Entergy

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June 19, 1997

1CAN069706

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

Subject: Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51
Comments on Proposed NRC Bulletin 96-01, Supplement 1; Control Rod Insertion Problems

Gentlemen:

By letter dated June 18, 1997, the Babcock and Wilcox Owners Group (BWOG) submitted comments on the subject proposed bulletin supplement. Entergy Operations at Arkansas Nuclear One (ANO) endorses the comments provided by the BWOG (attached for information only). NEI and NUBARG are also providing comments to the proposed bulletin. Entergy Operations has been involved with development of the NEI and NUBARG comments and agrees with the conclusions and recommendations that will be submitted. In order to supplement the BWOG comments, Entergy Operations also desires to provide the following comments.

Fuel Assembly Design:

The ANO-1 fuel design has prevented the occurrence of control rod insertion problems. One of the 11 key Mark-B fuel design differences compared to the Westinghouse V5H fuel and delineated in the BWOG comments is utilization of helical holddown springs. ANO-1 currently utilizes helical holddown springs in its Framatome Cogema Fuels (FCF) fuel design. For the helical spring fuel designs, the holddown force per guidetube is substantially less than the Westinghouse V5H fuel design. The ANO-1 fuel design features result in significantly less compressive loading or stress on the control rod guidetubes, less control rod guidetube deformation, and reduced control rod insertion forces. As a result of the margins incorporated into the design, ANO-1 fuel assemblies have not shown a similar susceptibility, nor are believed to be susceptible to the control rod guidetube distortion described in the subject bulletin.

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Control Rod Drop Time Testing:

ANO-1 control rod drop time data over the past three years indicates no correlation between higher fuel assembly burnups and control rod drop times (see attached graph). This includes technical specification required control rod drop time testing at the beginning of cycle and unplanned reactor trip data. Also, on September 12, 1996, ANO-1 experienced a reactor trip at the end of a fuel cycle. At the time of the trip, 44 of the 60 control rods were located in fuel assemblies with burnups greater than 35,000 MWd/mtU, including 13 control rods which resided in fuel assemblies whose burnups were in the range of 43,000 to 48,000 MWd/mtU. The remaining 16 control rods were located in fuel assemblies with burnups greater than 31,000 MWd/mtU. When the reactor tripped, all control rods fully inserted as designed with no significant variation in previous control rod trip times. Therefore, ANO-1 fuel is not believed to be susceptible to exhibiting control rod insertion problems within the current licensed fuel burnup limits.

Operational Concerns:

The proposed control rod drop time testing would result in unnecessary reactor shutdowns and unwarranted reactor trips. Plant operation, other than at steady-state conditions, exposes a nuclear power plant to increased vulnerabilities. Special concerns arise during the approach to or return from shutdown conditions. Numerous operator actions occur during a controlled decrease in power which increases the chance for error. The operator has to diagnose off-normal conditions which are complicated by the transient plant conditions and the numerous actions occurring during plant maneuvering. Therefore, increasing the frequency of either controlled shutdowns or reactor trip events significantly increases the probability of operator error.

Fuel Integrity and Reliability:

The frequency of reactor trip events impacts fuel integrity. During a reactor trip the fuel is thermally cycled, thus increasing the probability for inducing failure in a pre-existing flaw (e.g., the local wear of the cladding by debris or increased grid to fuel rod fretting due to changes in core cross-flow). Furthermore, a reactor trip aggravates any pre-existing fuel failures. The probability for inducing secondary hydriding failures is also increased. This normally results in increased levels of tramp activity which persists for several cycles following removal of the failed fuel.

Radiological, Industrial, and Environmental Considerations:

Failed fuel provides a path for fission products to enter the primary reactor coolant. During a reactor trip with failed fuel present, iodine spiking occurs which can briefly increase the reactor coolant activity by an order of magnitude of two or more. Also, highly radioactive "crud bursts" can occur during a reactor trip. These phenomena increase the radiation dose that plant employees receive.

Higher reactor coolant activity levels impact the balance of plant if primary-to-secondary leakage exists. Increasing the frequency of plant shutdowns, especially late in cycle, substantially increases the amount of liquid and gaseous radwaste generated and subsequently discharged. In addition to the environmental considerations, this has dose consequences as well, given the increased frequency of changing filters and resins. Therefore, a control rod testing program with high reactor coolant activity levels would substantially increase the radiation dose to plant employees.

