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The Northeast Utilities System

May 7, 1997
Docket No. 50-336
B16412

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Millstone Nuclear Power Station, Unit No. 2
Spent Fuel Rack Poison Surveillance Coupon Program

In a letter to the NRC dated July 24, 1985 [1], Northeast Nuclear Energy Company (NNECO) committed to a long term poison material in-service surveillance program for Boraflex neutron poison material used in the Millstone Unit No. 2 Spent Fuel Pool (SFP).

As part of the SFP poison material in-service surveillance program, NNECO committed to testing representative Boraflex samples placed within surveillance coupons positioned within specified areas of the SFP. At specific intervals the coupons were to be removed and tested. Based on the most recent coupon test, as reported in Attachment 1 of this letter, NNECO is informing the NRC that Boraflex obtained from the in-service Millstone Unit No. 2 spent fuel racks will be used as a substitute for the Boraflex coupons for future surveillance testing.

There are no commitments contained within this letter.

Should you have any questions on the information provided, please contact Mr. R. G. Joshi at (860) 440-2080.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

M. L. Bowling
Millstone Unit No. 2 Recovery Officer

cc: See Page 2

(1) J. F. Opeka to Edward J. Butcher of the U.S. Nuclear Regulatory Commission, "Millstone Nuclear Power Station, Unit No. 2, Proposed Change to Technical Specifications Modifications to Spent Fuel Storage Pool," dated July 24, 1985.

cc: W. D. Travers, PhD.,Director, Special Projects Office
H. J. Miller, Region I Administrator
D. P. Beaulieu, Senior Resident Inspector, Millstone Unit No. 2
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Attachment 1

Millstone Nuclear Power Station, Unit No. 2

Spent Fuel Rack Poison Surveillance Coupon Program

May 1997

Millstone Nuclear Power Station, Unit No. 2
Spent Fuel Rack Poison Surveillance Coupon Program

This report describes activities related to the recent removal of a Boraflex surveillance coupon from the Millstone Unit No. 2 Spent Fuel Pool (SFP). Some of the spent fuel storage racks in the SFP contain Boraflex as the neutron absorbing material. In May 1996, NNECO removed Boraflex surveillance coupon number 6 from the SFP. This is the 5th time an irradiated Boraflex surveillance coupon has been removed from the SFP. The testing results of the first 4 irradiated Boraflex surveillance coupons were provided in the Northeast Nuclear Energy Company (NNECO) response to NRC Generic Letter 96-04 (reference 1).

This report provides the following information:

1) Describe the poor condition of the Boraflex observed in coupon number 6;

2) Re-affirm the past conclusions reached by NNECO (in reference 2), and concurred with by the NRC (in reference 3), that because the Boraflex coupons contain vent holes which leave the Boraflex coupons open to water, the coupon degradation is not indicative of the Boraflex condition in the spent fuel racks, which are not directly exposed to water;

3) The response to NRC Generic Letter 96-04 (reference 1) is still valid because the Boraflex degradation in the coupons are not indicative of the Boraflex condition in the racks, and;

4) The coupons have reached a point where they are no longer useful in providing information concerning performance of the Boraflex in the spent fuel racks, therefore, NNECO is planning to use Boraflex removed from the spent fuel racks for future Boraflex surveillance testing.

Because NNECO committed in reference 4, Section 4.7, to test Boraflex samples "to be placed within surveillance capsules", NNECO is informing the NRC that Boraflex obtained from the in-service Millstone Unit No. 2 spent fuel racks will be used as a substitute for the Boraflex coupons for future surveillance testing.

Background

The Boraflex surveillance coupons consist of a Boraflex sample of about 3 inches in length, 2.75 inches in width and 0.11 inches in thickness. The coupon is sandwiched between two stainless steel plates which are .033 inches thick. A 3/8 inch diameter

vent hole is located in the center of each plate, exposing the Boraflex to water. The surveillance coupon assembly is placed between fuel assemblies, such that the gamma dose received by the surveillance system exceeds the dose received by typical Boraflex material in the SFP racks.

