50-250/251

the Turkey Point License Renewal Application

From: <Steve_Hale@fpl.com>
To: <rca@nrc.gov>, <ssk2@nrc.gov>
Date: 3/15/01 4:39PM
Subject: Draft Responses to RAIs Transmitted by letter dated 2/1/01 regarding theBoraflex Surveillance, Boric Acid Wastage Surveillance, Chemistry Control, andFlow Assisted Corrosion Programs

Raj/Steve,

Attached are the draft responses to the subject RAIs. Please review the attached draft responses to see if they address the reviewers' questions. Please arrange a telecon to discuss comments/questions on these responses when the reviewers are ready, or, if possible, we can discuss them at the 3/20/01 meeting. Note there is no draft transmittal letter and the page numbers will change in the future because this is a partial response to your letter of 2/1/01.

Thanks

(See attached file: NRC Review four AMPs.doc)

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SECTION 3.9.2 BORAFLEX SURVEILLANCE PROGRAM (LRA SECTION 3.2.2 OF APPENDIX B)

RAI 3.9.2-1:
Provide further information for each of the 10 elements to include a discussion of the current program and the manner in which this program is enhanced to ensure that the aging effects of Boraflex gap formation and dissolution are managed.

FPL RESPONSE:
The current Boraflex Surveillance Program described in LRA Appendix B, Subsection 3.2.2 (page B-41) consists of blackness testing and silica monitoring. The enhanced Boraflex Surveillance Program described in the LRA will consist of areal density testing (or other approved testing methodology) and silica monitoring. Therefore, the enhancement to this program is to perform density testing in lieu of blackness testing. The program enhancements are discussed in the Safety Evaluation by the Office of Nuclear Reactor Regulation related to Amendment No. 206 to Facility Operating License No. DPR-31 and Amendment No. 200 to Facility Operating License No. DPR-41, Florida Power & Light Company, Turkey Point Units 3 and 4, Docket Nos. 50-250 and 50-251, transmitted by NRC Letter from Kahtan N. Jabbour to T.F. Plunkett dated July 19, 2000.

The aging effect requiring management for Boraflex is change in material properties. Change in material properties includes gap formation and dissolution. Dissolution is described as "physical loss of boron carbide" in LRA Appendix B, Subsection 3.2.2 (page B-41). Thus, the 10 attributes discussed in LRA Appendix B, Subsection 3.2.2 apply to managing gap formation and dissolution.

RAI 3.9.2-2:
Based on the known mechanism governing the boraflex polymer matrix breakdown, boraflex degradation can be limited by minimizing disturbances to the spent fuel pool and maintaining silica equilibrium between the Boraflex panel and the surrounding water. Provide a description of the steps taken, if any, to limit the disturbance of the quiescent state of the spent fuel pool.

FPL RESPONSE:
The silica concentration in the spent fuel pool water is considered to be near equilibrium since the purification system has a low turnover rate, a low propensity to remove soluble silica, and no special measures are taken to reduce its concentration. The overall changes in the concentration including its variability, are small and slow with respect to time. As a result, no additional steps are taken to limit disturbances to the quiescent state of the spent fuel pool.

RAI 3.9.2-3:

The staff agrees that blackness testing will provide information regarding gap formation consistent with the description of the change in material properties, due to irradiation, given in Section 3.6.2.2.2 of the LRA. However, justify the exclusion of the change in material properties due to both irradiation and convective forces in the spent fuel pool; i.e., a change in material properties due to dissolution of the boraflex panel and provide more detail discussing how the enhanced Boraflex Surveillance Program will determine the amount of degradation of the Boraflex material through this mechanism.

FPL RESPONSE:

The enhanced Boraflex Surveillance Program evaluates changes in material properties due to dissolution of the Boraflex panels as stated in LRA Appendix B, Subsection 3.2.2 (page B-41). As discussed in this subsection, the enhanced Boraflex Surveillance Program involves monitoring silica levels and Boraflex density testing (or other approved testing method). More specifically, this testing method determines the areal density, the weight per unit area, of the encapsulated boron carbide via neutron attenuation. Comparison of the measured areal density relative to the minimum required areal density is used to determine the amount of boron carbide remaining which is indicative of the panels' condition.

