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AUTH. NAME AUTHOR AFFILIATION
WOODY, C. O. Florida Power & Light Co.
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SUBJECT: Forwards response to NRC 870901 request for addl info re use of Boraflex in rerack & spent fuel pool filter demineralizer in support of util 870612 application for amend to License DPR-67.

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OCTOBER 20 1987

L-87-424

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Re: St. Lucie Unit 1
Docket No. 50-335
Spent Fuel Pool Rerack - Boraflex and Pool Cleanup

By letter L-87-245, dated June 12, 1987, Florida Power & Light Company (FPL) submitted a proposed license amendment to permit replacement of the spent fuel pool racks at St. Lucie Unit 1 to ensure that sufficient future capacity exists for storage of spent fuel.

By letter dated September 1, 1987 (E. G. Tourigny to C. O. Woody) the NRC Staff requested additional information in the area of the use of Boraflex in the rerack and the spent fuel pool filter demineralizer it needed to continue its review of this proposed license amendment.

Attached is FPL's response to this request.

If additional information is required, please contact us.

Very truly yours,

C. O. Woody
Group Vice President
Nuclear Energy

COW/EJW/gp

Attachments

cc: Dr. J. Nelson Grace, Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant

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ATTACHMENT

RESPONSES TO NRC LETTER

DATED SEPTEMBER 1, 1987

(E. G. Tourigny to C. O. Woody)

QUESTION #1 Recent anomalies have been identified in the Quad Cities and Point Beach spent fuel pools due to Boraflex shrinkage caused by irradiation. Based on this, provide justification to demonstrate the continued acceptability of Boraflex for application in the St Lucie spent fuel pool.

RESPONSE: Boraflex is the neutron absorbing poison used in the new St Lucie Unit 1 spent fuel racks. This material assures a shutdown margin of 5% with no boron in the spent fuel pool water. Additional details are provided in Section 4.7.2 of the St Lucie Plant Unit No 1 Spent Fuel Storage Facility Modification, Safety Analysis Report, transmitted via letter L-87-245 dated June 12, 1987.

Boraflex has undergone extensive qualification testing to study the effects of gamma and neutron irradiation in various environments and to verify its structural integrity and stability as a neutron absorbing material. These tests indicated that Boraflex maintains its neutron attenuation capabilities when subjected to an environment of borated water and 1.03×10^{11} rads gamma radiation. Additionally, further tests(1) have recently been conducted and preliminary results indicate that some shrinkage (a maximum of about 2%) can occur in Boraflex, and that this shrinkage is complete at approximately 1×10^{10} rads gamma.

- Three plants (Point Beach, Prairie Island and Quad Cities) have reported the results of their Boraflex surveillance. Of these three, the Boraflex material used at Point Beach Nuclear Power Plant has received the highest accumulated dose. This Boraflex material has been in use for a total of five years, and some of the Boraflex panels have received a 20 year-equivalent radiation dose due to the spent fuel management techniques used at Point Beach. The examination of the 2" x 2" sample coupons at Point Beach (which had a maximum exposure of 1.6×10^{10} rads gamma) showed that the coupons had experienced changes in physical characteristics such as color, size, hardness, and brittleness, with some sample thinning. However, the nuclear characteristics of the samples had not experienced any unexpected changes, and the boron absorbing properties of the samples met the acceptance criteria for maintaining the 5% $\Delta k/k$ shutdown margin. Point Beach also examined two full size (150" long x 8" wide) Boraflex panels, which had a maximum exposure of about 1×10^{10} rads gamma. These panels had a far lesser amount of physical changes than the 2" x 2" sample coupons. Thus, the examination of the Point Beach coupons and Boraflex panels indicates that, while some physical changes in Boraflex may occur with accelerated radiation exposure, the Boraflex will retain its neutron absorbing characteristics.

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(1) Irradiation Study of Boraflex Neutron Absorber, Interim Test Data, Bisco Products, Inc. Technical Report No NS-1-050 (Interim), June 25, 1987, Rev. 0.

QUESTION #1

RESPONSE: (continued) Prairie Island has also examined two large (8" x 12") Boraflex coupons(2). One of the coupons (which had a 6 month exposure) had an appearance similar to the as-manufactured Boraflex. The other coupon (which had a 12 month exposure) had some slight physical changes similar to that experienced by the Boraflex panels at Point Beach.