Increasing the frequency of performing a controlled power decrease, reactor trip, and power ascension increases the likelihood of component failure due to mechanical and thermal cycling. Such failures pose industrial hazards to plant employees and could result in extended outages. If an anticipated or actual component failure requires cooldown to cold shutdown conditions, or even opening or draining the reactor coolant system, consequences increase dramatically. This substantially increases employee exposure to industrial and radiological hazards and significantly increases liquid, gaseous, and solid radiological waste generation.

Safety Impact:

The ANO-1 Probabilistic Safety Assessment identifies a number of complicating events, such as losses of feedwater or offsite power, which in conjunction with reactor trip lead to core damage. During plant maneuvering to shutdown or to perform a reactor trip, key operator actions are required to realign main feedwater and offsite power. Though operators are aware of protecting these critical safety functions, the opportunity for error is greater during plant maneuvering. The proposed testing plan would systematically require the plant to enter transient operating conditions. The resulting increase in exposure to conditions potentially adverse to safety must be thoughtfully considered.

Entergy Operations has made a significant effort to decrease unnecessary reactor trips. Although ANO-1 can be safely shutdown and restarted when required, it is not prudent to mandate a testing program that results in approximately five extra shutdowns or reactor trips per year for a concern that is not applicable to ANO-1. From a safety standpoint, control rod drop time testing would provide no increased safety benefit and could potentially degrade safety.

Therefore, Entergy Operations concludes that control rod insertion problems are not a safety concern for ANO-1 and requests that the reactors operating with FCF Mark-B fuel be excluded from the final bulletin supplement. Entergy Operations appreciates the NRC's consideration of these comments. Should you have any questions, please contact me.

Very truly yours,

Alan R. Ashley
for
Dwight C. Mims
Director, Nuclear Safety

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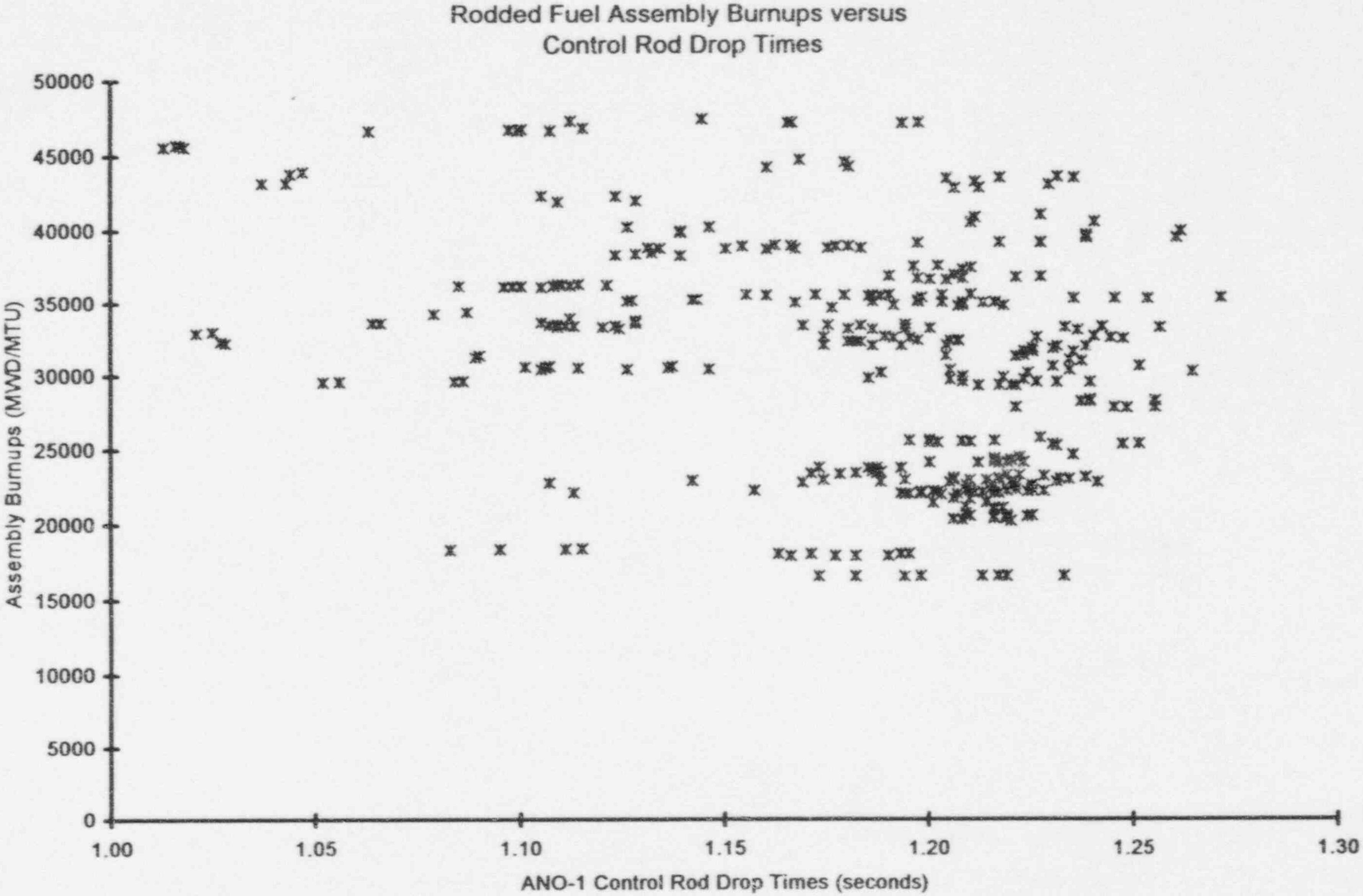