RAI 3.9.2-4:
The applicant commits to checking the density of the panels (or other approved methods) to ascertain the physical loss of boron carbide. Provide additional details describing the nature of this commitment. The description should include what alternatives will be in place in the event that the degree to which this valid aging effect is occurring cannot be determined.

FPL RESPONSE:
This commitment is discussed in the response to RAI 3.9.2-3. The measurement of areal density is made relative to the panels irradiated dose. Panels to be tested are chosen to cover the range of irradiated dose, thus providing data indicative of the aging effect due to the dose rate at the panel and the accumulated time of irradiation. This method has been approved by the NRC for use in plant specific applications (including Turkey Point), and has been successfully utilized by several utilities to determine the loss of boron carbide. Therefore, the need for alternatives is not anticipated.

RAI 3.9.2-5:
Blackness testing is an appropriate method for determining gap formation in the panels but is not indicative of the concentration of boron carbide remaining in the panel. Discuss how the enhanced Boraflex Surveillance Program will support conclusions drawn from the applicant's operating experience.

FPL RESPONSE:
The enhanced Boraflex Surveillance Program is intended to provide data on the concentration of boron carbide remaining in the panels in addition to data on gaps. The additional data associated with areal density of the Boraflex panels will provide more detailed information relative to the condition of the panels.

Industry and Turkey Point plant-specific operating experience support the conclusion that change in material properties of Boraflex panels is an aging effect requiring management. The areal density information obtained from the enhanced Boraflex Surveillance Program will manage this aging effect by ensuring criticality analysis assumptions continue to bound observed data.

RAI 3.9.2-6:
The staff notes that the only aging effect discussed in Section 3.6.2.2.2 of the LRA is gap formation. Clarify how this aging effect will be detected through Blackness Testing.

FPL RESPONSE:
The enhanced Boraflex Surveillance Program as stated in LRA Appendix B, Subsection 3.2.2 (page B-41) involves testing of the Boraflex panels for areal density as well as gaps and shrinkage. All of these effects are related to the panel's irradiated dose, which is a function of dose rate and time. These effects are indicative of aging and are detectable by the enhanced Boraflex Surveillance Program.

RAI 3.9.2-7:
Clarify how shrinkage, gap formation, and density changes of the Boraflex panels are currently trended and analyzed and provide details of how the enhanced program will affect the current analyses of these parameters.

FPL RESPONSE:
Data from periodic Boraflex surveillances is evaluated to determine the number, size, and location of shrinkage and gaps within and among the tested panels. This data is then compared to the criticality analysis assumptions, that were conservatively chosen, to confirm that the analysis continues to bound observed data.

The enhanced Boraflex Surveillance Program will continue to evaluate shrinkage and gap data as well as incorporate areal density of the tested panels relative to their irradiated dose. Data on areal density changes are not currently trended, since there is no previous history on this data. However, areal density data will be evaluated to determine the impact on assumptions in the criticality analysis, and subsequent areal density tests will be evaluated for trending.

RAI 3.9.2-8:
The applicant states that the acceptability of Boraflex degradation is controlled by the assumptions in the criticality analysis. Provide details regarding how the surveillance results assure that the 5% subcriticality margin will be maintained given that dissolution of the Boraflex is not addressed in the existing program.

FPL RESPONSE:
The enhanced Boraflex Surveillance Program as stated in LRA Appendix B, Subsection 3.2.2 (page B-41) in connection with the commitments referenced in RAI Response 3.9.2-1 involves areal density testing of the Boraflex panels. This testing provides a comparison of the measured areal density relative to the minimum required areal density, and is used to determine the amount of boron carbide remaining to address boron carbide dissolution. Evaluation of this data along with the data on gaps and shrinkage, against the assumptions in the criticality analysis of record assures that the 5% subcriticality margin will be maintained.

SECTION 3.9.3 BORIC ACID WASTAGE SURVEILLANCE PROGRAM (LRA SECTION 3.2.3 OF APPENDIX B)

RAI 3.9.3-1:
Provide further detail regarding the enhancement of this program. Specifically, provide details discussing how the systems outside containment, currently inspected under other existing programs, will continue to be inspected under the enhanced Boric Acid Wastage Surveillance Program.

