



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

ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATING TO EVALUATION OF RESPONSE TO NRC BULLETIN NO. 90-02  
PHILADELPHIA ELECTRIC COMPANY  
PEACH BOTTOM UNIT 2  
DOCKET NO. 50-277

1.0 INTRODUCTION

The licensee's response to NRC Bulletin 90-02, "Loss of Thermal Margin Caused by Channel Box Bow," issued March 20, 1990, was documented in the letter dated April 25, 1990, in which the licensee indicated that 59 channel boxes in the Peach Bottom, Unit 2 reactor core (Cycle 8) are being used for a second fuel bundle lifetime (Ref. 1). The response described the number and disposition of these channel boxes in the core, and described the actions taken to assure compliance with the technical specification thermal limits. The staff review of the April 25 submittal identified the need for additional information. Specifically, the staff requested that the licensee provide the data base on channel box bow versus exposure associated with the methods used to account for the effects of channel box bow on thermal margin during the second fuel bundle lifetime. The licensee responded in a letter dated August 3, 1990 (Ref. 2).

This safety evaluation covers the staff review of the Philadelphia Electric Company's reuse of channel boxes for the current cycle (Cycle 8) only.

2.0 EVALUATION

Fuel Channel Boxes Disposition in the Core

There are a total of fifty-nine (59) channel boxes being reused for a second fuel bundle lifetime in the reactor core at Peach Bottom Atomic Power Station (PBAPS), Unit 2, and their location in the core is shown in Figure 1 of Reference 1. The reused channel boxes were installed on unirradiated Reload No. 6 fuel bundles which were loaded into the reactor core for use in operating Cycle 7 at PBAPS, Unit 2. They are currently in the second cycle of their second fuel bundle lifetime (operating Cycle 8).

GE Methodology and Associated Data Base

General Electric performed a Cycle 8 specific calculation of the impact of channel box bow on CPR. To assure that current technical specification limits are met throughout the remainder of Cycle 8, an administrative control to limit the Maximum Fraction of Limiting CPR (MFLCPR) to less than or equal to 0.91 was established. This administrative control was determined by dividing the core

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into four bundle cells, each cell surrounding a control blade location. Those four bundle cells containing reused channel boxes were identified and checked to see if the limiting bundle in the cell was also in a reused channel box. Analysis by the licensee showed that none of the cells had limiting bundles in reused channels. The licensee also showed that the increased bow of the reused channel box did not cause a bundle in a reused channel box to become the limiting bundle in the cell.

The licensee provided the NRC staff with channel box bow data as a function of exposure. This data was comprised of measured and predicted (to end of Cycle 8) data for the bounding reused channels. Three channel boxes were singled out as being representative of minimum and maximum exposure data (Ref. 2). The channel box bow history for each of the three channel boxes was represented by three or four connected data points. The lowest exposure data is the measured value of channel box bow at the end of the first bundle lifetime. GE's channel box bow methodology was then applied to each channel box using each channel's actual operating history to predict the channel box bow at the end of the first bundle lifetime. The prediction was then normalized to the measured channel box bow at the end of the first bundle lifetime, and the prediction was then extended to the subsequent cycles, concluding with the end of Cycle 8. The remaining reused channels present in Peach Bottom Unit 2 Cycle 8, fall between the maximum and the minimum values.

To aid the NRC staff in evaluating this data, the staff correlated all of the channel box bow data available to it from fuel vendors and licensees. This bow data was usually in the form of scatter plots of channel bow as a function of burnup. The staff developed limiting curves for each data source. The data from all of the sources were plotted as limiting curves. This provided the NRC staff with a visual representation of all the limiting bow data as a function of exposure. The plots indicate that there is very good agreement among all the data especially within the constraint of the single bundle lifetime, which is taken to be approximately 38-40 GWD/MTu. That is, all of the data were consistent in magnitude and trends. In fact, from 0 to approximately 40 GWD/MTu, channel box bowing can be taken to be approximately linear. Beyond 40 GWD/MTu, data from all sources is sparse and consequently, viable data comparison is very difficult. However, the rate of bowing with exposure appears to increase sharply.

#### Conformance With CPR Technical Specifications

Since MFLCPR is the ratio of the TS MCPR limit to the actual operating value of MCPR, the TS MCPR limit is not exceeded as long as MFLCPR remains less than or equal to 1.0. The licensee incorporated the 0.91 MCPR adjustment factor into its process computer for fuel bundles in cells containing reused channel boxes, thus insuring that the TS MCPR operating limits are not exceeded for PBAPS, Unit 2 operating Cycle 8.

In their response to NRC Bulletin No. 90-02, the licensee indicated that a decision has not been made (as of that time, April 25, 1990), whether or not PBAPS will continue reusing the 59 second fuel bundle lifetime channel boxes, for a third and last cycle of operation. The licensee also pointed out that

if it did decide to reuse these channel boxes, such use will be addressed as an unreviewed safety question in the reload core evaluation performed in accordance with 10 CFR 50.59 as specified in NRCB No. 90-02.

### 3.0 CONCLUSION

Based on the above evaluation, the NRC staff concludes that licensee's utilization of reused channel boxes, for the existing cycle (Cycle 8) is acceptable. However, the application of this data and methodology to any future reuse of channel boxes must be evaluated on a cycle specific basis. While the current methodology appears to compensate adequately for severely bowed channels, further study by the licensee is needed with respect to its impact on core wide analyses at advanced exposures. For example, core inlet flow distribution, fuel shuffling scheme, MCPR Safety Limit, LHGR, MAPLHGR limitation on exposure, and continued demonstration that the bow model is adequate for advanced exposures are important and would require further analysis.

### 4.0 REFERENCES

1. Letter from G. A. Hunger, Jr., Philadelphia Electric Company, to NRC, Response to NRC Bulletin 90-02, "Loss of Thermal Margin Caused by Channel Box Bow," dated April 25, 1990.
2. Letter from G. A. Hunger, Jr., Philadelphia Electric Company, to NRC, Response to NRC Request for Additional Information on Response to NRC Bulletin 90-02, "Loss of Thermal Margin Caused by Channel Box Bow," dated August 3, 1990.

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