Tera

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

OCT 18 1979

Mr. James H. Taylor
Manager, Licensing
Babcock & Wilcox Company
Nuclear Power Generation
P. O. Box 1260
Lynchburg, Virginia 24505

Dear Mr. Taylor:

SUBJECT: EVALUATION OF INTERIM PROCEDURE FOR CALCULATING DNBR REDUCTIONS DUE TO ROD BOW

We have completed our evaluation of your report entitled "Determination of the Fuel Rod Bow DNB Penalty" (Reference 2). We have determined that the proposed method described in this report, as modified by the information provided in References 4 and 5, is acceptable for use in licensing calculations. A summary of our evaluation is enclosed.

If our criteria or regulations change, such that our conclusions concerning this report are invalidated, we will notify you and provide you with an opportunity to revise and, if you desire, resubmit this report for our review.

In your letter of March 27, 1979 (Reference 4), you requested that Appendix A, "The Analysis of the Bowed and Unbowed CHF Test Data," be withheld from public disclosure pursuant to 10 CFR 2.790. In support of this request, you submitted an affidavit with your letter of March 27, 1979, which contained statements as to the reasons for withholding this information from public disclosure. We have reviewed your application and material based on the requirements and criteria of 10 CFR 2.790 and have determined that the above-mentioned document sought to be withheld contains trade secrets or confidential or privileged commercial or financial information. We also have found at this time that the right of the public to be fully apprised as to the bases for and effects of the proposed licensing action does not outweigh the demonstrated concern for protection of your competitive position. Accordingly, we have determined that the information should be withheld from public disclosure. We therefore approve your request for withholding pursuant to 10 CFR 2.790 and are withholding Appendix A from public inspection as proprietary.

Withholding from public inspection shall not affect the right, if any, of persons properly and directly concerned to inspect the documents. If the need arises, we may send copies of this information to our consultants working in this area. We will, of course, assure that the consultants have signed the appropriate agreements for handling proprietary data.

1229 164

7910300 359 C

If the basis for withholding this information from public inspection should change in the future such that the information could then be made available for public inspection, you should promptly notify the NRC.

Sincerely,

L. S. Rubenstein, Acting Chief
Light Water Reactors Branch No. 4
Division of Project Management

Enclosure:
As stated

cc: Mr. Robert B. Borsum
Babcock & Wilcox Company
7735 Old Georgetown Road
Bethesda, Maryland 20014

1229 165

References

1. Letter from D. B. Vassallo, USNRC, to J. H. Taylor, B&W, June 12, 1978.

2. Letter from J. H. Taylor, B&W, to D. B. Vassallo, USNRC, December 13, 1978.

3. Letter from S. A. Varga, USNRC, to J. H. Taylor, B&W, March 12, 1978.

4. Letter from J. H. Taylor, B&W, to S. A. Varga, USNRC, March 27, 1979.

5. Letter from J. H. Taylor, B&W, to S. A. Varga, USNRC, June 22, 1979.

ENCLOSURE

The reduction of fuel rod spacing due to fuel rod bowing has been shown experimentally to result in a reduction in the departure from nucleate boiling ratio (DNBR). The magnitude of this reduction in DNBR is a function of the closure of the gap between adjacent fuel rods. Babcock & Wilcox performed a series of experiments in which the spacing was reduced to 55% of the nominal. The conclusion drawn from these experiments by B&W was that at this spacing, no reduction in DNBR occurs.

This conclusion was used by B&W in a suggested staff procedure adopted by B&W for calculating the reduction in the DNBR safety limit for a reactor core. B&W presented their analysis in Reference 2.

We reviewed this procedure and the accompanying data (as presented in References 2 and 4). It was our conclusion from this review that upon statistically testing the hypothesis that there was a DNBR reduction at 55% closure, the hypothesis could not be rejected at a 95% confidence level; that is, there appeared to be a reduction in DNBR at 55% gap closure.

After discussions with B&W, B&W proposed a statistical procedure to account for the fact that there was a non-zero probability of a DNBR reduction at 55% gap closure. This procedure is described in Reference 3. The procedure is illustrated in Figure 1. Rather than drawing a line from the DNBR reduction resulting from 100% closure to a zero reduction in DNBR at 55% (the dotted line in Figure 1), a finite reduction in DNBR is calculated at 55% gap closure based on the difference between the means of the data from the bowed bundle (C10) and the similar unbowed bundle (C9). Including this effect, as can be seen by the solid line in Figure 1, results in the DNBR reduction being predicted to become non-zero at a gap closure of less than 55%. This analysis does not take into account the variation of all the critical heat flux data submitted by B&W in Reference 4, it only compares CHF data from bundle C9 (unbowed) with CHF data from bundle C10 (bowed). Thus, the analysis is not as conservative as it could have been, but it is our judgement that the B&W procedure is sufficiently conservative for licensing calculations.

Applying the B&W procedure results in a reduction in DNBR at a bundle average burnup of 33,000 Mwd/MTU (a typical end-of-life burnup) of 4.8%. B&W did not discuss generic margins which may be available to offset this DNBR reduction. We, therefore, expect that any margins available to offset this DNBR reduction will be addressed on each reload submittal, if desired.

It should also be noted that the CHF data presented by B&W in Reference 4 was used only to establish a threshold for an amount of fuel rod bowing at which there would be a DNBR reduction. To accomplish this, only the variation of the data was required, the critical heat flux values were not used. The data are presently being reviewed by the staff and the use in the context of fuel rod bowing does not imply acceptance by us of the data or the resulting BWC correlation for other applications.

Conclusion

The procedure suggested by Babcock & Wilcox in Reference 2 and modified in Reference 5 for calculating the reduction in DNBR due to fuel rod bowing is acceptable for licensing calculations. Acceptance of this procedure does not imply acceptance of the CHF data or the BWC correlation for other applications. This is still under review by the staff.

Any margins used to offset the reduction in DNBR due to fuel rod bowing should be discussed in the individual reload or OL applications.

IGURE 1

NEW B&W CURVE FOR REDUCTION IN
DNBR DUE TO FUEL ROD BOWING