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November 30, 1988

U. S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D. C. 20555

Attention: Document Control Desk

Gentlemen:

SUBJECT: Grand Gulf Nuclear Station
Unit 1
Docket No. 50-416
License No. NPF-29
Response to RAI Regarding Boraflex
Gap Analysis
AECM-88/0237

By letter dated November 25, 1988, the NRC Staff requested additional information regarding the impact of gaps in Boraflex on the criticality analysis of Cycle 4 fuel to be stored in the Grand Gulf Nuclear Station (GGNS) Unit 1 spent fuel pool storage racks.

System Energy Resources, Inc. (SERI) personnel discussed the request for additional information with Mr. L. Kopp of the NRC Staff on November 28, 1988. SERI's response to the NRC request as clarified by Mr. Kopp is attached.

If you have additional questions, please advise.

Yours truly,

JGC:swb
Attachment

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Response to NRC Questions Regarding
GGNS Boraflex Gap Analysis

Introduction

As described in AECM-88/0233 analyses were performed in order to assess the impact of observed gaps on the GGNS-1 Cycle 4 Reload Spent Fuel Rack Criticality analysis. These analyses used 3-D KENO models with different gap sizes in the midplane of all 4 Boraflex sheets.

Impact of Observed Gaps on Cycle 4 LTA Criticality Analysis

Advanced Nuclear Fuels performed an assessment of the impact of gaps upon the 9x9-5 LTA criticality analysis. This analysis resulted in a unbiased infinite multiplication factor of 0.9062 for a gap size of 1.6 inches. This is comparable to the Cycle 4 LTA criticality analysis of 0.9079 with no gaps present. This small difference is attributed to the statistical variation of the KENO methodology and does not represent a real variation in reactivity. When the results of the 1.6 inch analysis are adjusted for the associated bias and uncertainties, the 0.920 value generated for the criticality analysis currently under review is confirmed.

Impact of Observed Gaps on 8x8 Criticality Analysis

A. Discussion

An assessment of the impact of the observed gaps on the Cycle 4 8x8 fuel was performed by System Services, Inc. (SSI), a subsidiary of Middle South Utilities (MSU) using KENO. The MSU/SSI methodology and benchmark is described in "Issuance of Amendment No. 71 to Facility Operating License NPF-6 Arkansas Nuclear One, Unit 2", Docket No. 50-368, April 1986. This benchmark documents a very conservative tolerance factor of 0.021 (0.004 bias + 0.017 uncertainty). The tolerance factor has been updated and a new value will be used in the long term analysis plan described in AECM-88/0233.

In order to confirm the performance of the SSI methodology to GGNS a 2-D model of the GGNS spent fuel racks was developed. This model calculated a bias corrected k-infinity of 0.906 which is comparable to the value of 0.904 (as reported in AECM-88/0206 for Cycle 4 8x8 criticality analyses, currently under review).

B. Analysis Results

The 2-D model was expanded to three dimensions and gaps of 1.6 and 3.0 inches were modeled. The results of these analyses were combined with the SSI bias and calculational uncertainties and the mechanical tolerances from the Cycle 4 8x8 analysis in order to establish 95/95 upper limit k-infinities. The k-infinities determined from these analyses are 0.923 and 0.947 respectively. This indi[illegible] that a 3.0 inch gap in the midplane of all Boraflex sheets ca[illegible]ted within the 0.95 acceptance criteria.

C. Comparison to Cycle 4 8x8 Criticality Analyses

The Cycle 4 8x8 criticality analyses did not use a 3-D model which is necessary to evaluate Boraflex gaps and therefore did not take credit for the axial leakage associated with 3-D models. The worth of axial leakage was determined (0.008 delta-k) in order to provide a comparison of the SSI analysis to the Cycle 4 8x8 analysis. Accounting for the axial leakage worth, a k-infinity of 0.931 was determined for a gap size of 1.6 inches which is comparable to the Cycle 4 8x8 result of 0.936 as reported in AECM-88/0206. This difference is due to variations in methodologies and the associated uncertainties.

Impact of Projected Gaps

As previously stated, the k-effective for 3.0 inch gaps has been demonstrated to be 0.947 on a 95/95 basis. This is a very conservative result since it is approximately twice the maximum gap size currently observed and does not account for the distribution of gaps within the rack. As described in AECM-88/0233 an evaluation of the long term growth of the Boraflex gaps and their impact on the GGNS-1 racks is scheduled for completion by February 15, 1989. This evaluation will include projected gap sizes through the next measurement interval.

It is anticipated that with the currently available margin and a more realistic treatment of the gap distribution that significantly larger randomly distributed gaps can be tolerated without challenging the 0.95 acceptance criteria. As presented in

"Effects of Poison Panel Shrinkage and Gaps on Fuel Storage Rack Reactivity", W. A. Boyd and Donald E. Muller, ANS Transactions Vol. 56, ISSN: 0003-018, June 1988,

and

"Quad Cities Station Units 1 and 2, Spent Fuel Storage Racks", NRC Docket Nos. 50-254 and 50-265, May 5, 1987,

the assumption of overlapping gaps in all 4 sheets approximately triples the reactivity impact when compared to overlapping gaps in 2 sheets. The GGNS-1 measurements indicated most cells with only one gap in any plane. Therefore, including a conservative gap distribution, the long term results are expected to bound the projected gap sizes through the next measurement period. Should this fail to be demonstrated, then the next measurement will be adjusted accordingly.

Basis for Blackness Testing Program

The initial Boraflex blackness testing was conducted using 53 irradiated cells. The cell locations were selected in a scatter configuration, measuring every other cell. Since Boraflex sheets are common to two rack cell locations this procedure resulted in 84 cells being fully characterized and an additional 17 having 3 sides characterized. This corresponds to approximately 15% of the cells with significant irradiation being fully characterized (i.e., 84 cells). While the irradiation history of the test region is typical of the GGNS-1 spent fuel racks, the BORAFLEX gap criticality analyses (8x8 and 9x9) was performed with the maximum observed gap size in all Boraflex sheets. This assumption bounds the 95/95 upper limit on the measured gap size distribution. Additionally, as previously discussed the assumption of tears in every Boraflex sheet is very conservative. Therefore, while the measurements were performed for a typical irradiated area and did not include all irradiated locations in the racks, the analysis assumptions were conservatively established.

The measurement plan described in AECM-88/0233 includes approximately 50 test locations. The bulk of these test locations will have had previous exposure history. Since these locations will be loaded with freshly discharged fuel and the bulk of the gamma dose occurs during the first year following discharge, these locations will bound the other areas of the spent fuel rack storage area. The detailed analysis planned for completion by February 15, 1989 will address the potential reactivity impact of the cumulative dose rates on the test area.

Summary

While the presence of small gaps in the GGNS spent fuel rack Boraflex has been detected, they have no impact upon the criticality safety analysis currently under review by the NRC Staff. The analysis performed, conservatively bounds the measured gaps in the Boraflex. A detailed assessment of the long term impact of the Boraflex gaps is on schedule for completion in February 1989. This analysis will address the potential long term growth of the gaps and the corresponding impact upon reactivity. Additionally, it will consider the criticality safety impact on the test area and adjust the test schedule if the projected gap sizes represent a challenge to the criticality safety of the racks.