Rodded Fuel Assembly Burnups versus
Control Rod Drop Times
Assembly Burnups (MWD/MTU)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1.00
1.05
1.10
1.15
1.20
1.25
1.30
ANO-1 Control Rod Drop Times (seconds)

THE B&W OWNERS GROUP

Duke Power Company — Oconee 1, 2, 3
Entergy Operations, Inc. — ANO-1
Florida Power Corporation — Crystal River 3
GPU Nuclear Corporation — TMI-1
Toledo Edison Company — Davis-Besse
Framatome Technologies, Inc.

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June 18, 1997
OG-1660

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

Subject: B&W Owners Group (B&WOG) Comments on Proposed NRC Bulletin Supplement Concerning Control Rod Insertion Issues Specific to B&WOG and FCF Fuel

Reference: Proposed Generic Communication
62 Fed. Reg. 27629 - May 20, 1997

Gentlemen:

The above reference requests comments from interested parties on a proposed NRC bulletin supplement concerning the potential for incomplete control rod insertion in Babcock & Wilcox (B&W) and Westinghouse designed reactors. The bulletin supplement provides proposed actions for applicable utilities to address this concern. The B&W Owners Group (B&WOG) is aware of the importance to nuclear safety of having control rods insert fully and promptly when needed, and provides the following comments to the proposed bulletin.

The application of the actions requested by the proposed bulletin supplement to fuel assemblies manufactured by Framatome Cogema Fuel (FCF) for B&W and Westinghouse designed plants is not appropiate. The FCF fuel designs are distinctly different from those which were involved in the events leading to the proposed bulletin supplement. Information provided to the NRC by FCF and the B&WOG does not support the broad application of such actions. Analytical results, operational data, and design comparisons

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have shown that FCF fuel designed for B&W and Westinghouse designed reactors does not exhibit Control Rod Assembly (CRA) or Rod Cluster Control Assembly (RCCA) insertion problems or associated root causes, and therefore should not be included in the final bulletin supplement.

Overview

The following issues and items should be thoroughly considered by the NRC in a review of the applicability of the proposed bulletin supplement to B&WOG and FCF fuel. Previous B&WOG submittals should be utilized, and the evaluation should be completed prior to issuing the final bulletin supplement.

1) FCF fuel designs should be evaluated for susceptibility to the problems similar to those highlighted in the supplement.

2) FCF fuel operational history should be reviewed to ascertain whether there are indications of slow control rod trip times or stuck control rods. The FCF fuel design and performance should be evaluated for verification of compliance with the current licensing basis.

3) The safety significance of any requirements must be carefully assessed to determine the ramifications of any NRC proposed actions.

4) The environmental impact of the proposed requirements should be assessed.

5) The impact of the required testing on the current licensing bases should be evaluated.

6) The potential impact on future fuel cycle designs and the associated economies should be assessed thoroughly.

