3. AGING MANAGEMENT REVIEW RESULTS

The staff's evaluation of the applicant's aging management programs (AMPs) focuses on program elements, rather than the details of specific plant procedures. To determine whether the applicant's AMPs are adequate to manage the effects of aging so that the intended functions of systems, structures, and components (SSCs) within the scope of license renewal will be maintained in a manner that is consistent with the current licensing basis (CLB) throughout the period of extended operation, the staff used 10 elements to evaluate each program and activity. The 10 elements of an effective AMP were developed as part of the staff's draft standard review plan (SRP) for license renewal, which was released in 1997 and contained in the final SRP, NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (July 2001). This SER describes the extent to which the 10 elements apply to a particular program or activity, and evaluates each program and activity against those elements that are determined to be applicable. On the basis of the NRC's experience with maintenance programs and activities, the staff concluded that conformance with the 10 elements of an AMP, or a combination of AMPs, provides reasonable assurance that an AMP (or combination of programs and activities) is demonstrably effective at managing the applicable aging effects. The following 10 elements of an effective AMP are considered in evaluating each AMP used by the applicant to manage the applicable aging effects identified within this SER:

- program scope
- preventive or mitigative actions
- parameters monitored or inspected
- detection of aging effects
- monitoring and trending
- acceptance criteria
- corrective actions
- confirmation process
- administrative controls
- operating experience

In Section 2.0, "Structures and Components Subject to an Aging Management Review," of Appendix B to the license renewal application (LRA), the applicant states that the elements involving corrective actions and administrative controls for license renewal are in accordance with the site-controlled corrective actions program pursuant to 10 CFR Part 50, Appendix B, and cover all systems and components that are subject to an aging management review (AMR). In addition, the applicant states that the confirmation process element ensures that corrective actions have been taken and are effective. The staff's evaluation of the applicant's corrective action program, including the confirmation process, is separately discussed and generically evaluated in Section 3.1.2 of this SER.

3.1 Common Aging Management Programs

3.1.1 Chemistry Control Program

Section 3.2.4, "Chemistry Control Program," of Appendix B to the LRA includes a review of relevant material from Sections 3.2, "Reactor Coolant System," 3.3, "Engineered Safety Features Systems," 3.4, "Auxiliary Systems," 3.5, "Steam and Power," and 3.6, "Structures and

Structural Components," of the LRA. These sections address the interaction of the primary, secondary, treated water, and diesel generator fuel oil with the components in different systems and describes the resulting aging effects. The staff reviewed the applicant's description of the program in Section 3.2.4 of Appendix B to the LRA and the material in the other referenced sections of the LRA to determine whether the applicant has demonstrated that the chemistry control program will adequately manage the applicable aging effects so that the systems covered by this activity will perform their intended functions in accordance with the CLB throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.1.1 Summary of Technical Information in the Application

The chemistry control program applies to the systems containing primary, secondary, and treated water, as well as diesel fuel oil. Specifically, the LRA identified the following systems:

- systems containing primary water
  - reactor coolant system
  - steam generator primary side
  - residual heat removal system
  - safety injection system
  - chemical and volume control system
  - containment spray system
  - emergency containment filtration system
  - spent fuel pool cooling system
  - spent fuel storage and handling system
  - sample system
- systems containing secondary water
  - steam generator secondary side
  - feedwater and blowdown system
  - auxiliary feedwater and condensate storage system
  - main steam and turbine generators
  - sample system
- systems containing treated water
  - control building ventilation system
  - turbine building ventilation system
  - component cooling water system
  - primary water makeup system
  - EDG cooling water
- systems containing diesel generator fuel oil
  - emergency diesel generators and support systems

The LRA identified the following aging effects caused by the water and diesel fuel oil environments:

- loss of material
- cracking
- fouling

These aging effects were caused by the following corrosion mechanisms identified in the LRA:

- general corrosion
- pitting corrosion
- crevice corrosion
- microbiologically influenced corrosion
- graphitic corrosion
- stress corrosion cracking
- intergranular attack
- corrosion fouling
- fouling caused by microbiologically influenced corrosion

The applicant concluded that the chemistry control program will mitigate these corrosion effects in the systems that are exposed to water or diesel fuel oil environments, and the appropriate corrective actions can be taken so that the components will perform their intended functions in a manner that is consistent with the CLB, throughout the period of extended operation.

As described in the following paragraphs, different chemical environments exist in the systems containing primary, secondary, and treated water, and diesel generator fuel oil; therefore, different types of chemistry control apply to these systems, and different types of sampling and analysis are needed.

Primary Water

The primary water identified in the LRA consists of treated water-primary and treated water-borated. The distinction between these two types of primary water is that the treated water-primary is the water in the reactor coolant system, and the treated water-borated is the water in all other systems that perform functions requiring borated water. Both of these types of water contain dissolved boric acid. In the reactor coolant system, the boron concentration is controlled by a boron/lithium/pH chemistry regime that is required for reactivity, radiation, and corrosion control. Its concentration varies during plant operation. In the systems containing treated water-borated, the concentration of boric acid remains constant. Most of the components in the systems containing primary water are made of stainless steel, but other materials (such as Alloy 600, which is used for steam generator tubing) are also present. All of these components may be subject to corrosion if the chemistry of the primary water is not properly controlled.

Secondary Water

Treated water-secondary is a demineralized water containing pH and oxygen controlling chemicals. The components in the systems containing secondary water are constructed mostly from carbon steel, although other materials (such as stainless steel or low alloy steel) are also present. Proper chemistry control is needed to prevent their corrosion.

Treated Water

Treated water is a demineralized water that is used in systems requiring clean water. Depending on its application, treated water can be deaerated and can contain corrosion inhibitors and biocides. Five systems containing treated water are included in the chemistry control program in the LRA. Specifically, these are the component cooling water (CCW), primary water makeup, EDG Cooling Water, Control Building Ventilation, and Turbine Building Ventilation systems. The CCW system removes heat from various power plant auxiliary systems. It contains components that are made from carbon steel, stainless steel, cast iron, aluminum brass, copper nickel, and brass. These materials may corrode in an uncontrolled treated water environment. The primary water makeup system stores high-purity treated water. Valves and piping in this system are included in the chemistry control program. Although these components are made from stainless steel, in an uncontrolled treated water environment, they may exhibit aging effects caused by a loss of material due to corrosion.

The EDG Cooling Water system provides cooling for the emergency diesel generators. It contains components made of carbon steel, cast iron, and copper alloys. The Control Building and Turbine Building Ventilation Systems utilize chilled water for removal of heat from rooms that contain essential electrical equipment. They contain components made of carbon steel, stainless steel, and copper. These materials may corrode and foul in an uncontrolled treated water environment.

Diesel Generator Fuel Oil

Emergency diesel generator support systems ensure proper operation of the emergency diesel generator. The fuel oil portion of the system includes the storage tank; day tanks; skid tanks; fuel oil pumps; and various valves piping, tubing, and hoses. These components are made from carbon steel, stainless steel, cast iron, and copper. They are exposed to the environment of diesel fuel oil, which can produce aging effects due to loss of materials by corrosion in the presence of accumulated water.

3.1.1.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information in the LRA regarding the applicant's demonstration that the chemistry control program for water and fuel oil chemistries will ensure that the effects of aging will be adequately managed so that intended functions will be maintained consistent with the CLB throughout the period of extended operation for all components in the systems included in the LRA. After completing the initial review, the staff issued several requests for additional information (RAIs) by letter dated February 1, 2001. By letter dated April 19, 2001, the applicant responded to the staff's RAIs.

The staff's evaluation of the applicant's AMPs related to water and fuel oil chemistries focused on program elements, rather than detailed plant-specific procedures. To determine whether these programs adequately mitigate the effects of aging to maintain intended functions consistent with the CLB throughout the period of extended operation, the staff evaluated seven elements that apply to these programs. The corrective actions and administrative controls for license renewal were not discussed in this section because the application indicates that they are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components that are subject to an AMR. For the confirmation process element, the applicant states that followup testing is performed to confirm satisfactory completion of the corrective action. The staff's evaluation of the quality assurance program including the confirmation process is provided separately in Section 3.1.2 of this SER. The remaining seven elements are discussed below.

[Program Scope] In Section 3.2.4 of Appendix B to the LRA, the applicant stated that the scope of this program includes managing the aging effects of loss of material, cracking, and fouling within the systems specified in LRA Sections 3.2, 3.3, 3.4, 3.5, and 3.6. The scope of inspection consists of sampling activities and analysis of treated water-primary, treated water-borated, treated water-secondary, treated water, and diesel fuel oil. Appropriate corrective actions are taken when the chemistry parameters do not meet specified limits. The staff finds that there is reasonable assurance that the applicant has included all plausible aging effects related to water and fuel oil chemistries for aging management considerations, and the scope of the chemistry control program is adequate.

[Preventive or Mitigative Actions] The objective of the chemistry control program is to ensure that the chemistry parameters for water and diesel fuel oil remain within their optimum values. Although it will not completely eliminate corrosion, the program will reduce the damaging effects of corrosion, and will ensure that the resultant aging effects will not invalidate the functions performed by the components that are exposed to water or diesel fuel oil environments. The staff finds that the chemistry control program will effectively mitigate aging effects caused by corrosion.

[Parameters Monitored or Inspected] The chemistry control program monitors chemistry parameters in different systems in the plant for the purpose of aging management. The monitoring and inspection procedures are based on the guidelines specified in Electric Power Research Institute (EPRI) reports TR-105714, Rev. 4, and TR-102134, Rev. 5, for primary and secondary water chemistries, respectively. The procedures also rely on different equipment vendor specifications, and information from water treatment experts. These procedures allow the applicant to determine the concentrations of different chemical species, including fluoride, sulfate, oxygen, biocide, and corrosion inhibitor. The chemistry control program for the diesel fuel oil relies on the American Society for Testing and Materials (ASTM) D-4176 qualitative test and the ASTM D-2276 quantitative test for monitoring water and particulate content in diesel fuel oil. The staff finds that these procedures for monitoring and inspecting chemistry parameters will help the applicant to control aging effects in the affected plant systems.

[Detection of Aging Effects] Aging effects due to corrosive environments of water and diesel fuel oil are specific for different systems, and their detection is handled by the appropriate programs described in the LRA and evaluated by the staff. Localized corrosive damage (such as crevice corrosion) is detected during routine and corrective maintenance when the inspected components are disassembled and visually inspected for loss of material and other aging effects. The staff finds that the chemistry control program has the capability to satisfactorily manage aging effects.

[Monitoring and Trending] The monitoring and trending requirements for the parameters that are controlled by the chemistry control program are included in plant procedures. The staff finds that these procedures will allow the applicant to detect operational problems and take appropriate corrective action.

[Acceptance Criteria] The acceptance criteria in the chemistry control program for the chemistry parameters to be monitored in the systems carrying primary, secondary, and treated water chemistries and diesel fuel oil are described in the Nuclear Chemistry Parameters Manual, Technical Specifications, and other plant procedures. These parameters specify operational chemistry limits for specific systems. The staff finds that these criteria will ensure that chemistries of water and diesel fuel oil will be maintained at their optimum conditions.

[Operating Experience] The applicant states that review of Turkey Point's past performance has indicated that the overall effectiveness of the program is supported by very satisfactory operating experience for the systems, structures, and components that are affected by the program. A review of plant condition reports indicated that no Level 3 chemistry excursions, as defined by EPRI's water chemistry guidelines, were experienced. The program has been subject to periodic internal and external assessments to ensure continuous effectiveness and improvement. The staff finds that the operating experience presented by the applicant supports the determination that the chemistry control program will adequately manage the aging effects associated with the chemical environments existing at the Turkey Point nuclear power plant throughout the period of extended operation.

3.1.1.3 Conclusions

The staff has reviewed the information in Section 3.2.4 of Appendix B to the LRA and the applicant's responses to staff's RAIs. On the basis of its review, the staff concludes that the applicant has demonstrated that there is reasonable assurance that the chemistry control program will adequately manage aging effects associated with primary, secondary, treated water, and diesel generator fuel oil chemistries in accordance with the CLB throughout the period of extended operation.

3.1.2 FPL Quality Assurance Program

The NRC staff has reviewed LRA Section 3.1.2, "FPL Quality Assurance Program," in accordance with 10 CFR 54.21(a)(3) and 10 CFR 54.21(d). In Section 3.1.2 of the LRA, the applicant references its quality assurance program information contained in Section 2.0, "Aging Management Program Attributes," of Appendix B, "Aging Management Programs," to the LRA. The staff has evaluated the adequacy of certain aspects of the applicant's programs to manage the effects of aging. The particular aspects reviewed by the staff in this section encompass three quality assurance program attributes, namely corrective actions, confirmation process, and administrative controls. These three attributes of the quality assurance program are addressed for all of the applicant's aging management programs.

The license renewal applicant is required to demonstrate that the effects of aging on structures and components that are subject to an AMR will be adequately managed to ensure that their intended functions will be maintained in a manner that is consistent with the CLB of the facility throughout the period of extended operation. Therefore, those aspects of the aging management process that affect the quality of safety-related SSCs are subject to the quality assurance requirements of Appendix B to 10 CFR Part 50. For non-safety-related SSCs that are subject to an AMR, the existing 10 CFR Part 50, Appendix B, quality assurance program may be used by the applicant to address the attributes of corrective actions, confirmation process, and administrative controls.

3.1.2.1 Summary of Technical Information in Application

In Section 2.0 of Appendix B to the LRA, the applicant provides a generic description of the corrective actions, administrative controls, and confirmation process common to all aging management programs within the scope of license renewal. In this section, the applicant states that the corrective actions and administrative controls apply to all aging management programs that are credited for license renewal. The confirmation process is described as a process to ensure that adequate corrective actions have been completed and are effective. The corrective actions and administrative controls are described as part of the applicant's quality assurance program required by 10 CFR Part 50, Appendix B. For each aging management program listed in Section 3.0, "Aging Management Programs," of Appendix B to the LRA, the confirmation process is described as establishing followup examination requirements based on the evaluation of the inspection results. Also, the applicant states that it will enter unacceptable inspection results into its corrective action program.

The applicant's programs and activities that are credited with managing the effects of aging can be divided into new and existing programs. As defined in Section 2.0 of Appendix B to the LRA, the applicant uses the following specific attributes to describe these programs and activities:

- Corrective Actions: A description of the action taken when the established acceptance criterion or standard is not met. This includes timely root cause determination and prevention of recurrence, as appropriate.

- Administrative Controls: The identification of the plant administrative structure under which the programs are executed.

- Scope: A clear statement of the reason why the program exists for license renewal.

- Preventive Actions: A description of preventive actions taken to mitigate the effects of the susceptible aging mechanisms, and the basis for the effectiveness of these actions.

- Parameters Monitored or Inspected: A description of parameters that are monitored or inspected, and how they relate to the degradation of the particular component or structure and its intended function.

- Detection of Aging Effects: A description of the type of action or technique used to identify or manage the aging effects or relevant conditions.

- Monitoring and Trending: A description of the monitoring, inspection, or testing frequency and sample size (if applicable).

- Acceptance Criteria: The identification of the acceptance criteria or standards for the relevant conditions to be monitored or the chosen examination methods.

- Confirmation Process: A description of the process to ensure that adequate corrective actions have been completed and are effective.

- Operating Experience and Demonstration: A summary of the operating experience of the aging management program, including past corrective actions resulting in program enhancements or additional programs. Program demonstration is also included in this summary.

The applicant's programs and activities that demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation are described in Section 3.0, "Aging Management Programs," of Appendix B to the LRA. Summary descriptions of new and existing programs are contained in Chapter 16 of the applicant's UFSAR Supplement, which is provided in Appendix A to the LRA.

3.1.2.2 Staff Evaluation

The staff has determined the adequacy of certain aspects of the applicant's programs to manage the effects of aging. The particular aspects reviewed by the staff in this section encompass three quality assurance program attributes, namely corrective actions, confirmation process, and administrative controls. These three attributes of the quality assurance program are used by all of the applicant's aging manage programs. During the scoping/screening methodology and quality assurance audit conducted on November 13–16, 2000, the NRC staff reviewed the applicant's implementation of the corrective actions, administrative controls, and confirmation process described in LRA Section 3.1.2. The results were documented in an audit report dated April 25, 2001.

Chapter 3.0, "Aging Management Review Results," of the LRA provides an aging management review summary for each unique structure, component, or commodity group at Turkey Point determined to require aging management during the period of extended operation. This summary includes identification of aging effects requiring management and aging management programs utilized to manage these aging effects. Appendix B to the LRA demonstrates how the identified programs manage aging effects using attributes described in Section 3.1.2.1 of this SER. The staff determined that the attributes identified for each program consistent with those attributes described in Section A.1, "Aging Management Review — Generic," Table A.1-1, "Elements of an Aging Management Program for License Renewal," of the draft SRP.

Pursuant to 10 CFR 54.21, a license renewal applicant must demonstrate that the effects of aging on structures and components that are subject to an AMR will be adequately managed so that the intended functions will be maintained in a manner that is consistent with the CLB of the facility throughout the period of extended operation. Consistent with this approach, the applicant's aging management programs should contain the elements of corrective action, confirmation process, and administrative controls in order to ensure proper supervision of the aging management programs.

For all of these aging management programs, two attributes (corrective actions and administrative controls) are specifically addressed by reference to the FPL Topical Quality Assurance Report. However, neither Section 2.0 nor Section 3.0 of Appendix B to the LRA describe how the Topical Quality Assurance Report specifically addresses the confirmation process for which credit is being sought. In a February 2, 2001, letter, the NRC staff requested that the applicant provide a description of how the Topical Quality Assurance Report specifically addresses the confirmation process in the context of the corrective action program. Subsequently, in a letter dated March 22, 2001, the applicant described that the confirmation process is part of the corrective action process, which is part of the Topical Quality Assurance Report that meets the requirements of 10 CFR Part 50, Appendix B. The applicant's response resolved this open item.

Based on the information provided in the LRA, as supplemented by the applicant's letter, the NRC staff has determined that the corrective actions, confirmation process, and administrative controls are addressed in the applicant's approved quality assurance program. The staff has also determined that all aging management programs within the scope of license renewal are subject to the requirements of the applicant's quality assurance program. This includes the safety-related and non-safety-related aging management programs within the scope of license renewal. The staff finds that the FPL Topical Quality Assurance Report contains the applicant's commitments for managerial and administrative controls, including a discussion of how the applicable requirements of Appendix B to 10 CFR Part 50 will be satisfied.

3.1.2.3 FSAR Supplement

The applicant has provided a summary description of the programs and activities for managing the effects of aging and the evaluation of time-limited aging analyses for the period of extended operation in UFSAR Chapter 16, which is also included in Appendix A to the LRA. The UFSAR Supplement provides a brief explanation of the new and existing programs that the applicant will use to manage the effects of aging. The explanation contains a summary of several important technical attributes, such as inspections and techniques used to identify aging effects. However, the quality assurance programs, which include three attributes (corrective actions, confirmation process, and administrative controls), were not described.

For non-safety-related structures and components that are subject to an AMR for license renewal, an applicant has an option to expand the scope of its 10 CFR Part 50, Appendix B, program to include these structures and components to address corrective actions, confirmation process, and administrative controls for aging management during the period of extended operation. In accordance with Appendix A.2, "Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1)," Section A.2.2, Item 2 to the SRP, the applicant should document a commitment to expand the scope of its 10 CFR Part 50,

Appendix B, quality assurance program to include non-safety-related structures and components in the UFSAR Supplement consistent with Section 2 of Appendix B to the LRA. Several aging management programs pertain to both safety-related and non-safety-related SSCs. Therefore, committing to the FPL Quality Assurance Program for all aging management programs is acceptable. The applicant may develop another approach to meet Branch Technical Position IQMB-1. This issue was discussed with the applicant during the scoping and screening audit and was listed as Confirmatory Item 3.1.2-1. By letter dated November 1, 2001 the applicant responded to issue. The applicant stated that two attributes, Corrective Actions and Administrative Controls, were identified as common to all programs and are described in LRA Appendix B, Section 2.0, as being under the guidance of the FPL Quality Assurance Program. Confirmatory Actions are described in each individual program by stating that the followup actions will be entered into the corrective action programs. Furthermore, the FPL Quality Assurance Program will be applied to all aging management programs. The FSAR Supplement Section 16.0 is being revised to include the following:

> "FPL has established and implemented a Quality Assurance Program to provide assurance that the design, procurement, modification and operation of nuclear power plants conform to applicable regulatory requirements. The FPL Quality Assurance Program, described in the FPL Topical Quality Assurance Report, is in compliance with the requirements of 10 CFR 50, Appendix B. The FPL Quality Assurance Program meets the requirements provided by regulatory guidance and industry standards as listed in Appendix C of the FPL Topical Quality Assurance Report. Corrective actions, confirmatory actions, and administrative controls apply to all aging management programs credited for license renewal and performed, or in the case of new programs, to be performed, in accordance with the FPL Quality Assurance Program."

The staff has reviewed the applicant response and concludes that there is reasonable assurance that the applicant has expanded the scope of its 10 CFR Part 50, Appendix B, quality assurance program to include all safety-related and non-safety-related structures, systems, and components within the scope of license renewal in the UFSAR Supplement consistent with Section 2 of Appendix B to the LRA.

3.1.2.4 Conclusion

The staff finds that the quality assurance attributes are consistent with 10 CFR 54.21(a)(3). The staff finds that the applicant's UFSAR Chapter 16 Supplement description as revised in their response dated November 12, 2001, to the staff's confirmatory issue 3.1.2-1 provides a sufficient description of the programs and activities for managing the effects of aging, and ensures both safety-related and non-safety-related structures, systems, and components within the scope of license renewal will be evaluated and managed in accordance with their 10 CFR Part 50 Appendix B Quality Assurance Program. Therefore, the applicant's quality assurance description for its aging management programs is acceptable and Confirmatory Item 3.1.2-1 has been satisfied.

3.1.3 Systems and Structural Monitoring Program

3.1.3.1 Summary of Technical Information in the Application

The applicant describes its systems and structural monitoring program in Section 3.2.15 of Appendix B to the LRA. The applicant credits this inspection program with assessing the overall condition of the Turkey Point Unit 3 and 4 buildings and structures, and identifies any ongoing degradation through a visual inspection process. The program monitors and assesses the condition of structures and structural components affected by aging, which may cause loss of material, cracking, flow blockage, and change of material properties. The staff reviewed the LRA to determine whether the applicant has demonstrated that the structural monitoring program will adequately manage aging effects throughout the period of extended operation, as required by 10 CFR 54.21(a)(3).

In Section 3.2.15 of Appendix B to the LRA, the applicant describes the systems and structural monitoring program credited for aging management, and provides for periodic visual inspections to monitor the condition of structures, systems, components, and commodities. The structures monitored include the auxiliary building, containment, control building, diesel-driven fire pump enclosure, discharge structure, electrical penetration rooms, emergency diesel generator buildings, fire protection monitoring station, intake structure, main steam and feedwater platforms, plant vent stack, spent fuel storage and handling structure, turbine building, turbine gantry cranes, and yard structures. There are 20 key systems monitored by this program including auxiliary building ventilation, auxiliary feedwater, condensate storage, chemical and volume control, component cooling water, and containment isolation. The applicant lists the specific structural components and systems, which are fabricated from either carbon steel, stainless steel, or concrete, and inspected as part of the systems and structures monitoring program in Sections 3.2 through 3.6 of Appendix B to the LRA.

The aging effects managed by the structural monitoring program are discussed in Section 3.6 of the LRA. The applicant credits this inspection program to manage loss of material, cracking, fouling, loss of seal, and change in material properties for the above listed systems, structures, and components within the scope of license renewal. The program provides for visual inspection and examination of accessible surfaces of specific systems, structures, and components, including welds and bolting. Aging management of structural components that are inaccessible for inspection is accomplished by inspecting accessible structural components with similar materials and environments for aging effects that may be indicative of aging effects for the inaccessible structural components.

The applicant states that the program will be enhanced by restructuring it to address inspection requirements to manage the aging effects in accordance with 10 CFR Part 54, modifying the scope of specific inspections, and improving documentation requirements. Commitment dates associated with the enhancement of this program are contained in Appendix A to the LRA.

3.1.3.2 Staff Evaluation

The staff's evaluation of the structural monitoring program focused on how the program manages aging effects through the effective incorporation of the following 10 elements: program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The corrective actions and administrative controls for license renewal were not discussed as part of the program description because the applicant indicates that they are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components that are subject to AMR. For the confirmation process element, the applicant states that degradations identified by this program are evaluated and entered into the corrective action program. The staff's evaluation of the quality assurance program, including the confirmation process, is provided separately in Section 3.1.2 of this SER. The remaining seven elements are discussed below.

[Program Scope] The applicant lists the structures, systems, components, and commodities that are covered by the systems and structural monitoring program in Section 3.2.15 of Appendix B to the LRA. In RAI 3.6.2.1-2, the staff asked the applicant to provide an aging management program for monitoring the condition of reinforced concrete components located above groundwater elevation and outside containment. The applicant responded that its aging management review of these concrete components identified no aging effects that could cause loss of intended function and, therefore, listed no aging management program for these components in the LRA. However, the applicant proposed to modify its ASME Section XI, Subsection IWL Inservice Inspection Program to manage the aging of containment structure concrete components located above groundwater elevation and to use these inspections as an indicator for the condition of reinforced concrete components outside containment. Subsequent communication between the staff and applicant culminated in a letter, dated October 30, 2001, in which the staff stated its position that all concrete structures and components within the scope of license renewal require aging management via a dedicated aging management program. In its supplemental response to RAI 3.6.2.1-2, dated November 1, 2001, the applicant committed to modify its systems and structural monitoring program in order to manage loss of material, cracking, and change in material properties for reinforced concrete components outside containment as well as containment internal structural concrete components. Once incorporated, as committed in this response, the staff considers this issue to be resolved.

In RAI 3.9.15-1 dated February 2, 2001, the staff asked the applicant to indicate how it will manage aging effects of structural components that are inaccessible for inspection, and to discuss how it intends to manage or monitor aging effects of inaccessible structural components when conditions in accessible areas may not indicate the presence of degradation in inaccessible areas. The applicant was also asked to provide a summary discussion of specific program attributes that will be enhanced to address inspection requirements to manage certain aging effects pursuant to 10 CFR Part 54. The applicant responded by letter dated April 19, 2001, stating that aging management of structural components that are inaccessible for inspection is accomplished by inspecting accessible structural components with similar materials and environments for aging effects that may be indicative of aging effects for inaccessible structural components. This is described in the systems and structures monitoring program, Appendix B, Section 3.2.15, page B-84, of the LRA. The applicant states that since components in inaccessible areas have the same materials and environments as those in accessible areas, indications of degradation (or the lack of indications) in accessible areas is an effective way to manage components in inaccessible areas.

As described in the response to RAI 3.6.1.1-1, dated March 30, 2001, the applicant indicates that the systems and structures monitoring program is credited for managing aging of the inaccessible containment concrete below the groundwater. Aging effects are managed by performing visual inspections of the non-safety-related tendon access gallery concrete below groundwater to provide early indication of potential aging effects for the containment concrete.

Currently, inspections that are within the scope of the systems and structures monitoring program are performed under a variety of plant programs and processes. For the renewal term, the applicant plans to enhance these inspections by restructuring them to identify certain aging effects in accordance with 10 CFR Part 54, by adding specific structures and components that are not currently inspected under an existing program, and by improving documentation requirements. These enhancements will be incorporated prior to the end of the initial license term for Turkey Point, as described in Appendix A to the LRA, Section 16.2.15, page A-41.

With the above clarifications provided in response to the RAI, the staff finds that the scope of this program is acceptable, since it includes a walkdown inspection and aging effects assessment of all structures and components that are within the scope of license renewal. Therefor, RAI 3.9.15-1 is closed.

[Preventive Actions] The applicant stated that external surfaces of carbon steel and cast iron valves, piping, and fittings, and specific stainless steel piping welds are coated to minimize corrosion, as are surfaces of steel structures and supports. The applicant asserts that coatings minimize corrosion by limiting exposure to the environment; however, the applicant did not take credit for coatings in the determination of the aging effects requiring management. The applicant’s approach is acceptable.

[Parameters Monitored or Inspected] The applicant states that surface conditions of structures, system components/piping (including those exposed to a wetted environment), and supports are monitored through visual examinations to determine the existence of external corrosion and the internal corrosion of certain ventilation equipment. Flexible connections are monitored for cracking due to embrittlement, and ventilation heat exchangers are monitored for fouling. External surfaces of concrete are monitored through visual examination for exposed rebar, extensive rust bleeding, cracks that exhibit rust bleeding, and cracking of block walls and building roof seals. The applicant further states that leakage inspections of valves, piping, and fittings at limited locations of the intake cooling water and waste disposal systems are utilized to detect the presence of internal corrosion. Additionally, visual inspection of external surfaces of certain ventilation systems is used to assess internal system conditions. Inspection of protective coatings on specific stainless steel piping welds in outdoor locations will be performed to determine coating degradation. Inspection of weatherproofing material for deterioration is also performed.

With respect to this attribute, the staff's RAI 3.9.15-2, dated February 2, 2001, stated that the applicant's parameter description is incomplete. The RAI asked the applicant to augment the discussion to demonstrate that the specific parameters that are monitored or inspected are selected to ensure that aging degradation leading to loss of intended functions will be detected, and the extent the degradation can be determined. The parameters monitored or inspected must be commensurate with industry-standard practice, and must also consider industry and plant-specific operating experience. For concrete structural elements, typical parameters to be monitored or inspected are structural cracking, spalling, scaling, erosion, corrosion of reinforcement bars, settlement, and deformation. For structural steel elements (including connections), typical parameters to be monitored or inspected are corrosion, cracking, erosion, discoloration, wear, pitting, gouges, dents, and other signs of surface irregularities.

In the applicant's response, dated April 19, 2001, the applicant stated that the systems and structures monitoring program, as described in Section 3.2.15 of Appendix B to the LRA, manages the aging effects of loss of material, cracking, fouling, loss of seal, and change in material properties to ensure that aging degradation leading to loss of intended functions will be detected. The program provides for periodic visual inspection of concrete and masonry structures, steel structures, and system commodities and components (e.g., piping, ductwork, electrical raceways, valves, heat exchangers, and electrical enclosures). The applicant further stated that the parameters monitored are selected based on industry and plant experience to ensure that aging degradation that could lead to loss of intended function will be identified and addressed. Concrete and masonry parameters monitored include exposed rebar, cracking, rust bleeding, spalling, scaling, other surface irregularities, and settlement. For steel structures, the parameters monitored include corrosion, flaking, pitting, gouges, cracking, other surface irregularities, and missing parts. For system commodities and components, the parameters monitored include corrosion, flaking, pitting, gouges, cracking, fouling, other surface irregularities, protective coating degradation on select stainless steel pipe welds, leakage at limited locations, and missing parts. The staff finds that the parameters that are monitored or inspected as described above are adequate and acceptable because they are directly related to the degradation of civil structures, systems, and components, and visual inspections and associated aging effects evaluations of these parameters are effective means to detect degraded conditions. Therefore, RAI 3.9.15-2 is closed. In addition, in its supplemental response to RAI 3.6.2.1-2, dated November 1, 2001, the applicant committed to the examination of external surfaces of concrete for cracking, loss of material, and change in material properties as well as the other conditions listed above.

[Detection of Aging Effects] The applicant states that aging effects due to loss of material, crack initiation, fouling, loss of seal, and change in material properties are detected by visual inspection of external surfaces (including internal surfaces of certain ventilation equipment) for evidence of corrosion, cracking, leakage, fouling, or coating damage. The staff's RAI 3.9.15-5, dated February 2, 2001, asked the applicant to provide the inspection methods, inspection schedule (frequency), and inspector qualifications for each structure/aging effect combination to ensure that aging degradation will be detected and quantified before there is loss of intended functions.

In its response dated April 19, 2001, the applicant indicated that as described in Section 3.2.15 of Appendix B to the LRA, the systems and structures monitoring program employs the visual inspection method. Structures and structural commodities are visually inspected on an area basis, and system commodities and components are visually inspected on a system basis. Conditions documented and evaluated via the corrective action program may employ other methods, such as volumetric examination, to determine the extent of degradation.

The applicant stated that the inspection schedule varies depending on the system, structure, or component being inspected. Generally, inspections will be performed on a frequency of 5 years or less; however, as documented in the response to RAI 3.4.1-2, dated March 22, 2001, some inspections of the intake cooling water (ICW) system will be performed on an 18-month interval. These frequencies are based on Turkey Point plant experience regarding degradation rates and the ability of a structure or component to accommodate degradation without a loss of intended function. The frequency of inspections may be adjusted as necessary based on future inspection results and industry experience. The applicant indicated that personnel responsible for the performance of inspections and the evaluation of inspection results are qualified in accordance with the engineering training program (ETP), which is accredited by the Institute of Nuclear Power Operations (INPO) and required by 10 CFR 50.120.

The applicant stated that the inspection methods, inspection schedules, and personnel qualifications described above provide reasonable assurance that aging degradation will be detected and evaluated before there is a loss of intended functions. The staff finds this section of the program acceptable. Therefore, RAI 3.9.15-5 is closed.

[Monitoring and Trending] The applicant's discussion did not appear to adequately address the monitoring and trending aspects of the program. Proactive monitoring and understanding of trending behavior is needed to monitor structural aging so that corrective actions can be taken prior to exceeding the acceptance criteria. The staff's RAI 3.9.15-4, dated February 2, 2001, asked the applicant to describe the monitoring and analysis activities to be included for each of the commodity groups to track the extent and rate of degradation and their relationship to the applicable acceptance criteria.

In its response dated April 19, 2001, the applicant stated that the systems and structures monitoring program is primarily credited for managing loss of material due to corrosion, as well as other aging effects identified in Section 3.2.15 of Appendix B to the LRA. Monitoring is accomplished through detailed system and structure material condition inspections, performed periodically in accordance with approved plant procedures. When degraded conditions are identified, they are evaluated and corrected via the corrective action program. Typically, this involves quantifying the extent of the condition, evaluating the capability of the structure or component to perform its intended function, and then designating appropriate corrective actions. The applicant indicated that the corrective action program includes periodic trending assessments and evaluations. When trends are identified, they are addressed under the corrective action program. Further evaluation is performed including identification and implementation of programmatic improvements, as required. Programmatic improvements may include adjustment of program scope, frequency, acceptance criteria, and/or corrective actions. This process ensures that applicable aging effects are adequately managed. The staff finds this section of the program acceptable. Therefore, RAI 3.9.15-4 is closed.

[Acceptance Criteria] In RAI 3.9.15-3, dated February 2, 2001, the staff asked the applicant to provide additional descriptions of the criteria used to assess or categorize the overall condition of the structures and systems that are monitored. In addition, the RAI asked the applicant to discuss Turkey Point-specific criteria that are used to assess the severity of observed degradations and determine whether corrective action(s) are needed. The RAI also asked the applicant to briefly describe walkdown procedures, checklists, or inspection forms that are provided to personnel who implement the systems and structures monitoring program.

In its response dated April 19, 2001, the applicant stated that detailed structural and system/equipment material condition inspections are performed in accordance with approved plant procedures. Existing procedures include detailed guidance for inspecting and evaluating the material condition of systems, structures, and components within the scope of the program. The guidance includes specific parameters to be monitored and criteria to be used for evaluating identified degradation. In addition, the procedures provide sample forms to be used to document the analysis and assessment, and a system checklist for documenting relevant information from a system walkdown.

Conditions identified through the systems and structures monitoring program are evaluated to determine if the condition(s) should be addressed under the FPL 10 CFR Part 50, Appendix B, corrective action program (i.e., deficient or unacceptable conditions). For example, the criterion for structural steel is loss of material exceeding $^{1}/_{32}$ of an inch, and the criterion for piping is any corrosion greater than uniform light surface corrosion. The applicant stated that the results of the inspections and testing are evaluated in accordance with the acceptance criteria in the appropriate corrective action and administrative procedures. The staff finds the above described approach reasonable and adequate. The staff also finds that this section of the program addressing acceptance criteria is acceptable. Therefore, RAI 3.9.15-3 is closed.

[Operating Experience and Demonstration] The applicant states that systems and piping/component support material condition inspections have been successfully performed at Turkey Point since the mid-1980s. The inspection requirements in support of the NRC's Maintenance Rule (10 CFR 50.65) have been in effect since 1996, and have proven effective at maintaining systems/structures material condition and detecting unsatisfactory conditions, and have resulted in effective corrective actions being taken. The applicant further states that the systems and structures monitoring program has been an ongoing program at Turkey Point and has been enhanced over the years to include the best practices recommended by INPO and other industry guidance. Additionally, the systems and structures monitoring program will continue to support implementation of the Maintenance Rule. The effectiveness of the systems and structures monitoring program is supported by the improved system and structure material conditions documented by internal as well as external assessments of the last several years. Additionally, the systems and structures monitoring program is the subject of periodic internal and external assessments to ensure effectiveness and continued improvement. Based upon the above, the applicant asserts that continued implementation of the systems and structures monitoring program provides reasonable assurance that the aging effects (loss of material, crack initiation, fouling, loss of seal, and change in material properties) will be managed such that systems and structures within the scope of license renewal will continue to perform their intended functions consistent with the CLB throughout the period of extended operation. The staff finds that this section of the program is acceptable.

3.1.3.3 Conclusion

The staff has reviewed the information in Section 3.2.15 of Appendix B to the LRA and the applicant's responses to the staff's RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects managed by the systems and structures monitoring program will be adequately managed so that there is reasonable assurance that the commodities and components covered by this inspection program will perform their intended functions in accordance with the CLB during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2 Reactor Coolant Systems

The LRA includes the following reactor coolant mechanical and structural components within the reactor coolant systems that require an AMR:

- reactor coolant piping (Class 1 and non-Class 1)
- regenerative and excess letdown heat exchangers
- pressurizers
- reactor vessels
- reactor vessel internals
- reactor coolant pumps
- steam generators

Results from AMR of these components are described in LRA Section 3.2, "Reactor Coolant Systems." The staff issued an RAI on February 2, 2001. The applicant provided the additional information by letter dated April 19, 2001.

3.2.1 Reactor Coolant Piping

The reactor coolant piping at Turkey Point consists of Class 1 and non-Class 1 components. In the LRA, the applicant provided separate descriptions of the AMR for these two classifications of piping.

3.2.1.1 Class 1 Piping

3.2.1.1.1 Summary of Technical Information in the Application

The applicant described its AMR of the Class 1 piping for license renewal in LRA Section 3.2.1.1, "Class 1 Piping," as supplemented by the April 19, 2001, response to the RAI. The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on the Class 1 piping will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Class 1 piping is included in topical report WCAP-14575, "License Renewal Evaluation: Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components." WCAP-14575 is not incorporated by reference in the LRA, but the Turkey Point AMR was compared to WCAP-14575, as described in Section 3.2.6.2 of this SER. The draft safety evaluation (SE) for WCAP-14575 was issued by letter dated February 10, 2000. The final SE for WCAP-14575 was issued by letter dated November 8, 2000, after the Turkey Point LRA was submitted to the NRC for review. However, all of the LRA action items identified in the final SE of WCAP-14575 were addressed either as applicant action items or open items by the applicant in Tables 2.3-2 and 2.3-3 of the LRA. Specifically, the open items that were identified in the draft SE of WCAP-14575 were either resolved, or added to the list of renewal applicant action items for the final SE. The applicant's responses are discussed and evaluated in Section 3.2.6.2 of this SER.

Although topical report WCAP-14575 is not incorporated by reference in the application, the results of the applicant's AMR were compared to those of the topical report in Tables 2.3-2 and 2.3-3 of the LRA. The applicant's review concluded that the Turkey Point Unit 3 and 4 reactor coolant Class 1 piping is bounded by the description of Class 1 piping contained in WCAP-14575 with regard to design criteria and features, materials of construction, fabrication techniques, installed configuration, modes of operation, and environments/exposures. Further, the applicant concluded that the component intended functions for reactor coolant Class 1 piping are inclusive of the intended functions identified in WCAP-14575. In addition to the functions identified in WCAP-14575, the applicant identified an additional function for the flow-restricting orifices and reducers. The applicant concluded that these orifices and reducers provide throttling to limit the maximum flow through a postulated line break in an attached non-Class 1 line to a value within the makeup capability of the chemical and volume control system. These orifices and reducers provide the code class break in the applicant's evaluation.

The applicant identified additional aging effects, specifically cracking due to stress corrosion and loss of mechanical closure integrity due to aggressive chemical attack and stress corrosion cracking (SCC), not identified in the evaluation of topical report WCAP-14575.

The applicant identified that the reactor coolant Class 1 piping components are exposed to an internal environment of treated water-primary, and external environments of containment air and potential borated water leaks, as described in Tables 3.0-1 and 3.0-2 of the LRA.

The application identifies that reactor coolant Class 1 piping components are constructed of stainless steel and low alloy steel, and notes that there are no Alloy 600 penetrations associated with reactor coolant Class 1 piping components. The piping components, and their intended functions, materials, and environments are summarized in Table 3.2-1 of the LRA.

The LRA identifies cracking, reduction in fracture toughness, and loss of mechanical closure integrity as aging effects requiring management during the license renewal period for Class 1 piping. Table 3.2-1 of the LRA summarizes the environment and material combinations requiring aging management, along with the programs and activities for aging management during the license renewal period.

Cracking due to flaw growth and stress corrosion is identified in the application as an aging effect requiring management for the period of extended operation. Cracking due to fatigue is identified in the application as a time-limited aging analysis (TLAA), and is addressed in LRA Section 4.3, "Metal Fatigue."

The LRA identifies that cracking due to growth of original manufacturing flaws is managed during the license renewal period through the ASME Section XI, Subsections IWB, IWC, and IWD inservice inspection (ISI) program, as supplemented by the one-time small bore piping inspection program. For cracking due to stress corrosion, the LRA identifies that specific design, fabrication, and construction measures were taken to minimize or eliminate susceptible material from reactor coolant Class 1 piping components, including preventing sensitized stainless steel from coming in contact with an aggressive environment. The LRA identifies that the chemistry control program provides additional assurance that SCC is managed.

The LRA identifies reduction in fracture toughness due to thermal embrittlement of Class 1 piping components fabricated from cast austenitic stainless steel (CASS). The LRA identifies affected components as the primary loop elbows, reactor coolant pump casings and closure flanges, and selected valves exceeding a temperature threshold criterion of 482 °F. Reduction in fracture toughness of the reactor coolant pump casings and closures is discussed in LRA Section 3.2.6, “Reactor Coolant Pumps.”

The impact of thermal embrittlement on the primary loop elbows is evaluated in the primary loop leak-before-break (LBB) analysis, which has been identified as a TLAA by the applicant. This TLAA is described in LRA Section 4.7.3, “Leak-Before-Break for Reactor Coolant System Piping.”

Consistent with the conclusions drawn in the NRC’s safety evaluation for WCAP-14575, the applicant concludes that screening Class 1 CASS valves for susceptibility to thermal embrittlement is not required during the period of extended operation because the reduction in fracture toughness of these components should not have a significant impact on critical flaw size. The LRA further concludes that the ASME Section XI, Subsections IWB, IWC, and IWD ISI program provides assurance that reduction in fracture toughness due to thermal aging is managed, and that the intended function of the reactor coolant Class 1 CASS valves is maintained consistent with the CLB throughout the period of extended operation.

The LRA identifies that loss of mechanical closure integrity due to stress relaxation can be managed by periodic inservice inspections and leakage testing. The LRA identifies that the ASME Section XI, Subsections IWB, IWC, and IWD ISI program provides assurance that loss of mechanical closure integrity due to stress relaxation is managed, and that the intended function of reactor coolant Class 1 piping components is maintained consistent with the CLB throughout the period of extended operation.

The application identifies that loss of mechanical closure integrity due to aggressive chemical attack has been observed in the industry, and is the most common aging mechanism of concern for ferritic fasteners of stainless steel components. Mechanical closure bolting associated with reactor coolant Class 1 piping components is made of low alloy steel bolting material, and is subject to aggressive chemical attack from potential borated water leaks. The application identifies that the boric acid wastage surveillance program provides assurance that the aging mechanism of loss of mechanical closure integrity due to aggressive chemical attack is managed, and that the intended function of reactor coolant Class 1 piping components is

maintained consistent with the CLB throughout the period of extended operation.
The applicant identifies applicable industry and plant-specific operating experience in LRA Section 3.2.1.1.3, "Operating Experience." The LRA notes that no additional aging effects requiring management were identified from this review of operating experience beyond those previously identified in the LRA.

3.2.1.1.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2.1, "Reactor Coolant Systems," (including Table 3.2-1) and pertinent sections of Appendices A and B to the LRA regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation for the Class 1 reactor coolant piping system.

As described in Section 3.2.1.1.1 of this SER, the final SE for WCAP-14575 was issued by letter dated November 8, 2000, after the Turkey Point LRA was submitted to the NRC for review. However, all of the open items that were identified in the draft SE were either resolved or added to the list of renewal applicant action items for the final SE. Therefore, the applicant addressed all renewal applicant action items that are included in the final SE report for WCAP-14575. There were six renewal applicant action items, and six open items from the draft SE for WCAP-14575. The action items, open items, applicant's responses, and staff's evaluations are provided in Section 3.2.6.2 of this SER. From its review of this information, the staff finds that the applicant's responses (Tables 2.3-2 and 2.3-3 of the LRA) to the renewal applicant action items and open items from the draft safety evaluation resolve the applicant action items in the final SE for WCAP-14575.

3.2.1.1.2.1 Aging Effects

The applicant identifies the following aging effects for the Class 1 reactor coolant piping system:

- cracking
- reduction in fracture toughness
- loss of mechanical closure integrity

On the basis of the description of the internal and external environments, materials used, and the applicant's review of industry and plant-specific experience, the NRC staff concludes that the applicant has identified the aging effects that are applicable for the Class 1 reactor coolant piping system.

3.2.1.1.2.2 Aging Management Programs

The applicant identifies existing and new programs for managing aging effects for the Class 1 reactor coolant piping system during the license renewal term. The following existing AMPs are identified in the application:

- ASME Section XI, Subsections IWB, IWC, and IWD ISI program
- boric acid wastage surveillance program
- chemistry control program

Staff evaluations of these existing programs are described in Sections 3.9.1, 3.9.3, and 3.1.1 of this SER, respectively.

A new AMP identified in the application is small bore Class 1 piping inspection. Staff evaluation of this new AMP is described in Section 3.8.7 of this SER.

On the basis of the evaluations of these AMPs in the SER sections identified above, the staff concludes that these AMPs are acceptable for managing the pertinent aging effects and providing assurance that the intended function of the reactor coolant Class 1 piping components will be maintained consistent with the CLB throughout the period of extended operation.

3.2.1.1.3 FSAR Supplement

The FSAR supplement sections pertinent to the Class 1 piping system include 16.1.7, "Small Bore Class I Piping Inspection," 16.2.1.1, "ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program," 16.2.3, "Boric Acid Wastage Surveillance Program," and 16.2.4, "Chemistry Control Program." These programs and associated FSAR supplement sections are evaluated in Sections 3.8.7, 3.9.1, 3.9.3, and 3.1.1, respectively, of this SER.

3.2.1.1.4 Conclusion

The staff has reviewed the information in Section 3.2.1.1 of the LRA, as supplemented by the April 19, 2001, response to the RAI. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the Class 1 piping will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB throughout the period of extended operation.

3.2.1.2 Non-Class 1 Piping

3.2.1.2.1 Summary of Technical Information in the Application

The applicant describes its AMR of the non-Class 1 piping for license renewal in LRA Section 3.2.1.2, "Non-Class 1 Piping," as supplemented by the April 19, 2001, response to the RAI. The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on the non-Class 1 piping will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Reactor coolant non-Class 1 piping components are not within the scope of topical report WCAP-14575. However, several reactor coolant non-Class 1 piping components are identified in the application as being within the scope of license renewal. The component intended function of these in-scope components is pressure boundary integrity. The reactor coolant non-Class 1 piping components requiring an AMR are listed in LRA Section 2.3.1.2.2, "Non-Class 1 Piping."

Reactor coolant non-Class 1 piping components are exposed to internal environments of air/gas, treated water, treated water-primary, and lubricating oil, as well as external environments of containment air and potential borated water leaks.

Reactor coolant non-Class 1 piping components are constructed of stainless steel, low alloy steel, carbon steel, admiralty brass, and 90/10 copper-nickel. Table 3.2-1 of the LRA provides the individual reactor coolant non-Class 1 piping components, as well as their intended functions, materials, and environments.

The application identifies cracking, loss of material, and loss of mechanical closure integrity as aging effects requiring management during the license renewal period. Table 3.2-1 of the application summarizes the environment and material combinations requiring aging management, along with the programs and activities for aging management during the license renewal period.

Cracking due to stress corrosion is identified in the application as an aging effect requiring management for the period of extended operation. Cracking due to fatigue is identified in the application as a TLAA, and is addressed in LRA Section 4.3.4.

For cracking due to stress corrosion, the LRA identifies that specific design, fabrication, and construction measures were taken to minimize or eliminate susceptible material from reactor coolant non-Class 1 piping components, including preventing sensitized stainless steel from coming in contact with an aggressive environment. The LRA identifies that the chemistry control program provides assurance that SCC is managed.

The LRA identifies that mechanisms that can cause loss of material for reactor coolant non-Class 1 piping components are general corrosion, crevice corrosion, pitting corrosion, microbiologically influenced corrosion (MIC), selective leaching, galvanic corrosion, and aggressive chemical attack.

General corrosion, crevice corrosion, pitting corrosion, MIC, and selective leaching have been identified as aging mechanisms for the internal surfaces of reactor coolant non-Class 1 piping components. The applicant stated that the chemistry control program is credited for managing the corrosion effects of the non-Class 1 piping components.

In addition, general corrosion and pitting corrosion have been identified as aging mechanisms for external surfaces of carbon steel components. The applicant states that although existing protective coatings applied to these surfaces have effectively protected them from corrosion effects, the systems and structures monitoring program is credited for managing the general corrosion and pitting corrosion for the external surfaces of the non-Class 1 piping components.

Galvanic corrosion has been identified as an aging mechanism between the reactor coolant pump lower bearing heat exchanger tube coil (copper alloy) and the component cooling water (CCW) supply piping (carbon steel), and between the reactor coolant pump upper bearing heat exchanger tubes (brass) and the carbon steel heat exchanger tube sheet. The applicant stated that although galvanic action is considered to be a corrosion mechanism, no adverse effect of galvanic corrosion has been identified for these material combinations and environments at Turkey Point. The applicant stated that the galvanic corrosion susceptibility inspection program is credited for managing the galvanic corrosion of the non-Class 1 piping components.

Aggressive chemical attack is corrosion that may be localized or general, and is caused by a corrodent that is particularly active on a specified material. Highly concentrated boric acid solutions or deposits of boric acid crystals may be very corrosive for carbon steel. Aggressive chemical attack is, therefore, identified as an aging mechanism for external surfaces of carbon steel components that are exposed to potential borated water leaks. The applicant states that the boric acid wastage surveillance program is credited for managing the loss of material due to aggressive chemical attack.

The LRA identifies that loss of mechanical closure integrity due to aggressive chemical attack has been observed in the industry and is the most common aging mechanism of concern for ferritic fasteners of stainless steel components. Mechanical closure bolting associated with reactor coolant non-Class 1 piping components is made of low alloy steel bolting material, and is subject to aggressive chemical attack from potential borated water leaks. The LRA identifies that the boric acid wastage surveillance program provides assurance that the aging mechanism of loss of mechanical closure integrity due to aggressive chemical attack is managed, and that the intended function of reactor coolant non-Class 1 piping components is maintained consistent with the CLB throughout the period of extended operation.

The applicant identifies industry and plant-specific operating experience in LRA Section 3.2.1.2.3, “Operating Experience.” The application notes that no additional aging effects requiring management were identified from this review of operating experience beyond those previously identified in the application.

3.2.1.2.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2.1 (including Table 3.2-1), pertinent sections of Appendices A and B to the LRA, and the applicant’s responses to the staff’s RAIs, regarding the applicant’s demonstration that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation for the reactor coolant non-Class 1 piping system.

3.2.1.2.2.1 Aging Effects

The applicant identifies the following aging effects for the reactor coolant non-Class 1 piping components:

- cracking
- loss of material
- loss of mechanical closure integrity

The inner reactor vessel flange O-ring leak detection line tubing, fittings, and valves, and the reactor vessel head vent piping, fittings, and valves are located downstream of restricting orifices that limit reactor coolant flow in the case of a rupture in these items. In addition, the inner reactor vessel flange O-ring leak detection line is pressurized with a nitrogen environment during operation, as described in the April 19, 2001, response to RAI 3.2.1-1, thereby precluding cracking of the items in this line. On the basis of the restricting orifices and the nitrogen environment, the staff agrees with the applicant's conclusions regarding the applicable aging effects for these items.

On the basis of the description of the internal and external environments, materials used, the applicant's review of industry and plant-specific experience, and the applicant's RAI responses, the NRC staff concludes that the applicant has identified the aging effects that are applicable for the reactor coolant non-Class 1 piping components.

3.2.1.2.2.2 Aging Management Programs

The applicant identifies existing and new programs for managing the aging effects for the reactor coolant non-Class 1 piping components during the license renewal term. The LRA identifies the following existing AMPs:

- boric acid wastage surveillance program
- chemistry control program
- systems and structures monitoring program

Staff evaluations of these existing programs are described in Sections 3.9.3, 3.1.1, and 3.1.3, respectively, of this SER.

A new AMP identified in the application is the galvanic corrosion susceptibility inspection program. Staff evaluation of this new AMP is described in Section 3.8.5 of this SER.

On the basis of the evaluations of these AMPs in the SER sections identified above, the staff concludes that these AMPs are acceptable for managing the pertinent aging effects and providing assurance that the intended function(s) of the reactor coolant non-Class 1 piping components will be maintained consistent with the CLB throughout the period of extended operation.

3.2.1.2.3 FSAR Supplement

The FSAR supplement sections pertinent to the non-Class 1 piping system include 16.1.5, "Galvanic Corrosion Susceptibility Inspection Program," 16.2.3 "Boric Acid Wastage Surveillance Program," 16.2.4, "Chemistry Control Program," and 16.2.15, "Systems and Structures Monitoring Program." These programs and associated FSAR supplement sections are evaluated in Sections 3.8.5, 3.9.3, 3.1.1, and 3.1.3, respectively, of this SER.

3.2.1.2.4 Conclusions

The staff has reviewed the information in Section 3.2.1.2 of the LRA, as supplemented by the April 19, 2001, responses to the RAI. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the non-Class 1 piping will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB during the period of extended operation.

3.2.2 Regenerative and Excess Letdown Heat Exchangers

The regenerative and excess letdown heat exchangers are a part of chemical and volume control. They are addressed in this section, however, because they are within the reactor coolant system (RCS) pressure boundary. The regenerative and excess letdown heat exchangers are described in UFSAR Section 9.2.

3.2.2.1 Summary of Technical Information in the Application

The applicant describes its AMR of the regenerative and excess letdown heat exchangers for license renewal in LRA Section 3.2.2, "Regenerative and Excess Letdown Heat Exchangers," as supplemented by the April 19, 2001, responses to the RAI. The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on the regenerative and excess letdown heat exchangers will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The regenerative heat exchangers have a multiple shell and U-tube design, each consisting of three heat exchangers interconnected in series by piping and mounted on a common support frame. The heat exchangers are designed to recover heat from the letdown stream by heating the charging stream, thus minimizing reactivity effects due to injection of cold water and minimizing thermal stress on the charging line penetrations in the reactor coolant loop piping. The letdown stream flows through the shell of the heat exchangers, and the charging stream flows through the tubes.

The excess letdown heat exchangers have a U-tube design. Their function is to cool reactor coolant letdown flow equivalent to that portion of the nominal seal injection flow that enters the RCS through the labyrinth of the reactor coolant pump (RCP) seals. They may be used when the normal letdown path is temporarily out of service or for supplementing the maximum letdown during heatup. The letdown is a four-pass flow through the tubes, while CCW system flow is a single pass through the shells.

In Section 2.3.1.3 of the LRA, the applicant states that the intended functions of the regenerative and excess letdown heat exchangers are pressure boundary integrity and heat transfer.

Aging Effects

The regenerative and excess letdown heat exchangers are exposed to internal environments of treated water and treated water-primary, and external environments of containment air and potential borated water leaks (see Tables 3.0-1 and 3.0-2 of the LRA).

The regenerative and excess letdown heat exchangers are constructed of stainless steel, low alloy steel, and carbon steel. The heat exchanger components and their intended functions, materials, and environments are summarized in Table 3.2-1 of the LRA.

In Section 3.2.6 of the LRA, the applicant identifies the following aging effects for the regenerative and excess letdown heat exchangers:

- stress corrosion cracking
- loss of material due to corrosion and aggressive chemical attack
- loss of mechanical closure integrity (by stress relaxation and/or aggressive chemical attack)
- fouling

In Section 3.2.2.2.1 of the LRA, the applicant states that specific design, fabrication, and construction measures were taken to minimize or eliminate material susceptible to SCC in the regenerative and excess letdown heat exchangers. In addition, to reduce the susceptibility of regenerative and excess letdown heat exchangers materials to SCC, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment.

In Section 3.2.2.2.2 of the LRA, the applicant identifies several forms of corrosion and aggressive chemical attack as aging mechanisms that can cause loss of material for the regenerative and excess letdown heat exchangers. Specifically, these forms of corrosion are general, crevice, pitting, galvanic, and MIC. The applicant notes that the regenerative heat exchangers are an all welded, stainless steel construction and not subject to loss of material. The applicant states that general corrosion has been identified as an aging mechanism for internal carbon steel surfaces of the excess letdown heat exchangers. MIC has been identified as an aging mechanism for the stainless steel tube sheets and the outside diameter of the stainless steel tubing of the excess letdown heat exchangers. These parts are exposed to CCW that contains dissolved oxygen.

Section 3.2.2.2.2 of the LRA also identifies galvanic corrosion as an aging mechanism for the internal surfaces of the carbon steel shells of the excess letdown heat exchangers at the vicinity of their contact point with the stainless steel tube sheets. Although galvanic action is considered to be a corrosion mechanism, no adverse effect of galvanic corrosion has been identified for these material combinations and environments at Turkey Point.

The LRA states that the external carbon steel surfaces of the excess letdown heat exchanger shells are exposed to the containment air environment, and are typically wetted with condensation when operating. General corrosion, crevice corrosion, pitting corrosion, and MIC were identified by the applicant as aging mechanisms for external carbon steel surfaces of the excess letdown heat exchangers. Aggressive chemical attack was identified by the applicant as an aging mechanism for the excess letdown heat exchanger external surfaces that are exposed to potential borated water leaks.

Section 3.2.2.2.3 of the LRA states that loss of mechanical closure integrity can result from aggressive chemical attack. Loss of mechanical closure integrity due to aggressive chemical attack has been observed in the industry, and is the most common aging mechanism of concern for ferritic fasteners of stainless steel components. The LRA notes that mechanical closure bolting associated with the excess letdown heat exchangers is made of low alloy steel bolting material, and is subject to aggressive chemical attack from potential borated water leaks. In addition, there are no bolted mechanical closures associated with the regenerative heat exchangers.

Section 3.2.2.2.4 of the LRA identifies biological fouling as an aging mechanism affecting the excess letdown heat exchanger tubing that is exposed to CCW. Particulate fouling has been identified as an aging mechanism for the regenerative and excess letdown heat exchanger tubing.

Industry Experience

The applicant performed a review of industry operating history and NRC generic communications to validate the set of aging effects that require management. Specifically, the applicant reviewed the following industry correspondence for regenerative and excess letdown heat exchangers operating experience:

- NRC Bulletin 79-17, "Pipe Cracks in Stagnant Borated Water Systems at PWR Plants"
- NRC Circular 76-06, "Stress Corrosion Cracks in Stagnant, Low-Pressure Stainless Piping Containing Boric Acid Solution at PWRs"
- NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants"
- NRC Information Notice 79-19, "Pipe Cracks in Stagnant Borated Water Systems at PWR Plants"
- SAND 93-7070, "Aging Management Guideline for Commercial Nuclear Power Plants — Heat Exchangers"

No aging effects requiring management were identified from the above documents beyond those already identified in Section 3.2.2.2 of the LRA.

Plant-Specific Experience

The applicant reviewed Turkey Point Unit 3 and 4 operating experience to validate the identified aging effects requiring management. This review included a survey of Turkey Point non-conformance reports, licensee event reports, and condition reports for any documented instances of regenerative and excess letdown heat exchanger component aging, in addition to interviews with responsible engineering personnel. No aging effects requiring management were identified from this review beyond those identified in Section 3.2.2.2 of the LRA.

3.2.2.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2.2 (including Table 3.2-1) and pertinent sections of Appendices A and B to the LRA, regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation for the regenerative and excess letdown heat exchangers.

3.2.2.2.1 Aging Effects

The applicant states that the applicable aging effects include the following:

- stress corrosion cracking
- loss of material due to corrosion and aggressive chemical attack

- loss of mechanical closure integrity (by stress relaxation and/or aggressive chemical attack)
- fouling

By letter dated February 2, 2001, the staff requested additional information regarding the excess letdown heat exchangers. The April 19, 2001, RAI response stated that there have been three occurrences on each unit of minor leakage of borated water at the tube sheet flange gasket of the excess letdown heat exchangers. Inspections performed as part of the boric acid wastage surveillance program identified this leakage, which was characterized by boric acid residue or the presence of wetness on the exterior surfaces of the heat exchanger cover. Therefore, the leakage did not affect the intended function of the heat exchangers. Corrective actions to address this leakage included replacing the gaskets and inspecting and replacing fasteners, as required. On the basis of the timely identification of this borated water leakage, no enhancements to the boric acid wastage surveillance program were deemed necessary. No leakage from the excess letdown heat exchangers has been reported since 1995. In order to address this potential for loss of material and loss of mechanical closure integrity due to aggressive chemical attack, periodic inspections performed under the boric acid wastage surveillance program are credited for managing these aging effects.

In Section 5.4 of Appendix C, the LRA indicates that high-yield stress materials and contaminants, such as lubricants containing molybdenum disulfide (MoS_2), have caused cracking of bolting in the industry. In RAI 3.2.2-2, dated February 2, 2001, the staff requested additional information on how yield strength and elimination of contaminants will be addressed during the period of extended operation. In the April 19, 2001, RAI response, the applicant reiterated that high stress in conjunction with an aggressive environment can cause cracking of certain bolting materials due to SCC. As identified in NRC IE Bulletin 82-02 and Generic Letter 91-17, cracking of bolting in the industry has occurred due to SCC. These instances of SCC have primarily been attributed to the use of high-yield strength bolting materials, excessive torquing of fasteners, and contaminants, such as the use of lubricants containing MoS_2. In its responses to NRC IE Bulletin 82-02, dated July 15, 1983, and March 9, 1984, for Units 4 and 3, respectively, the applicant verified that (1) specific maintenance procedures are in place that address bolted closures of the reactor coolant pressure boundary with a nominal diameter of 6 inches or greater; (2) the procedures in use address detensioning and retensioning practices and gasket installation and controls; (3) threaded fastener lubricants used in the reactor coolant pressure boundary have specified maximum allowable limits for chloride and sulfur content to minimize susceptibility to SCC environments; and (4) maintenance crew training on threaded fasteners is performed.