Recent Boraflex Coupon Testing Results

In January 1997, a report on the testing (performed by HOLTEC International) of Boraflex coupon number 6 was received. This report indicated that the Boraflex in the coupon was in poor condition due to washout (erosion) of the Boraflex in the area of the vent hole in the coupons. This is similar to the condition reported by NNECO to the NRC in 1990 (reference 2) when coupon number 5 was inspected, but the extent of Boraflex washout in coupon 6 is much larger than what was found in coupon number 5. Coupon 5 (removed in July 1990) had about a 3/8 inch hole of missing Boraflex, corresponding to the size of the vent hole in the stainless steel cover, with about a surrounding 1 inch diameter annulus of eroded Boraflex of varying thickness. The Boraflex weight loss for coupon 5 (compared to its original condition) was about 1.3%. The testing of coupon number 6 (removed in May 1996) showed the Boraflex coupon was in poor condition, with about a 1 inch hole of missing Boraflex in the center, with the missing Boraflex centered on the vent hole in the stainless steel cover. The center hole was surrounded by a roughly annular region of Boraflex which had been tapered by erosion from a sharp edge at the hole to almost a normal thickness at the outer edge of the annular region. The corners and edges of the coupon remained generally sharp and well defined, despite some areas of visible edge erosion. The cumulative loss of Boraflex material in coupon number 6 is approximately 17% by weight, relative to its original weight. Neutron attenuation tests of four intact areas showed normal B-10 areal density in 2 of the 4 locations and 15% lower B-10 areal density in 2 other locations where significant erosion was present. The density of the coupon indicates a very high radiation dose to the coupon that is not far from the saturation value.

Relationship of Boraflex coupons to Boraflex in the spent fuel racks

The Boraflex washout (erosion) damage observed in coupons 5 and 6 is typical of that seen in the industry for Boraflex exposed to high gamma irradiation doses simultaneous with direct exposure to water. The Boraflex coupon system provides early warning of the Boraflex condition in the racks, since the coupons are positioned to receive the highest gamma doses. However, the Boraflex washout of the coupons is not indicative of the current condition of the Boraflex in the spent fuel racks. The washout of the Boraflex in the coupons is primarily due to the coupons having a 3/8 inch hole in both sides of the stainless steel (SS) jackets which encase the Boraflex. This allows for direct contact of the Boraflex with water. The Boraflex in the spent fuel racks is not directly exposed to water, with one exception. This exception being the spent fuel rack Boraflex panels which have a 3/8 inch vent hole in one side of the SS that covers each Boraflex panel. This vent hole is located at an elevation above the

top of active fuel, and is not subject to the high gamma doses typically received by Boraflex material located in the active fuel region of the SFP.

In 1990, when Boraflex coupon 5 was removed from the SFP, the Boraflex degradation in the vent hole location was reported to the NRC in reference 2. In reference 2, NNECO stated:

"NNECO's conclusion is that this deterioration experienced in the surveillance coupon does not affect the calculated Keff of the spent fuel racks... The conclusion is based upon the fact that the vent hole in the spent fuel racks is above the active fuel region and, if the erosion exists at the vent hole location in the racks, it does not affect the current qualification to store spent fuel."

In February 1991, the NRC concurred with this assessment in reference 3.

Therefore, as we have previously stated, any deterioration of the Boraflex in the vent holes of the actual racks (should it occur) will have a negligible effect on the Keff of the SFP. Therefore, the results from Boraflex coupon number 6 are a continuation of a previously documented problem.

Relationship of Boraflex coupon results to Generic Letter 96-04 Response

NNECO's recent submittal to the NRC (ref. 1) described our current Boraflex testing program, including past results and how we ensure that Keff of the spent fuel pool is maintained at less then 0.95. The results from the testing of Boraflex coupon 6 does not provide information which is directly applicable to the Boraflex in the spent fuel racks because of the coupon vent hole. Therefore, the results from coupon number 6 testing do not alter the conclusion provided in reference 1 that the Keff of the spent fuel pool is maintained at less then 0.95.

Also in reference 1, based on what we had previously seen with coupon 5, we had predicted that this problem would eventually occur. In reference 1 we stated to the NRC our expectation, that due to the vent holes in the coupon, the coupons would eventually not provide any further useful information on the performance of the Boraflex in the racks. Further removal and examination of coupons will not provide any value. As stated in our letter to the NRC (reference 1), NNECO anticipated that when this point was reached, there would be a switch from inspection and testing of Boraflex coupons, to inspection and testing of Boraflex directly from the spent fuel racks, obtained by removing a Boraflex poison box from the racks. In 1991 a poison box from the SFP was removed and inspected, and the results of the Boraflex inspection were described to the NRC in reference 1. The poison box inspected in 1991 had Boraflex with a very high gamma dose, estimated to be 2×10^{10} rads, and was in very good condition except for expected Boraflex gaps (identified by previous Blackness testing) and some minor Boraflex erosion. The gamma exposures to Boraflex panels have not changed appreciably since then, given the amount of shutdown time for Millstone Unit

