NEXTera ENERGY DUANE ARNOLD

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Duane Arnold Energy Center
Docket 50-331
License No. DPR-49

Response to Request for Additional Information Regarding Boral and Protective Coatings in the Duane Arnold Energy Center License Renewal Application

References:
1. Letter, Richard L. Anderson (FPL Energy Duane Arnold, LLC) to Document Control Desk (USNRC), "Duane Arnold Energy Center Application for Renewed Operating License (TSCR-109)," dated September 30, 2008, NG-08-0713 (ML082980623)
2. Letter, Richard L. Anderson (FPL Energy Duane Arnold, LLC) to Document Control Desk (USNRC), "License Renewal Application, Supplement 1: Changes Resulting from Issues Raised in the Review Status of the License Renewal Application for the Duane Arnold Energy Center," dated January 23, 2009, NG-09-0059 (ML090280418)
3. Letter, Brian K. Harris (USNRC) to Christopher Costanzo (Florida Power & Light Company), "Request for Additional Information Regarding Use of Boral Neutron Absorbing Material in Spent Fuel Pool Racks and the Protective Coating Monitoring and Maintenance Program (TAC No. MD9769)," dated September 24, 2009 (ML092580409)

By Reference 1, FPL Energy Duane Arnold, LLC submitted an application for a renewed Operating License (LRA) for the Duane Arnold Energy Center. Reference 2 provided Supplement 1 to the application. By Reference 3 the U.S. Nuclear Regulatory Commission (NRC) Staff requested additional information regarding the use of Boral and the need for a Protective Coating Monitoring and Maintenance Program.

The enclosure to this letter contains the NextEra Energy Duane Arnold, LLC, (f/k/a FPL Energy Duane Arnold, LLC) responses to the Staff's requests for additional information.

This letter contains no new commitments or changes to existing commitments.

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If you have any questions or require additional information, please contact Mr. Kenneth Putnam at (319) 851-7238.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on October 23, 2009.

Christopher R. Costanzo
Vice President, Duane Arnold Energy Center
NextEra Energy Duane Arnold, LLC

Enclosure: DAEC Responses to NRC Requests for Additional Information

cc: Administrator, Region III, USNRC
Project Manager, DAEC, USNRC
Senior Resident Inspector, DAEC, USNRC
License Renewal Project Manager, USNRC
License Renewal Inspection Team Lead, Region III, USNRC
M. Rasmusson (State of Iowa)

RAI 3.3.2.2.6

Note: For ease of review, the response to each subpart of the RAI is provided immediately following the statement of the subpart.

Background:

The applicant states that aging effects due to sustained irradiation of Boral is insignificant, and therefore the implementation of an aging management program (AMP) is not required.

Issue:

Boral has been used at Duane Arnold Energy Center (DAEC) for over 30 years with no evidence of bulging, reduction in neutron absorbing capacity, and/or loss of material. In addition, DAEC, performed spent fuel pool coupon inspections in 2005 and found the results to be consistent with previous staff findings regarding aging effects of Boral. However, this justification is not sufficient in stating that there will not be any bulging, reduction in neutron absorbing capacity, and/or loss of material during the period of extended operation. The staff requires more information in order to determine if an AMP would be required.

Request:

<u>RAI 3.3.2.2.6 Part 1</u>

1. Please provide details regarding the operating experience of the Boral at DAEC. With regards to verifying minimum B-10 areal density in Boral, please also include the following:

<u>Response to RAI 3.3.2.2.6 Part 1</u>

See the responses to subparts a through d below:

<u>RAI 3.3.2.2.6 Subpart 1.a</u>

a. Describe the racks currently in the spent fuel pool at DAEC. Include manufacturer(s) and time spent in spent fuel pool in the description.

<u>DAEC Response to RAI 3.3.2.2.6 Subpart 1.a</u>

As described in the DAEC UFSAR Section 9.1.2.2.1, the spent fuel pool currently contains two types of spent fuel storage racks. There are twelve Programmed and Remote Systems Corporation (PaR) racks installed in 1978, and nine Holtec racks installed in 1994.

The PaR spent fuel racks are of a bolted anodized aluminum construction with a neutron absorber of natural B4C in an aluminum matrix core clad with 1100 series aluminum. The neutron absorber is Boral. The Boral is sealed within two concentric square aluminum tubes forming a "poison can." The outer can is formed into the inner can at the ends and totally seal welded to isolate the Boral from the spent fuel pool water. Each can was pressure and vacuum leak tested. The PaR rack Boral thickness is .080 inches with a minimum B-10 areal density of 0.0232 g/cm².

The principal construction material in the Holtec racks is ASME 240, type 304, stainless steel sheet and plate stock. The neutron absorbing material is boron carbide aluminum cermet under the brand name Boral. The Boral panels are placed in pockets formed between the cell box and the outer sheathing. The sheathing and cell are welded together. The Holtec rack Boral thickness is .070 inches with a minimum B-10 areal density of 0.0162 g/cm².

