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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO WESTINGHOUSE FUEL AUGMENTATION FACTOR ELIMINATION

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION, UNIT 1

DOCKET NO. 50-285

## 1.0 INTRODUCTION

By letter dated July 26, 1991 (Ref. 1), Omaha Public Power District (OPPD) submitted a Westinghouse topical report titled "Augmentation Factor Elimination for Westinghouse Fuel in Fort Calhoun" (WCAP-12996, proprietary; WCAP-12997, non-proprietary), dated June 1991 (Ref. 2). This report supports the use of an augmentation factor of 1.0 for future Westinghouse reload fuel designs.

## 2.0 EVALUATION

Early fuel designs by Westinghouse and other vendors were fabricated with low initial fuel densities (undersintering) and with non-prepressurized fuel rods. The fuel pellet microstructure (small grain size and substantial porosity) resulting from the first process led to excessive fuel densification during operation. The unpressurized fuel rods were also subject to substantial early cladding creepdown and contact with the fuel. The combination of these two effects resulted in the formation of significant axial gaps in the fuel stack. The presence of large axial gaps in the fuel column leads to local flux peaking due to reduced neutron absorption in the gap region, and clad flattening into the gap further increases the local power due to increased local moderation. The augmentation or flux spiking factor was developed to bound the effects of fuel densification on power peaking, assuming maximum gap size and worst case gap distribution (Ref. 3).

The current generation Westinghouse fuel fabrication processes have been developed to consistently produce fuel pellets which exhibit a controlled microstructure with respect to both grain size and pore size distribution. The current Westinghouse densification and swelling fuel performance model, along with an extensive data base of measured fuel density, has been previously reviewed and approved by the NRC (Ref. 4).

The subject topical report also summarizes and references recent gamma-scan data of irradiated fuel rods obtained from extended burnup demonstration programs conducted at Zion, Surry, BR-3, and Zorita. This data from both on-site and hot-cell examination programs was used to determine gap frequency, size, and axial location, as well as to measure the total fuel stack length.

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This data shows that axial pellet column gaps due to fuel densification occur very infrequently and are extremely small. When corrected for differential contraction between the fuel and cladding from the hot full power to the cold shutdown measurement condition, the maximum observed gap (a proprietary value) would not significantly impact local power peaking.

## 3.0 CONCLUSION

We have reviewed the licensee submittal of a topical report on the elimination of the augmentation factor for Westinghouse reload fuel. Based on our evaluation of the measured data and the use of approved methodologies, we conclude that an augmentation factor of 1.0 may be used for future Westinghouse reload fuel for Fort Calhoun.

## 4.0 REFERENCES

1. Letter from W. G. Gates (OPPD) to USNRC, "Submittal of Westinghouse Topical Reports WCAP-12996 (Proprietary) and WCAP-12997 (Nonproprietary)," dated July 26, 1991.

2. "Augmentation Factor Elimination for Westinghouse Fuel in Fort Calhoun," WCAP-12996 (Proprietary), WCAP-12997 (Nonproprietary), June 1991.

3. Hellman, J. M. (Ed.), "Fuel Densification Experimental Results and Model for Reactor Application," WCAP-8218-P-A (Proprietary), March 1975.

4. Weiner, R. A., et al., "Improved Fuel Performance Models for Westinghouse Fuel Rod Design and Safety Evaluation," WCAP-10851-P-A (Proprietary), August 1988.

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