JUN 2 3 1980

MEMORANDUM FOR: Laurence I. Kopp, Core Performance Branch, Division of Systems Safety, NRR

FROM: Lee R. Abramson, Acting Chief, Applied Statistics Branch, MPA

SUBJECT: EXXON NUCLEAR RESPONSE TO NRC REQUEST FOR INFORMATION ON "UNCERTAINTY ANALYSIS FOR THE MEASURED RELATIVE POWER DISTRIBUTION", XN-NF-79-6(P).

I have reviewed Exxon's response to my preliminary review of the subject document (memo to Bob Schemel, January 7, 1980) and find that they have missed the point. Exxon argues that the test for normality is carried out simply to confirm the model assumption of normality, whose validity they see no reason to question. While a model assumption of overall approximate normality (nothing in the real world is exactly normal) may or may not be reasonable, it is the normality of the tails which is at issue. The desired tolerance limits refer to the behavior in the tail of the distribution, and this might differ significantly from normality, even if the distribution as a whole passes a test for normality. For example, from Table 4.5 of XN-NF-76-6(P), there are 19 observations greater than 4.0, as compared with an expected number of about 14. The possible significance of this result is swamped by the good fit of the remainder of the observations. What is needed here is a method of calculating tolerance limits which will not be invalidated by departures from normality in the tails*. It is for this reason that I suggested using nonparametric tolerance limits.

Another potential problem which was not addressed in my preliminary review relates to the pooling of data. From Table 4.11 of XN-NF-79-6(P), the degrees of freedom associated with the estimates of the relative standard deviations are quite large. This suggests that data from a number of experiments was pooled to arrive at each of the estimates. If this was the case, then the pooling must be justified, i.e., it must be shown that the data from the various experiments being pooled must all have approximately the same distribution.

*See James V. Bradley, Distribution - Free Statistical Tests, Prentice-Hall, 1968, for a Monte Carlo investigation of distributions which are normal except for a slight departure from normality in the tails. Bradley shows that the results of normal-based statistical tests of such slightly contaminated distributions can lead to unpredictable gross errors.

OFFICE ▶						RDS ENCL
SURNAME ▶						
DATE ▶						

NRC FORM 318 (9-76) NRCM 0240 ★ U.S. GOVERNMENT PRINTING OFFICE: 1976 - 265 - 769

Specific comments on the Exxon responses are as follows.

A2. It is not a minor point to make a distinction between mathematical equality and an approximation. If an approximation is being used, then it is essential to verify that the error in the approximation is not so large as to invalidate the approximation. This is best done by carrying an error term along in the calculations and then using a bounding argument to show that the error is sufficiently small.

The point about a mathematical model being only an approximation to the real world is irrelevant. What is being discussed here is the proper analysis of the mathematical model.

A3. What is needed here, and what is meant by a detailed mathematical model, is an explicit representation of the "true" values, the measured values and the relations among them.

A4. The Exxon assertion about the normality of a mixture is incorrect for the case at hand. In order for a mixture of normals with fixed means and with the same variance to be normal, they must all have the same mean. If the mean of each subpopulation is itself an observation on a normal distribution and if there is only one observation on each subpopulation, then the resultant mixture is again normal. However, if there is more than one observation on any subpopulation, which is certainly the case here, then the resultant mixture is not normal.

Furthermore, I question the appropriateness of considering the means of the subpopulations as random variables. If the means correspond to different reactors or different fuel regions, it is not clear that it is appropriate to average over the reactors or the fuel regions, which is what the modeling of the means as random variables is tantamount to.

The Exxon response and the unresolved questions which it raises are an excellent example of the confusion that can result in the absence of an explicit model.

A6. Exxon's comments are correct. Q6 should have referred to Page 31, not Page 26.

A7. For the reasons discussed above, I consider any normal-based tolerance limits as unjustified. It is essential that nonparametric tolerance limits be used.

Please call me at x27806 if you have any questions.

Original Signed by

Lee R. Abramson, Acting Chief
Applied Statistics Branch
Office of Management and Program Analysis

cc: H. S. Bassett, MPA
N. M. Haller, MPA
R. Schemel, NRR

DISTRIBUTION:
Central Files
ASB Reading
ASB Subject
LRAbramson (3)

OFFICE	ASB/MPA					
	x27851:tsb	LRAbramson				
SURNAME						
DATE	6/23/80	6/23/80				