<u>RAI 3.3.2.2.6 Subpart 1.b</u>

b. For each manufacturer and/or age of rack, describe how the neutron absorbing capacity of the Boral is verified such that the minimum B-10 areal density is maintained for the criticality analysis of record.

<u>DAEC Response to RAI 3.3.2.2.6 Subpart 1.b</u>

The DAEC Boral surveillance program administrative document provides the program requirements for surveillance of the Boral coupons for the Holtec racks. A coupon "tree" is located in the spent fuel pool which originally contained ten coupons. To date, four have been removed for testing. The coupons were placed in the fuel pool in 1994 when the Holtec spent fuel racks were installed. The current test schedule under the program will have a coupon removed for testing prior to every third refueling outage (RFO) with the next coupon being removed and tested prior to RFO 22, currently scheduled for October, 2010. The test schedule may be revised based on industry and plant experience, if warranted. The testing includes visual examination and photographic documentation of appearance, dimensional measurements (length, width, and thickness), neutron attenuation, weight and specific gravity.

Of the measurements performed on the Boral coupons, the most important are (1) the neutron attenuation measurements (to confirm the continued presence of Boron-10) and (2) the thickness measurements (as a monitor for bulging and swelling). The acceptance criteria for these measurements are as follows:

- Decrease of no more than 5% in Boron-10 content as determined by neutron attenuation. This is effectively a requirement for no loss of boron within the accuracy of measurement.
- No increase in thickness at any point greater than 10% of the initial thickness at that point.

The test report from the last coupon test indicated no decrease in B-10 areal density.

The PaR spent fuel racks were installed in 1978 as authorized by License Amendment No. 45 to the DAEC Facility Operating License, issued on July 7, 1978. At that time, no need had been identified for a surveillance program. The license amendment did not contain either a requirement for a coupon program, or a requirement to monitor Boral for degradation of neutron attenuation capability.

The design of the PaR racks is such that the Boral is encapsulated within the racks and is not exposed to the water in the spent fuel pool. Without exposure to water, no surface corrosion, blister formation, or change in dimensions would be expected. In addition, industry operating experience indicates that Boral does not experience significant changes in B-10 areal density due to irradiation. Therefore, there are no apparent mechanisms that are anticipated to degrade the Boral in the PaR racks in a manner that would affect the criticality analysis.

The coupon testing performed for the Holtec racks is viewed as a surrogate indicator for the condition of the Boral in the PaR racks. The wet environment of the Boral in the Holtec racks is considered to be much more severe than the dry, sealed environment of the Boral in the PaR racks. The Boral in the PaR racks also has a substantially higher B-10 areal density than the Boral in the Holtec racks (0.0232 g/cm^2 vs. 0.0162 g/cm^2). In the event changes in the Boral B-10 areal density are detected in the Holtec coupons, the findings will be evaluated for applicability to the PaR racks. To date, no decrease in B-10 areal density has been found in the coupons tested from the Holtec racks.

<u>RAI 3.3.2.2.6 Subpart 1.c</u>

c. If the method used to verify minimum B-10 areal density utilizes Boral coupons, please answer the following:

<u>DAEC Response to RAI 3.3.2.2.6 Subpart 1.c</u>

The responses to Subparts 1.c.i through 1.c.viii apply to the Holtec racks, which are monitored using Boral coupons. The PaR racks are addressed in responses to Subparts 1.d.i through 1.d.v below.

<u>RAI 3.3.2.2.6 Subpart 1.c.i</u>

i. What is the location of coupons relative to the spent fuel racks? What exposure do the coupons receive relative to the range of neutron fluxes given off by the fuel assemblies? Describe how the coupons are mounted. Are they fully exposed to the spent fuel pool water, e.g., fully submerged or bolted to a wall?

<u>DAEC Response to 3.3.2.2.6 Subpart 1.c.i</u>

The Boral coupon "tree" is located in a spent fuel cell. The Boral surveillance program required that the coupon tree be surrounded by recently discharged fuel bundles for the first five refueling outages following installation in 1994. This requirement was inadvertently not satisfied during RFO 17. The coupon tree currently is in a cell in the spent fuel pool surrounded in adjacent cells by fuel which was discharged during RFO 20 in 2007. These requirements are intended to ensure the coupons are exposed to a higher radiation dose than the Boral in the racks would typically experience.

RAI 3.3.2.2.6 Subpart 1.c.ii

ii. What specific testing procedures are used for determining areal density, verifying surface corrosion and examining for blister formation?