FPL RESPONSE:
LRA Appendix B, Subsection 3.2.3 (page B-44) provides a list of systems for which the Boric Acid Wastage Surveillance Program has been credited for managing loss of material and loss of mechanical closure integrity due to aggressive chemical attack. The Boric Acid Wastage Surveillance Program will be enhanced to include Spent Fuel Pool Cooling and Waste Disposal in the scope of inspection of systems outside containment. Spent Fuel Pool Cooling and Waste Disposal are currently inspected under the Systems and Structures Monitoring Program, LRA Appendix B, Subsection 3.2.15 (page B-83). Also, applicable procedures will be enhanced to provide additional guidance for evaluating potential effects of boric acid leakage (i.e., boric acid corrosion) on adjacent components and structural components.

RAI 3.9.2-2: (sic) [3.9.3-2]
Discuss the exclusion of components constructed from aluminum, brass, bronze, carbon, and galvanized steel which may also be exposed to the corrosive boric acid environment.

FPL RESPONSE:
In LRA Appendix C, Section 7.5 (page C-43), Subsection 7.5.3.1, Borated Water Leaks, "Loss of Material" states that loss of material due to aggressive chemical attack is an aging effect requiring management for carbon steel, low alloy steel, cast iron, and galvanized carbon steel susceptible to borated water leaks. As stated in LRA Appendix C, Section 5.1 (page C-18) other metals, such as copper, copper alloys, nickel, nickel alloys, and aluminum, are resistant to boric acid corrosion, therefore, loss of material due to aggressive chemical attack does not require management for these materials.

Reference: Handbook of Corrosion Data, American Society of Metals, 1995.

RAI 3.9.2-3(sic) [3.9.3-3]
In the case of electrical cables or insulated piping, discoloration of the insulation is used to indicate boric acid coolant leakage. Provide the acceptance criteria and the bases for this method. In addition, provide operating experience that identifies aging prior to loss of function.

FPL RESPONSE:
As discussed in LRA Appendix B, Subsection 3.2.3 (page B-44), components and structural components constructed of cast iron, carbon steel and low alloy steel are susceptible to loss of material and loss of mechanical closure integrity due to aggressive chemical attack. If insulated piping or electrical cable shows signs of boric acid leakage (e.g. boric acid residue), the source of the leakage is determined. The leakage is corrected or evaluated to ensure component intended function is maintained. FPL has been aggressive in its implementation of commitments related to NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants." A review of plant history shows that several minor boric acid leaks (e.g. valve packing leakage) have been identified and corrected through implementation of this program. None of the leaks identified have resulted in significant component/system degradation or loss of intended function due to boric acid corrosion.

RAI 3.9.3-4:
Provide details regarding the evaluation of a boric acid leakage discovery to include, but not limited to, specific evaluation criteria and the bases for such criteria.

FPL RESPONSE:
As stated in LRA Appendix B, Subsection 3.2.3 (page B-44), Boric Acid Wastage Surveillance Program, the program monitors the effects of boric acid corrosion by detection of coolant leakage as required by NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants," including guidelines for locating small leaks, conducting examinations and performing evaluations.

Procedural controls are utilized to ensure that boric acid leaks are identified, monitored, evaluated and corrected before they cause significant degradation. Leak evaluations are performed under the corrective action program and generally consider the location of the leak, type of leak, leak characteristics (e.g. boric acid accumulation, steam leak, water leak, etc.), the component function in the system, other systems affected by the leak, plant status, operability requirements, means of leak identification, leak monitoring, long term effects, Technical Specification, UFSAR, and procedural requirements.

SECTION 3.9.4 CHEMISTRY CONTROL PROGRAM (LRA SECTION 3.2.4 OF APPENDIX B)

RAI 3.9.4-1:
Identify guidelines and/or standards including revision numbers to which the Chemistry Control Program is implemented (i.e., EPRI reports TR-105714 and TR-102134, respectively). If deviations from the guidelines, then justify the differences. If alternate means of controlling water chemistry are utilized, describe major controlling parameters, their ranges, corresponding acceptance criteria and any corrective measures which have to be taken when these criteria are exceeded.

