Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402-2801

June 18, 1997

Chief, Rules Review and Directives Branch
U.S. Nuclear Regulatory Commission
Mail Stop T-6D-69
Washington, D.C. 20555-0001

Gentlemen:

NUCLEAR REGULATORY COMMISSION (NRC) - REQUEST FOR COMMENTS ON PROPOSED BULLETIN 96-01, SUPPLEMENT 1, "CONTROL ROD INSERTION PROBLEMS"

On May 20, 1997, the NRC published a proposed generic communication related to control rod insertion problems for public comment. The public comment period expires June 19, 1997. TVA has reviewed the subject generic communication, and our comments are provided in the enclosure.

We appreciate the opportunity to respond to the subject proposed bulletin.

Sincerely,

Pedro Salas
Manager
Licensing and Industry Affairs

IE57

Enclosures
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ENCLOSURE

Proposed NRC Bulletin 96-01, Supplement 1, Requirements

"In order to ensure the continued operability of the control rods, all licensees of Westinghouse and Babcock & Wilcox (B&W) designed plants are requested to verify the full insertability and rod drop times by testing control rods in fuel assemblies with burnups greater than 35,000 MWD/MTU for assemblies without intermediate flow mixing grids for 12 foot cores, ... upon first reaching the limit and approximately every 2,500 MWD/MTU until the end of cycle. In addition, end-of-cycle rod drop times tests and drag testing of all rodded fuel assemblies should be performed . . . ."

TVA Comments and Concerns

TVA operates two Pressure Water Reactor (PWR) units at the Sequoyah Nuclear Plant (SQN) and a single PWR unit at the Watts Bar Nuclear Plant (WBN) which will be subject to the provisions of Bulletin 96-01, Supplement 1. The reload fuel for the SQN units is the Fragema-Cogema Fuel (FCF) BW-17 design and the burned fuel is predominately Westinghouse Vantage 5-H with a few Westinghouse Standard 17 x 17 fuel assemblies. The reload fuel for WBN is the Westinghouse 17 x 17 Performance Plus design (ZIRLO fuel cladding, guidetubes, and grids), and the burned fuel is the Westinghouse Vantage 5-H design.

TVA fully endorses the responses to the draft bulletin supplement from the Westinghouse Owners Group (WOG), the B&W Owners Group, and the Nuclear Energy Institute. The comments, technical assessments, and conclusions are applicable to the fuel types used in TVA owned and operated PWR plants.

Comments Relative to Westinghouse Fuel

Following the issuance of Bulletin 96-01, WOG members and Westinghouse have performed extensive testing and analysis to determine the root cause for the incomplete Rod Cluster Control Assembly (RCCA) insertions which occurred in two domestic Westinghouse Nuclear Steam Supply System plants. As part of the root cause investigation, two skeletons of fuel assemblies that experienced Incomplete RCCA Insertion from the Wolf Creek plant were sent to a hot cell, and extensive post-irradiation examinations were performed. A Westinghouse report (WCAP-14782) was issued detailing the results from the various testing and analyses performed to arrive at the root cause. The incomplete rod insertion observed at Wolf Creek was caused by excessive compressive loads on the fuel assembly guide thimble tube. The increased compressive loads were caused by unusual fuel assembly growth due to oxide accumulation and accelerated growth, both of which are a function of local temperature.

A significant amount of testing and monitoring has been conducted by WOG member utilities and Westinghouse in response to Bulletin 96-01. Rod drop tests were performed in 32 different plants having a total of 2766 control rod insertions with burnups ranging up to 54,900 MWD/MTU. Approximately 800 different drag tests were performed in 23 different plants containing a variety of different fuel designs with assembly average burnups in excess of 50,000 MWD/MTU. This huge experience base from hundreds of rodded fuel assemblies demonstrates the validity of the Wolf Creek root cause and the highly unusual nature of the incomplete insertions in that plant.

A significant effort by Westinghouse in 1996 and 1997 has been expended to develop a mechanical model to better understand the first order parameters which influence incomplete rod insertion. The large amount of data accumulated from different plants on many different fuel designs and the information learned from the hot cell work provided ample insight for the model development. With a fundamental understanding of the key parameters and the field data, a mechanical model has been developed to assess the potential for incomplete rod insertion on a global basis as a function of operating and fuel design parameters.