The Boraflex panels in the Quad Cities racks (which had an exposure of about 10^9 rads gamma) were examined by a neutron surveillance technique. Gaps were noted in the Boraflex panels, and review of the size and number of gaps was performed. This review indicated that the gaps were attributed to a rack design and fabrication process which did not allow the Boraflex to shrink without cracking. The Quad Cities racks were designed to hold smaller BWR fuel. The fabrication process required the Boraflex material to be glued to the stainless steel fuel rack walls. Also, the Boraflex remained tightly clamped during service. This did not allow for the predicted shrinkage of Boraflex and as such gaps developed. Less than half of the Boraflex panels at Quad Cities had gaps, varying in length up to a maximum of 4", and were located at various locations along the height of the panels. A k_{eff} analysis of the Quad Cities spent fuel pool demonstrated that these gaps did not cause Quad Cities to exceed its 0.95 limit on k_{eff}.

The St Lucie racks are designed to hold the larger PWR fuel assemblies. The Boraflex sheets are not glued or clamped in place; but instead are supported by the stainless steel cell walls, stainless steel cover sheets and/or connecting strips, as illustrated in Figures 4-7 and 4-8 of the St Lucie Plant Unit No 1 Spent Fuel Storage Facility Modification, Safety Analysis Report, transmitted via letter L-87-245 dated June 12, 1987. This arrangement allows the Boraflex sheets to contract freely in Region 2 and the exterior cell walls of Region 1, with no mechanism for restraint of the Boraflex. For the interior cell walls of Region 1, as illustrated on coordinate C-2 of Joseph Oat Corporation drawing D-8286, REV. 1, provided with Response 1a of FPL Letter L-87-422, dated October 20, 1987, the Boraflex is similarly allowed to contract without restraint unless and until the potential Boraflex shrinkage is sufficient to result in contact between the Boraflex cutouts and the cell wall to cover sheet spot welds. Should these spot welds act as a restraint on the Boraflex, they would effectively pin the Boraflex in place, preventing formation of any large gaps due to further shrinkage of Boraflex.

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(2) May 26, 1987 memorandum from Ray W Lambert of Electric Power Research Institute to Attendees of Boraflex Review Meeting at the EPRI Workshop of May 20, 1987, EPRI-RP-2813-4.

QUESTION #1

RESPONSE: (continued)

The St Lucie spent fuel racks design requires oversized (in length) Boraflex sheets to be used to provide a four inch shrinkage allowance, and that allowances for the elastic rebound of the Boraflex material be made before installation should the material be stretched during shipment or handling. The installation of the material in a stretched or restrained condition is not permitted. Florida Power & Light Company has a full-time Quality Assurance representative assigned to the fabricator's shop to ensure that the specification requirements are adhered to. The installation of torn or cracked sheets of Boraflex is never permitted.

In conclusion, the St Lucie racks design features and fabrication procedures ensure that any shrinkage of the Boraflex sheets during in service irradiation will not result in potential criticality problems for the stored fuel by:

- Using oversized Boraflex sheets to provide a four inch allowance for potential Boraflex shrinkage.
- Allowing for Boraflex shrinkage with no restraint mechanism.
- Preventing large gap formation over long term irradiation in Region 1 interior cell walls.
- Providing for installation of Boraflex in a non-stretched condition, with no tears or cracks.
- Maintaining a full-time Florida Power and Light Company Quality Assurance representative during fabrication in addition to the Boraflex manufacturer's and rack fabricator's own Quality Assurance staff to ensure specification requirements are met.

Further, the experience at Point Beach indicates that some physical changes may occur in Boraflex, but that the Boraflex will retain its neutron attentuation properties. Both testing of Boraflex and the experience at Quad Cities indicate that some shrinkage in Boraflex may occur, but that this shrinkage is limited to a maximum of about 2% of the length of the Boraflex. This resulted in some gaps in the Quad Cities Boraflex panels because the racks did not permit the Boraflex to shrink without cracking. In any case, due to the small size and the random orientation of the gaps, the calculated k_{eff} of the Quad Cities spent fuel pool did not exceed the 0.95 limit. Since there are differences in the installation process of the Boraflex used at Quad Cities and St Lucie 1, the anomalies experienced at Quad Cities are not expected at St Lucie.

QUESTION #2 Based on the recent information pertaining to degradation of Boraflex, provide any changes to the inservice surveillance program for Boraflex and describe the frequency of examination and acceptance criteria for continued use.

RESPONSE: To confirm that the Boraflex at St Lucie is acceptable for continued use, as described in Section 4.8 "Testing and In-Service Surveillance" of the St Lucie Plant Unit No 1 Spent Fuel Storage Facility Modification, Safety Analysis Report, transmitted via L-87-245 dated June 12, 1987, FPL will conduct an in-service surveillance program. This program will evaluate both Region 1 and Region 2 Boraflex samples.