FPL RESPONSE:
As described in LRA Appendix B, Subsection 3.2.4 (page B-48), Chemistry Control Program, the parameters monitored by the Chemistry Control Program for the purposes of aging management are chloride, fluoride, sulfate, hydrogen, oxygen, biocide, corrosion inhibitor, and water content. With reference to the above parameters, the Chemistry Control Program currently complies with the following industry guidelines:

(a) EPRI, TR-105714, Rev. 4, PWR Primary Water Chemistry Guidelines, Vols. 1 and 2.

(b) EPRI, TR-102134, Rev. 5, PWR Secondary Water Chemistry Guidelines.

Additionally, the Chemistry Control Program considers equipment vendor specifications, information from water treatment experts and Turkey Point and industry operating experience.

RAI 3.9.4-2:
Describe the Chemistry Control Program as it relates to emergency diesel fuel oil. The description should include the actions taken to prevent ingress of water into the fuel oil system. Reference any relevant standards.

FPL RESPONSE:
Loss of material is an aging effect requiring management for Emergency Diesel Generator (EDG) fuel oil components. The Chemistry Control Program is credited for managing this aging effect by:

(a) Verification that fuel oil shipments are free from water and particulate contamination before the oil is transferred to the Diesel Oil Storage Tanks (DOSTs). This is currently accomplished by sampling and analyzing each fuel oil shipment in accordance with ASTM D4176 - Clear and Bright Analysis.

(b) Addition of stability and biocide agents to fuel oil shipments before the oil is transferred to the DOSTs.

(c) Sampling and analysis of stored fuel oil on a monthly basis for particulates in accordance with ASTM D2276 - Particulate Contamination in Aviation Turbine Fuels. If the particulate analysis approaches a significant fraction of the acceptance criteria, the fuel in the tank is filtered until the acceptance criteria is met followed by the addition of biocide as necessary.

In addition to the above, the DOSTs are checked for water and the water drained, as necessary, as part of the Periodic Surveillance and Preventive Maintenance Program.

RAI 3.9.4-3:
In the discussion of "Parameters Monitored or Inspected," the applicant specifies chemicals and water content as the parameters monitored. For microbiologically influenced corrosion (MIC), which is grouped under the aging effect of loss of material, in Appendix C, the applicant states for the purpose of aging management review, loss of material due to MIC is not considered significant at temperatures greater than 120□F or pH greater than 10. Given these parameters, provide a discussion of how the Chemistry Control Program, which does not appear to focus on these parameters, would adequately manage this aging effect.

FPL RESPONSE:
As described in LRA Appendix B, Subsection 3.2.4 (page B-47), the Chemistry Control Program is not credited to manage any aging effect by monitoring pH or temperature. However, system operating temperature was considered during the performance of aging management reviews due to its influence on susceptibility to certain aging mechanisms, such as stress corrosion cracking (SCC), microbiologically influenced corrosion (MIC) and thermal embrittlement. The operating temperature of a system is governed by the system process and the environment. No aging management programs are utilized to control system operating temperature. There were no cases where pH was credited for precluding loss of material due to MIC.

RAI 3.9.4-4:
In the discussion on "Detection of Aging Effects," the applicant states the following aging mechanisms can be minimized or prevented by the Chemistry Control Program include general corrosion, pitting corrosion, crevice corrosion, microbiologically influenced corrosion, graphitic corrosion, stress corrosion cracking, intergranular attack, corrosion fouling, and fouling caused by microbiologically influenced corrosion. These mechanisms were grouped by the applicant into the following aging effects of concern (i.e., loss of material, cracking, and fouling). However, high concentrations of impurities at crevices and locations of stagnant flow conditions could cause localized loss of material by some of the identified aging mechanisms. Provide a discussion on verification of the effectiveness of the chemistry control program (e.g., use of a one-time inspection of select components and susceptible locations) to ensure that this aging effect is not occurring.

FPL RESPONSE:
During routine and corrective maintenance, that require equipment disassembly, internal surfaces of components are visually inspected for loss of material and other aging effects. If the results of the inspections indicate loss of material (other than light surface corrosion), cracking or fouling, the condition is evaluated via the corrective action program. The corrective action process includes cause determination and if the aging mechanism is not readily apparent, metallurgical analysis may be performed.