No. 2 over the last 5 years. Also, as described in reference 1, Millstone Unit No. 2 continues to have very low Silica concentrations in the SFP, about 1.5 ppm. Silica is a direct by-product of Boraflex erosion. The low silica levels are indicative of the racks not being susceptible to significant Boraflex erosion. Also, as described in reference 1, a 3rd campaign of Blackness testing was performed in the SFP in 1996. While Blackness testing is performed for the purpose of identifying Boraflex gaps, not erosion, any erosion which essentially eliminates all Boraflex would also be noted. No unusual results from the Blackness testing were noted, with the largest gaps found to be less than 2 inches. In this third round of Blackness testing, 89 of 384 Boraflex cells were checked. The 89 cells tested were located in the rack area with the largest gamma dose. Based on the 1991 poison box examination of Boraflex from the racks and the continuing low values of SFP silica concentrations, the racks are not suffering any significant erosion damage, and the conclusions NNECO stated to the NRC in reference 1 are still valid.

Future Boraflex Monitoring Activities

The Boraflex washout (erosion) damage of coupon number 6 is typical of that seen in the industry for Boraflex exposed to high gamma irradiation doses simultaneous with direct exposure to water. Boraflex coupon number 6 provides an early warning that the Boraflex in the SFP racks with the highest gamma dose, if directly exposed to water, has the potential for substantial erosion. While Boraflex in the racks is not directly exposed to water (other than the vent hole above the active fuel height), direct periodic examination of the Boraflex in the racks will be needed to confirm that the Keff limit of 0.95 is not exceeded due to erosion. NNECO has previously described to the NRC (reference 1) several planned future activities with regard to Boraflex, namely periodic blackness testing, monitoring of SFP silica concentrations, setting up of EPRI RACKLIFE models to further understand the performance of Boraflex in the racks, removal of Boraflex from the racks for examination (as necessary), and calculations/planning to determine the necessary steps to eventually stop crediting Boraflex as a long term solution. These activities have not been altered due to the results of Boraflex coupon number 6.

NNECO has previously committed to the NRC in reference 4, Section 4.7, to test Boraflex samples "to be placed within surveillance capsules." Therefore, the NRC is being informed of NNECO's plan to change the Boraflex surveillance program to use Boraflex from spent fuel racks poison boxes for future surveillance of Boraflex performance. As previously stated, Boraflex has been removed and inspected from the SFP racks, so this is a known, demonstrated process. NNECO would perform the same tests on the Boraflex taken from the racks as would be performed on a Boraflex coupon. The Boraflex used for future testing would be removed from area in the SFP estimated to have a high gamma dose and/or largest Boraflex gaps. New poison boxes are available to replace the removed poison boxes.

Conclusions

A review of the results from the testing of Boraflex surveillance coupon 6 demonstrated that the known problem with the coupon vent holes has degraded. As previously documented to the NRC (reference 2), and concurred with by the NRC (reference 3), washout of the Boraflex coupon due to the coupon vent hole does not appear to be indicative of the general condition of the Boraflex in the spent fuel racks. NNECO's recent response to Generic Letter 96-04 (reference 1) described our current testing program, past results, and how we ensure that Keff of the spent fuel pool is maintained at less then 0.95. The results from coupon number 6 testing does not alter our conclusions as stated in our response to Generic Letter 96-04. Further, in reference 1 NNECO stated to the NRC the expectation that due to the vent holes in the Boraflex coupons, the coupons would eventually provide no further useful information on the performance of Boraflex located in the SFP racks. Therefore, NNECO is informing the NRC that the Boraflex surveillance program will no longer use Boraflex coupons, but instead use Boraflex from the spent fuel racks poison boxes for future surveillance of Boraflex performance.

References:

(1) T. C. Feigenbaum letter to Nuclear Regulatory Commission, "Haddam Neck Plant, Millstone Nuclear Power Station, Unit Nos. 1, 2, and 3, Response to NRC Generic Letter 96-04, Boraflex Degradation in Spent Fuel Pool Storage Racks," dated October 24, 1996.

(2) E. J. Mroczka letter to U.S. Nuclear Regulatory Commission, "Millstone Unit No. 2, Spent Fuel Racks Poison Coupon, Surveillance Coupon Boraflex Degradation," dated August 7, 1990.

(3) Guy S. Vissing to E. J. Mroczka, "Boraflex Degradation in Millstone Unit No. 2 Spent Fuel Racks (TAC NO. 77725)," dated February 7, 1991.

(4) J. F. Opeka to Edward J. Butcher of the U.S. Nuclear Regulatory Commission, "Millstone Nuclear Power Station, Unit No. 2, Proposed Change to Technical Specifications Modifications to Spent Fuel Storage Pool," dated July 24, 1985.