The mechanical model has been described to the NRC at a number of meetings. Various sensitivity studies and responses to specific questions have been provided to the NRC to clarify the impact of different parameters such as operating temperature, holddown spring force, etc.

The application of this model, along with a susceptibility criteria derived from measured drag data from many plants, should be used as the predictive methodology. This can be used to determine the acceptability of currently operating fuel as opposed to a single burnup value of 35,000 MWD/MTU for all fuel types and operating conditions.

A process based upon the Westinghouse mechanical model would not set arbitrary burnup limits as recommended in the Supplement, but would instead make use of drag data from hundreds of tests accumulated for different fuel to arrive at a physical basis to determine acceptable insertion behavior. By this means, different fuel features can be represented instead of a broad brush approach which gives no credit for either fuel aspects that mitigate incomplete insertion or operational aspects. This process would not be solely dependent on prior performance to predict future performance. Such a process would address potentially significant differences in fuel design and/or other factors such as cycle length, operating temperatures, and fuel management through application of a mechanical model which interactively accounts for all factors influencing fuel assembly distortion.

Comments Relative to BW-17 Fuel

Distinguishing FCF design features, performance data, and analyses specific to the incomplete control rod insertion issue were discussed in detail with the NRC staff in a meeting with FCF and utility representatives on December 18, 1996. At the conclusion of the meeting, the NRC requested that FCF make a formal submittal summarizing the meeting. FCF provided that submittal on January 30, 1997. The letter summarized the data and key points presented in the December 18, 1996 meeting.

The following design characteristics directly or indirectly result in significantly less compressive loading or stress on the fuel guide thimbles, less guide thimble deformation, and reduced control rod insertion forces for the BW-17 fuel type:

1. Shorter fuel assembly length, which significantly reduces the in-reactor axial compressive holddown forces on the guide thimbles and also allows for more fuel assembly irradiation growth.

2. Lower preloaded holddown springs, which significantly reduce the axial compressive loads on the guide thimbles.

3. Fuel rods seated on the bottom nozzle, which substantially reduce the axial compressive load on guide thimbles.

4. Increased guide tube outer and inner diameters, which provide more control rod to guide tube clearance and increase the strength of the guide thimble.

5. Intermediate (floating) grids that are not rigidly attached to the guide thimbles, which minimize the operating stresses due to differential growth between the fuel rods and guide thimbles and minimize the local guide thimble distortion.

6. Taller intermediate and end grids which increase the lateral stiffness of the fuel assembly and reduce guide thimble bow.

7. Top and bottom end grids which transmit loads directly to the top and bottom nozzles respectively, instead of to the guide thimbles.

8. Keyed grids, which permit stress-free installation of the fuel rods during fabrication where the guide thimbles experience no fabrication-induced loads.

The analytical results, operational data, and design comparisons demonstrate that FCF fuel does not exhibit control rod insertion problems or the associated root causes, and therefore, should be excluded from the testing requirements of the bulletin supplement. TVA requests that the NRC review, in detail, the FCF submittal of January 30, 1997 and the December 18, 1996 presentation package in its assessment of the applicability of the incomplete control rod insertion issue to FCF fuel prior to final issuance of the bulletin supplement. If the NRC issues the final bulletin supplement with the proposed control rod insertion testing requirements and corresponding fuel burnup restrictions, TVA requests that the NRC exclude FCF fuel from any such restrictions and testing until a review of the FCF January 30, 1997 submittal is complete.

Risk Assessment

A significant issue neglected by Bulletin 96-01, Supplement 1, in its proposed form is the risk associated with bringing the plant to the required operating state to perform the test. A host of ancillary issues pertaining to the physical plant and operation should be considered prior to requiring all Westinghouse and B&W designed plants to shutdown every 60 to 75 days.

Since the test will be performed at hot standby conditions (Mode 3), the operators will need to reduce power and transfer the feedwater flow from the main feedwater system to the emergency or auxiliary feedwater system. Following the test, the operators will need to increase power and switch feedwater flow back to the main system.