DAEC Response to RAI 3.3.2.2.6 Subpart 1.c.ii

The governing procedure for coupon testing at DAEC is the Boral surveillance program administrative document. Testing has been performed by Holtec International. The testing consists of visual examination (to detect pitting, swelling, or other degradation), thickness measurements (to monitor for bulging and swelling), length and width measurements, weight and specific gravity determinations, and neutron attenuation. The results are compared with archive coupons and with the results of previous tests, and any trends are evaluated. Areal density is determined from neutron attenuation, which is measured using a collimated thermal neutron beam and a neutron counter (BF_3).

RAI 3.3.2.2.6 Subpart 1.c.iii

iii. Provide a summary of the test results for the coupons, including areal density measurements. What are the acceptance criteria for these results?

DAEC Response to RAI 3.3.2.2.6 Subpart 1.c.iii

The test results indicate the test coupons were received in good condition with no evidence of blistering, bulging, or degradation. Edges and corners were sharp and well defined indicating an absence of erosion. The average B-10 areal density for the coupons prior to irradiation was 0.0169 g/cm^2. Four Boral coupons have been removed and tested to date with the results for B-10 areal density being 0.0169 g/cm^2, 0.0174 g/cm^2, 0.0164 g/cm^2, and 0.0179 g/cm^2. The acceptance criteria are:

- A decrease of no more than 5% in Boron-10 content, as determined by neutron attenuation.
- An increase in thickness at any point should not exceed 10% of the initial thickness at that point.

RAI 3.3.2.2.6 Subpart 1.c.iv

iv. Discuss the correlation between measurements of the physical properties of Boral coupons and the integrity of the Boral panels in the storage racks.

DAEC Response to RAI 3.3.2.2.6 Subpart 1.c.iv

The Boral in the Holtec spent fuel rack panels and the Boral in the coupons are made from the same production run. In addition, the coupons are mounted in a stainless steel jacket simulating as nearly as possible the actual in-service geometry, physical mounting, materials, and flow conditions of the Boral in the spent fuel storage racks. With the materials and environment being as identical as reasonably achievable, the Boral coupons are designed to be representative of the Boral in the storage racks.

RAI 3.3.2.2.6 Subpart 1.c.v

v. After removal from the pool for inspection, are the coupons inserted back at the same locations in the pool?

DAEC Response to RAI 3.3.2.2.6 Subpart 1.c.v

None of the coupons removed from DAEC spent fuel pool and sent off site for testing have been reinstalled in the spent fuel pool, and no tested coupons are planned to be reinstalled.

RAI 3.3.2.2.6 Subpart 1.c.vi

vi. How is the potential degradation during the time in between surveillance periods accounted for in the criticality analysis of record?

DAEC Response to RAI 3.3.2.2.6 Subpart 1.c.vi

Industry operating experience and the results of testing performed on coupons from the DAEC spent fuel pool indicates Boral does not experience significant changes in B-10 areal density due to irradiation. No degradation of the Boral in the Holtec racks which would affect the criticality analysis is anticipated. Changes in neutron attenuation would develop slowly enough to be detected by the Boral surveillance program coupon testing in time for corrective actions to be implemented prior to the criticality analysis being affected.

In addition, some of the conservative assumptions listed in the spent fuel rack criticality analysis include: 1) the moderator is assumed to be at a temperature corresponding to the highest reactivity (4° C); 2) no credit is taken for radial neutron leakage; and 3) neutron absorption in minor structural members is neglected (i.e., spacer grids are assumed to be replaced by water). DAEC Technical Specification 4.3.1.1 states that the spent fuel storage racks are designed and shall be maintained with fuel assemblies having limits for maximum k-infinity in the normal reactor core configuration at cold conditions of ≤1.29 k-∞ and maximum lattice-average U-235 enrichment weight percent of ≤4.95 wt% for Holtec racks, and ≤1.39 k-∞ and ≤4.95 wt% for PaR racks. Also, k-effective must be ≤0.95 which includes allowance for uncertainties as described in section 9.1 of the DAEC UFSAR. These same values are also present in the spent fuel rack criticality analysis. This compares to an actual maximum of 1.2553 k-∞ and 4.70 wt% U-235 for new fuel in the current cycle. The cumulative exposure of fuel, when finally discharged to the spent fuel pool, averages 25,000 to 35,000 MWD/ton. This exposure reduces the reactivity worth of the fuel to a fraction of its original value and results in substantial margin to the rack design k-∞ and U-235 wt% limits. This demonstrates that ample margin exists in both the PaR and Holtec spent fuel rack designs so that, at no time would the design limits be challenged.

RAI 3.3.2.2.6 Subpart 1.c.vii

vii. Describe the corrective actions implemented if coupon test results are not acceptable.

