Review of BAW-10120P - "Comparison of Core Physics Calculations with Measurements."

Report Number:	BAW-10120P (Proprietary)
Report Title:	Comparison of Core Physics Calculations with Measurements
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Originating Organization:	Babcock & Wilcox
Reviewed by:	Core Performance Branch/Walter L. Brooks

The Power Generation Group of Babcock & Wilcox has submitted licensing topical report BAW-10120P entitled "Comparison of Core Physics Calculations with Measurements." The report describes the techniques used to measure various core parameters, discusses the accuracy of the measurements, and presents a comparison of measured values with those calculated by methods which have been described in other topical reports. BAW-10120P is one of a series of topical reports which have been submitted by Babcock & Wilcox in order to provide the staff with generic information on the nuclear design of B&W reactors.

Our review of the subject topical report follows.

1. Summary of Report

This report documents the techniques currently used to measure core physics parameters in B&W reactors, provides estimates of the uncertainties in the measurements and compares measured and calculated values of the various parameters. The parameters discussed in the reports are: control rod worths - individual (ejected) rods, individual bank, regulating banks and total worth, the all rods out boron concentration as a function of core life, and the moderator and fuel temperature coefficients.

For each parameter discussed the measurement technique is described (including the data analysis method), the measurement uncertainty is assessed, and comparisons are made between measured and calculated results. As a result of the comparisons values for calculational biases and uncertainties are obtained. Certain calculated values (e.g., rod bank worths) used in safety analyses are corrected by the biases but conservative values are employed for the uncertainties. For other parameters (e.g., moderator coefficients) conservative values are used in the safety analyses and the measurements are used to confirm their conservatism

2. Summary of Evaluation

We reviewed the description of the measurement techniques, the evaluation of measurement uncertainties, the comparisons between measurement and calculation, and the conclusion drawn from the comparisons. The following discussion summarizes our findings.

Reactivity measurements are made with the Babcock & Wilcox Reactimeter which uses periodic samples of neutron flux as input to the mono-energetic, point-reactor kinetics equations with six delayed neutron groups to compute the overall core reactivity. The algorithm employed in the Reactimeter is described and an analysis of the errors in the reactivity measurement is presented. The Reactimeter is similar in nature to other reactivity meters employed in the industry and we conclude that it is state-of-the-art and therefore acceptable.

Control rod worths are measured by boron swap, rod swap or rod drop techniques. These techniques are described and analyses performed of the uncertainties in the measurements. These techniques are standard ones used throughout the industry and are acceptable

Reactivity coefficients are determined directly by making a change in the appropriate parameter (moderator temperature, power, etc.) and measuring the resultant reactivity change. Reactivity changes are measured with the Reactimeter or by making compensating control rod changes on previously calibrated rods. The techniques are described and analyses are presented of measurement uncertainties. The techniques are state-of-the-art and are acceptable.

Comparisons are presented between calculated and measured values of rod bank worths, single rod worths, critical boron concentration, and reactivity coefficients. The calculations were performed for the same reactor conditions at which the measurements were made. In some cases earlier experimental values were reanalyzed using current analysis techniques.

The comparisons show that rod bank worths may be calculated to within the measurement uncertainty (about 7 percent). Single (ejected) rod worths tend to be overpredicted with the largest difference between prediction and measurement being 0.17 percent reactivity change. It should be noted that conservative values are used in the safety analyses rather than adding an uncertainty to the calculated value.

Critical boron concentrations are predicted to within 20 parts per million for cycles which contain no lumped burnable poison and to within 30 parts per million for cycles that contain lumped burnable poison. Reactivity coefficients are also predicted to within approximately the measurement error.

It should be noted that the measurements and calculations were performed for several Babcock & Wilcox reactors for up to three cycles of operations. Thus the conclusions are applicable for both first and succeeding cycles.

3. Evaluation Procedure

The review of topical eport BAW-10120P has been conducted within the guidelines provided by the Standard Review Plan, Section 4.3. Sufficient information is presented to permit a knowledgeable person to conclude that appropriate techniques have been employed to do the measurements, suitable analyses of the measurement uncertainty have been performed, and proper conclusions have been drawn with respect to calculational uncertainties and conservations.

4. Regulatory Position

Based on our review of licensing topical report BAW-10120P we conclude that it is acceptable for reference in licensing actions in regard to comparison of core physics calculations and measurements.