In order for SCC to occur, the three conditions that must exist are a susceptible material, high-tensile stresses, and a corrosive environment. In its RAI response, the applicant stated that the potential for SCC of fasteners at Turkey Point is minimized by utilizing ASTM A193 Gr. B7 bolting material, and limiting contaminants, such as chlorides and sulfur, in lubricants and sealant compounds. Additionally, sound maintenance bolt torquing practices are used to control bolting material stresses. The use of ASTM A193 Gr. B7 bolting specifies a minimum yield strength of 105 ksi, which is well below the 150 ksi threshold value specified in EPRI NP-5769, “Degradation of Bolting in Nuclear Power Plants,” dated April 1988. Bolting fabricated in accordance with this standard could be expected to have yield strengths less than 150 ksi. However, since the maximum yield strength is not specified for this bolting material, assurance cannot be provided that the yield strength of the bolting would not exceed 150 ksi.

For these cases, the combination of specifying ASTM A193 Gr. B7 bolting material, control of bolt torquing, and control of contaminants will ensure that SCC will not occur. These actions have been effective in eliminating the potential for SCC of bolting materials. The results of a review of the Turkey Point condition report (1992 through 2000) and metallurgical report (1987 through 2000) databases support this conclusion, in that no instances of bolting degradation due to SCC were identified. Additionally, review of NRC generic communications did not identify any recent bolting failures attributed to SCC. Therefore, cracking of bolting material due to SCC is not considered an aging effect requiring management at Turkey Point.

On the basis of the description of the regenerative and excess letdown heat exchangers internal and external environments, materials used in the fabrication of various regenerative and excess letdown heat exchanger components, the Turkey Point experience, the applicant's survey of industry and plant-specific experience, and the applicant's RAI responses, the NRC staff concludes that the applicant has identified the aging effects that are applicable for the regenerative and excess letdown heat exchanger.

3.2.2.2.2 Aging Management Programs

The applicant identifies existing and new programs for managing the aging effects for the regenerative and excess letdown heat exchanger during the license renewal term. The following existing AMPs will be continued during the period of extended operation:

- boric acid wastage surveillance program
- chemistry control program
- systems and structures monitoring program

Staff evaluations of these existing programs are described in Sections 3.9.3, 3.1.1 and 3.1.3, respectively, of this SER.

A new AMP identified in the application is the galvanic corrosion susceptibility inspection program. Staff evaluation of this new program is described in Section 3.8.5 of this SER.

On the basis of the evaluations of these AMPs in the SER sections identified above, the staff concludes that these AMPs are acceptable for managing the pertinent aging effects and providing assurance that the intended function(s) of the regenerative and excess letdown heat exchangers will be maintained consistent with the CLB throughout the period of extended operation.

3.2.2.3 FSAR Supplement

On the basis of the staff's evaluation described above, the summary description of the AMPs for the regenerative and excess letdown heat exchangers contained in Appendix A to the LRA is acceptable.

3.2.2.4 Conclusions

The staff has reviewed the information in Section 3.2.2 and Appendices A and B to the LRA, as supplemented by the April 19, 2001, responses to the RAI. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the regenerative and excess letdown heat exchangers will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB during the period of extended operation.

3.2.3 Pressurizers

3.2.3.1 Summary of Technical Information in the Application

The applicant described its AMR of the pressurizers for license renewal in LRA Section 3.2.3, "Pressurizers," as supplemented by the April 19, 2001, responses to the RAI. The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on the pressurizers will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Components of the Turkey Point Unit 3 and 4 pressurizers that are subject to aging management are identified in Table 3.2-1 to the Turkey Point LRA. The LRA identifies that a plant-specific aging management evaluation was performed for components in the pressurizers of Turkey Point, Units 3 and 4, and states that the plant-specific aging management evaluation for the pressurizers was compared to the aging management evaluation for Westinghouse-designed pressurizers, as described in topical report WCAP-14574, "License Renewal Evaluation: Aging Management Evaluation for Pressurizers." With respect to the comparison with WCAP-14574, the LRA states that the pressurizers at Turkey Point, Units 3 and 4, are bounded by the description of pressurizers in WCAP-14574 with respect to design criteria and features, modes of operation, intended functions, and environments/exposures.

Materials and Environments

Section 3.2.3.1 of the LRA identifies that the pressurizers are exposed to treated primary water on internal surfaces, and to containment air on external surfaces. The LRA clarifies that the external surfaces of the pressurizers may be exposed to borated water if leaks occur from the primary boundary. Section 3.2.3.1 of the LRA also identifies that the materials for pressurizer components correspond to those described in WCAP-14574, with the exception of the pressurizer shells, which are fabricated from ASTM A-302, Grade B low alloy steel instead of the SA-533 Grade A, Class 2 quenched and tempered steel.

Aging Effects

The LRA identifies that the following aging effects require aging management for pressurizer components that are within the scope of license renewal:

- cracking
- loss of material
- loss of mechanical closure integrity

The LRA states that cracking may be subdivided into the following aspects that require management during the proposed periods of extended operations: (1) growth of existing flaws, (2) cracks induced by stress corrosion, and (3) cracks induced by fatigue. In so doing, the LRA adds growth of existing flaws in pressurizer components as an aging effect that requires management. The applicant also identifies that loss of material on the external surfaces of the pressurizer may result from aggressive chemical attack if borated water leaks from the internal environment of the pressurizer. The LRA identifies that this aggressive attack may result in a loss of mechanical closure integrity if the aggressive attack occurs on ferritic fasteners of stainless steel components or low alloy steel bolting materials. The LRA also identifies that loss of mechanical closure integrity may also occur as a result of stress relaxation.

The aging effects requiring management and the programs and activities to manage the aging effects for each applicable environment and material combination are provided in Table 3.2-1 of the LRA. The LRA also states that the descriptions of the individual AMPs for managing the aging effects are provided in Appendix B to the LRA, and are based on the 10 program attributes described in Appendix B to the LRA. This is in contrast to basing the AMPs on six program attributes as defined in Table 4-1 of WCAP-14574.

Operating Experience

The LRA provides a list of the NRC's generic communications that were reviewed as part of the aging management evaluation for the pressurizers described in Section 3.2.3.3 of the LRA. In addition, the applicant indicates that it performed a review of plant-specific operating experience to validate that its aging management evaluation had encompassed all possible aging effects requiring aging management. Specifically, the applicant reviewed (1) non-conformance reports, (2) licensee event reports, and (3) Turkey Point condition reports. The applicant indicates that no additional effects requiring aging management were identified as a result of its review of either pertinent NRC generic communications or plant-specific operating experience.

3.2.3.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2.3 (including Table 3.2-1) and pertinent sections of Appendices A and B to the LRA for Turkey Point Units 3 and 4, regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation for the pressurizers. During the staff's review of the AMR for the Turkey Point pressurizers, the staff determined that a majority of the applicant action items summarized in the staff's final SER on WCAP-14574 were already addressed in the LRA, but four required further clarification. The evaluation that follows is based on the staff's review of Section 3.2.3 and Table 3.2-1 of the LRA, pertinent portions of Appendices A and B to the LRA, and the applicant's April 19, 2001, RAI responses.

Action Items from Previous Staff Evaluation of WCAP-14574

As stated in Section 3.2.3.1 of this SER, the applicant indicated that the results of its AMR for the Turkey Point pressurizers were compared to the AMR in WCAP-14574. During the staff's review of the AMR for the Turkey Point pressurizers, the staff determined that four of the applicant action items summarized in the staff's SER on WCAP-14574 were applicable to the AMR for the Turkey Point pressurizers. The staff requested that the applicant address these action items (RAIs 3.2.3-1 to 3.2.3-4) to demonstrate that its AMRs for the pressurizers are consistent with the assumptions in the topical report. As discussed below, the staff finds that the applicant's responses to these RAIs resolve these action items:

Applicant Action Item 1 (RAI 3.2.3-1):

The topical report concluded that general corrosion is not significant for the internal surfaces of Westinghouse-designed pressurizers and that no further evaluations of general corrosion are necessary. In its SER on WCAP-14574 the staff concurred that hydrogen overpressure would be a sufficient means of mitigating the aggressive corrosive effect of oxygen in creviced geometries on the internal pressurizer surfaces. The staff therefore requested applicants for license renewal to provide a basis demonstrating that their water chemistry control programs will provide for a sufficient level of hydrogen overpressure to manage general corrosion of the internal surfaces of their pressurizer.

Response: In its April 19, 2001, RAI response, the applicant indicated that hydrogen concentrations in the RCS are strictly maintained within specified limits by taking periodic measurements of the hydrogen concentrations as part of the applicant's water chemistry control program, and adjusting the hydrogen overpressure in the volume control tanks accordingly.

The staff concludes that this response is sufficient to ensure that loss of material due to crevice corrosion will not be significant for the internal surfaces of the pressurizers during the license renewal period. Therefore, the staff concludes that loss of material due to crevice corrosion is not an aging effect that needs to be managed during the license renewal period, consistent with the staff's conclusions in the final SER on WCAP-14574.

Applicant Action Item 2 (RAI 3.2.3-2):

In its SER on WCAP-14574 the staff concurred with the topical report finding that the potential to develop SCC in the bolting materials will be minimized if the yield strength of the material is held to less than 150 ksi, or the hardness is less than 32 on the Rockwell C hardness scale; however, the staff concluded that conformance with the minimum yield strength criteria in ASME Specification SA–193 Grade B7 does not preclude a quenched and tempered low-alloy steel from developing SCC, especially if the acceptable yield strength is greater than 150 ksi. To verify that SCC would not be an applicable aging effect for the SA–193 Grade B7 bolting material, the staff requested that the applicant provide a confirmatory statement that the acceptable yield strengths for the quenched and tempered low-alloy steel bolting materials (e.g., SA–193, Grade B7 materials) are in the range of 105–150 ksi.

Response: In its April 19, 2001, RAI response, the applicant indicated that although procurement of the bolting materials to ASTM Standard Specification A–193 would provide assurance of a 105 ksi minimum yield strength for the SA–193 Grade B7 bolting materials, it could not provide assurance that the yield strength for bolting materials would be less than 150 ksi.

The applicant also indicated that SCC of bolting materials has been primarily attributed to use of high-yield strength bolting materials, excessive torquing of the fasteners for these bolts, and the introduction of contaminants such as the use of lubricants containing molybdenum disulfide. The applicant stated that the combined practices of procuring the pressurizer bolting materials to SA–193, Grade B7, controlling torquing of these bolts through use of approved plant procedures, and controlling introduction of contaminants by limiting the chloride and sulfide levels of lubricants used in bolting applications is effective in limiting the potential for SCC to develop in the bolting materials.

The applicant also indicated that a review of its condition report and metallurgical report databases and the NRC's generic communications support the conclusion that no instances of bolting degradation due to SCC have been identified in the industry. These findings, when combined with the practices identified in the previous paragraph, support the conclusion that SCC of SA–193 Grade B7 pressurizer bolting materials is not an aging effect that needs to be managed during the license renewal period.

The staff concludes that these bases are sufficient to ensure that SCC is not an aging effect that requires management for the pressurizer SA–193 Grade B7 bolting materials, and therefore, does not need to be managed for the pressurizer bolting materials during the license renewal period. This finding is consistent with the staff's findings for these materials for license renewal in NUREG-1705 and NUREG-1733, for the Calvert Cliffs and Oconee Nuclear Power Stations, respectively.

Applicant Action Item 3 (RAI 3.2.3-3):

In its SER on WCAP-14574, the staff was concerned that IGSCC in the heat-affected zone material of Type 304 stainless steel supports that are welded to the pressurizer cladding could grow as a result of thermal fatigue into the adjacent pressure boundary during the license renewal term. The staff considered that these welds would not require aging management in the extended operating periods if applicants could provide a reasonable justification that sensitization has not occurred in these welds during the fabrication of these components. Therefore, the staff requested applicants to provide a discussion of how the implementation of its plant-specific procedures and quality assurance requirements, if any, for the welding and testing of these austenitic stainless steel components would give reasonable assurance that sensitization has not occurred in these welds and their associated heat-affected zones.

Response: In its response to RAI 3.2.3-3, the applicant indicated that it could not preclude the possibility of sensitized areas in stainless steel weldments that join internal Type 304 stainless steel supports to the cladding of the pressurizer shells. In a letter dated August 13, 2001, the applicant clarified that the scope of the AMR for the pressurizer shells (page 3.2-64 of LRA Table 3.2-1) includes the weldments of internal supports to the cladding, and that cracking due to stress corrosion is therefore identified as an aging effect that will require management for these stainless steel weldments during the extended periods of operation for the Turkey Point Units. Aging management for these weldments is provided by the Chemistry Control Program and appropriate ASME Section XI inspection requirements, which is acceptable to the staff.

Applicant Action Item 4 (RAI 3.2.3-4):

In its SER on WCAP-14574, the staff identified that applicants would need to address whether erosion is a plausible aging effect for Westinghouse-designed pressurizer surge nozzle thermal sleeves, spray nozzle thermal sleeves, surge nozzle safe-ends, and spray nozzle safe-ends, and stated that if erosion is plausible, then an AMP would be required to manage this effect.

Response: In its April 19, 2001, RAI response, the applicant indicated that it had conducted an AMR of the Turkey Point pressurizer surge nozzle thermal sleeves, spray nozzle thermal sleeves, surge nozzle safe-ends, and spray nozzle safe-ends, and had determined that these materials are fabricated from austenitic stainless steel. In its response the applicant also indicated that stainless steel materials are considered to be resistant to erosion. The applicant, therefore, stated that loss of material from the pressurizer surge nozzle thermal sleeves, surge nozzle safe ends, spray nozzle thermal sleeves, and spray nozzle safe ends was therefore not an aging effect that would require management during the periods of extended operation for the Turkey Point units.

The staff concurs with the applicant's conclusion that austenitic stainless steel materials are erosion-resistant materials. Since the pressurizer surge nozzle thermal sleeves, surge nozzle safe ends, spray nozzle thermal sleeves, and spray nozzle safe ends are either fabricated from austenitic stainless steel materials or clad on their internal surfaces with austenitic stainless steel materials, the staff concurs that erosion is not an aging effect that requires management for the surfaces of the pressurizer surge nozzle thermal sleeves, surge nozzle safe ends, spray nozzle thermal sleeves, and spray nozzle safe ends that will be exposed to the internal borated water environment during the license renewal period.

3.2.3.2.1 Materials and Environment

The staff has reviewed the applicant's overview of the materials of fabrication for the pressurizers, and concurs with the applicant's conclusion that the materials for fabrication of the pressurizer components are bounded by the materials of fabrication listed in Section 2.3.2 of WCAP-14574, with the exception of the pressurizer shells, which were fabricated from ASTM A-302, Grade B ferritic steel instead of SA-533 Grade A, Class 2 ferritic steel. Section 3.2.3 of the LRA concludes that the difference in the materials for the pressurizer shells does not constitute a significant deviation because the materials are essentially the same.

ASME SA-533 Grade A, Class 2 quenched and tempered steel and ASTM A-302 Grade B low alloy steel are structural steels that have been commonly used for the fabrication of pressure vessels in nuclear applications. Table 3.2.3.2.1-1 below provides a comparison of the alloying content requirements and tensile property requirements for these materials.

Table 3.2.3.1.2-1
Comparison of Alloying Content and Material Property Requirements
for ASTM A-302 Grade B Low Alloy Steel Materials and
ASME SA-533 Grade A, Class 2 Quenched and Tempered Steel Materials

Steel ID	Heat Analysis Alloy Content Requirements (Weight Percent) [a]						Material Property Requirements	
	C	Mn	P	S	Si	Mo	Min. Yield Strength (ksi)	Tensile Strength (ksi)
A-302 Grade B	0.25 [b]	1.15–1.50	0.035	0.040	0.15–0.40	0.45–0.60	50	80–100
SA-533 Grade A, Class 2	0.25	1.15–1.50	0.035	0.040	0.15–0.40	0.45–0.60	70	90–115

Notes: a. Maximum allowable alloying content unless an allowable alloying range is specified.
b. Specification for plates greater than 2 inches in thickness.

A review of Table 3.2.3.1.2-1 indicates that the alloying and tensile requirements for ASME SA-533 Grade A, Class 2 steel and ASTM A-302 Grade B steel are not significantly different. Since both of these steel materials have been used in nuclear pressure vessel applications, and since the alloying and tensile property requirements are not significantly different, the staff concludes that use of ASTM A-302 Grade B low alloy steel for fabrication of the pressurizer shells does not make the pressurizers beyond the scope of the materials evaluated in topical report WCAP-14574.

Section 3.2.3.1 of the LRA summarizes the internal and external environments for the pressurizer pressure boundary components. These environments include treated water-primary on the internal surfaces of the pressurizers, and containment air on the external surfaces of the pressurizers. The applicant also identifies that the external surfaces have the potential to be exposed to the borated-primary coolant if leaks occur through the pressure boundary.

The staff concludes that Section 3.2.3.1 of the LRA provides a sufficient description of the pressurizer environment, and is therefore acceptable.

3.2.3.2.2 Aging Effects

Section 3.2.3.2 of the LRA identifies that the following aging effects are the only aging effects for the pressurizers that require aging management during the proposed periods of extended operation: (1) cracking, including managing growth of pre-existing flaws, cracking due to stress corrosion, and cracking due to fatigue; (2) loss of material due to aggressive chemical attack; and (3) loss of mechanical closure integrity. By stating that the plant-specific pressurizer aging evaluation is bounded by the evaluation stated in WCAP-14574, the applicant implies that the following aging effects do not require aging management during the periods of extended operation:

- general corrosion of exposed internal pressurizer pressure boundary surfaces
- crevice corrosion of the internal surfaces of the pressure boundary components
- stress corrosion cracking of SA-193 Grade B7, low alloy steel bolting materials
- SCC of type 304 stainless steel supports that are welded to the pressurizer cladding

- irradiation embrittlement of pressurizer structural shell materials
- thermal aging of pressurizer pressure boundary components
- loss of material in pressurizer pressure boundary components due to wear
- loss of material in pressurizer pressure boundary components due to erosion
- loss of material in pressurizer pressure boundary components due to erosion/corrosion

In its final SER of WCAP-14574, the staff concurred with the finding that the pressurizer pressure boundary components would not be degraded by general corrosion, loss of material due to wear, loss of material due to erosion/corrosion, or degradation due to creep.

3.2.3.2.3 Operating Experience

In Section 3.2.3.3 of the LRA, the applicant indicates that it reviewed pertinent NRC generic communications and plant-specific operating experience in order to validate that its aging management evaluation had encompassed all possible effects requiring aging management for the pressurizer components falling under the scope of license renewal. The plant-specific operating experience included non-conformance reports, licensee event reports, and condition reports. The applicant did not indicate whether or not it had reviewed nonconformance reports, licensee event reports, and nonconformance reports issued by other WOG-member facilities. The applicant indicated that no additional effects requiring aging management were identified as a result its review of either pertinent NRC generic communications or plant-specific operating experience.

In WCAP-14574, the WOG indicated that SCC had occurred in two instrumentation nozzles to the pressurizer of the Surry Nuclear Power Station, Unit 1. The root cause analysis for the degradation of the Surry pressurizer instrumentation nozzles is documented in Virginia Electric and Power Company Licensee Event Reports (LERs) 50-280/95-007-00 and 50-280/95-007-01, dated October 9, 1995, and February 23, 1996, respectively. WCAP-14574 stated that cracking had occurred in the pressurizer cladding of the Haddam Neck Nuclear Power Plant in 1990. This cracking is documented in a letter from Connecticut Yankee Atomic Power Company to the U.S. Nuclear Regulatory Commission Document Control Desk, "Haddam Neck Plant Pressurizer Inspection Results" (March 1992).

In RAI 3.2.3-5, the staff requested that the applicant propose an AMP to verify that thermal fatigue-induced cracking in the pressurizer cladding has not propagated through the clad into the ferritic base metal or weld metal materials beneath the clad. In its April 19, 2001, RAI response, the applicant described the following bases for its findings on its AMPs:

(1) The pressurizer shell designs consider fatigue usage factors throughout the operating lifetimes of Turkey Point, Units 3 and 4, and include adequate margins.

(2) Since these fatigue analyses are expected to preclude the formation of fatigue cracks in the pressurizer cladding, and since fracture mechanics evaluations of observed cracks indicate that the cracks do not grow significantly over the plant's lifetime, an AMP is not necessary to manage postulated fatigue-induced cracking of the pressurizer cladding.

(3) While a specific AMP is not required for the pressurizer cladding, the ASME Section XI ISI program is credited for managing the potential for the pressurizer surge nozzles, which are the limiting pressurizer locations from a fatigue usage perspective, to crack as a result of fatigue.

It needs to be stated that the applicant does not always credit the Turkey Point Unit 3 and 4 ISI programs as being aging programs that will manage the cracking during the extended operating terms. However, the fact that the applicant may not be crediting the ISI program for managing cracking during license renewal does not mean that the applicant will be omitting the inspections of the pressurizer components that are required to be inspected under the current ISI programs for the units. The applicant will continue to perform all required ISI inspections of pressurizer components in conformance with 10 CFR 50.55a and Section XI of the ASME Code during the extended operating terms for the units. When taken in context with the information in Items 1 through 3 above, the applicant has provided a reasonable assurance that fatigue-induced cracking of the pressurizer cladding will be managed during the proposed term of extended operation, even though the applicant has not formally credited the Section XI ISI programs as managing this effect in the LRA analysis for the pressurizers. This is acceptable to the staff.

3.2.3.2.4 Aging Management Programs

In Section 3.2.3.4 of the LRA, the applicant states that, as a result of its review of industry information, NRC generic communications, and operating experience, no additional aging effects beyond those listed in Section 3.2.3.3 of the LRA and those summarized in Table 3.2-1 for the pressurizer components need be evaluated during the license renewal period. The applicant also indicated that the aging effects identified in Section 3.2.3.2 of the LRA would be managed through implementation of the following existing programs:

- ASME Section XI, Subsections IWB, IWC, and IWD ISI program
- boric acid wastage surveillance program
- chemistry control program

Staff evaluations of these existing programs are described in Sections 3.9.1, 3.9.3, and 3.1.1 of this SER, respectively.

On the basis of the evaluations of these AMPs in the SER sections described above, the staff concludes that these AMPs are acceptable for managing the pertinent aging effects and providing assurance that the intended function(s) of the pressurizers will be maintained consistent with the CLB throughout the period of extended operation.

3.2.3.3 FSAR Supplement

On the basis of the staff’s evaluation described above, the summary descriptions of the AMPs for the pressurizers contained in Appendix A to the LRA are acceptable.

3.2.3.4 Conclusion

The staff has reviewed the information in Section 3.2.3 of the LRA, as supplemented by the April 19, 2001, and August 13, 2001, responses to the RAI. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the pressurizers will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB during the period of extended operation.

3.2.4 Reactor Vessels

The reactor vessel (RV) components in the internal environment consist of the closure head domes, closure head flanges, upper shell flanges, upper shells, primary inlet and outlet nozzles, primary nozzle safe ends, intermediate and lower shell welds, circumferential welds, bottom head toruses and domes, control rod drive mechanism rod travel housings/latch housings/flanges/housing tubes, head vent pipes, O-ring leak monitor tubes, core support lugs, instrumentation tubes and safe ends, bottom-mounted instrumentation guide tubes and seal table fittings.

The RV components in the external environment consist of the closure head domes (includes lifting lugs), closure head flanges, upper shells, primary inlet and outlet nozzles, intermediate and lower shells, upper shell flanges, refueling seal ledges, primary nozzle safe ends, nozzle support pads, bottom head toruses, bottom head domes, control rod drive mechanism rod travel housings/latch housings/flanges/housing tubes/ventilation shroud support rings, head vent pipes, O-ring leak monitor tubes, instrumentation tubes and safe ends, bottom-mounted instrumentation guide tubes, bottom-mounted instrumentation flux thimble tubes, seal tables and fittings, and closure studs, nuts, and washers.

3.2.4.1 Summary of Technical Information in the Application

The applicant described its AMR of the RVs for license renewal in LRA Section 3.2.4, “Reactor Vessels,” as supplemented by the April 19, 2001, responses to the RAI. The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on the RVs will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The applicant states that the RV components that are subject to an AMR include the shell and closure head, nozzles, interior attachments, and bolted closures. In addition, the applicant has included the bottom-mounted instrumentation tubing, thimble tubes, and seal tables within the scope of license renewal for Turkey Point, Units 3 and 4.

In Section 2.3.1.5 of the LRA, the applicant states that the intended functions of the RV components include pressure boundary integrity and structural support.

Materials and Environments

RV components are exposed to internal environments of treated water—primary and air/gas (o-ring leak monitor tubes), and external environments of containment air, treated water-primary (bottom mounted instrumentation guide tubes), and potential borated water leaks. The applicant states that the RV components are constructed of stainless steel, low alloy steel, carbon steel, and Alloy 600.

Aging Effects Requiring Management

In Section 3.2.4 of the LRA, the applicant identifies the following internal and external aging effects that require management during the period of extended operation for the RVs:

- cracking
- reduction in fracture toughness
- loss of material
- loss of mechanical closure integrity

The RV components, their intended functions, the materials and environments are summarized in Table 3.2-1 of the LRA.

[Cracking] Cracking due to flaw growth and stress corrosion is an aging effect requiring management for the period of extended operation. At Turkey Point, cracking due to fatigue (including RV underclad cracking) is identified as a TLAA. The staff's evaluation of fatigue is provided in Section 4.3 of this SER.

Growth of original manufacturing flaws over time by service loading can cause cracking. Detection and evaluation of flaws is important in maintaining the structural integrity of the RV pressure boundary. ASME Section XI inservice examinations of components are intended to detect significant flaw growth and development. These examinations provide assurance that significant flaws do not exist, or a large flaw subject to crack growth would be detected so that it could be characterized, evaluated, and repaired, if necessary.

SCC is a localized, non-ductile failure caused by a combination of stress, susceptible material, and an aggressive environment. Specific design, fabrication, and construction measures were taken to minimize or eliminate susceptible material from the RVs. In addition, to reduce the susceptibility of RV materials to SCC, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment. The chemistry control program provides assurance that SCC will be managed and that the intended function of the RVs will be maintained consistent with the CLB throughout the period of extended operation.

Primary water SCC of the control rod drive mechanism (CRDM) housing tubes is a recognized industry issue. The RV head Alloy 600 penetration inspection program has been specifically designed to address primary water SCC of CRDM housing tubes. The RV head Alloy 600 penetration inspection program, in conjunction with the ASME Section XI, Subsections IWB, IWC, and IWD ISI program and the chemistry control program, provide assurance that the intended function of the CRDM housing tubes is maintained consistent with the CLB throughout the period of extended operation. Note that the RVs are the only reactor coolant system components with Alloy 600 penetrations at Turkey Point.

SCC is an aging mechanism for RV closure studs and nuts. Visual, surface, and volumetric inspections performed as part of the ASME Section XI, Subsections IWB, IWC, and IWD ISI program have been proven to be effective for managing the aging effects of SCC and provide assurance that the intended function(s) of the RV closure studs and nuts will be maintained consistent with the CLB throughout the period of extended operation.

SCC of the external surfaces of the bottom-mounted instrumentation guide tubes has been previously experienced at Turkey Point. The boric acid wastage surveillance program provides assurance that the intended function(s) of the bottom mounted instrumentation guide tubes will be maintained consistent with the CLB throughout the period of extended operation.

[Reduction in Fracture Toughness] Fracture toughness of RV materials is primarily reduced by irradiation in the beltline region of the RV. Reduction in fracture toughness of RV beltline materials is an aging effect that requires management during the license renewal period. Several TLAAs associated with reduction in fracture toughness are addressed in Section 4.2 of the LRA. These TLAAs include pressurized thermal shock (PTS), upper-shelf energy (USE), and pressure-temperature (P-T) limit curves for heatup and cooldown. The RV integrity program ensures that the time-dependent parameters used in the TLAA evaluations will remain valid throughout the license renewal period.

[Loss of Material] Loss of material is an aging effect requiring management for the period of extended operation. The aging mechanisms that can cause loss of material for RVs are general corrosion, mechanical wear, fretting wear, and aggressive chemical attack.

General corrosion has caused leakage of CRDM canopy seal welds. Canopy seal weld leaks are effectively managed through a combination of system pressure tests, performed in accordance with the requirements of the ASME Section XI, Subsections IWB, IWC, and IWD ISI program, and the boric acid wastage surveillance program. These programs provide assurance that the intended function(s) of these RV components will be maintained consistent with the CLB throughout the period of extended operation.

Loss of material due to wear is an aging effect requiring management for the reactor closure studs, stud holes, nuts and washers, and core support lugs. Examinations performed as part of the existing ASME Section XI, Subsections IWB, IWC, and IWD ISI program provide assurance that the intended function(s) of these RV components will be maintained consistent with the CLB throughout the period of extended operation.

Fretting wear is an aging mechanism that affects the bottom-mounted instrumentation thimble tubes. The evaluation performed for thimble tube thinning has been identified as a TLAA, and the staff's evaluation of this TLAA is provided in Section 4.7 of this SER. On the basis of that evaluation, thimble tube N-05 requires aging management in accordance with 10 CFR 54.21(c)(1)(iii). The thimble tube inspection program provides assurance that the intended function(s) of the RV bottom-mounted instrumentation thimble tubes will be maintained consistent with the CLB throughout the period of extended operation.

[Loss of Mechanical Closure Integrity] Loss of mechanical closure integrity can result from stress relaxation and/or aggressive chemical attack.

Loss of mechanical closure integrity due to stress relaxation is a relevant aging effect that requires management. This aging effect can be managed by periodic ISIs and leakage testing. The ASME Section XI, Subsections IWB, IWC, and IWD ISI program provides assurance that loss of mechanical closure integrity due to stress relaxation will be managed, and that the intended function(s) of the RVs will be maintained consistent with the CLB throughout the period of extended operation.

Loss of mechanical closure integrity due to aggressive chemical attack has been observed in the industry, and is the most common aging mechanism of concern for ferritic fasteners of stainless steel components. Mechanical closure bolting associated with the RVs is made of low alloy steel bolting material, and is subject to aggressive chemical attack from potential borated water leaks. The boric acid wastage surveillance program provides assurance that the aging mechanism of loss of mechanical closure integrity due to aggressive chemical attack will be managed, and the intended function(s) of the RVs will be maintained consistent with the CLB throughout the period of extended operation.

Industry Experience

The applicant performed a review of industry operating history and NRC generic communications to validate the set of aging effects that require management. Specifically, the applicant reviewed the following industry correspondence for the RV's operating experience:

- NRC Bulletin 88-09, "Thimble Tube Thinning in Westinghouse Reactors"
- NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants"
- NRC Generic Letter 92-01, "Reactor Vessel Structural Integrity"
- NRC Generic Letter 97-01, "Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations"
- NRC Information Notice 87-44, "Thimble Tube Thinning in Westinghouse Reactors"
- NRC Information Notice 96-32, "Implementation of 10 CFR 50.55a(g)(6)(ii)(A), 'Augmented Examination of Reactor Vessel'"

No aging effects requiring management were identified from the above documents beyond those already identified in Section 3.2.4.2 of the LRA.

Plant-Specific Experience

The applicant reviewed Turkey Point Unit 3 and 4 operating experience to validate the identified aging effects requiring management. This review included a survey of Turkey Point nonconformance reports, licensee event reports, and condition reports for any documented instances of RV component aging, in addition to interviews with responsible engineering personnel. Outside diameter-initiated SCC of bottom-mounted instrumentation guide tubes and loss of material due to general corrosion of canopy seal welds has been experienced at Turkey Point. Accordingly, AMPs were identified, as discussed above, to manage these effects. No other aging effects requiring management were identified from this review beyond those identified in Section 3.2.4.2 of the LRA.

3.2.4.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2.4 (including Table 3.2-1) and Appendix B to the LRA, regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation for the RVs.

3.2.4.2.1 Aging Effects

The applicant states that the applicable aging effects include the following:

- cracking
- reduction in fracture toughness
- loss of material
- loss of mechanical closure integrity

On the basis of the description of the RV internal and external environments, materials used in the fabrication of various RV components, the Turkey Point experience, and the applicant's survey of industry and plant-specific experience, the NRC staff concludes that the applicant has identified the aging effects that are applicable for the RVs.

3.2.4.2.2 Aging Management Programs

As discussed above, the following existing AMPs will be continued during the period of extended operation:

- ASME Section XI, Subsections IWB, IWC, and IWD ISI program
- boric acid wastage surveillance program
- chemistry control program
- RV head Alloy 600 penetration inspection program
- RV integrity program
- thimble tube inspection program

The staff's review of the AMPs listed above may be found in Sections 3.9.1.1, 3.9.3, 3.1.1, 3.9.12, 3.9.13, and 3.9.16, respectively, of this SER.

The applicant indicates that VT-3 examinations will be used to detect cracking of the core support lugs. The staff did not believe that the VT-3 examinations were sufficient to detect cracking. Therefore, the staff requested that the applicant provide details of a plant-specific AMP to detect cracking of the core support lugs. In its April 19, 2001, response to the RAI, the applicant indicated that the Turkey Point ASME Section XI Subsections IWB, IWC, and IWD ISI program currently performs an enhanced VT-3 visual examination on the core support lugs.

This enhanced visual examination employs the same resolution requirements as that required by ASME Section XI for VT-1 examinations. The applicant indicated that for the period of extended operation, the ASME Section XI Subsections IWB, IWC, and IWD ISI program will be enhanced to require ASME Section XI VT-1 examinations of the core support lugs. The staff found the applicant's response to be acceptable for detection of cracking of the core support lugs.

On the basis of the evaluations of these AMPs in the SER sections identified above, the staff concludes that these AMPs are acceptable for managing the pertinent aging effects and providing assurance that the intended function(s) of the RV components will be maintained consistent with the CLB throughout the period of extended operation.

3.2.4.3 FSAR Supplement

On the basis of the staff's evaluation described above, the summary descriptions of the AMPs for the reactor vessels contained in Appendix A to the LRA are acceptable.

3.2.4.4 Conclusions

The staff has reviewed the information in Section 3.2.4, "Reactor Vessels," and Appendices A and B to the LRA, as supplemented by the April 19, 2001, response to the RAI. The staff concludes that the applicant has demonstrated that the effects of aging associated with the RVs will be adequately managed such that there is reasonable assurance that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation.

3.2.5 Reactor Vessel Internals

3.2.5.1 Summary of Technical Information in the Application

The applicant described its AMR of the RV internals for license renewal in LRA Section 3.2.5, "Reactor Vessel Internals," as supplemented by the April 19, 2001, response to the RAI. The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on the RV internals will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

The components that comprise the RV internals and are within the scope of license renewal and therefore, subject to an AMR are listed in Table 3.2-1 of the LRA, along with their identified intended functions, materials, and environmental exposures.

The Westinghouse Owners Group topical report WCAP-14577 is not incorporated by reference in the LRA. However, the application states that the RV internals are bounded by the description in the topical report with regard to design criteria and features, modes of operation, intended functions, and environmental exposures. The Turkey Point RV internals are constructed of stainless steel, Alloy 600, and Alloy X-750, and the materials, fabrication techniques and installed configuration are consistent with the respective components contained in the topical report.

The LRA indicates that fatigue is the only TLAA that applies to RV internals, as addressed in Section 4.3.1 of the LRA.

The following RV internals aging effects require management during the extended period of operation:

- cracking
- reduction in fracture toughness
- loss of material
- loss of mechanical closure integrity
- loss of preload
- dimensional change

The programs and activities that manage the aging effects for each applicable environment and material combination are listed in Table 3.2-1 of the LRA.

Each of the aging effects requiring management is described in the LRA with regard to RV internals component affectations and the proposed AMPs. The following AMPs are identified in the LRA:

- ASME Section XI, Subsection IWB, IWC, and IWD ISI program
- chemistry control program
- reactor vessel internals inspection program

The latter is a new program developed for the license renewal period, and the other two are existing programs.

The LRA provides a summary of the industry and plant-specific operating experience that the applicant reviewed to validate the set of aging effects that require management. On the basis of the review of the identified operating experience, the licensee did not identify any additional aging effects requiring management for the extended period of operation beyond those listed in Table 3.2-1 of the LRA.

On the basis of the evaluations provided in Appendix B to the LRA for the programs identified, the applicant concluded that aging effects will be adequately managed so that the intended functions of the RV internals components listed in Table 3.2-1 of the LRA will be maintained consistent with the CLB throughout the period of extended operation.

3.2.5.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2.1 (including Table 3.2-1) and pertinent sections of Appendix B to the LRA, regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation for the RV internals.

The staff has reviewed the RV internals technical information provided in Section 3.2.5 of the LRA for Turkey Point, Units 3 and 4. The staff requested additional information needed to complete its review and prepare an SE based on the RAI responses and the balance of the technical information provided in Section 3.2.5 of the LRA. The applicant subsequently met with the staff twice to provide additional information and clarifications prior to forwarding its response to the RAI.

Action Items from Previous Staff Evaluation of WCAP-14577

As described in Section 3.2.5.1 of this SER, the final SER for WCAP-14577, "License Renewal Evaluation: Aging Management Evaluation for Reactor Internals," was issued by letter dated February 10, 2001, after the Turkey Point LRA was submitted to the NRC for review. In response to RAI 3.2.5-4, by letter dated April 19, 2001, the applicant provided a response to the applicant action items in the final SER for WCAP-14577. As discussed below, the staff finds that the applicant's responses resolve the applicant action items from the final SER for WCAP-14577:

Applicant Action Item 1:

To ensure applicability of the results and conclusions of WCAP-14577 to the applicant's plant(s), the license renewal applicant is to verify that the critical parameters for the plant are bounded by the topical report. Further, the renewal applicant must commit to programs described as necessary in the topical report to manage the effects of aging during the period of extended operation on the functionality of the RV components. Applicants for license renewal will be responsible for describing any such commitments and proposing the appropriate regulatory controls. Any deviations from the AMPs described in this topical report as necessary to manage the effects of aging during the period of extended operation and to maintain the functionality of the RV internal components or other information presented in the report, such as materials of construction, must be identified by the renewal applicant and evaluated on a plant-specific basis in accordance with 10 CFR 54.21(a)(3) and (c)(1).

Response: LRA Subsections 2.3.1.6 (page 2.3-10) and 3.2.5 (page 3.2-29) provide a summary of the comparison of the critical parameters and attributes of Turkey Point to WCAP-14577 and describe the WCAP applicability to Turkey Point.

Applicant Action Item 2:

A summary description of the programs and activities for managing the effects of aging and the evaluation of TLAAs must be provided in the license renewal FSAR supplement in accordance with 10 CFR 54.21(d).

Response: Programs necessary to manage the effects of aging for the Turkey Point RV internals are the RV internals inspection program, the ASME Section XI, Subsection IWB, IWC, and IWD ISI program, and the chemistry control program. Summary descriptions of these programs are provided in the LRA FSAR Supplement, Appendix A, Subsections

16.1.6 (page A-34), 16.2.1 (page A-34), and 16.2.4 (page A-36), respectively. As stated in LRA Subsection 3.2.5 (page 3.2-29), the only TLAA applicable to the Turkey Point RV internals is fatigue. A summary description of the fatigue TLAA evaluation is provided in the LRA FSAR Supplement, Appendix A, Subsection 16.3.2 (page A-44).

Applicant Action Item 3:

For the holddown spring, applicants for license renewal are expected to address intended function, AMR, and appropriate AMP(s).

Response: The information on the holddown springs is provided in LRA Subsection 3.2-5 (pages 3.2-29 through 3.2-36) and in Table 3.2-1 (page 3.2-78).

Applicant Action Item 4:

The license renewal applicant must address AMR, and appropriate AMP(s), for guide tube support pins.

Response: The information on the guide tube support pins is provided in LRA Subsection 3.2-5 (pages 3.2-29 through 3.2-36) and in Table 3.2-1 (page 3.2-77).

Applicant Action Item 5:

The license renewal applicant must explicitly identify the materials of fabrication of each of the components within the scope of the topical report. The applicable aging effect should be reviewed for each component based on the materials of fabrication and the environment.

Response: Upon further review of the plant-specific RV internals materials and environments, FPL has identified the following:

- The lower support castings identified in LRA Table 3.2-1 (page 3.2-78) are forgings.
- The bottom-mounted instrumentation columns identified in LRA Table 3.2-1 (page 3.2-76) are cast stainless steel.
- The lower support columns identified in LRA Table 3.2-1 (page 3.2-76) are cast stainless steel.
- The upper support column bases (new line item for LRA Table 3.2-1 on

  page 3.2-77) are cast stainless steel, but not exposed to a fluence greater than 10^{21} n/cm^2.
- The lower support forgings will be exposed to a fluence in excess of 10^{21} n/cm^2, as discussed in the response to RAI 3.2.5-1.

With the exception of the changes discussed above, the specific materials of fabrication and environments for all parts of the Turkey Point RV internals that require AMR are identified in LRA Subsection 3.2.5.1 (page 3.2-30) and in Table 3.2-1 (pages 3.2-76 through 3.2-79). Changes to Table 3.2-1 as a result of the above are included in the following tables. *[NOTE: The revisions to Table 3.2-1 are not duplicated here - see letter dated April 19, 2001.]*

Applicant Action Item 6:

The license renewal applicant must describe its aging management plans for loss of fracture toughness in cast austenitic stainless steel reactor vessel internals (RVI) components, considering the synergistic effects of thermal aging and neutron irradiation embrittlement in reducing the fracture toughness of these components.

Response: Considering the response to item (5) above, the only CASS RV internals components within the scope of license renewal are the lower support columns, the bottom-mounted instrumentation columns, and the upper support column bases. Of these components, only the lower support columns will be subjected to fluences of greater than 10^{21} n/cm^2. Accordingly, synergistic effects of thermal aging and irradiation embrittlement in reducing the fracture toughness will be a consideration for the lower support columns. As noted in item (5) above and in LRA Table 3.2-1 (pages 3.2-76 through 3.2-79), reduction in fracture toughness will be managed by the RV internals inspection program, as described in LRA Appendix B, Subsection 3.1.6 (page B-21).

Applicant Action Item 7:

The license renewal applicant must describe its aging management plans for void swelling during the license renewal period.

Response: Aging management plans regarding dimensional change due to void swelling of the Turkey Point RV internals are discussed in LRA Subsection 3.2.5.2.6 (page 3.2-33). These plans are included in the RV internals inspection program, which is described in LRA Appendix B, Subsection 3.1.6 (page B-21).

Applicant Action Item 8:

Applicants for license renewal must describe how each plant-specific AMP addresses the following elements: (1) scope of the program, (2) preventive actions, (3) parameters monitored or inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria, (7) corrective actions, (8) confirmation process, (9) administrative controls, and (10) operating experience.

Response: The programs necessary to manage the effects of aging of the Turkey Point RV internals are the RV internals inspection program, the ASME Section XI, Subsection IWB, IWC, and IWD ISI program, and the chemistry control program. The descriptions of these programs, provided in LRA Appendix B, Subsections 3.1.6 (page B-21), 3.2.1.1 (page B-27), and 3.2.4 (page B-47), respectively, address the 10 elements identified. Two elements, corrective action and administrative controls, are common to all programs and are described in LRA Appendix B Section 2.0 (page B-5).

Applicant Action Item 9:

The license renewal applicant must address plant-specific plans for management of cracking (and loss of fracture toughness) of RVI components, including any plans for augmented inspection activities.

Response: Aging management plans to address cracking and reduction in fracture toughness of the Turkey Point RV internals are discussed in LRA Subsections 3.2.5.2.1 (page 3.2-30) and 3.2.5.2.2 (page 3.2-31), respectively. The programs necessary to manage cracking and reduction in fracture toughness are the RV internals inspection program, the ASME Section XI, Subsection IWB, IWC, and IWD ISI program, and the chemistry control program. The descriptions of these programs are provided in LRA Appendix B, Subsections 3.1.6 (page B-21), 3.2.1.1 (page B-27), and 3.2.4 (page B-47), respectively. The RV internals inspection program includes inspection activities for cracking and reduction in fracture toughness.

Applicant Action Item 10:

The license renewal applicant must address plant-specific plans for management of age-related degradation of baffle/former and barrel/former bolting, including any plans for augmented inspection activities.

Response: Aging management plans to address loss of mechanical closure integrity of the Turkey Point baffle/former and barrel/former bolting are discussed in LRA Subsection 3.2.5.2.4 (page 3.2-33). Note that these plans also consider information provided in WCAP-14577, Revision 1, "License Renewal Evaluation: Aging Management for Reactor Internals," submitted to the NRC by the WOG on October 9, 2000. The program necessary to manage loss of mechanical closure integrity of this bolting is the RV internals inspection program. The description of this program is provided in LRA Appendix B, Subsection 3.1.6 (page B-21). The RV internals inspection program includes augmented inspection activities as they apply to loss of mechanical closure integrity of the baffle/former and barrel/former bolting.

Applicant Action Item 11:

The license renewal applicant must address the TLAA of fatigue on a plant-specific basis.

Response: A description of the plant-specific fatigue TLAA evaluation performed for Turkey Point is provided in LRA Section 4.3 (pages 4.3-1 through 4.3-13). Also, refer to response to RAI 3.2.5-7.

The following summarizes the February 2, 2001, RAIs and the information, clarification, and April 19, 2001, responses provided by the applicant with regard to Section 3.2.5:

(1) In Section 3.2.5 of the LRA, the applicant states that the RV internals components for Turkey Point, Units 3 and 4, are bounded by the description in topical report WCAP-14577, with regard to their intended functions and within the scope of license renewal, as discussed in Subsection 2.3.1.6 of the LRA. However, this raised a potential contradiction between this information and other renewal application text with regard to the holddown ring having an intended function. Contrary to the staff's position in its final SER, topical report WCAP-14577, Rev. 1, indicates that the holddown ring does not have an intended core support function. The staff requested that the LRA include the holddown ring in the discussion in Section 2.3.1.6, which lists the components that comprise the RV internals, or provide the basis for its exclusion.

    During the initial RAI followup meeting with the staff, the applicant provided a clarification, stating that the applicant does not agree with the topical report on this issue, and included the holddown ring in Table 3.2-1 of the LRA as having a core support intended function. The staff withdrew the RAI question.

(2) In Section 3.2.5 of the LRA, the applicant indicates that the Turkey Point RV internals components with fluence greater than 10^{21} n/cm^2 do not include the lower support casting. In RAI 3.2.5-1, the staff requested that the applicant provide the maximum fluence expected for the lower support casting during the license renewal period and the basis for that expectation.

    In the RAI 3.2.5-1 followup discussions and response, FPL indicated that the lower support casting was subsequently identified as a forging, and will likely be exposed to a fluence greater than 10^{21} n/cm^2 at the end of the extended period of operation. This is expected to produce some reduction in fracture toughness, as well as increased susceptibility to irradiation-assisted SCC. The LRA will be revised to include the lower support forging in the list of components that are potentially susceptible to reduction in fracture toughness due to irradiation embrittlement. The LRA will also be revised to indicate that the only cast austenitic stainless steel components in the RV internals are the lower support columns, the bottom-mounted instrumentation columns, and the upper support column bases.

(3) The RV internals baffle assembly contains three categories of baffle bolts that are designated as former/baffle bolts, barrel former/bolts and baffle/baffle bolts. In RAI 3.2.5-2, the staff requested that the applicant clarify or provide the basis for not including the baffle/baffle bolts in the baffle assembly bolting described in Sections 3.2.5.2.2 and 3.2.5.2.4 and Table 3.2-1 of the LRA.

    In the response to RAI 3.2.5-2, the applicant indicated that the Turkey Point baffle assembly baffle/baffle bolts (baffle plate edge bolts) perform no structural function and are not required to perform an intended function. The WOG developed a methodology as part of the baffle bolt cracking inspection program to evaluate acceptable baffle assembly bolting patterns under faulted conditions. Applications of this methodology have identified acceptable bolting patterns without taking credit for baffle/baffle bolts.

(4) In Section 3.2.5.2.1 of the LRA, the applicant indicates that susceptibility has been observed at fluence as low as $1x10^{21}$ n/cm^2 in laboratory studies on Type 304 stainless steel in PWR environments. Further, the applicant indicates that Type 316 stainless steel is less susceptible, and that field information suggests that greater exposures are required for the development of susceptibility. In RAI 3.2.5-3, the staff requested that the applicant identify the field information that suggests that greater exposures are required for the development of susceptibility.

In its response to RAI 3.2.5-3, the applicant identified the field information resources that it referred to in Section 3.2.5.2.1, as material contained in four proceedings of symposiums and conferences that occurred prior to 1998. The response also provided some new limited fluence information on Type 316 and 347 stainless steel bolts obtained during baffle bolt cracking inspections conducted on four WOG plants in 1999.

(5) In Section 3.2.5.2.4 of the LRA, the applicant states that significant data, information, and industry experience relative to the aging of baffle bolting is provided in WCAP-14577 and is not duplicated in the LRA. In RAI 3.2.5-4, the staff requested that the applicant review the staff RAIs, the associated owners group responses, and address the applicability and need for inclusion with regard to the Turkey Point Unit 3 and 4 LRA. The staff also requested that the applicant provide responses to the renewal applicant action items provided in the final SER for WCAP-14577.

In the RAI 3.2.5-4 response, the applicant indicated that it reviewed and addressed the NRC topical report WCAP-14577 RAIs and associated WOG responses in the Turkey Point AMR performed on the RV internals. The applicant identified applicable information included in the Turkey Point LRA that addressed these RAIs and their responses, including References 2.3-9 on page 2.3-43 and 3.2-8 on page 3.2-53 of the LRA. The applicant also provided responses to the Renewal Applicant Action Item for WCAP-14577, as previously described in this section.

(6) The response to Action Item (6) to RAI 3.2.5-4 addresses the staff's concern regarding the applicant's LRA reference to WCAP-14577, Revision 0, dated June 1997, as the source for significant data, information, and industry experience relative to the aging of baffle bolting, in lieu of WCAP-14577, Revision 1, dated October 2000. The staff is concerned with the use of the earlier topical report revision for aging management plans to address loss of mechanical closure of baffle former bolting, because Revision 0 provides limited and dated domestic plant baffle bolting degradation experience. This version indicates that there have been no historical incidents that involve baffle/former bolting degradation in domestic plants. By contrast, Revision 1 provides significant data, information, and industry experience relative to the aging of baffle bolting in domestic plants that was developed during 1998 through mid-2000. The Action Item (6) response indicated that aging management plans to address the loss of mechanical closure of Turkey Point baffle/former and barrel/ former bolting are discussed in LRA Section 3.2.5.2.4 (page 3.2-33), and noted that these plans also consider the information provided in WCAP-14577, Revision 1, dated October 2000. Based on this information contained in the response to RAI 3.2.5-4, the applicant has committed to revise the reference to WCAP-14577 Revision 0 to specify WCAP-14577 Revision 1, which contains the significant data, information, and industry experience relative to the aging of baffle bolting that is addressed in Subsection 3.2.5.2.4.

(7) In Section 3.2.5.2.6 of the LRA, the applicant discusses the RV internals material dimensional changes and cites references indicating that the material may be subject to various levels of dimensional changes resulting from void swelling under certain conditions. One reference cited in the discussion concludes that at the approximate RV internal end-of-life dose of 100 displacements per atom, swelling would be less than 2% at irradiation temperatures between 572 °F and 752 °F. In the discussion, the LRA indicates that field service experience in PWR plants has not shown any evidence of swelling and, at present, there have been no indications from the different RV internals bolt removal programs, or from any of the other inspection and functional evaluations (e.g., refueling), that there are any discernible adverse effects attributable to swelling. In RAI 3.2.5-5, the staff requested that the applicant identify some specific examples of field service experience, bolt removal programs, and other inspections and functional evaluations with detailed descriptions of the examinations, inspections, and evaluations that have been performed to support the conclusion that there is not any evidence of, or any discernible effects attributable to swelling. In RAI 3.2.5-5, the staff further requested that the applicant describe the change in loading on the baffle bolt, and its impact on the bolt integrity that would occur if the thickness of the baffle material located under the bolt head were subjected to a 2% or less dimensional change due to swelling.

In its response to RAI 3.2.5-5, the applicant reported that field service material swelling experience is derived from refueling outages and ISIs performed on industry plants since their startup. The absence of gap closures and physical distortion caused by localized dimensional increases is indicative of the absence of significant material swelling. Data on swelling are currently being evaluated as part of the industry's baffle bolt cracking evaluation program. Several bolts removed from Westinghouse plants during the 1999 baffle bolt cracking inspections were subject to detailed hot-cell micrographics examination, and some void swelling formations were observed. The measured volumetric changes were less than 0.03 percent. The applicant also obtained the following information from F.A. Garner to clarify the question of bolt integrity when subject to loading resulting from a 2% swelling of baffle plate material under the bolt head:

The stresses developed by void formation will be limited by irradiation creep. Void swelling and irradiation creep have an interrelated relationship to the local stress state. Irradiation creep exists prior to the onset of swelling, and will relieve any applied or thermally induced stresses. Once swelling begins, a new and much larger component of creep develops that is directly proportional to the instantaneous swelling rate. Therefore, any swelling-induced stress will be relaxed at a rate proportional to the swelling rate. This leads to a maximum stress well below 200 MPA, regardless of the local swelling rate. The yield stress can never be exceeded for a typical bolt application. The stress is maintained as long as the swelling rate difference is minimal.

In the RAI 3.2.5-5 response, the applicant concluded that the field service experience, and hot-cell evaluations indicate that the localized swelling is much less than 2%, and reasonable extrapolations to the end of life suggest that it will remain small. In LRA Table 3.2-1, the applicant indicates that the RV internals components requiring management for dimensional changes due to void swelling have yet to be determined. In its April 19, 2001, response to RAI 3.8.6-1, the applicant indicated that the EPRI Materials Reliability Project (MRP) has a task underway to issue a “white paper” on void swelling that will include available data and effects on RV internals. The applicant committed to evaluate these results and factor them into the RV internals inspection program.

(8) The LRA uses 1 x 10^{21} n/cm^2 (E>0.1 MeV) as a fluence threshold for neutron embrittlement of stainless steel used in RV components. In RAI 3.2.5-6, the staff requested that the applicant provide data to support this position, or revise the LRA to expand the list of potentially susceptible components to include those at lower fluences.

In its response to RAI 3.2.5-6, the applicant provided data generally at higher irradiation temperatures than those that apply to RV internals components. The staff does not agree with the applicant’s conclusion regarding a fluence threshold for neutron embrittlement of stainless steel used in RV components. However, the applicant’s approach to managing neutron embrittlement of RV internals components (as described in Section 3.1.6 of the LRA) does provide adequate management of this degradation mechanism. The staff’s evaluation of this program is provided in Section 3.8.6 of the SER.

(9) In Section 3.2.5 of the LRA, the applicant states that, “Turkey Point’s TLAA identification effort also identified fatigue as the only TLAA applicable to the RV internals. Fatigue of the RV internals is addressed in Subsection 4.3.1.” In RAI 3.2.5-7, the staff requested that the applicant provide a list of the TLAAs associated with fatigue used in verifying that the structural integrity of the RV internals were evaluated and determined to remain valid for the period of extended operation, in accordance with 10 CFR 54.21(c)(1)(i).

In the RAI 3.2.5-7 followup discussions and response, the applicant indicated that an extensive review of the Turkey Point CLB was performed to identify TLAAs requiring evaluation for license renewal. Their review is documented in a detailed engineering evaluation that includes a description of the TLAA identification process, evaluation results, and summary tables. This evaluation is available on site for NRC review. A fatigue evaluation was performed on the Turkey Point RV internals in support of the thermal power uprate of the units in the mid-1990s (Turkey Point Units 3 and 4 Operating License Amendment 191/185, issued September 25, 1996). Further, the applicant indicated that the existing 40-year design cycles and cycle frequencies were determined to be conservative and bounding for the period of extended operation.

3.2.5.2.1 Aging Effects

The applicant identifies the following aging effects for the RV internals:

- cracking
- reduction in fracture toughness
- loss of material
- loss of mechanical closure integrity
- loss of preload
- dimensional change

Based on the description of the internal and external environments, materials used, and the applicant's review of industry and plant-specific experience, the NRC staff concludes that the applicant has identified the aging effects that are applicable for the RV internals.

3.2.5.2.2 Aging Management Programs

The applicant identifies existing and new programs for managing aging effects for the RV internals during the license renewal term. Specifically, the LRA identifies the following existing AMPs:

- ASME Section XI, Subsections IWB, IWC, and IWD ISI program
- chemistry control program

Staff evaluations of these existing programs are provided in Sections 3.9.1.1 and 3.1.1 of this SER.

A new AMP identified in the application is RV internals inspection program. Staff evaluation of this new AMP is provided in Section 3.8.6 of this SER.

On the basis of the evaluations of these AMPs in the SER sections identified above, the staff concludes that these AMPs are acceptable for managing the pertinent aging effects and providing assurance that the intended function(s) of the RV internals components will be maintained consistent with the CLB throughout the period of extended operation.

3.2.5.3 FSAR Supplement

The FSAR supplement sections pertinent to the RV internals include 16.1.6, "Reactor Vessel Internals Program," 16.2.1.1," ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program," and 16.2.4, "Chemistry Control Program." These programs and associated FSAR supplement sections are evaluated in Sections 3.8.6, 3.9.1.1, and 3.1.1, respectively, of this SER.

3.2.5.4 Conclusion

The staff has reviewed the information in LRA Section 3.2.5, "Reactor Vessel Internals," as supplemented by the April 19, 2001, responses to the RAI. The staff concludes that the applicant has demonstrated that the effects of aging associated with the RV internals will be adequately managed such that there is reasonable assurance that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation.

3.2.6 Reactor Coolant Pumps

Each of the three reactor coolant loops for Turkey Point, Units 3 and 4, contains a vertically mounted, single-stage centrifugal reactor coolant pump (RCP) that employs a controlled leakage seal assembly. The RCPs provide the motive force for circulating the reactor coolant through the reactor core, piping, and steam generators. The RCPs used at Turkey Point are Westinghouse Model 93.

3.2.6.1 Summary of Technical Information in the Application

The applicant describes its AMR of the RCPs for license renewal in LRA Section 3.2.6, "Reactor Coolant Pumps," as supplemented by the April 19, 2001, response to the RAI. The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on the RCPs will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In Section 2.3.1.7 of the LRA, the applicant states that the intended function of the RCPs for license renewal is to maintain reactor coolant system pressure boundary integrity. The RCP components that support this intended function and are subject to an AMR include the pump casing, cover, pressure-retaining bolting, and integral thermal barrier heat exchanger. Non-Class 1 piping, instrumentation, and other components attached to the RCPs are addressed in Section 2.3.1.2.2 of the LRA.

The RCP is included in WCAP-14575, "License Renewal Evaluation: Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components." WCAP-14575 is not incorporated by reference in the LRA, but the Turkey Point AMR was compared to WCAP-14575 with the results presented below. The draft safety evaluation for WCAP-14575 was issued by letter dated February 10, 2000. The final safety evaluation for WCAP-14575 was issued by letter dated November 8, 2000, after the Turkey Point LRA was submitted to the NRC for review. However, all of the renewal applicant action items that are in the final safety evaluation are addressed either as applicant action items or open items in Tables 2.3-2 and 2.3-3 of the LRA. Specifically, the open items that were identified in the draft safety evaluation were either resolved or added to the list of renewal applicant action items for the final safety evaluation. The applicant's responses are discussed in Section 3.2.6.2 of this SER.

The design and operation of the RCPs were reviewed using the process described in Section 2.3.1.1.1 of the LRA. This review confirmed that the Turkey Point Unit 3 and 4 RCPs are bounded by the description contained in WCAP-14575, with regard to design criteria and features, materials of construction, fabrication techniques, installed configuration, modes of operation, and environments/exposures. The component intended functions for the RCPs are consistent with the intended functions identified in WCAP-14575. The applicant has determined that cracking due to stress corrosion and loss of mechanical closure integrity due to aggressive chemical attack are additional aging effects, not included in WCAP-14575, that require management during the license renewal term.

CASS Class 1 components at Turkey Point consist of the reactor coolant primary loop elbows, RCP casings and closure flanges, and selected valves exceeding a temperature threshold criterion of 482 °F. Reduction in fracture toughness of the reactor coolant CASS primary loop elbows and valves is discussed in Section 3.2.1 of the LRA.

Aging Effects

RCPs are exposed to an internal environment of treated water-primary, and external environments of containment air and potential borated water leaks. The integral thermal barrier heat exchangers are exposed to an internal environment of treated water and treated water-primary, and an external environment of containment air and potential borated water leaks (see Tables 3.0-1 and 3.0-2 of the LRA).

The RCP and integral thermal barrier heat exchanger components are constructed of stainless steel and low alloy steel. The RCP and integral thermal barrier heat exchanger components, intended functions, materials of construction, and environments are summarized in Table 3.2-1 of the LRA.

In Section 3.2.6 of the LRA, the applicant identified the following aging effects for the components of the RCPs that are subject to an AMR:

- SCC
- reduction in fracture toughness of CASS items due to thermal aging embrittlement
- loss of material due to MIC
- loss of mechanical closure integrity (by stress relaxation and/or aggressive chemical attack)
- fouling

Cracking due to fatigue is identified as a TLAA and is addressed in Sections 4.3.1 and 4.3.4. of the LRA.

In Section 3.2.6.2.1 of the LRA, the applicant states that specific design, fabrication, and construction measures were taken to minimize or eliminate material susceptible to SCC in the RCPs. In addition, to reduce the susceptibility of RCP materials to SCC, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment.

In Section 3.2.6.2.2 of the LRA, the applicant states that the only RCP components subject to reduction in fracture toughness due to thermal embrittlement are austenitic stainless steel castings. Consistent with the conclusions drawn in the NRC final SER for WCAP-14575, the applicant stated that CASS RCP casings and closure flanges do not require an AMP to manage thermal embrittlement beyond the examinations programmatically required by ASME Section XI as modified by Code Case N-481.

Section 3.2.6.2.3 of the LRA identifies MIC as an aging mechanism that can cause loss of material for the RCP integral thermal barrier heat exchanger.

In Section 3.2.6.2.4 of the LRA, the applicant states that loss of mechanical closure integrity can result from stress relaxation and/or aggressive chemical attack. In addition, the applicant states that loss of mechanical closure integrity due to aggressive chemical attack has been observed in the industry and is the most common aging mechanism of concern for ferritic fasteners of stainless steel components.

In Section 3.2.6.2.5 of the LRA, the applicant states that aging mechanisms that can result in fouling of the RCP integral thermal barrier heat exchanger tubing include biological fouling and particulate fouling. Biological fouling has been identified as an aging effect for tubes exposed to CCW. Particulate fouling has been identified as an aging effect for heat transfer surfaces of the RCP integral thermal barrier heat exchangers.

Industry Experience

The applicant performed a review of industry operating history and a review of NRC generic communications to validate the set of aging effects that require management. The industry correspondence that was reviewed for RCP operating experience includes the following:

- NRC Bulletin 79-17, “Pipe Cracks in Stagnant Borated Water Systems at PWR Plants”
- NRC Circular 76-06, “Stress Corrosion Cracks in Stagnant, Low-Pressure Stainless Piping Containing Boric Acid Solution at PWRs”
- NRC Generic Letter 88-05, “Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants”
- NRC Information Notice 79-19, “Pipe Cracks in Stagnant Borated Water Systems at PWR Plants”
- NRC Information Notice 86-108, “Degradation of Reactor Coolant System Pressure Boundary Resulting From Boric Acid Corrosion”
- NRC Information Notice 92-86, “Unexpected Restriction to Thermal Growth of Reactor Coolant Piping”
- NRC Information Notice 93-61, “Excessive Reactor Coolant Leakage Following a Seal Failure in a Reactor Coolant Pump or Reactor Recirculation Pump”
- NRC Information Notice 93-84, “Determination of Westinghouse Reactor Coolant Pump Seal Failure”
- NRC Information Notice 93-90, “Unisolatable Reactor Coolant System Leak Following Repeated Application of Leak Sealant”
- NRC Information Notice 97-31, “Failures of Reactor Coolant Pump Thermal Barriers and Check Valves in Foreign Plants”

No aging effects requiring management were identified from the above documents beyond those already identified in section 3.2.6.2 of the LRA. Note that a summary of industry experience associated with RCPs is provided in WCAP-14575.