DAEC Response to RAI 3.3.2.2.6 Subpart 1.c.vii

According to the Boral surveillance program, any changes in excess of the acceptance criteria require investigation and engineering evaluation, which may include early retrieval and measurement of one or more of the remaining coupons to provide corroborative evidence that the indicated changes are valid. If the changes are determined to be valid, an engineering evaluation would be performed to identify any further testing or corrective action that may be necessary. One option that may be considered to augment the coupon measurement program is to perform in-situ testing (Blackness Tests) as required in the event significant degradation is indicated by the coupon tests.

RAI 3.3.2.2.6 Subpart 1.c.viii

viii. Discuss the past testing frequency of the coupons.

DAEC Response to RAI 3.3.2.2.6 Subpart 1.c.viii

When the Holtec spent fuel racks were installed, a coupon "tree" with ten coupons was inserted in a cell location. Four coupons have been removed and tested to date. Testing of these coupons was completed on January 30, 1997, February 9, 1999, January 14, 2000, and May 16, 2005. Coupon testing is performed in accordance with the schedule in the Boral surveillance program administrative document.

RAI 3.3.2.2.6 Subpart 1.d

d. If the method used to verify that minimum B-10 areal density does not utilize Boral coupons, please answer the following:

DAEC Response to RAI 3.3.2.2.6 Subpart 1.d

As previously discussed, the PaR racks do not use Boral coupons for monitoring. The responses to Subparts 1.d.i through 1.d.v apply to the PaR racks. The Holtec racks are addressed in responses to Subparts 1.c.i through 1.c.viii above.

RAI 3.3.2.2.6 Subpart 1.d.i

i. What specific testing procedures are used for determining areal density, verifying surface corrosion, examining for blister formation, and changes in dimensions?

DAEC Response to RAI 3.3.2.2.6 Subpart 1.d.i

No testing was required by License Amendment No. 45, and no testing has been performed on the PaR spent fuel racks.

The Boral in the PaR spent fuel racks is contained in a sealed space that is not exposed to water, so no surface corrosion, blister formation, or change in dimensions is expected. Industry operating experience and DAEC experience with Holtec Boral coupons indicates Boral does not experience significant changes in B-10 areal density due to irradiation. Therefore, there are no apparent mechanisms that are anticipated to degrade the Boral in the PaR racks in a manner that would affect the criticality analysis.

RAI 3.3.2.2.6 Subpart 1.d.ii

ii. What are the parameters tested and acceptance criteria for test results covered under question (i) above?

DAEC Response to RAI 3.3.2.2.6 Subpart 1.d.ii

No testing has been performed on the PaR spent fuel racks.

RAI 3.3.2.2.6 Subpart 1.d.iii

iii. How is the potential degradation during the time in between surveillance periods accounted for in the criticality analysis of record?

DAEC Response to RAI 3.3.2.2.6 Subpart 1.d.iii

Industry operating experience indicates Boral does not experience significant changes in B-10 areal density due to irradiation, so no degradation of the Boral in the PaR racks which would affect the criticality analysis is anticipated. The Boral in the PaR racks has a substantially higher B-10 areal density than the Boral in the Holtec racks and is in a sealed environment. In the event changes in the Boral B-10 areal density are detected in the Holtec coupons, the findings will be evaluated for applicability to the PaR racks.

RAI 3.3.2.2.6 Subpart 1.d.iv

iv. Describe the corrective actions implemented if test results are not acceptable.

DAEC Response to RAI 3.3.2.2.6 Subpart 1.d.iv

No testing has been performed on the PaR spent fuel racks.

RAI 3.3.2.2.6 Subpart 1.d.v

v. Discuss the past testing frequency.

DAEC Response to RAI 3.3.2.2.6 Subpart 1.d.v

No testing has been performed on the PaR spent fuel racks.

RAI 3.3.2.2.6 Part 2

2. Confirm that a method to verify minimum B-10 areal density will continue to be in place during the period of extended operation. Also, please address the following:

DAEC Response to RAI 3.3.2.2.6 Part 2

For the Holtec spent fuel racks, the Boral Surveillance Program utilizing coupons to verify B-10 areal density will be in place during the period of extended operation. No plans are currently in place to verify B-10 areal density in the PaR racks. As discussed above, the coupon testing performed for the Holtec racks is viewed as a surrogate indicator for the condition of the Boral in the PaR racks.

RAI 3.3.2.2.6 Subpart 2.a

a. For each manufacturer and/or age of rack, describe how the neutron absorbing capacity of the Boral will be verified such that the minimum B-10 areal density is maintained for the criticality analysis of record through the period of extended operation.

DAEC Response to RAI 3.3.2.2.6 Subpart 2.a

The responses to Subparts 1.b and 2 above will continue to be applicable during the period of extended operation.

RAI 3.3.2.2.6 Subpart 2.b.i

b. If the method used to verify minimum B-10 areal density will utilize Boral coupons, please answer the following:

i. Confirm that DAEC has sufficient Boral coupon samples to maintain the sampling frequency through the period of extended operation.

