VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

June 10, 1997

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No. 97-305
NL&OS/ETS R2
Docket Nos. 50-338, 339
License Nos. NPF-4, 7

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2
SUPPLEMENTAL RESPONSE TO NRC GENERIC LETTER 96-04

In a letter dated October 24, 1996 (Serial No. 96-350), Virginia Electric and Power Company responded to Generic Letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks." North Anna Power Station spent fuel storage rack design does include Boraflex as a neutron absorber and additional testing and evaluation were required. The attachment to this letter discusses the results of the blackness testing and evaluation for North Anna Power Station.

The generic letter requested that licensees with spent fuel storage racks containing the neutron absorber Boraflex provide an assessment of the physical condition of the Boraflex and provide the results of that assessment and any actions to ensure five percent subcritical margin is maintained. The assessment of the physical condition of the Boraflex in the North Anna spent fuel storage racks provided in our initial response to Generic Letter 96-04 was based primarily on estimated gamma dose to the Boraflex panels and an empirical shrinkage correlation. The shrinkage correlation is a function of gamma dose and bounds most of the utility data derived from Boraflex surveillance coupon programs. Based on test results reported by EPRI, it was anticipated that the actual condition of the Boraflex panels in the North Anna racks would be less limiting than what was assumed in the initial assessment provided the NRC. Testing of the Boraflex was planned to determine the actual configuration of a sample of Boraflex panels. In the interim, compensatory measures were procedurally implemented to ensure that five percent subcritical margin in the storage racks would be maintained in unborated water.

The blackness tests performed at North Anna Power Station in January 1997 showed that there is no significant uniform amount of top-down shrinkage of Boraflex in the North Anna spent fuel storage racks. However, testing identified that small gaps had formed in random axial locations along the Boraflex panels. Subsequent analyses confirmed that a minimum of five percent subcritical margin is maintained in unborated water as stated in the Unit 1 and Unit 2 Technical Specifications.

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Since the North Anna testing program and subsequent analyses have verified that a minimum of 5 percent subcritical margin in unborated water is maintained in the North Anna storage racks, compensatory measures for burnup credit are no longer necessary and will no longer be imposed. Virginia Electric and Power Company anticipates that additional licensing action will be taken to achieve a final resolution regarding the use of Boraflex in the design of the North Anna spent fuel storage racks.

No new commitments were intended as a result of this letter. Should you have any questions regarding this response, please contact us.

Very truly yours,

James P. O'Hanlon

James P. O'Hanlon
Senior Vice President - Nuclear

Attachment

cc: U. S. Nuclear Regulatory Commission
Region II
Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
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NRC Senior Resident Inspector
North Anna Power Station

Attachment

VIRGINIA ELECTRIC AND POWER COMPANY

NORTH ANNA UNITS 1 AND 2

SUPPLEMENTAL RESPONSE TO NRC GENERIC LETTER 96-04

BORAFLEX DEGRADATION IN SPENT FUEL POOL STORAGE RACKS

ATTACHMENT
SUPPLEMENTAL RESPONSE TO GENERIC LETTER 96-04

BACKGROUND

The assessment of the physical condition of the Boraflex in the North Anna spent fuel storage racks provided in Virginia Power's initial response to Generic Letter 96-04 was based on estimated gamma dose to the Boraflex panels and an empirical shrinkage correlation as a function of gamma dose which bounds most of the utility data derived from Boraflex surveillance coupon programs. The assessment indicated that 5 percent subcritical margin could not be maintained if uniform shrinkage of the Boraflex occurred resulting in a single large gap at the top of the panel. However, based on test results reported by EPRI, it was anticipated that shrinkage would result in randomly formed gaps along the Boraflex panel instead of resulting in a single large gap at the top. The k_{eff} penalty resulting from gaps forming in random axial locations is significantly less than the penalty if the gaps form in a uniform axial location.

Testing of the Boraflex was planned to determine the actual configuration of a conservative representative sample of Boraflex panels. In the interim, compensatory measures were procedurally implemented to ensure that 5 percent subcritical margin in the storage racks would be maintained in unborated water even in the unlikely event that gaps formed in a uniform axial location. The results of the Boraflex testing would determine whether the current licensing basis for the North Anna rack design must be modified.

NORTH ANNA BORAFLEX BLACKNESS TESTING

A vendor was contracted to perform blackness testing of a sample of the Boraflex panels in North Anna's spent fuel storage racks. Blackness testing provides an indication of the presence of an absorber (or the absence of an absorber in the case of gaps or shrinkage) but does not provide an indication of the areal density of the absorber material (i.e., the quantity of an absorber material which could be decreased as in the case of Boraflex washout or thinning). Based on information and data presented in our initial response to Generic Letter 96-04, thinning or washout of the Boraflex material in the North Anna spent fuel storage rack design is not considered to be a problem.