7) The application of the required testing as a compliance or backfit ruling should be thoroughly assessed.

These issues are described in greater detail below.

Design Considerations

FCF supplies nuclear fuel to both B&W and Westinghouse designed reactors. 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 B&WOG 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 31, 1997. The letter summarized the data and key points presented in the December 18 meeting. The analytical results and design comparisons showed that FCF fuel does not exhibit CRA/RCCA insertion problems or associated root causes and, therefore, should be excluded from the final bulletin supplement.

<u>Mark-B Fuel - Used in B&W Designed Plants</u>

The B&W designed reactors utilize the Mark-B 15x15, 12 foot fuel assembly design. The fuel in these reactors has been supplied by FCF or its predecessor, B&W Fuel Company, except for eight lead test assemblies (LTAs). As discussed with the NRC, FCF fuel has design features which preclude the occurrence of control rod insertion problems exhibited by the Westinghouse V5H fuel.

The Mark-B fuel has key design differences compared to the Westinghouse V5H fuel, which include:

1) Larger diameter guide tubes, which significantly increase the strength and resistance to deformation

2) Fuel rods seated on the lower end fitting, which substantially reduce the axial compressive load on guide tubes

3) Uniform diameter guide tubes with no dashpot, which provide significantly more clearance for the control rods and significantly increase the strength of the guide tube in the lower region of the fuel assembly

4) Intermediate (floating) grids that are not rigidly attached to the guide tubes, which minimize the operating stresses due to differential growth between the fuel rods and guide tubes and minimize local guide tube distortion

5) Taller intermediate and end grids, which increase the lateral stiffness of the fuel assembly and reduce guide tube bow

6) Significantly larger design margins which allow for more fuel assembly irradiation growth

7) Top and bottom end grids, which transmit loads directly to the upper and lower end fittings, respectively, instead of to the guide tubes

8) Lower operating temperatures, which reduce guide tube corrosion. This has been confirmed with no corrosion driven fuel assembly growth ever being observed.

9) Additional reduced axial compressive forces for fuel with the helical holddown spring

10) A control rod drive system, which fully absorbs the control rod drop energy and does not allow the control rod assembly to impact the fuel assembly, thus significantly reducing axial compressive loads on the guide tubes during a trip

11) Keyed grids, which permit stress free installation of the fuel rods during fabrication where the guide tubes experience minimal fabrication-induced loads

These features directly or indirectly result in significantly less compressive loading or stress on the guide tubes, less guide tube deformation, and reduced CRA insertion forces for FCF Mark-B fuel.

Mark-BW Fuel - Used in Westinghouse Designed Plants

FCF also supplies 17x17, 12 foot fuel, designated Mark-BW, to Westinghouse designed reactors. Duke Power McGuire Nuclear Units 1 and 2 and Catawba Nuclear Units 1 & 2, TVA Sequoyah Nuclear Units 1 and 2 (fresh batches only), and Virginia Power North Anna Unit 1 (4 LTAs) utilize FCF Mark-BW fuel. Mark-BW fuel, similar to the Mark-B fuel, has key design differences compared to the Westinghouse V5H fuel design, which are:

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 thimble outer and inner (upper) diameters, which provide more control rod to guide thimble 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 minimal fabrication-induced loads

These features directly or indirectly result in significantly less compressive loading on the guide thimbles, less guide thimble deformation, and reduced RCCA insertion forces for FCF Mark-BW fuel.

Operational Considerations

In addition to the noted design features, performance data previously provided to the NRC (which included fuel assembly growth, guide tube/thimble corrosion, fuel assembly bow, guide tube/thimble distortion, control rod trip, and control rod drag measurements) have confirmed that the Mark-B and Mark-BW fuel assemblies have shown no anomalies relative to their design bases for burnups close to the design burnup limits. Fuel assembly growth and guide tube/thimble corrosion data are as predicted, showing no indication of aberrant, accelerated rates. Fuel assembly bow and guide tube/thimble distortion have been shown to be minimal with no unusual behavior.