DAEC Response to RAI 3.3.2.2.6 Subpart 2.b.i

For the Holtec spent fuel racks, the DAEC has sufficient Boral coupons to maintain the sampling frequency specified in the Boral Surveillance Program through the period of extended operation. The program requires removal and testing of a coupon prior to every third refueling outage. With six coupons remaining, four coupons will be tested with two extra coupons available for testing as needed.

RAI 3.3.2.2.6 Subpart 2.b.ii

ii. What will be the location of coupons relative to the spent fuel racks? What exposure will the coupons receive relative to the range of neutron fluxes given off by the fuel assemblies?

<u>DAEC Response to RAI 3.3.2.2.6 Subpart 2.b.ii</u>

The Boral coupon tree will be located in a spent fuel cell in the spent fuel pool. The Boral surveillance program requires that the coupon tree be surrounded by discharged fuel. The coupons have experienced a higher exposure than the Boral in a typical spent fuel cell by being surrounded by recently discharged fuel.

<u>RAI 3.3.2.2.6 Subpart 2.b.iii</u>

iii. Describe how the coupons will be mounted. Will they be fully exposed to the spent fuel pool water, e.g., fully submerged or bolted to a wall?

<u>DAEC Response to RAI 3.3.2.2.6 Subpart 2.b.iii</u>

The coupons will continue to be mounted to a coupon tree which is in a cell in the spent fuel pool surrounded by discharged fuel in adjacent cells.

<u>RAI 3.3.2.2.6 Subpart 2.b.iv</u>

iv. What specific testing procedures will be used for determining areal density, verifying surface corrosion and examining for blister formation?

<u>DAEC Response to RAI 3.3.2.2.6 Subpart 2.b.iv</u>

The governing procedure for coupon testing at DAEC will be the Boral surveillance program administrative document. The testing will consist of visual examination (to detect pitting, swelling, or other degradation), thickness measurements (to monitor for bulging and swelling), length and width measurements, weight and specific gravity determinations, and neutron attenuation. The results will be compared with archive coupons and with the results of previous tests and any trends evaluated. Areal density will be determined from neutron attenuation, which is measured using a collimated thermal neutron beam and a neutron counter (BF3).

<u>RAI 3.3.2.2.6 Subpart 2.b.v</u>

v. What will be the acceptance criteria for test results covered under question (iv) above?

<u>DAEC Response to RAI 3.3.2.2.6 Subpart 2.b.v</u>

The acceptance criteria are:

- A decrease of no more than 5% in Boron-10 content, as determined by neutron attenuation.
- An increase in thickness at any point should not exceed 10% of the initial thickness at that point.

RAI 3.3.2.2.6 Subpart 2.b.vi

vi. Discuss the correlation between measurements of the physical properties of Boral coupons and the integrity of the Boral panels in the storage racks.

DAEC Response to RAI 3.3.2.2.6 Subpart 2.b.vi

The Boral in the Holtec spent fuel rack panels and the Boral in the coupons are made from the same production run. In addition, the coupons are mounted in a stainless steel jacket simulating as nearly as possible the actual in-service geometry, physical mounting, materials, and flow conditions of the Boral in the storage racks. With the same material and environment conditions, the Boral coupons should be representative of the Boral in the Holtec spent fuel storage racks.

RAI 3.3.2.2.6 Subpart 2.b.vii

vii. After removal from the pool for inspection, will the coupons be inserted back at the same locations in the pool?

DAEC Response to RAI 3.3.2.2.6 Subpart 2.b.vii

None of the coupons removed from the DAEC spent fuel pool and sent off site for testing have been reinstalled in the spent fuel pool, and no tested coupons are planned to be reinstalled.

RAI 3.3.2.2.6 Subpart 2.b.viii

viii. How will the potential degradation during the time in between surveillance periods be accounted for in the criticality analysis of record?

DAEC Response to RAI 3.3.2.2.6 Subpart 2.b.viii

Industry operating experience indicates Boral does not experience significant changes in B-10 areal density due to irradiation, so no degradation of the Boral in the Holtec racks which would affect the criticality analysis is anticipated. Changes in neutron attenuation would develop slowly enough to be detected by the Boral Surveillance Program coupon testing in time for corrective actions to be implemented prior to the criticality analysis being affected.