Materials experts within FPL are typically requested to support root cause analysis and to perform metallurgical analysis when necessary. FPL has a metallurgical laboratory and trained staff available for performing metallurgical analyses. The metallurgical analyses include the use of standard metallurgical laboratory techniques for the identification of aging mechanisms such as crevice and pitting corrosion, etc. The results of these material evaluations are formally documented and issued as metallurgical laboratory reports and are maintained in a computerized database. A review of approximately 100 Turkey Point Units 3 and 4 metallurgical laboratory reports issued between 1986 and the present, associated with license renewal passive components, was performed to identify any material failures attributed to crevice corrosion. The results of this review concluded that there have been no occurrences of crevice corrosion in treated water systems. Therefore, it can be concluded that the effectiveness of the Chemistry Control Program has been verified.

SECTION 3.9.9 FLOW-ACCELERATED CORROSION PROGRAM (LRA SECTION 3.2.9 OF APPENDIX B)

RAI 3.9.9-1:
Describe in detail the flow accelerated corrosion (FAC) program in the Turkey Point plant. Specifically, provide the following information:

- List guidance and recommendations used in developing the program.
- Specify the methodology or methodologies used for predicting loss of materials from the components subjected to FAC. If a generic methodology (e.g. CHECWORKS program developed by EPRI) is used, provide the reference. However, if it is a plant-specific methodology developed by the applicant, describe the methodology in detail.
- What are the acceptance criteria for the maximum acceptable wall thinning in the components subjected to FAC? Specify these criteria and the codes upon which they are based.

FPL RESPONSE:
First Bullet:
The FAC program was originally developed utilizing available guidelines from Electric Power Research Institute (EPRI) and the Nuclear Utility Management and Resource Council (NUMARC). The Turkey Point program was reviewed by the NRC staff in August of 1988 in support of NUREG-1344, "Erosion/Corrosion-Induced Pipe Wall Thinning in U.S. Nuclear Power Plants" and determined to meet the requirements for erosion/corrosion inspections. FPL later confirmed that the program satisfied the requirements of Generic Letter 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning," via FPL letter to the NRC, L-89-265 regarding docket numbers 50-250 and 50-251, dated July 21, 1989. The program has been regularly upgraded utilizing current consensus industry guidance, e.g., NSAC-202L-R2, "Recommendations for an Effective Flow-Accelerated Corrosion Program."

Second Bullet:
FPL currently utilizes CHECWORKS as the predictive plant model for components subjected to FAC.

Third Bullet:

As stated in LRA Appendix B, Subsection 3.2.9(page B-60), Acceptance Criteria,

"Inspection results are used to calculate the number of refueling or operating cycles remaining before the component reaches its minimum wall thickness. If calculations indicate that an area will reach its minimum allowable wall thickness before the next inspection interval, the component is repaired, replaced, or reevaluated."

Minimum allowable wall thickness is based on the ANSI B31.1 code and is determined as follows:

COMPONENT TYPE	MINIMUM WALL
Seismic/Safety Related	Calculated minimum wall
Balance of Plant (Hoop stress min. wall $\geq 0.5\ t_{nominal}$)	Hoop stress minimum wall thickness due to pressure
Balance of Plant (Hoop stress min. wall $< 0.5\ t_{nominal}$)	Use the largest of: 1. Hoop stress due to pressure 2. 30% of nominal thickness 3. 0.150″ (large bore) or 0.100″ (small bore)

RAI 3.9.9-2:
The description of the scope of the program mentioned "limited baseline inspection." Describe the nature of this inspection.

FPL RESPONSE:
LRA Appendix B, Subsection 3.2.9 (page B-59), referred to a limited baseline inspection that is performed when a large bore component (butt welded piping with a nominal diameter greater than 2 inches) is repaired or replaced. The inspection consists of a pre-service examination of the new material to determine initial wall thickness. This data permits determination of actual wear rates in the future.

RAI 3.9.9-3:
Susceptibility to FAC can be reduced by maintaining proper water chemistry. Describe how the secondary water chemistry (treat water-secondary) will be controlled in order to achieve optimum environment for the components subjected to FAC. List any relevant guidelines or standards used to achieve this goal.

