System Energy

System Energy
P.O. Box 756
Port Gibson, MS 39150
Tel 601 437 6809

William T. Cottle
Vice President
Nuclear Operations

April 30, 1990

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 NRC Request for Additional Information Regarding Boraflex Gap Analysis
AECM-90/0041

References:
1) NRC letter dated August 25, 1989 regarding Gaps in Boraflex of High Density Spent Fuel Racks (MAEC-89/0258)
2) SERI letter dated December 5, 1989 regarding Boraflex Gap Analysis (AECM-89/0209)
3) Telecon between T. Le/J. Wing (NRC) and M. L. Crawford/ F. H. Smith (SERI) dated January 9, 1990 regarding NRC comments on SERI's letter, AECM-89/0209 (MTO-90/0006)
4) NRC letter dated March 29, 1990 regarding Gaps in Boraflex of High Density Spent Fuel Racks (MAEC-90/0073)

On December 5, 1989, SERI submitted information in response to an NRC Request for Additional Information on gaps in the Boraflex panels of the high density spent fuel storage racks (References 1 and 2). Based on NRC's review of this information and after subsequent discussion with SERI on January 9, 1990 (Reference 3), NRC issued a second Request for Additional Information to gain further clarification on the Boraflex gap analysis and surveillance program (Reference 4).

The attached information provides SERI's response. If you have further questions, please advise.

Yours truly,

W T Cottle

WTC:tkm
Attachment

cc: (See Next Page)

A9002201/SNLICFLR - 1



A001
1/1

cc: Mr. D. C. Hintz (w/a)
Mr. T. H. Cloninger (w/a)
Mr. R. B. McGehee (w/a)
Mr. N. S. Reynolds (w/a)
Mr. H. L. Thomas (w/o)
Mr. H. O. Christensen (w/a)

Mr. Stewart D. Ebneter (w/a)
Regional Administrator
U.S. Nuclear Regulatory Commission
Region II
101 Marietta St., N.W., Suite 2900
Atlanta, Georgia 30323

Mr. L. L. Kintner, Project Manager (w/a)
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Stop 14B20
Washington, D.C. 20555

# RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING THE HIGH DENSITY SPENT FUEL RACK BORAFLEX GAP SURVEILLANCE PROGRAM FOR GRAND GULF NUCLEAR STATION, UNIT 1

1. **QUESTION**: With reference to Response No. 5 (Reference AECM-89/0209), it is indicated that the silicon-based cement used to attach the Boraflex panels to the racks will keep the panels in place within the cell walls. Provide information regarding tests performed to ensure such adherence under seismic type loading.

**RESPONSE**: The cement was used as a construction aid in positioning the Boraflex sheets. It is considered a contributing factor in restricting Boraflex shrinkage which leads to the production of tears and gaps in the sheets. However there is no analytical assurance that the cement will continue to adhere throughout the life of the racks.

As described in the response to Question 2 below, the ell, tee, and cruciform elements were tightly clamped during fabrication, utilizing side and end strips to avoid excessive compression of the Boraflex sheets. Shrinkage of the stainless steel elements during rack assembly welding created minor distortion of the panels.

These characteristics tend to resist migration of the Boraflex sheets even with the presence of gaps. While there is no positive design feature to preclude downward movement of the Boraflex, it is extremely unlikely. Movement could occur if no binding existed over the entire portion of the Boraflex panel above the gap. This is unlikely since the cladding thickness tolerance (0.006 inches) and the Boraflex thickness tolerance (0.007 inches) are very small and would have to be in an unfavorable orientation over a large surface area. This orientation must allow a free unrestricted downward movement of the Boraflex and a corresponding relocation of the displaced water.

However, if a panel did slip downward, this would in effect relocate the gap to the top of the Boraflex panel. The Cycle 4 Boraflex gap analysis (AECM-89/0037) assumed that all gaps were co-planar in the mid-plane of the rack. Relocation of a gap to the higher neutron leakage area at the top of the rack is a less reactive configuration and therefore is bounded by the Cycle 4 analysis.

The Cycle 5 Boraflex Gap analysis (AECM-90/0068) assumed that all gaps occurred adjacent to enriched fuel. The gaps were assumed to occur in random locations in the central 6 feet about the center of the rack. Relocation of a gap to the top of the rack would place the gap in a high leakage area adjacent to the naturally enriched fuel in the top 12 inches of the Cycle 5 bundles. This is a less reactive configuration and therefore is bounded by the Cycle 5 analysis.