In addition, some of the conservative assumptions listed in the spent fuel rack criticality analysis include 1) the moderator is assumed to be at a temperature corresponding to the highest reactivity (4° C), 2) no credit is taken for radial neutron leakage, and 3) neutron absorption in minor structural members is neglected, i.e., spacer grids are assumed to be replaced by water. DAEC Technical Specification 4.3.1.1 states that the spent fuel storage racks are designed and shall be maintained with fuel assemblies having limits for maximum k-infinity in the normal reactor core configuration at cold conditions of ≤1.29 k-∞ and maximum lattice-average U-235 enrichment weight percent of ≤4.95 wt% for Holtec racks, and ≤1.39 k-∞ and ≤4.95 wt% for PaR racks. Also, k-effective must be ≤0.95 which includes allowance for uncertainties as described in section 9.1 of the DAEC UFSAR. These same values are also present in the spent fuel rack criticality analysis. This compares to actual new fuel maximum of 1.2553 k-∞ and 4.70 wt% U-235 for new fuel in the current cycle. Fuel cumulative exposure when finally discharged to the spent fuel pool averages 25,000 to 35,000 MWD/ton. This exposure reduces the reactivity worth of the fuel to a fraction of its original value and results in substantial margin to the rack design k-∞ and U-235 wt% limits. This demonstrates that ample margin exists in both the PaR and Holtec spent fuel rack designs so that at no time would the design limits be challenged.

RAI 3.3.2.2.6 Subpart 2.b.ix

ix. Describe the corrective actions implemented if coupon test results are not acceptable.

DAEC Response to RAI 3.3.2.2.6 Subpart 2.b.ix

In accordance with the Boral surveillance program, any changes in excess of the acceptance criteria require investigation and engineering evaluation, which may include early retrieval and measurement of one or more of the remaining coupons to provide corroborative evidence that the indicated changes are valid. If the changes are determined to be valid, an engineering evaluation would be performed to identify any further testing or corrective action that may be necessary. One option that may be considered to augment the coupon measurement program is to perform in-situ testing (Blackness Tests) as required in the event significant degradation is indicated by the coupon tests.

RAI 3.3.2.2.6 Subpart 2.b.x

x. Discuss the schedule for coupon removal and testing during the period of extended operation to demonstrate continued Boral performance.

DAEC Response to RAI 3.3.2.2.6 Subpart 2.b.x

In accordance with the current Boral surveillance program, a Boral coupon is to be removed and tested prior to every third refueling outage. During the period of extended operation, coupons would be removed and tested prior to RFO 25, RFO 28, and RFO 31. This schedule will allow for the two remaining coupons to be available for testing as needed.

RAI 3.3.2.2.6 Subpart 2.c.i

c. If the method used to verify minimum B-10 areal density will not utilize Boral coupons, please answer the following:

i. What specific testing procedures will be used for determining areal density, verifying surface corrosion, examining for blister formation, and changes in dimensions?

DAEC Response to RAI 3.3.2.2.6 Subpart 2.c.i

Boral coupons will be utilized for the Holtec racks. No testing of the PaR spent fuel racks is planned.

The Boral in the PaR spent fuel racks is contained in a sealed space not exposed to water, so no surface corrosion, blister formation, or changes in dimensions are expected. Any visual examination of the Boral in the PaR racks would require the rack to be dismantled. Industry operating experience and DAEC experience with Holtec Boral coupons indicates Boral does not experience significant changes in B-10 areal density due to irradiation. Therefore, there are no apparent mechanisms that are anticipated to degrade the Boral in the PaR racks in a manner that would affect the criticality analysis.

RAI 3.3.2.2.6 Subpart 2.c.ii

ii. What will be the acceptance criteria for test results covered under question (i) above?

DAEC Response to RAI 3.3.2.2.6 Subpart 2.c.ii

Boral coupons will be utilized for the Holtec racks. No testing is planned for the PaR spent fuel racks.

RAI 3.3.2.2.6 Subpart 2.c.iii

iii. How will the potential degradation during the time in between surveillance periods be accounted for in the criticality analysis of record?

DAEC Response to RAI 3.3.2.2.6 Subpart 2.c.iii

Boral coupons will be used for the Holtec racks. Industry operating experience and the results of testing performed on coupons from the DAEC spent fuel pool indicates Boral does not experience significant changes in B-10 areal density due to irradiation. No degradation of the Boral which would affect the criticality analysis is anticipated. Changes in neutron attenuation would develop slowly enough to be detected by the Boral surveillance program coupon testing in time for corrective actions to be implemented prior to the criticality analysis being affected. If changes in the Holtec coupons are observed, the findings will be evaluated for applicability to the PaR racks.

RAI 3.3.2.2.6 Subpart 2.c.iv

iv. Describe the corrective actions implemented if coupon test results are not acceptable.

DAEC Response to RAI 3.3.2.2.6 Subpart 2.c.iv

As discussed above, Boral coupon test results will be utilized for the Holtec racks. No coupons are available for the PaR spent fuel racks. Degradation identified by Holtec rack coupon testing would be entered into the Corrective Action Program and evaluated for any potential applicability to the PaR racks.