Full insertion of control rods in FCF fuel have been demonstrated in all cases with all trip times meeting Technical Specification requirements. Full insertion of control rods has occurred in both high and low temperature plants with challenging power histories. Over 5,000 successful insertions have been made with FCF fuel since 1990. Of these, more than 900 successful insertions have been above the proposed 35,000 MWD/mtU burnup limit. The maximum fuel assembly burnups achieved with successful control rod insertion have been greater than 53,000 and 58,000 MWD/mtU for the Mark-BW and Mark-B fuel designs, respectively. In addition to the successful control rod insertion data, over 200 Mark-BW fuel assemblies were measured for control rod drag force (all of which exhibited drag force within acceptable limits) with burnups up to ~53000 MWD/mtU.

These data, in addition to the specific FCF design features, validate that no CRA/RCCA insertion problems exist for the Mark-B and Mark-BW fuel designs for the present licensed burnup limits. Considering the substantial design differences noted for FCF fuel, coupled with the proven performance history, it is clear that FCF fuel will perform its intended safety function. Therefore, the proposed control rod trip testing at the burnup limits and intervals provided in the draft bulletin supplement is not appropriate for FCF fuel.

FCF fuel performance and design data and analyses support continued operation to the currently licensed burnup limits without any additional control rod insertion testing.

Safety Assessment

Based on the foregoing discussions and FCF fuel design and performance data provided to the NRC, the FCF fuel designs are not susceptible to the control rod insertion failures discussed in the bulletin supplement. Therefore, the current test programs have demonstrated that structures, systems, and components perform satisfactorily, and there is no safety concern or compliance issue for the current licensed burnup limits.

Contrary to the above, the proposed bulletin supplement requires additional testing as a means to address the postulated safety concern. Therefore, the safety impact of the testing regime itself must be assessed.

The proposed bulletin supplement delineates:

> In order to ensure the continued operability of the control rods, all licensees of Westinghouse and Babcock and Wilcox 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 IFMs for 12 foot cores; 40,000 MWD/mtU for assemblies with IFMs for 12 foot cores; and 25,000 MWD/mtU for assemblies in 14 foot cores, upon first reaching the limit(s), and approximately every 2,500 MWD/mtU until the end of cycle. In addition, end-of-cycle rod drop time tests and drag testing of all rodded fuel assemblies should be performed.

Such testing would result in unwarranted CRA trip time testing from hot shutdown conditions, approximately every 60 to 80 days of operation for units utilizing FCF fuel. These unnecessary trip time tests require review from a safety perspective to determine the benefit of the additional testing requirement. While planned reactor trips at hot shutdown conditions are routinely performed without complication, proposing an increase in the frequency of CRA trip time testing is undesirable for a number of reasons.

- Given the numerous operator actions required during a controlled decrease or increase in reactor power, additional CRA trip time testing increases plant operator burden. For example, operator actions during plant shutdown increase the likelihood of undesirable consequential events: loss-of-offsite power and loss-of-main feedwater. Though operators are aware of protecting the critical safety functions, the opportunity for error is greater during plant maneuvering. The proposed testing plan would systematically require the plant to enter transient operating conditions. The resulting increase in exposure to potentially adverse conditions must be thoughtfully considered.

- Increasing the frequency of trip time testing subjects the fuel to additional duty cycles and increases the possibility of fuel failures and associated fission product inventory in the reactor coolant system (RCS). Furthermore, this additional testing would exacerbate any pre-existing fuel failures.

- Increasing the frequency of CRA trip time testing subjects the physical plant to additional mechanical and thermal duty cycles, which increases the possibility of plant component and system failures.

- The additional CRA trip time testing would also challenge the primary and secondary chemistry, which is integral to system integrity and corrosion control.

The B&WOG has worked diligently to decrease unnecessary reactor trips. Although all units can successfully and safely shutdown when required, it is not prudent to propose a testing program that results in approximately five additional trip time tests per year per plant and that does not contribute to increased safety for plants utilizing fuel where no such safety issue exists.

Environmental Impact

Obligating an increase in trip time testing frequency results in greater generation of liquid and gaseous radwastes. The volumes of radwaste and the subsequent impact on the environment should be considered by the NRC prior to issuing the bulletin supplement.

Current Licensing Basis

While the proposed bulletin supplement makes reference to maintaining the current licensing basis with respect to ensuring that the control rods will satisfactorily perform their intended function, it does not address the effect of the proposed testing on the limited number of startup and shutdown transients contained in each plant's current licensing basis. The effect on plant systems, structure, and components due to the proposed increase in the number of plant cooldown and heatup cycles (resulting from increased control rod trip testing) should be thoroughly analyzed by the NRC Staff prior to proceeding further with the proposed bulletin supplement, particularly as it applies to the B&WOG plants and FCF fuel.