FPL RESPONSE:
Ideally for FAC control, the secondary system would be operated under oxidizing conditions with an elevated pH. However, secondary water chemistry is selected for optimal corrosion protection of the steam generators. Cycle specific chemistry information is used as one of the inputs to the predictive plant (FAC) models and is appropriately considered in the FAC program.

RAI 3.9.9-4:
In the description of monitoring and trending activities in the program, it was indicated that in steam traps, in addition to material loss from the internal walls of piping due to FAC, material loss also occurred from the external walls due general corrosion. Both these material losses are measured by a volumetric examination performed on these lines. Explain how the loss of material from internal surfaces and from external surfaces can be determined by volumetric measurements performed on these lines when the volumetric examination technique can only give total material losses from the piping, equal to a sum of losses from internal and external surfaces.

FPL RESPONSE:
Steam trap lines are generally categorized as small bore piping, e.g., both butt-welded and socket welded piping with a nominal diameter of less than or equal to two inches. These lines are examined using either ultrasonic techniques or radiographic techniques to determine component wall thickness. The intent of the examination is to detect component wall loss that can result in loss of function. Whether the degradation has occurred internally, externally or both, these volumetric examination techniques adequately determine loss of material, which is the aging effect requiring management.

RAI 3.9.9-5:
Describe the inspection program for the components subjected to FAC. The description should include the following:

- State methodology for selecting the components to be examined during a given outage.
- State the frequency of examination of individual components.
- Describe the techniques used for performing these examinations. i.e. ultrasonic, radiography, or visual examination. If ultrasonic examination is used, how is the wall thickness determined from the individual instrument readings.

FPL RESPONSE:
First Bullet:
The methodology for selecting components to be examined during a given outage is based on the guidance contained in NSAC-202L-R2, "Recommendations for an Effective Flow-Accelerated Corrosion Program." Selection of components is based on: wear rankings from the predictive plant model, components identified by the predictive plant model as having a short remaining service life, industry experience, plant specific experience, and prior inspection results.

Second Bullet:
Reinspection frequency is based on the calculated remaining life for each component.

Third Bullet:
Inspections are performed by various non-destructive techniques: ultrasonic techniques, radiographic techniques, visual techniques. When ultrasonic techniques are used, the calibrated instrument provides a direct measurement of wall thickness. The lowest of the measured wall thickness values for the inspected component is utilized to determine the need for further evaluation.

RAI 3.9.9-6:
Were the replacements for the components damaged by FAC made using the same material or in some cases was a more FAC resistant material used? If change in material is used, explain how the FAC program is impacted.

FPL RESPONSE:
Component replacements may be either the same material, that is, like-for-like replacement, or FAC-resistant material. Replacement material is determined on a case-by-case basis; however, replacement with FAC-resistant materials is desired. Replacement information, such as material type and inservice date are entered into the predictive plant (FAC) models. In addition, the plant design drawings are updated to indicate changes in piping material.

RAI 3.9.9-7:
In the attribute, "Operating Experience and Demonstration," the applicant stated that wall thinning problems have occurred. Provide more information on the operating experience related to the wall thinning observed in the components located in the main steam and turbine generators and feedwater and blowdown systems. Specifically:

- How many components experienced wall thinning beyond the acceptable level and needed replacement?
- Were there any leaks or pipe breaks in the components damaged by FAC? If such events have occurred describe them in detail.

FPL RESPONSE:
First Bullet:
Operating experience related to FAC-induced degradation is available from several sources, e.g., NRC, INPO, CHECWORKS Users Group. Specific to Turkey Point, there have been a small number of component replacements due to FAC-related issues in the portions of Main Steam and Turbine Generators and Feedwater and Blowdown in the scope of license renewal.

These include:

Turkey Point Unit 3
The nozzle, elbow, and expander at the discharge from the 3A and 3B Feedwater Pumps.

Turkey Point Unit 4
Expanders/reducers associated with the feedwater regulating valves, and one pipe segment associated with the "B" train feedwater line in containment.

Second Bullet:
There have been no inservice failures of components due to FAC in the portions of the Main Steam and Turbine Generators and Feedwater and Blowdown within the scope of license renewal. This plant specific experience demonstrates the effectiveness of Turkey Point's FAC program.