Plant-Specific Experience

The applicant reviewed Turkey Point Unit 3 and 4 operating experience to validate the identified aging effects requiring management. This review included a survey of Turkey Point non-conformance reports, licensee event reports, and condition reports for any documented instances of RCP component aging, in addition to interviews with responsible engineering personnel. No aging effects requiring management were identified from this review beyond those identified in Section 3.2.6.2.

Aging Management Programs

In Section 3.2.6.4 of the LRA, the applicant identifies the following existing AMPs for the RCPs:

- ASME Section XI, Subsections IWB, IWC, and IWD ISI program
- boric acid wastage surveillance program
- chemistry control program

The applicant concludes that these programs will manage the applicable aging effects so that the intended function(s) of the components of the RCPs will be maintained consistent with the CLB, under all design loading conditions throughout the period of extended operation.

3.2.6.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Sections 3.2.6 (including Table 3.2-1), and pertinent sections of Appendix B of the Turkey Point Units 3 and 4 LRA, regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function would be maintained consistent with the CLB throughout the period of extended operation for the RCPs.

As mentioned in Section 3.2.6.1 of this report, the final SER for WCAP-14575, "License Renewal Evaluation: Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components," was issued by letter dated November 8, 2000, after the Turkey Point LRA was submitted to the NRC for review. However, all of the open items that were identified in the draft safety evaluation were either resolved, or added to the list of renewal applicant action items for the final safety evaluation. Therefore, the applicant addressed all renewal applicant action items that are included in the final safety evaluation report for WCAP-14575. There were six renewal applicant action items, and six open items from the draft safety evaluation for WCAP-14575. The action items, open items, applicant's responses, and staff's evaluations are given below.

Action Items From Previous Staff Evaluation of WCAP-14575

As discussed below, the staff finds that the applicant's responses (Tables 2.3-2 and 2.3-3 of the LRA) to the renewal applicant action items and open item from the draft safety evaluation resolve the 10 action items in the final safety evaluation for WCAP-14575.

> Applicant Action Item 1: The license renewal applicant is to verify that its plant is bounded by the technical report. Further, the renewal applicant is to commit to programs described as necessary in the technical report to manage the effects of aging during the period of extended operation on the functionality of the reactor coolant system piping. Applicants for license renewal will be responsible for describing any such commitments and identifying how such commitments will be controlled. Any deviations from the AMPs within this technical report described as necessary to manage the effects of aging during the period of extended operation and to maintain the functionality of the reactor coolant system piping and associated pressure boundary components or other information presented in the report, such as materials of construction, will have to be identified by the renewal applicant and evaluated on a plant-specific basis in accordance with 10 CFR 54.21(a)(3) and (c)(1).

Response: As summarized in sections 2.3.1.2 and 2.3.1.7 of the LRA, the Turkey Point Unit 3 and 4 Class 1 piping and RCPs are bounded by the topical report with regard to design criteria and features, materials of construction, fabrication techniques, installed configuration, modes of operation, and environments/exposures. Programs necessary to manage the effects of aging are described in Sections 3.2.1 and 3.2.6 of the LRA, and are summarized in Table 3.2-1 of the LRA. Program commitments to manage the effects of aging for Class 1 piping and RCPs are described in Appendix B to the LRA and are summarized in the proposed UFSAR supplement provided in Appendix A to the LRA. Deviations from the AMPs included in the topical report are described in Sections 3.2.1 and 3.2.6 of the LRA. The staff found this response to be acceptable.

Applicant Action Item 2: Summary description of the programs and evaluation of TLAAs are to be provided in the license renewal FSAR supplement in accordance with 10 CFR 54.21(d).

Response: A summary of the programs identified to manage the effects of aging for Class 1 piping and RCPs is included in the proposed UFSAR supplement in Appendix A to the LRA. A markup of the UFSAR sections affected by the TLAA evaluations is also included in the proposed UFSAR supplement. The staff found this response to be acceptable.

Applicant Action Item 3: Applicants must provide a description of all insulation used on austenitic stainless steel nuclear steam supply system (NSSS) piping to ensure the piping is not susceptible to stress-corrosion cracking from halogens.

Response: During construction, the Class 1 piping was insulated in accordance with the applicable Westinghouse equipment specification. The specification listed specific trade names that were approved, by Westinghouse, for use on austenitic stainless steel. As described in the Turkey Point UFSAR, Section 4.2.5 "...external corrosion resistant surfaces in the reactor coolant system are insulated with low halide or halide free insulating material...". During 1979 the insulation on the reactor coolant piping was changed to reflective insulation. The insulation is made of austenitic stainless steel. Any non-metallics comply with NRC Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel," dated October 1973. Subsequent additions of insulation were done in accordance with the applicable Bechtel specification, which also imposes the requirements of Regulatory Guide 1.36. Since all the insulation that was used on the reactor coolant piping is low halide or halide free, the piping is not susceptible to SCC initiated by such halides. The staff found this response to be acceptable.

Applicant Action Item 4: The license renewal applicant should describe how each plant-specific AMP addresses the following 10 elements: (1) scope of the program, (2) preventive actions, (3) parameters monitored or inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria, (7) corrective actions, (8)confirmation process, (9) administrative controls, and (10) operating experience.

Response: Programs necessary to manage the effects of aging for Class 1 piping and RCPs address the 10 elements identified. These programs are described in Appendix B of the LRA. The staff found this response to be acceptable.

Applicant Action Item 5: The license renewal applicant should perform additional fatigue evaluations or propose an AMP to address the components labeled I-M and I-RA in Tables 3-2 through 3-16 of WCAP 14575.

Response: The applicant has performed a plant-specific fatigue evaluation for Turkey Point Unit 3 and 4 Class 1 piping and RCPs. This evaluation is included in Section 4.3. The staff found this response to be acceptable.

Applicant Action Item 6: The staff recommendation for the closure of Generic Safety Issue (GSI)-190, "Fatigue Evaluation of Metal Components for 60-Year Plant Life" is contained in a memorandum from Ashok Thadani to William Travers, dated December 26, 1999. The license renewal applicant should address the effects of the coolant environment on component fatigue life as AMPs are formulated in support of license renewal. The evaluation of a sample of components with high-fatigue usage factors using the latest available environmental fatigue data is an acceptable method to address the effects of the coolant environment on component fatigue life.

Response: The applicant has performed a plant-specific evaluation for Turkey Point Unit 3 and 4 Class 1 piping and RCPs with regard to environmental effects on fatigue. This evaluation is included in Section 4.3.5.

The following six items were open items in the draft safety evaluation for WCAP-14575:

Item 1: WOG should complete the specific revisions to the subject topical report that it has committed to perform in response to the staff's requests for additional information discussed in Section 3.1 of the safety evaluation. As described by WOG in its letter to the staff, dated July 19, 1999, these planned modifications are limited to Section 2.3.2.2, "Branch Line Restrictors," Section 2.3.2.4, "Thermal Barrier and RCP Seals," and the "Summary" sections of the topical report.

Response: The Turkey Point Class 1 piping AMR includes branch line restrictors and their associated license renewal component intended function of throttling. The AMR of the Class 1 piping is addressed in section 3.2.1 and summarized in Table 3.2-1 of the LRA. The Turkey Point position regarding RCP seals is summarized in Section 2.3.1.7 of the LRA. The staff found this response to be acceptable.

Item 2: WOG should complete the updated review of generic communications and revise Section 3.1 of the topical report to describe the process used by the WOG to perform the review and to capture any additional items not identified by the original review.

Response: The applicant has completed an updated review of generic communications for applicability to Class 1 piping and RCPs. All generic communications applicable to aging effects are summarized in Sections 3.2.1 and 3.2.6 of the LRA. The staff found this response to be acceptable.

Item 3: The topical report indicates that thermal aging-related cracking of austenitic steel castings is an aging effect that the WOG considers potentially significant for the reactor coolant system piping and associated components. Thermal aging does not cause cracking; it causes a reduction in the fracture toughness of the material. The reduction in fracture toughness of the material results in a reduction in the critical flaw size that could lead to component failure. The WOG should revise the topical report, accordingly.

Response: The applicant's AMR methodology identifies reduction in fracture toughness as the aging effect related to thermal aging. Reduction in fracture toughness for Class 1 piping and RCPs is addressed in Sections 3.2.1 and 3.2.6 of the LRA. The staff found this response to be acceptable.

Item 4: Components that have delta ferrite levels below the susceptibility screening criteria have adequate fracture toughness and do not require supplemental inspection. As a result of thermal embrittlement, components that have delta ferrite levels exceeding the screening criterion may not have adequate fracture toughness and do require additional evaluation or examination. WOG should address thermal-aging issues in accordance with the staff's comments in Section 3.3.3 of this evaluation.

Response: As noted above for Item 3, reduction in fracture toughness for Class 1 piping and RCPs is addressed in Sections 3.2.1 and 3.2.6 of the LRA. The applicant's methodology is consistent with the staff's comments. The staff found this response to be acceptable.

Item 5: WOG should propose to perform additional inspection of small-bore reactor coolant system piping, that is, less than 4-inch-size piping, for license renewal to provide assurance that potential cracking of small-bore reactor coolant system piping is adequately managed during the period of extended operation.

Response: The AMR and specific program commitments for Class 1 small bore piping are addressed in Section 3.2.1 and summarized in Table 3.2-1 of the LRA. Specifically, the applicant committed to perform a one-time inspection in order to confirm that cracking is not occurring in small bore piping (less than 4 inches in diameter). The staff found this response to be acceptable.

Item 6: WOG should revise AMP-3.6 to include an assessment of the margin on loads in conformance with the staff guidance provided in Reference 11. In addition, AMP-3.6 should be revised to indicate if the CASS component is repaired or replaced per ASME Code, Section XI IWB-4000 or IWB-7000, then a new leak-before-break (LBB) analysis based on the material properties of the repaired or replaced component (and accounting for its thermal aging through the period of extended operation, as appropriate), is required to confirm the applicability of LBB. The inservice examination/flaw evaluation option is, per the basis on which the NRC staff has approved LBB in the past, insufficient to reestablish LBB approval. The original Turkey Point (LBB) analysis was performed consistent with the criteria specified in NUREG-1061, Volume 3, and utilized the modified limit load method as specified in the draft Standard Review Plan, Section 3.6.3. The NRC review and safety evaluation of the original Turkey Point LBB analysis is documented in the June 23, 1995, NRC letter to Florida Power and Light.

Response: The revised Turkey Point LBB analysis, which addresses the extended period of operation, utilizes a methodology consistent with the original LBB analysis. If Class 1 piping CASS components are repaired or replaced, Turkey Point design control procedures would require a new LBB analysis based on replacement material properties. The staff found this response to be acceptable.

3.2.6.2.1 Aging Effects

The applicant states that the applicable aging effects include the following:

- SCC
- reduction in fracture toughness of CASS items due to thermal aging embrittlement
- loss of material due to MIC
- loss of mechanical closure integrity (by stress relaxation and/or aggressive chemical attack)
- fouling

On the basis of the description of the RCP internal and external environments, materials used in the fabrication of various RCP components, the Turkey Point experience, and the applicant’s survey of industry and plant-specific experience, the NRC staff concludes that the applicant has identified the aging effects that are applicable for the RCPs.

3.2.6.2.2 Aging Management Programs

The applicant identifies existing and new programs for management of aging effects for the RCPs during the license renewal term. The existing AMPs identified in the application are:

- ASME Section XI, Subsections IWB, IWC, and IWD ISI program
- boric acid wastage surveillance program
- chemistry control program

Staff evaluations of these existing programs are described in Sections 3.9.1, 3.9.3, and 3.1.1 of this SER, respectively.

On the basis of the evaluations of these AMPs in the SER sections described above, the staff concludes that these AMPs are acceptable in managing the pertinent aging effects and providing assurance that the intended function of the RCPs is maintained consistent with the CLB throughout the period of extended operation.

3.2.6.3 FSAR Supplement

On the basis of the staff's evaluation described above, the summary descriptions of the AMPs for the RCPs described in Appendix A to the LRA is acceptable.

3.2.6.4 Conclusions

The staff has reviewed the information in Section 3.2.6, "Reactor Coolant Pumps," as supplemented by the April 19, 2001, response to RAI, and Appendices A and B to the LRA. The staff concludes that the applicant has demonstrated that the effects of aging associated with the RCPs will be adequately managed such that there is reasonable assurance that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation.

3.2.7 Steam Generators

Turkey Point, Units 3 and 4, each have three steam generators. One is installed in each reactor coolant loop. Each steam generator is a vertical shell and tube heat exchanger, which transfers heat from a single-phase fluid at high temperature and pressure (the reactor coolant) in the tube side, to a two-phase (steam-water) mixture at lower temperature and pressure in the shell side.

The reactor coolant enters and exits the tube side of each steam generator through nozzles located in the lower hemispherical head. The reactor coolant system fluid flows through inverted U-tubes connected to the tube sheet. The lower head is divided into inlet and outlet chambers by a vertical partition plate extending from the lower head to the tube sheet. The steam-water mixture is generated on the secondary, or shell side, and flows upward through moisture separators and dryers to the outlet nozzle at the top of the vessel, providing essentially dry, saturated steam. Manways are provided to permit access to both sides of the lower head and to the U-tubes and moisture separating equipment on the shell side of the steam generators.

3.2.7.1 Summary of Technical Information in the Application

The applicant described its AMR of the steam generators for license renewal in Section 3.2.7, "Steam Generators," of the LRA, as supplemented by the April 19, 2001, response to the RAI. The staff reviewed this section of the LRA to determine whether the applicant has demonstrated that the effects of aging on the steam generators will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The applicant identified steam generator components that are subject to an AMR in Table 3.2-1 of the LRA. These components include channel heads, primary inlet and outlet nozzles, primary inlet and outlet nozzle safe ends, tube sheets, U-tubes, divider plates, steam generator tube plugs, primary manways, upper and lower shells, elliptical heads, transition cones, feedwater and steam outlet nozzles, steam flow limiters, blowdown piping nozzles and secondary side shell penetrations, secondary closure covers, tube bundle wrappers, wrapper support systems, tube support plates, antivibration bars, support pads, seismic lugs, and primary and secondary bolting.

Intended Functions

The applicant determined the following intended functions to be applicable to the Turkey Point Unit 3 and 4 steam generators:

- maintain primary pressure boundary
- maintain secondary pressure boundary
- provide heat transfer from the primary fluid to the secondary fluid
- provide secondary side flow distribution and throttling
- provide structural support

Aging Effects

The steam generators are exposed to internal environments of treated water - primary and treated water - secondary, and external environments of containment air and potential borated water leaks. The steam generator components are constructed of stainless steel, carbon steel, alloy steel, Alloy 600, and Alloy 690. The steam generator components, their intended functions, the materials, and environments are summarized in Table 3.2-1 of the LRA.

Aging Management Programs

Aging effects for the steam generator components subject to an AMR, as given in the LRA, are the following:

- cracking
- loss of material
- loss of mechanical closure integrity

The aging effects requiring management are managed by the following programs:

- ASME Section XI, Subsections IWB, IWC, and IWD ISI program
- boric acid wastage surveillance program
- chemistry control program
- steam generator integrity program

Operating Experience

A review of industry operating history and a review of NRC generic communications were performed to validate the set of aging effects that require management. Turkey Point Unit 3 and 4 operating experience was also reviewed to validate the identified aging effects requiring management. This review included a survey of Turkey Point non-conformance reports, licensee event reports, and condition reports for any documented instances of steam generator component aging, in addition to interviews with responsible engineering personnel.

The Turkey Point Unit 3 and 4 steam generators (with the exception of the channel heads and steam domes) were replaced in 1982 and 1983. This replacement was due to significant degradation of the original mill annealed Alloy 600 tubing and deterioration of the carbon steel support plates. Cracking of feedwater nozzles due to fatigue has been experienced at Turkey

Point and was discussed in the applicant's description of cracking (Section 3.2.7.2.1 of the LRA). No additional aging effects requiring management were identified from this review beyond those identified in Section 3.2.7.2 of the LRA.

3.2.7.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.2.7 (including Table 3.2-1), pertinent sections of Appendix B of the Turkey Point Units 3 and 4 LRA and the applicant's April 19, 2001, response to the staff's February 2, 2001, RAI, regarding the applicant's demonstration that the effects of aging will be adequately managed so that the intended function would be maintained consistent with the CLB throughout the period of extended operation for the steam generators.

The staff's review of the applicant's LRA for aging effects that apply to the steam generators includes the review of aging management during the period of extended operation for the following internal and external aging effects: (1) cracking, (2) loss of material, and (3) loss of mechanical closure integrity.

As stated in Table 3.2-1 of the LRA, cracking is managed by the ASME Section XI ISI programs, chemistry control and the steam generator integrity program; loss of material is managed by the chemistry control program; and loss of mechanical closure integrity is managed by the boric acid wastage surveillance program and the ASME Section XI ISI programs. Staff evaluations of these existing programs are described in Sections 3.1.1 ("Chemistry Control Program"), 3.9.1 ("ASME Section XI ISI Programs"), 3.9.3 ("Boric Acid Wastage Surveillance Program") and 3.9.14 ("Steam Generator Integrity Program"). On the basis of the evaluations of these AMPs in the SER sections described above and the following evaluation, the staff finds that these AMPs are acceptable in managing the pertinent aging effects consistent with the CLB throughout the period of extended operation.

Section 3.2.7.2.1 of the LRA states that, at Turkey Point, cracking due to fatigue is identified as a TLAA and is analytically addressed in Section 4.3.1 of the LRA. The staff's evaluation of fatigue is presented in Section 4.3 of this SER.

In Section 3.2.7.2.2 (Loss of Material) of the LRA, the aging mechanisms that can cause loss of material for the steam generators are listed. However, industry operating experience indicated that erosion (aging mechanism) could cause the loss of section thickness (aging effect) of a component, and this aging effect is not addressed in the application. One example of this aging effect is the loss of section thickness of the feedwater impingement plate supports in the Harris Nuclear Plant steam generators. In RAI 3.2.7-1, the staff requested that the applicant provide the plant-specific AMP for this aging effect in general for the steam generators and other components in the plant within the scope of license renewal for the period of extended operation. In response to this RAI, the applicant stated that the feedwater impingement plate design at the Harris Nuclear Plant is not present in the Turkey Point Plant steam generators. The Turkey Point steam generator tube support system is stainless steel and is not susceptible to erosion. Other steam generator components are inspected for loss of material due to erosion as part of the steam generator integrity program. The applicant further stated that the only components requiring aging management for loss of material due to erosion are the emergency containment coolers (ECCs). The ECCs are evaluated in Section 3.3.1 of this SER. The staff finds that the applicant's treatment of this aging effect is reasonable.

The applicant identified “loss of mechanical closure integrity” as the aging effect requiring management for primary bolting. Section 3.2.7.2.3 of the LRA identifies stress relaxation and/or aggressive chemical attack as two potential causes of a loss of mechanical closure integrity. However, industry operating experience indicates that a loss of mechanical closure integrity can also result from SCC. Section 5.4 of Appendix C to the LRA discusses the “loss of mechanical closure integrity” aging effect. The last paragraph of Section 5.4 briefly discusses SCC; however, the applicant did not thoroughly describe the actions taken to prevent SCC in primary bolting. In RAI 3.2.7-3, the staff requested that the applicant more thoroughly describe the actions taken (e.g., the use of non-susceptible material and/or the use of non-aggressive lubricants) to prevent SCC in primary bolting. In addition, since operating experience has shown that some alloy steels with lower yield strengths are susceptible to SCC, the staff requested the applicant identify the range of yield strengths used at Turkey Point, Units 3 and 4, and the susceptibility of those material strengths. In response to this RAI, the applicant thoroughly described the actions taken to address the concern of loss of mechanical closure integrity of primary bolting due to SCC.

The applicant also discussed the actual bolting material used at Turkey Point, Units 3 and 4, and indicated that the bolting is expected to have yield strengths less than 150 ksi based on the use of ASTM A-193 Grade B7 bolting at Turkey Point, Units 3 and 4. However, because the maximum yield strength is not specified for this bolting material, the applicant stated that assurance cannot be provided that the yield strength of the bolting would not exceed 150 ksi. (Bolting with a yield strength above 150 ksi could potentially be susceptible to SCC.) The applicant pointed to maintenance practices that control bolt torquing and contaminants that have been effective in eliminating the potential for stress corrosion of bolting materials. In addition, the applicant reviewed industry and Turkey Point operating experience and did not identify any recent bolting failures attributed to SCC. The applicant concluded that cracking of bolting material due to SCC at Turkey Point is not considered an aging effect requiring management.

Several NRC generic communications (e.g., NRC IE Bulletin 82-02, “Degradation of Threaded Fasteners in the Reactor Coolant Pressure Boundary of PWR Plants” and NRC Generic Letter 91-17, “Generic Safety Issue 29, ‘Bolting Degradation or Failure in Nuclear Power Plants’”) provide information on industry operating experience associated with the degradation of primary bolting, but are not referenced by the applicant in Section 3.2.7.3.1 of the LRA. In RAI 3.2.7-3, the staff requested the applicant explain why these generic communications were not identified as reference documents and whether the information contained within was assessed for Turkey Point, Units 3 and 4. In addition, NRC Information Notice (IN) 97-88, “Experiences During Recent Steam Generator Inspections,” was also not identified as a reference in Section 3.2.7.3.1 of the LRA. In RAI 3.2.7-5, the staff requested that the applicant discuss why the IN was not listed as a reference for the Turkey Point Unit 3 and 4 LRA. In response to these RAIs, the applicant stated that these generic communications were inadvertently omitted from the LRA and had been assessed for Turkey Point, Units 3 and 4.

3.2.7.3 FSAR Supplement

The staff has confirmed that the FSAR supplement contains an appropriate summary description of the programs and activities for managing the effects of aging for the Turkey Point plant steam generators.

3.2.7.4 Conclusion

The staff has reviewed the information in Section 3.2.7, “Steam Generators,” Appendices A and B to the LRA as supplemented by the April 19, 2001, response to the RAI. Based on the staff’s evaluation of aging effects and AMPs the staff concludes that the applicant has demonstrated that the effects of aging associated with the steam generators will be adequately managed such that there is reasonable assurance that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation.

3.3 Engineered Safety Features Systems

In LRA, Sections 2.3.2, “Engineered Safety Features Systems,” and 3.3, “Engineered Safety Features Systems,” the applicant describes the scoping and AMR for the engineered safety features (ESFs) systems. Appendices A, B, and C to the LRA also contain supplementary information relating to the AMR of the ESFs systems. The staff reviewed Sections 2.3.2 and 3.3, and the applicable portions of Appendices A, B, and C to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, in accordance with 10 CFR 54.21(a)(3) for the ESFs system structures and components (SCs) that are determined to be within the scope of license renewal and subject to an AMR.

The Turkey Point ESFs systems include the following seven systems:

- emergency containment cooling
- containment spray
- containment isolation
- safety injection
- residual heat removal
- emergency containment filtration
- containment post-accident monitoring and control

In LRA Section 2.1, “Scoping and Screening Methodology,” the applicant describes the method used to identify the SCs that are within the scope of license renewal and subject to an AMR. The applicant identifies and lists the ESFs system SCs in Section 2.3.2 of the LRA. The staff’s evaluation of the scoping methodology and the ESFs system SCs included within the scope of license renewal and subject to an AMR is documented in Sections 2.1 and 2.3.2 of this SER, respectively.

In LRA Appendix A, “Updated Final Safety Analysis Report Supplement,” the applicant provides a summary description of the programs and activities used to manage the effects of aging, as required in 10 CFR 54.21(d). The applicant provides a more detailed description of these AMPs for the staff to use in its evaluation in Appendix B to the LRA. In Appendix C to the LRA, the applicant describes the processes used to identify the applicable aging effects for the SCs that are subject to an AMR. In Appendix D to the LRA, the applicant states that no changes to the Turkey Point Technical Specifications (TSs) have been identified. A discussion of each system follows.

3.3.1 Emergency Containment Cooling System

3.3.1.1 Summary of Technical Information in the Application

The applicant describes its AMR of the emergency containment cooling system for license renewal in Section 2.3.2.1, "Emergency Containment Cooling," and Section 3.3 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging associated with the emergency containment cooling system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The emergency containment cooling system is designed to remove sufficient heat to maintain the containment below its structural design pressure and temperature during a loss-of-coolant accident or main steam line break. In addition, the emergency fan cooling units continue to remove heat after the maximum hypothetical accident and reduce containment pressure to atmospheric. Heat removed from the containment is transferred to component cooling water. Emergency containment cooling consists of three fan cooling units that are located above the refueling floor, around the inside of each containment.

The emergency containment cooling components subject to an AMR include the emergency fan cooler units (pressure boundary only) and the associated heat exchanger coils. The intended functions of the emergency containment cooling components subject to an AMR include pressure boundary integrity and heat transfer. A complete list of the emergency containment cooling components requiring an AMR, the component intended functions, and the applicable AMPs is provided in Table 3.3.1 of the LRA.

3.3.1.2 Staff Evaluation

3.3.1.2.1 Effects of Aging

The components in the emergency containment cooling system are fabricated from carbon steel and admiralty brass exposed to an internal environment of treated water. The components include emergency containment cooler headers, tubes, and housings. The aging effects of these materials in the treated water environment are identified in Table 3.3-1 of the LRA. The treated water environment is CCW for this application. The applicable internal aging effects in the treated water environment include loss of material and fouling. A discussion of the aging effects for carbon steel and admiralty brass components in a treated water environment is provided below.

The loss of material due to general corrosion for carbon steel components exposed to treated water is the result of a chemical or electrochemical reaction between the material and the environment when both oxygen and moisture are present. Carbon steels are susceptible to external general corrosion in all areas with the exception of those exposed to a controlled, air-conditioned environment, and those applications where the metal temperature is greater than 212 °F.

The loss of material due to pitting corrosion for carbon steel components and admiralty brass components in a treated water environment is also an aging effect requiring management. Pitting corrosion is a form of localized attack that results in depressions in the metal. For treated water systems, oxygen is required for the initiation of pitting corrosion with contaminants, such as halogens or sulfates. Pitting corrosion occurs when passive films in local areas attack passive materials. Once a pit penetrates the passive film, galvanic conditions occur because the metal in this pit is anodic relative to the passive film. Maintaining adequate flow rates over this exposed surface of a component can inhibit pitting corrosion. However, stagnant or low flow conditions are assumed to exist in all systems where dead legs of piping, such as vents or drains exist.

The loss of material due to galvanic corrosion for carbon steel and admiralty brass in a treated water environment is an aging effect requiring management, when coupled with material having higher electrical potential. The loss of material due to galvanic corrosion can occur only when materials with different electrochemical potentials are in contact within an aqueous environment. Generally the effects of galvanic corrosion are precluded by design. In galvanic couples involving brass and carbon steel materials, the lower potential (more anodic) material would be preferentially attacked.

Loss of material due to erosion is an aging effect requiring management for the inside diameter of the admiralty brass tubes of the coolers due to their operation above the nominal design flow during certain plant conditions. Emergency containment cooler tube wear was identified as a TLAA and is discussed in Section 4.7.2 of the Application. A one time inspection for minimum tube wall thickness will be conducted in accordance with the Emergency Containment Coolers Inspection described in Appendix B.

The loss of material due to microbiologically influenced corrosion (MIC) is an aging effect requiring management for carbon steel and admiralty brass in a treated water environment. MIC is a form of localized, corrosive attack accelerated by the influence of microbiological activity due to the presence of certain organisms. Microbiological organisms can produce corrosive substances, as a byproduct of their biological processes, that disrupt the protective oxide layer on the component materials and lead to a material depression similar to pitting corrosion.

The loss of material due to selective leaching is an aging effect requiring management for admiralty brass in a treated water environment. Selective leaching (also known as dealloying) is the dissolution of one element from a solid alloy by corrosion processes. The most common form of selective leaching is dezincification with the removal of zinc from susceptible brass. The addition of small amounts of alloying elements such as phosphorus, arsenic, and antimony is effective in inhibiting this attack in copper-zinc alloys. Therefore, selective leaching of brass applies only to “uninhibited” materials.

Biological and particulate fouling of admiralty brass is an aging effect requiring management in treated water environments. Fouling may be due to an accumulation of particulates or macro-organisms. Fouling is an aging effect that could cause the loss of heat transfer as an intended function at Turkey Point. Biological fouling can also lead to environmental conditions conducive to MIC.

The components in the emergency containment cooling system are also fabricated from carbon steel exposed to an internal environment of air/gas. The components include the emergency containment cooler housings. The aging effects of these materials in the air/gas environment are identified in Table 3.3-1 of the LRA. The applicable internal aging effects in the air/gas environment include loss of material. The loss of material due to general and pitting, corrosion is an aging effect requiring management for carbon steel in atmospheric air/gas environments.

The components in the emergency containment cooling system are also fabricated from carbon steel and admiralty brass exposed to an external environment of containment air and borated water leaks. The components include emergency containment cooler headers, tubes (outside diameter), housings and bolting. The aging effects of these materials in the external environment are identified in Table 3.3-1 of the LRA. The aging effects of these materials in the containment air and borated water leaks are loss of material and loss of mechanical closure integrity.

The loss of material due to aggressive chemical attack is an aging effect requiring management for carbon steel susceptible to potential borated water leaks. The loss of mechanical closure integrity due to aggressive chemical attack is also an aging effect requiring management for mechanical closure carbon and low alloy steel bolting susceptible to potential borated water leaks.

Based on the description of the emergency containment cooling system components in the internal and external environments, and the materials used in the fabrication of the various components, the staff determined that the applicant has identified the applicable aging effects consistent with published literature and industry experience.

3.3.1.2.2 Aging Management Programs

To manage the aging effects for the carbon steel emergency containment cooler headers exposed to treated water, the applicant identified the following AMPs:

- chemistry control program
- galvanic corrosion susceptibility inspection program

To manage the aging effects for the admiralty brass emergency containment cooler tubes (inside diameter) exposed to treated water, the applicant identified the following AMPs:

- chemistry control program
- emergency containment cooler inspection

To manage the aging effects for carbon steel emergency containment cooler housings exposed to air/gas, the applicant identified the following AMP:

- systems and structures monitoring program

To manage the aging effects for emergency containment cooler headers exposed to containment air and borated water leaks, the applicant identified the following AMPs:

- systems and structures monitoring program

- boric acid wastage surveillance program

To manage the aging effects for the emergency containment cooler housings exposed to containment air and borated water leaks, the applicant identified the following AMPs:

- systems and structures monitoring program
- boric acid wastage surveillance program

To manage the aging effects for bolting exposed to borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

The staff reviewed the information provided in the LRA for the AMPs used by the applicant to manage the aging of the emergency containment cooling system components, and determined that the applicant adequately identified the AMPs to manage the applicable aging effects of this system. Refer to Sections 3.1.1, 3.1.3.3, 3.8.3, 3.8.5, and 3.9.3 of this SER for the review of these AMPs.

3.3.1.3 Conclusion

The staff has reviewed the information in Sections 2.3.2.1 and 3.3 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the emergency containment cooling system will be adequately managed so that there is reasonable assurance that this system will perform its intended functions in accordance with the CLB during the period of extended operation.

3.3.2 Containment Spray

3.3.2.1 Summary of Technical Information in the Application

The applicant describes its scoping and AMR of the containment spray system for license renewal in Section 2.3.2.2, “Containment Spray,” and Section 3.3 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging associated with the containment spray system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The containment spray system is designed to remove sufficient heat to maintain the containment below its design pressure and temperature during a loss-of-coolant accident or main steam line break. The containment spray system is composed of two motor-driven horizontal centrifugal pumps, each discharging to two spray lateral headers located near the top of the containment structure. The system also utilizes the residual heat removal (RHR) pumps and heat exchangers for the long-term recirculation phase of containment spray, as described in subsection 2.3.2.5 of the LRA. Additionally, the containment spray system provides a source of water for the emergency containment filtration spray. The components associated with this function are included in the scope of the emergency containment filtration.

The containment spray components subject to an AMR include the pumps and valves (pressure boundary only), heat exchangers, cyclone separators, piping, tubing, fittings, orifices, and spray nozzles. The intended functions for the containment spray components subject to an AMR include pressure boundary integrity, spray, throttling, filtration, and heat transfer. A complete list of the containment spray components requiring an AMR and the component intended functions are provided in Table 3.3-2 of the LRA. The AMR for containment spray is discussed in Section 3.3 of the LRA.

3.3.2.2 Staff Evaluation

3.3.2.2.1 Effects of Aging

For the containment spray system, the applicant stated that stainless steel pumps, valves, piping, fittings, tubing and other components are exposed to treated borated water, treated water or air/gas. As discussed in Table 3.3-2 of the LRA, for the stainless steel components exposed to treated borated water, loss of material is the applicable aging effect. In the Florida Power and Light (FPL) letter L-2001-60, dated March 30, 2001, the applicant provided additional technical discussions that justified that the aging effect of crack initiation and growth due to stress-corrosion cracking (SCC) for stainless steel components is not an applicable aging effect for the containment spray system. For the stainless steel components exposed only to treated water, such as, the containment spray pump seal water heat exchanger tubes (outside diameter), tube coil bands and clips, loss of material and fouling are applicable aging effects. Loss of material alone is the applicable aging effect for carbon steel, brass and cast iron components that are exposed to treated borated water. For carbon steel valves, piping, and fittings and bronze spray nozzles that are exposed to air/gas, there is no aging effect.

There are no aging effects for containment spray system components exposed to “indoor-not air-conditioned” and the containment air environments on stainless steel, brass and bronze. For containment spray pump seal water heat exchanger shells and covers made of cast iron exposed to an “indoor-not air-conditioned” environment or borated water leaks, the applicable aging effect is loss of material. For valves, piping, and fittings, made of carbon steel and exposed to borated water leaks or the containment air environment, loss of material is the applicable aging effect. For carbon steel bolting exposed to borated water leaks the aging effect is loss of mechanical closure integrity.

Based on the description of the containment spray system components in the internal and external environments, and the materials used in the fabrication of the various components, the staff found that the applicant adequately identified the aging effects that are applicable for this system.

3.3.2.2.2 Aging Management Programs

To manage the aging effects for the stainless steel pumps, valves, piping, fittings, tubing and other components exposed to treated borated water, treated water or air/gas, the applicant identified the following AMP:

- chemistry control program

To manage the aging effects on the stainless steel components exposed to treated water, such as the containment spray pump seal water heat exchanger tubes (outside diameter), tube coil bands and clips, the applicant identified the following AMP:

- chemistry control program

To manage the aging effects for the brass and cast iron components exposed to treated borated water, the applicant identified the following AMPs:

- chemistry control program
- galvanic corrosion susceptibility inspection program

To manage the aging effects for the carbon steel valves, piping, fittings and tubing exposed to air/gas and treated borated water, the applicant identified the following AMPs:

- chemistry control program
- galvanic corrosion susceptibility inspection program
- containment spray system piping inspection program

To manage the aging effects for cast iron containment spray pump seal water heat exchanger shells and covers and carbon steel valves, piping, and fittings exposed to an “indoor-not air-conditioned” environment or a containment air environment, the applicant identified the following AMP:

- systems and structures monitoring program

To manage the aging effects for cast iron containment spray pump seal water heat exchanger shells and covers and carbon steel valves, piping, and fittings exposed to borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

To manage the aging effects for the carbon steel bolting exposed to borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

The staff reviewed the information provided in the LRA for the AMPs used by the applicant to manage the aging of the containment spray system components, and determined that the applicant adequately identified the AMPs to manage the applicable aging effects of this system. Refer to Sections 3.1.1, 3.1.3, 3.8.5, 3.9.3, and 3.9.5 of this SER for the review of these AMPs.

3.3.2.3 Conclusion

The staff has reviewed the information in Sections 2.3.2.2 and 3.3 of the LRA and the applicant's response to the staff's RAI. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the containment spray system will be adequately managed so that there is reasonable assurance that this system will perform its intended functions in accordance with the CLB throughout the period of extended operation.

3.3.3 Containment Isolation

3.3.3.1 Summary of Technical Information in the Application

The applicant describes its scoping and AMR of the containment isolation system for license renewal in Section 2.3.2.3, "Containment Isolation," and Section 3.3 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging associated with the containment isolation system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The containment isolation system is an ESF that provides for the closure or integrity of containment penetrations to prevent leakage of uncontrolled or unmonitored radioactive materials to the environment. All containment penetrations and associated containment isolation valves and components that ensure containment integrity, regardless of where they are described, require an AMR. Breathing air, nitrogen and hydrogen, and containment purge are the process systems for which the only license renewal intended function is containment isolation. The flow diagrams listed in Table 2.3-4 of the LRA display the evaluation boundaries for the portions of breathing air, nitrogen and hydrogen, and containment purge that are within the scope of license renewal.

The breathing air, nitrogen and hydrogen, and containment purge components within the scope of license renewal and subject to an AMR include valves (pressure boundary only), piping, tubing, fittings, and debris screens (containment purge). The intended functions for breathing air, nitrogen and hydrogen, and containment purge components requiring an AMR and the component intended functions are listed in Table 3.3-3 of the LRA. The AMR for containment isolation is discussed in Section 3.3 of the LRA.

3.3.3.2 Staff Evaluation

3.3.3.2.1 Effects of Aging

Containment Purge Systems

The components in the containment purge systems are fabricated from carbon and stainless steel exposed to an internal environment of air/gas. The components include valves, piping, tubing, fittings, debris screen gratings and debris screen banding. The applicant did not identify any aging effects of these materials in the air/gas environment, as indicated in Table 3.3-3 of the LRA. The applicant's position was found to be acceptable because the staff agreed that there are no aging effects associated with carbon and stainless steel components exposed to air/gas that could cause a component to lose its ability to perform an intended function during the period of extended operation.

The components in the containment purge systems are also fabricated from carbon and stainless steel exposed to external environments of outdoor, containment air, and borated water leaks. The components include valves, piping, tubing, fittings, and bolting. The applicant identified loss of material and loss of mechanical closure integrity as the aging effects requiring management for the carbon and stainless steel components exposed to these external environments.

The loss of material due to general and pitting corrosion, is the aging effect requiring management for carbon steel components exposed to the outdoor environment. The loss of material due to aggressive chemical attack is an aging effect requiring management for carbon steel susceptible to potential borated water leaks. The loss of mechanical closure integrity due to aggressive chemical attack is an aging effect requiring management for mechanical closure carbon and low alloy steel bolting susceptible to potential borated water leaks.

A detailed description of the aging effects associated with the loss of material due to general and pitting corrosion is provided above in Section 3.3.1.2.1 of this SER. The descriptions in Section 3.3.1.2.1 of this SER are also applicable to carbon steel components exposed to external environments.

The loss of mechanical closure integrity due to aggressive chemical attack is an aging effect that requires management of mechanical closure carbon steel and low alloy steel bolting that is susceptible to potential borated water leaks. For a general discussion of aging mechanisms associated with loss of mechanical closure integrity see the Auxiliary Systems Section 3.4.16.2.

Breathing Air Systems

The components in the breathing air systems are fabricated from stainless steel exposed to an internal environment of air/gas. The components include valves, piping, and fittings. The applicant did not identify any aging effects of this material in the air/gas environment, as indicated in Table 3.3-3 of the LRA. The applicant's position was found to be acceptable because the staff agreed that there are no aging effects associated with stainless steel components exposed to air/gas that could cause a component to lose its ability to perform an intended function during the period of extended operation.

The components in the breathing air systems are also fabricated from carbon and stainless steel exposed to external environments of containment air, indoor-not air-conditioned, and borated water leaks. The components include valves, piping, fittings, and bolting. The applicant did not identify any aging effects of stainless steel in the containment air and indoor-not air-conditioned environment, as indicated in Table 3.3-3 of the LRA. The applicant's position was found to be acceptable because the staff agreed that there are no aging effects associated with the stainless steel components exposed to the containment air and indoor-not air-conditioned environment that could cause a component to lose its ability to perform an intended function during the period of extended operation. The applicant identified loss of mechanical closure integrity due to aggressive chemical attack as an aging effect requiring management for the carbon steel components exposed to the borated water leaks environment. The staff agreed that the loss of mechanical closure integrity is an aging effect associated with bolted mechanical closures that can result from the loss of pre-load due to cyclic loading, gasket creep, thermal or other effects, cracking, or loss of bolting material.

Nitrogen and Hydrogen Systems

The components in the nitrogen and hydrogen systems are fabricated from carbon steel and stainless steel exposed to an internal environment of air/gas. The components include valves, tubing, piping, and fittings. The applicant did not identify any aging effects of this material in the air/gas environment, as indicated in Table 3.3-3 of the LRA. The applicant's position was found to be acceptable because the staff agreed that there are no aging effects associated with stainless steel and carbon steel components exposed to air/gas that could cause a component to lose its ability to perform an intended function during the period of extended operation.

The components in the nitrogen and hydrogen systems are also fabricated from carbon and stainless steel exposed to external environments of containment air, indoor-not air-conditioned, and borated water leaks as indicated in Table 3.3-3 of the LRA. The components include valves, piping, tubing, fittings, and bolting. The applicant did not identify any aging effects of stainless steel components in the containment air and indoor-not air-conditioned environment. The applicant's position was found to be acceptable because the staff agreed that there are no aging effects associated with the stainless steel components exposed to the containment air and indoor-not air-conditioned environment that could cause a component to lose its ability to perform an intended function during the period of extended operation. The applicant identified the loss of material for carbon steel components in the external environments of containment air, indoor-not air-conditioned, and borated water leaks. The staff agreed that the loss of material due to general and pitting corrosion is an aging effect requiring management for carbon steel in containment air. In addition, the staff agreed that loss of material due to general and pitting corrosion is an aging effect requiring management for carbon steel components exposed to an indoor-not air-conditioned environment. The applicant identified loss of mechanical closure integrity due to aggressive chemical attack as an aging effect requiring management for the carbon steel components exposed to the borated water leaks environment. For a general discussion of aging mechanisms associated with loss of mechanical closure integrity, see the Auxiliary Systems Section 3.4.16.2.

Based on the description of the containment isolation system components in the internal and external environments, and the materials used in the fabrication of the various components, the staff found that the applicant adequately identified the aging effects that are applicable for these systems.

3.3.3.2.2 Aging Management Programs

Containment Purge Systems

To manage the aging effects of the carbon steel valves, piping and fittings exposed to the external environments of the outdoor and containment air, the applicant identified the following AMP:

- systems and structures monitoring program

To manage the aging effects of the carbon steel valves, piping and fittings exposed to the external environments of borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

To manage the aging effects of the carbon steel bolting in the external environment of borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

Breathing Air Systems

No aging effects were identified for the stainless steel components of the breathing air systems. To manage the aging effects of the carbon steel bolting in the environment of borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

Nitrogen and Hydrogen Systems

To manage the aging effects of the carbon steel valves, piping and fittings in the external environments of containment air and indoor-not air-conditioned environments, the applicant identified the following AMP:

- systems and structures monitoring program

To manage the aging effects of the carbon steel valves, piping and fittings in the external environment of borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

To manage the aging effects of the carbon steel bolting in the environment of borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

The staff reviewed the information provided in the LRA for the AMPs used by the applicant to manage the aging of the containment isolation system components, and determined that the applicant adequately identified the AMPs to manage the applicable aging effects of this system. Refer to Sections 3.1.3 and 3.9.3 of this SER for the review of these AMPs.

3.3.3.3 Conclusion

The staff has reviewed the information in Sections 2.3.2.3 and 3.3 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the containment isolation system will be adequately managed so that there is reasonable assurance that this system will perform its intended functions in accordance with the CLB throughout the period of extended operation.

3.3.4 Safety Injection

3.3.4.1 Summary of Technical Information in the Application

The applicant describes its AMR of the safety injection (SI) system for license renewal in Section 2.3.2.4, “Safety Injection,” and Section 3.3 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging associated with the SI system will be adequately managed during the period of extended operation, as required by 10 CFR 54.21(a)(3).

In Section 3.3.1 of the Turkey Point LRA, FPL identifies that the SI system for Turkey Point, Units 3 and 4, is subject to internal environments of treated water-borated, treated water, lubricating oil, and air/gas. FPL clarifies the scope of the definitions for these internal environments in Table 3.0-1 of the Turkey Point LRA. In Section 3.3.1 of the Turkey Point LRA, FPL identifies that the SI system for Turkey Point, Units 3 and 4, is subject to the external environments of outdoor, indoor-not air conditioned, containment air, and potential borated water leak environments. FPL defines the scope for these external environments in Table 3.0-2 of the Turkey Point LRA. Table 3.3-4 of the Turkey Point LRA clarifies which of these environments apply to the respective SI components that are within the scope of license renewal.

In Table 3.3-4 of the Turkey Point LRA, FPL identifies that the tanks, pumps, heat exchangers, piping, tubing, and associated components and commodity groups for the SI system are constructed of either stainless steel, carbon steel, cast iron, gray cast iron Inconel, and brass materials.

In Section 3.3.2 of the Turkey Point LRA, FPL identifies that the SI system is subject to the following aging effects: loss of material for components fabricated from carbon steel, stainless steel, brass or cast iron materials; cracking for certain stainless steel components; loss of material and fouling for stainless steel heat exchanger tubing and cast iron thrust bearing coolers; and loss of mechanical closure integrity for mechanical closure bolts that are fabricated from carbon steel. Table 3.3-4 of the Turkey Point LRA further summarizes the aging effects that apply to the specific SI components that fall within the scope of license renewal.

3.3.4.2 Staff Evaluation

In Table 3.3-4 of the Turkey Point LRA, FPL identifies which of the internal and external environments identified in Section 3.3.1 of the LRA for the SI system apply to the respective SI components that fall within the scope of license renewal. In Table 3.3-4 of the Turkey Point LRA, FPL also identifies the materials of fabrication for the SI components that are within the scope of license renewal.

The staff concurs with FPL’s determination of the environments that could induce the aging effects for the SI components identified in the LRA, and with FPL’s identification of the materials of fabrication for the SI components.

3.3.4.2.1 Aging Effects

Section 3.3.4.2.2 of this SE, and Section 3.3.2 and Table 3.3-4 provides a summary of the aging effects that may affect the intended functions of the SI components during periods of extended operation for the Turkey Point nuclear units. In a letter dated March 30, 2001 (L-2001-60), FPL provided additional technical discussions that justified that the aging effects identified in Section 3.3.2 and Table 3.3-4 of the LRA. FPL letter L-2001-60, dated March 30, 2001, contained the following information relative to the aging effects identified for the SI components:

- Provided FPL’s responses to the staff’s RAIs on the SI system as it relates to license renewal of the Turkey Point units (i.e., provided the responses to RAIs Nos. 3.3.4-1, 3.3.4-2, and 3.3.4-3).

- Informed the staff that there are no SI components fabricated from welded cast iron materials, and that therefore cracking would not be an aging effect that would require management for the SI pump thrust bearing coolers and SI shaft seal heat exchanger shells during the extended periods of operation for the Turkey Point units.

- Clarified that cracking is a potential effect that would require management during the extended periods of operation for the non-stress-relieved heat-affected zones of weld joints on the external surfaces of large-bore, thin-walled stainless steel SI piping located in trenches and outdoors.

- Clarified that, since the necessary conditions for SCC of austenitic stainless steels and nickel-based alloys in contact with treated water are concentrations of halogens above 150 parts-per billion (ppb) and sulfates above 100 ppb, and elevated system operating temperatures above 140 °F, and since the SI system is normally in the standby condition at temperatures less than 140 °F, cracking of the internal surfaces of the SI system in contact with borated treated water is not an aging effect requiring management during the extended periods of operation for the Turkey Point units.

- Stated that cracking in the tube shields of heat exchangers can result from either flow-induced vibrational fatigue or SCC.

- Provided a reference, “Corrosion of Metals in Marine Environments,” J.A. Beavers, K.H. Koch, and W.E. Berry, Metals and Ceramics Information Center Report (July 1986), to support the FPL conclusion that copper-based alloys exhibit excellent corrosion resistance in treated water systems.

- Clarified that, since copper alloy materials exhibit excellent resistance to SCC in treated water, SCC of brass tube shields to the SI pump shaft heat exchangers is not an aging effect that requires managing during the periods of extended operation for the Turkey Point units.

- Clarified that, since high cycle fatigue failures of components subject to flow-induced vibration would have already been reported during the early part of the 40-year licensed term for the Turkey Point units, and since FPL’s review of U.S. operating history did not identify instances of cracking in tube shields, flow-induced vibrational fatigue of brass tube shields to the SI pump shaft heat exchangers is not an aging effect that requires managing during the periods of extended operation for the Turkey Point units.

The information in Section 3.3.2 and Table 3.3-4 of the Turkey Point LRA, as amended by the contents of FPL’s responses in letter L-2001-60 to the staff RAIs 3.3.4-1, 3.3.4-2, and 3.3.4-3, demonstrates that FPL has sufficiently evaluated the SI components as exposed to the internal and external environmental conditions for the components and has sufficiently identified those aging effects that could affect the intended functions of the SI components during periods of extended operation for the Turkey Point nuclear units. The scope of RAIs 3.3.4-1, 3.3.4-2, and 3.3.4-3 on the SI system is based on whether FPL has identified those SI components that could potentially be susceptible to cracking within the extended operating terms for the SI units. FPL’s responses to the RAIs demonstrate that FPL has performed a sufficient evaluation to identify which of the SI components falling within the scope of license renewal have the potential to crack during the extended operating terms for the units. FPL’s justification for omitting cracking as an applicable aging effect for the SI components is based on any of the following bases or combinations thereof:

- Operating conditions for the SI system preclude cracking from being an applicable aging effect for a particular SI component.

- Environmental conditions will be controlled to a sufficient level to preclude cracking from being an applicable aging effect for a particular SI component.

- Material properties for the SI component material, when combined with industry experience provide sufficient justification to omit identifying cracking as an applicable aging effect for the SI component.

For those SI components that have not been identified as being susceptible to cracking within the extended operating periods, FPL has provided sufficient evaluation and justification to omit cracking as a potential aging effect for these components. The staff therefore finds FPL’s identification of the applicable aging effects for the SI components to be acceptable.

3.3.4.2.2 Aging Management Programs

Table 3.3-4 of the Turkey Point LRA includes the following programs that will be used to manage the aging effects that are identified as being applicable to the SI components that fall within the scope of license renewal:

- boric acid wastage surveillance program
- chemistry control program
- field-erected tanks internal inspection program
- galvanic corrosion susceptibility program
- systems and structures monitoring program

For those SI components that have been identified as having the potential to crack within the extended operating terms for the Turkey Point units, FPL does not always credit the ISI program as being one of the AMPs that will manage cracking during the extended operating term. However, the fact that FPL may not be crediting the ISI as a program for managing cracking during license renewal does not mean that FPL will be omitting the inspections of the SI system that are required under its current ISI program. FPL will still perform all ISIs of the SI system required to be conducted under 10 CFR 50.55a and Section XI of the ASME Code during the initial 40-year license operating terms for the units.

The staff reviewed the information provided in the LRA for the AMPs used by the applicant to manage the aging of the ISI system components, and determined that the applicant adequately identified the AMPs to manage the applicable aging effects of this system. Refer to Sections 3.1.1, 3.1.3, 3.8.4, 3.8.5, and 3.9.3 of this SER for the review of these AMPs.

3.3.4.3 Conclusion

FPL has performed an evaluation of the SI system as it relates to identifying and managing the applicable aging effects for the SI components within the scope of license renewal. FPL's evaluation of the components in SI system as provided in Section 3.3 and Table 3.3.4 of the Turkey Point LRA, as amended by the responses to RAIs 3.3.4-1, 3.3.4-2, and 3.3.4-3 in FPL letter no. L-2001-60, demonstrates that FPL has identified those aging affects that are applicable to the SI components and that will require management during the extended periods of operation. Table 3.3.4 clearly identifies how these aging effects will be managed during the periods of extended operation for the Turkey Point units. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the SI system will be adequately managed so that there is reasonable assurance that this system will perform its intended functions in accordance with the CLB throughout the period of extended operation.

3.3.5 Residual Heat Removal

3.3.5.1 Summary of Technical Information in the Application

The applicant describes its AMR of the residual heat removal (RHR) system for license renewal in Section 2.3.2.5, “Residual Heat Removal,” and Section 3.3 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging associated with the RHR system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The RHR system delivers borated water to the reactor coolant systems during the injection phase of a design-basis accident. Following a loss-of-coolant accident, the RHR system cools and recirculates water that is collected in the containment recirculation sumps and returns it to the reactor coolant, containment spray, and SI systems to maintain reactor core and containment cooling functions. In addition, during normal plant operations, the RHR system removes residual and sensible heat from the core during plant shutdown, cooldown, and refueling operations.

The RHR components subject to an AMR include pumps and valves (pressure boundary only), heat exchangers, orifices, piping, tubing, and fittings. The intended functions for the RHR system components subject to an AMR include pressure boundary integrity, heat transfer, and throttling. A complete list of the RHR components requiring an AMR and the component intended functions are provided in Table 3.3-5 of the LRA. The AMR for the RHR system is discussed in Section 3.3 of the LRA.

In Section 3.3.1, “Materials and Environments,” of the Turkey Point LRA, FPL identifies that the engineered safety features systems for Turkey Point, Units 3 and 4, is subject to the internal environments of treated water-borated, treated water, lubricating oil and air/gas. FPL clarifies the scope of the definitions for these internal environments in Table 3.0-1 of the Turkey Point LRA. In Section 3.3.1 of the Turkey Point LRA, FPL identifies that the engineered safety features systems for Turkey Point, Units 3 and 4, is subject to the external environments of outdoor, indoor-not air conditioned, containment air, embedded/encased, and potential borated water leakage. FPL defines the scope for these external environments in Table 3.0-2 of the Turkey Point LRA. Table 3.3-5 of the Turkey Point LRA clarifies which of these environments are applicable to the respective RHR components that are within the scope of license renewal.

In Table 3.3-5 of the Turkey Point LRA, FPL identifies that the pumps; valves; piping; and heat exchangers shells, baffles, and tubing; and associated components and commodity groups for the RHR system are constructed of either stainless steel or carbon steel materials.

In Section 3.3.2, “Aging Effects Requiring Management,” of the Turkey Point LRA, FPL identifies that the RHR system is subject to the following aging effects: loss of material for components fabricated from carbon steel or stainless steel; cracking for certain stainless steel components; loss of material, cracking and fouling for stainless steel heat exchanger tubing; and loss of mechanical closure integrity for mechanical closure bolts that are fabricated from carbon steel. Table 3.3-5 of the Turkey Point LRA further summarizes the aging effects that apply to the specific RHR components that fall within the scope of license renewal.

3.3.5.2 Staff Evaluation

In Table 3.3-5 of the Turkey Point LRA, FPL identifies which of the internal and external environments identified in Section 3.3.1 of the LRA for the RHR system are applicable to the respective RHR components falling under the scope of license renewal. In Table 3.3-5 of the Turkey Point LRA, FPL also identifies the materials of fabrication for the RHR components within the scope of license renewal.

The staff concurs with FPL’s determination of the environments that could induce the aging effects for the RHR components identified in the LRA, and with FPL’s identification of the materials of fabrication for the RHR components.

3.3.5.2.1 Aging Effects

Section 6.0, “Aging Effects Requiring Management for Internal Environments,” of Appendix C to the LRA lists and discusses the aging effects requiring management for each of the internal environments in the Turkey Point nuclear units; Section 7.0, “Aging Effects Requiring Management for External Environments,” of Appendix C lists and discusses the aging effects requiring management for each of the external environments in the Turkey Point nuclear units. Section 5.0, “Potential Aging Effects,” of Appendix C discusses the environmental, material, and loading parameters governing these aging effects. Section 3.3.2 of the Turkey Point LRA provides a general summary of the aging effects that may affect the intended functions of the RHR systems during periods of extended operation for the Turkey Point nuclear units. Table 3.3-5 narrows the scope of Section 3.3.2 by identifying which specific aging effects identified in Section 3.3.2 apply to the specific RHR components that fall within the scope of license renewal. The combined summaries in Section 3.3.2, Table 3.3-5, and Sections 5.0, 6.0, and 7.0 of Appendix C provide a sufficient basis as to how FPL determined which aging effects apply to the specific RHR components that fall within the scope of license renewal.

Based on the description of the RHR system components in the internal and external environments, and the materials used in fabricating the various components, the staff finds that the applicant has adequately identified the aging effects that apply to this system.

3.3.5.2.2 Aging Management Programs

Section 3.3.4, “Conclusion,” of the Turkey Point LRA states that the following AMPs will be used to manage the applicable aging effects for the Turkey Point Engineered Safety Features systems:

- boric acid wastage surveillance program
- chemistry control program
- containment spray system piping inspection program
- field erected tanks internal inspection program
- emergency containment cooler inspection
- galvanic corrosion susceptibility program
- periodic surveillance and preventive maintenance program
- systems and structures monitoring program

Table 3.3-5 of the LRA identifies which of these programs will be used to manage the aging effects identified as needing management for the specific RHR components that are within the scope of license renewal. Section 5.0 of Appendix C to the LRA discusses potential aging effects that may need to be managed during the periods of extended operation for Turkey Point non-ASME-Class 1 components. Section 6.0 of Appendix C discusses the aging effects requiring management for internal environments. For those RHR components that have been identified having the potential to crack within the extended operating terms for the Turkey Point units, FPL does not always credit the ISI program as being one of the aging programs that will manage the cracking during the extended operating terms. However, FPL will continue to perform all ISIs of the RHR required to be conducted under 10 CFR 50.55a and Section XI of the ASME Code during the initial 40-year licensed operating terms for the units.

The staff reviewed the information provided in the LRA for the AMPs used by the applicant to manage the aging effects of the RHR system components, and determined that the AMPs identified above are acceptable to manage the applicable aging effects. Refer to Sections 3.1.1, 3.1.3, 3.8.3, 3.8.4, 3.8.5, 3.9.3, 3.9.5, and 3.9.11 of this SER for the review of these AMPs.

3.3.5.3 Conclusion

The staff has reviewed the information in Sections 2.3.2.5 and 3.3 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the RHR system will be adequately managed so that there is reasonable assurance that this system will perform its intended functions in accordance with the CLB throughout the period of extended operation.

3.3.6 Emergency Containment Filtration

3.3.6.1 Summary of Technical Information in the Application

The applicant describes its AMR of the emergency containment filtration system for license renewal in Section 2.3.2.6, “Emergency Containment Filtration,” and Section 3.3 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging associated with the emergency containment filtration system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The emergency containment filtration system serves to reduce the iodine concentration in the containment atmosphere following a loss-of-coolant accident with failed fuel, to levels ensuring that the offsite dose will not exceed the guidelines of 10 CFR Part 100 at the site boundary, and to assist in limiting the dose to the control room operators to less than the limits specified by 10 CFR Part 50, Appendix A, General Design Criterion 19. The emergency containment filtration system consists of three filter units, each containing a moisture separator, a high-efficiency particulate filter bank, an impregnated charcoal filter bank, and a fan. Included in the scope of the emergency containment filtration are components carrying water from the containment spray to the emergency containment filtration for filter spray. The filter spray provides cooling of the filter in the unlikely event of a post-accident fan trip.

The emergency containment filtration components subject to an AMR include the filter units and valves (pressure boundary only), piping, tubing, fittings, and spray nozzles. The intended functions for the emergency containment filtration components subject to an AMR include pressure boundary integrity and spray. A complete list of the emergency containment filtration components requiring an AMR and the component intended functions are provided in Table 3.3-6 of the LRA. The AMR for this system is discussed in Section 3.3 of the LRA.

3.3.6.2 Staff Evaluation

3.3.6.2.1 Effects of Aging

The components in the emergency containment filtration system are fabricated from carbon steel, brass, copper, and stainless steel in an internal environment of air/gas and stainless steel exposed to an internal environment of treated water. The components include emergency containment filter housings, floodjet spray nozzles, piping/fittings, valves, and tubing. The aging effects of these materials in the internal environments of air/gas and treated water are identified in Table 3.3-6 of the LRA. The treated water environment is borated water for this application. The applicable aging effect in the air/gas and treated water environment includes loss of material. A discussion of the aging effects for the carbon steel, brass, copper, and stainless steel components exposed to the internal environments of air/gas and treated water is provided below.

The applicant did not identify any aging effects for the brass, copper, and stainless steel emergency containment filtration system components exposed to an internal environment of air/gas, as indicated in Table 3.3-6 of the LRA. The applicant’s position was found to be acceptable because the staff agreed that there are no aging effects associated with brass, copper, and stainless steel components exposed to air/gas that could cause a component to lose its ability to perform an intended function during the period of extended operation.

The loss of material for carbon steel components exposed to an internal environment of air/gas is an aging effect requiring management due to general and pitting corrosion.

Stainless steel exposed to an internal environment of treated water is assumed susceptible to the loss of material due to pitting corrosion in the presence of halogens in excess of 150 ppb or sulfates in excess of 100 ppb when dissolved oxygen is in excess of 100 ppb.

The components in the emergency containment filtration system exposed to the external environments of containment air or borated water leaks are fabricated from carbon steel, brass, copper, and stainless steel. These components include the emergency containment filter housings, floodjet spray nozzles, piping/fittings, valves, and tubing. The aging effects of these materials in the external environments of containment air and borated water leaks are identified in Table 3.3-6 of the LRA. The applicable aging effects in the containment air and borated water leaks include loss of material and loss of mechanical closure integrity, respectively. A discussion of the aging effects for the carbon steel, brass, copper, and stainless steel components exposed to the external environments of containment air and borated water leaks is provided below.

The applicant did not identify any aging effects for the brass, copper, and stainless steel emergency containment filtration system components exposed to an external environment of containment air, as indicated in Table 3.3-6 of the LRA. The applicant's position was found to be acceptable because the staff agreed that there are no aging effects associated with the brass, copper, and stainless steel components exposed to containment air that could cause a component to lose its ability to perform an intended function during the period of extended operation.

The loss of material of carbon steel components in the external environment of containment air is due to general and pitting corrosion.

The loss of mechanical closure integrity due to aggressive chemical attack is an aging effect that requires management of mechanical closure carbon and low alloy steel bolting that is susceptible to potential borated water leaks.

Based on the description of the emergency containment filtration system components in the internal and external environments, and the materials used in the fabrication of the various components, the staff found that the applicant adequately identified the aging effects that are applicable for this system.

3.3.6.2.2 Aging Management Programs

To manage the aging effects for the emergency containment filter housings exposed to an internal environment of air/gas, the applicant identified the following AMP:

- periodic surveillance and preventive maintenance program

To manage the aging effects for the emergency containment filtration valves, and piping/fittings, exposed to an internal environment of treated water, the applicant identified the following AMP:

- chemistry control program

To manage the aging effects for the emergency containment filter housings exposed to an external environment of containment air, the applicant identified the following AMP:

- periodic surveillance and preventive maintenance program

To manage the aging effects for the emergency containment filter housings exposed to an external environment of borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

To manage the aging effects for the emergency containment filtration bolting exposed to an external environment of borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

The staff reviewed the information provided in the LRA for the AMPs used by the applicant to manage the aging of the emergency containment filtration system components, and determined that the AMPs identified above are acceptable to manage the applicable aging effects. Refer to Sections 3.1.1, 3.9.3, and 3.9.11 of this SER for the review of these AMPs.

3.3.6.3 Conclusion

The staff has reviewed the information in Sections 2.3.2.6 and 3.3 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the emergency containment filtration system will be adequately managed so that there is reasonable assurance that this system will perform its intended functions in accordance with the CLB throughout the period of extended operation.

3.3.7 Containment Post-Accident Monitoring and Control

3.3.7.1 Summary of Technical Information in the Application

The applicant describes its AMR of the containment post-accident monitoring and control system for license renewal in Section 2.3.2.7, “Containment Post-Accident Monitoring and Control,” and Section 3.3 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging associated with the containment post-accident monitoring and control system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The containment post-accident monitoring and control system includes the following subsystems: post-accident hydrogen monitoring, post-accident hydrogen control, containment pressure monitoring, post-accident sampling, and containment air particulate and gas monitoring. A description of these systems is provided below.