Gamma dose is the principal cause of Boraflex shrinkage and gap formation. Boraflex is considered to have a saturated dose (i.e., additional shrinkage not expected to occur once the Boraflex material receives a saturated dose) in the range of 1×10^{10} rads to 1.5×10^{10} rads. Therefore, a sample of storage cells having high integrated gamma dose (saturated or nearly saturated) represents a conservative sample selection. Fifty-two storage cells (208 Boraflex panels) were selected as test candidates. Of the 52 cells that were tested, 45 cells had at least one Boraflex panel which exceeded 1.1×10^{10} rads. Twenty-nine of the 52 cells had Boraflex panels with integrated gamma dose ranging from 1.5×10^{10} rads to 2.2×10^{10} rads. Therefore, most of the tested cells had Boraflex panels which had received or had nearly received a saturated gamma dose. Two of the cells were selected

because of their low integrated gamma dose (less than 1×10^6 rads) to verify that any gap formation observed in the other fifty cells could clearly be attributed to dose and not some other physical phenomenon.

Testing of selected spent fuel storage cells began on January 8, 1997 and was completed on January 14, 1997. There were two types of blackness tests performed. The first type of test examined only the top four feet of the storage cell to determine if any significant top-down shrinkage of Boraflex had occurred. Twenty-five cells (100 Boraflex panels) were tested in this manner for top-down shrinkage. The second type of test examined the full length of the Boraflex panels to determine the gap distribution and gap widths. Fifty-two cells (208 Boraflex panels) were tested for full length effects.

RESULTS AND EVALUATION

Blackness testing revealed that there is no uniform top down shrinkage in excess of two inches, and top-down shrinkage in excess of one inch is atypical. While several panels had shrunk from the top-down by more than one inch, the data indicate that most top-down shrinkage is on the order of several tenths of an inch referenced from the nominal top axial position of the Boraflex panels.

Two low dose cells were also tested for comparison purposes. The cumulative gamma dose in these cells is less than 10^6 rads. This dose is below the point at which shrinkage is expected to begin. The full length measurements in these cells indicated that there are no gaps in any of the Boraflex panels in these cells. Even though top-down shrinkage measurements were not specifically performed in these two cells, there was no indication of any significant top-down shrinkage by review of the strip charts for the full length gap tests.

The full length measurements in the high gamma dose cells indicated that the Boraflex in the North Anna spent fuel storage racks contained numerous small gaps distributed over the length of the Boraflex panel. Of the 50 high gamma dose cells that were tested, 560 small gaps (a small gap is defined as any gap less than 0.7 inch wide) were detected with many gaps too small to accurately quantify. In addition to the small gaps, 65 larger gaps were also measured. The 65 larger gaps range in width from 0.7 inch to 1.9 inches. All but 11 of the these 65 gaps are 1 inch wide or less, and the average width is 0.9 inch.

A criticality analysis of the as-found condition of the Boraflex in a representative 4x4 matrix of cells resulted in a k_{eff}, including uncertainties, less than 0.95. This analysis confirms that the North Anna spent fuel storage racks continue to maintain a minimum of 5 percent subcritical margin in unborated water as defined in the Technical Specifications, and the design basis of the North Anna spent fuel storage racks continues to be met. No compensatory measures for burnup credit are required to maintain subcritical margin at this time.

CONCLUSIONS

The blackness tests performed at North Anna in January 1997 showed that there is no significant uniform amount of top-down shrinkage of Boraflex in the North Anna spent fuel storage racks. To the extent that there is any uniform top-down shrinkage, it is generally less than an inch referenced from the nominal unirradiated location of the top of the Boraflex panels. This amount of top down shrinkage is not significant with respect to k_{eff}. The blackness test results indicated that there are numerous small gaps randomly located along the Boraflex panels (axially). There are a total of about 560 very small gaps in 50 panels having an appreciable gamma dose. In addition to the 560 gaps, there are 65 larger gaps ranging from 0.7 inch wide to 1.9 inch wide with an average width of 0.9 inch. When the presence of these gaps are factored into criticality evaluations which assume the pool is flooded with unborated water, the resultant k_{eff}, including uncertainties, is less than 0.95.

Therefore, a minimum of 5 percent subcritical margin is available in unborated water as stated in the Unit 1 and Unit 2 Technical Specifications. In addition, the use of Boraflex continues to meet its design basis intent of maintaining subcritical margin in the spent fuel storage racks, and compensatory measures which take credit for reactivity depletion in irradiated fuel are not required at this time. Since many of the tested Boraflex panels had already received a saturated gamma dose, additional shrinkage and gap formation of significance in these cells is not expected. Furthermore, as the Boraflex panels which currently have lower gamma dose accumulate additional dose, it is expected that gaps will form in random axial locations in a manner similar to the gap formation in high dose cells. The reactivity effect as a result of this shrinkage and gap formation is expected to be insignificant.