are consistent with the rest of the data, yet could lead to a percent change larger than the maximum value identified.

An explanation of what axial flux shapes were used and why, together with a rationale as to why specific axial shapes have such a marked change in MDNBR, would be helpful.

(d) The selection of the most sensitive pressure and temperature in Section 3.1.3 refers to Table 3-3 for support. However, half of the data (the high temperature data) in Table 3-3 was not used because quality limits were exceeded. The effect of this is that Table 3-3 contains no information on the variation of MDNBR with temperature. If the high temperature was too extreme, an intermediate point should have been examined.

492.40 Section 3-2, Radial Power Distribution, needs support and justification. If this were handled in the same manner as outlined in CEN-124(B)-P, Part 2, and in the answers submitted to questions concerning this point, it should be adequate.

492.41 Section 3-3, Inlet Flow Distribution, states that "a large part of the uncertainty in the flow splits results from measurement uncertainty. This measurement uncertainty is considered random and may be characterized by a normal probability distribution function (p.d.f.)." What is the p.d.f (mean and standard deviation) and what is its source? It is possible to quantify the assumption that the distribution is normal?

492.42 Paragraph 3-4 of the ANO report states that the exit pressure distribution has little or no affect on MDNBR. Justification, at least a reference, should be provided.

492.43 Paragraphs 3-5 and 3-6 point out that as-built data and tolerance deviations were used to evaluate the enthalpy rise factor. How are the variations in the deviations combined into the standard deviation of the rise factor? These combination techniques are standard, but they should be identified.

492.44 How is the systematic pitch reduction given in paragraph 3-8 used. Presumably it must enter into the enthalpy rise factor and into the equivalent diameter in the OMB correlation. Is this true?

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492.46 Paragraph 3-1 states that since TORC code is used to calculate local coolant conditions to develop the CE-1 CHF correlation. "Any calculational uncertainty in the TORC code is implicitly included in the MDNBR limit that is used with the TORC/CE-1 package." This was questioned during the initial review and the responding answer only partly allays our concerns. A more detailed expression of our question (letter, G. M. Hesson (Pacific Northwest Laboratories, to Distribution, March 20, 1981) is enclosed for this discussion. Provide a response to the topics discussed in the attached memorandum.

492.47 In Section 5-2, page 5-2, it is claimed that Figure 5-1 indicates that the MDNBR p.d.f approximates a normal distribution. Thereafter, the document proceeds as if the MDNBR p.d.f were in fact a normal distribution. Figure 5-1 presents a qualitative comparison and does not provide sufficient grounds for accepting the hypothesis of a normal distribution. There are quantitative tests of that hypothesis (e.g., a Kolmorgorov-Smirnov test or a X^2 test) that could be used. Provide justification for treating the p.d.f as a normal distribution.