The post-accident hydrogen monitoring system provides indication of the hydrogen gas concentration in the containment atmosphere following a loss-of-coolant accident. The mechanical portions of the post-accident hydrogen monitoring system provide a flow path from the containment to the hydrogen monitors and then back to the containment.

The containment pressure monitoring system consists of redundant containment pressure signals that are provided to isolate the containment and initiate several reactor safeguard actions. The mechanical portions of the containment pressure monitoring system provide sensing lines from the containment to the containment pressure monitors.

The only mechanical portion of the post-accident sampling in the scope of license renewal is the sample cooler because it forms a part of the component cooling water pressure boundary. Component cooling water is described in UFSAR Section 9.3.

The post-accident hydrogen control system provides the means for achieving and maintaining containment post-accident hydrogen control. Post-accident hydrogen control is described in UFSAR Section 9.12.

The containment air particulate and gas monitoring system measures radioactivity in the containment air. The mechanical portions of containment air particulate and gas monitoring provide a flow path from the containment to the monitors and then back to the containment. The containment air particulate and gas monitoring system is described in UFSAR Section 11.2.3.

The containment post-accident monitoring and control components subject to an AMR include pumps and valves (pressure boundary only), orifices, piping, tubing and fittings. The intended functions for the containment post-accident monitoring and control components subject to an AMR include pressure boundary integrity and throttling. A complete list of the containment post-accident monitoring and control components requiring an AMR and the component intended functions are provided in Table 3.3-7 of the LRA.

3.3.7.2 Staff Evaluation

3.3.7.2.1 Effects of Aging

For the containment post-accident monitoring and control system, the applicant stated that the stainless steel hydrogen monitor pumps, filter housings, valves, piping, tubing, fittings, and orifices; carbon steel tubing and fittings; aluminum pump casings; brass piping and fittings and copper tubing and fittings are exposed to air/gas. As discussed in Table 3.3-7 of the LRA, for these items exposed to air/gas there is no aging effect. For the post-accident sampling system stainless steel cooler shells, covers and tube coils exposed only to treated water, loss of material is the applicable aging effect.

There are no aging effects for containment post-accident monitoring and control system components exposed to external environments on stainless steel, aluminum, brass or copper. For valves, piping, fittings, and tubing made of carbon steel, which are exposed to an “indoor-not air-conditioned,” containment air environment, or borated water leaks, the applicable aging effect is loss of material. For carbon steel bolting that is exposed to borated water leaks, the aging effect is loss of mechanical closure integrity.

Based on the description of the containment post-accident monitoring and control system components in the internal and external environments, and the materials used in the fabrication of the various components, the staff finds that the applicant has adequately identified the aging effects that apply to this system.

3.3.7.2.2 Aging Management Programs

To manage the aging effects on the stainless steel components exposed to treated water, such as, the post-accident sampling system stainless steel cooler shells, covers and tube coils, the applicant identified the following AMP:

- chemistry control program

To manage aging effects for the carbon steel valves, piping, fittings and tubing exposed to “indoor-not air-conditioned” or containment air environment, the applicant identified the following AMP:

- systems and structures monitoring program

To manage the aging effects for the carbon steel valves, piping, fittings and tubing exposed to borated water leaks, the applicant identified the following AMPs:

- boric acid wastage surveillance program

To manage the aging effects for the carbon steel bolting exposed to borated water leaks, the applicant identified the following AMP:

- boric acid wastage surveillance program

The staff reviewed the information provided in the LRA for the AMPs used by the applicant to manage the aging effects of the containment post-accident monitoring and control system components, and determined that the AMPs identified above are acceptable to manage the applicable aging effects. Refer to Sections 3.1.3 and 3.9.3 of this SER for the review of these AMPs.

3.3.7.3 Conclusion

The staff has reviewed the information in Sections 2.3.2.7 and 3.3 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the containment post-accident monitoring and control system will be adequately managed so that there is reasonable assurance that this system will perform its intended functions in accordance with the CLB during the period of extended operation.

3.4 Auxiliary Systems

In LRA Section 3.4, "Auxiliary Systems," the applicant describes the AMR for the auxiliary systems. Appendices A, B, and C to the LRA also contain supplementary information related to the AMR of the auxiliary systems. The staff reviewed Section 3.4 and the applicable portions of Appendices A, B, and C to determine whether the applicant has provided sufficient information to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB throughout the period of extended operation, in accordance with 10 CFR 54.21(a)(3) for the auxiliary system structures and components (SCs) that are determined to be within the scope of license renewal and subject to an AMR.

The Turkey Point auxiliary systems include the following 15 systems:

- intake cooling water (ICW)
- component cooling water (CCW)
- spent fuel pool cooling
- chemical and volume control
- primary water makeup
- sample systems
- waste disposal
- instrument air
- normal containment and control rod drive mechanism cooling

- auxiliary building ventilation
- control building ventilation
- emergency diesel generator building ventilation
- turbine building ventilation
- fire protection
- emergency diesel generators and support systems

In the LRA, Section 2.1, “Scoping and Screening Methodology,” the applicant describes the method used to identify the SCs that are within the scope of license renewal and subject to an AMR. The applicant identifies and lists the auxiliary system SCs in Section 2.3.3 “Auxiliary Systems,” of the LRA. The staff’s evaluation of the scoping methodology and the auxiliary system SCs included within the scope of license renewal and subject to an AMR is documented in Sections 2.1 and 2.3.3 of this SER, respectively. In LRA Appendix A, “Updated Final Safety Analysis Report Supplement,” the applicant provides a summary description of the programs and activities used to manage the effects of aging, as required in 10 CFR 54.21(d). The applicant provides a more detailed description of these AMPs for the staff to use in its evaluation in Appendix B to the LRA. In LRA Appendix C, the applicant describes the processes used to identify many of the applicable aging effects for the SCs that are subject to an AMR. In LRA Appendix D, the applicant states that no changes to the Turkey Point Technical Specifications (TS) have been identified. A discussion of each system follows.

3.4.1 Intake Cooling Water

The intake cooling water (ICW) system removes heat from the component cooling water (CCW) and the turbine plant cooling water. The ICW pumps supply salt water from the plant’s intake area through two redundant piping headers to the tube side of the CCW and turbine plant cooling water heat exchangers.

3.4.1.1 Summary of Technical Information in the Application

The applicant described its AMR of the ICW system for license renewal in Section 2.3.3.1, “Intake Cooling Water,” and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the ICW system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The applicant identifies the following SCs of the ICW system that are within the scope of license renewal and subject to an AMR:

- SCs that are safety-related and are relied upon to remain functional during and following design-basis events

- SCs that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions

- SCs that are relied on during postulated fires and station blackout events

The applicant states that the components subject to an AMR include pumps and valves (pressure boundary only), strainers, orifices, piping, tubing and fittings. The intended functions of ICW components that are subject to an AMR are pressure boundary integrity, filtration, structural integrity, structural support, and throttling. A complete list of ICW components that require an AMR and their component intended functions appears in Table 3.4-1 of the LRA.

3.4.1.2 Staff Evaluation

The components in the ICW system are fabricated from carbon steel, stainless steel, cast iron, rubber, bronze, copper-nickel, monel, and aluminum-bronze exposed to an internal environment of raw water in the cooling canals. These components include ICW pumps and pump expansion joints; basket strainer (shells and internal screens); valves, piping, and fittings; orifices; and thermowells chemical injection nozzles (Units 3 only). The aging effects of these materials in the raw water environment are identified in Table 3.4-1, and are discussed in Section 6.2, “Raw Water,” of Appendix C to the LRA. The raw water environment in the cooling canals is defined as salt water used as the ultimate heat sink. Applicable aging effects in this internal environment include loss of material (due to general corrosion, pitting corrosion, galvanic corrosion, crevice corrosion, microbiologically induced corrosion (MIC), and selective leaching) and cracking (due to embrittlement for rubber).

Components in the ICW system which are exposed externally to an outdoor environment are manufactured from the following materials: stainless steel, carbon steel, cast iron, rubber, bronze, copper nickel, monel, and aluminum-bronze. The outdoor environment consists of a moist, salt-ladened atmospheric air, temperature 30°F to 95°F, and exposure to weather (including precipitation and wind). The aging effects of these materials exposed externally to the outdoor environment are identified in Table 3.4-1 and are discussed in Section 7.0, “Outdoor,” of Appendix C to the LRA. Applicable aging effects for these components exposed externally to the outdoor environment include loss of material due to general, pitting, galvanic, crevice and MIC; cracking due to stress corrosion and embrittlement (in the case of rubber).

A few components in the ICW system have external surfaces which may be exposed to borated water leaks. These components include the carbon steel basket strainer shells, as well as the cast and carbon steel iron valves, piping, and fittings. The aging effects associated with external exposure to borated water leaks are identified in Table 3.4-1 and are discussed in Section 7.5, “Borated Water Leaks,” of Appendix C to the LRA. Applicable aging effects include loss of material and loss of mechanical closure due to aggressive chemical attack.

3.4.1.2.1 Aging Management Programs

To manage the aging effects of stainless steel, carbon steel, cast iron, bronze, copper-nickel, monel, rubber, and aluminum-bronze components exposed internally to a raw water environment in the cooling canals, the applicant relies on the following AMPs:

- periodic surveillance and preventive maintenance program
- ICW system inspection program
- systems and structures monitoring program

The periodic surveillance and preventive maintenance program provides for visual inspection of selected surfaces of specific components and structural components, or alternatively their replacement/refurbishment during the performance of periodic surveillance and preventive maintenance activities. The description of this program is provided in Appendix B, Section 3.2.11, "Periodic Surveillance and Preventive Maintenance Program," of the LRA. This program is credited for managing the aging effects of stainless steel, carbon steel and cast iron ICW pumps; rubber ICW pump expansion joints; and aluminum-bronze pump discharge valves that are internally exposed to the raw water environment. The periodic surveillance and preventive maintenance program is a current program that will be enhanced with regard to the scope of specific inspections and their documentation. The staff requested that the applicant provide applicable frequencies, bases and the most recent operating history supporting the adequacy of this program in managing the aging effects associated with the following components: stainless steel, carbon steel and cast iron ICW pumps; rubber ICW pump expansion joints; and aluminum-bronze pump discharge valves that are externally exposed to the raw water environment. In response to the staff's RAI, the applicant indicated that this program is used to manage internal and external aging effects of these components. In addition, the scheduled frequency of preventive maintenance activity for the replacement of the ICW pumps, discharge check valves, and expansion joints is 42 months. The applicant further stated that this frequency is based on the operating and maintenance history of these components at Turkey Point, and adjustments to this frequency may be made based on future plant-specific performance and/or industry experience.

On the basis of this information, the staff finds this program acceptable in managing the aging effects associated with these components in the ICW system. The staff's detailed evaluation of the periodic surveillance and preventive maintenance program is provided in Section 3.9.11 of this SER.

The ICW system inspection program was developed in response to NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment." This program includes performance testing and evaluations, systematic inspections, leakage evaluations, and corrective actions to ensure that loss of material, cracking or biological fouling does not lead to loss of component intended function. The description of this program is provided in LRA Appendix B, Section 3.2.10, "Intake Cooling Water System Inspection Program." This program is credited for managing the aging effects of carbon steel basket strainer shell; stainless steel basket internal screen and cast iron, copper-nickel, and bronze valves, piping, and fittings exposed internally to the raw water environment. The staff finds this program adequate in managing the aging effects for these components in the ICW system. The staff's detailed evaluation of the ICW system inspection program is provided in Section 3.9.10 of this SER.

The systems and structures monitoring program provides for visual inspection and examination of accessible surfaces of specific systems, structures and components, including welds and bolting. The description of this program is provided in Appendix B, Section 3.2.15, "Systems and Structures Monitoring Program," of the LRA. This program is credited for managing the aging effects of cast iron, carbon steel, bronze, monel, and stainless steel valves, piping, tubing, and fittings; stainless steel orifices; monel chemical injection nozzles and stainless steel thermowells that are internally exposed to the raw water environment. For structures that are inaccessible for inspection through the systems and structures monitoring program, an inspection of structures with similar materials and environments may be indicative of aging effects. Several components in the ICW system credit this program for managing loss of material in the raw water environment. The staff requested the applicant provide the applicable frequencies, bases and the most recent operating history supporting the adequacy of this program for the following components in the ICW system: cast iron, carbon steel, bronze, monel, and stainless steel valves, piping, tubing, and fittings; stainless steel orifices; and stainless steel thermowells. In response to the staff's request, the applicant provided the following information: leakage inspection of the ICW orifices, thermowells and tubing/fittings was inadvertently omitted from the systems and structures monitoring program description of Appendix B, Section 3.2.15, of the LRA. In addition, the applicant responded that the leakage inspection is performed at least once per 18 months and that evaluations have been performed to show that throughwall leakage equivalent to a 1-inch diameter opening will not reduce ICW flow to the CCW heat exchangers below design requirements. The applicant provided the following reasons supporting the adequacy of this program in managing the aging effect of loss of material for these components:

- For above ground cement-lined cast iron piping, the maintenance history shows that localized failures of the cement lining have occurred. This results in small corrosion cells which will be detected through small throughwall leakage.

- For carbon steel piping/fitting and valves on the discharge channel of the CCW heat exchangers, leakage does not impact the intended function because of the heat transfer capability of this component.

- For small instrument valves and piping/tubing/fittings and thermowells and orifices made of stainless steel, monel and bronze, leakage does not affect the system function due to the size of these components. In addition, operating maintenance history has shown that leakage from these components has not been significant at Turkey Point.

On the basis of the information provided by the applicant, the staff finds that this program is appropriate and adequate for managing the aging effects associated with components in the ICW system. The staff's detailed evaluation of the systems and structures monitoring program is provided in Section 3.1.3 of this SER.

To manage the aging effects of the stainless steel, carbon steel, cast iron, rubber, bronze, copper-nickel, monel, and aluminum-bronze components externally exposed to an outdoor environment, the applicant relies on the following AMPs:

- periodic surveillance and preventive maintenance program
- systems and structures monitoring program

The periodic surveillance and preventive maintenance program provides for visual inspection of selected surfaces of specific components and structural components, or alternatively their replacement/refurbishment during the performance of periodic surveillance and preventive maintenance activities. The description of this program is provided in Appendix B, Section 3.2.11, of the LRA. This program is credited for managing the aging effects of stainless steel, carbon steel, and cast iron intake cooling pumps, as well as rubber ICW pump expansion joints externally exposed to an outdoor environment. This program is discussed above.

The systems and structures monitoring program provides for visual inspection and examination of accessible surfaces of specific systems, structures and components, including welds and bolting. The description of this program is provided in Appendix B, Section 3.2.15, of the LRA. This program is credited for managing the aging effects of carbon steel basket strainers shell; stainless steel, carbon steel, and cast iron valves, piping, and fittings; stainless steel orifices; and stainless steel thermowells externally exposed to an outdoor environment. This program is discussed above.

To manage the aging effects of the carbon steel and cast iron components externally exposed to borated water leaks, the applicant relies on the following AMP:

- boric acid wastage surveillance program

The boric acid wastage surveillance program is an enhanced program which uses systematic inspections, leakage evaluations, and corrective actions to ensure that boric acid corrosion does not lead to degradation of the pressure boundary or structural integrity of components, supports or structures. The description of this program is provided in Appendix B, Section 3.2.3, "Boric Acid Wastage Surveillance Program," of the LRA. This program is credited for managing the aging effects of carbon steel basket strainers shell; carbon steel bolting; and cast iron and carbon steel valves, piping, and fittings externally exposed to borated water leaks. The boric acid wastage surveillance program provides for visual inspection of external surfaces for evidence of corrosion, cracking, leakage, fouling or coating damage. In RAI 3.4-3, dated February 2, 2001, the staff requested the applicant to provide more detail of the location of the bolts in the CCW heat exchanger room and the applicable frequencies, bases, and the most recent operating history supporting the adequacy of this program in managing the aging effects for these components. In its March 22, 2001, response to the staff's request, the applicant provided additional information that carbon and low alloy steel mechanical closures located near borated water systems are considered susceptible to aggressive chemical attack. In the ICW system, the bolted connections for piping, fittings and equipment (including valve bonnets) located in the CCW heat exchanger rooms are potentially exposed to leakage from the borated water systems. The applicant further stated that a review of the condition report and metallurgical report databases (1992 through 2000) did not identify any instance of bolting degradation due to boric acid corrosion in this system.

On the basis of the information provided, the staff finds that this program is appropriate and acceptable for managing the aging effects associated with these components. The staff's detailed evaluation of the boric acid wastage surveillance program is provided in Section 3.9.3 of this SER.

3.4.1.3 Conclusion

The staff has reviewed the information in Section 2.3.3.1 and Section 3.4 of the LRA and the applicant's responses to the staff's RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the ICW system will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB throughout the period of extended operation.

3.4.2 Component Cooling Water

The CCW system removes heat from safety-related and non-safety-related components during normal and emergency operation. The component cooling water pumps circulate component cooling water through heat exchangers and coolers that are associated with other systems. The component cooling water heat exchangers transfer the heat from these systems to the intake cooling water.

3.4.2.1 Summary of Technical Information in the Application

The applicant described its AMR of the component cooling water system for license renewal in Section 2.3.3.2, “Component Cooling Water,” and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the component cooling water system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The applicant identifies the following SCs of the CCW system that are within the scope of license renewal and subject to an AMR:

- SCs that are safety-related and are relied upon to remain functional during and following design-basis events

- SCs that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions

- SCs that are part of the environmental qualification program

- SCs that are relied on during postulated fires and station blackout events

The applicant states that the components subject to an AMR include pumps and valves (pressure boundary only), heat exchangers, tanks, orifices, piping, tubing and fittings. The intended functions for component cooling water components subject to an AMR include pressure boundary integrity, heat transfer, and throttling. A complete list of component cooling water components that require AMR and their component intended functions appears in Table 3.4-2 of the LRA.

3.4.2.2 Staff Evaluation

The components in the CCW system are fabricated from stainless steel, carbon steel, cast iron, copper nickel, brass, aluminum-brass, and copper internally exposed to the treated water environment. The components exposed internally to the treated water environment are: stainless steel component cooling water head tanks; carbon steel component cooling water surge tanks; cast iron component cooling water pumps; carbon steel, copper-nickel, and aluminum-brass component cooling water heat exchanger internals; carbon steel and stainless steel valves, piping, fittings, and thermowells; brass valves, carbon steel and stainless steel rotometers; and stainless steel orifices. The aging effects of these materials in the treated water environment are identified in Table 3.4-2 and are discussed in Section 6.1, “Treated Water,” of Appendix C to the LRA. Applicable internal aging effects in the treated water environment are loss of material due to general, pitting, and galvanic corrosion, MIC, and selective leaching; cracking due to stress corrosion, intergranular stress-corrosion, embrittlement, and high-cycle fatigue of stainless steel materials; and fouling due to biological and particulate fouling. Although cracking due to stress corrosion, intergranular stress corrosion, embrittlement, and high-cycle fatigue are applicable aging effects for stainless steel materials that are internally exposed to the treated water environment, these aging effects are not identified for any stainless steel component in Table 3.4-2 of the LRA. In RAI 3.4.2-1, dated February 2, 2001, the staff requested the applicant provide the bases for excluding these applicable aging effects for stainless steel components in the CCW system. In its March 22, 2001, response, the applicant provided the following information:

- The highest operating temperature in the CCW system is 140 °F, the threshold temperature for stress corrosion cracking (SCC) in a treated water environment. In addition, at this temperature, components of the CCW system are not susceptible to intergranular stress-corrosion cracking (IGSCC) or embrittlement. The applicant further stated that this conclusion is supported by plant operating experience which did not identify any instances of SCC or IGSCC in stainless steel CCW components.

- High cycle fatigue (such as vibration-induced fatigue) is fast acting, and typically occurs early in a component's life. The applicant did not find any instances of fatigue-induced cracking of stainless steel components in the CCW system.

On the basis of this information, the staff finds that stainless steel components in the CCW system are not subject to stress corrosion, intergranular stress corrosion, embrittlement, and high-cycle fatigue.

The CCW system also has components internally exposed to the raw water environment in the closed cooling canals. These components are the copper-nickel component cooling water heat exchanger tube sheets (tube side), channels, and channel door overlay, as well as the aluminum-brass component cooling water heat exchanger tubes (inside diameter). The aging effects of these materials in the raw water environment are identified in Table 3.4-2 and are discussed in Section 6.2 of Appendix C of the LRA. The raw water environment in the cooling canals is defined as salt water used as the ultimate heat sink. Applicable aging effects in this internal environment include loss of material due to pitting corrosion, crevice corrosion, and MIC.

The air/gas environment is an applicable internal environment for the stainless steel component cooling water head tanks; carbon steel pressure vessels (air reservoirs); stainless steel, carbon steel, and brass valves, piping, fittings, tubing, and filters; and stainless steel orifices. The applicant did not identify any aging effects of these components in the air/gas environment. The aging effects associated with exposure to the air/gas environment are identified in Table 3.4-2 and are discussed in Section 6.3, "Air/Gas," of Appendix C to the LRA. Several air/gas environment descriptions are provided for each of the air/gas environments found in the plant. Aging effects of components exposed to the air/gas environment is dependent, in part, on the type of air/gas environment, the operating temperature, and the water content. The staff requested the applicant provide the characteristic parameters of the air/gas environments applicable to the components found in the CCW system and to provide the bases by which the determination of no aging effects requiring management was concluded for all components exposed to the air/gas environment. This RAI is similar to information requested for stainless steel components exposed to an air/gas environment in the chemical and volume control system (RAI 3.4.4-1). The staff evaluated the information and on the basis of the applicant's response, stainless steel is not susceptible to loss of material in this environment and therefore, no AMP is required.

Components in the CCW system which are exposed externally to an outdoor environment are manufactured from the following materials: stainless steel, carbon steel, cast iron, brass and copper-nickel. The outdoor environment consists of a moist, salt-ladened atmospheric air, temperature 30 °F to 95 °F, and exposure to weather, including precipitation and wind. The aging effects associated with external exposure to an outdoor environment are identified in Table 3.4-2 and are discussed in Section 7.1, "Outdoor," of Appendix C to the LRA. Applicable aging effects for the remaining components exposed externally to the outdoor environment include loss of material due to general, and pitting corrosion.

Components in the CCW system which are exposed externally to an indoor environment - not air-conditioned are carbon steel component cooling water surge tanks; carbon steel pressure vessels (air reservoirs); carbon steel valves, pipings, and fittings; stainless steel valves, piping, fittings, filters, and thermowells; stainless steel orifices and rotometers; carbon steel rotometers; and brass valves. The indoor, not air-conditioned environment, is defined as atmospheric air with a maximum air temperature of 104 °F, humidity between 5% and 95%, and no exposure to weather. The aging effects associated with external exposure to an outdoor environment are identified in Table 3.4-2 and are discussed in Section 7.2, "Indoor - Not Air Conditioned," of Appendix C to the LRA. The applicable aging effect is loss of material due to general and pitting corrosion for carbon steel.

The CCW system also contains carbon steel valves, piping, and fittings that are externally exposed to containment air. The containment air environment is described as atmospheric air with a maximum temperature of 120 °F, humidity between 5% and 95%, radiation total integrated dose rate of 1 rad/hr, and no exposure to weather. The aging effects associated with external exposure to the containment air environment are identified in Table 3.4-2 and are discussed in Section 7.4, "Containment Air," of Appendix C to the LRA. Applicable aging effects for carbon steel components include loss of material due to general and pitting corrosion.

A few components in the CCW system have external surfaces which may be exposed to borated water leaks. These components include the carbon steel pressure vessels (air reservoirs); cast iron component cooling water pumps; carbon steel component cooling water heat exchanger shells, flanges, and doors; carbon steel valves, piping, fittings, rotometers, and bolting. The aging effects associated with external exposure to borated water leaks are identified in Table 3.4-2 and are discussed in Section 7.5 of Appendix C to the LRA. Borated water leaking from systems undergoes evaporation, which results in a highly concentrated solution of boric acid or deposits of boric acid crystals. Applicable aging effects include loss of material and loss of mechanical closure due to aggressive chemical attack. The staff finds that the aging effects identified by the applicant are acceptable.

3.4.2.2.1 Aging Management Programs

To manage the aging effects of stainless steel, carbon steel, cast iron, copper-nickel, aluminum-brass, and brass that are internally exposed to a treated water environment, the applicant relies on the following AMPs:

- chemistry control program
- galvanic susceptibility inspection program (carbon steel only)

The chemistry control program provides for sampling and analysis of treated water. The description of this program is provided in Appendix B, Section 3.2.4 "Chemistry Control Program," of the LRA. The staff finds this program appropriate in managing the aging effects associated with the treated water environment. The staff's detailed evaluation of this program is found in Section 3.1.1 of this SER.

The galvanic susceptibility inspection program is a new program which will provide for one-time inspections the results of which will be used to determine the need for additional actions. The description of this program is provided in Appendix B, Section 3.1.5, "Galvanic Corrosion Susceptibility Inspection Program," of the LRA. The staff requested that the applicant provide the bases for the determination of corrosion rates and for the techniques which will be used in this new program. The applicant stated in its response to the staff's RAI that plant experience with galvanic corrosion has been limited and typically has occurred in saltwater. In addition, the applicant stated that examination techniques that have previously been employed at Turkey Point include ultrasonic, radiographic, and visual inspections. The type of examination employed will be selected based on component geometry, material of construction, and accessibility, and will utilize accepted industry practices and standards (e.g., American Society of Mechanical Engineers standards). The applicant further stated that the corrosion rate will be estimated from the original thickness, if known, or from an unaffected zone and the service time of the component. On the basis of the information provided, the staff finds that this new program is appropriate and acceptable for managing components in the chemical and volume control system. The staff's detailed evaluation of this program is provided in Section 3.8.5 of this SER.

To manage the aging effects of the carbon steel and cast iron components externally exposed to containment air, outdoor and indoor - not air-conditioned environment, the applicant relies on the following AMP:

- systems and structures monitoring program

The systems and structures monitoring program provides for visual inspection and examination of accessible surfaces of specific systems, structures and components, including welds and bolting. The description of this program is provided in Appendix B, Section 3.2.15 of the LRA. The staff's detailed evaluation of these programs are provided in Sections 3.9.11 and 3.1.3 of this SER.

To manage the aging effects of the carbon steel and cast iron components externally exposed to borated water leaks, the applicant relies on the following AMP:

- boric acid wastage surveillance program

The boric acid wastage surveillance program is an enhanced program which uses systematic inspections, leakage evaluations, and corrective actions to ensure that boric acid corrosion does not lead to degradation of the pressure boundary or structural integrity of components, supports or structures. The description of this program is provided in Appendix B, Section 3.2.3 of the LRA. The staff's detailed evaluation of this program is provided in Section 3.9.3 to this SER.

3.4.2.3 Conclusion

The staff has reviewed the information in Section 2.3.3.2 and Section 3.4 of the LRA and the applicant's responses to the staff's RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the CCW system will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB during the period of extended operation.

3.4.3 Spent Fuel Pool Cooling

The spent fuel pool (SFP) cooling system removes decay heat from the spent fuel pool and filters and demineralizes the water in the spent fuel pool. There are two SFPs and SFP cooling systems. Spent fuel pool cooling consists of three separate cooling, purification, and skimmer loops.

3.4.3.1 Summary of Technical Information in the Application

The applicant described its AMR of the SFP cooling system for license renewal in Section 2.3.3.3, "Spent Fuel Pool Cooling," and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the SFP cooling system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The applicant identifies the following SCs of the SFP cooling that are within the scope of license renewal and subject to an AMR:

- SCs that are safety-related and are relied upon to remain functional during and following design-basis events

- SCs that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions

- SCs that are relied on during station blackout events

The applicant states that the components that are subject to an AMR include pumps and valves (pressure boundary only), heat exchangers, filters, demineralizers, orifices, piping, tubing, and fittings. The intended functions of SFP cooling components that are subject to an AMR include pressure boundary integrity, heat transfer, and throttling. A complete list of SFP cooling components that require AMR and the component intended functions appears in Table 3.4-3 of the LRA.

3.4.3.2 Staff Evaluation

The components in the SFP cooling system are fabricated from stainless steel, worthite (nickel-based alloy), and carbon steel exposed to an internal environment of treated water. These components include SFP cooling pumps (refueling water purification pumps), emergency SFP cooling pumps, SFP cooling heat exchanger internals, valves, piping, fittings, tubing, filters, demineralizers, flow elements, and orifices. The aging effects of these materials in the treated water environment are identified in Table 3.4-3 and are discussed in Section 6.1 of Appendix C of the LRA. The treated water environments are treated water-borated and treated water for this application. Applicable internal aging effects in the treated water environment are loss of material due to general, pitting, and galvanic corrosion, MIC, and fouling due to biological and particulate fouling.

Components in the SFP cooling system which are exposed externally to an indoor environment - not air-conditioned are stainless steel SFP cooling pumps; stainless steel refueling water purification pumps; worthite (nickel-based alloy) emergency SFP cooling pumps; carbon steel SFP cooling heat exchanger shells and covers; stainless steel valves, piping, fittings, filters, demineralizers, flow elements, and orifices. The “indoor environment-not air-conditioned,” is defined as atmospheric air with a maximum air temperature of 104 °F, humidity between 5% and 95%, and no exposure to weather. The aging effects associated with external exposure to an outdoor environment are identified in Table 3.4-3, and are discussed in Section 7.2 of Appendix C to the LRA. Applicable aging effects include loss of material due to general and pitting corrosion for carbon steel.

Components in the SFP cooling system that are exposed externally to an outdoor environment are the stainless steel refueling water purification pumps, valves, piping, fittings, tubing, filters and demineralizers. The outdoor environment consists of a moist, salt-ladened atmospheric air, temperature 30 °F to 95 °F, and exposure to weather, including precipitation and wind. The aging effects of these materials which are externally exposed to the outdoor environment are identified in Table 3.4-3 and discussed in Section 7.0 to Appendix C of the LRA. There are no applicable aging effects for these stainless steel components, which are externally exposed to the outdoor environment.

A few components in the SFP cooling system have external surfaces that may be exposed to borated water leaks. These components include carbon steel bolting and the carbon steel SFP cooling heat exchanger shells and covers. Borated water leaking from systems undergoes evaporation, which results in a highly concentrated solution of boric acid or deposits of boric acid crystals. The aging effects associated with external exposure to borated water leaks are identified in Table 3.4-3 and are discussed in Section 7.5 of Appendix C of the LRA. Applicable aging effects include loss of material and loss of mechanical closure due to aggressive chemical attack.

The SFP cooling system has stainless steel piping and fittings which are encased or embedded in concrete. There are no applicable aging effects requiring management for these components.

3.4.3.2.1 Aging Management Programs

To manage the aging effects of stainless steel, worthite (nickel-based alloy), and carbon steel components that are internally exposed to a treated water environment, and submerged stainless steel piping and fittings in the same environment, the applicant relies on the following AMPs:

- chemistry control program
- galvanic susceptibility inspection program (carbon steel only)

The chemistry control program provides for sampling and analysis of treated water. The description of this program is provided in Appendix B, Section 3.2.4 of the LRA. The staff finds this program appropriate in managing the aging effects associated with the treated water environment. The staff's detailed evaluation of this program is found in Section 3.1.1 of this SER.

The galvanic susceptibility inspection program is a new program which will provide for one-time inspections, the results of which will be used to determine the need for additional actions. The description of this program is provided in Appendix B, Section 3.1.5. The staff requested that the applicant provide the bases for the determination of corrosion rates and for the techniques which will be used in this new program. The applicant stated in its response to the staff's RAI that plant experience with galvanic corrosion has been limited and typically has occurred in saltwater. In addition, the applicant stated that examination techniques that have previously been employed at Turkey Point include ultrasonic, radiographic, and visual inspections. The type of examination employed will be selected based on component geometry, material of construction, and accessibility, and will utilize accepted industry practices and standards (e.g., American Society of Mechanical Engineers standards). The applicant further stated that the corrosion rate will be estimated from the original thickness, if known, or from an unaffected zone and the service time of the component.

On the basis of the information provided, the staff finds that this new program is appropriate and acceptable for managing components in the SFP cooling system. The staff's detailed evaluation of this program is provided in Section 3.8.5 of this SER.

To manage the aging effects of carbon steel exposed externally to an indoor - not air-conditioned environment, the applicant relies on the following AMP:

- systems and structures monitoring program

The systems and structures monitoring program provides for visual inspection and examination of accessible surfaces of specific systems, structures and components, including welds and bolting. The description of this program is provided in Section 3.2.15 of Appendix B to the LRA. The staff's detailed evaluation of this program is provided in Section 3.1.3 of this SER.

To manage the aging effects of the carbon steel components externally exposed to borated water leaks, the applicant relies on the following AMP:

- boric acid wastage surveillance program

The boric acid wastage surveillance program is an enhanced program which uses systematic inspections, leakage evaluations, and corrective actions to ensure that boric acid corrosion does not lead to degradation of the pressure boundary or structural integrity of components, supports or structures. The description of this program is provided in Appendix B, Section 3.2.3 of the LRA. This program is credited for managing the aging effects of carbon steel SFP cooling heat exchanger shells and covers and carbon steel bolting externally exposed to borated water leaks. The boric acid wastage surveillance program provides for visual inspection of external surfaces for evidence of corrosion, cracking, leakage, fouling or coating damage. The staff requested the applicant provide more detail of the location of the bolts in the SFP cooling water system and the applicable frequencies, bases and the most recent operating history supporting the adequacy of this program in managing the aging effects for these components. In response to the staff's request, the applicant provided the following additional information: carbon and low alloy steel mechanical closures located near borated water systems are considered susceptible to aggressive chemical attack. In the SFP cooling water system, all bolted connections for piping, fittings and equipment (including valve bonnets), regardless of location, are potentially exposed to leakage from the borated water systems. The applicant further stated that a review of the condition report and metallurgical report databases (1992 through 2000) did not identify any instance of bolting degradation due to boric acid corrosion in this system.

On the basis of the information provided, the staff finds that this program is appropriate and acceptable for managing the aging effects associated with these components. The staff's detailed evaluation of the boric acid wastage surveillance program is provided in Section 3.9.3 of this SER.

3.4.3.3 Conclusion

The staff has reviewed the information in Section 2.3.3.3 and Section 3.4 of the LRA and the applicant's responses to the staff's RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the SFP cooling system will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB throughout the period of extended operation.

3.4.4 Chemical and Volume Control

The chemical and volume control system provides for continuous feed and bleed for the reactor coolant system to maintain proper water level and to adjust boron concentration. This system includes the boron addition and supply system, which provides makeup, transfer boric acid solution, and maintains reactor water purity.

3.4.4.1 Summary of Technical Information in the Application

The applicant described its AMR of the chemical and volume control system for license renewal in Section 2.3.3.4 "Chemical and Volume Control," and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the chemical and volume control system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The applicant identifies the following SCs of the chemical and volume control system that are within the scope of license renewal and subject to an AMR:

- SCs that are safety-related and are relied upon to remain functional during and following design-basis events
- SCs that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions
- SCs that are part of the environmental qualification program
- SCs that are relied on during postulated fires and station blackout events

The applicant states that the components subject to an AMR include pumps and valves (pressure boundary only), tanks, heat exchangers, orifices, piping, tubing, and fittings. The intended functions for chemical and volume control components subject to an AMR are pressure boundary integrity, heat transfer, and throttling. A complete list of chemical and volume control system (CVCS) components that require AMR and the component intended functions appears in Table 3.4-4 of the LRA.

3.4.4.2 Staff Evaluation

The components exposed internally to the treated water environment are: stainless steel boric acid storage and batching tanks, volume control tanks, holdup tanks, boric acid storage tank pumps, charging pump suction stabilizers and pulsation dampeners, non-regenerative heat exchanger internals, valves, piping, fittings, thermowells charging pumps, demineralizers and filters, orifices and flow meters; copper charging pump oil cooler tubes; cast iron charging pump oil cooler bonnets and tubes; and carbon steel non-regenerative heat exchanger shells and tube supports. The aging effects of these materials in the treated water environment are identified in Table 3.4-4 and are discussed in Section 6.1 of Appendix C of the LRA. The treated water environment is defined as either borated water or water with corrosion and/or biocides added. Applicable internal aging effects in the treated water environment are loss of material due to general, pitting, and galvanic corrosion, MIC, and selective leaching; cracking due to stress corrosion, intergranular stress corrosion and high-cycle fatigue of stainless steel materials; and fouling due to biological and particulate fouling.

The outside diameter of the copper charging pump oil cooler tubes is exposed to a lubricating oil environment. The aging effects associated with this component are identified in Table 3.4-4 and are discussed in Section 6.5, "Lubricating Oil," of Appendix C to the LRA. There are no applicable aging effects for the copper tubes.

The air/gas environment is an applicable internal environment for the stainless steel boric acid storage and batching tanks; stainless steel volume control and holdup tanks; stainless steel valves, piping, tubing, and fittings; and brass valves. The applicant did not identify any aging effects of these components in the air/gas environment. The aging effects associated with exposure to the air/gas environment are identified in Table 3.4-4 and are discussed in Section 6.3 of Appendix C to the LRA. Several air/gas environment descriptions are provided for each of the air/gas environments found in the plant. Aging effects of components exposed to the air/gas environment is dependent, in part, on the type of air/gas environment, the operating temperature, and the water content. The staff requested the applicant to provide the characteristic parameters of the air/gas environments applicable to the components found in the chemical and volume control system and to provide the bases by which the determination of no aging effects requiring management was concluded for all components exposed to the air/gas environment. In response to the staff's request, the applicant provided the following information:

- The volume control tanks internal gas space surfaces and associated valves, piping/fittings, and tubing/fittings are made up of stainless steel and exposed to a non-wetted hydrogen environment with traces of nitrogen, oxygen, and helium at a temperature of 100 °F to 130 °F.

- The holdup tanks gas space surfaces are constructed from stainless steel and are exposed to a non-wetted nitrogen environment with traces of hydrogen, helium, and oxygen at a temperature of 50 °F to 130 °F.

- The boric acid storage and boric acid batching tanks gas space surfaces and associated valves and tubing/fittings are constructed from stainless steel and exposed to a non-wetted indoor not-air conditioned environment at a maximum temperature of 104 °F.

Since stainless steel is not susceptible to loss of material in any of these environments, the applicant concluded that no AMP is required. In addition, plant operating history supports this conclusion. Based on this additional information, the staff finds that there are no applicable aging effects for stainless steel components the chemical and volume control system exposed to these environments. Therefore, there is no need for an AMP for these components.

Components in the chemical and volume control system which are exposed externally to an indoor environment not air conditioned are: stainless steel boric acid storage and batching tanks, volume control and holdup tanks, boric acid storage tank pumps, charging pumps, charging pump suction stabilizers and discharge dampeners, valves, piping fittings, thermowells, tubings, fittings, filters, demineralizers, orifices, and flow meters; brass solenoid valves; cast iron charging pump oil cooler bonnets; and carbon steel non-regenerative heat exchanger shells. The indoor environment - not air-conditioned, is defined as atmospheric air with a maximum air temperature of 104 °F, humidity between 5% and 95%, and no exposure to weather. The aging effects associated with external exposure to an outdoor environment are identified in Table 3.4-4 and are discussed in Section 7.2 of Appendix C to the LRA.

The applicable aging effect for carbon steel and cast iron components exposed to a non-air conditioned indoor environment is loss of material due to general and pitting corrosion. There are no applicable aging effects for stainless steel components exposed to a non-air-conditioned indoor environment except for components that were previously heat traced. Cracking due to stress corrosion is an applicable aging effect for stainless steel components exposed to a non-air conditioned indoor environment and previously heat-traced.

The chemical and volume control system also contains stainless steel valves, piping, fittings, thermowells, tubing, and orifices, as well as brass instrument solenoid valves that are externally exposed to containment air. The containment air environment is described as atmospheric air with a maximum temperature of 120 °F, humidity between 5% and 95%, radiation total integrated dose rate of 1 rad/hr, and no exposure to weather. The aging effects associated with external exposure to the containment air environment are identified in Table 3.4-4 and are discussed in Section 7.4 of Appendix C to the LRA. There are no applicable aging effects for these components in the containment air environment.

A few components in the chemical and volume control system have external surfaces which may be exposed to borated water leaks. These components include the cast iron charging pump oil cooler bonnets, carbon steel non-regenerative heat exchanger shells, and carbon steel bolting. The aging effects associated with external exposure to borated water leaks are identified in Table 3.4-4 and are discussed in Section 7.5 of Appendix C of the LRA. Borated water leaking from systems undergoes evaporation, which results in a highly concentrated solution of boric acid or deposits of boric acid crystals. Applicable aging effects include loss of material and loss of mechanical closure due to aggressive chemical attack.

3.4.4.2.1 Aging Management Programs

To manage the aging effects of stainless steel, carbon steel, cast iron, and copper exposed internally to a treated water environment, the applicant relies on the following AMPs:

- chemistry control program
- periodic surveillance and preventive maintenance program
- galvanic susceptibility inspection program (carbon steel, cast iron, copper)

The chemistry control program provides for sampling and analysis of treated water. The description of this program is provided in Appendix B, Section 3.2.4 of the LRA. The staff's detailed evaluation of this program is provided in Section 3.1.1 of the SER.

The periodic surveillance and preventive maintenance program provides visual inspection of selected surfaces of specific components and structural components, or alternatively their replacement/refurbishment during performance of periodic surveillance and preventive maintenance activities. The description of this program is provided in Appendix B, Section 3.2.11.

The galvanic susceptibility inspection program is a new program which will provide for a one-time inspection, the results of which will be used to determine the need for additional actions. The description of this program is provided in Appendix B, Section 3.1.5 of the LRA. The staff requested that the applicant provide the bases for the determination of corrosion rates and for the techniques which will be used in this new program. The applicant stated in its response to the staff's RAI that plant experience with galvanic corrosion has been limited and typically has occurred in saltwater. In addition, the applicant stated that examination techniques that have previously been employed at Turkey Point include ultrasonic, radiographic, and visual inspections. The type of examination employed will be selected based on component geometry, material of construction, and accessibility, and will utilize accepted industry practices and standards (e.g., American Society of Mechanical Engineers standards). The applicant further stated that the corrosion rate will be estimated from the original thickness, if known, or from an unaffected zone and the service time of the component.

On the basis of the information provided, the staff finds that this new program is appropriate and acceptable for managing components in the chemical and volume control system. The staff's detailed evaluation of this program is provided in Section 3.8.5 of the SER.

To manage the aging effects of the stainless steel, cast iron, and carbon steel components externally exposed to an "indoor-not air-conditioned environment," the applicant relies on the following AMPs:

- periodic surveillance and preventive maintenance program
- systems and structures monitoring program

The periodic surveillance and preventive maintenance program provides for visual inspection of selected surfaces of specific components and structural components, or alternatively their replacement/refurbishment during the performance of periodic surveillance and preventive maintenance activities. The description of this program is provided in Appendix B, Section 3.2.1.1 of the LRA. Cracking has been identified as a potential aging effect for stainless steel components which have been previously heat-traced. The staff requested the applicant to provide the justification of crediting a sampling program of visual inspections for detecting cracking in these stainless steel components. In addition, the staff requested additional information on the most recent inspection of these stainless steel components, the baseline inspection of these components, if applicable, and the plant history of previously heat-traced components. The applicant responded to the staff's RAI by stating that all safety-related components in the chemical and volume control system which were previously heat traced are visually inspected for leakage on a periodic basis. In addition, plant operating experience has shown that leakage in a previously heat-traced component occurred due to SCC resulting from halogen contaminants. Corrective actions resulting from this experience included inspections and replacement, as needed. The applicant stated that the most recent visual leakage inspection did not reveal any throughwall leakage, and there are no other stainless steel components at Turkey Point, presently in service, where previously existing heat tracing was removed.

On the basis of this information, the staff finds that this program will adequately manage the aging effects associated with previously heat-traced components. The staff's detailed evaluation of this program is provided in Section 3.9.11 of this SER.

The systems and structures monitoring program provides for visual inspection and examination of accessible surfaces of specific systems, structures and components, including welds and bolting. The description of this program is provided in Appendix B, Section 3.2.15 of the LRA. The staff's detailed evaluation of this program is provided in Section 3.1.3 of this SER.

To manage the aging effects of the carbon steel and cast iron components externally exposed to borated water leaks, the applicant relies on the following AMP:

- boric acid wastage surveillance program

The boric acid wastage surveillance program is an enhanced program which uses systematic inspections, leakage evaluations, and corrective actions to ensure that boric acid corrosion does not lead to degradation of the pressure boundary or structural integrity of components, supports or structures. The description of this program is provided in Appendix B, Section 3.2.3 of the LRA. The staff's detailed evaluation of this program is provided in Section 3.9.3 of this SER.

3.4.4.3 Conclusion

The staff has reviewed the information in Sections 2.3.3.4 and 3.4 of the LRA and the applicant's responses to the staff's RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the chemical and volume control system will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB throughout the period of extended operation.

3.4.5 Primary Water Makeup

The primary water makeup system provides demineralized and deaerated water for makeup to various systems throughout the plant.

3.4.5.1 Summary of Technical Information in the Application

The applicant described its AMR of the primary water makeup system for license renewal in Section 2.3.3.5, "Primary Water Makeup," and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the primary water makeup system will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The applicant identifies the following SCs of the primary water makeup system that are within the scope of license renewal and subject to an AMR:

- SCs that are safety-related and are relied upon to remain functional during and following design-basis events

- SCs that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions

- SCs that are relied on during postulated fires and station blackout events

The applicant states that the components that are subject to an AMR include valves (pressure boundary only), piping, tubing and fittings. The intended function for primary water makeup components that are subject to an AMR is pressure boundary integrity. A complete list of primary water makeup components that require AMR and the component intended functions appears in Table 3.4-5.

3.4.5.2 Staff Evaluation

The components in the primary water makeup system are fabricated from stainless steel and carbon steel exposed to an internal environment of treated water. These components are stainless steel valves, piping, and fittings. The aging effects of these materials in the treated water environment are identified in Table 3.4-5 and are discussed in Section 6.1 of Appendix C of the LRA. Applicable internal aging effects in the treated water environment are loss of material due to pitting corrosion. Components in the primary water makeup system, which are exposed externally to an indoor not air conditioned environment are stainless steel valves, piping, and fittings. The indoor environment not air conditioned, is defined as atmospheric air with a maximum air temperature of 104 °F, humidity between 5% and 95%, and no exposure to weather. The aging effects associated with external exposure to an outdoor environment are identified in Table 3.4-5 and discussed in Section 7.2 of Appendix C to the LRA. There are no applicable aging effects for these components.

Carbon steel bolts in the primary water makeup system have external surfaces which may be exposed to borated water leaks. The aging effects associated with external exposure to borated water leaks are identified in Table 3.4-5 and discussed in Section 7.5 of Appendix C to the LRA. Borated water leaking from systems undergoes evaporation, which results in a highly concentrated solution of boric acid or deposits of boric acid crystals. Applicable aging effects are loss of mechanical closure due to aggressive chemical attack.

3.4.5.2.1 Aging Management Programs

To manage the aging effects of stainless steel components exposed internally to a treated water environment, the applicant relies on the following AMP:

- chemistry control program

The chemistry control program provides for sampling and analysis of treated water. The description of this program is provided in Appendix B, Section 3.2.4 of the LRA. The staff finds this program appropriate in managing the aging effects associated with the treated water environment. The staff's detailed evaluation of this program is found in Section 3.1.1 of this SER.

To manage the aging effects of the carbon steel bolts externally exposed to borated water leaks, the applicant relies on the following AMP:

- boric acid wastage surveillance program

The boric acid wastage surveillance program is an enhanced program which uses systematic inspections, leakage evaluations, and corrective actions to ensure that boric acid corrosion does not lead to degradation of the pressure boundary or structural integrity of components, supports or structures. The description of this program is provided in Appendix B, Section 3.2.3 of the LRA. This program is credited for managing the aging effects of carbon steel externally exposed to borated water leaks. The boric acid wastage surveillance program provides for visual inspection of external surfaces for evidence of corrosion, cracking, leakage, fouling or coating damage. The staff requested the applicant to provide more detail of the location of the bolts in the primary water makeup system and the applicable frequencies, bases and the most recent operating history supporting the adequacy of this program in managing the aging effects for these components. In response to the staff's request, the applicant provided the following additional information: carbon and low alloy steel mechanical closures located near borated water systems are considered susceptible to aggressive chemical attack. In the primary water makeup system, the bolted connections for piping, fittings, and equipment (including valve bonnets) located in the auxiliary and containment buildings are potentially exposed to leakage from the borated water systems. The applicant further stated that a review of the condition report and metallurgical report databases (1992 through 2000) did not identify any instance of bolting degradation due to boric acid corrosion in this system.

On the basis of the information provided, the staff finds that this program is appropriate and acceptable for managing the aging effects associated with these components. The staff's detailed evaluation of the boric acid wastage surveillance program is provided in Section 3.9.3 of this SER.

3.4.5.3 Conclusion

The staff has reviewed the information in Section 2.3.3.5 and Section 3.4 of the LRA and the applicant's responses to the staff's RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the primary water makeup system will be adequately managed so that there is reasonable assurance that these systems will perform its intended functions in accordance with the CLB throughout the period of extended operation.

3.4.6 Sample Systems

3.4.6.1 Summary of Technical Information in the Application

The applicant described its AMR of the sample systems in Section 2.3.3.6, "Sample Systems," and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the sample systems will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

Turkey Point Unit 3 and 4 sample systems each consist of two subsystems, namely the sample system-nuclear steam supply system and sample system-secondary. Both subsystems are designed to operate manually, on an intermittent basis. Samples can be obtained under conditions ranging from full power to cold shutdown.

The sample system-nuclear steam supply system permits remote sampling of fluids of the primary plant systems. The subsystem is used to evaluate fluid chemistry in the reactor coolant, emergency core cooling, and chemical and volume control systems.

The sample system-secondary permits remote sampling of fluids of the secondary systems. The subsystem is used to evaluate fluid chemistry in the feedwater, condensate/condenser hotwell, steam generator blowdown, main steam, and heater drain systems.

The flow diagrams listed in Table 2.3-5 of the LRA show the evaluation boundaries for the portions of the sample systems that are within the scope of license renewal.

Sample systems components subject to an AMR include: valves and coolers (pressure boundary only), piping, tubing, and fittings. The intended functions for sample system components that are subject to an AMR include pressure boundary integrity and throttling. A complete list of sample systems components that require an AMR and the component intended functions appears in Table 3.4-6 of the LRA.

3.4.6.2 Staff Evaluation

The aging effects requiring management in the sample systems are loss of material for carbon steel and stainless steel components, and cracking for certain stainless steel components. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

The applicant supplied references pertaining to Turkey Point plant-specific as well as industry-wide experience to support its identification of applicable aging effects for all auxiliary systems identified above. The aging effects were identified based upon the description of internal and external environments and material of construction of the system components. The applicant has included all aging effects that are consistent with published literature and industry experience and, thus, the applicable aging effects for sample systems have been properly identified.

3.4.6.2.1 Aging Management Programs

The applicant also identified three AMPs for controlling the effects of aging on the sample system: chemistry control program, system and structures monitoring program, and the boric acid wastage surveillance program. The programs were developed from industry-wide data, industry-developed methodologies, NRC documents, and the applicant's own experience. The applicant concluded that these programs would manage the aging effects in such a way that the intended function of the components in the sample systems will be maintained throughout the period of extended operation, consistent with the CLB, under all design conditions. The staff's detailed evaluations of the programs are found in Sections 3.1.1, 3.1.3 and 3.9.3 of this SER.

3.4.6.3 Conclusion

The staff reviewed the information in Sections 2.3.3.6, “Sample Systems,” and 3.4 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that aging effects associated with the sample systems will be adequately managed so that there is a reasonable assurance that the system will perform the intended functions in accordance with the CLB throughout the period of extended operation.

3.4.7 Waste Disposal

3.4.7.1 Summary of Technical Information in the Application

The applicant described its AMR of the waste disposal systems for license renewal in Section 2.3.3.7, “Waste Disposal,” and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the waste disposal systems will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

Waste disposal collects and processes potentially radioactive reactor plant wastes prior to release or removal from the plant site. The system is common to Units 3 and 4, except for the components associated with each containment. Waste disposal consists of three subsystems, including the liquid, solid, and gaseous waste disposal systems.

The flow diagrams listed in Table 2.3-5 of the LRA show the evaluation boundaries for the portions of waste disposal that are within the scope of license renewal.

Waste disposal components subject to an AMR include pumps, valves and heat exchangers (pressure boundary only), piping, tubing, and fittings. The intended function for waste disposal components subject to an AMR is pressure boundary integrity. A complete list of waste disposal components that require an AMR and the component intended functions appears in Table 3.4-7 of the LRA.

3.4.7.2 Staff Evaluation

The aging effects requiring management in the waste disposal systems are loss of material for carbon steel and stainless steel components and admiralty brass heat exchanger tubing, and fouling for stainless steel drain piping. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

The applicant supplied references pertaining to Turkey Point plant-specific as well as industry-wide experience to support its identification of applicable aging effects for all auxiliary systems identified above. The aging effects were identified based upon the description of internal and external environments and material of construction of the system components. The applicant has included all aging effects that are consistent with published literature and industry experience and, thus, the applicable aging effects for waste disposal systems have been properly identified.

3.4.7.2.1 Aging Management Programs

The applicant also identified five AMPs for controlling the effects of aging on the waste disposal systems: chemistry control program, system and structures monitoring program, galvanic corrosion susceptibility inspection program, periodic surveillance and preventive maintenance program and the boric acid wastage surveillance program. The programs were developed from industry-wide data, industry-developed methodologies, NRC documents, and the applicant's own experience. The applicant concluded that these programs will manage the aging effects in such a way that the intended function(s) of the components in the waste disposal systems will be maintained during the period of extended operation, consistent with the CLB, under all design conditions. The staff's detailed evaluations of the programs are found in Sections 3.1.1, 3.1.3, 3.8.5, 3.9.3, and 3.9.11 of this SER.

3.4.7.3 Conclusion

The staff reviewed the information in Sections 2.3.3.7 and 3.4 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that aging effects associated with the waste disposal system will be adequately managed so that there is a reasonable assurance that the system will perform their intended functions in accordance with the CLB throughout the period of extended operation.

3.4.8 Instrument Air

3.4.8.1 Summary of Technical Information in the Application

The applicant described its AMR of the instrument air for license renewal in Section 2.3.3.8, "Instrument Air," and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the instrument air systems will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

Instrument air provides a reliable source of dry, oil-free air for instrumentation and controls and pneumatic valves. Instrument air provides motive power and control air to safety-related and non-safety-related components. Instrument air contains both electric driven and diesel driven air compressors.

Safety-related air-operated valves, normally supplied by instrument air, which are required to operate following design-basis events are provided with backup sources of either air or nitrogen. These backup sources are considered safety-related and were screened with the particular valves they serve.

The flow diagrams listed in Table 2.3-5 of the LRA show the evaluation boundaries for the portions of instrument air that are within the scope of license renewal. Instrument air components that are subject to an AMR include valves (pressure boundary only), flasks/tanks, filters, strainers, heat exchangers, orifices, piping, tubing, and fittings. The intended functions for instrument air components subject to an AMR include pressure boundary integrity, heat transfer, filtration, and throttling. A complete list of instrument air components that require an AMR and the component intended functions appears in Table 3.4-8 of the LRA.

3.4.8.2 Staff Evaluation

The aging effects requiring management in the instrument air system are loss of material for carbon steel, stainless steel, and copper alloy components, as well as fouling for aluminum heat exchanger fins. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

The applicant supplied references pertaining to Turkey Point plant-specific as well as industry-wide experience to support its identification of applicable aging effects for all auxiliary systems identified above. The aging effects were identified based upon the description of internal and external environments and material of construction of the system components. The applicant has included all aging effects that are consistent with published literature and industry experience and, thus, the applicable aging effects for instrument air systems have been properly identified.

3.4.8.2.1 Aging Management Programs

The applicant also identified four AMPs for controlling the effects of aging on the instrument air system: galvanic corrosion susceptibility inspection program, periodic surveillance and preventive maintenance program, system and structures monitoring program, and the boric acid wastage surveillance program. The programs were developed from industry-wide data, industry-developed methodologies, NRC documents, and the applicant's own experience. The applicant concluded that these programs will manage the aging effects in such a way that the intended function(s) of the components in the instrument air systems will be maintained during the period of extended operation, consistent with the CLB, under all design conditions. The staff's detailed evaluations of the programs are found in Sections 3.1.3, 3.8.5, 3.9.3, and 3.9.11 of this SER.

3.4.8.3 Conclusion

The staff reviewed the information in Sections 2.3.3.8 and 3.4 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that aging effects associated with the instrument air system will be adequately managed so that there is a reasonable assurance that the system will perform its intended functions in accordance with the CLB throughout the period of extended operation.

3.4.9 Normal Containment and Control Rod Drive Mechanism Cooling

3.4.9.1 Summary of Technical Information in the Application

The applicant described its AMR of the normal containment and control rod drive mechanism cooling for license renewal in Section 2.3.3.11, "Normal Containment and Control Rod Drive Mechanism Cooling," and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the normal containment and control rod drive mechanism (CRDM) cooling systems will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

Normal containment and control rod drive mechanism cooling provides air circulation and cooling to maintain containment bulk ambient temperature below design limits and to remove heat from the CRDM.

The flow diagrams listed in Table 2.3-5 of the LRA show the evaluation boundaries for the portions of normal containment and CRDM cooling that are within the scope of license renewal.

Normal containment and CRDM cooling components subject to an AMR include heat exchangers, coolers, ductwork, tubing, and fittings. The intended functions for normal containment and CRDM cooling components that are subject to an AMR include pressure boundary integrity, heat transfer, and structural support. A complete list of normal containment and CRDM cooling components that require an AMR and the component intended functions appears in Table 3.4-9 of the LRA.

3.4.9.2 Staff Evaluation

The aging effects requiring management in the normal containment and CRDM cooling are loss of material for carbon steel components; cracking for neoprene and coated canvas flexible connectors; and loss of material and fouling for admiralty brass, stainless steel, and aluminum heat exchanger tubing and fins. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

The applicant supplied references pertaining to Turkey Point plant-specific as well as industry-wide experience to support its identification of applicable aging effects for all auxiliary systems identified above. The aging effects were identified based upon the description of internal and external environments and material of construction of the system components. The applicant has included all aging effects that are consistent with published literature and industry experience and, thus, the applicable aging effects for normal containment and CRDM cooling systems have been properly identified.

3.4.9.2.1 Aging Management Programs

The applicant also identified five AMPs for controlling the effects of aging on the normal containment and CRDM cooling systems: chemistry control program, system and structures monitoring program, galvanic corrosion susceptibility inspection program, periodic surveillance and preventive maintenance program and the boric acid wastage surveillance program. The programs were developed from industry-wide data, industry-developed methodologies, NRC documents, and the applicant's own experience. The applicant concluded that these programs would manage the aging effects in such a way that the intended function of the components in the normal containment and CRDM cooling systems will be maintained during the period of extended operation, consistent with the CLB, under all design conditions. The staff's detailed evaluations of the programs are found in Sections 3.1, 3.8 and 3.9 of this SER.

3.4.9.3 Conclusion

The staff reviewed the information in Sections 2.3.3.9, “Normal Containment and CRDM Cooling,” and 3.4 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that aging effects associated with the normal containment and CRDM cooling will be adequately managed so that there is reasonable assurance that the system will perform the intended functions in accordance with the CLB during the period of extended operation.

3.4.10 Auxiliary Building Ventilation and Electrical Equipment Room Ventilation

3.4.10.1 Summary of Technical Information in the Application

The applicant described its AMR of the auxiliary building ventilation and electrical equipment ventilation systems for license renewal in Section 2.3.3.10, “Auxiliary Building Ventilation,” and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the auxiliary building ventilation systems will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

Auxiliary building ventilation provides adequate heat removal to ensure proper operation of safety-related equipment in the auxiliary building. Auxiliary building ventilation includes electrical equipment room ventilation.

Auxiliary building ventilation is common to both units. The system provides clean air to the operating areas of the auxiliary building and exhausts air from the equipment rooms and open areas of the auxiliary building. Electrical equipment room ventilation is the same for Turkey Point, Units 3 and 4. Electrical equipment room ventilation provides cooling for the electrical equipment room under normal and emergency conditions. During normal operations, non-safety-related chillers maintain the desired room temperature. In the event of a failure of the non-safety-related system or a loss of offsite power, safety-related air conditioners will perform the same function. The flow diagrams listed in Table 2.3-5 of the LRA show the evaluation boundaries for the portions of auxiliary building ventilation and electrical equipment room ventilation that are within the scope of license renewal. Auxiliary building ventilation and electrical equipment room ventilation components subject to an AMR include air handlers (pressure boundary only), damper housings, supply and exhaust fan housings filters, ductwork, tubing, and fitting. The intended function for auxiliary building ventilation and electrical equipment room ventilation components subject to an AMR is pressure boundary integrity. A complete list of auxiliary building ventilation and electrical equipment room ventilation components that require AMR and the component intended functions appears in Table 3.4-10 of the LRA.

3.4.10.2 Staff Evaluation

The aging effects requiring management in the auxiliary building ventilation system are loss of material for carbon steel components and cracking for coated canvas flexible connectors. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

The applicant supplied references pertaining to Turkey Point plant-specific as well as industry-wide experience to support its identification of applicable aging effects for all auxiliary systems identified above. The aging effects were identified based upon the description of internal and external environments and material of construction of the system components. The applicant has included all aging effects that are consistent with published literature and industry experience and, thus, the applicable aging effects for auxiliary building and electrical equipment room ventilation have been properly identified.

3.4.10.2.1 Aging Management Programs

The applicant also identified two AMPs for controlling the effects of aging on the auxiliary building and electrical equipment room ventilation: system and structures monitoring program and the boric acid wastage surveillance program. The programs were developed from industry-wide data, industry-developed methodologies, NRC documents, and the applicant's own experience. The applicant concluded that these programs will manage the aging effects in such a way that the intended function(s) of the components in the auxiliary building and electrical equipment room ventilation will be maintained throughout the period of extended operation, consistent with the CLB, under all design conditions. The staff's detailed evaluations of the programs are found in Sections 3.1.3, and 3.9.3 of this SER.

3.4.10.3 Conclusion

The staff reviewed the information in Sections 2.3.3.10 and 3.4 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that aging effects associated with the auxiliary building ventilation system will be adequately managed so that there is a reasonable assurance that the system will perform its intended functions in accordance with the CLB throughout the period of extended operation.

3.4.11 Control Building Ventilation

3.4.11.1 Summary of Technical Information in the Application

The applicant described its AMR of the control building ventilation systems for license renewal in Section 2.3.3.11 and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the control building ventilation systems will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

Control building ventilation provides a temperature controlled environment to ensure proper operation of equipment in the control building. Control building ventilation is composed of three subsystems: control room ventilation; computer/cable spreading room ventilation; and DC equipment/inverter room ventilation. These subsystems are common for Turkey Point, Units 3 and 4.

Control room ventilation circulates air from the control room and the control room offices through roughing filters to the air handling units. Conditioned air is returned and distributed throughout the control room. Control room ventilation maintains the habitability of the control room following design-basis events. Control room ventilation is described in UFSAR Section 9.9.1.

Computer/cable spreading room ventilation maintains the temperature and humidity requirements of the vital electrical equipment installed in the computer and cable spreading rooms. It also provides sufficient ventilation for intermittent occupancy by operations and maintenance personnel. Computer/cable spreading room ventilation is described in UFSAR Section 9.9.3.