In order to assure that the consequences of such an event remains bounded by the analyses results, the Boraflex gap measurement results will be compared to the acceptance criteria described in AECM-90/0068 for both the Cycle 4 and 5 analysis assumptions.

2. **QUESTION**: In the second paragraph of Response No. 5 (Reference AECM-89/0209), it is indicated that the Boraflex sheets at GGNS are so tightly sandwiched between sheets of stainless steel that even if a Boraflex segment is to become unattached from the cell wall, it would not be susceptible to movement. A review of Figures 3.1 and 3.2 of "The Licensing Report on High Density Spent Fuel Racks," submitted by letter dated May 6, 1985, indicates that the clear gap between stainless steel sheets is 0.132 inches, and the nominal Boraflex thickness is 0.070 inches. Thus, there is a clear space of 0.062 inches in which the sheets can slump under seismic loading, if not kept in place by the adhesive. Provide information on means to assure no excessive downward movement of Boraflex during a seismic event.

**RESPONSE**: The tee, ell, and cruciform elements used in the construction of the high density racks were first fabricated as individual elements and then assembled to form a rack. Boraflex sheets were first cemented to two faces of about half of the angular stainless steel subelements (Figure 3.3 of AECM-85/0143). To fabricate a cruciform, for example, two angular subelements with Boraflex on two faces and two angular subelements without Boraflex were used. These four panels were clamped together to form the cruciform utilizing 0.070" $\pm$ 0.006" side strips and end strips to avoid excessive compression of the Boraflex sheets. The sides and ends of the cruciform were then welded to maintain this configuration until the cruciform was used in a rack assembly. Consequently, the dimensions of the Boraflex space in between the sandwiched elements is controlled by the side and end spacer strips.

The tee, ell and cruciform elements are welded together to fabricate the racks using a "jig" to maintain cell pitch and the overall rack dimensions. The overall rack is measured to confirm the average cell pitch along with a random measurement of approximately 30 percent of the cells. This process assures that the cell pitch (6.2585 inches) is within the specified tolerances. The cell face-to-face dimension (6.0 inches) is provided for reference only.

Since the Boraflex geometry is controlled by the thickness of the end strips, sliding of one panel past another is precluded even considering the worst case application of the Boraflex and end strip tolerances.

3. **QUESTION**: With reference to Responses 4 and 6 (Reference AECM-89/0209), provide clarification of what is meant by "scatter loading" if excessive degradation of Boraflex is indicated in the surveillance program. If use of the racks is restricted because of excessive degradation describe the safety evaluation that will be performed and approvals, including NRC approval, that will be obtained prior to such use.

**RESPONSE**: A scatter loading plan, also known as a checker board loading, is one in which every other rack cell is empty such that no two fueled cells have adjacent faces but may have adjacent corners.

If the Boraflex gap testing program indicates excessive degradation, a safety evaluation will be performed under the guidelines of 10CFR50.59. Should this safety evaluation indicate the presence of an unreviewed safety question, a criticality safety analysis will be submitted for NRC review and approval.

4. **QUESTION**: Provide results of blackness tests to date and compare with the EPRI data in EPRI NP-6159, December 1988. Provide a commitment to submit data and analysis justifying discontinuance of the surveillance tests to the NRC for review and approval prior to discontinuing the tests.

**RESPONSE**: GGNS-1 Boraflex gap measurements, i.e., a curve of Boraflex shrinkage versus gamma fluence for the initial gap measurements, are provided in Figure 1. The EPRI predictions for maximum Boraflex shrinkage (1) are also provided in Figure 1 for reference. This figure shows the average panel shrinkage versus average gamma fluence for four gap size intervals as follows:

| Category | Gap Size (inches) |
|---|---|
| A | 0.0 |
| B | 0.1 - 0.5 |
| C | 0.6 - 1.0 |
| D | 1.1 - 1.4 |

The shrinkage is estimated based upon 144 inch Boraflex panels and the assumption that the shrinkage is equal to the gap size.

SERI will continue testing for each cycle until an evaluation of the data and analysis justifying discontinuance of the surveillance tests is submitted for NRC review, and NRC approval for discontinuing the tests is obtained.

Figure 1: Boraflex Shrinkage vs Gamma Fluence