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September 3, 1982

Mr. John S. Berggren
Standardization and Special Products Branch
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Berggren:

Enclosed are 35 copies of B&W's response to three questions on BAW-10150, "Control Rod Assembly Ejection - Analyses of the CRA Accident in B&W Pressurized Water Reactors, January 1982."

The questions were sent to us by your office 5/24/82 as Request No. 1 for Additional Information on BAW-10150.

Yours very truly,

J. H. Taylor
Manager, Licensing

JHT/fw
cc: R. B. Borsum - B&W Bethesda Office

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QUESTION 1.

In the past, B&W has indicated that event induced errors in the neutron flux detector readings, and thus, effective flux trip levels, could be larger for some events than those normally assumed in analyses. One such event was the CRA ejection where the error arises from the change in power distribution caused by the ejected rod making the effective power level as seen by the flux detector different from the average used in the point kinetics analyses. Situations could, therefore, arise in which low rod worth ejections may not cause a flux trip. B&W has stated, on the basis of engineering judgment, that, if heat transfer out of the fuel pin during the transient were included in the ejection analysis, the power and peaking increases for the range of reactivity insertion that might not cause flux trips would not result in peak enthalpies exceeding limits (280 cal/gm). Please justify this position quantitatively by presenting results using the CADDS/LYNXT method with detailed fuel thermal-hydraulic analysis for a low worth CRA ejection where a flux trip would not occur.

RESPONSE

Babcock & Wilcox is currently evaluating the system and fuel response to the low worth rod ejection accident. Preliminary LYNXT thermal-hydraulic results indicate significant voiding which is not accounted for in the conservative point kinetics CADDS model. These conservative assumptions include:

- The point kinetics model does not include a Doppler reactivity weighting factor.
- The reactivity feedback effects due to coolant voiding are not modeled.
- The high flux trip and the high and low pressure trip functions are assumed to be inoperative. The only available trip function is assumed to be the slow responding high outlet temperature trip.

Topical Report BAW-10150 describes the CADDS/LYNXT models to analyze large worth rod ejection accidents. The primary reactivity feedback mechanism during this very rapid transient is the fuel temperature (Doppler) feedback. The spatial effects are approximated by using a conservative reactivity weighting factor. Due to the expanded time frame of the low worth rod ejection accident, the moderator temperature and voiding feedback mechanisms become significant.

In order to account for these additional feedback effects, the three-dimensional spatial kinetics code BWKIN is being used to evaluate the transient power and peaking response. The results of this evaluation are expected to be available by January 1983.

Question 2.

Maximum fuel enthalpy comparisons between CADDS/LYNXT and current FSAR methods are shown in the report. How do these compare to BWKIN three-dimensional results?

RESPONSE

The comparison of the CADDS reactivity weighted point kinetics and BWKIN spatial kinetics total core power responses (Figures 4.4 and 4.5) shows that the BWKIN transient power response is much less severe than the CADDS transient power. The three-dimensional BWKIN results were used as a calculational benchmark to justify the conservative application of the Doppler reactivity weighting factor. The BWKIN/LYNXT maximum fuel enthalpy, therefore, would be less than the enthalpy obtained using the CADDS/LYNXT and the current FSAR methods.

Question 3

The BWKIN calculations used only one delayed neutron group whereas the CADDS model used six delayed neutron groups. How are the BWKIN results affected by the use of one rather than six delayed groups? How are the one or six delayed groups determined when there is an appreciable amount of U-235, U-238, and PU-241 present?

RESPONSE

The BWKIN one delayed neutron group model was conservatively selected based on a CADDS delayed neutron group model sensitivity study. The total effective delayed neutron fraction (β_{eff}) used in the BWKIN analyses was identical to the total β_{eff} of the 6-group CADDS model. The BWKIN one group decay constant of $\lambda = 0.3\ sec^{-1}$ was selected to yield a conservative transient power response in the 0 sec → 5 sec time frame, when compared with the 6-group model.

The concentration of the fissile isotopes varies as a function of burnup. The core average β_{eff} is determined by weighting the isotopic delayed neutron fraction by the respective fission rates to account for the varying isotopic concentrations of uranium and plutonium.