DC equipment/inverter room ventilation provides cooling to the rooms that house the safety-related battery banks, battery chargers, inverters, and DC load centers. DC equipment/inverter room ventilation is described in UFSAR Section 9.9.2.

Control building ventilation components subject to an AMR include air handling units and valves (pressure boundary only), heat exchangers, ductwork, piping, tubing, and fittings. The intended functions for control building ventilation components subject to an AMR include pressure boundary integrity, throttling, and heat transfer. A complete list of control building ventilation components that require an AMR and the component intended functions appears in Table 3.4-11 of the LRA. The AMR for control building ventilation is discussed in Section 3.4 of the LRA.

The control building ventilation system contains various components (e.g., cable spreading room and computer room chilled water surge tanks, cable spreading room and computer room chilled water pumps, cable spreading room and computer room chilled water boxes, wye strainers, thermowells, valves, piping/fittings, level gauges, flow elements, air separators, valves, tubing/fittings, cable spreading room and computer room air handling unit headers, and cable spreading room and computer room air handling unit tubes) fabricated from carbon steel, stainless steel, and/or copper and exposed to treated water. The applicant evaluated the aging effects for carbon steel, stainless steel, and/or copper exposed to treated water in Sections 5 and 6 of Appendices C.5 and C.6 to the LRA and identified several forms of corrosion that may result in loss of material (e.g., general corrosion, pitting, galvanic corrosion, erosion/corrosion, and MIC).

The control building ventilation system contains various components (e.g., cable spreading room and computer room chilled water surge tanks, valves, piping/fittings, level gauges, air separators, cable spreading room and computer room air handling unit air boxes in air handlers, ductwork, and ductwork flexible connectors) fabricated from carbon steel, and/or coated canvas exposed to an air/gas environment. The applicant identified loss of material as the aging effect requiring management for carbon steel, and cracking for coated canvas. The applicant evaluated the aging effects for carbon steel exposed to an air/gas environment in Sections 4, 5, and 6 of Appendix C to the LRA.

3.4.11.2 Staff Evaluation

3.4.11.2.1 Effects of Aging

The control building ventilation system contains various components (e.g., cable spreading room and computer room chilled water surge tanks, cable spreading room and computer room chilled water pumps, cable spreading room and computer room chilled water boxes, wye strainers, thermowells, flow elements, air separators, valves, and tubing/fittings) that are fabricated from carbon steel and exposed to outdoor air environment. The applicant identified loss of material as an aging effect requiring management in an external environment and evaluated the aging effects for carbon steel exposed to an outdoor air environment in Section 7 of the application. The applicant identified several forms of corrosion that may result in loss of material (e.g., general corrosion, pitting, galvanic corrosion, crevice corrosion, and MIC) in Sections 5 and 7 of Appendix C to the LRA.

The control building ventilation system contains ductwork fabricated from galvanized steel exposed to an air/gas environment. The applicant concluded that there are no aging effects requiring management for this material in this environment. The staff agrees there are no aging effects for galvanized steel exposed to an air/gas environment.

The control room ventilation system contains ductwork flexible connectors constructed of coated canvas exposed to an air/gas environment. The applicant identified cracking as the aging effect requiring management for this material in this environment as discussed in Section 6 of Appendix C to the LRA.

The control room ventilation system contains various components (e.g., valves, piping/fittings, thermowells, flow elements, control room ventilation air handling unit housings, control room ventilation recirculation filter housing, inverter room and battery room air handling unit housing, cable room and computer room air handling unit housings, and bolting) fabricated from carbon steel, carbon steel-galvanized and stainless steel exposed to air conditioned air. The applicant did not identify any aging effects requiring management for these components in this environment. The staff agrees that there are no aging effects required for these components in an air conditioned air environment.

The control room ventilation system contains various components (e.g., cable spreading room and room air handling unit headers, cable spreading room and room air handling unit tubes, cable spreading room and room air handling unit air boxes in air handlers, cable spreading room and room air handling unit tube fins) constructed from stainless steel, copper, carbon steel, and aluminum exposed to air conditioned air wetted with condensation. The applicant identified loss of material as the aging effect requiring management for these components in this environment as discussed in Sections 5 and 7 of Appendix C to the LRA.

3.4.11.2.2 Aging Management Programs

To manage corrosion-induced aging effects for carbon steel, stainless steel, and copper exposed to a treated water environment, the applicant relies on the following AMPs:

- chemistry control program
- galvanic corrosion susceptibility program

The chemistry control program manages loss of material, cracking, and fouling aging effects for primary and secondary systems, structures, and components. The aging effects are minimized or prevented by controlling the chemical species that cause the underlying mechanism(s) that results in these aging effects. Alternatively, chemical agents, such as corrosion inhibitors and biocides, are introduced to prevent certain aging mechanisms. The program includes sampling activities and analysis. The program provides assurance that an elevated level of contaminants and oxygen does not exist in the systems, structures, and components covered by the program, and thus prevents and minimizes the occurrences of aging effects. The staff's detailed review of this program is described in Section 3.1.1, "Chemistry Control Program," of this SER.

The galvanic corrosion susceptibility inspection program manages the aging effect of loss of material due to galvanic corrosion on the internal surfaces of susceptible piping and components. The program involves selected, one-time inspections on the internal surfaces of piping and components with the greatest susceptibility to galvanic corrosion. Loss of material is expected mainly in carbon steel components directly coupled to stainless steel components in raw water systems, however, baseline examinations in select systems will be performed and evaluated to establish if the corrosion mechanism is active.

On the basis of the results of these inspections, the need for followup examinations or programmatic corrective actions will be established. The program will be implemented prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff's detailed review of this program is described in Section 3.8.5 of this SER.

To manage corrosion-induced aging effects for carbon steel exposed to an air/gas environment, the applicant relies on the following AMP:

- systems and structures monitoring program

The systems and structures monitoring program manages the aging effects of loss of material, cracking, fouling, loss of seal, and change in material properties. The program provides for periodic visual inspection and examination for degradation of accessible surfaces of specific systems, structures, and components, and corrective actions as required based on these inspections.

This program will be enhanced by restructuring it to address inspection requirements to manage certain aging effects in accordance with 10 CFR 54, modifying the scope of specific inspections, and improving documentation requirements prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff's detailed review of this program is described in Section 3.1.3 of this SER.

To manage corrosion-induced aging effects for carbon steel exposed to an outdoor environment, the applicant relies on the following AMP:

- systems and structures monitoring program
- galvanic corrosion susceptibility inspection program

These programs have been previously discussed.

To manage corrosion-induced aging effects for stainless steel, copper, carbon steel, and aluminum exposed to an air/gas environment wetted with condensation, the applicant relies on the following AMP:

- periodic surveillance and preventive maintenance program

The periodic surveillance and preventive maintenance program manages the aging effects of loss of material, cracking, fouling buildup, loss of seal, and embrittlement for systems, structures, and components. The scope of the program provides for visual inspection and examination of selected surfaces of specific components and structural components. The program also includes leak inspection of limited portions of the chemical and volume control systems. Additionally, the program replacement/refurbishment of selected components is on a specified frequency, as appropriate.

Specific enhancements to the scope and documentation of some inspections performed under this program will be implemented prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff's detailed discussion of this program is found in Section 3.9.11 of this SER.

To manage corrosion-induced aging effects for ductwork flexible connectors exposed to an air/gas environment, the applicant relies on the systems and structures monitoring program. This program is discussed above.

3.4.11.3 Conclusion

The staff has reviewed the information in Section 2.3.3.11, "Control Building Ventilation," and Section 3.4 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the control building ventilation systems will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB throughout the period of extended operation.

3.4.12 Emergency Diesel Generator Building Ventilation

3.4.12.1 Summary of Technical Information in the Application

The applicant described its AMR of the emergency diesel generator building ventilation systems for license renewal in Section 2.3.3.12, "Emergency Diesel Generator Building Ventilation," and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the emergency diesel generator building ventilation systems will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

Emergency diesel generator building ventilation is required to provide cooling functions for the emergency diesel generators and associated equipment. Emergency diesel generator building ventilation is different for Turkey Point, Units 3 and 4. Emergency diesel generator building ventilation is necessary to ensure proper operation of the emergency diesel generators and other safety-related electrical equipment.

Unit 3 emergency diesel generator building ventilation consists of one wall-mounted exhaust fan and associated ductwork for each emergency diesel generator. The fan operates to maintain cooling in the room when its associated emergency diesel generator is running. Unit 4 emergency diesel generator building ventilation includes the following subsystems: emergency diesel generator room ventilation; diesel control room ventilation; and 3d and 4d switchgear room ventilation. Unit 4 emergency diesel generator building ventilation is described in UFSAR Section 8.2.2.1.1.3.

The flow diagrams listed in Table 2.3-5 show the evaluation boundaries for the portions of emergency diesel generator building ventilation that are within the scope of license renewal. Note: there is no flow diagram for Unit 3 emergency diesel generator building ventilation, however, all components associated with this system are in the scope of license renewal. Emergency diesel generator building ventilation is in the scope of license renewal because it contains:

- SCs that are safety-related and are relied upon to remain functional during and following design-basis events

- SCs that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions

- SCs that are relied on during postulated fires, anticipated transients without scram, and station blackout events

Emergency diesel generator building ventilation components subject to an AMR include filters (pressure boundary only), ductwork, tubing, and fittings. The intended function for emergency diesel generator building ventilation components subject to an AMR is pressure boundary integrity. A complete list of emergency diesel generator building ventilation components that require an AMR and the component intended functions is provided in Table 3.4-12 of the LRA. The AMR for emergency diesel generator building ventilation is discussed in Section 3.4 of the LRA.

3.4.12.2 Staff Evaluation

3.4.12.2.1 Effects of Aging

The emergency diesel generator building ventilation contains components (e.g., ductwork and filter housings) fabricated from galvanized carbon steel exposed to a not air conditioned, indoor environment and an air conditioned, indoor environment. The emergency diesel generator building ventilation contains components (e.g., ductwork and filter housings) fabricated from galvanized carbon steel exposed to an air/gas environment. The applicant did not identify any aging effects requiring management for these components in this environment and the staff agrees with this assessment.

The emergency diesel generator building ventilation contains bolting (mechanical closures) fabricated from carbon steel exposed to a not air conditioned, indoor environment and an air conditioned, indoor environment. The applicant did not identify any aging effects requiring management for these components in this environment and the staff agrees with this assessment.

3.4.12.2.2 Aging Management Programs

There are no AMPs for the emergency diesel generator building ventilation because there are no aging effects requiring aging management and the staff agrees with this assessment.

3.4.12.3 Conclusion

The staff has reviewed the information in Section 2.3.3.12 and Section 3.4 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that there are no aging effects associated with the emergency diesel generator building ventilation systems requiring aging management throughout the period of extended operation.

3.4.13 Turbine Building Ventilation

3.4.13.1 Summary of Technical Information in the Application

The applicant described its AMR of the turbine building ventilation systems for license renewal in Section 2.3.3.13, “Turbine Building Ventilation,” and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the turbine building ventilation systems will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

Turbine building ventilation provides a temperature controlled environment to ensure proper operation of equipment in the turbine building. Turbine building ventilation consists of two subsystems, including the load center and switchgear rooms ventilation, and the steam generator feed pump ventilation.

Load center and switchgear rooms ventilation provides a temperature controlled environment for the safety-related 4160V switchgear and 480V load centers, located in the rooms, during normal and emergency conditions. Load center and switchgear rooms ventilation is described in UFSAR Section 9.16. Steam generator feed pump ventilation provides cooling to the steam generator feed pump room. The steam generator feed pump ventilation is non-safety-related, performs no safety-related functions, and is not within the scope of license renewal.

The flow diagrams listed in Table 2.3-5 show the evaluation boundaries for the portions of turbine building ventilation that are within the scope of license renewal. Turbine building ventilation is within the scope of license renewal because it contains the following types of SCs:

- SCs that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions

- SCs that are relied on during postulated fires and station blackout events in the turbine building

Ventilation components that are subject to an AMR include pumps, valves, and air handling units (pressure boundary only), as well as heat exchangers, piping, tubing, and fittings. The intended functions for turbine building ventilation components that are subject to an AMR include pressure boundary integrity, throttling, and heat transfer. A complete list of turbine building ventilation components that require an AMR and the component intended functions appears in Table 3.4-13 of the LRA. The AMR for turbine building ventilation is discussed in Section 3.4 of the LRA.

3.4.13.2 Staff Evaluation

3.4.13.2.1 Effects of Aging

The turbine building ventilation system contains various components (e.g., chilled water surge tanks, chilled water air separators, chilled water pumps, chiller water boxes, valves, piping/fittings, wye strainers, flexible hoses, flow elements, air handling unit headers, and air handling unit heat exchanger tubes) fabricated from carbon steel, stainless steel, or copper and exposed to treated water. The applicant evaluated the aging effects for these materials and environments in Section 5.1 of Appendix C of the LRA and identified several forms of corrosion that may result in loss of material (e.g., general corrosion, pitting, crevice corrosion, galvanic corrosion, and selective leaching). The applicant also identified fouling as an aging effect for the air handling unit heat exchanger tubes as discussed in Section 5.3 of the LRA.

The turbine building ventilation system contains various components (e.g., valves, piping/fittings, level gauges, air handling unit housings, air handling unit air boxes) fabricated from stainless steel and carbon steel exposed to an air/gas (wetted with condensation) environment. The applicant evaluated the aging effects for these materials and environments in Section 5.1 of Appendix C of the LRA. The applicant identified several forms of corrosion that may result in loss of material (e.g., general corrosion, pitting, crevice corrosion, and galvanic corrosion).

The turbine building ventilation system contains various components (e.g., chilled water surge tanks, chilled water air separator, chilled water pumps, chiller water boxes, valves, piping, wye strainers, thermowells, flexible hoses, level gauges, flow elements, and bolting) fabricated from carbon steel and stainless steel and exposed to outside air. The applicant evaluated the aging effects for these materials and environments in Section 5.1 of Appendix C of the LRA. The applicant identified several forms of corrosion that may result in loss of material (e.g., general corrosion, pitting, crevice corrosion, and galvanic corrosion).

The turbine building ventilation system contains various components (e.g., valves, piping/fittings, test wells, flexible hoses, flow elements, air handling unit housings, and bolting) fabricated from carbon steel, galvanized carbon steel, and stainless steel exposed to air conditioned, indoor air. The applicant evaluated the aging effects for these materials and environment in Section 4.2.3 and 7.3 of Appendix C of the LRA and identified no corrosion-related aging effects because sufficient moisture is not present. The staff agrees that there will be no aging effects requiring management of these materials in this environment.

The turbine building ventilation system contains various components (e.g., air handling unit headers, air handling unit heat exchanger tubes, air handling unit air boxes, and air handling unit heat exchanger fins) fabricated from carbon steel, copper, and aluminum exposed to air conditioned inside air wetted with condensation. The applicant evaluated the aging effects for these materials and environment in Sections 4.2.3 and 7.3 of Appendix C of the LRA and identified several forms of corrosion that may result in loss of material (e.g., general corrosion, pitting, crevice corrosion, and galvanic corrosion.)

3.4.13.2.2 Aging Management Programs

To manage corrosion-induced aging effects for carbon steel, copper, and stainless steel exposed to a treated water environment, the applicant relies on the following AMPs:

- chemistry control program
- galvanic corrosion susceptibility inspection program

The chemistry control program manages loss of material, cracking, and fouling aging effects for primary and secondary systems, structures, and components. The aging effects are minimized or prevented by controlling the chemical species that cause the underlying mechanism(s) that result in these aging effects. Alternatively, chemical agents, such as corrosion inhibitors and biocides, are introduced to prevent certain aging mechanisms. The program includes sampling activities and analysis. The program provides assurance that an elevated level of contaminants and oxygen does not exist in the systems, structures, and components covered by the program and, thus, prevents and minimizes the occurrences of aging effects.

The galvanic corrosion susceptibility inspection program manages the aging effect of loss of material due to galvanic corrosion on the internal surfaces of susceptible piping and components. The program involves selected, one-time inspections on the internal surfaces of piping and components with the greatest susceptibility to galvanic corrosion. Loss of material is expected mainly in carbon steel components directly coupled to stainless steel components in raw water systems, however, baseline examinations in select systems will be performed and evaluated to establish if the corrosion mechanism is active. On the basis of the results of these inspections, the need for followup examinations or programmatic corrective actions will be established. The program will be implemented prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff's detailed evaluations of the programs are found in Sections 3.1.1, and 3.8.5 of this SER.

To manage corrosion-induced aging effects for carbon steel exposed to an air/gas environment, the applicant relies on the following AMP:

- systems and structures monitoring program

The systems and structures monitoring program manages the aging effects of loss of material, cracking, fouling, loss of seal, and change in material properties. The program provides for periodic visual inspection and examination for degradation of accessible surfaces of specific systems, structures, and components, and corrective actions as required based on these inspections.

This program will be enhanced by restructuring it to address inspection requirements to manage certain aging effects in accordance with 10 CFR Part 54, modifying the scope of specific inspections, and improving documentation requirements prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff's detailed evaluation of this program is found in Section 3.1.3 this SER.

To manage corrosion-induced aging effects for carbon steel exposed to an outside air environment, the applicant relies on the following AMPs:

- systems and structures monitoring program
- galvanic corrosion susceptibility inspection program

These programs are discussed above.

To manage corrosion-induced aging effects for carbon steel, copper, and aluminum exposed to an air conditioned inside air wetted with condensation environment, the applicant relies on the following AMP:

- periodic surveillance and preventive maintenance program

The periodic surveillance and preventive maintenance program manages the aging effects of loss of material, cracking, fouling buildup, loss of seal, and embrittlement for systems, structures, and components. The scope of the program provides for visual inspection and examination of selected surfaces of specific components and structural components. The program also includes leak inspection of limited portions of the chemical and volume control systems. Additionally, the program provides for replacement/refurbishment of selected components on a specified frequency, as appropriate. Specific enhancements to the scope and documentation of some inspections performed under this program will be implemented prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff's detailed evaluation of this program is found in Sections 3.9.11 of this SER.

3.4.13.3 Conclusion

The staff has reviewed the information in Section 2.3.3.13 and Section 3.4 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the turbine building ventilation systems will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB throughout the period of extended operation.

3.4.14 Fire Protection

3.4.14.1 Summary of Technical Information in the Application

The applicant described its AMR of the fire protection system for license renewal in Section 2.3.3.14, “Fire Protection” and Section 3.4, “Auxiliary Systems,” of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the fire protection systems will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

Fire protection protects plant equipment in the event of a fire, to ensure safe plant shutdown, and minimizes the risk of a radioactive release to the environment. Fire protection consists of fire water supply including sprinklers, Halon suppression, fire dampers, RCP oil collection, alternate shutdown, safe shutdown, and fire detection and protection. Individual components that constitute alternate shutdown and safe shutdown were screened with their respective systems. Fire detection and protection was screened with electrical and instrumentation and controls (see Section 2.5). Fire protection is described in UFSAR Appendix 9.6A. The majority of fire protection is common to Units 3 and 4.

The flow diagrams listed in Table 2.3-5 show the evaluation boundaries for the portions of fire protection that are within the scope of license renewal. Fire protection is within the scope of license renewal because it contains the following types of SCs:

- SCs that are safety-related and are relied upon to remain functional during and following design-basis events

- SCs that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions

- SCs that are relied on during postulated fires

Fire protection components subject to an AMR include the raw water tanks, pumps and valves (pressure boundary only), tanks, heat exchangers, hose stations, flame arrestors, sprinklers, strainers, orifices, piping, tubing, and fittings. The intended functions for fire protection components subject to an AMR are pressure boundary integrity, heat transfer, filtration, throttling, fire spread prevention, and spray. A complete list of the fire protection components that require an AMR and the component intended functions appears in Tables 3.4-14 and 3.6-12 of the LRA. The aging management reviews for fire protection are discussed in Sections 3.4 and 3.6.2. Fire extinguishers, fire hoses, and air packs are not subject to an AMR because they are replaced based on conditions in accordance with National Fire Protection Association (NFPA) standards and plant surveillance procedures for fire protection equipment. This position is consistent with the NRC staff's guidance on consumables provided in the NRC's March 10, 2000, letter to NEI.

3.4.14.2 Staff Evaluation

The fire protection system contains various components [e.g., basket strainers (body), basket strainers (elements) orifices, valves, piping/fittings, sprinkler heads, tubing/fittings, flexible hoses, tanks, pumps and flow restriction orifices] that are fabricated from either cast iron, stainless steel, carbon steel, galvanized carbon steel, or copper alloys exposed to raw city water. The applicant evaluated the aging effects for these materials and environment in Sections 5 and 6.2 of Appendix C to the LRA. The applicant identified several forms of corrosion that may result in loss of material. Loss of material due to general corrosion is an aging effect requiring management for cast iron and carbon steel in raw water environments. Loss of material due to pitting corrosion is an aging effect requiring management for aluminum bronze, carbon steel, cast iron, monel, and stainless steel in raw water environments. Loss of material due to galvanic corrosion is an aging effect requiring management for carbon steel and cast iron in raw water environments when coupled with materials having higher electrical potential. Loss of material due to crevice corrosion and MIC are aging effects requiring management for carbon steel, cast iron, copper-nickel, and stainless steel in raw water environments. Loss of material due to selective leaching is an aging effect requiring management for aluminum bronze and gray cast iron in raw water environments.

The fire protection system contains components (e.g., valves, piping/fittings, sprinkler heads, and flame arrestors) fabricated from carbon steel, stainless steel, galvanized carbon steel, cast iron, and copper alloy components exposed to an air/gas environment. The applicant evaluated the aging effects for these materials in Sections 4.1.3 and 6.3 of Appendix C to the LRA. Loss of material due to general corrosion is an aging effect requiring management for carbon steel and cast iron in an atmospheric air/gas environment. The applicant did not identify any aging effects for stainless steel, galvanized steel and copper alloy components.

The fire protection system contains valves, piping/fittings, tubing/fittings, tanks, oil collection enclosures and flexible hoses constructed from carbon steel and stainless steel exposed to lubrication oil or air/gas with an oil film. The applicant evaluated the aging effects for these material in Section 6.5 of Appendix C to the LRA and identified no corrosion-related aging effects because of the presence of the oil film. The staff agrees that there are no aging effects requiring aging management.

The fire protection system contains various components (e.g., raw water tanks, diesel-driven fire pump fuel oil tank, electric fire pump, basket strainer, bodies, valves, piping/fittings, flexible hoses, sprinkler heads, flow restriction orifices, and flame arrestors) fabricated from carbon steel, cast iron, galvanized carbon steel, copper alloy, and stainless steel exposed to an outdoor environment. The applicant evaluated the aging effects for these materials and environment in Section 7.0 of the LRA. Loss of material due to general corrosion is an aging effect requiring management for low alloy steel, carbon steel, and cast iron in outdoor environments. Loss of material due to pitting corrosion is an aging effect requiring management for low alloy steel, carbon steel, and cast iron in outdoor environments.

The fire protection system contains a reactor coolant pump oil collection tank, valve, piping/fittings, tubing/fittings, enclosures and drip pans, and flexible hoses fabricated from carbon steel and stainless steel exposed to containment air. The applicant evaluated the aging effects in Section 7.4.3.1 of Appendix C to the LRA and identified several forms of corrosion that may result in loss of material. Loss of material due to general corrosion is an aging effect requiring management for carbon steel in containment environments when wetted. Loss of material due to pitting corrosion is an aging effect requiring management for carbon steel in containment environments. Corrosion is an aging effect requiring management for carbon steel when wetted in containment environments.

The fire protection system contains a reactor coolant pump oil collection tank, valves, piping/fittings, and bolting fabricated from carbon steel exposed to borated water leaks. The applicant evaluated the aging effects for these components and environment in Section 7.5 of Appendix C of the LRA. The applicant identified severe chemical attack that could lead to loss of material for these components. In addition, severe chemical attack of the bolting in bolted connections could lead to loss of mechanical closure integrity.

The fire protection system contains a diesel fire pump heat exchanger shell and cover (radiator), valves, piping and fittings, expansion joints, tubing/fittings, and flexible hoses fabricated using carbon steel, cast iron, copper alloy, stainless steel, and rubber exposed to not air conditioned indoor air. The applicant evaluated the aging effects for these materials and environment in Section 7.2 of Appendix C to the LRA. Loss of material due to general corrosion is an aging effect requiring management for carbon steel and cast iron in non-air conditioned indoor environments. Loss of material due to pitting corrosion is an aging effect requiring management for carbon steel and cast iron in non-air conditioned indoor environments. The applicant identified cracking as the aging effect for rubber in this environment. The applicant did not identify any aging effects for stainless steel and copper alloys.

The fire protection system contains valves, piping, and fittings fabricated from cast iron and carbon steel and exposed to a buried environment. The applicant evaluated the aging effects for these materials and this environment in Section 7 of Appendix C of the LRA. Loss of material due to general corrosion is an aging effect requiring management for carbon steel and cast iron in buried environments. Loss of material due to crevice and pitting corrosion, MIC and selective leaching is an aging effect requiring management for carbon steel and cast iron in buried environments.

In RAI 2.3.3.14, the staff identified that neither the Halon suppression system components nor the Halon suppression system as a whole appeared to be included in Tables 3.4-14 or 3.6-12 of the LRA. The components which appeared to be missing from the table include, but are not limited to, Halon cylinders, Halon nozzles, nitrogen cylinders, Halon piping, pilot heads, pilot lines, pilot valve bodies, and auxiliaries. The staff requested that these components be included in the scope of license renewal. The staff also requested that the applicant provide a discussion if these components should be subject to an AMR and justification for those components that are not subject to an AMR.

The applicant responded that Halon Suppression is included as part of Fire Protection in Subsection 2.3.3.14 of the LRA. All Halon Suppression components, as depicted on drawing 0-FP-08, were determined to perform or support license renewal system intended functions and are within the scope of license renewal. Except for nitrogen and Halon cylinders, Halon nozzles, and flexible hoses, all components of Halon Suppression were included in an aging management review.

Nitrogen cylinders are monitored routinely and replaced based on condition replacement criteria, therefore, nitrogen cylinders are considered short-lived and do not require an aging management review.

Halon cylinders and flexible hoses are also monitored and/or inspected on a specified frequency, however, the Halon cylinders and flexible hoses are not normally replaced. Therefore, the Halon cylinders and flexible hoses are not short-lived and should have been included in an aging management review. Additionally, the Halon nozzles were inadvertently omitted from Table 3.4-14 of the LRA.

In the response to RAI 2.3.314-14, the applicant identified that the fire protection system contains additional component (e.g., Halon cylinders, flexible hoses and Halon nozzles) fabricated of carbon steel, wire reinforced rubber and aluminum, exposed to an internal air/gas environment. The applicable external environments for these components are outdoor air for the Halon cylinders and flexible hoses and indoor-air conditioned air for the Halon nozzles. The applicant evaluated the aging effects of these materials and concluded that cracking due to embrittlement is an aging effect requiring management for wire reinforced rubber in an internal atmospheric air/gas environment. The applicant did not identify any aging effects for carbon steel and aluminum components exposed to an internal air/gas environment. The applicant concluded that loss of material due to general and pitting corrosion is an aging effect requiring management for carbon steel Halon cylinders exposed externally to an outdoor air environment. Cracking due to embrittlement is an aging effect requiring management for wire reinforced rubber exposed externally to an outdoor air environment. The applicant did not identify any aging effects for aluminum Halon nozzles exposed to an external indoor-air conditioned environment.

Additionally, in the response to RAI 2.3.3.14-4, the applicant identified that Table 3.4-14 of the LRA should have included the aging management review results for valves and piping/fittings exposed to an external environment of “indoor-air conditioned.” These components are fabricated of copper alloys and galvanized carbon steel. The applicant did not identify any aging effects for these components.

In RAI 2.3.3.14-6, the staff indicated that Fire Protection License Renewal Boundary Drawing 0-FP-03, showed the fire water jockey pumps in the scope of license renewal. The pump casings were not included in the list of components identified in the scope of license renewal (Table 3.4-14). The staff requested that the applicant clarify this apparent discrepancy between the drawings and the LRA.

The applicant responded that the fire water jockey pumps were screened within the scope of LR and require and AMR. These pumps were inadvertently omitted from LRA Table 3.4-14. The response to RAI 2.3.3.14-6 indicated that the jockey pumps are fabricated of cast iron and are exposed internally to raw water - city water and externally to an outdoor air environment. The applicant concluded that loss of material due to general corrosion, crevice corrosion, pitting corrosion, MIC, selective leaching and galvanic corrosion is an aging effect requiring management for cast iron exposed to an internal environment of raw water - city water. Additionally loss of material due to general and pitting corrosion in an aging effect requiring aging management for cast iron exposed to an external outdoor air environment.

3.4.14.2.1 Aging Management Programs

To manage corrosion-induced aging effects for cast iron, stainless steel, carbon steel, galvanized steel, and copper alloys exposed to raw city water, the applicant relies on the following AMPs:

- fire protection program
- galvanic corrosion susceptibility inspection program

The fire protection program manages the aging effects of loss of material, cracking, and fouling for the components/piping of the fire protection system and fire rated assemblies. Additionally, this program manages the aging effects of loss of material, loss of seal, cracking, and erosion for structures and structural components associated with fire protection. UFSAR Appendix 9.6A contains a detailed discussion of the fire protection program. The scope of the fire protection program will be enhanced to include inspection of additional components prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff's detailed evaluations of these programs are found in Sections 3.9.8 of this SER.

The galvanic corrosion susceptibility inspection program manages the aging effects of loss of material due to galvanic corrosion on the internal surfaces of susceptible piping and components. The program involves selected, one-time inspections of the internal surfaces of piping and components with the greatest susceptibility to galvanic corrosion. Loss of material is expected mainly in carbon steel components directly coupled to stainless steel components in raw water systems, however, baseline examinations in select systems will be performed and evaluated to establish if the corrosion mechanism is active. On the basis of the results of these inspections, the need for followup examinations or programmatic corrective actions will be established. The program will be implemented prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff's detailed review of this program is described in Section 3.8.5 of this SER.

To manage corrosion-induced aging effects for cast iron and carbon steel exposed to air/gas environment, the applicant relies on the AMP for the fire protection program. The fire protection program is described above and in Section 3.9.8 of this SER.

To manage corrosion-induced aging effects for cast iron and carbon steel exposed to outdoor environment, the applicant relies on the AMP for the fire protection program. The fire protection program is described above and in Section 3.9.8 of this SER.

To manage corrosion-induced aging effects for carbon steel exposed to a containment air environment, the applicant relies on the following AMP:

- periodic surveillance and preventive maintenance program

The periodic surveillance and preventive maintenance program manages the aging effects of loss of material, cracking, fouling buildup, loss of seal, and embrittlement for systems, structures, and components. The scope of the program provides for visual inspection and examination of selected surfaces of specific components and structural components.

Additionally, the program provides for replacement/refurbishment of selected components on a specified frequency, as appropriate.

Specific enhancements to the scope and documentation of some inspections performed under this program will be implemented prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff's detailed evaluation of this program is found in Section 3.9.11 of this SER.

To manage corrosion-induced aging effects for carbon steel exposed to borated water leaks, the applicant relies on the following AMP:

- boric acid wastage surveillance program

The boric acid wastage surveillance program manages the aging effects of loss of material and mechanical closure integrity due to aggressive chemical attack resulting from borated water leaks. The program addresses the reactor coolant system and structures and components containing, or exposed to, borated water. This program utilizes systematic inspections, leakage evaluations, and corrective actions to ensure that boric acid corrosion does not lead to degradation of pressure boundary or structural integrity of components, supports, or structures, including electrical equipment in proximity to borated water systems. This program includes commitments to NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants."

Some systems outside containment (i.e., SFP cooling and portions of waste disposal associated with containment integrity) are currently inspected under other existing programs. The scope of the boric acid wastage surveillance program will be enhanced to include these systems and components prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff's detailed evaluation of this program is found in Section 3.9.3 of this SER.

To manage corrosion-induced aging effects for carbon steel and cast iron exposed to not-air conditioned indoor air environment, the applicant relies on the following AMP:

- fire protection program

The fire protection program is described above.

To manage corrosion-induced aging effects for carbon steel and cast iron exposed to a buried environment, the applicant relies on the following AMP:

- fire protection program

The fire protection program is described above.

3.4.14.3 Conclusion

The staff has reviewed the information in Sections 2.3.3.14 and 3.4 of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the fire protection systems will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB throughout the period of extended operation.

3.4.15 Emergency Diesel Generators and Support Systems

3.4.15.1 Summary of Technical Information in the Application

The applicant described its AMR of the emergency diesel generators and support systems for license renewal in Section 2.3.3.15, "Emergency Diesel Generators and Support Systems," and Section 3.4 of the LRA. The staff reviewed these sections of the LRA to determine whether the applicant has demonstrated that the effects of aging on the emergency diesel generators and support systems will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

The emergency diesel generators provide AC power to the onsite electrical distribution system to ensure the capability for a safe and orderly shutdown. The following emergency diesel generators support systems are necessary to ensure proper operation of the emergency diesel generators:

- air intake and exhaust
- air start
- fuel oil
- cooling water
- lube oil

The emergency diesel generators are described in UFSAR Section 8.2.2.1.1.1 and the emergency diesel generators support systems are described in Section 9.15. The Unit 3 emergency diesel generator fuel oil storage tank is a free-standing steel tank. The Unit 4 emergency diesel generator fuel oil storage tank is a concrete structure with a steel liner that is an integral part of the Unit 4 emergency diesel generator building. The flow diagrams listed in Table 2.3-5 show the evaluation boundaries for the portions of emergency diesel generators and support systems (EDGASS) that are within the scope of license renewal. Emergency diesel generators and support systems are in the scope of license renewal because they contain the following types of SCs:

- SCs that are safety-related and are relied upon to remain functional during and following design-basis events

- SCs that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions

- SCs that are relied on during postulated fires, anticipated transients without scram, and station blackout events

Emergency diesel generators and support systems components subject to an AMR include two diesel oil storage tanks, pumps and valves (pressure boundary only), tanks, heat exchangers, flame arrestors, filters, strainers, piping, tubing, and fittings. The intended functions for emergency diesel generators and support systems components subject to an AMR include pressure boundary integrity, filtration, heat transfer, throttling, and fire spread prevention. A complete list of the emergency diesel generators and support systems components that require an AMR and component intended functions appears in Table 3.4-15 of the LRA. The AMR for the emergency diesel generators and support systems are discussed in Section 3.4 of the LRA.

3.4.15.2 Staff Evaluation

The emergency diesel generators and support systems contain various components (e.g., exhaust piping/fittings, silencers, air filter assemblies, expansion joints, tubes/fittings, air start accumulators, air start motors, air start system lubricators, valves, governor bypasses, filters, flexible hose, Unit 4 diesel oil storage tank liner, emergency diesel generator fuel oil pumps, diesel oil skid tanks, sight glasses, flexible couplings, air start piping/fittings, day tanks, Unit 3 diesel oil storage tanks and flame arrestors) fabricated either from carbon steel, galvanized steel, stainless steel, copper alloy, cast iron, aluminum, rubber, or rubber braided hoses that are exposed to an air/gas environment. The applicant evaluated the aging effects for these materials and environments in Sections 5 and 6 of Appendix C to the LRA and identified several forms of corrosion that may result in loss of material or cracking.

The EDGASS contains various components (e.g., exhaust piping/fittings, bolting, Unit 3 diesel oil storage tank, Unit 3 emergency diesel generator fuel oil pumps, various valves, piping/fittings silencers, tubing/fittings, and flame arrestors) that are fabricated from carbon steel, cast iron, and stainless steel exposed to outside air. The applicant evaluated the aging effects for these materials and environments in Sections 5 and 6 of Appendix C to the LRA, and identified several forms of corrosion that may result in loss of material.

The EDGASS contains various components (e.g., exhaust piping/fittings, silencers, air filter assemblies, expansion joints, flexible couplings, tubing/fittings, bolting, air start accumulators, air start motors, air start system lubricators, governor bypasses, flexible hoses, diesel oil day tanks, diesel oil skid tanks, Unit 3 emergency diesel generator fuel oil pumps, sight glasses, filters, diesel generator cooling water expansion tanks, diesel generator cooling water pumps, diesel generator cooling water immersion heaters, radiator water boxes, radiator tubes, orifices, diesel lube oil pumps, heat exchanger shells, and heat exchanger channel heads) that are fabricated from carbon steel, galvanized steel, cast iron, stainless steel, aluminum alloy, copper, copper alloy, and rubber exposed to not-air conditioned indoor air. The applicant evaluated the aging effects for these materials and environment in Sections 5 and 6 of Appendix C to the LRA and identified loss of material for carbon steel, copper alloys, and cast iron and cracking for stainless steel and rubber as the aging effects. No aging effects were identified for galvanized steel, copper alloy or aluminum alloy components. In several cases, the applicant identified no aging effects for carbon steel and stainless steel components when exposed to not-air conditioned indoor air. In addition, in Table 3.4-15 (page 3.4-87) of the LRA, the applicant shows that stainless steel exposed to not-air conditioned indoor air has the aging effect of loss of material. These aging effects are not consistent and needed to be explained. The applicant provided an explanation for these inconsistencies in letter L-2001-50, dated March 22, 2001. Carbon steel exposed to exhaust air/gas has the potential aging effect of loss of material due to general corrosion, crevice corrosion, and pitting because exhaust gases contain moisture and other potential contaminates the staff found the explanation adequate. Stainless steel exposed to ambient air/gas has no aging effect. Stainless steel, carbon steel, galvanized carbon steel, aluminum, and copper alloys exposed to a compressed air/gas environment has no aging effect. Carbon steel exposed to an air/gas environment in an enclosed area with diesel fuel oil vapor has no aging effect since the fuel oil vapor will prevent corrosion. Stainless steel expansion joints exposed to exhaust gas/air are subject to cracking due to fatigue. The cracking is minor and is managed by periodic inspection. The carbon steel in the diesel oil storage tank is subject to temperature fluctuations that may result in condensation on the inside of the tank. However, due to the size of the tank, the oil vapor may not provide protection against corrosion. Therefore, the applicant listed loss of material as a potential aging effect for the Unit 3 diesel oil storage tank.

The EDGASS contains various components (e.g., Unit 3 diesel oil storage tank, Unit 4 diesel oil storage tank liner, Unit 3 emergency diesel generator fuel oil pumps, diesel oil day tanks, diesel oil skid tanks, valves, piping/fittings, sight glasses, flex hoses, filters, and tubing) that are fabricated from carbon steel, cast iron, copper, and stainless steel exposed to fuel oil. The applicant evaluated the aging effects for these materials and environment in Sections 5 and 6 of Appendix C to the LRA and identified MIC that may lead to loss of material.

The EDGASS contains various components (e.g., diesel generator cooling water expansion tanks, diesel generator cooling water pumps, diesel generator cooling water immersion heaters, radiator water boxes, radiator tubes, valves, piping/fittings, tubing/fittings, flexible hoses, orifices, sight glasses, and heat exchanger channel heads) that are fabricated from carbon steel, cast iron, stainless steel, red brass, and copper alloy exposed to a treated water environment. The applicant evaluated the aging effects for these materials and environment in Sections 5 and 6 of Appendix C to the LRA, and identified several forms of corrosion that could lead to loss of material (e.g., general corrosion, pitting, and MIC for carbon steel and cast iron, and pitting for copper alloy and stainless steel).

The EDGASS contains the Unit 4 diesel oil storage tank liner constructed of carbon steel exposed to an embedded/encased environment. The applicant evaluated the aging effects for carbon steel in an embedded/encased environment in Section 7.7 of Appendix C to the LRA, and did not identify any aging effects.

The EDGASS contains various components (e.g., diesel generator lube oil pumps, heat exchanger shells, heat exchanger tubing, valves, piping/fittings, flexible hoses, sight glasses, filters, tubing/fittings, and orifices) that are constructed from carbon steel, cast iron, red brass, and stainless steel exposed to lubricating oil. The applicant evaluated the aging effects for these materials exposed to lubricating oil in Section 6.5 of Appendix C of the application and did not identify any aging effects requiring management.

3.4.15.2.2 Aging Management Programs

Emergency Diesel Generators and Support Systems

To manage corrosion-induced aging effects for carbon steel, stainless steel, and rubber exposed to an air/gas environment, the applicant relies on the following AMP:

- periodic surveillance and preventive maintenance program

The periodic surveillance and preventive maintenance program is credited for managing the aging effects of loss of material, cracking, fouling, loss of seal, and embrittlement for structures, systems, and components within the scope of license renewal. This program provides for visual inspection of selected surfaces of specific components and structural components, or alternatively their replacement/ refurbishment during the performance of periodic surveillance and preventive maintenance activities. The program also includes leak inspections of limited portions of the chemical and volume control systems. The staff's detailed evaluation of this program is found in Section 3.9.11 of this SER.

To manage corrosion-induced aging effects for carbon steel exposed to outdoor air, the applicant relies on the following AMP:

- periodic surveillance and preventive maintenance program
- systems and structures monitoring program

This program is described above.

To manage corrosion-induced aging effects for carbon steel, cast iron, stainless steel, and rubber exposed to not-air conditioned indoor air, the applicant relies on the following AMPs:

- periodic surveillance and preventive maintenance program
- systems and structures monitoring program

The periodic surveillance and preventive maintenance program has been previously discussed.

The systems and structures monitoring program manages the aging effects of loss of material, cracking, fouling, loss of seal, and change in material properties for selected systems, structures, and components within the scope of license renewal. The program provides for visual inspection and examination of accessible surfaces of specific systems, structures, and components, including welds and bolting. Aging management of structural components that are inaccessible for inspection is accomplished by inspecting accessible structural components with similar materials and environments for aging effects that may be indicative of aging effects for inaccessible structural components. For example, rust bleeding on an accessible surface of a concrete structure may be indicative of corrosion of inaccessible reinforcing steel embedded in the concrete.

This program will be enhanced by restructuring it to address inspection requirements to manage certain aging effects in accordance with 10 CFR Part 54, modifying the scope of specific inspections, and improving documentation requirements. The staff's detailed evaluation of this program is found in Section 3.1.3 of this SER.

To manage corrosion-induced aging effects for carbon steel, cast iron, stainless steel, and copper and exposed to fuel oil, the applicant relies on the following AMPs:

- chemistry control program
- periodic surveillance and preventive maintenance program

The chemistry control program is credited for managing the aging effects of loss of material, cracking, and fouling buildup for the internal surfaces of primary and secondary systems and structures. The program includes sampling activities and analysis for treated water—primary, treated water—borated, treated water—secondary, treated water, and fuel oil.

The periodic surveillance and preventive maintenance program has been previously described.

To manage corrosion-induced aging effects for carbon steel, cast iron, stainless steel, and copper alloy exposed to treated water, the applicant relies on the following AMPs:

- chemistry control program
- Unit 3 - periodic surveillance and preventive maintenance program
- Unit 4 - galvanic corrosion susceptibility inspection program

The chemistry control program and the periodic surveillance and preventive maintenance program have already been described. The staff's detailed evaluations of these programs are found in Sections 3.1.1 and 3.8.5 of this SER.

The galvanic corrosion susceptibility inspection program will manage the potential effects of loss of material due to galvanic corrosion on the internal surfaces of susceptible piping and components. Carbon steel components directly coupled to stainless steel components in raw water systems at Turkey Point are the most susceptible to galvanic corrosion. However, baseline examinations in select systems will be performed and evaluated to establish if the corrosion mechanism is active. The program will involve selected one-time inspections, the results of which will be utilized to determine the need for additional actions. The staff's detailed evaluation of this program is found in Section 3.8.5 of this SER.

3.4.15.3 Conclusion

The staff has reviewed the information in Sections 2.3.3.15 and 3.4 of the LRA and applicant's responses to the staff's RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the emergency diesel generators and support systems will be adequately managed so that there is reasonable assurance that these systems will perform their intended functions in accordance with the CLB throughout the period of extended operation.

3.4.16 General

3.4.16.1 Thermal Fatigue

The applicant did not identify cracking due to thermal fatigue as an aging effect requiring management in Section 3.4.2 for the auxiliary system components. However, the applicant identified thermal fatigue for piping systems designed to the requirements of ANSI B31.1 as a time limited aging analysis (TLAA) in Section 4.3.4 of the LRA. The staff's evaluation of that TLAA is in Section 4.3 of this SER, and aging effect due to thermal fatigue, as it applies to auxiliary system components, will not be discussed further in this section of the SER.

3.4.16.2 Mechanical Closure Integrity

In Section 5.4 of Appendix C of the LRA, the applicant stated that the loss of mechanical closure integrity is an aging effect associated with bolted mechanical closures that can result from the loss of preload due to cyclic loading, gasket creep, thermal or other effects, cracking, or loss of bolting material. The applicant further stated that the effects of the mechanisms associated with loss of preload are the same as that of a degraded gasket; that is, the potential for external leakage of the internal fluid at the mechanical joint. However, the applicant stated that with the exception of the situation where a gasket/seal is utilized to provide a radiological boundary/barrier, the aging mechanisms associated with loss of preload are not considered to require management for non-Class 1 components during the period of extended operation. Furthermore, the applicant stated that it utilizes the proper bolt torquing procedures to prevent loss of preload. Furthermore, leakage of auxiliary systems mechanical joints due to loss of preload has not been a significant issue at Turkey Point. The applicant concluded that there are no aging effects associated with loss of preload resulting from settling, relaxation after cyclic loading, gasket creep, and temperature effects in the auxiliary systems during the period of extended operation. On the basis of the information provided by the applicant, the staff agrees that loss of preload is not a significant issue at Turkey Point for mechanical joints in the auxiliary systems.

Loss of bolting material can result in a loss of components pressure boundary integrity. Most carbon steel bolting is in a dry environment and coated with a lubricant; thus, general corrosion of bolting has not been a major concern in the industry. Corrosion of fasteners has only been a concern, when leakage of a joint occurs, specifically, when bolting is exposed to boric acid. Loss of mechanical closure integrity due to boric acid corrosion was considered a potential aging effect for components in proximity, to borated water systems.

Susceptibility to cracking due to SCC of bolting material is controlled by yield strength and minimizing contaminants. Therefore, no AMP was required for cracking of bolting.

3.4.16.3 Ventilation Systems Flexible Connectors

Several ventilation systems included in Section 3.4 of the LRA contain flexible connectors (rubber, neoprene, or coated canvas materials). The ductwork in the heating, ventilation, and air conditioning (HVAC) system typically includes isolators (such as flexible connectors between ducts and fans) to prevent transmission of vibration and dynamic loading to the rest of the system. Those isolators may degrade (e.g., hardening and cracking) because of relative motion between vibrating equipment, warm moist air, temperature changes, oxygen, and radiation. In Section 5.2 of Appendix A to the LRA, the applicant stated that embrittlement is an aging mechanism that could cause cracking of rubber, neoprene, or coated canvas materials. To manage that aging effect, the applicant relies on the visual inspection included in two AMPs, periodic surveillance and preventive maintenance program, and systems and structures monitoring program described in LRA Appendix B, Sections 3.2.11 and 3.2.15, respectively. Both programs do not provide a description of the inspection schedule (frequency). In a letter dated February 2, 2001, the staff requested the applicant to describe the frequency of the subject visual inspection. Also, the applicant is requested to demonstrate the adequacy of that inspection frequency and method to ensure that aging degradation will be detected before there is loss of intended functions. The applicant responded to this RAI in a letter dated March 22,

2001. The applicant stated that the ductwork flexible connectors for HVAC system within the scope of license renewal are visually inspected on a 5-year frequency, except for the flexible connectors for the normal containment coolers. The visual inspection of the flexible connectors for the normal containment coolers is included as part of an 18-month preventive maintenance task for these coolers. The applicant further stated that these inspection frequencies are appropriate, based on the environment (ambient air) that the connectors are exposed to and the operating history of these components at Turkey Point. The applicant also stated that the frequency of these inspections may be adjusted as necessary, based on future inspection results and industry experience. The staff concurs with this response. The staff's detailed evaluations of periodic surveillance and preventive maintenance program and systems and structures monitoring program are discussed separately in Sections 3.9.11 and 3.1.3 of this SER.

3.4.16.4 Scoping Issues Related to Aging Management Programs for Auxiliary Systems

The scoping requirements of 10 CFR 54.4(a)(2) include all non-safety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1)(i), (ii), or (iii). In Section 2.1.1.3 of the LRA, the applicant stated that Turkey Point, Units 3 and 4, were not originally licensed for "seismic II over I." However, "seismic II over I" was considered for license renewal scoping. In a letter dated February 2, 2001, the staff requested that the applicant clarify whether the scope of the auxiliary systems discussed in Section 3.4 of the LRA includes any seismic II over I piping. In addition, the applicant requested to clarify how the AMPs for those piping systems including their supports have been addressed. Specifically, the staff asked whether the same AMPs discussed in tables included in LRA Section 3.4 also apply to those seismic II over I piping components. The applicant responded to this RAI in letters dated March 22, and May 3, 2001. The applicant stated those piping supports for non-safety-related systems with the potential of "seismic II over I" interactions with safety-related components were identified as within the scope of license renewal. Piping for these non-safety-related systems, however, was not identified as within the scope of license renewal. The applicant also stated that the Turkey Point CLB does not require the assumption of collapse and/or deformation of non-safety-related piping under seismic loading. However, non-safety-related piping system and their supports were designed, manufactured, and installed in accordance with recognized conventional practice. The applicable codes and standards were established based on conservative criteria resulting in design stresses well within the yield strength of the materials during maximum postulated loading conditions. In addition, non-safety-related piping systems are maintained in good, essentially leak tight, operating condition, especially in the areas where safety-related components are located. System engineer walkdowns and operator rounds are performed in accordance with plant administrative, engineering, operation, and Maintenance Rule procedures. Current procedures require system engineers to perform walkdowns at least quarterly (and in some cases monthly) of their assigned systems. Operator rounds are performed at least daily, and are specifically designed to route operators through most areas of the plant to observe system operating conditions. Although not anticipated, significant degradation of non-safety-related piping would be promptly identified and resolved through FPL's 10 CFR Part 50, Appendix B corrective action program. Furthermore, the applicant stated that safety-related systems are protected from water spray, jet impingement, and pipe whip effects (due to postulated failures of non-safety-related piping) by the use of pipe whip restraints and internal barriers, as described in Turkey Point UFSAR Section 5.4.

The staff reviewed the information described above and disagreed with the applicant's scoping criteria for seismic II over I piping systems. The staff's position is that the seismic II over I piping systems whose failure could prevent safety-related systems and structures from accomplishing their intended functions should be within the scope of license renewal in accordance with the scoping requirements of 10 CFR 54.4(a)(2). The staff considers the seismic II over I piping segments to be within the scope of license renewal. For these seismic II/I piping systems, the applicant should perform an AMR to determine if there are any plausible aging effects, and identify appropriate aging management programs. Furthermore, the applicant needs to clarify the scope of its seismic II over I piping systems (i.e., whether it includes non-safety-related piping systems that are connected to safety related piping systems as well as non-safety-related piping systems that are not connected to safety-related piping systems). The applicant also needs to address the criteria used to postulate breaks and cracks in non-safety-related piping systems that are within the seismic II over I scope, if it wishes to take credit for protection of safety-related systems. The applicant must demonstrate that plant mitigative features which are provided to protect safety-related SSCs from a failure of non-safety-related piping segments are within the scope of license renewal. This issue is also discussed in Section 2.1 of this SER and is identified as open item 2.1.2-1.

By letter dated November 1, 2001, the applicant provided additional information to supplement the March 22, 2001, and May 2, 2001, responses. The applicant reiterated those SSCs, including mitigative design features, included within the scope of license renewal as a result of their initial evaluation. The applicant also addressed staff's concerns regarding the potential for age-related degradation of non-safety-related piping segments which could affect safety-related SSCs by performing a supplemental review to establish what additional non-safety-related piping should be included in the scope of license renewal. As a result of this supplemental review, the applicant brought additional non-safety-related piping segments into the scope of license renewal. On the basis of the additional information provided by the applicant, the staff concludes that all SSCs that meet the 54.4(a)(2) Scoping criteria, have been included within the scope of license renewal. The staff's evaluation of the applicant's Scoping criteria and results is discussed in Section 2.1.2.1 of this SER.

In the letter dated November 1, 2001, the applicant also provided information regarding the management of aging effects associated with those additional non-safety-related piping segments that are brought into the scope of license renewal. These contain carbon seel piping, fittings and valves in auxiliary steam, in the condensate downstream of the #4 feedwater heaters to the main feedwater pump suction line, and the #6 to #5 feedwater heater drains. The inside of these carbon steel components are exposed to treated, secondary side water and the effects of aging is loss of material. The applicant is using the chemistry control program and the flow-accelerated corrosion program to manage the effects of aging. The chemistry control program is reviewed in Section 3.2.4 and the flow-accelerated corrosion program is reviewed in Section 3.2.9 of this SER. The staff agrees that these programs are the applicable programs for managing loss of material since both of these programs follow EPRI Guidelines that have been endorsed by the staff. The applicant did not identify any effects of aging for the outside surface of these components, and the staff agrees with this conclusion.

On the basis of the additional information provided by the applicant in response to Open Item 2.1.2-1, the staff concludes that the aging management of seismic II/I piping systems is adequate and provides reasonable assurance that safety-related structures, systems, and components will be adequately protected from the consequences of a failure in the seismic II/I piping systems. Therefore, the Open Item 2.1.2-1 is closed.

3.5 Steam and Power Conversion Systems

The applicant has described its AMR of the steam and power conversion systems (SPCSs) for license renewal in Sections 2.3.4, “Steam and Power Conversion Systems,” and 3.5, “Steam and Power Conversion Systems,” of its LRA. The staff has reviewed these sections of the application to determine whether the applicant has provided adequate information to meet the requirements of 10 CFR 54.21(a)(3) for managing the aging effects of the SPCSs for license renewal.

3.5.1 Summary of Technical Information in the Application

The LRA has identified three systems that will require aging management to meet the requirements of 10 CFR 54.21(a)(3) for management of aging effects. The three systems are main steam and turbine generators, feedwater and blowdown, and auxiliary feedwater and condensate storage. A brief description of the systems is provided in the LRA and is given below.

3.5.1.1 Main Steam and Turbine Generators

Main steam transports saturated steam from the steam generators to the main turbine and other secondary steam system components. Main steam provides the principal heat sink for the reactor coolant system protecting the reactor coolant system and the steam generators from overpressurization, provides isolation of the steam generators during a postulated steam line break, and provides steam supply to the auxiliary feedwater pump turbines.

Turbine generators convert the steam input from main steam to the plants’ electrical output, provide first-stage pressure input to the reactor protection system, and provide isolation under certain postulated steam line break scenarios. Main steam and turbine generators are described in UFSAR Section 10.2.2.

The flow diagrams listed in the LRA, Table 2.3-6 show the evaluation boundaries for the mechanical portions of main steam and turbine generators that are within the scope of license renewal. As described in the LRA, the initial scoping was performed on the basis of functions.

Main steam and turbine generators components that are subject to an AMR include valves (pressure boundary only), steam traps, flow elements, piping, tubing, and fittings. The intended functions for main steam and turbine generators components that are subject to an AMR are pressure boundary integrity and throttling. A complete list of main steam and turbine generators components that require an AMR and the component intended functions appears in Table 3.5-1. The AMR for main steam and turbine generators is discussed in Section 3.5 of LRA.

3.5.1.2 Feedwater and Blowdown

Feedwater and blowdown provide sufficient water flow to the steam generators to maintain an adequate heat sink for the reactor coolant system, provide for feedwater and blowdown isolation following a postulated loss-of-coolant accident or steam line break event, and assist in maintaining steam generator water chemistry. Feedwater and blowdown consists of three subsystems, including main feedwater, steam generator blowdown, and standby steam generator feedwater. Main feedwater supplies preheated, high-pressure feedwater to the steam generators at a rate equal to main steam and the steam generator blowdown flows. The feedwater flow rate is controlled by the steam generator level control system, which determines the desired feedwater flow by comparing the feed flow, steam flow, and the steam generator level. Main feedwater system is described in UFSAR Section 10.2.2.

Steam generator blowdown assists in maintaining required steam generator chemistry by providing a means for removal of foreign matter that concentrates in the evaporator section of the steam generator. Steam generator blowdown is fed by three independent blowdown lines (one per steam generator), which tie to a common blowdown flask. Steam generator blowdown is continuously monitored for radioactivity during plant operation. Steam generator blowdown is described in UFSAR Section 10.2.4.3.

Standby steam generator feedwater is common to Turkey Point, Units 3 and 4. Standby steam generator feedwater supplies steam generator feedwater during normal startup, shutdown, and hot standby conditions. Standby steam generator feedwater delivers sufficient feedwater to maintain one unit at hot standby, while providing makeup for maximum blowdown. The standby steam generator feedwater pumps take suction from the demineralized water storage tank and discharge to a common header upstream of the feedwater regulating valves. Standby steam generator feedwater is described in UFSAR Section 9.11. The flow diagrams listed in Table 2.3-6 show the evaluation boundaries for the portions of feedwater and blowdown that are within the scope of license renewal.

Feedwater and blowdown components that are subject to an AMR include the demineralized water storage tank, pumps and valves (pressure boundary only), orifices, piping, tubing, and fittings. The intended functions for the feedwater and blowdown system components that are subject to an AMR are pressure boundary integrity and throttling. A complete list of feedwater and blowdown components that require AMR and the component intended functions, is provided in Table 3.5-2. The aging management review for feedwater and blowdown is discussed in Section 3.5 of the LRA.

3.5.1.3 Auxiliary Feedwater and Condensate Storage

The auxiliary feedwater system supplies feedwater to the steam generators when normal feedwater sources are not available, provides for auxiliary feedwater steam and feedwater isolation during a postulated steam generator tube rupture event, and provides for auxiliary feedwater isolation to the faulted steam generator and limits feedwater flow to the steam generators to limit positive reactivity insertion during a postulated steam line break event. The auxiliary feedwater system is a shared system between Turkey Point, Units 3 and 4.

The auxiliary feedwater system contains three steam turbine-driven pumps. The pumps can be supplied steam from the steam generators in either unit. The pumps take suction from either condensate storage tank and discharge to one of two redundant headers. Each header can supply each steam generator. The auxiliary feedwater system is normally maintained in standby with one pump aligned to one discharge header and two pumps aligned to the other header. Upon initiation, all three pumps start to supply the affected steam generator with feedwater. The auxiliary feedwater system is described in UFSAR Section 9.11.

The condensate storage tank stores water for use by the auxiliary feedwater system to support safe shutdown of the plant. The condensate storage tank on each unit supplies water using three auxiliary feedwater pumps. The tank outlet piping is cross-connected between the units so that either tank can supply auxiliary feedwater to the steam generators. The condensate storage system is described in UFSAR Section 9.11.3.

The flow diagrams listed in Table 2.3-6 show the evaluation boundaries for the portions of the auxiliary feedwater system and the condensate storage system that are within the scope of license renewal.

3.5.1.4 Aging Management Programs

The LRA has identified eight aging management programs that will manage the aging effects associated with the steam and power conversion systems. These programs are auxiliary feedwater pump oil coolers inspection, auxiliary feedwater steam piping inspection program, boric acid wastage surveillance program, chemistry control program, field-erected tanks internal inspection, flow-accelerated corrosion program, galvanic corrosion susceptibility inspection program, and systems and structures monitoring program. A detailed description concerning each of the above listed programs is included in Appendix B to the LRA.

The steam and power conversion systems (SPCSs) are exposed to internal environments of treated water, lubricating oil, and air/gas, as well as external environments of outdoor, containment air, underground, and potential borated water leaks. The only parts of the SPCS components that are considered to be inaccessible for inspection are those that are buried underground. On February 8, 2001, in response to a staff RAI dated January 10, 2001, the applicant indicated that sections of the standby steam generator feedpumps suction and recirculation piping are buried underground as shown on drawing 0-FW-01. The underground sections of this piping are made of stainless steel and externally coated and wrapped in plastic to protect the coating against backfill damage. Although the pipe is buried, it is above the ground water level and therefore not exposed to ground water chemicals. Additionally, the area where the pipe is buried is paved or covered by a concrete slab, making it unlikely that the surface of the pipe will be exposed to a water environment. As part of the AMR process, the applicant reviewed the plant’s operating experience, and confirmed that there has been no external corrosion of buried stainless steel piping at Turkey Point. The applicant concluded that this piping is adequately protected against potential external aging mechanisms, and that there are no external aging effects requiring management. The staff concurs with the applicant’s conclusion that the AMR program is adequate to protect these buried piping sections at Turkey Point against potential aging effects.

3.5.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff has reviewed the information included in Sections 2.3.4 and 3.5 of the LRA. The purpose of the review was to ascertain whether the applicant has adequately demonstrated that the effects of aging will be adequately managed so that the intended function of the systems will be maintained consistent with the CLB throughout the period of extended operation.

3.5.2.1 Effects of Aging

The components of the SPCSs are constructed from carbon steel low alloy steel, cast iron, brass, and stainless steel. They are exposed to an external environment of outdoor, containment air, buried, and potential borated water leaks. Internally, the components in the SPCSs are exposed to environments of treated water, steam, lubricating oil, and air/gas. Section 5 of Appendix C to the LRA provides a discussion of the potential aging effects based on materials and environments. Aging effects are considered to require management if the effects could cause a component to lose its ability to perform an intended function during the period of extended operation.

The following aging effects were identified in the systems carrying treated water and steam: loss of material, cracking and loss of mechanical enclosure integrity. Tables 3.5-1, 3.5-2, and 3.5-3 of the LRA list the components, component function, material, environment, applicable aging effects and applicable aging management programs. In Tables 3.5-1 and 3.5-2 for carbon steel bolting, the effect of humidity in the external environment is not considered to cause aging that leads to loss of material due to general corrosion and loss of preload. The applicant relies on the boric acid wastage surveillance program to manage the aging effects of mechanical bolting in piping connections and closures to ensure that boric acid corrosion does not lead to degradation of the pressure boundary. When external leakage involves borated water, the aging effect of concern is loss of carbon or low alloy steel bolting material due to aggressive chemical attack (i.e., boric acid corrosion).

Therefore, the LRA addresses loss of mechanical closure integrity resulting from the external environment of “borated water leaks” and credits the boric acid wastage surveillance program for management of this effect on carbon and low alloy steel bolting. This is acceptable to the staff.

The applicant has provided references to Turkey Point plant-specific as well as industry-wide experience to support its identification of applicable aging effects for steam and power conversion systems. The staff concludes that, on the basis of the description of the internal and external environments and material of fabrication for these systems, the applicant has included aging effects that are consistent with published literature and industry experience and, thus, are acceptable to the staff.

3.5.2.2 Aging Management Programs

The applicant has identified the following eight aging management programs for controlling the effects of aging in the SPCSs:

- auxiliary feedwater pump oil coolers inspection
- auxiliary feedwater steam piping inspection program
- boric acid wastage surveillance program
- chemistry control program
- field-erected tanks internal inspection
- flow-accelerated corrosion program
- galvanic corrosion susceptibility inspection program
- systems and structures monitoring program

The programs were developed from industry-wide data, industry-developed methodologies, NRC documents, and the applicant's own experience. The applicant concluded that these programs would manage the aging effects in such a way that the intended function of the components in the SPCSs will be maintained during the period of extended operation, consistent with the current licensing basis (CLB), under all design conditions.