Power plant shutdowns require the primary and secondary systems to be mechanically and thermally cycled. This causes component wear and increases the potential for equipment failures. Such failures would adversely impact safety, result in prolonged shutdown, and raise employee exposure to radiological and industrial hazards.

Requiring an increase in reactor shutdown frequency results in greater generation of liquid and gaseous radwastes to be processed and discharged. This is especially true at cycle end-of-life where low coolant system boron concentrations require large volumes of water processing for reactivity control. Compensating for the effects of xenon during end-of-life startups can be challenging to operators and reactor engineers. The safest way to deal with an end-of-life startup is to wait until xenon has decayed--typically 72 hours. The net effect is a three-day outage for a test which takes a few hours. In considering the costs of the proposed actions, the NRC should include the entire outage length.

The proposed actions would require additional operational transients. Experience has shown that plant transients increase risk as compared to steady-state operation.

Importance to Safety

TVA recognizes the importance to nuclear safety of having control rods insert fully and promptly when needed. Control rods are one of two independent means of terminating the fission process as required by General Design Criteria 26, of Appendix A to 10 CFR Part 50, with the other being the ability to add soluble boron. TVA believes the safety significance of the actual industry events are not commensurate with the actions mandated in Bulletin 96-01, Supplement 1 (i.e., shutdown of all Westinghouse and B&W designed reactors every 2500 MWD/MTU burnup for control rod testing) when fuel under control rods exceeds a burnup of 35,000 MWD/MTU).

Only one domestic reactor (Wolf Creek) with 12 foot Westinghouse fuel has had a control rod insertion problem. The actual uninserted rod worth for the Wolf Creek event was negligible and easily bounded by conservatism routinely incorporated in core design shutdown margin evaluations. No control rods became stuck above the fuel guide tube dashpot region.

Economic Impact

TVA conservatively estimates the cost of compliance with proposed Bulletin 96-01, Supplement 1, at $2,000,000 to $3,000,000 per unit for each 18 month fuel cycle. This estimate is based upon a low range of replacement power costs for three to five reactor shutdowns per cycle, and do not include plant related costs associated with water processing, shutdown surveillance activities, personnel radiological exposure, etc. The actual costs could easily double if plants experience any outage delays due to equipment problems associated with the shutdowns.

Cores designed to preferentially place new fuel under control rod locations will result in lower operating margins, increased vessel fluence due the placement of new or low burnup fuel in peripheral rod locations, create the need to purchase a new fuel assembly solely for use in the center control rod location, and increased fuel costs equivalent to the plant shutdown costs of $2,000,000 to $3,000,000 per 18-month operating cycle.

Backfit

Utility and fuel vendor testing, analysis, and model development indicate Westinghouse and B&W fuel designs address the root causes of the Wolf Creek Nuclear Plant insertion problems. Additional insertion testing, as required by the NRC, will not address the root cause of these insertion problems, and as a result will not provide a benefit commensurate with the substantial cost of additional testing. Therefore, TVA believes the new testing requirements contained in the proposed bulletin would not pass the requirements of 50.109.

Summary

TVA proposes the following revisions to proposed Bulletin 96-01, Supplement 1:

1. The Westinghouse developed mechanical model, along with susceptibility criteria derived from plant measured drag data, should be used as the predictive methodology to determine the acceptability and testing requirements of currently operating Westinghouse fuel as opposed to a single burnup value of 35,000 MWD/MTU for all fuel types and operating conditions.

2. The analytical results, operational data, and design comparisons demonstrate that FCF fuel does not exhibit control rod insertion problems or the associated root causes, and therefore, should be excluded from the testing requirements.

3. A detailed risk and safety assessment of a host of ancillary issues (as discussed in the comments above) pertaining to the physical plant, fuel performance, and plant operations should be considered prior to requiring all Westinghouse and B&W designed plants to shutdown every 60 to 75 days. Consideration should be given to testing during planned outages, forced outages of sufficient duration, and end-of-cycle shutdowns as was required by Bulletin 96-01.