Fuel Cycle Designs

The proposed action, which requires control rod trip testing for 12 foot fuel assemblies with greater than 35,000 MWd/MtU burnup (for non-IFM designs), would result in core management restrictions for those B&WOG utilities choosing to adhere to the proposed burnup limit to preclude such testing. This unduly penalizes FCF fuel users given that the FCF fuel is not susceptible to the control rod insertion problem and any associated safety concern. Fuel cycles required to meet the restrictions result in significant cost inefficiencies and additional spent fuel storage and disposal. In order to minimize the cost, risk, and operational impact of the proposed testing, future fuel cycle designs and resulting fuel economies would be significantly altered from current designs.

In addition, the proposed control rod trip testing itself (which imposes regular mid-cycle CRA/RCCA trip test intervals) also unduly penalizes FCF fuel users. The additional costs associated with the required control rod trip testing are unwarranted when imposed to address an issue that has been demonstrated by FCF to have no applicability to B&W and Westinghouse designed plants using FCF fuel assemblies.

Regulatory Compliance

In the proposed bulletin supplement, the NRC characterizes the new test requirements as justified under the compliance exception of 10 CFR 50.109. The supplement states that the objective of the requirements is to verify that licensees are in compliance with current licensing bases with respect to shutdown margin and control rod trip times. The B&WOG does not agree with the compliance exception interpretation. Control rod trip testing and shutdown margin requirements are already specified in plant technical specifications and are met by the B&WOG plants using FCF fuel. Therefore, the B&WOG plants are in compliance with their licenses. The actions of the proposed bulletin supplement should not be considered a compliance issue for FCF fuel. The actions should be addressed as a backfit issue which requires appropriate supporting analyses.

Pursuant to 10CFR 50.109(c), the NRC Staff is obligated to perform a backfit analysis, which must address the costs associated with the backfit, the potential safety impact of changes in the complexity of the operation of the plants, the potential impact of differences in facility types, etc.

Conclusions

Extensive data have been collected by FCF and the B&WOG utilities as part of NRC Bulletin 96-01, fuel post irradiation examinations, hot cell programs, and Technical Specification required testing. This data, in conjunction with corresponding analyses and distinguishing design features, demonstrate that FCF fuel is not susceptible to incomplete control rod insertion, or suspected root causes for the currently licensed fuel assembly burnup limits.

Therefore, the proposed control rod trip test requirements are unwarranted and unnecessary for B&WOG plants and FCF fuel. Such test requirements, which increase the frequency of CRA trip time testing and the prerequisite plant maneuvering, unduly impose increased mechanical, radiological, environmental, licensing, and fuel integrity concerns in addition to fuel cycle design challenges for B&WOG plants.

Therefore, the B&WOG requests that:

- The NRC review in detail the FCF January 31, 1997 submittal and December 18, 1996 presentation package in its assessment of the applicability of the incomplete control rod insertion issue to FCF fuel prior to the final issuance of the bulletin supplement.

- If the NRC issues the final bulletin supplement with the proposed control rod assembly trip time test requirements, the B&WOG plants and FCF fuel be excluded from any such testing until review of the 1/31/97 and 12/18/96 FCF submittals is completed.

- Based on the information previously provided to the NRC, all FCF fuel operating in Westinghouse and Babcock & Wilcox designed reactors be excluded from the final bulletin supplement.

- If FCF fuel is to be included in the final bulletin supplement, the NRC provide specific cause for such determination and accommodate additional technical meetings between FCF, BWOG, and the NRC prior to the final issue of the bulletin supplement.

- Prior to imposing any additional test requirements, the NRC re-evaluate its assessment of the compliance exception ruling and perform the necessary analyses required to implement the control rod trip test requirements pursuant to 10 CFR 50.109(c).

The B&WOG is prepared to assist the NRC to help communicate a complete understanding of the design and operational differences associated with the FCF Mark-B and Mark-BW fuel. Please contact me at 864/885-3163 if we may be of additional assistance.

Very truly yours,

William W. Foster

W.W. Foster, Chairman
B&W Owners Group Steering Committee

DUKE POWER COMPANY

WWF/bcc

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