The staff has evaluated the FPL aging management programs in order to determine if they contain the essential elements needed to provide adequate aging management of the components in the SPCSs so that the components will perform their intended functions in accordance with the CLB during the period of extended operation. In Appendix B to the LRA, the applicant discusses the attributes that each aging management program is required to address. Those attributes are (1) scope of program including the specific structure, component or commodity for the identified aging effect, (2) preventive actions to mitigate or prevent aging degradation, (3) parameters monitored or inspected which are linked to the degradation of the particular intended function, (4) method of detection of the aging effects, (5) monitoring and trending for timely corrective actions, (6) acceptance criteria, (7) corrective actions including root cause determination and prevention of recurrence, (8) confirmation process, (9) administrative controls, and, (10) operating experience including past corrective actions resulting in program enhancements or additional programs. The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled corrective actions program pursuant to 10 CFR Part 50, Appendix B, and covers all structures and components that are subject to an aging management review. The staff's evaluation of the applicant's corrective actions program is provided separately in Section 3.1.2 of this SER. The QA program satisfies the elements of corrective actions, confirmation process, and administrative controls.

On the basis of the information provided, the staff finds that the following 8 AMPs are appropriate and acceptable for managing the aging effects associated with these components:

- auxiliary feedwater pump oil coolers inspection
- auxiliary feedwater steam piping inspection program

- boric acid wastage surveillance program
- chemistry control program

- field-erected tanks internal inspection
- flow-accelerated corrosion program
- galvanic corrosion susceptibility inspection program
- systems and structures monitoring program

The eight AMPs are discussed in Sections 3.1.1, 3.1.3, 3.8.1, 3.8.2, 3.8.4, 3.8.5, 3.9.3, and 3.9.9 of this SER.

3.5.3 Conclusion

The staff has reviewed the information in LRA Sections 2.3.4, “Steam and Power Conversion Systems,” and 3.5, “Steam and Power Conversion Systems,” as well as applicant’s responses to the staff’s RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that aging effects associated with the subject systems will be adequately managed so that there is a reasonable assurance that the subject systems will perform their intended functions in accordance with the CLB during the period of extended operation.

3.6 Structures and Structural Components

3.6.1 Containments

3.6.1.1 Containment Structure Concrete Components

3.6.1.1.1 Summary of Technical Information in the Application

Containment structure concrete components are described in Section 3.6.1.1 of the LRA. The containment structure provides radiation shielding, protects the reactor vessel and other safety-related systems, equipment, and components against missiles and environmental conditions, and serves as the last engineered barrier to the release of radioactivity. The containment structure concrete components identified by the licensee are the dome, cylinder wall, floor, and foundation mat. These components are made of concrete and reinforced by steel bars. The dome and cylinder wall were further reinforced with a post-tensioning steel system. The containment structure concrete components were designed and constructed in accordance with the American Concrete Institute (ACI) and the American Society for Testing and Materials (ASTM) standards.

Containment structure concrete components are exposed to several different environments depending on their location. Below-grade containment structure concrete components can be either above or below the groundwater elevation. Containment structure concrete components that are below grade and above the groundwater elevation are exposed to a soil/fill environment. Containment structure concrete components that are below the groundwater elevation are exposed to a soil/fill and groundwater environment. Above-grade external surfaces of the containment structure are exposed to both indoor (without air conditioned) and outdoor environments. Internal components of the containment structure are exposed to the containment air environment.

The aging effects identified by the applicant that could cause loss of intended function(s) for containment structure concrete components are loss of material, cracking, and change in material properties. The aging management program used by the applicant to manage these aging effects is the systems and structures monitoring program.

3.6.1.1.2 Staff Evaluation

In addition to Section 3.6.1.1 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results — Structures" and the applicable aging management program descriptions provided in Appendix B to the LRA to determine whether the aging effects for the containment structure concrete components have been properly identified and will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.6.1.1.2.1 Effects of Aging

The aging effects identified by the applicant that could cause loss of intended function(s) for containment structure concrete components are loss of material, cracking, and change in material properties. Loss of material is manifested in containment structure concrete components as scaling, spalling, pitting and erosion. Cracking is manifested in containment structure concrete components as complete or incomplete separation of the concrete into two or more parts. Change in material properties is manifested in concrete as increased permeability, increased porosity, reduction in pH value, reduction in tensile strength, reduction in compressive strength, reduction in modulus of elasticity, and reduction in bond strength.

For the loss of material aging effect, the applicant identified the following plausible aging mechanisms: (1) freeze-thaw, (2) abrasion and cavitation, (3) elevated temperature, (4) aggressive chemical attack, and (5) corrosion of reinforcing and embedded steel. Of these aging mechanisms, the applicant stated that only aggressive chemical attack and corrosion of reinforcing and embedded steel are applicable for containment structure concrete components exposed to groundwater. As such, the applicant committed to manage loss of material only for reinforced containment concrete walls below groundwater elevation.

For the cracking aging effect, the applicant identified the following plausible aging mechanisms: (1) freeze-thaw, (2) reaction with aggregates, (3) shrinkage, (4) settlement, (5) fatigue, and (6) elevated temperature. The applicant stated that none of these aging mechanisms are applicable for containment structure concrete components at Turkey Point that are located either above or below groundwater elevation, and therefore, listed no aging management program to manage cracking in Table 3.6-2 of the LRA.

For the change in material properties aging effect, the applicant identified the following plausible aging mechanisms: (1) leaching, (2) creep, (3) elevated temperature, (4) irradiation embrittlement, and (5) aggressive chemical attack. Of these aging mechanisms, the applicant stated that only aggressive chemical attack is applicable for containment structure concrete components exposed to groundwater. As such, the applicant committed to manage change in material properties only for reinforced containment concrete walls below groundwater elevation.

The staff considers each of the above aging effects (loss of material, cracking, and change in material properties) to be both plausible and applicable for containment structure concrete components located above groundwater elevation. As such, in RAI 3.9.1.4-1 the staff requested that the applicant identify the aging management program that will be used to manage the aging effects for containment structure concrete components that are located above groundwater elevation. In its response, the applicant argued that there are no aging effects that could cause a loss of intended function for containment concrete above groundwater. At the same time, the applicant recognized the existence of the concrete degradations depicted in Appendix A to NUREG-1522. The applicant proposed to modify its ASME Section XI, Subsection IWL aging management program to include aging management of containment reinforced concrete above groundwater elevation. FPL also committed to use ACI 201.1R, "Guide for Making a Condition Survey of Concrete in Service," to establish degradation type and IWL-3211 for the acceptance criteria. Once incorporated, as committed in this response, the staff considers this issue to be resolved.

3.6.1.1.2.2 Aging Management Program

The aging management program used by the applicant to manage loss of material and cracking for containment structure concrete components located below groundwater elevation is the systems and structures monitoring program. The structural monitoring program provides condition monitoring and appraisal of containment structure concrete components through periodic visual inspections. In its description of the systems and structures monitoring program, the applicant stated that external surfaces of concrete are monitored through visual examination for exposed rebar, extensive rust bleeding, cracks that exhibit rust bleeding, and cracking of block walls and building roof seals. The results of the visual inspection for systems, structures and components are documented and the frequency for the inspection may be adjusted, as necessary, based on the inspection results and industry experience. In RAI 3.6.1.1-1, the staff requested that the applicant specifically identify how the systems and structures monitoring program manages the two aging effects, loss of material and change in material properties caused by aggressive chemical attack for containment structure concrete components that are exposed to groundwater. In its response the applicant stated that, for the containment building concrete below groundwater, which is inaccessible, visual inspection of the tendon access gallery concrete below groundwater will be required to provide early indication of potential aging effects for the containment concrete and the visual inspection will look for signs of degradation (e.g., concrete cracking, spalling, scaling, leaching, discoloration, groundwater leakage, and rust stains). The staff finds the applicant's response acceptable because the walls of the tendon access gallery are much thinner than the containment base mat or the reactor pit and, thus, any aging effects on concrete will show up sooner on the tendon access gallery than containment base mat or the reactor pit. The systems and structures monitoring program is discussed in greater detail in Section 3.1.3 of this SER.

Since the applicant did not identify any plausible and applicable aging effects for containment structure concrete components located above groundwater elevation, there are no aging management programs listed in Table 3.6-2 of the LRA to manage loss of material, cracking, and change in material properties. However, in response to the staff's position that each of these aging effects are both plausible and applicable for containment structure concrete components located above groundwater elevation, the applicant committed in its response RAI 3.9.1.4-1 to modify its ASME Section XI, Subsection IWL aging management program to include aging management of containment reinforced concrete above groundwater elevation. The ASME Section XI, Subsection IWL inservice inspection program is discussed in greater detail in Section 3.9.1.4 of this SER.

On the basis of the information discussed above, the staff concludes that the applicant has demonstrated that the aging effects for containment structure concrete components will be adequately managed by the systems and structures monitoring program for the period of extended operation.

3.6.1.1.3 Conclusion

The staff has reviewed the information in Sections 3.6.1.1, “Containment Structure Concrete Components,” and Section 2.4, “Scoping and Screening Results – Structures,” as well as the applicable aging management program descriptions provided in Appendix B to the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the containment structure concrete components will be adequately managed so that there is reasonable assurance that these structural components will perform their intended functions in accordance with the CLB during the period of extended operation.

3.6.1.2 Containment Structure Steel Components

3.6.1.2.1 Summary of Technical Information in the Application

Containment structure steel components are described in Section 3.6.1.2 of the LRA. The purpose of the containment structure steel components is to provide several safety-related functions including serving as a pressure boundary or a fission-product retention barrier, providing structural and/or functional support to safety and non-safety-related equipment, and serving as missile and flood protection barriers. The following containment structure steel components are identified by the applicant:

- liners (including the liner plate, anchors/embedments/attachments, leak chase channels, and moisture barriers)

- penetrations [including mechanical piping, mechanical ventilation, and steel portions (pressure boundary) of the electrical penetration assemblies]

- airlocks and hatches (personnel hatch, equipment hatch, escape hatch, including seals and gaskets)

- fuel transfer tube blind flanges

The containment structure steel components were designed and constructed in accordance with ASME Section III - 1965 for the pressure boundary, and the American Institute of Steel Construction (AISC) “Manual of Steel Construction” for structural steel. The gaskets, seals, and moisture barriers that protect the containment structure steel components are elastomers.

Containment structure steel components are exposed to containment air, both indoor (not air conditioned) and outdoor air, and embedded/encased environments. Borated water is also a potential environment for containment structure steel components.

The aging effects identified by the applicant that could cause loss of intended function(s) for containment structure steel components are loss of material, cracking, and change in material properties. The aging management programs used by the applicant to manage these aging effects are the ASME Section XI, Subsection IWE inservice inspection program and the boric acid wastage surveillance program.

3.6.1.2.2 Staff Evaluation

In addition to Section 3.6.1.2 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results — Structures," and the applicable aging management program descriptions provided in Appendix B to the LRA to determine whether the aging effects for the containment structure steel components have been properly identified and will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.6.1.2.2.1 Effects of Aging

The aging effects identified by the applicant that could cause loss of intended function(s) for containment structure steel components are loss of material, cracking, and change in material properties.

For the loss of material aging effect, applicant identified the following plausible aging mechanisms: (1) material compatibility, (2) mechanical wear, (3) corrosion, and (4) aggressive chemical attack. Of these aging mechanisms, the applicant stated that corrosion and aggressive chemical attack (due to boric acid) are applicable for containment structure steel components exposed to containment air or borated water leaks. As such, the applicant committed to manage loss of material using their ASME Section XI, Subsection IWE inservice inspection program for containment steel exposed to air and their boric acid wastage surveillance program for containment steel exposed to borated water leaks. The staff agrees with the applicant's findings.

For the cracking aging effect, the applicant identified the following plausible aging mechanisms: (1) stress corrosion and (2) fatigue. The applicant stated that neither of these aging mechanisms are applicable for containment structure steel components at Turkey Point that are exposed to any environment, and therefore, listed no aging management program to manage cracking in Table 3.6-2 of the LRA. In RAI 3.6.1.2-2 the staff requested that the applicant evaluate the potential for cracking of the radiant energy shields and reactor vessel supports due to stress corrosion cracking and thermal fatigue. These items along with the fuel transfer blind flanges, and non-safety-related pipe segments are made of stainless steel and listed in Table 3.6-2 of the LRA. Section 3.6.1.5 of the LRA provides only a brief explanation for concluding that these items do not require aging management. In its response, the applicant responded that, as stated in Section 5.2 of Appendix C to the LRA, cracking is a non-ductile failure of a component due to stress corrosion, fatigue, or embrittlement. Stress corrosion cracking (SCC) requires a combination of a susceptible material and tensile stress. Cracking due to thermal fatigue requires cyclic thermal stresses beyond the material endurance limit. The environment for the stainless steel components discussed in the RAI is containment air, which is dry. These components are not exposed to the corrosive environment necessary to cause SCC. Consequently, SCC is not an aging effect requiring management for these components. The applicant further stated that, by design, the components discussed in the RAI are not exposed to cyclic thermal stresses of the quantity or magnitude necessary to cause thermal fatigue. Consequently, thermal fatigue is not an aging mechanism that can lead to cracking for these components. The staff finds this response adequate to resolve RAI 3.6.1.2-2.

For the change in material properties aging effect, the applicant identified the following plausible aging mechanisms: (1) elevated temperature, (2) irradiation embrittlement, and (3) embrittlement and permanent set of elastomers. Of these aging mechanisms, the applicant stated that only embrittlement and permanent set of elastomers is applicable for elastomers associated with containment structure steel components. As such, the applicant committed to manage change in material properties using their ASME Section XI, Subsection IWE inservice inspection program for elastomers associated with containment steel exposed to air. In RAI 3.6.1.2-3, the staff asked the applicant to evaluate the potential for material changes for the steam generator support material (Lubrite), and to justify its exclusion for items requiring aging management. The applicant indicated in its response that Lubrite is the trade name for a low-friction lubricant material used in applications where relative motion (sliding) is desired. At Turkey Point, the intended function of the Lubrite plates is to facilitate relative motion (sliding) during RCS heatup and cooldown. As described in an engineering brief supplied by the applicant’s Lubrite vendor, Lubrite resists deformation, has a low coefficient of friction, resists softening at elevated temperatures, absorbs grit and abrasive particles, is not susceptible to corrosion, withstands high intensities of radiation, and will not score or mar. In addition, the applicant stated that Lubrite products are solid, permanent, completely self lubricating, and require no maintenance. Also, the Lubrite lubricants used in nuclear applications are designed for the environments to which they are exposed. The applicant also performed an extensive search of industry and plant-specific operating experience and found no reported instances of Lubrite plate degradation or failure to perform their intended function. Based on the above information, the applicant determined that there are no known aging effects for the Lubrite material that would lead to a loss of intended function. The staff agrees with the applicant’s determination, and considers RAI 3.6.1.2-3 resolved.

The staff finds that the applicant’s approach for evaluating the applicable aging effects for containment structure steel components to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for containment structure steel components.

3.6.1.2.2.2 Aging Management Programs

The aging management programs used by the applicant to manage the above aging effects are the ASME Section XI, Subsection IWE inservice inspection program and the boric acid wastage surveillance program.

The ASME Section XI, Subsection IWE inservice inspection program is credited with managing the effects of loss of material for containment steel components and change in material properties for elastomers associated with containment steel components. The program provides inspection and examination of accessible surface areas, including surfaces of welds, pressure-retaining bolting, and moisture barriers intended to prevent intrusion of moisture against inaccessible containment metallic surfaces. In its description of the ASME Section XI, Subsection IWE inservice inspection program, the applicant stated that visual inspections of steel components are performed to detect loss of material due to general corrosion and visual inspections of elastomers are performed to detect change in material properties. The results of the visual inspections are documented and the examinations performed during any inspection interval that reveal flaws or areas of degradation exceeding the acceptance criteria are expanded to include additional examinations within the same category. In RAI 3.6.1.2-4, the staff asked the applicant to provide a discussion of any plant-specific program content for inspection of Class CC metallic liners and pressure retention components, which is part of the ASME Section XI, Subsection IWE inservice inspection program. Specifically, the staff requested that the applicant provide a discussion of how the visual inspection of the internal and external surfaces and fasteners is to be implemented, thereby providing assurance that the containment shell and internal structures have not degraded due to corrosion. In its response, the applicant stated that the Turkey Point ASME Section XI, Subsection IWE inservice inspection program includes a visual examination of all accessible interior and exterior surfaces of the metallic shell and penetrations, thereby providing assurance that the containment shell and internal structures have not degraded due to corrosion. The program also requires visual examination of moisture barriers intended to prevent intrusion of moisture against inaccessible areas of the pressure retaining liner at concrete-to-metal interfaces and at metal-to-metal interfaces that are not seal welded (Category E-D), thereby providing assurance that the moisture barriers are not degraded. The staff finds the applicant's response to be acceptable. The ASME Section XI, Subsection IWE inservice inspection program is discussed in greater detail in Section 3.9.1.2 of this SER.

The boric acid wastage surveillance program is credited for aging management of carbon steel and low alloy steel components for the containment structure. The boric acid wastage surveillance program manages the effects of loss of material due to aggressive chemical attack of steel components through the detection of leakage of coolant containing boric acid. Conditions leading to boric acid corrosion are detected by visual inspections on external surfaces in accordance with plant procedures. The boric acid wastage surveillance program is discussed in greater detail in Section 3.9.3 of this SER.

On the basis of the information discussed above, the staff concludes that the applicant has demonstrated that the aging effects for containment structure steel components will be adequately managed by the Turkey Point ASME Section XI, Subsection IWE inservice inspection program and the boric acid wastage surveillance program for the period of extended operation.

3.6.1.2.3 Conclusion

The staff has reviewed the information in Sections 3.6.1.2, "Containment Structure Steel Components," and Section 2.4, "Scoping and Screening Results — Structures," as well as the applicable aging management program descriptions provided in Appendix B to the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the containment structure steel components will be adequately managed so that there is reasonable assurance that these structural components will perform their intended functions in accordance with the CLB during the period of extended operation.

3.6.1.3 Containment Structure Post-Tensioning System

3.6.1.3.1 Summary of Technical Information in the Application

Containment structure post-tensioning system components are described in Section 3.6.1.3 of the LRA. The post-tensioning system provides pre-compression for the containment structure. The containment structure post-tensioning system components identified by the licensee are the tendon wires and tendon anchorage.

Each tendon of the containment structure post-tensioning system is housed in spirally wrapped, corrugated, thin wall sheathing and capped at each end with a sheathing filler cap. After fabrication, the tendon is shop dipped in grease. The tendon sheathing provides the channel in the concrete through which the tendon is pulled, and contains the tendon sheathing filler material, which is grease. The tendon anchorages and tendon wires are contained in the sheathing filler material.

The aging effects identified by the applicant that could cause loss of intended function(s) for the containment structure post-tensioning system are loss of material and loss of prestress. The aging management program used by the applicant to manage these aging effects is the ASME Section XI, Subsection IWL inservice inspection program.

3.6.1.3.2 Staff Evaluation

In addition to Section 3.6.1.3 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, “Scoping and Screening Results — Structures,” and the applicable aging management program descriptions provided in Appendix B to the LRA to determine whether the aging effects for the containment structure post-tensioning system have been properly identified and will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.6.1.3.2.1 Effects of Aging

The aging effects identified by the applicant that could cause loss of intended function(s) for the containment structure post-tensioning system are loss of material and loss of prestress. The applicant identified corrosion as an aging mechanism that can lead to the loss of material aging effect for the containment structure post-tensioning system. Corrosion can affect both the tendon wires within the grease-filled conduits and the anchorages providing the tendon terminations.

The applicant identified elevated temperatures, irradiation, stress relaxation of the prestressing wire, shrinkage, creep or elastic deformation of the concrete, anchorage seating losses, and tendon friction as aging mechanisms that can lead to the loss of prestress aging effect for the containment structure post-tensioning system. The loss of prestress aging effect is monitored by the applicant through a time-limited aging analysis and is discussed in greater detail in Section 4.5 of this SER.

The staff finds that the applicant's approach for evaluating the applicable aging effects for the containment structure post-tensioning system to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for the containment structure post-tensioning system.

3.6.1.3.2.2 Aging Management Programs

The aging management program used by the applicant to manage the loss of material aging effect for the containment structure post-tensioning system is the ASME Section XI, Subsection IWL inservice inspection program. The program provides for inspection of tendon wires and tendon anchorage hardware surfaces for loss of material, as well as a confirmatory program for measurement of tendons for loss of prestress. In its description of the ASME Section XI, Subsection IWL inservice inspection program, the applicant stated that unbonded post-tensioning system components are examined. These components consist of tendons, wires or strand, anchorage hardware and surrounding concrete, corrosion protection medium, and free water. Surface conditions are monitored through visual examinations to determine the extent of corrosion or concrete degradation around anchorage locations. The results of the visual inspections are documented in accordance with the corrective action program and areas of degradation are evaluated to determine if repair or replacement is required. The ASME Section XI, Subsection IWL inservice inspection program is discussed in greater detail in Section 3.9.1.4 of this SER.

On the basis of the information discussed above, the staff concludes that the applicant has demonstrated that the loss of material aging effect for the containment structure post-tensioning system will be adequately managed by the ASME Section XI, Subsection IWL inservice inspection program for the period of extended operation.

3.6.1.3.3 Conclusion

The staff has reviewed the information in Sections 3.6.1.3, "Containment Structure Post-Tensioning System," and 2.4, "Scoping and Screening Results — Structures," as well as the applicable aging management program descriptions provided in Appendix B to the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the containment structure post-tensioning system will be adequately managed so that there is reasonable assurance that these structural components will perform their intended functions in accordance with the CLB during the period of extended operation.

3.6.1.4 Containment Internal Structural Concrete Components

3.6.1.4.1 Summary of Technical Information in the Application

Containment internal structural concrete components are described in Section 3.6.1.4 of the LRA. The containment structure provides radiation shielding, protects the reactor vessel and other safety-related systems, equipment, and components against missiles and environmental conditions, and serves as the last engineered barrier to the release of radioactivity. The following containment internal structural concrete components are identified by the applicant:

- reinforced concrete primary shield walls

- reinforce concrete secondary shield walls
- reinforced concrete upper secondary compartment walls (steam generator and pressurizer cubicles)
- reinforced concrete refueling cavity walls
- reinforced concrete containment sumps
- reinforced concrete equipment pads
- reinforced concrete missile shields

- reinforced concrete beams, floors, mats, and walls
- reinforce concrete curbs

These components were designed and constructed in accordance with ACI and ASTM standards. Containment internal structural concrete components are exposed to the containment air environment.

The aging effects identified by the applicant that could cause loss of intended function(s) for containment internal structural concrete components are loss of material, cracking, and change in material properties. However, the applicant determined for the containment internal structural concrete components that none of these aging effects required aging management for the period of extended operation and as such there is no aging management program used by the applicant to manage these aging effects.

3.6.1.4.2 Staff Evaluation

In addition to Section 3.6.1.4 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results – Structures" and the applicable aging management program descriptions provided in Appendix B to the LRA to determine whether the aging effects for the containment internal structural concrete components have been completely identified and will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.6.1.4.2.1 Effects of Aging

The aging effects identified by the applicant that could cause loss of intended function(s) for the containment internal structural concrete components are loss of material, cracking, and change in material properties. Loss of material is manifested in containment internal structural concrete components as scaling, spalling, pitting, and erosion. Cracking is manifested in containment internal structural concrete components as complete or incomplete separation of the concrete into two or more parts. Change in material properties is manifested in containment internal structural concrete components as increased permeability, increased porosity, reduction in pH, reduction in tensile strength, reduction in compressive strength, reduction in modulus of elasticity, and reduction in bond strength.

For the loss of material aging effect, the applicant identified the following plausible aging mechanisms: (1) freeze-thaw, (2) abrasion and cavitation, (3) aggressive chemical attack, (4) corrosion of reinforcing and embedded steel, and (5) elevated temperature. The applicant stated that none of these aging mechanisms are applicable for containment internal structural concrete components at Turkey Point and therefore, listed no aging management program to manage loss of material in Table 3.6-2 of the LRA.

For the cracking aging effect, the applicant identified the following plausible aging mechanisms: (1) freeze-thaw, (2) reactions with aggregates, (3) shrinkage, (4) settlement, (5) fatigue, and (6) elevated temperature. The applicant stated that none of these aging mechanisms are applicable for containment internal structural concrete components at Turkey Point and therefore, listed no aging management program to manage cracking in Table 3.6-2 of the LRA.

For the change in material properties aging effect, the applicant identified the following plausible aging mechanisms: (1) leaching, (2) creep, (3) aggressive chemical attack, (4) irradiation embrittlement, and (5) elevated temperature. The applicant stated that none of these aging mechanisms are applicable for containment internal structural concrete components at Turkey Point and therefore, listed no aging management program to manage change in material properties in Table 3.6-2 of the LRA.

The staff considers that each of the above aging effects (loss of material, cracking, change in material properties) are both plausible and applicable for containment internal structural concrete components at Turkey Point. As such, in RAI 3.6.2.1-2 the staff requested that the applicant provide an aging management program to manage the aging of reinforced concrete structures. In its initial response, the applicant reasserted its position that aging management reviews performed on above groundwater reinforced concrete did not identify any aging effects requiring management. However, FPL proposed to use its inspections of containment structure concrete components through the ASME Section XI, IWL inservice inspection program as an indicator for the condition of other reinforced concrete structures. Subsequent communication between the staff and FPL culminated in a staff letter, dated October 30, 2001, in which the staff asserted its position that all concrete structures within the scope of license renewal require aging management via a dedicated aging management program. In its response to the staff's position (see supplemental response to RAI 3.6.2.1-2 dated November 1, 2001), the applicant committed to manage the aging of containment internal structural concrete components for loss of material, cracking, and change in material properties through inspections performed by its systems and structural monitoring aging management program. Once incorporate, as committed in this response, the staff considers this issue to be resolved.

3.6.1.4.2.2 Aging Management Programs

Since the applicant did not identify any plausible and applicable aging effects for containment internal structural concrete components, there are no aging management programs listed in Table 3.6-2 of the LRA to manage loss of material, cracking, and change in material properties. However, in response to the staff's position that each of these aging effects are both plausible and applicable for containment internal structural concrete components, the applicant committed in its supplemental response to RAI 3.6.2.1-2 to manage the aging of containment internal structural concrete components for loss of material, cracking, and change in material properties through inspections performed by its systems and structural monitoring aging management program. The systems and structures monitoring program is discussed in greater detail in Section 3.1.3 of this SER.

3.6.1.4.3 Conclusion

The staff has reviewed the information in Sections 3.6.1.2, “Containment Internal Structural Concrete Components,” and 2.4, “Scoping and Screening Results — Structures,” as well as the applicable aging management program descriptions provided in Appendix B to the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the containment internal structural concrete components will be adequately managed so that there is reasonable assurance that these structural components will perform their intended functions in accordance with the CLB during the period of extended operation.

3.6.1.5 Containment Internal Structural Steel Components

3.6.1.5.1 Summary of Technical Information in the Application

Containment internal structure steel components are described in Section 3.6.1.5 of the LRA. The purpose of the containment internal structural steel components is to provide several safety-related functions including serving as a pressure boundary or a fission-product retention barrier, providing structural and/or functional support to safety-and non-safety-related equipment, and serving as missile and flood protection barriers. The following containment internal structural steel components are identified by the applicant:

- equipment component supports
- heating, ventilation, and air-conditioning (HVAC) ductwork supports
- piping supports
- pipe whip restraints
- cable trays, conduits, and supports
- electrical and instrument panels and enclosures
- anchorages/embedments exposed surfaces
- instrument line supports
- instrument racks and frames
- structural steel beams and columns
- stairs, platforms, and grating
- sump screens
- Lubrite plates
- radiant energy shields
- polar crane
- reactor coolant system supports (including reactor vessel supports, steam generator supports, reactor coolant pump supports, pressurizer supports, and the surge line support)
- non-safety-related piping between class break and anchor

The containment internal structural steel components were designed in accordance with the AISC “Manual of Steel Construction.” The materials of construction for the reactor coolant system supports include structural steel, low alloy steel, and carbon steel pipe. The primary bolting material is carbon steel. Pipe segments beyond the safety-related/non-safety-related boundaries are constructed of carbon and stainless steel and consist of piping and inline components.

Containment internal structural steel components are exposed to containment air and treated water. Borated water is also a potential environment for containment internal structural steel components.

The aging effects identified by the applicant that could cause loss of intended function(s) for containment structure steel components are loss of material, cracking, and change in material properties. The aging management programs used by the applicant to manage these aging effects are the ASME Section XI, Subsection IWF inservice inspection program, the boric acid wastage surveillance program, and the systems and structures monitoring program.

3.6.1.5.2 Staff Evaluation

In addition to Section 3.6.1.5 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results – Structures," and the applicable aging management program descriptions provided in Appendix B of the LRA to determine whether the aging effects for the containment internal structural steel components have been properly identified and will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.6.1.5.2.1 Effects of Aging

The aging effects identified by the applicant that could cause loss of intended function(s) for containment internal structural steel components are loss of material, cracking, and change in material properties.

For the loss of material aging effect, applicant identified the following plausible aging mechanisms: (1) material compatibility, (2) mechanical wear, (3) corrosion, and (4) aggressive chemical attack. Of these aging mechanisms, the applicant stated that corrosion and aggressive chemical attack (due to boric acid) are applicable for containment internal structural steel components at Turkey Point that are exposed to containment air or borated water leaks. As such, the applicant committed to manage loss of material using their ASME Section XI, Subsection IWF inservice inspection program or the systems and structures monitoring program for containment internal structural steel exposed to air and their boric acid wastage surveillance program for containment steel exposed to borated water leaks.

For the cracking aging effect, the applicant identified the following plausible aging mechanisms: (1) stress corrosion and (2) fatigue. The applicant stated that neither of these aging mechanisms are applicable for containment internal structural steel components at Turkey Point that are exposed to any environment, and therefore, listed no aging management program to manage cracking in Table 3.6-2 of the LRA.

For the change in material properties aging effect, the applicant identified the following plausible aging mechanisms: (1) elevated temperature, (2) irradiation embrittlement, and (3) creep and stress relaxation. The applicant stated that neither of these aging mechanisms are applicable for containment internal structural steel components at Turkey Point that are exposed to any environment, and therefore, listed no aging management program to manage change in material properties in Table 3.6-2 of the LRA.

In addition to the three aging effects listed above, the staff requested in RAI 3.6.1.5-3 that the applicant provide the technical justification for not including loss of preload as an aging effect for expansion and undercut anchors due to the effects of vibration on the surrounding concrete. In its response, the applicant stated that the FPL design specification for expansion and undercut anchors specifically prohibits the use of these anchors in vibratory service conditions. In addition, the applicant stated that any degradation due to vibratory loading would occur relatively early in plant life and such an occurrence would be detected and corrective actions implemented to preclude recurrence. Therefore, degradation due to vibration is not an aging effect requiring management for Turkey Point. The staff finds this response acceptable.

The staff finds that the applicant's approach for evaluating the applicable aging effects for containment internal structural steel components to be reasonable and acceptable. The staff concludes that the applicant has properly identified the aging effects for containment internal structural steel components.

3.6.1.5.2.2 Aging Management Programs

The aging management programs used by the applicant to manage the above aging effects are the ASME Section XI, Subsection IWF inservice inspection program, the boric acid wastage surveillance program, and systems and structures monitoring program.

The ASME Section XI, Subsection IWF inservice inspection program is credited with managing the effects of loss of material for Class 1, 2, and 3 component supports in the containment. The program provides for a visual inspection of the surfaces of component supports for evidence of surface irregularities such as flaking, blistering, peeling or discoloration. The results of the visual examinations are documented and the component supports that are subjected to corrective measures are reexamined during the next inspection period. The ASME Section XI, Subsection IWF inservice inspection program is discussed in greater detail in Section 3.9.1.3 of this SER.

The boric acid wastage surveillance program is credited for aging management of carbon steel and low alloy steel components for the containment structure. The boric acid wastage surveillance program manages the effects of loss of material due to aggressive chemical attack of steel components through the detection of leakage of coolant containing boric acid. Conditions leading to boric acid corrosion are detected by visual inspections on external surfaces in accordance with plant procedures. In RAI 3.6.1.5-5, the staff requested that FPL provide the basis for omitting the boric acid waste surveillance program as the aging management program for containment anchorages/embedments that are located above the groundwater table or in an air conditioned environment. In its response, the applicant stated that Table 3.6-2 of the LRA lists two types of containment anchorages/embedments, which are located above groundwater. Specifically, these anchorages/embedments are those encased in concrete and those exposed to containment air. For anchorages and embedments that are encased in concrete, the applicant maintains that the surrounding concrete protects the anchorages/embedments; thus, aging management is not required. However, the applicant confirmed that the anchorages/embedments that are exposed to containment air and borated water leaks are subject to the loss of material aging effect, and are managed by the boric acid wastage surveillance program. The boric acid wastage surveillance program is discussed in greater detail in Section 3.9.3 of this SER.

The systems and structures monitoring program is credited with managing the loss of material aging effect due to corrosion for containment internal structural steel components other than component supports. The structural monitoring program provides condition monitoring and appraisal of containment internal structural steel components through periodic visual inspections. In its description of the systems and structures monitoring program, the applicant stated that external surfaces of steel components are examined for evidence of corrosion such as flaking, blistering, peeling or discoloration. The results of the visual inspections are documented and the frequency of the inspection may be adjusted based on the inspection results and industry experience. In RAI 3.6.1.5-1 the staff requested that the applicant explain the omission of the systems and structures monitoring program as an aging management program for the galvanized carbon steel components such as electrical, instrument panels and enclosures, miscellaneous steel (stairs, platforms, and grating). In its response, the applicant stated that galvanized carbon is steel that is not considered to be susceptible to general corrosion except where buried, submerged in fluid, or subject to wetting. Hence, the boric acid wastage surveillance program is the only aging management program for these galvanized carbon steel components. The systems and structures monitoring program is discussed in greater detail in Section 3.1.3 of this SER.

On the basis of the information discussed above, the staff concludes that the applicant has demonstrated that the aging effects for containment internal structural steel components will be adequately managed by the Turkey Point ASME Section XI, Subsection IWF inservice inspection program, the boric acid wastage surveillance program, and the systems and structures monitoring program for the period of extended operation.

3.6.1.5.3 Conclusion

The staff has reviewed the information in Sections 3.6.1.5, “Containment Internal Structural Steel Components,” and 2.4, “Scoping and Screening Results — Structures,” as well as the applicable aging management program descriptions provided in Appendix B to the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the containment internal structural steel components will be adequately managed so that there is reasonable assurance that these structural components will perform their intended functions in accordance with the CLB during the period of extended operation.

3.6.2 Other Structures

3.6.2.1 Steel-in-Air Structural Components

3.6.2.1.1 Summary of Technical Information in the Application

The following steel-in-air structural components are described in Section 3.6.2.1 of the LRA:

- framing, bracing, and connections
- decking, grating, and checkered plate
- stairs and ladders
- exposed anchors and embedments
- piping, duct, and component supports
- non-safety-related piping between class break and anchor
- crane rails and girders

- cable trays, conduits, and electrical enclosures
- instrumentation supports
- instrument racks and frames

The in-scope steel-in-air structural components listed above are found in the auxiliary building, control building, intake structure, turbine building, yard structures, and other smaller, miscellaneous enclosures listed in Tables 3.6-3 through 3.6-20.

The applicant stated that the steel-in-air structural components were designed and constructed in accordance with AISC standards. Turkey Point steel-in-air structural components are constructed of painted or galvanized carbon steel and stainless steel. The applicant stated that pipe segments beyond the safety-related/non-safety-related boundaries are constructed of carbon and stainless steel and consist of piping and inline components. The steel-in-air structural components are exposed to containment air, outdoor, indoor (both air and non-air conditioned), and potential borated water leak environments.

The aging effects identified by the applicant that could cause loss of intended function(s) for steel-in-air structural components are loss of material, cracking, and change in material properties. The aging management programs used by the applicant to manage these aging effects are the systems and structures monitoring program, ASME Section XI, Subsection IWF inservice inspection program, and boric acid wastage surveillance program.

3.6.2.1.2 Staff Evaluation

In addition to Section 3.6.2.1 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results – Structures" and the applicable aging management program descriptions provided in Appendix B to the LRA to determine whether the aging effects for the steel-in-air structural components have been properly identified and will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.6.2.1.2.1 Effects of Aging

The aging effects identified by the applicant that could cause loss of intended function(s) for the steel-in-air structural components are loss of material, cracking, and change in material properties.

For the loss of material aging effect, the applicant identified the following plausible aging mechanisms: (1) mechanical wear, (2) corrosion, (3) and aggressive chemical attack. Of these aging mechanisms the applicant identified corrosion of carbon steel in an air environment and aggressive chemical attack due to boric acid as applicable to steel structural components. As such, the applicant committed to manage loss of material for steel-in-air structural components.

For the cracking aging effect, the applicant identified the following plausible aging mechanisms: (1) stress corrosion and (2) fatigue. The applicant stated that neither of these aging mechanisms is applicable for steel-in-air structural components at Turkey Point, and therefore, listed no aging management program to manage cracking for these components in Tables 3.6-3 through 3.6-20 in the LRA.

For the change in material properties aging effect, the applicant identified thermal and irradiation embrittlement as a plausible aging mechanism. The applicant determined that since none of the steel-in-air structural components outside the containment are exposed to elevated temperatures or fluences that would cause reduction in fracture toughness, that change in material properties is not an aging effect requiring management for steel-in-air structural components.

The staff finds the applicant's approach for evaluating the applicable aging effects for steel-in-air structural components to be reasonable and acceptable. The staff concludes that the applicable aging effects for steel-in-air structural components have been properly identified.

3.6.2.1.2.2 Aging Management Programs

The aging management programs used by the applicant to manage the above aging effects are the ASME Section XI, Subsection IWF inservice inspection program, the boric acid wastage surveillance program, and systems and structures monitoring program.

The ASME Section XI, Subsection IWF inservice inspection program is credited with managing the effects of loss of material for Class 1, 2, and 3 component supports in the auxiliary building, containment, emergency diesel generator buildings, and yard structures. The program provides for a visual inspection of the surfaces of component supports for evidence of surface irregularities such as flaking, blistering, peeling or discoloration. The results of the visual examinations are documented and the component supports that are subjected to corrective measures are reexamined during the next inspection period. The ASME Section XI, Subsection IWF inservice inspection program is discussed in greater detail in Section 3.9.1.3 of this SER.

The boric acid wastage surveillance program is credited for aging management of carbon steel and low alloy steel components for several different systems and structures. The boric acid wastage surveillance program manages the effects of loss of material due to aggressive chemical attack of steel components through the detection of leakage of coolant containing boric acid. Conditions leading to boric acid corrosion are detected by visual inspections on external surfaces in accordance with plant procedures. The boric acid wastage surveillance program is discussed in greater detail in Section 3.9.3 of this SER.

The systems and structures monitoring program is credited with managing the loss of material aging effect due to corrosion for steel-in-air structural components other than component supports. The structural monitoring program provides condition monitoring and appraisal of structural steel components through periodic visual inspections. In its description of the systems and structures monitoring program, the applicant stated that external surfaces of steel components are examined for evidence of corrosion such as flaking, blistering, peeling or discoloration. The results of the visual inspections are documented and the frequency of the inspection may be adjusted based on the inspection results and industry experience. In Tables 3.6-3 and 3.6-13 of the LRA, the applicant credited the systems and structures monitoring program with managing the loss of material aging effect for anchorages/embedments located below groundwater elevation. In RAI 3.6.2.1-1 the staff questioned the effectiveness of the systems and structures monitoring program for managing the loss of material aging effect for the normally inaccessible steel components that are enclosed in concrete below groundwater elevation. In its response, the applicant stated that the systems and structures monitoring program will manage aging of concrete below the groundwater elevation by direct visual inspections of exposed surfaces of the concrete structures (i.e., intake structure and auxiliary building). Visual inspections of exposed surfaces of concrete below groundwater elevation will identify signs of degradation (e.g., concrete cracking, spalling, scaling, leaching, discoloration, groundwater in-leakage, or rust stains). Satisfactory inspection of the concrete surfaces will ensure adequate aging management for the steel anchorages/embedments below groundwater elevation. The applicant's response is acceptable to the staff. The systems and structures monitoring program is discussed in greater detail in Section 3.1.3 of this SER.

On the basis of the information discussed above, the staff concludes that the applicant has demonstrated that the aging effects for steel-in-air structural components will be adequately managed by the Turkey Point ASME Section XI, Subsection IWF inservice inspection program, the boric acid wastage surveillance program, and the systems and structures monitoring program for the period of extended operation.

3.6.2.1.3 Conclusion

The staff has reviewed the information in Sections 3.6.2.1, "Steel-In-Air Structural Components," and 2.4, "Scoping and Screening Results — Structures," as well as the applicable aging management program descriptions provided in Appendix B to the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the steel-in-air structural components will be adequately managed so that there is reasonable assurance that these structural components will perform their intended functions in accordance with the CLB during the period of extended operation.

3.6.2.2 Steel-in-Fluid Structural Components

3.6.2.2.1 Summary of Technical Information in the Application

The following steel-in-fluid structural components are described in Section 3.6.2.2 of the LRA:

- refueling pool cavity liner plates
- spent fuel pool liner plates
- spent fuel handling equipment and tools
- spent fuel pool keyway gates
- fuel transfer tubes, penetration sleeves, and gate valves
- reactor cavity seal rings
- spent fuel pool anchorages and embedments
- intake structure traveling screens

The in-scope steel-in-fluid structural components listed above are found primarily in the intake structure, spent fuel storage and handling, and yard structures listed in Tables 3.6-13, 3.6-16, and 3.6-20.

The applicant stated that the steel-in-fluid structural components were designed and constructed in accordance with AISC standards. Turkey Point steel-in-fluid structural components are constructed of painted or galvanized carbon steel and stainless steel. In addition, the spent fuel storage racks contain Boraflex panels. The steel-in-fluid structural components are exposed to fluid environments of raw water, borated water, and indoor, outdoor and containment air environments.

The aging effects identified by the applicant that could cause loss of intended function(s) for steel-in-fluid structural components are loss of material, cracking, and change in material properties. The aging management programs used by the applicant to manage these aging effects are the systems and structures monitoring program, Boraflex surveillance program, chemistry control program, and periodic surveillance and preventive maintenance program.

3.6.2.2.2 Staff Evaluation

In addition to Section 3.6.2.2 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, “Scoping and Screening Results – Structures,” and the applicable aging management program descriptions provided in Appendix B of the LRA to determine whether the aging effects for the steel-in-fluid structural components have been properly identified and will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.6.2.2.2.1 Effects of Aging

The aging effects identified by the applicant that could cause loss of intended function(s) for the steel-in-fluid structural components are loss of material, cracking, and change in material properties.

For the loss of material aging effect, the applicant identified the following plausible aging mechanisms: (1) leaching, (2) aggressive chemical attack, (3) mechanical wear, and (4) corrosion. In Appendix C of the LRA, the applicant stated that leaching, aggressive chemical attack, and mechanical wear are not aging mechanisms that can lead to the loss of material aging effect for steel-in-fluid structural components. Loss of material due to selective leaching is an aging effect requiring management for admiralty brass, brass, and gray cast iron in treated water environments and is not applicable to structural steel components. Aggressive chemical attack due to boric acid is an applicable aging mechanism for steel-in-air structural components, since steel-in-air may be exposed to highly concentrated boric acid solutions resulting from borated water leaks. However, steel-in-fluid structural components are not exposed to highly concentrated boric acid solutions and therefore the applicant determined that aggressive chemical attack is not an applicable aging mechanism that will lead to the loss of material aging effect. The applicant also determined that there is no mechanical wear for the in-scope steel-in-fluid structural components. Corrosion is identified as an aging mechanism that can lead to the loss of material aging effect for steel-in-fluid structural components.

For the cracking aging effect, the applicant identified the following plausible aging mechanisms: (1) fatigue, (2) hydrogen damage and (3) stress corrosion cracking. In Appendix C of the LRA, the applicant stated that none of these three aging mechanisms can lead to the cracking aging effect for steel-in-fluid structural components at Turkey Point, and therefore, listed no aging management program to manage cracking for these components in Tables 3.6-3 through 3.6-20 in the LRA. The applicant stated that vibration induced fatigue is fast acting and typically detected early in a component’s life, at which time corrective actions are initiated to prevent recurrence. These corrective actions typically involve modifications to the plant, such as the addition of supplemental restraints to a piping system, replacement of tubing with flexible hose, etc. Based upon these considerations, the applicant concluded that cracking due to vibration induced fatigue is not an aging effect requiring management. The applicant also concluded, based on its own operating experience and a review of other PWR treated water systems, that cracking due to hydrogen damage is not an aging effect requiring management for stainless steel components. The applicant also stated that for carbon steels, stress corrosion cracking occurs most commonly in the presence of aqueous chlorides. Industry data do not indicate a significant problem of stress corrosion cracking of low strength carbon steels. Therefore, the applicant concluded that stress corrosion cracking of carbon steels is not an aging effect requiring management. Based on the above, the applicant concluded that cracking is not an aging effect requiring management for steel-in-fluid structural components.

For the change in material properties aging effect, the applicant identified the following plausible aging mechanisms: (1) creep and stress relaxation and (2) thermal and irradiation embrittlement. Regarding creep and stress relaxation, the applicant stated that this aging mechanism can lead to change in material properties for steel components if the component operating temperature approaches or exceeds the crystallization temperature for the metal. Austenitic stainless steel with temperatures less than 800 °F and carbon steel and low alloy steels with temperatures less than 700 °F are not susceptible to creep and stress relaxation. All Turkey Point plant systems operate at temperatures below 700 °F and, thus, are not susceptible to creep and stress relaxation. Therefore, the applicant concluded that creep and stress relaxation would not lead to change in material properties for steel-in-fluid structural components at Turkey Point. Regarding thermal and irradiation embrittlement, the applicant stated that steel-in-fluid structural components outside containment are not exposed to the elevated temperatures or fluences that would cause reduction in fracture toughness. However, the applicant stated that Boraflex panels, which are neutron absorbers inserted between the fuel storage cells in high-density fuel storage racks, are susceptible to change in material properties resulting from irradiation embrittlement.

The staff finds the applicant's approach for evaluating the applicable aging effects for steel-in-fluid structural components to be reasonable and acceptable. The staff concludes that the applicable aging effects for steel-in-fluid structural components have been properly identified.

3.6.2.2.2.2 Aging Management Programs

The aging management programs used by the applicant to manage the above aging effects are the Boraflex surveillance program, the chemistry control program, and the systems and structures monitoring program.

The Boraflex surveillance program is credited with managing the change in material properties aging effect for the Boraflex panels that are inserted between the fuel storage cells in the fuel storage racks. The Boraflex surveillance program seeks to determine the amount of degradation of the Boraflex material through blackness testing and tracking of the spent fuel pool silica levels. The results of the Boraflex surveillance testing are evaluated to determine the schedule for subsequent testing. The Boraflex surveillance program is discussed in greater detail in Section 3.9.2 of this SER.

The chemistry control program is credited with managing the loss of material aging effect for spent fuel storage and handling stainless steel components in a treated water-borated environment. The chemistry control program includes sampling activities and analysis for treated water-borated that determine the amount of corrosion inhibitors that is introduced to prevent loss of material. The acceptance criteria for the chemistry control program are in accordance with the Nuclear Chemistry Parameters Manual, Technical Specifications, and appropriate plant procedures. The chemistry control program is discussed in greater detail in Section 3.1.1 of this SER.

The systems and structures monitoring program is credited with managing the loss of material aging effect for most of the steel-in-fluid structural components. The structural monitoring program provides condition monitoring and appraisal of components through periodic visual inspections. In its description of the systems and structures monitoring program, the applicant stated that external surfaces of steel components are examined for evidence of corrosion such as flaking, blistering, peeling or discoloration. The results of the visual inspections are documented and the frequency of the inspection may be adjusted based on the inspection results and industry experience. The systems and structures monitoring program is discussed in greater detail in Section 3.1.3 of this SER.

On the basis of the information discussed above, the staff concludes that the applicant has demonstrated that the aging effects for steel-in-fluid structural components will be adequately managed by the Boraflex surveillance program, the chemistry control program, and the systems and structures monitoring program for the period of extended operation.

3.6.2.2.3 Conclusion

The staff has reviewed the information in Sections 3.6.2.2, “Steel-In-Fluid Structural Components,” and 2.4, “Scoping and Screening Results — Structures,” as well as the applicable aging management program descriptions provided in Appendix B to the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the steel-in-fluid structural components will be adequately managed so that there is reasonable assurance that these structural components will perform their intended functions in accordance with the CLB during the period of extended operation.

3.6.2.3 Concrete Structural Components

3.6.2.3.1 Summary of Technical Information in the Application

The concrete structural components are described in Section 3.6.2.3 of the LRA. Concrete structural components include foundations, columns, walls, floors, roofs, equipment pads, electric duct banks, manholes, trenches, masonry block walls, embedded steel, embedded anchors, and concrete piping. The in-scope concrete structural components listed above are found in the auxiliary building, cold chemistry lab, control building, diesel driven fire pump enclosure, discharge structure, electrical penetration rooms, emergency diesel generator buildings, intake structure, main steam and feedwater platforms, plant vent stack, spent fuel storage and handling room, turbine building, chimneys, and yard structures, listed in Tables 3.6-3 through 3.6-20.

The applicant stated that the concrete structural components were designed and constructed in accordance with ACI and ASTM standards. Turkey Point concrete structural components are exposed to environments of outdoor, indoor-not air-conditioned, indoor-air conditioned, buried, raw water cooling canals, and embedded/encased.

The aging effects identified by the applicant that could cause loss of intended function(s) for concrete structural components are loss of material, cracking, and change in material properties. The aging management program used by the applicant to manage these aging effects is the systems and structures monitoring program.

3.6.2.3.2 Staff Evaluation

In addition to Section 3.6.2.3 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results – Structures," and the applicable aging management program descriptions provided in Appendix B of the LRA to determine whether the aging effects for the containment structure concrete components have been properly identified and will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.6.2.3.2.1 Effects of Aging

The aging effects identified by the applicant that could cause loss of intended function(s) for concrete structural components are loss of material, cracking, and change in material properties. Loss of material is manifested in concrete structural components as scaling, spalling, pitting and erosion. Cracking is manifested in concrete structural components as complete or incomplete separation of the concrete into two or more parts. Change in material properties is manifested in concrete structural components as increased permeability, increased porosity, reduction in pH value, reduction in tensile strength, reduction in compressive strength, reduction in modulus of elasticity, and reduction in bond strength.

For the loss of material aging effect, the applicant identified the following plausible aging mechanisms: (1) freeze-thaw, (2) abrasion and cavitation, (3) elevated temperature, (4) aggressive chemical attack, and (5) corrosion of reinforcing and embedded/encased steel. Of these aging mechanisms, the applicant stated that only aggressive chemical attack and corrosion of reinforcing and embedded steel are applicable for concrete structural components exposed to groundwater or saltwater. As such, the applicant committed to manage loss of material only for reinforced concrete structures that are below groundwater elevation or exposed to saltwater.

For the cracking aging effect, the applicant identified the following plausible aging effects: (1) freeze-thaw, (2) reactions with aggregates, (3) fatigue, (4) shrinkage, (5) settlement, and (6) elevated temperature. Of these aging mechanisms, the applicant stated that only shrinkage and settlement are applicable for unreinforced masonry block walls at Turkey Point. For all other concrete structural components, the applicant stated that none of the above aging mechanisms are applicable and therefore, listed no aging management program to manage cracking for these components in Tables 3.6-3 through 3.6-20 of the LRA. For unreinforced masonry block walls, the applicant committed to using the systems and structures monitoring aging management program to manage cracking.

For the change in material properties aging effect, the applicant identified the following plausible aging effects: (1) leaching, (2) creep, (3) elevated temperature, (4) irradiation embrittlement, and (5) aggressive chemical attack. Of these aging mechanisms, the applicant stated that only aggressive chemical attack is applicable for concrete structural components exposed to groundwater or saltwater. As such, the applicant committed to manage change in material properties only for concrete structural components that are below groundwater elevation or exposed to saltwater.

The staff considers that each of the above aging effects (loss of material, cracking, change in material properties) are both plausible and applicable for containment internal structural concrete components. As such, in RAI 3.6.2.1-2 the staff requested that the applicant provide an aging management program to manage the aging of concrete structural components. In its initial response, the applicant reasserted its position that aging management reviews performed on above groundwater reinforced concrete did not identify any aging effects requiring management. However, FPL proposed to use its inspections of containment structure concrete components through the ASME Section XI, IWL inservice inspection program as an indicator for the condition of other reinforced concrete structures. Subsequent communication between the staff and FPL culminated in a staff letter, dated October 30, 2001, in which the staff asserted its position that all concrete structures within the scope of license renewal require aging management. In its response to the staff's position (see supplemental response to RAI 3.6.2.1-2 dated November 1, 2001), the applicant committed to manage the aging of concrete structural components for loss of material, cracking, and change in material properties through inspections performed by its systems and structural monitoring aging management program. Once incorporated, as committed in this response, the staff considers this issue to be resolved.

3.6.2.3.2.2 Aging Management Programs

The aging management program used by the applicant to manage the above aging effects is the systems and structures monitoring program. The structural monitoring program provides condition monitoring and appraisal of concrete structural components through periodic visual inspections. In its supplemental response to RAI 3.6.2.1-2 (dated November 1, 2001), the applicant stated that the "Parameters Monitored or Inspected" section of the systems and structural monitoring program has been revised to include the monitoring for change in material properties, cracking, and loss of material of all reinforced concrete components and not just those concrete components located below groundwater elevation or exposed to saltwater. The results of the visual inspection for systems, structures and components will be documented and the frequency for the inspection may be adjusted, as necessary, based on the inspection results and industry experience. In RAI 3.6.2.3-1, the staff requested that the applicant identify the specific inspection procedure used by the systems and structures monitoring program for monitoring the condition of masonry block walls. In its response, the applicant stated that the inspection procedures require visual inspection of masonry walls for signs of degradation, including cracks, missing or degraded mortar, missing or degraded masonry units, and degradation at bracing connections. When cracks are identified, they are evaluated under the Corrective Action Program to ensure the extent of cracking does not invalidate the evaluation basis established either in response to IEB 80-11 or established for implementation of USI A-46. The response is acceptable to the staff because all the components of the masonry block walls are inspected and the safety of the masonry block walls is evaluated against the acceptable criteria to the staff. The systems and structures monitoring program is discussed in more detail in Section 3.1.3 of this SER.

On the basis of the information discussed above, the staff concludes that the applicant has demonstrated that the aging effects for concrete structural components and masonry block walls will be adequately managed by the systems and structures monitoring program for the period of extended operation.

3.6.2.3.3 Conclusion

The staff has reviewed the information in Sections 3.6.2.3, "Concrete Structural Components," 2.4, "Scoping and Screening Results — Structures," as well as the applicable aging management program descriptions provided in Appendix B to the LRA and responses to the staff's RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the concrete structural components will be adequately managed so that there is reasonable assurance that these structural components will perform their intended functions in accordance with the CLB during the period of extended operation.

3.6.2.4 Miscellaneous Structural Components

3.6.2.4.1 Summary of Technical Information in the Application

Miscellaneous structural components are described in Section 3.6.2.4 of the LRA. Miscellaneous structural components include fire rate assemblies, cooling water canals, weatherproofing, flood protection seals and stop logs, and control room ceiling and raised floor. The in-scope miscellaneous structural components listed above are found in the control building, cooling water canals, electrical penetration rooms, emergency diesel generator buildings, fire protection monitoring station, fire rated assemblies, spent fuel storage and handling, and turbine building listed in Tables 3.6-3 through 3.6-20.

The applicant stated that the miscellaneous structural components consist of a variety of materials including painted and galvanized carbon steel, aluminum, earth/rock, wood, gypsum board, acoustical panels, weatherproofing materials, and fire protection materials. Turkey Point miscellaneous structural components are exposed to environments of outdoor and indoor air (both air and non-air conditioned).

The aging effects identified by the applicant that could cause loss of intended function(s) for miscellaneous structural components are loss of material and loss of seal. The aging management programs used by the applicant to manage these aging effects are the systems and structures monitoring program, fire protection program, and periodic surveillance and preventive maintenance program.

3.6.2.4.2 Staff Evaluation

In addition to Section 3.6.2.3 of the LRA, the staff reviewed the pertinent information provided in Section 2.4, "Scoping and Screening Results – Structures," and the applicable aging management program descriptions provided in Appendix B of the LRA to determine whether the aging effects for the miscellaneous structural components have been properly identified and will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.6.2.4.2.1 Effects of Aging

The aging effects identified by the applicant that could cause loss of intended function(s) for the miscellaneous structural components are loss of material and loss of seal.

Aging mechanisms, identified by the applicant, that can lead to the loss of material aging effect for miscellaneous structural components are wear, weathering, corrosion, and organic decomposition. The applicant evaluated each of these aging mechanisms for loss of material of the fire rated assemblies, cooling water canals, weatherproofing (structures and sealants), control room ceiling and raised floor, and the fire protection monitoring station miscellaneous structural components. In particular, the applicant determined that loss of material due to (1) weathering is an aging effect requiring management for Thermo-Lag insulation materials, (2) corrosion is an aging effect requiring management for certain fire doors since these doors are constructed of carbon steel, and (3) organic decomposition is an aging effect requiring management for wooden stop logs, which provide flood protection. However, the applicant determined that loss of material is not an applicable aging effect for (1) the control room ceiling and raised floor and the fire protection monitoring station since these are indoor - air conditioned environments that are occupied 24 hours per day, (2) fire penetration seals, as concluded in SECY 96-146, (3) the cooling water canals and (4) aluminum stop logs. In response to RAI 3.6.2.4-1, the applicant stated that based on its plant operating experience and the findings of SECY 96-146, fire penetration seals are not subject to aging effects. The applicant further clarified that, as part of the plants' existing fire protection program mandated by Appendix R to 10 CFR Part 50 and Branch Technical Position (BTP) 9.5-1, visual inspections of the fire penetrations will continue to be performed. In response to RAI 3.6.2.4-3, the applicant stated that since aluminum is highly resistant to corrosion, there are no aging effects that would cause a loss of intended function for aluminum stop logs and pipe trench penetration seals. Based on the above, the applicant concluded that loss of material due to weathering, corrosion, and organic decomposition is an aging effect requiring management for miscellaneous structural components. The staff concurs with the applicant's conclusions.

The aging mechanism, identified by the applicant, that can lead to loss of seal for miscellaneous structural components is weathering. The applicant determined that loss of seal due to weathering is an aging effect requiring management for manholes and associated sealants, weatherproofing components, and pipe trench penetration seals. Regarding the flood protection provided by wooden and aluminum stop logs, the applicant stated, in response to RAI 3.6.2.4-4, that the purpose of the wooden and aluminum stop logs is to provide a flood protection barrier against wave run-up and that the stop logs are not intended to be leak-tight barriers. The staff agrees with the applicant's response.

The staff finds the applicant's approach for evaluating the applicable aging effects for miscellaneous structural components to be reasonable and acceptable. The staff concludes that the applicable aging effects for miscellaneous structural components have been identified.

3.6.2.4.2.2 Aging Management Programs

The aging management programs used by the applicant to manage the above aging effects are the systems and structures monitoring program, fire protection program, and periodic surveillance and preventive maintenance program.

The systems and structures monitoring program is credited with managing the loss of material and loss of seal aging effects for many of the miscellaneous structural components. The structural monitoring program provides condition monitoring and appraisal of components through periodic visual inspections. In its description of the systems and structures monitoring program, the applicant stated that external surfaces of steel components are examined for evidence of corrosion such as flaking, blistering, peeling or discoloration and inspection of weatherproofing material for deterioration is performed. The results of the visual inspections are documented and the frequency of the inspection may be adjusted based on the inspection results and industry experience. The systems and structures monitoring program is discussed in greater detail in Section 3.1.3 of this SER.

The fire protection program is credited for aging management of specific components associated with fire protection and fire rated assemblies. The fire protection program manages the loss of material and loss of seal aging effects for the miscellaneous structural components associated with fire protection. The fire protection program provides condition monitoring and appraisal of components through periodic visual inspections. In its description of the fire protection program, the applicant stated that component surface conditions are monitored visually to determine the extent of external material degradation such as loss of material due to general, crevice, and pitting corrosion; and loss of seal or cracking due to embrittlement. The results of the visual inspections are documented and the frequency of the inspection may be adjusted based on the inspection results and industry experience. The fire protection program is discussed in greater detail in Section 3.9.8 of this SER.

The periodic surveillance and preventive maintenance program is credited for aging management of weatherproofing, pipe trench penetrations, and wooden stop logs. The periodic surveillance and preventive maintenance program manages the loss of material and loss of seal aging effects for these miscellaneous structural components. The periodic surveillance and preventive maintenance program provides condition monitoring and appraisal of components through periodic visual inspections. In its description of the periodic surveillance and preventive maintenance program, the applicant stated that component surface conditions are monitored visually to determine the extent of material degradation, such as loss of material due to organic decomposition and loss of seal due to weathering. The results of the visual inspections are documented, and the frequency of the inspection may be adjusted based on the inspection results and industry experience. The periodic surveillance and preventive maintenance program is discussed in greater detail in Section 3.9.11 of this SER.

3.6.2.4.3 Conclusion

The staff has reviewed the information in Sections 3.6.2.4, “Miscellaneous Structural Components,” and 2.4, “Scoping and Screening Results — Structures,” as well as the applicable aging management program descriptions provided in Appendix B to the LRA and responses to the staff’s RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that the aging effects associated with the miscellaneous structural components will be adequately managed so that there is reasonable assurance that these structural components will perform their intended functions in accordance with the CLB during the period of extended operation.

3.7 Electrical and Instrumentation and Controls

The applicant described its AMR results of electrical/I&C components requiring AMR at Turkey Point, Units 3 and 4, in Section 3.7 of the LRA. The staff reviewed this section of the application to determine whether the applicant has demonstrated that the effect of aging on the electrical/I&C components will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

On the basis of this review, the staff requested additional information in a letter to the applicant, dated January 17, 2001. The applicant responded to this request for additional information (RAI) in a letter to the staff, dated March 30, 2001. The applicant provided supplemental responses to the staff's RAI 3.7.1-1 on May 11 and May 29, 2001.

3.7.1 Summary of Technical Information in the Application

3.7.1.1 Non-Environmentally Qualified Insulated Cables and Connections, and Electrical/I&C Penetrations

In Section 3.7.1.1 of the LRA, the applicant described the process used to identify the applicable aging effects of the electrical/I&C components. The process is based on the Department of Energy (DOE) aging management guide (AMG). This AMG provides a comprehensive compilation and evaluation of information on the insulated cables and connections, spliced connections, and terminal blocks. The electrical/I&C non-metallic materials are also evaluated with the cable and connector materials in this AMG. The DOE Cable AMG evaluated the stressors acting on cable and connection components, industry data on aging and failures of these components, and the maintenance activities performed on cable systems. Also evaluated were the main subsystem within cables, including the conductors, insulation, shielding, tape wraps, and jacketing, as well as all subcomponents associated with each type of connection.

The applicant also identified, evaluated, and correlated the principal aging mechanisms and anticipated effects resulting from environmental and operating stresses with plant experience to determine whether the predicted effects are consistent with field experience. As such, the information, evaluations, and conclusions contained in the DOE Cable AMG are used for the evaluation of aging effects.

The most significant and observed aging mechanisms for insulated cable and connections are listed in the DOE Cable AMG, Table 4-18. The applicant used the aging mechanisms from that table as the starting point for identifying aging effects for insulated cables and connections. The applicant presents the potential aging effects along with the applicable stressors that are evaluated for insulated cables and connections in Table 3.7-1 of the LRA.

In its response to the NRC letter dated March 30, 2001, the applicant also states that in order to provide reasonable assurance that the intended functions of non-environmentally qualified (EQ) cables, connections, and penetration exposed to postulated adverse localized equipment environments caused by heat or radiation will be maintained consistent with the CLB throughout the period of extended operation, the applicant proposes an AMP for non-EQ cables, connections, and penetration in the containment at Turkey Point. The non-EQ cables, connections, and penetrations managed by this program include those used for power and instrumentation and control that are within the scope of license renewal.