Based on industry observations that small surveillance coupons are not representative of (e.g., show significantly more degradation than) full length Boraflex sheets, FPL has increased the size of the surveillance coupons to 5" x 15". No other changes in FPL's surveillance program are proposed at this time, however, FPL plans to monitor the results of industry programs currently underway to evaluate the performance of Boraflex, and may propose changes in the surveillance program at a future date.

In the current program, two types of tests for each Region are planned - a long term test, with coupons surrounded by the same spent fuel assemblies during the entire irradiation period, and an accelerated test, with coupons surrounded by freshly discharged spent fuel assemblies each refueling. The long term test coupon examination frequency is after irradiation times of 90 days, 180 days, 1 year, 5 years, 10 years, 15 years, 25 years and 35 years. The accelerated test coupon examination frequency is after each discharge from the second discharge to ninth discharge rack utilization. Acceptance criteria for continued use are dimensional changes no more than 2.5% from the original, hardness not less than 90% of the original, and minimum areal density of boron not less than the original. Any test results exceeding these limits will require an engineering evaluation to determine continued acceptability.

QUESTION #3 Describe the corrective actions to be taken if degraded Boraflex specimens or absorber sheets are found in the spent fuel pool.

RESPONSE: FPL will follow the industry efforts concerning the performance of Boraflex. EPRI, Bisco (the manufacturers of Boraflex) and several utilities are analyzing data as it becomes available and will notify the industry of the results. FPL will evaluate these results and determine whether any additional actions are warranted for the St Lucie Unit 1 spent fuel racks.

In the meantime, the St Lucie design provisions and fabrication procedures indicated in response to Question #1 ensure that currently understood observations of Boraflex degradation will not result in potential criticality problems for the stored fuel.

In addition, the following corrective action options to assure continued safe storage of St Lucie spent fuel would be considered by FPL if unexpected degradation problems are detected:

1) The degraded Boraflex could be evaluated to determine whether the degradation and any expected future degradation would adversely affect FPL's ability to satisfy the .95 k_{eff} limit for the St Lucie spent fuel pool. If the pool could still satisfy this limit, no further action would be necessary.

2) Administrative controls could be imposed on the enrichment and/or burnup of fuel to be placed in or adjacent to storage cell locations that have degraded Boraflex to assure that the k_{eff} would remain less than or equal to the .95 limit.

3) A poison material such as a control rod or burnable poison could be added to any new fuel assembly to be placed in a storage cell with degraded Boraflex. This would reduce the k_{eff} to less than or equal to the .95 limit.

4) Poison plates could be added into the space between the fuel assembly and the cell wall to assure a k_{eff} of less than or equal to .95.

5) FPL has taken no credit for the 1720 ppm soluble boron concentration in the spent fuel pool water. This boron concentration is equivalent to a Δk_{eff} of .17 to .18 for the as-designed racks, as indicated in Table 3-1 of the St Lucie Plant Unit No 1 Spent Fuel Storage Facility Modification, Safety Analysis Report, transmitted via letter L-87-245 dated June 12, 1987, resulting in subcriticality even with a postulated significant loss of boron from the Boraflex.

QUESTION #3

RESPONSE:

6) The storage cells with the degraded Boraflex could be blocked off to prevent loading of any fuel assembly into the cell.

7) The storage racks with the degraded Boraflex could be coated with boron with a sufficient density to assure k_{eff} of less than or equal to .95.

QUESTION #4 Provide information regarding criteria for replacing the filter demineralizer of the spent fuel pool clean-up system to ensure its effectiveness to handle the high-density storage.

RESPONSE: The filter demineralizer of the spent fuel pool clean-up system for St Lucie Unit No 1 consists of the purification filter and the ion exchanger. The criteria for replacing the purification filter and the ion exchanger is limited by operating procedures to not exceed a differential pressure of 20 psig across each component.

No significant increase in the volume of solid radioactive wastes is expected due to the new high density spent fuel racks. Other plant operating experience with high density fuel storage has not indicated any noticeable increase in the solid radioactive wastes generated by the increased fuel storage capability. Additional details are provided in Section 5.2 of the St Lucie Plant Unit No 1 Spent Fuel Storage Facility Modification, Safety Analysis Report, transmitted via letter L-87-245 dated June 12, 1987.

Therefore, the criteria for replacing the filter demineralizer of the spent fuel pool clean-up system ensures its effectiveness to handle the high-density storage.