RAI 3.3.2.2.6 Subpart 2.c.v

v. Discuss the schedule for testing during the period of extended operation to demonstrate continued Boral performance.

DAEC Response to RAI 3.3.2.2.6 Subpart 2.c.v

Boral coupons will be utilized for the Holtec racks. For the PaR spent fuel racks, there are no plans to implement a testing program. If industry operating experience or the results of the Boral coupon tests for the Holtec racks indicates a loss of B-10 areal density due to irradiation in Boral, this information will be evaluated for applicability to the PaR spent fuel racks.

RAI 3.3.2.2.6 Part 3

3. Operating experience has shown that Boral may experience degradation. For example, Seabrook (ML032880525) and Beaver Valley Unit 1 (ML090220216) recently experienced blistering and/or bulging of aluminum cladding in their Boral. How does the Boral surveillance program at DAEC address plant specific and industry operating experience with Boral?

DAEC Response to RAI 3.3.2.2.6 Part 3

The DAEC administrative procedure for the operating experience program contains requirements for review and distribution of an extensive list of industry operating experience from various sources and for review of plant specific operating experience. The current coupon testing program would detect blistering or bulging in the aluminum cladding of the Boral.

RAI 3.3.2.2.6 Part 4

4. On page 3.3-37, of Section 3.3.2.2.6, of the DAEC license renewal application (LRA), the licensee states, "The potential for aging effects due to sustained irradiation of Boral was previously evaluated by the staff (Brookhaven National Lab-NUREG-25582 [BNLNUREG-25582], dated January 1979; NUREG-1787, (Virgil C. Summer Safety Evaluation Report [VC Summer SER]), paragraph 3.5.2.4.2, page 3-408) and determined to be insignificant." Please justify the applicability of BNL-NUREG-25582 and the VC Summer SER to DAEC in determining the significance of aging effects of Boral in the spent fuel pool during the period of extended operation.

<u>DAEC Response to RAI 3.3.2.2.6 Part 4</u>

BNL-NUREG-25582 and NUREG-1787, VC Summer SER, both concluded that the aging effects due to sustained irradiation of Boral were insignificant. The neutron absorber in both the Holtec and PaR spent fuel racks at the DAEC is Boral. All testing performed to date of coupons removed from the DAEC spent fuel pool have indicated no loss of B-10 areal density, confirming industry experience that Boral does not experience loss of attenuation due to irradiation. The Boral Surveillance Program will continue during the period of extended operation at the DAEC. If industry operating experience or the results of the Boral coupon tests for the Holtec racks indicates a loss of B-10 areal density due to irradiation in Boral, this information will be evaluated for applicability to the PaR spent fuel racks.

<u>RAI 3.3.2.2.6 Part 5</u>

5. Please discuss if holes have been drilled in the spent fuel pool racks at DAEC.

<u>DAEC Response to RAI 3.3.2.2.6 Part 5</u>

No holes have been drilled in the spent fuel pool racks at DAEC. The PaR rack design with concentric sealed "cans" containing the Boral material and constructed of anodized aluminum have presented no problems with cell deformation from gas accumulation. The Holtec racks are constructed of stainless steel and the sheathing containing the Boral material is designed to allow venting at the bottom and top so gas accumulation is not expected. No problems with cell deformation have been experienced at DAEC.

<u>RAI 3.3.2.2.6 Part 6</u>

6. On page 9.1-7, of Section 9.1.2.2.1, of the DAEC Final Safety Analysis Report dated October 2003, the licensee states, "the only non-stainless steel material utilized in the rack is the neutron absorber material which is a boron carbide aluminum cement manufactured under a US patent and sold under the brand name Boral by AAR Advanced Structures, Livonia, Michigan." Please clarify if the "cement" means "cermet."

<u>DAEC Response to RAI 3.3.2.2.6 Part 6</u>

The word "cement" should have been "cermet". This is a typographical error in the UFSAR.

RAI B.2.2

Background

XI. S8 Protective Coating Monitoring and Maintenance Program

Issue:

This program in the licensee's application is cited as not applicable for aging management. However, NUREG-1801, "Generic Aging Lessons Learned Report", states that "Proper maintenance of protective coatings inside containment is essential to ensure operability of post–accident safety systems that rely on water recycled through the containment sump/drain system." Licensees should assure proper maintenance of the protective coatings in containment, such that they will not degrade and become a debris source that may challenge the emergency core cooling systems performance, therefore, the staff requires the following information:

Request:

1. On page B-11 of the application (ML0829804810), line item XI.S8 states that the NUREG-1801 program is not applicable for DAEC. Please justify why NUREG-1801 AMP XI S.8 does not apply to DAEC.

2. Please describe in detail the Coatings Program at DAEC. How will the program ensure that there will be proper maintenance of protective coatings inside containment and ensure operability of post–accident safety systems that rely on water recycled through the containment sump/drain system in the extended period of operation? Also, describe the frequency and scope of inspections, acceptance criteria, and the qualification of personnel who perform the inspections.