The applicant stated that this program is an acceptable aging management program for non-EQ cables, connections and penetration within the scope of license renewal exposed to adverse localized equipment environments due to heat and radiation in the Turkey Point Containment. This program will be added to the Turkey Point LRA.

3.7.1.1.1 Low-Voltage Metal Connector Contact Surfaces — Moisture and Oxygen

The applicant stated that the DOE AMG states that 3% of all low-voltage metal connector failures were identified as being caused by moisture intrusion. In each case, the source of moisture was precipitation. Based on the total number of reported connector failures in the DOE Cable AMG, moisture intrusion accounted for only 10 failures in all of the operating plants in the United States.

The applicant indicates structures where electrical/I&C components may be exposed to moisture in Table 3.7-2 of the LRA. The potential moisture sources from Table 3.7-2 that are applicable to connectors at Turkey Point are precipitation and potential boric acid leaks. The applicant also indicated that all metal connectors are located in enclosures or protected from the environment with Raychem splices. Thus, aging related to moisture and oxygen do not require an AMP for low-voltage connectors at Turkey Point. The applicant also noted that electrical enclosures are treated as structural components and are discussed with each structure, as applicable, in Section 3.6 of the LRA.

3.7.1.1.2 Low-Voltage Metal Compression Fittings – Vibration and Tensile Stress

The applicant states that the aging mechanism of mechanical stress will not result in aging effects requiring AMP for the following reasons:

- Damage to cables during installation at Turkey Point is unlikely due to standard installation practices, which include limitations on cable pulling tension and bend radius. Even though installation damage is unlikely, most (including all safety-related) cables are tested after installation and before operation. Failures induced by installation damage generally occur within a short time after the damaged cable is energized.

- NRC resolution of License Renewal Issue No. 98-0013, which states, “Based on the above evaluation, the staff concludes that the issue of degradation induced by human activities need not be considered as a separate aging effect and should be excluded from an AMR.”

- Mechanical stress due to forces associated with electrical faults is mitigated by the fast action of circuit protective devices at high currents. However, mechanical stress due to electrical faults is not considered an aging mechanism since such faults are infrequent and random in nature.

- Vibration is generally induced in cables and connections by the operation of external equipment, such as compressors, fans, and pumps. Vibration can affect cable connections at a running motor by producing fatigue damage of the metallic cable or termination components in the immediate vicinity of the connection point. Normally, there has to be some physical damage as well to have an effect (e.g., a nicked connector). Terminations at equipment are part of the equipment and are inspected and maintained along with the equipment. These terminations are not within the evaluation boundary for insulated cable and connections and are not included in the insulated cable and connection review.

- Manipulation of cables is not considered an aging mechanism since such manipulation occurs during maintenance activities. Such activities require post-maintenance testing to detect any deficiency in the cables. Any evidence of cable abnormalities would result in condition being addressed under the corrective program.

3.7.1.1.3 Medium-Voltage Cable and Connections and Electrical/I&C Penetration Insulation – Moisture and Voltage Stress

The applicant stated that electrical/I&C penetrations are not located in structures exposed to outside ambient conditions and therefore, not subject to moisture.

In Table 3.7-2 of the LRA, the applicant indicates structures where electrical/I&C cable and connectors may be exposed to moisture. The effects of moisture-produced water trees on medium-voltage cable were examined in Section 4.1.2.5 of the DOE Cable AMG. Water trees occur when the insulating materials are exposed to long-term, continuous electrical stress and moisture. These trees eventually result in breakdown of the dielectric materials and ultimate failure. The growth and propagation of water trees is somewhat unpredictable and few occurrences have been noted for cables operated below 15 kV. Water treeing is a long-term degradation and failure phenomenon that is documented only for medium-voltage electrical cable with cross-linked polyethylene (XLPE) or high molecular weight polyethylene (HMWPE) insulation. However, some cables are located in structures exposed to outside ambient conditions and are evaluated for the potential of moisture-produced water trees.

The applicant also indicates that Turkey Point Unit 3 and 4 medium-voltage applications, defined as 2 kV to 15 kV, use lead sheath cable to prevent effects of moisture on the cables. In addition, the applicant indicated Turkey Point does not use XLPE or HMWPE insulated cable in medium-voltage applications. Therefore, aging effects related to cable exposed to moisture and voltage stress do not require AMP at Turkey Point.

3.7.1.1.4 Medium-and Low-Voltage Cable and Connections and Electrical/I&C Penetration Insulation — Radiation and Oxygen

The applicant states that DOE Cable AMG, Section 4.1.4, Table 4-7, provides a threshold value and a moderate dose for various insulating materials. The threshold value is the amount of radiation that causes incipient to mild insulation damage. Once this threshold is exceeded, damage to the insulation increases from mild to moderate to severe as the total dose increases. The moderate damage value indicates the value at which the insulating material has been damaged but is still functional. Turkey Point evaluations use the moderate damage dose from the DOE Cable AMG as the limiting radiation value. The maximum operating dose and moderate damage dose of insulation material is shown in Table 3.7-3 of the LRA. The maximum operating dose shown in Table 3.7-3 includes the maximum 60-year normal exposure for inside containment.

The applicant compares the maximum operating dose and the moderate damage doses in Table 3.7-3 and indicates that all of the insulation materials included in this AMR will not exceed the moderate damage doses and concludes that aging effects caused by radiation exposure will not adversely affect the intended function of insulated cables and connections and electrical/I&C penetration during the extended period of operation. Therefore, the applicant concludes that aging effects related to radiation do not require an AMP for cables and connections and electrical/I&C penetrations.

3.7.1.1.5 Medium- and Low-Voltage Cable and Connections and Electrical/I&C Penetration Insulation – Heat and Oxygen

The applicant states that a maximum operating temperature was developed for each insulation type based on cable application at Turkey Point, Units 3 and 4. The maximum operating temperature indicated in Table 3.7-4 in the LRA incorporates a value for self-heating for power applications combined with the maximum design ambient temperature.

The applicant used Arrhenius method, as described in EPRI NP-1558, “A Review of Equipment Aging Theory and Technology,” to determine the maximum continuous temperature to which the insulation material can be exposed so that the material has an indicated “endpoint of 60 years.” These limiting temperatures for 60 years of service are provided in Table 3.7-4.

The applicant then compared the maximum operating temperature to the maximum 60-year continuous use temperature for the various insulation materials and indicated that except for polyethylene (PE) and Butyl used in power application, all of the insulation materials used in low- and medium-voltage power cables and connections can withstand the maximum operating temperature for at least 60 years.

For PE and Butyl cable insulation, the applicant states that the maximum operating temperatures, including self-heating, for PE and Butyl are 138.7 °F and 132.6 °F, respectively. The maximum temperatures for a 60-year life are 131 °F for PE and 125.1 °F for Butyl, which are 7.7 °F and 7.5 °F, respectively, less than the maximum operating temperature. The applicant states that the difference is small and is considered to be within the conservatism incorporated in the maximum operating temperatures and the maximum 60-year continuous use temperature.

The applicant also states that Butyl and PE insulated cables and connections are not used in containment and are not subject to an accident environment. Therefore, the endpoints chosen for this aging management review are extremely conservative and the 60-year endpoint values can be reduced without a loss of function, thus resulting in higher maximum 60-year continuous use temperatures.

The applicant states that maximum operating temperature in the application Table 3.7-4 includes a calculated self-heating temperature rise that assumes normal operation 100% of the time since receipt of the original operating licenses. In addition, the actual daily and seasonal temperature vary from 30 °F to 95 °F, which is less than the 104 °F limit assumed in the calculation of 60-year lifetime for Butyl and PE. The Turkey Point units have historically operated less than the 90% of the time since receipt of the original operating licenses. This amount of shutdown time lessens the amount of aging actually occurring and thus extends the lives of the materials.

Given these conservatisms, the applicant states that there is reasonable assurance that PE and Butyl insulated cables will not thermally age to the point at which they will not be able to perform their intended function during the period of extended operation. The applicant states that aging effects related to heat and oxygen do not require management for cables and electrical/I&C penetration included in the aging management review.

3.7.1.2 Uninsulated Ground Conductors

The applicant states that the ground cable material used at Turkey Point, Units 3 and 4, is copper. Copper is a good choice for this application because of its high electrical conductivity, high fusing temperature, and high corrosion resistance. Copper is also relatively strong, and it is easy to join by welding, compression, or clamping. Ground connections are commonly made with welds or mechanical type connectors, which include compression-, bolted-, and wedge-type devices.

The applicant also states that a review of available technical information regarding material aging revealed that there are no aging effects requiring management for copper grounding materials. In addition, a review of industry and plant operating experiences did not identify any failures of copper grounding systems due to aging effects. Also, several underground portions of the Turkey Point grounding system were inspected during plant modification to add two additional emergency diesel generators in 1990 and 1991 and no aging-related effects were identified. The system was approximately 20 years old at the time of that inspection. The portion of the grounding system inspected is buried in the same type of soil as other underground portions of the grounding system. Therefore, based on industry and plant-specific experiences, no aging effects requiring management were identified for the plant grounding system.

The applicant also reviewed industry and plant operating experience to ensure that no unique aging effects exist beyond those discussed in Section 3.7 for cables and connections.

3.7.2 Staff Evaluation

The staff evaluated the information on aging management presented in the LRA, Section 3.7 and in the applicant's response to the staff RAIs, dated March 30, May 11, and May 29, 2001, to determine if there is a reasonable assurance that the applicant has demonstrated that the effects of aging will be adequately managed, consistent with its CLB throughout the period of extended operation, in accordance with 10 CFR 54.21(a)(3).

3.7.2.1 Aging Management Program

The staff evaluation of the applicant's AMPs focused on the program element rather than details of specific plant procedures. The staff's approach to evaluating each program and activity used to manage the applicable aging effects is described in Section 3.1 of this SER.

[Program Scope] The scope of inspection includes accessible non-EQ cables, connections and penetrations within the scope of license renewal in the containment structures at Turkey Point that are installed in adverse localized environments caused by heat or radiation in the presence of oxygen. The staff found the scope of the program acceptable because it includes cables, connections and penetrations that are subject to potentially adverse localized environments that can result in applicable aging effects on these insulated cables, connections and penetrations.

[Preventive/Mitigative Actions] There are no preventive or mitigative actions taken as part of this program, and the staff did not identify the need for such actions.

[Parameter Inspected/Monitored] Accessible non-EQ cables, connections and penetrations within the scope of license renewal in the containment structures installed in adverse localized environments are visually inspected for cable and connection jacket surface anomalies such as embrittlement, discoloration, of cracking of surfaces. The staff found this approach acceptable because it provides means for monitoring the applicable aging effects for accessible in-scope cables, connections, and penetrations.

[Detection of Aging Effects] Cable and connection jacket surface anomalies are precursor indication of conductor insulation aging degradation from heat or radiation in the presence of oxygen and may indicate existence of an adverse localized equipment environment. An adverse localized environment is a condition in a limited plant area that is significant more severe than the specified service condition for the electrical cable, connection, or penetration. Accessible non-EQ cables, connections, or penetrations that are within the scope of license renewal in the containment structures installed in adverse localized environment are visually inspected at least every 10 years, which is an adequate period to preclude failures of the conductor insulation. The first inspection will be performed before the end of the initial 40-year licence term. EPRI TR-109619, "Guideline for the Management of Adverse Localized Equipment Environments," will be used as guidance in performing inspections. The staff found the inspection scope and inspection technique for accessible non-EQ cables, connections, and penetrations acceptable on the basis that the AMP is focused on detecting change in material properties of the conductor insulation, which is the applicable aging effect when cables and connections are exposed to an adverse, localized environment.

[Monitoring and Trending] Trending actions are not included as part of this program because the ability to trend inspection results is limited. The staff found the absence of a trending program acceptable.

[Acceptance Criteria] No unacceptable visual indications of cables and connection jacket surface anomalies, which suggest that conductor insulation degradation exists, as determined by engineering evaluation. An unacceptable indication is defined as a noted condition or situation that, if left unmanaged, could lead to a loss of the intended function. The staff found these acceptance criteria acceptable because it should ensure that the cables and connections intended functions are maintained under all CLB design condition during the period of extended operation.

[Corrective Actions] Further investigation is performed through the corrective action program on non-EQ cables, connections and penetrations when the acceptance criteria are not met in order to ensure that the intended function will be maintained consistent with the current licensing basis. Corrective action may include, but are not limited to, testing, shielding or

otherwise changing the environment, relocation or replacement of the affected cable, connection, or penetration. Corrective actions implemented as part of the corrective action program are performed in accordance with FPL's 10 CFR Part 50, Appendix B, Quality Assurance Program. As indicated above, if an unacceptable condition or situation is identified for a cable, connections, penetration in the inspection, the applicant will perform further investigation through the corrective action program. However, the applicant did not specifically include a determination of whether the same condition or situation is applicable to other accessible or inaccessible cables, connections and penetration. In this regard, the staff requested the applicant address the aging management associated with inaccessible cables, connections, or penetrations. In response to the staff's request, the applicant specifically requires that when an adverse localized environment is identified for a cable, connection, or penetration, a determination is made as to whether the same condition or situation is applicable to other accessible or inaccessible cables, connections, or penetrations. The staff found the applicant response acceptable because selected cables, connections, and penetrations from accessible areas (the inspection sample) are inspected and represent, with reasonable assurance, all cables, connections, and penetrations in the adverse localized environments. It also found that as discussed in Section 3.1.2 of this report, the requirement of 10 CFR Part 50, Appendix B, acceptable to address corrective actions.

[Confirmation Process] The confirmation process implemented as part of the corrective program is performed in accordance with FPL's 10 CFR Part 50, Appendix B, Quality Assurance Program. As discussed in Section 3.1.2 of this report, the staff found the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process.

[Administrative Controls] Administrative controls associated with this program will be performed in accordance with FPL's 10 CFR Part 50, Appendix B, Quality Assurance Program. The staff found the requirements of 10 CFR Part 50, Appendix B, acceptable to address administrative controls.

[Operating Experience] The licensee did not identify the presence of adverse localized heat and radiation environments in the containment at Turkey Point. However, operating experience identified by the staff in the draft GALL Report has shown that adverse localized environments caused by heat or radiation for electrical cables and connections may exist next to or above (within three feet of) steam generators, pressurizers or hot process pipes such as feedwater lines. The staff found that the proposed inspection program will detect the adverse localized environment caused by heat or radiation of electrical cables and connections.

3.7.2.2 Non-Environmentally Qualified Insulated Cables and connections, and Electrical/I&C Penetrations

The NRC staff has evaluated the information presented in Sections 3.7.1.1.1, 3.7.1.1.2, 3.7.1.1.3, 3.7.1.1.4, 3.7.1.1.5, and 3.7.1.2 of the LRA to determine if there is a reasonable assurance that the applicant has identified the applicable aging effects and the bounding conditions for electrical/I&C components. The process to determine the applicable effect on these components is based on industry literature defining the operating environment and operating stresses for each of the components that are subject to an AMR. The NRC staff reviewed each of the environments and resulting mechanisms and effects as they apply to the electrical/I&C component commodities.

3.7.2.2.1 Low-Voltage Metal Connector Contact Surfaces — Moisture and Oxygen

3.7.2.2.1.1 Effects of Aging

The potential aging mechanisms considered for low-voltage metal connector surfaces is corrosion due to moisture intrusion. Structures where electrical/I&C components may be exposed to moisture are indicated in the LRA Table 3.7-2. The potential moisture sources from this table that are applicable to connectors at Turkey Point are precipitation and potential boric acid leaks. All metal connectors at Turkey Point are located in enclosures or protected from the environment with Raychem splices. Thus, aging effects related to moisture and oxygen do not require management for low-voltage connectors at Turkey Point.

3.7.2.2.1.2 Aging Management Program

The NRC staff has evaluated the information on low-voltage metal connectors as presented in Section 3.7.1.1.1 of the LRA to determine if there is a reasonable assurance that the applicant has demonstrated that the aging affects for low-voltage connectors will be adequately managed, consistent with the applicant’s CLB throughout the period of extended operation.

The staff agrees with the applicant’s assessment and the conclusion that low-voltage connectors are located in enclosure or protected from the environment with Raychem splices and aging effects related to moisture and oxygen do not require an AMP for low-voltage connectors at Turkey Point.

3.7.2.2.2 Low-Voltage Metal Compression Fitting - Vibration and Tensile Stress

3.7.2.2.2.1 Effects of Aging

The aging mechanism of mechanical stress will not result in effects requiring management for the following reasons (1) damage to cables during installation at Turkey Point is unlikely due to standard installation practice, which include limitation on cable pulling tension and bend radius. (2) NRC resolution of License Renewal Issue No. 98-0013 states that the issue of degradation induced by human activities need not be considered as a separate aging affect and should be excluded from an AMR. (3) Mechanical stress due to forces associated with electrical faults is mitigated by the fast action of circuit protective devices at high currents. However, the mechanical stress due to electrical faults is not considered an aging mechanism since such faults are infrequent and random in nature. (4) Vibration is generally induced in cables and connections by the operation of external equipment, such as compressor, fans, and pumps. Vibration can affect cable connections at a running motor by producing fatigue damage of the metallic cable or termination components in the immediate vicinity of the connection point. Normally, there has to be some physical damage as well to have an effect (e.g., a nicked connector). Terminations at equipment are part of the equipment and are inspected and maintained along with the equipment. These terminations are not within the evaluation boundary for insulated cable and connections and are not included in the insulated cable and connection review. (5) Manipulation of cables is not considered an aging mechanism since such manipulation occurs during maintenance activities. Such activities require post-maintenance testing to detect any deficiencies in the cables. Any evidence of cable abnormalities would result in the condition being addressed under the corrective action program.

3.7.2.2.2.2 Aging Management Programs

The staff has evaluated the information on low-voltage metal compression fittings as presented in Section 3.7.1.1.2 of the LRA to determine if there is a reasonable assurance that the applicant has demonstrated that the aging affects for low-voltage metal compression fittings will be adequately managed, consistent with the applicant's CLB throughout the period of extended operation.

The staff agrees with the applicant's assessment and conclusion that aging mechanism of mechanical stress will not result in aging effects requiring an AMP for low-voltage metal compression fittings.

3.7.2.2.3 Medium-Voltage Cable and Connections and Electrical/I&C Penetration Insulation — Moisture and Voltage Stress

3.7.2.2.3.1 Effects of Aging

Electrical/I&C penetrations are not located in structures exposed to outside ambient conditions and, therefore, not subject to moisture.

Structures where electrical/I&C cable and connectors may be exposed to moisture are indicated in Table 3.7-2. Water trees occur when the insulating materials are exposed to long-term, continuous electrical stress and moisture. These trees eventually result in breakdown of the dielectric materials and ultimately failure. The growth and propagation of water trees is somewhat unpredictable, and occurrences have been noted for cable operated below 15 kV. Water treeing is a long-term degradation and failure phenomenon that is documented only for medium-voltage electrical cable with conductor insulation made of various organic polymers (e.g., EPR, SR, EPDM, XLPE).

3.7.2.2.3.2 Aging Management Program

The staff has evaluated the information on medium-voltage cable and connections and electrical/I&C penetration insulation as presented in Section 3.7.1.1.3 of the LRA to determine if there is a reasonable assurance that the applicant has demonstrated that the aging affects for medium-voltage cable, connections, and electrical/I&C penetration insulation will be adequately managed, consistent with the applicant's CLB throughout the period of extended operation.

The applicant states that Turkey Point Unit 3 and 4 medium-voltage applications use lead sheath to prevent effects of moisture on the cables. In addition, the applicant states that Turkey Point does not use XLPE or HMWPE insulated cables in medium-voltage applications and, therefore, the aging effects related to cable exposed to moisture and voltage stress do not require an AMP at Turkey Point.

Most electrical cables in nuclear power plant are located in dry environments. However, some cables may be exposed to condensation and wetting in some locations (such as conduits, cable trenches, cable troughs, duct banks, underground vaults, or direct buried installations). When an energized cable that is not specifically designed for submergence is exposed to these conditions, water treeing or a decrease in the dielectric strength of the conductor insulation can occur. This can potentially lead to electrical failure. The purpose of the aging management program is to provide a reasonable assurance that the intended functions of medium-voltage cables exposed to adverse localized environments caused by moisture while energized will be maintained consistent with the current licensing basis through the period of operation. It was not clear to the staff that the lead sheath would prevent moisture ingress if the cable was subjected to significant moisture simultaneously with significant voltage. Water treeing is a long-term degradation and failure phenomenon with conductor insulation made of various organic polymers. In the letter to the applicant dated January 17, 2001 (RAI Number 3.7.1-1), the staff requested the applicant to provide an aging management program for accessible and inaccessible electrical cable operated below 15 kV exposed to an adverse localized environment caused by moisture-produced water trees.

In response to the staff's request, the applicant stated that Turkey Point medium voltage application use lead sheath cable to prevent effects of moisture on cables. This cable is designed with a thick layer of lead over the cable insulation with an overall jacket over the lead and insulation. This differs from the typical medium voltage cable design of insulation with an overall jacket. The applicant uses lead sheath cable as a standard for medium voltage applications because of its good characteristics in moisture environments. The applicant's cable specification states that lead sheath cables are designed to be installed in wet environments for extended periods. In addition, the cable manufacturer's specification for lead sheath cable states that "...EPR/lead sheath cable is designed for application in which liquid contamination is present and reliability is paramount. The sheath combined with the overall jacket provided a virtually impenetrable barrier against hostile environments — liquids, fire hydrocarbons, acids, caustic, sewage, etc." As an added level of protection, Turkey Point underground medium-voltage cables are only routed in concrete-encased duct banks. Industry experience shows no failures of the medium-voltage lead sheath cable under various environments, including moisture. In addition, the applicant performed an extensive review of Turkey Point's plant-specific operating experience and found no cases of medium-voltage cable failures due to adverse localized environments.

Based on the review of the LRA and the applicant's response to the staff's RAIs, the staff concludes that since the applicant uses lead sheath in medium voltage cables, an aging management program for accessible and inaccessible medium-voltage cable to address adverse localized environments caused by moisture-produced water trees and voltage stress is not required.

3.7.2.2.4 Medium- and Low-Voltage Cable and Connections and Electrical/I&C Penetration Insulation — Radiation and Oxygen

3.7.2.2.4.1 Effects of Aging

Radiation-induced degradation in cable jacket and insulated material produces change in organic material properties, including reduced elongation and changes in tensile strength. Visible of indication of radiative aging may include embrittlement, cracking, discoloration, and swelling of the jacket and insulation. Table 3.7-3 of the LRA lists both the maximum operating doses and the moderate damage doses.

3.7.2.2.4.2 Aging Management Program

The staff has evaluated the information on medium-voltage cable and connections/I&C penetration insulation as presented in Section 3.7.1.1.4 of the LRA to determine if there is a reasonable assurance that the applicant has demonstrated that the aging affects for medium- and low-voltage cable and connections and electrical/I&C penetration insulation will be adequately managed, consistent with the applicant's CLB throughout the period of extended operation.

The applicant compares the maximum operating dose and the moderate damage doses in Table 3.7-3 and shows that all of the insulation materials included in this AMR will not exceed the moderate damage doses and concludes that aging effects caused by radiation exposure will not adversely affect the intended function of insulated cables and connections and electrical/I&C penetrations during the extended period of operation. The applicant concludes that aging effects related to radiation do not require an AMP for cables and connections and electrical/I&C penetrations.

Conductor insulation material used in cables and connections and electrical/I&C penetrations may degrade more rapidly than expected in the adverse localized environments due to radiation. The radiation levels most equipment experience during normal service have little degrading effect on most materials. The evaluations or calculations that determine or bound the expected radiation doses usually account for doses seen in all plant areas. However, some localized areas may experience higher-than-expected radiation conditions. Typical areas prone to elevated radiation levels include areas near primary reactor-coolant-system piping or the reactor-pressure-vessel; areas near waste processing system and equipment (e.g., gaseous-waste system, reactor-purification system, reactor-water-cleanup system, and spent-fuel-pool cooling and cleanup system); and areas subject to radiation streaming. The applicant's conclusion is not consistent with the aging management program and activities for electrical cables and connections exposed to localized environments caused by radiation as described in the previous LRAs that have been approved by the staff. In a letter to the applicant dated January 17, 2001 (RAI Number 3.7.1-1), the staff requested the applicant to provide an aging management program for accessible and inaccessible electrical cable and connections and electrical/I&C penetrations exposed to an adverse localized environment caused by radiation.

In response to the staff's request, in a letter dated March 30, 2001, the applicant stated that the intake structure, main steam and feedwater platforms, and yard structures are outdoor areas where cable, connections, and penetrations are not subject to adverse localized radiation effects. The turbine building is an outdoor area with no external walls or roof. The only buildings with any appreciable radiation levels are the containment and the auxiliary buildings. In order to provide reasonable assurance that the intended functions of non-EQ cables, connection, and penetration exposed to adverse localized equipment environments cause by radiation will be maintained consistent with the current licensing basis through the period of extended operation, the applicant proposes an aging management program for non-EQ cables, connections, and penetrations in the containment at Turkey Point. The non-EQ cables, connections and penetrations managed by this program include those used for power and instrumentation and control that are within the scope of license renewal. The acceptability of the AMP is evaluated in section 3.7.2.1 of the staff's safety evaluation report.

As indicated above, the applicant states that the only buildings with any appreciable radiation levels are the containment and auxiliary buildings. However, the aging management program that the applicant proposed is only include the non-EQ cables, connections, and penetrations in the containment. It does not include those cables, connections and penetrations in the auxiliary buildings. In a telephone conference, the staff requested the applicant explain why auxiliary building was not included in the scope of electrical inspection program. In response to the staff request, the applicant modified its response to the staff's RAI to state that with regard to radiation, the only buildings with any appreciable radiation levels are the containment building and the auxiliary building. However, non-EQ cables, connections, and penetration in the auxiliary building are not located in the areas which would be subject to adverse localized radiation environments during plant operation. The staff finds the applicant's response to be acceptable because it is consistent with the scope of the proposed aging management program.

Based on the review of the LRA and the applicant's response to the staff's RAIs, the staff concludes that aging effects of radiation on medium- and low-voltage cables, connections, and electrical/I&C penetrations will be managed through an AMP. This program will provide reasonable assurance that the intended functions of electrical cables, connections and electrical/I&C penetration exposed to adverse localized environments caused by radiation will be maintained consistent with the CLB through the period of extended operation.

3.7.2.2.5 Medium- and Low-Voltage Cable and Connections and Electrical/I&C Penetration Insulation — Heat and Oxygen

3.7.2.2.5.1 Effects of Aging

Thermal-induced degradation in cable jacket and insulation materials can result in reduced elongation and changes in tensile strength. Visible indications of thermal aging may include embrittlement, cracking, discoloration, and swelling of the jacket and insulation. Arrhenius methodology with the time period fixed at 60 years was used by the applicant to determine the maximum continuous temperature to which the material can be exposed so the material will not have reached the endpoint at the end of 60 years.

3.7.2.2.5.2 Aging Management Program

The staff has evaluated the information as presented in Section 3.7.1.1.5 of the LRA to determine if there is a reasonable assurance that the applicant has demonstrated that the aging effects for medium- and low-voltage cables, connections, and electrical/I&C penetration insulation will be adequately managed, consistent with the applicant's CLB, for the period of extended operation.

The applicant uses the Arrhenius method to determine the maximum continuous temperature to which the insulation material can be exposed so that the material has an indicated "endpoint of 60 years." It then compares the maximum 60-year continuous use temperature to the maximum operating temperature for the various insulation materials. The applicant concludes that except for polyethylene (PE) and Butyl used in power application, all of the insulation materials used in low- and medium-voltage power cables and connections and electrical/I&C penetration insulation can withstand the maximum operating temperatures for at least 60 years. For Butyl and PE insulated cables and connections, the applicant states that Butyl and PE are not used in containment and are not subject to an accident environment. Therefore, the endpoint chosen for this AMR are extremely conservative, and the 60-year endpoints values can be reduced without a loss of function, thus resulting in higher maximum 60-year continuous use temperature. The applicant concludes that aging effects related to heat do not require management for cables, connections, and electrical/I&C penetrations included in the AMR.

The most common adverse localized equipment conditions are those created by elevated temperature. Elevated temperature can cause equipment to age prematurely, particularly equipment containing organic materials and lubricants. The effect of elevated temperature can be quite dramatic. The types of areas that are prone to high temperature include areas with high-temperature process fluid piping and vessels, areas with equipment that operates at high temperature, and areas with limited ventilation. The staff did not agree with the applicant that the Arrhenius method can be used to extend the qualified life of insulation material that is exposed to elevated temperature to 60 years. In a letter dated January 17, 2001, the staff requested that the applicant provide an aging management program for accessible and inaccessible electrical cables and connections and electrical/I&C penetrations exposed to adverse localized environments caused by heat. In response to the staff's request, in a letter dated March 30, 2001, the applicant stated that the intake structure, main steam and feedwater platforms, and yard structures are outdoor areas where cable, connections, and penetrations are not subject to adverse localized temperature effects. The turbine building is an outdoor area with no external wall or roof. The auxiliary building does not contain any high temperature reactor coolant, main steam, or feedwater and blowdown system piping and components. In order to provide reasonable assurance that the intended functions of non-EQ cables, connections, and penetrations exposed to adverse localized equipment environments caused by heat will be maintained consistent with the CLB basis through the period of extended operation, the applicant proposed an aging management program for non-EQ cables, connections, and penetrations in the containment at Turkey Point. The non-EQ cables, connections, and penetrations managed by this program include those used for power and instrumentation and control that are within the scope of license renewal. The acceptability of this AMP is evaluated in section 3.7.2.1 of the staff's safety evaluation report.

Based on the review of the LRA and the applicant's response to the staff's RAIs, the staff concludes that aging effects of heat on medium-and low-voltage cable and connections and electrical/I&C penetrations should be managed through the AMP. This program will provide reasonable assurance that the intended functions of electrical cables and connections and electrical/I&C penetration exposed to adverse localized environments caused by heat will be maintained consistent with the current licensing basis through the period of extended operation.

3.7.2.3 Uninsulated Ground Conductors

The ground cable material used at Turkey Point, Units 3 and 4, is copper. Copper is a good choice for this application because of its high electrical conductivity, high fusing temperature, and high corrosion resistance. Copper is also relatively strong, and it is easy to join by welding, compression, or clamping. Ground connections are commonly made with welds or mechanical type connectors, which include compression-, bolted-, and wedge-type devices.

The applicant has reviewed the available industry technical information regarding material aging and has determined that there are no aging effects requiring management for copper grounding materials. In addition, the applicant has reviewed of industry and plant operating experience and did not identify any failures of copper ground system due to aging affects. The applicant also inspected several underground portions of the Turkey Point grounding system during plant modification to add two additional emergency diesel generators in 1990 and 1991, and did not identify any aging-related effects. The system was approximately 20 years old at the time of that inspection. The applicant states that portion of the grounding system inspected is buried in the same type of soil as other underground portions of the grounding system. Therefore, based on industry and plant-specific experience, no aging affects requiring management were identified for the plant grounding system. The staff agrees with the applicant's assessment and conclusion that no AMP is required for the plant ground system.

3.7.3 FSAR Supplement

In response to the staff's RAI 3.7.1-1, the applicant proposed an AMP for non-EQ cables, connections, and electrical/I&C penetrations. The acceptability of the AMP is evaluated in Section 3.7.2.1 of this SER. The applicant committed to include the AMP in the UFSAR Supplement. By letter dated November 1, 2001, the applicant provided summary description of the programs in Appendix A, Chapter 16, section 16.1.8, "Containment Cable Inspection Program," of the UFSAR Supplement. The summary description is sufficient, and therefore, confirmatory item 3.0-1 FSAR item 3.7-1 is closed.

3.7.4 Conclusion

On the basis of the staff's evaluation described above, the staff finds that there is reasonable assurance that the effects of aging of cables, connections, and electrical/I&C penetrations at Turkey Point will be adequately managed so that the intended function will be maintained consistent with the applicant's CLB throughout the period of extended operation in accordance with the requirements of 10 CFR 54.21(a)(3).

3.8 New Aging Management Programs

3.8.1 Auxiliary Feedwater Pump Oil Coolers Inspection Program

3.8.1.1 Summary of Technical Information in the Application

The auxiliary feedwater system supplies feedwater to the steam generators when normal feedwater sources are not available. It provides for auxiliary feedwater steam and feedwater isolation during a postulated steam generator tube rupture event and, for auxiliary feedwater isolation to the faulted steam generator. The auxiliary feedwater system also limits feedwater flow to the steam generators to limit positive reactivity insertion during a postulated steam line break. The auxiliary feedwater system contains three steam turbine-driven pumps. Table 3.5.3 of the LRA indicates that the auxiliary feedwater pumps oil coolers inspection and chemistry control programs are credited for the aging management of the auxiliary feedwater pump oil coolers for the pumps in the auxiliary feedwater and condensate storage systems. The condensate storage tank stores water for use by the auxiliary feedwater system to support safe shutdown of the plant. The intended functions for the auxiliary feedwater and condensate storage components subject to an aging management review are pressure boundary integrity, heat transfer, and throttling.

3.8.1.2 Staff Evaluation

In Table 3.5-3 of the LRA, the applicant identified loss of material to be the aging effect requiring management for the cast steel auxiliary feedwater pump lube oil coolers channel and covers exposed to treated water. The lube oil coolers are tube and shell type heat-exchangers, with the lube oil flowing in the tubes and the feedwater on the shell side. The purpose of the coolers is to transfer heat from the lube oil to the feedwater and maintain the lube oil temperature to within acceptable limits. The applicant credited the auxiliary feedwater pump oil coolers inspection program for the aging management of the identified aging effect. This program is described in Appendix B, Section 3.1.1, of the LRA.

The staff evaluation of the auxiliary feedwater pump oil cooler inspection program focused on how the program manages the aging effect through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The corrective actions, confirmation process and administrative controls for license renewal are in accordance with the site-control quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to an aging management review. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this safety evaluation. This satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven (7) elements are discussed below.

[Program Scope] The applicant stated that this inspection is intended to be a one-time inspection of an oil cooler of one of the three shared auxiliary feedwater pumps. The auxiliary feedwater pump oil coolers inspection will manage the effects of loss of material due to graphitic corrosion (i.e., selective leaching) and other types of corrosion of the internal surfaces of cast iron parts of the coolers wetted internally by treated secondary water. A visual inspection will be performed to detect loss of material. The inspection will include the cast iron bonnet of one of the auxiliary feedwater pump lube oil coolers and, if necessary, the cast iron parts of an auxiliary feedwater turbine governor controller oil cooler. Commitment dates associated with the implementation of this new program are contained in Appendix A to the LRA.

In RAI 3.8.1-1, dated February 2, 2001, the staff requested that the applicant provide justification for only inspecting the oil cooler of one of the three pumps, and for doing a one-time-only inspection instead of multiple inspections with intervals of 3 or 5 years, as is generally prescribed in ASME Section XI programs for similar components.

In its response (FPL Letter L-2001-75, dated April 19, 2001), the applicant stated that the three auxiliary feedwater pump oil coolers are identical units and are subjected to the same internal environments and operating conditions. Therefore, the condition of one cooler is representative of all three coolers.

The applicant stated that the one-time inspection will provide confirmatory information on the condition of the coolers. Although Turkey Point's operating experience has not identified graphitic corrosion degradation of these coolers, the materials of construction and environment make them potentially susceptible to such degradation. This corrosion mechanism is not anticipated due to the quality of the water in the auxiliary feedwater system, and thus, a one-time inspection was selected. The results of the inspection will be evaluated to determine if further inspections are warranted. If significant loss of material is detected, the appropriate corrective action, including program revision, if needed, will be taken in accordance with the applicant's 10 CFR Part 50 Appendix B, Corrective Action Program. The staff finds the applicant's response reasonable and acceptable, and on this basis the issue in RAI item 3.8.1-1 is resolved. With the resolution of the staff's concerns, the staff finds the overall scope of the Auxiliary Feedwater Pump Oil Coolers Inspection Program is acceptable.

[Preventive Actions] The applicant stated that no preventive actions are applicable to this program. The staff finds this acceptable because the staff does not find a need for any.

[Parameters Monitored] The applicant stated that the auxiliary feedwater pump coolers inspection will identify the presence of graphitic corrosion activity and will quantify the loss of structurally sound wall thickness of cast iron parts. The inspection will consist of two parts, an "as found" inspection of parts and an inspection of parts after light sandblasting to bare metal. The staff finds the program is acceptable.

[Detection of Aging Effects] The applicant stated that the visual inspection will be used to verify whether graphitic corrosion has taken place. The aging effect of concern, loss of material because of graphitic corrosion and other types of corrosion, will be further evident by the reduced wall thickness of the material in the cast iron parts being examined (following the sandblasting). The staff concurs with the applicant and finds the detection methods acceptable.

[Monitoring and Trending] As stated above, the applicant intends to do a one-time inspection of one cooler. If significant loss of material due to graphitic corrosion or other corrosion is detected, the applicant will assess the extent of the corrosion, and determine if inspection of other coolers and additional future monitoring are required. The staff finds the applicant's monitoring and the trending method acceptable.

[Acceptance Criteria] The applicant states that if the inspection results in white non-porous metallic surface without major indications, it may declare the part as "not affected by graphitic corrosion" and to not require further evaluation. If there is evidence of significant effects of graphitic corrosion, an evaluation will be prepared to establish the minimum required wall

thickness including a corrosion allowance adequate for a pre-determined inspection interval. Wall thickness measurements greater than minimum wall thickness values will be acceptable. In RAI 3.8.1-2, dated February 2, 2001, the staff requested the applicant to provide the basis for the quantitative acceptance criteria which will be used to make the determination that inspection of other coolers and future monitoring are required.

In its response (FPL Letter L-2001-75, dated April 19, 2001), the applicant stated that the auxiliary feedwater pump oil cooler inspection program, as described in Appendix B, Section 3.1.1, page B-10, consists of a confirmatory one-time inspection of one auxiliary feedwater oil cooler to verify that loss of material due to graphitic corrosion is not occurring. In the event that significant loss of material is detected during this inspection, appropriate corrective actions will be established per FPL's 10 CFR Part 50, Appendix B, Corrective Action Program. Evaluation of inspection results will consider the minimum required wall thickness for the component and a corrosion allowance. Followup inspections, if required, will be scheduled based on actual corrosion rates or inspection findings. The staff finds the applicant's response reasonable and acceptable and, on this basis, the issue of concern in RAI 3.8.1-2 is considered resolved. The staff finds that the acceptance criteria are adequate.

[Operating Experience and Demonstration] Visual inspections and wall thickness measurements of equipment have been performed at Turkey Point for many years. The techniques have proven successful in determining actual material condition of components.

The auxiliary feedwater pump oil coolers inspection is a new program that will use techniques with demonstrated capability and a proven industry record to detect loss of material due to graphitic corrosion. Visual examination has been used in the past to identify graphitic corrosion. This inspection will be performed utilizing approved procedures and qualified personnel. The staff finds the applicant's inspection methods applicable and acceptable.

3.8.1.3 FSAR Supplements

The staff has reviewed the information in the UFSAR Supplement Section 16.1.1 of Appendix A to the LRA and has confirmed that it contains the appropriate elements of the program.

3.8.1.4 Conclusion

In conclusion, based on the information provided by the applicant, the staff finds the implementation of the auxiliary feedwater pump oil coolers inspection program will provide reasonable assurance that loss of material will be managed such that the components within the scope of license renewal will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

3.8.2 Auxiliary Feedwater Steam Piping Inspection Program

3.8.2.1 Summary of Technical Information in the Application

The auxiliary feedwater system supplies feedwater to the steam generators when normal feedwater sources are not available. It provides for auxiliary feedwater steam and feedwater isolation during a postulated steam generator tube rupture event, for auxiliary feedwater isolation to the faulted steam generator and limits feedwater flow to the steam generators to limit positive reactivity insertion during a postulated steam line break. The auxiliary feedwater system contains three steam turbine-driven pumps. The pumps can be supplied steam from the steam generators in either unit. The pumps take suction from either condensate storage tank and discharge to one of two redundant headers. Each header can supply each of the steam generators. The auxiliary feedwater system is normally maintained in standby with one pump aligned to one discharge header and two pumps aligned to the other header. Upon initiation, all three pumps start to supply the affected steam generator with feedwater. The condensate storage tank stores water for use by the auxiliary feedwater system to support safe shutdown of the plant. The intended functions for the auxiliary feedwater and condensate storage components subject to an aging management review are pressure boundary integrity, heat transfer, and throttling.

3.8.2.2 Staff Evaluation

In Table 3.5-3 of the LRA, the applicant identified loss of material to be the aging effect requiring management for the carbon steel auxiliary feedwater pump turbine casings, valves, steam traps, and piping/fittings that are exposed to either treated water-secondary and air/gas environments or outdoor environments. The applicant credited the Auxiliary Feedwater Steam Piping Inspection Program (Appendix B Section 3.1.2 of the Application) for the aging management of the identified aging effect.

The staff evaluation of the Auxiliary Feedwater Steam Piping Inspection Program focused on how the program manages the aging effect through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The corrective actions, confirmation process and administrative controls for license renewal are in accordance with the site-control quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to an aging management review. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this safety evaluation. This program satisfies the elements of corrective actions, confirmation process and administrative controls. The remaining seven (7) elements are discussed below.

[Program Scope] The applicant stated in Appendix B Section 3.1.2 of the Application that the Auxiliary Feedwater Steam Piping Inspection Program will manage the effects of loss of material due to general and pitting corrosion on the internal and external surfaces of the auxiliary feedwater steam supply carbon steel piping and fittings. The program will provide for representative volumetric examinations to detect loss of material in the auxiliary feedwater steam piping between the steam supply check valves and each of the three auxiliary feedwater pump turbines. In its RAI dated February 2, 2001, the staff requested the applicant to provide a detailed description of how samples will be selected for the representative volumetric examinations and the basis of the selection. The staff also requested the applicant to explain why, in Table 3.5-3 of the LRA, components other than piping and fittings, such as auxiliary feedwater pump turbine casings, are listed as the in-scope components to be managed by the program. The applicant provided its response to the RAI in a submittal dated April 19, 2001 (cf. L-2001-75). In its response, the applicant stated that sample selections will be based upon the potential for exposure to a wetted environment. This includes sections of lines where water

can accumulate, such as at the bottom of horizontal pipe runs and areas of contact with the lower section of wetted insulation. The staff considers the basis of the applicant's sample selection reasonable and, therefore, acceptable. The applicant also stated that having the least wall thickness, piping and fittings are considered the limiting components and the primary inspection points. However, where significant loss of material due to corrosion is detected, valves and steam traps would be inspected, as required. This is acceptable to the staff In regard to the staff's question on inclusion of the above-mentioned turbine casings. The applicant stated that Table 3.5-3 (pages 3.5-17 and 3.5-20) of the LRA inadvertently identified internal and external loss of material as an aging effect requiring management for the auxiliary feedwater (AFW) turbine casings, and credited the auxiliary feedwater steam piping integrity program for aging management. The applicant stated that, based on an inspection of an AFW turbine casing, after 17 years of operation, the aging management review of the AFW turbine casing has demonstrated that loss of material is indeed not an aging effect requiring management. The applicant stated that Table 3.5-3 (pages 3-17 and 3-20) will be revised accordingly. The staff finds the applicant's response to be in general accord with the industry experience and is, therefore, acceptable.

[Preventive Actions] The applicant stated that no preventive actions are applicable to this program, and the staff did not identify the need for any.

[Parameters Monitored or Inspected] The applicant stated that the program will monitor the wall thickness of representative piping/fittings in the auxiliary feedwater steam supply headers and the drain lines upstream of the steam traps. The volumetric examination will identify potential effects of inside diameter corrosion due to accumulation of water at the bottom of horizontal run pipes and outside diameter corrosion at areas of contact with the lower section of wet insulation. Based on the scope of the inspection, the staff finds parameters monitored are acceptable.

[Detection of Aging Effects] The applicant stated that the aging effect of concern, loss of material due to general and pitting corrosion, will be evident by the reduced wall thickness in the piping/fittings. Based on the scope of the inspection, the staff finds the detection method is acceptable.

[Monitoring and Trending] The applicant stated that the examination will initially be performed every five years. Piping/fittings thickness measurements will permit calculation of an integrated inside diameter and outside diameter corrosion rate. Inspection frequency may be adjusted based on corrosion rate to ensure that the minimum wall thickness requirements will be maintained. Based on the scope of the inspection the staff finds, the identified inspection frequency is acceptable.

[Acceptance Criteria] The applicant stated that wall thickness measurements greater than minimum values for the component design of record will be acceptable. Wall thickness measurements less than required minimum values will be entered into the corrective action program. This will ensure that the component section identified to have potentially inadequate wall thickness will be subject to subsequent evaluations and remedy actions. It is, therefore, acceptable to the staff.

[Operating Experience] Ultrasonic and computer-aided radiography wall thickness measurement techniques have been performed at Turkey Point for years. The applicant stated that these techniques have proven successful in determining wall thickness of piping and other components. Computer-aided radiography has been used in the auxiliary feedwater steam supply headers and drain lines. The results of these examinations have detected some areas of localized corrosion in the headers. The applicant stated that this new program will use the techniques with demonstrated capability and a proven industry record to measure pipe wall thickness. The examinations will be performed utilizing approved plant procedures and qualified personnel. Based on the applicant's description of the examination techniques and the evidence of their successful performance in the past, the staff considers the examination methods to be acceptable for the program.

3.8.2.3 FSAR Supplement

Section 16.1.2, "Auxiliary Feedwater Steam Piping Inspection Program," of Appendix A to the LRA provides an updated FSAR supplement for the auxiliary feedwater steam piping inspection program. The staff concludes that the updated FSAR Supplement is sufficient.

3.8.2.4 Conclusion

Based on the information provided by the applicant, the staff finds that the implementation of the auxiliary feedwater steam piping inspection program will provide reasonable assurance that loss of material will be managed such that the components within the scope of license renewal will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

3.8.3 Emergency Containment Coolers Inspection

3.8.3.1 Summary of Technical Information in the Application

The emergency containment coolers inspection program is designed to determine the extent of loss of material due to erosion in the emergency containment cooler tubes. This is a one-time inspection of a representative sample of tubes in the containment coolers. The results of the inspection will be evaluated to determine an actual erosion rate and projected minimum wall thickness at the end of the extended period of operation. Programmatic changes will be made on the basis of the inspection results.

Emergency containment cooling components subject to an aging management review include the emergency fan cooler units (pressure boundary only) and associated heat exchanger coils. The intended functions for emergency containment cooling components subject to an aging management review include pressure boundary integrity and heat transfer. A complete list of emergency containment cooling components requiring an aging management review and the component intended functions are provided in Table 3.3-1 of the LRA. The aging management review for emergency containment cooling is discussed in Section 3.3 of the LRA. The applicant has credited the emergency containment cooler inspection program for managing the identified aging effects. The program is described in Appendix B, Section 3.1.3 of the LRA

The analyses for the current licensing basis for emergency containment cooling tubes have used conservative erosion rates. The applicant contends that the actual wall loss is expected to be less and confirmation of the actual wall thickness degradation will be obtained through inspection.

3.8.3.2 Staff Evaluation

In Table 3.3-1 of the LRA, the applicant identified loss of material to be the aging effect requiring management for the admiralty brass emergency containment cooling tubes exposed to a treated water environment. Emergency containment cooling tube wear was identified as a TLAA as discussed in Section 4.7.2 of the LRA. Option (iii) of 10 CFR 54.21 (c) (1) was selected to address this aging effect.

The staff evaluation of the emergency containment coolers inspection program focused on how the program manages the aging effect through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The corrective actions, confirmation process and administrative controls for license renewal are in accordance with the site-control quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover structures and components that are subject to an aging management review. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this safety evaluation. This program satisfies the elements of corrective actions, confirmation process and administrative controls. The remaining seven elements are discussed below.

[Program Scope] The applicant stated that the emergency containment cooling inspection is a one-time inspection that will determine the extent of loss of material due to erosion in the Unit 3 and 4 emergency containment cooler tubes. A sample of tubes for examination will be selected based on piping geometry and flow conditions that represent those with the greatest susceptibility to erosion. This inspection and evaluation will be implemented prior to the end of the initial operating terms.

In RAI 3.8.3-1, dated February 2, 2001, the staff requested the applicant to provide a justification for their determination that a one time inspection of the emergency containment coolers is adequate. Operating experience with these coolers at other nuclear power plants indicates that loss of material caused by erosion and flow-induced vibration can vary during plant operation due to unanticipated transients and flow conditions.

In its response dated April 19, 2001, the applicant stated that the aging effect requiring management for the emergency containment coolers is loss of material due to erosion on the inside surface of the cooler tubes. Cracking due to flow-induced vibration is not an aging effect requiring management. Except for surveillance testing, the emergency containment coolers are normally not in operation and have minimal cooling water flow through the tubes (see UFSAR Section 6.3.2, page 6.3-6). Therefore, the tubes are not susceptible to unanticipated transients. The results of the inspection will be evaluated to determine an actual erosion rate to verify that the minimum required wall thickness for the emergency containment cooling tubes will be maintained during the period of extended operation. As stated in Section 3.1.3 of Appendix B to the LRA, the evaluation of the inspection results may determine the need for additional testing, monitoring, and trending. The staff concurs with the applicant's response. RAI Item 3.8.3-1 is therefore closed.

In RAI 3.8.3-2, dated February 2, 2001, the staff requested the applicant to provide the specific percentage of tubes that will be examined during the inspection. In its response (FPL Letter L-2001-75, dated April 19, 2001), the applicant stated that a sample of tubes for examination will be selected based on geometry and flow conditions that represent those with the greatest susceptibility to erosion. All six emergency containment coolers (three in each unit) are identical and are subjected to the same cooling water conditions. Additionally, the emergency containment coolers are in service (during testing) approximately the same amount of time. On this basis, one emergency containment cooler will be selected for inspection as representative of all six. The number of tubes to be inspected in this cooler will be in accordance with the sampling plan recommended by the American Society for Quality Control publications. The staff finds the applicant's response reasonable and acceptable. On this basis, the issue in RAI item 3.8.3-2 is considered closed. With the resolution of the staff's concerns as discussed above, the staff finds the scope of the program acceptable.

[Preventive Actions] The applicant stated that no preventive actions are applicable to this inspection. The staff does not find a need for any preventive actions and therefore this is acceptable.

[Parameters Monitored or Inspected] The applicant stated that the inspection will document wall thickness of the emergency containment cooler heat exchanger tubes. The staff finds that the parameters monitored will permit timely detection of aging effects and are therefore acceptable.

[Detection of Aging Effects] The aging effect of concern, loss of material due to erosion, will be detected and sized in accordance with the volumetric technique chosen by the applicant. The staff finds the detection method will provide a satisfactory means for identifying the aging effect and is therefore acceptable.

[Monitoring and Trending] The results of the inspection will be evaluated by the applicant to verify that the minimum required wall thickness for the emergency containment cooler heat exchanger tubes will be maintained during the period of extended operation. In RAI 3.8.3-3, dated February 2, 2001, the staff requested that the applicant discuss the acceptance criteria which it will use for tube examination in the emergency containment coolers inspection program, and also clarify the source and basis for the acceptance criteria to be applied for this examination.

In its response (FPL Letter L-2001-75, dated April 19, 2001), the applicant stated that the acceptance criteria for the emergency containment cooler tubes is minimum wall thickness plus margin based upon actual erosion rate. The minimum wall thickness for the Emergency containment cooler tubes is based on the coolers' design pressure as calculated per ASME Section III, Class 3. Appendix B Section 3.1.3 of the LRA states that the results of the inspection will be evaluated to verify that the minimum required wall thickness for the Emergency containment cooler tubes will be maintained during the period of extended operation. The staff finds the applicant's response reasonable and acceptable. Therefore, the issue in RAI item 3.8.3-3 is closed.

In RAI 3.8.3-4, dated February 2, 2001, the staff requested that the applicant discuss how the acceptance criteria for the emergency containment cooler heat exchanger tubes consider fatigue failure due to flow-induced vibration. In its response (FPL Letter L-2001-75, dated April 19, 2001), the applicant stated that vibration induced fatigue is fast acting and typically detected early in the component's life, and, as a result, corrective actions are initiated to prevent recurrence. A review of Turkey Point's operating experience for the Emergency containment coolers did not indicate the presence of flow-induced vibration degradation conditions. Therefore, cracking due to mechanical fatigue is not an aging effect requiring management for the Emergency containment coolers. The staff finds the applicant's response reasonable and acceptable and therefore the issue in RAI item 3.8.3-4 is considered resolved. With the resolution of the staff's concerns as discussed above, the staff finds the monitoring and trending methods acceptable.

[Operating Experience] The applicant proposed a one-time inspection which is a new activity that will use techniques with demonstrated capability and a proven industry record to detect wall thickness (loss of material due to erosion). Effective and proven volumetric examination techniques will be selected for use in performing this inspection. This inspection will be performed utilizing approved procedures and qualified personnel.

The staff finds that based on operating experience, the implementation of the emergency containment coolers inspection will provide reasonable assurance that loss of material due to erosion will be managed in the containment coolers and is therefore acceptable.

3.8.3.3 FSAR Supplements

The staff has reviewed the UFSAR Section 16.1.3 provided in Appendix A to the LRA and confirmed that it contains the applicable elements of the program.

3.8.3.4 Conclusion

On the basis of the information provided by the applicant, the staff finds the implementation of the emergency containment cooler inspection program will provide reasonable assurance that loss of material will be managed such that the components within the scope of license renewal will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

3.8.4 Field-Erected Tanks Internal Inspection

Florida Power and Light described its field-erected tanks internal inspection program in Section 3.1.4 of Appendix B to the LRA. The applicant credits this inspection program with managing, in part, the aging effect of the loss of material due to corrosion of the tanks within the scope of the program. The staff reviewed the Application to determine whether the applicant has demonstrated that the field-erected tanks internal inspection program will adequately manage the loss of material aging effect for the tanks within the scope of the program during the period of extended operation as required by 10 CFR 54.21(a) (3).

3.8.4.1 Summary of Technical Information in the Application

In Appendix B, Section 3.1.4, of the LRA, the applicant described a new aging management program, the field-erected tanks internal inspection, that manages, together with the chemistry control program, the loss of material aging effect for the two condensate storage tanks, two refueling water storage tanks, and the shared demineralized water storage tank. The applicant lists these tanks in Table 3.3-4 (refueling water storage tanks), Table 3.5-2 (demineralized water storage tank), and Table 3.5-3 (condensate storage tanks) of the LRA. These tanks are fabricated from carbon steel and the internal tank surfaces are coated to reduce corrosion. Each of the tanks contains treated water beneath an environment of air/gas.

The applicant plans on implementing the field-erected tanks internal inspection program as a one-time inspection of the two condensate storage tanks, two refueling water storage tanks, and the shared demineralized water storage tank rather than as a periodic inspection program. This one-time inspection will utilize either direct (e.g., divers) or remote (e.g., television cameras, fiber optic scopes, periscopes) observations. In addition to the field-erected tanks internal inspection program, the applicant also plans to use the chemistry control program to monitor the condition of the treated water in each of the tanks.

3.8.4.2 Staff Evaluation

The staff's evaluation of the field-erected tanks internal inspection program focused on how the program manages the loss of material aging effect through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled corrective actions program pursuant to 10 CFR Part 50, Appendix B and cover all structures and components subject to an aging management review. The staff evaluation of the applicant's corrective actions program is provided separately in Section 3.1.2 of this SER. The corrective actions program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[Program Scope] The applicant stated in Appendix B, Section 3.1.4, of the LRA, that the field-erected tanks internal inspection program will be a one-time inspection of the two condensate storage tanks, two refueling water storage tanks, and the shared demineralized water storage tank. This one-time inspection will cover selected internal areas, including surface welds, to determine the extent of internal corrosion in the tanks listed above. In order to ensure that the most susceptible internal areas of each tank are inspected, in RAI 3.8.4-2, dated February 2, 2001, the staff requested that the applicant describe the locations within each of the tanks that are the most susceptible to corrosion and to discuss why these locations are the most susceptible. In response (FPL Letter L-2001-75, dated April 19, 2001), the applicant stated that all locations within each of the tanks are considered to be susceptible to corrosion and therefore, all accessible internal surfaces of the tanks will be visually inspected rather than focusing on limited select locations suspected of being more susceptible to corrosion. The applicant's response to the staff is acceptable to close the issue in RAI Item 3.8.4-2.

[Preventive or Mitigative Actions] There are no preventive or mitigative actions taken as part of this program, and the staff did not identify the need for such actions.

[Parameters Inspected or Monitored] The applicant will perform visual inspections to determine the extent of any internal corrosion for each of the tanks. The internal tank surfaces will be examined for evidence of flaking, blistering, peeling, discoloration, pitting, or excessive corrosion. To determine the adequacy of the visual inspection, the staff requested in RAI 3.8.4-4 that the applicant describe the visual examination procedures in more detail, including any lighting and resolution requirements. In addition, the applicant was asked to describe any provisions for additional volumetric or surface examinations in the event that the scheduled one-time visual examination reveals extensive loss of material. In response, the applicant stated that the lighting and resolution requirements necessary to accomplish the internal tank inspections have not yet been established but the inspection requirements will be documented in the implementing procedure. Since the program requirements have not yet been established, RAI 3.8.4-4 became Open Item 3.8.4-1(b). In response to Open Item 3.8.4-1, dated November 1, 2001, the applicant stated that although the internal tank inspection will not be an ASME Section XI inspection, the lighting and resolution requirements will be the same as those specified for a VT-3 inspection, which is described in IWA-2210 of ASME Section XI. In addition, the applicant stated that if visual examination of the tanks reveals significant loss of material, the condition would be resolved through the FPL 10 CFR Part 50, Appendix B, corrective action program, which may involve volumetric or surface examinations. The applicant's response to the staff is acceptable to close Open Item 3.8.4-1(b). The staff finds that the monitoring of evidence of flaking, blistering, peeling, discoloration, pitting, or excessive corrosion is acceptable since they are directly related to the degradation of the internal tank surfaces, and visual inspections are effective and adequate to detect this condition.

[Detection of Aging Effects] An appropriate inspection frequency interval is important to ensure that the loss of material aging effect is identified before there is a loss of intended function; however, the applicant has determined that the field-erected tanks internal inspection program is to be a one-time inspection. In RAI 3.8.4-1, the staff has requested that the applicant justify a one-time inspection program rather than periodic inspections for each of the tanks. In response, the applicant stated that the condensate storage tanks (CSTs), the refueling water storage tanks (RWSTs), and demineralized water storage tank (DWST) are not currently inspected on a periodic basis. The Unit 4 CST was internally inspected and recoated in 1983. The Unit 3 CST was internally inspected, several $^{1}/_{16}$ inch pits were weld repaired, and the tank was recoated in 1991. The need for recoating activities was attributed to operational practices and the original coatings being inadequate for the application, and both have been corrected. The applicant further stated that a review of plant-specific operating experience revealed no other incidences of internal degradation for the CSTs. Since the results of previous inspections of the RWSTs and DWST were not provided by the applicant in response to RAI 3.8.4-1, the staff requested further information and RAI 3.8.4-1 became Open Item 3.8.4-1(c). In response to Open Item 3.8.4-1, dated November 1, 2001, the applicant stated that although the RWSTs and DWST are not currently inspected internally on a periodic basis, the DWST was recently inspected as part of a pre-inspection performed by divers and the cognizant engineer prior to the installation of a floating cover inside the tank. The DWST inspection did not identify any degraded coatings or tank corrosion. The applicant's expectation is that the RWST will similarly show little or no degradation and, therefore, the one-time field-erected tank internal inspection will provide confirmation that there are no aging effects requiring management for the field-erected tanks. However, if the inspection reveals internal surface degradation of the tanks,

then the degradation will be evaluated and repaired, as necessary, and additional inspections will be scheduled, as needed. The applicant's response to the staff is acceptable to close Open Item 3.8.4-1(c).

[Monitoring and Trending] Since the field-erected tanks internal inspection program is to be a one-time inspection, no monitoring and trending is anticipated; however, the applicant stated in Section 3.1.4 of Appendix B to the LRA, that the results of the one-time inspection will be evaluated to determine if additional actions are required.

[Acceptance Criteria] Specific acceptance criteria have not yet been developed for the field-erected tanks internal inspection program. In Section 3.1.4 of Appendix B to the LRA, the applicant stated that acceptance criteria will be provided in the implementing procedure. Since the review of acceptance criteria are an essential part of the staff evaluation of the effectiveness of an aging management program, the staff requested as Part A of Open Item 3.8.4-1 that the applicant provide acceptance criteria for the field-erected tanks internal inspection program. In response to Open Item 3.8.4-1(a), dated November 1, 2001, the applicant stated that the acceptance criteria for the internal inspection of field-erected tanks internal inspection will be the design corrosion allowance. Thus, any loss of material greater than the tank's corrosion allowance will require corrective action to ensure that the tank's intended functions are maintained under all CLB design conditions. The applicant further stated that the threshold at which additional inspections, beyond the one-time inspection, will be implemented is corrosion of the tank steel. Thus, if corrosion is observed, appropriate corrective actions will be implemented and additional inspections will be scheduled based on the corrective actions implemented. The applicant's response to the staff is acceptable to close Open Item 3.8.4-1(a).

[Operating Experience] The field-erected tanks internal inspection program is a new program; thus, the applicant did not submit Turkey Point-specific operating experience. However, in response to the staff's RAI 3.8.4-1, the applicant stated that previous inspections of the Unit 4 CST in 1983 and the Unit 3 CST in 1991 revealed corrosion at some of the welds at the roof to wall connection and coating degradation at several areas in the floor and wall of the tank. The applicant attributed these conditions to operational practices and the inadequacy of the original coatings, however, the applicant stated that both of these causes have been corrected. In addition, as documented above under *Detection of Aging Effects*, the DWST was also recently inspected and there were no signs of degradation. The RWSTs have not been previously internally inspected; however, the applicant expects to find little or no degradation to the internal surfaces of the RWSTs. In the event that the field-erected tanks internal inspection reveals degradation of the internal tank surfaces, appropriate corrective actions will be implemented and additional inspections will be scheduled based on the corrective actions implemented. The staff finds that the applicant's operating experience has demonstrated that significant aging of the internal tank surfaces is unlikely and, therefore, a one-time inspection, with the need for further inspections and corrective actions to be determined based on the one-time inspection results, is reasonable and sufficient.

3.8.4.3 FSAR Supplement

The staff has reviewed the UFSAR Section 16.1.4 as amended by the resolution of Open Item 3.8.4-1, and confirmed that it contains an acceptable program description.

3.8.4.4 Conclusions

The staff has reviewed the information in Appendix B, Section 3.1.4, of the LRA and responses to the staff's RAIs and Open Item. The staff also reviewed the program description provided in Section 16.1.4 of the UFSAR. The staff concludes that the applicant has demonstrated that the field-erected tanks internal inspection program will be adequate to detect the presence of the loss of material aging effect for each of the tanks covered by this inspection and that the one-time inspection results will be used to determine the need for additional inspections and/or corrective actions.

3.8.5 Galvanic Corrosion Susceptibility Inspection Program

3.8.5.1 Summary of Technical Information in the Application

Section 3.1.5, "Galvanic Corrosion Susceptibility Inspection Program," of Appendix B to the LRA, describes the program aimed at verifying the integrity of components subject to galvanic corrosion. The staff reviewed this section of the application to determine whether the applicant has demonstrated that the effects of aging caused by galvanic corrosion will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

As identified in Chapter 3, the galvanic corrosion susceptibility inspection program is credited for aging management of specific component/commodity groups in the following systems: auxiliary feedwater and condensate storage; chemical and volume control; CCW; containment spray; control building ventilation; emergency containment cooling; emergency diesel generators and support systems; feedwater and blowdown; fire protection; instrument air; normal containment and control rod drive mechanism cooling; reactor coolant; residual heat removal; safety injection; spent fuel pool (SFP) cooling; turbine building ventilation; and waste disposal.