DAEC Response to RAI B2.2

Part 1

As stated in the response to RAI B.3.4-5 in NextEra Energy letter NG-09-0764 dated October 13, 2009, the DAEC license renewal evaluations do not credit coatings for the function of preventing corrosion. The inspection and assessment of the condition of coatings inside containment and the suppression chamber (torus) are performed to confirm that the potential volume of debris would remain within design assumptions, and are not for the management of aging in coatings. These activities minimize debris that could be generated during a LOCA to mitigate the potential for ECCS strainer clogging. Therefore, NUREG-1801 AMP XI.S8 is not applicable as an aging management program for DAEC.

However, in response to NRC Generic Letter (GL) 98-04, DAEC implements a coatings program. This program was described to the NRC in letter NG-98-1901 dated November 11, 1998. The NRC closed GL 98-04 for DAEC in a letter dated November 3, 1999.

The management of Service Level 1 coatings at DAEC is described in UFSAR Section 1.8.30, which states:

> The Company is not committed to Regulatory Guide 1.54, June 1973. The Company's controls relative to protective coatings are described below.
>
> Special Protective Coatings (Paint):
>
> The application of a special protective coating shall be controlled as a special process when the failure (i.e., peeling or spalling) of the coating to adhere to the substrate can cause the malfunction of a safety-related, important to safety, or selected other structure, system or component. Special process coatings shall be applied by qualified personnel using qualified materials and equipment, and approved procedures. Documentation shall include identification of the following:
>
> 1. person applying the coating (and qualification),
> 2. material used,
> 3. procedure used (and qualifying procedure if different),
> 4. tests performed and results,
> 5. date of application of coating, and
> 6. traceability of coating location.

Part 2

Summary Description of DAEC Coating Program

The inspection and assessment of the condition of Service Level 1 coatings inside containment and the suppression chamber (torus) are performed to manage the potential volume of debris that could be generated during an accident. These activities minimize debris that could be generated during a LOCA to mitigate the potential for ECCS strainer clogging. As discussed in the November 11, 1998, letter, the ECCS pump suction strainer design accounts for 100% of the containment coatings which are installed in the LOCA pipe break steam/water jet zone of influence, as well as coating debris from containment coatings which are unqualified and/or degraded.

Service Level 1 coatings are inspected as part of the ASME Section XI inspection of the containment surface area. Visual inspection of the suppression chamber and drywell are performed by a Surveillance Test Procedure (STP).

ASME Code Section XI, Subsection IWE, inspections include Service Level I coatings (in addition to structures, welds, bolting, etc.) in their scope of inspection, and the procedure requires documentation of deficient conditions and notification of a coatings specialist of any deficient areas. DAEC defines a Service Level I Coating System as a coating system used in areas inside the reactor containment where coating failure could adversely affect the operation of post-accident fluid systems and thereby impair safe shutdown capability (including EQ equipment).

Scope and Frequency of Inspections

The purpose of the coatings inspection STP is to visually inspect (where possible) the interior and exterior surfaces of the suppression chamber, vent lines, and downcomers; and to visually inspect the interior and accessible exterior surfaces of the drywell for evidence of deterioration. This procedure also requires performance of visual inspection of the exterior surfaces of the ECCS Suction Strainers for transient debris. The scope of inspections is in accordance with ASME Section XI, Subsection IWE, Article IWE-1000, Scope and Responsibility.

The frequency of inspection is each refueling cycle. The schedule is in accordance with Table IWE-2500-1; and Article IWE -2000, Examination and Inspection.

Acceptance Criteria

The STP requires the inspector to note any evidence of deterioration (e.g., discoloration, bubbling or flaking of the coating, corrosion or pitting).

A Coating Specialist or designee is required to perform a more detailed inspection of areas noted to have deficient coating and areas previously designated as requiring additional coating inspections. The Coating Specialist also reviews inspection results to determine if updates are required to the Unqualified and Degraded Coatings Log. The Coating Specialist evaluates whether the quantity of unqualified and degraded coatings is acceptable. Corrective actions will be initiated as appropriate based on this evaluation.

A separate STP governs the visual examination of submerged areas of the suppression chamber. This procedure assesses the condition of the coatings applied to components and structures inside the suppression pool. The coatings applied within the suppression pool are classified as Service Level I coatings. This STP requires inspection of the suppression pool, documentation of surface degradation, and appropriate follow-up actions, in a manner similar to the requirements for the drywell and non-submerged areas of the suppression chamber.

Personnel Qualification

Inspection personnel qualifications are in accordance with IWE-2300. DAEC procedures provide the requirements for control and administration of qualification, training, and certification of NDE personnel.