The galvanic corrosion susceptibility inspection program manages the aging effect of loss of material due to galvanic corrosion on the internal surfaces of susceptible piping and components. The program involves selected, one-time inspections of the internal surfaces of piping and components with the greatest susceptibility to galvanic corrosion. Loss of material is expected mainly in carbon steel components directly coupled to stainless steel components in raw water systems. However, baseline examinations in select systems will be performed and evaluated to establish if the corrosion mechanism is active. On the basis of the results of these inspections, the need for followup examinations or programmatic corrective actions will be established. The program will be implemented prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4.

3.8.5.2 Staff Evaluation

The staff evaluation of the galvanic corrosion susceptibility inspection program focused on how the activities managed aging effects through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[*Program Scope*] The galvanic corrosion susceptibility inspection program will manage the potential effects of loss of material due to galvanic corrosion on the internal surfaces of susceptible piping and components. Carbon steel components directly coupled to stainless steel components in raw water systems at Turkey Point are the most susceptible to galvanic corrosion. However, baseline examinations will be performed and evaluated to establish if the corrosion mechanism is active in other systems. The program will involve selected one-time inspections, the results of which will be utilized to determine the need for additional actions. The staff finds that the scope of the galvanic corrosion susceptibility inspection program is adequate because locations likely to experience galvanic corrosion will be examined.

[*Preventive or Mitigative Actions*] Components and systems utilize insulating flanges or cathodic protection to minimize galvanic corrosion. The use of insulated flanges and cathodic protection is not credited with the elimination of galvanic corrosion. Since the applicant does not take credit for systems and components that minimize galvanic corrosion, there are no preventive or mitigative actions and the staff does not find a need for any.

[*Parameters Inspected or Monitored*] The program will assess the loss of material due to galvanic corrosion between dissimilar metals in locations determined to represent the most limiting conditions. Selection of the most limiting conditions will be based on high galvanic potential, high cathode/anode area ratio, and high conductivity of the fluid in contact with the materials. The staff finds the general program is acceptable because visual examination of selected locations will establish if galvanic corrosion is occurring.

[*Detection of Aging Effects*] Loss of material due to galvanic corrosion will be evident by material loss at the location of the junction between the dissimilar metals. Volumetric examinations or visual inspections will be utilized to address the extent of material loss.

Initial inspection results will be utilized to assess the need for expanded sample locations. Inspection frequency will be determined based on the corrosion rate identified during the initial inspections. The staff agrees that these are acceptable methods for identifying loss of material.

[*Monitoring and Trending*] These are planned as one-time inspections; therefore, there is no monitoring or trending, and the staff does not find any need for monitoring and trending.

[*Acceptance Criteria*] Wall thickness measurements greater than required minimum wall thickness values for the components will be acceptable. Wall thickness measurements less than required minimum values will be entered into the corrective action program. The staff finds that the acceptance criteria are adequate because this program will establish if the minimum wall thickness requirement is being satisfied.

[*Operating Experience*] Visual and volumetric inspection techniques have been used at Turkey Point for years. These techniques have proven successful in determining the material condition of components.

This is a new program that will use techniques with demonstrated capability and a proven industry record to monitor material loss due to galvanic corrosion. This examination will be performed utilizing approved procedures and qualified personnel. The inspection techniques used in this program have been previously used to monitor material condition for plant systems.

The applicant did not provide any operating experience on galvanic corrosion, either for Turkey Point, Units 3 and 4, or for the nuclear industry in general in the LRA. The applicant provided a summary of their operating experience in RAI response L-2001-65, Attachment 1. They reviewed their plant operating and maintenance history and discovered only a few incidences of loss of material in treated water systems. The applicant identified loss of material due to galvanic corrosion in the plant ventilation chilled water systems. The applicant installed electrical isolation kits and no further galvanic corrosion has been observed. There were also instances of loss of material in air handling units where aluminum fins are in contact with copper tubing in areas where condensation pooling has occurred.

The applicant stated in RAI response L-2001-65 that galvanic corrosion is more likely in raw water than in treated water. The applicant states that the effects of galvanic corrosion are precluded by design using such things as isolation and coating of dissimilar metals. The applicant states that galvanic corrosion is most likely in the intake cooling water (ICW). However, the applicant has the ICW system inspection program instead of the galvanic corrosion inspection program to manage this aging.

3.8.5.3 FSAR Supplement

The staff has reviewed the UFSAR Section 16.1.5 and confirmed that it contains an acceptable program description.

3.8.5.4 Conclusions

The staff has reviewed the information provided in Appendix B, Section 3.1.5 of the LRA and responses to the staff's RAIs. On the basis of this review, as set forth above, the staff concludes that the applicant has demonstrated that there is reasonable assurance that the galvanic corrosion susceptibility inspection program will adequately manage aging effects for dissimilar metals in contact with fluid for the period of extended operation.

3.8.6 Reactor Vessel Internals Inspection Program

Section 3.1.6, “Reactor Vessel Internals Inspection Program,” of Appendix B to the LRA describes the program credited for aging management of the reactor vessel internals. The reactor vessel internals inspection program consists of two types of examinations, visual and ultrasonic testing (UT), to manage the aging effects of cracking, reduction in fracture toughness, and loss of mechanical closure integrity.

As described in the LRA, the reactor vessel internals inspection program will involve the combination of several activities culminating in the inspection of Turkey Point Unit 3 and 4 reactor vessel internals once for each unit during the 20-year period of extended operation. The applicant states that this program is intended to supplement the reactor vessel internals inspections required by the ASME Section XI, Subsections IWB, IWC, and IWD inservice inspection program. In addition, ongoing industry efforts are aimed at characterizing the aging effects associated with the reactor vessel internals. As described in response to RAI 3.8.6-1, the applicant is a participant in industry research activities addressing aging effects on reactor vessel internals being conducted by the materials reliability project (MRP) of EPRI. Further understanding of these aging effects will be developed by industry over time and will provide additional bases for the inspections under this program. Pending results of industry progress with regard to validation of the significance of dimensional changes due to void swelling, the applicant states that the visual examinations may be supplemented to incorporate requirements for measurement of critical parts to evaluate potential dimensional changes. Accordingly, an evaluation will be performed to establish the requirements for dimensional verification of critical reactor vessel internals parts as part of the visual examination scope.

Commitment dates associated with the implementation of this new program are provided in Appendix A to the LRA. Specifically, this program will be in place prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. As described in response to RAI 3.8.6-4, FPL will submit to the NRC a report that will summarize the understanding of aging effects to apply to the reactor vessel internals, and will provide the Turkey Point inspection plan, including required methods for detection and sizing of cracks and acceptance criteria. This report will be submitted prior to the end of the initial 40-year operating license term for Unit 3. As described in response to RAI 3.8.6-3, the first of the reactor vessel internals inspections will occur early in the license renewal period on the unit leading in fluence at that time, and the second inspection will be conducted on the other unit at the next 10-year inspection interval, or 10 to 12 years into the license renewal term.

Since the application focuses discussion of this program around the visual examinations and the UT examinations, the review and evaluation of this program will be structured along those same lines.

3.8.6.1 Visual Examination

3.8.6.1.1 Summary of Technical Information in the Application

The application provides a description of this examination in Section 3.1.6.1 of Appendix B the LRA. The examination description is covered under eight items: scope, preventive actions, parameters monitored, or inspected, detection of aging affects, monitoring and trending, acceptance criteria, confirmation process, and operating experience and demonstration. A description of the contents of the application is provided below in the staff evaluation.

3.8.6.1.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.1.6.1 of Appendix B of the LRA regarding the applicant's demonstration of the visual examination activity of the reactor vessel internals inspection program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are evaluated below.

[*Program Scope*] As described in the application, this activity will manage the aging effects of cracking due to irradiation-assisted stress corrosion (IASCC) and reduction in fracture toughness due to irradiation and thermal embrittlement on accessible parts of the Turkey Point Unit 3 and 4 reactor vessel internals. The reactor vessel internals susceptible to these aging effects and included in the visual examination scope are accessible areas of the lower core plates and fuel pins, lower support columns, core barrel, baffle/former assemblies, thermal shields, and lower support forgings. The program will consist of VT-1 examinations utilizing remote equipment such as television cameras, fiber-optic scopes, periscopes, etc. The staff finds the scope of this program adequate for managing the aging effects for which it is intended because the program addresses the reactor vessel internal components of interest.

[*Preventive or Mitigative Actions*] The application states that there are no practical preventive actions available that will prevent IASCC and reduction in fracture toughness. However, to minimize the potential for IASCC, the concentrations of chlorides, fluorides, and sulfates in the reactor coolant are controlled by implementation of the chemistry control program. The staff agrees with the applicant's conclusions that there are no practical preventive actions.

[*Parameters Monitored or Inspected*] This examination monitors the effects of cracking and reduction in fracture toughness on the reactor vessel internals selected parts by the detection and sizing of cracks. The staff finds that the cited examination will be effective in managing IASCC and reduction in fracture toughness in reactor vessel internals components because this is a proven method for detecting and sizing of cracks in the components.

[*Detection of Aging Effects*] Cracking of reactor vessel selected parts will be detected by performance of VT-1 examinations. Cracking is expected to initiate at the surface and, therefore, will be detectable by visual examination. If ultrasonic examination of bolting (see Section 3.8.6.2.2 of this SER) determines that IASCC is occurring, then enhanced VT-1 inspections capable of detecting 0.5 mile wire against a gray background of the accessible areas of the lower core plates and fuel pins, lower support columns, core barrels, baffle/former assemblies, thermal shields, and lower support forgings will be performed. The staff finds that the visual examinations described by the applicant will be effective in detecting the aging effects cited in the application because this is a proven method for inspecting these components.

[*Monitoring and Trending*] The VT-1 examination of selected parts of the reactor vessel internals will be performed one time for each unit during the period of extended operation. On the basis of the results of each examination, additional examinations and/or repairs will be scheduled. The staff finds this approach to be acceptable because it provides a reasonable approach for addressing any degradation identified.

[*Acceptance Criteria*] The LRA states that acceptance criteria will be developed prior to the visual examinations, and cracks that are detected during the inspections will be evaluated for determination of the need and method of repair. The staff finds this approach to be acceptable because the acceptance criteria will be developed using acceptable procedures.

[*Operating Experience*] The LRA states that the remote visual examination proposed by this program utilizing equipment such as television cameras, fiber-optic scopes, periscopes, etc., has previously been demonstrated as an effective method to detect cracking of reactor vessel internals. The applicant states in the LRA that similar visual examinations were successfully performed at St. Lucie Unit 1 during the core barrel repair/modification. The staff concludes that the visual examination will be effective in managing the aging effects cited by the applicant because it uses proven techniques for the components of interest.

3.8.6.2 Ultrasonic Examination

3.8.6.2.1 Summary of Technical Information in the Application

The application provides a description of this examination in Section 3.1.6.2 of Appendix B of the LRA. The examination description is covered under eight items: scope, preventive actions, parameters monitored or inspected, detection of aging affects, monitoring and trending, acceptance criteria, confirmation process, and operating experience and demonstration. A description of the contents of the application is provided below in the staff evaluation.

3.8.6.2.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.1.6.2 of Appendix B of the LRA regarding the applicant’s demonstration of the UT examination activity of the reactor vessel internals inspection program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. The program satisfies the elements of corrective action, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[*Program Scope*] This activity manages the aging effect of loss of mechanical closure integrity on reactor vessel internals baffle/former bolts, barrel/former bolts, and lower support column bolts. The volumetric examination will involve UT examination on the baffle/former bolts in each unit to supplement the current examination techniques. The results of this examination will be utilized to determine the need for similar examinations of the barrel/former bolts, lower support column bolts, and other reactor vessel internals bolting. Additionally, the baffle/former bolting is the leading location for determining the extent of IASCC that may be occurring because it is subject to more limiting fluences and higher stresses than other potentially susceptible parts of the reactor internals addressed under the scope of the Reactor Vessel Internals Inspection Program. If IASCC is identified by the ultrasonic examination of the baffle/former bolting, then FPL will perform an enhanced VT-1 inspection capable of detecting 0.5mil wire against a gray background of the accessible areas of the lower core plates and fuel pins, lower support columns, core barrels, baffle/former assemblies, thermal shields and lower support forgings. The staff finds the scope of this program adequate for managing the aging effects for which it is intended.

[*Preventive or Mitigative Actions*] There are no practical preventive actions available that will prevent loss of mechanical closure integrity of reactor vessel internals bolting. However, to minimize the potential for loss of mechanical closure integrity due to IASCC, the concentrations of chlorides, fluorides, and sulfates in the reactor coolant are controlled by implementation of the chemistry control program. There are no preventive or mitigative actions associated with the ultrasonic examination, nor did the staff identify a need for such actions.

[*Parameters Monitored or Inspected*] This examination monitors loss of mechanical closure integrity of the reactor vessel internals bolts by the detection and sizing of cracks. The staff finds that the ultrasonic examination will be effective in managing the cited aging effects in the reactor vessel internals components.

[*Detection of Aging Effects*] The aging effect of loss of mechanical closure integrity of reactor vessel internals bolting will be detected by performance of ultrasonic examinations. The staff finds that the ultrasonic examinations described by the applicant will be effective in detecting the aging effects cited in the application because approved methods will be used to develop these criteria.

[*Monitoring and Trending*] The ultrasonic examination of the reactor vessel internals baffle/former bolts will be performed one time on each unit during the period of extended operation. On the basis of the results of the examination, additional examinations and/or repairs will be scheduled. The staff finds this approach to be acceptable based on industry experience of limited cracking of baffle/former bolts.

[*Acceptance Criteria*] The LRA states that the quantity of cracked baffle/former bolts shall be less than the number of bolts that can be damaged without affecting the intended function of the reactor vessel internals. This quantity will be established by evaluation. The staff finds this approach to be acceptable.

[*Operating Experience*] The LRA states that the UT examination methods are proven techniques that have been used in other programs to successfully detect cracking, and that UT examinations have been demonstrated as an effective method of detecting cracking in baffle/former bolting at other Westinghouse plants. The ultrasonic examinations utilize techniques with a demonstrated capability and a proven industry record to detect cracking. These examinations are performed utilizing approved procedures and qualified personnel.

The staff agrees that UT examination methods are effective for the components of interest.

3.8.6.3 FSAR Supplement

Section 16.1.6, "Reactor Vessel Internals Inspection Program," of Appendix A to the LRA provides an updated FSAR supplement for the reactor vessel internals inspection program, as amended by the applicant's response to RAI 3.8.6-4. The staff concludes that the updated FSAR Supplement is sufficient.

3.8.6.4 Conclusion

The staff has reviewed the information in Appendix B, Section 3.1.6 of the LRA and responses to the staff's RAIs. On the basis of the above evaluations of the visual and ultrasonic examination activities of the reactor vessel internals inspection program, the staff finds that this program provides reasonable assurance that the applicable aging effects will be managed so that reactor vessel internal components will continue to perform their intended functions consistent with the CLB throughout the period of extended operation.

3.8.7 Small Bore Class 1 Piping Inspection

The small bore Class 1 piping inspection program is credited for aging management of small bore Class 1 piping in the reactor coolant systems (RCS).

3.8.7.1 Summary of Technical Information in the Application

The applicant describes the piping inspection in Section 3.1.7, "Small Bore Class 1 Piping Inspection," of Appendix B to the LRA. This inspection will be a one-time inspection of a sample of Class 1 piping less than 4 inches in diameter. As described in Appendix A to the LRA, this inspection will be performed prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4, using a volumetric technique chosen to permit detection and sizing of significant cracking of small bore Class 1 piping. Since this is a one-time inspection, no monitoring or trending is anticipated by the applicant. The evaluation of the inspection results may result in additional examinations consistent with ASME Section XI, subsection IWB. A small sample of the affected welds will be selected for examination based on piping geometry, piping size, and flow conditions. As described in response to RAI 3.8.7-1, the sample of welds to be examined will be selected using a risk-informed approach approved previously by the NRC.

This one-time inspection is described in the LRA as a new activity, which will use techniques with demonstrated capability and a proven industry record to detect piping weld and base material flaws. The applicant states that effective and proven volumetric examination techniques will be selected for use in performing this inspection. This inspection will be performed utilizing approved procedures and qualified personnel. Results and recommendations from industry initiatives will be incorporated into the inspection. The staff reviewed the applicant's description of the program in Section 3.1.7 of Appendix B to the LRA to determine if the small bore Class 1 piping inspection will adequately manage cracking in small bore Class 1 piping welds such that these components will to perform their intended functions for the period of extended operation as required by 10 CFR 54.21(a)(3).

3.8.7.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in Section 3.1.7 of Appendix B to the LRA regarding the applicant's demonstration of the small bore Class 1 piping inspection to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[*Program Scope*] The small bore Class 1 piping inspection is a one-time inspection of a sample of Class 1 piping less than 4 inches in diameter. As described in response to RAI 3.8.7-1, the sample of welds to be examined will be selected using a risk-informed approach approved previously by the NRC. Commitment dates associated with the implementation of this new program are provided in Section 16.1.7, of Appendix A to the LRA. The staff agrees with the adequacy of the applicant's description of the scope of this program.

[*Preventive or Mitigative Actions*] The applicant states that no preventive actions are applicable to this inspection. The staff concurs with this finding.

[*Parameters Monitored or Inspected*] The LRA states that the volumetric technique chosen will permit detection and sizing of significant cracking of small bore Class 1 piping. The staff agrees with the adequacy of the examination technique described by the applicant because this is a proven method for this type of inspection.

[*Detection of Aging Effects*] The applicant states that the aging effect requiring management, cracking, will be detected and sized in accordance with the volumetric technique chosen. The staff agrees with the adequacy of the examination technique described by the applicant because this is a standard industry technique.

[*Monitoring and Trending*] The LRA states that this is a one-time inspection and, as such, no monitoring or trending is anticipated. Further, the LRA states that the evaluation of the inspection results may result in additional examinations consistent with ASME Section XI, Subsection IWB. The staff finds this approach acceptable because cracking of small bore piping has not been prevalent in the industry and a one-time inspection program is adequate.

[*Acceptance Criteria*] The LRA states that any cracks identified will be evaluated and, if appropriate, entered into the corrective action program. The staff finds this approach acceptable because industry standards will be used in the acceptance criteria.

[*Operating Experience*] The LRA describes this one-time inspection as a new activity, which will use techniques with demonstrated capability and a proven industry record to detect piping weld and base material flaws. Effective and proven volumetric examination techniques will be selected for use in performing this inspection. This inspection will be performed utilizing approved procedures and qualified personnel. Results and recommendations from industry initiatives will be incorporated into the inspection. The staff finds this approach acceptable.

3.8.7.3 FSAR Supplement

Section 16.1.7 of Appendix A to the LRA states that the small bore Class 1 piping inspection will be performed prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff agrees with the timing for this inspection. Because the LRA does not specify the number of items to be inspected nor the specific lines to be inspected, the applicant has committed to provide to the NRC a report describing the inspection plan prior to implementation of this inspection (Ref. FPL letter L-2001-136, dated June 25, 2001).

3.8.7.4 Conclusion

The staff has reviewed the information in Section 3.1.7 of Appendix B of the LRA and responses to the staff's RAIs. On the basis of the evaluation of the small-bore Class 1 piping inspection program, the staff finds that this program provides reasonable assurance that the applicable aging effects will be managed so that the small bore Class 1 piping and nozzles will continue to perform their intended functions consistent with the CLB throughout the period of extended operation.

3.9 Existing Aging Management Programs

3.9.1 ASME Section XI Inservice Inspection Programs

The applicant described the inservice inspection (ISI) programs, Section 3.2.1, "ASME Section XI Inservice Inspection Program," of Appendix B to the LRA. The applicant credits the examinations performed under the ASME Code, Section XI, ISI program with managing the effects of aging for Class 1, 2, 3, and MC pressure-retaining components and their supports during the period of extended operation. The staff has reviewed the section of the application to determine whether the applicant has demonstrated that the effects of aging will be adequately managed by the ISI program during the extended period of operation as required by 10 CFR 54.21(a)(3). The ASME Section XI ISI programs are broken down into the following four programs:

- ASME Section XI, subsections IWB, IWC, and IWD inservice inspection program
- ASME Section XI, subsection IWE inservice inspection program
- ASME Section XI, subsection IWF inservice inspection program
- ASME Section XI, subsection IWL inservice inspection program

3.9.1.1 ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program

3.9.1.1.1 Summary of Technical Information in the Application

The ASME Section XI, subsections IWB, IWC, and IWD ISI program is described in Section 3.2.1.1, "ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program," of Appendix B to the LRA. The applicant credits this program for managing the effects of cracking, loss of mechanical closure integrity, and loss of material for piping and components in the reactor coolant system during the period of extended operation. The staff has reviewed the section of the application to determine whether the applicant has demonstrated that the effects of aging will be adequately managed by the ISI plan during the period of extended operation as required by 10 CFR 54.21(a)(3).

As identified in Chapter 3, Table 3.2-1 of the LRA, the ASME Section XI, Subsections IWB, IWC, and IWD ISI program is credited for aging management of specific component/commodity groups in the RCS.

The staff notes that the licensee submitted a request to revise the Turkey Point Unit 3 ISI scope for Class 1 piping to risk informed inservice inspection (RI-ISI). The revision affects the nondestructive examination (NDE) scope of Class 1 piping currently required by ASME Section XI. Examinations performed are based upon the postulated failure mechanism associated with the piping being inspected. The licensee plans to submit a similar request for Turkey Point Unit 4 at a later date. The staff's evaluation of the Unit 3 request is dated November 30, 2000.

In Section 3.2.1.1 of Appendix B of the LRA, the applicant stated its intent to meet the requirements of the latest edition and addenda to the ASME Code, Section XI, that are incorporated by reference in 10 CFR 50.55a(b) for ISI.

3.9.1.1.2 Staff Evaluation

The staff evaluation of the ASME Section XI, subsections IWB, IWC, and IWD ISI program focused on how the activities managed aging effects through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and covers all structures and components subject to an AMR. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven programs are evaluated below.

[*Program Scope*] The ASME Section XI, subsections; IWB, IWC, and IWD ISI program, as defined by the third interval ISI program for Turkey Point, Units 3 and 4, is credited with managing the aging effects of cracking, loss of mechanical closure integrity, and loss of material for piping and components. This program provides for the inspection and examination of components, including welds, pump casing, valve bodies, steam generator tubing, and pressure-retaining bolting. (The staff notes that steam generator tubing is also covered under LRA Section 3.2.14, “Steam Generator Integrity Program,” and in this safety evaluation in Section 3.9.14.)

ISI requirements may be modified by applicable relief requests and code cases that are approved specifically for each unit. A particular code edition is applicable for a 120-month interval. Prior to the end of each interval, the program is revised to reflect the updated requirements of 10 CFR 50.55a.

Although ASME Section XI, subsection IWD is included in the scope of this program, this application does not credit subsection IWD for managing the effects of aging of in-scope Class 3 pressure retaining components and their integral attachments. The aging effects of these items are credited by other aging management programs.

The staff finds that the scope of the ASME Section XI, subsections; IWB, IWC, and IWD ISI program is adequate.

[*Preventive or Mitigative Actions*] There are no specific actions under this program to prevent or mitigate the effects of aging. Specific actions that serve to limit the effects of aging for Class 1, 2, and 3 piping and components are conservative design, fabrication, construction, ISIs, and strict control of chemistry. The operating experience with the ISI program indicates that it has been successful in identifying and leading to correction of degradation effects as expected of this program. The staff did not identify a need for preventive actions.

[*Parameters Inspected or Monitored*] ISI includes visual inspections, surface examinations, and volumetric examinations in accordance with the requirements of ASME Section XI. The parameters monitored are specified in the ASME Code for each type of examination required. The staff accepts the parameters being monitored during ISI of Class 1, 2, and 3 components in managing age-related degradation.

[*Detection of Aging Effects*] The degradation of piping and components is determined by visual, surface, or volumetric examination in accordance with the requirements of ASME Section XI as modified by the third interval ISI program for Turkey Point, Units 3 and 4 [Reference B-4 of the LRA]. Piping and components are examined for evidence of operation-induced flaws using volumetric and surface techniques. The VT-1 visual examination is used to detect cracks, symptoms of wear, corrosion, erosion, or physical damage. VT-2 examinations are conducted to detect evidence of leakage from pressure-retaining components. VT-3 examinations are conducted to determine the general mechanical and structural condition of components and to detect discontinuities and imperfections such as loss of integrity at bolted or welded connections, loose or missing parts, debris, corrosion, wear, or erosion. The extent and frequency of inspections are specified in ASME Section XI, as modified in accordance with the third interval ISI program for Turkey Point, Units 3 and 4. The frequency and scope of examinations are sufficient to ensure that the aging effects are detected before they impact the components’ intended functions. The inspection intervals are not restricted by the Code to the current term of operation, and are valid for the period of extended operation. The staff accepts the NDE methods prescribed by the Code for each class of components to be reliable and effective in detecting age-related degradation of components that are within the scope of license renewal.

[*Monitoring and Trending*] The frequency and scope of examinations are sufficient to ensure that the aging effects are detected before impacting the component's intended functions. Inspections are performed in accordance with the inspection intervals specified by ASME Code Section XI as modified by the third interval ISI program for Turkey Point, Units 3 and 4.

Examinations performed during any inspection interval that reveal flaws or areas of degradation exceeding the acceptance criteria are to be extended to include additional examinations within the same category. When examination results require evaluation of flaws or areas of degradation, the areas are reexamined during subsequent inspection intervals in accordance with the requirements of ASME Section XI.

Records of the inspection program, examination and test procedures, results of activities, examination/test data, and corrective actions taken or recommended are maintained in accordance with the requirements of ASME Section XI, subsection IWA.

The staff accepts this methodology to undertake further programmatic actions, including additional examinations, corrective actions, and repair and replacement in accordance with ASME Section XI, to manage these aging effects.

[*Acceptance Criteria*] Acceptance standards for the ISIs are identified in ASME Section XI. Relevant indications that are revealed by the ISI may require additional inspections of similar components in accordance with ASME Section XI. Examinations that reveal indications exceeding the acceptance standards are made acceptable by repair, replacement, or evaluation. The staff accepts the flaw evaluation methodology of the Code as the industry standard and, therefore, the management of aging effects based on the Code criteria is acceptable.

[*Operating Experience*] ASME Section XI provides rules and requirements for ISI, testing, repair, and replacement of Class 1, 2, and 3 components. Components are chosen for inspection in accordance with the requirements of subsections IWB, IWC, and IWD and are inspected using the volumetric, surface, or visual examination methods.

The ASME Section XI inspections are conducted as part of the ISIs typically performed during plant refueling outages. The ISI of Class 1, 2, and 3 components and piping has been conducted since initial plant start-up as required by the plant technical specifications and 10 CFR 50.55a. These inspections have documented, evaluated, and corrected degraded conditions associated with piping and components inspected under the program.

Implementation of the ASME Section XI program at Turkey Point currently includes more than 480 Class 1, 2, and 3 examinations per unit per 10-year interval. For Class 1 piping, the examinations have yielded only indications of surface anomalies and surface geometry with no indication of fatigue cracking. For Class 2 piping, the only indications have been surface anomalies, acceptable slag inclusion, surface geometry, and fatigue cracking of steam generator feedwater nozzle reducers. The feedwater reducers were replaced and subsequent inspections are being performed in accordance with the requirements of ASME Section XI.

The staff finds that operating experience shows the ASME Section XI, subsections IWB, IWC, and IWD ISI program has been successful in identifying and leading to correction of aging effects. Therefore, the staff finds the program effective in the management of age related degradation.

3.9.1.1.3 FSAR Supplement

Section 16.2.1.1, “ASME Section XI, IWB, IWC, and IWD ISI Program,” of Appendix A to the LRA provides an updated FSAR supplement for the ASME Section XI, Subsections IWB, IWC, and IWD ISI program. The staff concludes that the updated FSAR supplement is sufficient.

3.9.1.1.4 Conclusion

The staff has reviewed the information in Section 3.2.1 of Appendix B of the LRA. On the basis of this review, the staff finds that the ASME Section XI, subsections IWB, IWC, and IWD ISI program provides reasonable assurance that the aging effects of cracking, loss of mechanical closure integrity, and loss of material will be managed such that components within the scope of license renewal will continue to perform their intended functions consistent with the current licensing basis during the period of extended operation.

3.9.1.2 ASME Section XI, Subsection IWE Inservice Inspection Program

3.9.1.2.1 Summary of Technical Information in the Application

The applicant credits this program with managing the effects of loss of material for containment steel components and changes in material properties for elastomers (seals, gaskets, and moisture barriers) associated with containment steel components. The program addresses the following program elements: scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, confirmation process, and operating experience and demonstration. These elements are discussed in 3.9.1.2.2.

3.9.1.2.2 Staff Evaluation

Addressing the 10 program elements (scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience) provides an efficient method of describing the processes involved in an aging management program.

It is noted that corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and covers all SSCs subject to an aging management review.

The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this safety evaluation report. This program satisfies the elements of corrective actions, confirmation process and administrative controls. The remaining seven elements are discussed below.

[Program Scope] The program includes the examination, testing, and repair/replacement activities for the metallic components, moisture barriers, seals, and gaskets of the containment pressure boundary.

[Preventive Actions] In describing preventive actions, the applicant stated that coatings, cathodic protection, and moisture barriers are not credited in determination of the aging effects requiring management. However, it is the degradation of coating and moisture barriers and malfunction of cathodic protection system that could give rise to the degradation of the protected safety-related components. That is the reason Subsection IWE requires periodic examination of moisture barriers, and coating. The effectiveness of these preventive measures should be periodically assessed as part of the aging management program for the protected components. In RAI 3.9.1.2-1 the staff stated that the applicant should provide a summary of the procedures used for managing the effectiveness of these preventive measures.

In its response, the applicant stated, "moisture barriers located at the interface of the containment liner and concrete floor are credited in the determination of aging effects for the containment liner plate, and the aging degradation of the moisture barrier is provided by the implementation of ASME Section XI, Subsection IWE." On the subject of the protective benefits of coatings and cathodic protection, the applicant stated that the existing plant procedures ensured that these protective measures were effective. However, the applicant argued that these protective measures did not perform a license renewal intended function as defined in 10 CFR 54.4(a)(1), (2), and (3) and they were not credited in the determination of aging effects requiring management for protected structures and components. Therefore, coatings and cathodic protection did not require aging management review and aging management. In response to RAI 3.6.1.5-2, however, the applicant has provided the procedures used for ensuring the effectiveness of protective coatings. In a discussion on April 11, 2001, the applicant emphasized that the procedures for ensuring the effectiveness of the cathodic protection system are available at the plant site for a staff review. In the AMR inspection during August 20 - September 14, 2001, the inspectors verified that the operation procedures for the CPS are available at the plant site and are adequate.

[Parameters Monitored or Inspected] The parameters monitored and inspected are in accordance with the requirements of Subsection IWE of the ASME Section XI Code (the Code). They include examination categories E-A for containment surfaces; E-C for augmented examination; E-D for seals, gaskets, and moisture barriers; E-G for pressure-retaining bolting; and E-P for pressure-retaining components. For seals and gaskets, the applicant takes credit for implementing Appendix J to 10 CFR Part 50, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," as required by Examination Category E-P. The staff finds the parameters monitored and inspected acceptable.

[Detection of Aging Effects] Implementation of Subsection IWE examination requirements is credited for detecting aging effects of metal surfaces, such as pitting, excessive corrosion, and arc strikes. To detect the aging effects on seals and gaskets, the applicant relies on the requirements of Appendix J to 10 CFR Part 50.

With reference to the detection of aging effects element, the bottom liner plate of the containment structure at Turkey Point is covered with fill concrete, and hence its direct examination is not feasible. At the same time, borated water leaks and thermal and shrinkage related cracking of the fill concrete could give rise to corrosion of the bottom liner plate. In RAI 3.9.1.2-2 the staff asked if FPL has any program, whether as part of the IWE ISI or as part of the maintenance rule programs to detect the degradations and aging effects of the bottom liner plate. In the absence of a specific program, the applicant was asked to confirm that the bottom liner plate is not subjected to such degradation.

In its response to RAI 3.9.1.2-2, the applicant explained, that the Turkey Point containment structures have bottom liner plates that are embedded in the concrete with no exposed surfaces. The 18-inch thick concrete over the bottom liner protects the steel from corrosion. Containment concrete components are constructed of dense, well-cured concrete consistent with the guidance provided in ACI 201.2R-77. The concrete was designed in accordance with ACI 318-63. The aggregates were tested in accordance with ASTM C295. The concrete over the bottom liner is not normally exposed to an aggressive environment. These features ensure concrete cracking is minimized. Consequently, the concrete over the containment liner plate provides adequate protection of the inaccessible portions of the liner plate. In addition, a moisture barrier is provided that prevents intrusion of moisture between the concrete and the inaccessible liner surfaces. Additionally, when events occur such as borated water leaks, potential degradation of inaccessible structures is evaluated as part of the Corrective Action Program. Finally, the containment liner plate is periodically pressure tested in accordance with the ASME Section XI, Subsection IWE, Inservice Inspection Program (Category E-P), described in Application Appendix B, Subsection 3.2.1.2 (page B-30). Based on the design features and programs discussed above, there is reasonable assurance that the containment liner plate will continue to perform its intended function throughout the period of extended operation. Based on this response, the staff concludes that the applicant's program for managing the degradation of inaccessible liner plate is reasonable. The issue in RAI 3.9.1.2-2 is therefore closed. Based on the program element and the additional information provided by the applicant, the staff finds this element of the program acceptable.

[Monitoring and Trending] For frequency of examinations and augmented examinations which are required for monitoring and trending the aging effects the applicant relies on the examination and accepted criteria prescribed in subsection IWE. Furthermore, the applicant states that examinations performed during any inspection interval that reveal flaws or areas of degradation exceeding the acceptance criteria are expanded to include additional examinations within the same category. When examination results require evaluation of flaws or areas of degradation, the area(s) are reexamined during the next inspection interval. Flaws or areas of degradation are documented and evaluated in accordance with the corrective action program and the requirements of the ASME Section XI, Subsection IWE Inservice Inspection Program. The staff finds it acceptable

[Acceptance Criteria] Acceptance criteria are based on the acceptance standards established in IWE-3000 of Subsection IWE of the ASME Section XI Code. Moreover, the applicant stated that the inspection results that reveal evidence of degradation exceeding the acceptance standards may be subjected to additional inspections to determine the nature and extent of the conditions. The staff considers this acceptable.

[Operating Experience and Demonstration] The applicant stated that prior to the implementation of Subsection IWE as required by 10 CFR 50.55a, the examination of the containment's steel components were performed in accordance with the requirements of Appendix J to 10 CFR Part 50. The Appendix J tests performed at the Turkey Point units during the years of operation have not shown any loss of intended function of the containment steel components. Moreover, the applicant stated that material properties for nonmetallic components (such as gaskets and seals) change over time, and these components are replaced in accordance with approved plant procedures. Based on the inspections performed prior to the implementation of Subsection IWE, as part of the operating experience, in RAI 3.9.1.2-4 the applicant was asked to provide a summary of significant events related to the following failure mechanisms:

- liner corrosion
- major penetrations leakage (equipment hatches, airlocks, main steam line, feedwater line) that does not meet the Type B leakage rate requirements
- leakage and corrosion of bellows (if applicable)
- isolation valve leakages (system or Type B test)
- Type A tests that do not meet the containment leak rate criteria

The applicant was also asked to include the corrective actions taken and procedures modified to alleviate such events in the future. In its response, the applicant provided a summary of the operating experience related to the five items in the RAI. These responses indicated that the applicant is fully cognizant with the plant-specific experience, and the aging management program factors in the lessons learned from the operating experience. The issue in RAI item 3.9.1.2-4 is therefore closed

The staff believes that the applicant has provided pertinent operating experience and the program element is acceptable.

3.9.1.2.3 FSAR Supplement

UFSAR Supplement Section 16.2.1.2 included with the application contains a sufficient program description.

3.9.1.2.4 Conclusion

Based on the staff's review described above, the staff concludes that this aging management program provides reasonable assurance that the aging of the pressure retaining components of the primary containment structures at Turkey Point, Units 3 and 4, will be adequately managed during the period of extended operation.

3.9.1.3 ASME Section XI Subsection IWF Inservice Inspection Program

3.9.1.3.1 Summary of Technical Information in the Application

The applicant described its ASME Section XI, Subsection IWF Inservice Inspection Program in Section 3.2.1.3 of Appendix B to the Application. The applicant stated that the program is credited for aging management of Class 1, 2, and 3 component supports in the containments, auxiliary building, emergency diesel generator building, and yard structures.

3.9.1.3.2 Staff Evaluation

As indicated in Table 3.6-2 of the Application, the containments contain safety-related piping and component supports, reactor vessel supports, steam generator supports, pressurizer supports, reactor coolant supports, and surge line supports, all manufactured from carbon steel, which are exposed to the containment air environment. The applicant credited the Subsection IWF Inservice Inspection Program for managing the aging effect (loss of material) for these piping and component supports. Tables 3.6-3, 3.6-10, and 3.6-20 of the Application indicated the auxiliary building, emergency diesel generator building, and yard structures contain safety-related piping and component supports, manufactured from carbon steel, which are exposed to an indoor environment that is not air-conditioned. Based on Table 3.6-20, the yard structures also contain safety-related piping and component supports, manufactured from carbon steel, which are exposed to the outdoor environment. The applicant credited the Subsection IWF Inservice Inspection Program for managing the aging effect (loss of material) for these piping and component supports.

The staff evaluation of the Subsection IWF Inservice Inspection Program focused on how the program manages the aging effect of loss of material through effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

It is noted that corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and covers all structures and components subject to an aging management review. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this safety evaluation report. This program satisfies the elements of corrective actions, confirmation process and administrative controls. The remaining seven elements are discussed below.

[Program Scope] The applicant stated that the ASME Section XI, Subsection IWF Inservice Inspection Program is credited with managing the aging effect of loss of material for Class 1, 2, and 3 component supports (including pipe supports) located in the containments, auxiliary building, emergency diesel generator building, and yard structures. The scope of the Turkey Point program provides inspection and examination of accessible surface areas of these component supports. This is acceptable to the staff.

[Preventive Actions] The applicant stated that carbon steel surfaces are typically coated, in accordance with plant procedures, to reduce the effects of loss of material due to corrosion. Coatings minimize corrosion by limiting exposure to the environment. However, coatings are not credited in the determination of the aging effects requiring management. Therefore, no preventive actions are applicable to this program.

[Parameters Monitored or Inspected] The applicant stated that Class 1, 2, and 3 component supports are examined in accordance with ASME Section XI, Subsection IWF. The Subsection IWF Inservice Inspection Program provides for visual examination for general corrosion that could reduce the structural capacity of the component supports. This is acceptable to the staff, because the is in accordance with accepted industry code.

[Detection of Aging Effects] The applicant stated that the presence of corrosion that could lead to loss of material is determined by visual inspection of component supports. Surfaces are examined for evidence of flaking, blistering, peeling, discoloration, wear, pitting, corrosion, arc strikes, gouges, surface discontinuities, dents, or other signs of surface irregularities. The extent and frequency of the inspections are in accordance with ASME Section XI, Subsection IWF. This is acceptable to the staff.

[Monitoring and Trending] Selected supports are monitored during each inspection period. The program inspects 25% of non-exempt Class 1 piping supports, 15% of Class 2 piping supports, and 10% of Class 3 piping supports, plus several unique supports other than piping supports. The applicant stated that, for those component supports within a system that have similar design, function, and service, only one support is examined. Unacceptable supports are subject to corrective measures or evaluation, and are reexamined during the next inspection period. This is acceptable to the staff, because this is in accordance with accepted industry code.

[Acceptance Criteria] The applicant stated that acceptance standards for the examination and evaluation of supports are provided in ASME Section XI, Subsection IWF. A condition observed during a visual examination that requires supplemental examination, corrective measures, repair, replacement, or analytical evaluation is categorized as a relevant condition and is not considered acceptable. This is acceptable to the staff, because this is in accordance with accepted industry code.

[Operating Experience] The ASME Section XI, Subsection IWF, inspections are conducted as part of the inservice inspections typically during plant refueling outages. The applicant stated that the inspection of Class 1, 2, and 3 component supports has been conducted since initial plant startup, as required by the Technical Specifications.

ASME Section XI provides the rules and requirements for inservice inspection testing, repair, and replacement of Class 1, 2, and 3 component supports. The ASME Section XI, Subsection IWF Inservice Inspection Program applies to Class 1, 2, and 3 component supports. These supports are chosen for inspection in accordance with the requirements of ASME Section XI, Subsection IWF, and shall be inspected using visual examination methods.

The visual examinations of Class 1, 2, and 3 component supports look for deformations or structural degradations, corrosion, and other conditions that could affect the intended function of the support. All conditions noted during the inspection of component supports, whether or not they are considered to require further review, are documented on inspection reports. The applicant stated that the FPL Nuclear Division Quality Assurance Department performed an audit of the inservice inspection program, and concluded that the program was complete and in compliance with the requirements of the ASME Code, Section XI, and applicable commitments.

The staff finds that the past plant operation serves to ensure successful future performance of the ASME Section XI, Subsection IWF ISI program, and is acceptable.

3.9.1.3.3 FSAR Supplement

The applicant provided the updated FSAR Supplement, in Section 16.2.1.3 of Appendix A to the LRA, which states that ASME Section XI, Subsection IWF Inservice Inspection Program inspections identify and correct degradation of ASME Class 1, 2, and 3 component supports. The staff concludes that the updated FSAR Supplement is sufficient.

3.9.1.3.4 Conclusion

Based on the information provided by the applicant, the staff concludes that the continued examinations performed under the ASME Section XI, Subsection IWF inservice inspection program provide reasonable assurance that the aging effect of loss of material for the Class 1, 2, and 3 components and piping supports within the scope of license renewal will be managed for the period of extended operation.

3.9.1.4 ASME Section XI, Subsection IWL Inservice Inspection Program

This SER section addresses the review of Section 3.2.1.4 of Appendix B to the LRA related to Subsection IWL of the ASME Section XI inservice inspection program.

3.9.1.4.1 Summary of Technical Information in the Application

in Chapter 3 of the LRA, the applicant stated that this program is credited for aging management of post-tensioning system structural components in the containments. The applicant's description of the program addressing the seven program elements is discussed in 3.9.1.4.2.

3.9.1.4.2 Staff Evaluation

It is noted that corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and covers all SSCs subject to an aging management review. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this safety evaluation report. This program satisfies the elements of corrective actions, confirmation process and administrative controls. The remaining seven (7) elements are discussed below.

[Program Scope] The scope of the program provides for inspection of tendon wires and tendon anchorage hardware surfaces for loss of material, as well as a confirmatory program for measurement of tendons for loss of prestress.

In RAI 3.9.1.4-1, the staff stated that the applicant had credited the ASME Section XI, Subsection IWL, for aging management of the containment post-tensioning system components. However, Subsection IWL of Section XI of the ASME Code is established as a required program for the inservice inspection of concrete and post-tensioning system. The staff asked the applicant to provide a description of a program for managing the aging of containment concrete, including, inspection interval, personnel qualifications, examination method(s), acceptance criteria, and quality assurance requirements in lieu of its reference to subsection IWL, which does not contain specific acceptance criteria for examination of concrete. The staff requested the applicant to revise the discussion in Section 3.2.1.4 to incorporate specific acceptance criteria for examination of concrete in an overall ISI program to be used for aging management of the containment post-tensioning system component.

In its response, the applicant argued that there are no aging effects that could cause a loss of intended function for the containment concrete above groundwater. At the same time, the applicant recognized the existence of concrete degradations depicted in Appendix A to NUREG-1522. The applicant proposed to modify its exclusive reliance on the ASME Section XI, Subsection IWL in the description of the aging management program in Section 3.2.1.4 of Appendix B to the LRA to include aging management of containment reinforced concrete above ground water. In a letter dated April 19, 2001, the applicant stated, “the Turkey Point ASME Section XI, Subsection IWL Inservice Inspection Program was developed considering ACI 201.1R 68 (Revised 1984), ‘Guide for Making a Condition Survey of Concrete in Service,’ to establish degradation type and IWL-3211 acceptance criteria.” As supplemented by the RAI response, the staff considers this issue to be resolved.

[Preventive Actions] The applicant described the presence of two mechanisms that serve as preventive actions: (1) a layer of low-strength nonstructural concrete is provided to prevent the intrusion of rainwater under the grease caps of the top anchorages of vertical tendons, and (2) all the metallic components (such as reinforcing bars, liner plate, and tendon anchorages) are interconnected to an impressed current cathodic protection system (CPS). Additionally, the applicant states that the CPS is not credited in the determination of the aging effects requiring management.

A number of components (e.g., reinforcing bars, tendon anchorage components) to which the CPS is connected are embedded or not available for direct examination. Depending upon the reliability of the continuous source for applying impressed current, the CPS may or may not be effective at certain times (power outage, low battery). Such incidents could lead to adverse effects on the protected components. Thus, if the CPS is relied upon for preventing corrosion of the protected components, its effectiveness in performing its function has to be periodically assessed. The staff requested more information regarding ensuring the effectiveness of the CPS. During the AMR inspection in August — September 2001, the inspectors reviewed the procedures and records and concluded that the applicant has adequate procedures and sufficient surveillance that the staff’s concern is resolved.

[Parameters Monitored or Inspected] In accordance with ASME Section XI, Subsection IWL, unbonded post-tensioning system components are examined. These components consist of tendons, wires or strand, anchorage hardware and surrounding concrete, corrosion protection medium, and free water. Surface conditions are monitored through visual examinations to determine the extent of corrosion or concrete degradation around anchorage locations. Prestress forces are measured for sample tendons to determine loss of prestressing force. Tension tests are performed on wire or strand samples removed from tendons to be examined for corrosion and mechanical damage. As discussed in *{Program Scope}*, the applicant has committed to monitor the parameters associated with the degradation of concrete containment surfaces. The staff considers the program element acceptable.

[Detection of Aging Effects] The presence of age-related degradation is determined by visual inspection or by measurement. Tendon anchorage hardware is examined for corrosion. A select number of tendons are completely detensioned, and a sample wire from each group of tendons is examined for the presence of corrosion and tested to verify ultimate strength. Tendon anchorage hardware and concrete surfaces are examined for corrosion protection medium (grease) leakage and the tendon caps are examined for deformation. As discussed in *[Program Scope]*, the applicant has committed to monitor and detect aging effects in the above ground and below ground containment concrete surfaces. Thus, the staff finds the element acceptable.

[Monitoring and Trending] The applicant stated that the first period containment inspections are scheduled for completion by September 9, 2001, as required by 10 CFR 50.55a. The tendon inspections are performed as required by Subsection IWL of the ASME Section XI Code (the Code). Subsection IWL requires the evaluation of loss of material of the tendon components, and loss of prestress (the principal age-related effects on post-tensioning system components). Thus, these aging effects will be monitored and trended. As described, the staff finds this program element is acceptable.

[Acceptance Criteria] The results of inspections (performed in accordance with the requirements of Subsection IWL of the Code) are evaluated against the acceptance standards in the IWL. As discussed in *[Program Scope]*, the applicant has committed to implement the acceptance criteria IWL-3211 for concrete examination during the extended period of operation. As described, the staff finds this element description acceptable.

[Operating Experience and Demonstration] The applicant describes its operating experience related to the post-tensioning tendon system as follows:

The measured lift-off forces for a number of randomly selected surveillance tendons were below the predicted lower limit. Condition Reports and a Licensee Event Report were issued. In accordance with the Technical Specifications, engineering evaluations were prepared and concluded that the lower than expected tendon lift-off forces were caused by greater than expected tendon wire relaxation losses due to average tendon temperatures higher than originally considered.

To accommodate the increased prestress losses, a license amendment was submitted and approved to reduce the containment design pressure from 59 psig to 55 psig, and a containment reanalysis was performed to determine the new minimum required prestress forces to maintain Turkey Point licensing-basis requirements. The results of the reanalysis are provided in the UFSAR, Section 5.1.3. The ASME Section XI, Subsection IWL Inservice inspection program incorporates all of the inspection criteria and guidelines of the previous tendon inspection program attributes, and is implemented using existing plant procedures.

Based on the inspections performed prior to the implementation of Subsection IWL as part of the operating experience, RAI 3.9.1.4-3 asked the applicant to provide a summary of significant events related to the following causative agents:

- containment concrete (e.g., dome delamination, wide-spread scaling)

- containment prestressing force (unusual systematic losses) (closed based on the information provided in the UFSAR supplement)
- corrosion of post-tensioning system hardware (breakage of wires or anchor-head components)
- grease leakage through concrete

The applicant was also asked to include the corrective actions taken and procedures modified to alleviate such events in the future and to provide a description of the condition of tendon gallery environment and measures implemented to control it to alleviate the corrosion of vertical tendon anchorage hardware.

The applicant described the operating experience related to the above items in its response to the RAI. Based on the response, the staff finds that the applicant has adequately considered the plant-specific, as well as industry-wide experience in evaluating the aging management program for the extended period of operation. Therefore, RAI item 3.9.1.4-3 is closed and this program element is acceptable.

3.9.1.4.3 FSAR Supplement

A review of the UFSAR Supplement indicates that the response to RAI 3.9.1.4-3 is fully described in Section 5.1.3, and in Appendix 5H of the supplement Section 16.2.1.4 provides a sufficient summary of the program.

3.9.1.4.4 Conclusion

Based on its review, the staff concludes that this aging management program provides reasonable assurance that the aging of the concrete containment components (i.e., concrete and post-tensioning system components) of the primary containment structures at Turkey Point, Units 3 and 4, will be adequately managed during the period of extended operation.

3.9.2 Boraflex Surveillance Program

The applicant described the Boraflex surveillance program in Section 3.2.2, “Boraflex Surveillance Program,” of Appendix B to the LRA. The application of this program is provided in descriptions found in Section 3.6.2.2, “Steel-in-Fluid Structural Components,” of the LRA. The staff reviewed the application to determine whether the applicant has demonstrated that the effects of aging covered under the Boraflex surveillance program will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.2.1 Summary of Technical Information in the Application

The Boraflex surveillance program is credited for managing the aging effect of material changes in the Boraflex poison material found in the spent fuel storage racks. Currently, this program includes blackness testing and tracking of SFP silica levels as qualitative indicators of Boraflex degradation. The applicant states that prior to the end of the initial operating terms for Turkey Point, Units 3 and 4, this program will be enhanced to provide for density testing (or other approved testing methods). In response to the staff’s RAI, the applicant stated that the enhancement to this program is the performance of density testing on the racks in lieu of blackness testing. This program enhancement is discussed in the staff's safety evaluation to amendment No. 206 to facility operating license No. DPR-31 and amendment No. 200 to facility operating license No. DPR-41 transmitted by NRC letter dated July 19, 2000.

3.9.2.2 Staff Evaluation

The staff evaluation of the Boraflex surveillance program focused on how the activities managed aging effects through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[Program Scope] The Boraflex surveillance program is applied to the boron-impregnated polymer, Boraflex, found in the SFP storage racks. The staff agrees that it is appropriate to include this material component within the scope of the Boraflex surveillance program.

[Preventive or Mitigative Actions] The Boraflex surveillance program has no associated preventive or mitigative actions. There are no known methods of preventing the loss of boron carbide and the eventual release of silica since the Boraflex polymer matrix breaks down over time due to the convective aqueous environment of the SFP. The staff agrees that there are no preventive or mitigative actions to prevent the further break down of the polymer matrix and eventual release of boron carbide into the SFP. However, based on the known mechanism governing the polymer matrix breakdown, Boraflex degradation can be retarded by limiting disturbances to the SFP and maintaining silica equilibrium between the panel and the surrounding water. In response to the staff's RAI, the applicant stated that the SFP purification system has a low turnover rate, a low propensity to remove soluble boron, and no special measures are taken to reduce silica concentration. On the basis of this response, the staff concludes that the applicant's current program adequately accounts for the mechanism of Boraflex degradation.

[Parameters Monitored or Inspected] The application describes the current program consisting of blackness testing which confirms the inservice Boraflex panel performance data in terms of gap formation, gap distribution, and gap size. In addition, trending of the SFP silica levels is conducted to give a qualitative indication of boron carbide loss from the panels. The enhanced Boraflex surveillance program will include checking the density (or other approved methods) to ascertain the physical loss of boron carbide.

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, the staff requested the applicant to justify the non-inclusion of the change in material properties due to both irradiation and convective forces in the SFP (i.e., a change in material properties due to dissolution of the Boraflex panel). In response to the staff's concerns, the applicant responded that the enhancement of this program evaluates changes in material properties due to dissolution of the panel through the determination of boron areal density. The applicant further specified that results from this determination will be compared with the required minimum boron areal density to indicate the panels' condition. On the basis of this response, the staff concludes that the parameters inspected and monitored under this program are appropriate and adequate to determine degradation of the Boraflex panels in the spent fuel racks.

[Detection of Aging Effects] The application states that the presence of silica in the SFP water, which is periodically monitored, is a physical sign of the aging effect occurring in the Boraflex material. In addition, the application states that the enhanced Boraflex surveillance program will determine the amount of degradation of the Boraflex material.

Although the applicant discusses blackness testing in the introduction of this AMP, blackness testing is not discussed as a means of detecting the aging effect of gap formation in the Boraflex panels. In addition, the applicant stated that trending of silica concentration in the SFP gives an indication of Boraflex degradation; however, this indication does not provide the degree to which the Boraflex has degraded. In response to the staff's concerns, the applicant responded with further details regarding the enhancement of this AMP. The applicant stated that this program will be enhanced to include areal density testing of the panels which will be completed in lieu of blackness testing. The staff finds that this method of testing the panels, in conjunction with silica concentration monitoring, is more effective than blackness testing alone and is adequate in detecting the aging effects associated with degradation of the Boraflex panels.

[Monitoring and Trending] The application states that shrinkage, gaps, and density will be monitored during scheduled Boraflex surveillance testing and that subsequent Boraflex tests will be scheduled following evaluation of the measured results. The application continues stating that trends will be established following implementation of the enhanced Boraflex surveillance program.

The staff finds that it is appropriate and prudent to monitor and trend shrinkage, gap formation, and density changes of the Boraflex panels. However, the staff requested the applicant to clarify how these parameters are currently trended and analyzed. In addition, the staff requested the applicant to provide details of how the enhanced program will affect the current analyses of these parameters. In response to the staff's concerns, the applicant stated that data from the periodic surveillances are evaluated to determine the number, size, and location of shrinkage and gaps within and among the tested panels. The data is further compared with the criticality analysis assumptions which govern the SFP to confirm that the analysis continues to bound the observed data. The enhanced program will continue to obtain data related to shrinkage and gaps but will also include data related to the density of the panels. The additional data will also be evaluated and compared with the criticality analysis assumptions. The staff finds these methods appropriate and acceptable for monitoring and trending the degradation of the Boraflex panels.

[Acceptance Criteria] The acceptance criteria provided in the application for Boraflex degradation are controlled by the assumptions in the criticality analysis. The applicant states that the results of each surveillance are used to ensure that 5% criticality margin will be maintained.

The staff agrees that the acceptability of Boraflex degradation should be controlled by the assumptions in the criticality analysis. However, the staff requested the applicant provide details regarding how the surveillance results ensure that the 5% subcriticality margin will be maintained. In response to the staff's concerns, the applicant stated that the data related to the enhancement to this program (i.e., areal density) will be used in conjunction with shrinkage and gap formation to evaluate the assumptions governing the 5% subcriticality margin. On the basis of this information and clarifying information provided in other responses related to staff's concerns regarding this program enhancement, the staff concludes that this enhanced program has appropriate acceptance criteria in ensuring that the Boraflex panels continue to meet their intended function.

[Operating Experience] The application states the current Boraflex surveillance program was initiated following installation of high density SFP racks. The results of this program have indicated that Boraflex degradation is occurring due to accumulation of silica in the SFP water. The application further discusses that the blackness testing performed once every 5 years has demonstrated that the technical specification for maintaining the subcriticality margin has been met. On the basis of this discussion, the applicant concluded that the continued implementation of the Boraflex surveillance program provides reasonable assurance that the effects of aging will be adequately managed for the period of extended operation.

The staff requested the applicant (RAIs dated February 1, 2001) provide further details supporting the adequacy of the current program in determining the effectiveness of the degraded Boraflex panels currently in the SFP. 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. In addition, the staff requested the applicant to discuss how the enhanced Boraflex surveillance program will support conclusions drawn from the applicant's operating experience. On the basis of the staff's concerns, the applicant provided in a letter dated April 19, 2001, clarifying details of the enhanced program which includes areal density testing of the Boraflex panels. On the basis of the details provided in the responses to various aspects of this program, the staff concludes that the applicant's enhanced program will adequately address the Boraflex degradation experience at Turkey Point, Units 3 and 4.

3.9.2.3 FSAR Supplement

Based on the responses provided to the staff's RAIs, the staff requests the applicant to update Chapters 14 and 16 of the UFSAR Supplement found in Appendix A to the LRA, to include a description of all applicable aging effects of Boraflex and the program enhancement discussed in the staff's SER to amendment No. 206 to facility operating license DRP-31 and amendment No. 200 to facility operating license No. DRP-41 transmitted by NRC letter dated July 19, 2000. This is confirmatory item 3.9.2-1.

3.9.2.4 Conclusion

The staff has reviewed the Boraflex surveillance program, described in the following sections of the application: Sections 3.2.2, "Boraflex Surveillance Program," and 3.6.2.2, "Steel-in-Fluid Structural Components," of Appendix B and responses to staff's RAIs. On the basis of the review, the staff concludes that there is reasonable assurance that the Boraflex surveillance program, with the stated enhancements, will adequately manage the aging effects of gap formation and dissolution of the Boraflex panels in the SFP racks in accordance with the CLB during the period of extended operation.

3.9.3 Boric Acid Wastage Surveillance Program

The applicant described the boric acid wastage surveillance program in Section 3.2.3, "Boric Acid Wastage Surveillance Program," of Appendix B to the LRA. The application of this program is credited for managing the aging effects associated with cast iron, carbon steel and low alloy steel components/commodities found in the following systems and structures: auxiliary building ventilation, chemical and volume control, CCW, containment isolation, containment post-accident monitoring and control, containment spray, electrical/I&C components, emergency containment cooling, emergency containment filtration, feedwater and blowdown, fire protection, instrument air, intake cooling water, main steam and turbine generators, normal containment and control rod drive mechanism cooling, primary water makeup, reactor coolant, residual heat removal, safety injection, sample, SFP cooling, waste disposal, auxiliary building, containments, spent fuel storage and handling, and yard structures. The staff reviewed the application to determine whether the applicant has demonstrated that the aging effects covered by this activity will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.3.1 Summary of Technical Information in the Application

The boric acid wastage surveillance program manages the effects of loss of material and loss of mechanical closure integrity due to aggressive chemical attack of cast iron, carbon steel, and low alloy steel components and structural components including bolting. The program encompasses mechanical closures (e.g., bolted connections, valve packing, pump seals) and electrical structural components (e.g., enclosures, cable trays, conduits). This program will be enhanced to include some systems outside containment (i.e., SFP cooling and portions of the waste disposal associated with containment integrity) currently inspected under other existing programs. The enhancement does not reflect additional inspection activities but a modified grouping to include inspections currently completed in other activities.

3.9.3.2 Staff Evaluation

The staff requested additional information dated February 2, 2001, from the applicant with respect to the enhancement of this program. Specifically, the staff requested the applicant 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. In a response, dated April 19, 2001, the applicant stated that this program will be enhanced to include the SFP cooling and waste disposal system which is currently inspected under the systems and structures monitoring program described in Section

3.2.15, “Systems and Structures Monitoring Program,” of Appendix B to the LRA. The applicant further stated that 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. In addition, the procedures currently require leakage testing to be corrected or evaluated but do not explicitly address the potential for corrosion of adjacent components subjected to borated water. The staff has reviewed this information and has determined that this enhanced program will continue to inspect these additional systems in a manner similar to the current inspection program.

The staff evaluation of the boric acid wastage surveillance program focused on how the activities managed aging effects through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff evaluation of the applicant’s quality assurance program is provided separately in Section 3.1.2 of this safety evaluation report. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are evaluated below.

[Program Scope] The boric acid wastage surveillance program is applied to various cast iron, carbon steel, and low alloy steel components and structural components including bolting found in various systems and structures exposed to borated water. The program includes systematic inspections, leakage evaluations, and corrective actions to ensure that boric acid corrosion does not compromise the pressure boundary or structural integrity of components, supports or structures. In addition, this program includes electrical structural components in proximity to borated water systems, and will be enhanced to include inspections currently completed under other existing programs.

The staff agrees that it is appropriate and prudent to include components constructed from cast iron, carbon steel and low alloy steel. However, the external surfaces of other materials are also susceptible to corrosion from exposure to concentrated boric acid. The staff requested the applicant to discuss the non-inclusion of components constructed from aluminum, brass, bronze, carbon, and galvanized steel which may also be exposed to the corrosive boric acid environment. The applicant responded that other metals such as copper, copper alloys, nickel, nickel alloys, and aluminum are resistant to boric acid corrosion and therefore, loss of material due to aggressive chemical attack does not require management for these materials. The staff has reviewed this information and has concluded that the severity of the chemical attack on surrounding components is dependent on the concentration of boric acid. However, the staff notes that the methods in this program for monitoring and preventing the aging effects associated with boric acid are appropriate and adequate in controlling boric acid wastage on surrounding components.

[Preventive or Mitigative Actions] The applicant states that preventive actions included in the boric acid wastage surveillance program are removal of concentrated boric acid and boric acid residue and the elimination of boric acid leakage.

The staff agrees that these actions are applicable and prudent in mitigating corrosion by minimizing the exposure of susceptible material to the corrosive environment.

[Parameters Monitored or Inspected] The applicant states that this program monitors the effects of boric acid corrosion on the intended function of the component by detection of coolant leakage discussed in NRC Generic Letter (GL) 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. The applicant further states that crystal buildup and evidence of moisture are conditions that lead to boric acid corrosion.

The staff finds that the detection of coolant leakage through evidence of crystal buildup and moisture is acceptable because these are conditions which are directly related to the degradation of components exposed to boric acid.

[Detection of Aging Effects] The applicant states that degradation of components cannot occur without leakage of coolant containing boric acid. Visual inspections resulting from discovery of crystal buildup and evidence of moisture are performed on external surfaces in accordance with plant procedures and are used to indicate leakage of coolant containing boric acid.

The staff finds that the discovery of crystal buildup and/or moisture is an appropriate and acceptable method of determining coolant leakage which will eventually lead to corrosion of the material. However, in the case of electrical cables or insulated piping, discoloration of the insulation is also indicative of a coolant leakage. The staff requested the applicant to provide additional information related to the adequacy of this program in identifying aging effects prior to the loss of component intended function. The applicant, in its response, stated that if insulated piping or electrical cables show signs of boric acid leakage (e.g., boric acid residue), the source of the leakage is determined and corrected. In addition, the applicant stated that the commitments to GL 88-05 have been aggressively implemented and that a review of plant history shows minor leaks which have been corrected. The applicant noted that none of the identified leaks resulted in significant component/system degradation or loss of intended function. On the basis of the information provided, the staff finds that the AMP includes appropriate and adequate methods for detecting boric acid leaks prior to affected component loss of function.

[Monitoring and Trending] The applicant states that leakage calculations are performed each shift. If identified or unidentified RCS leakage is greater than 0.5 gpm, an RCS leakage investigation is initiated to identify and address the source of the leakage. In addition, during each refueling, inspections of systems inside containment are performed. Every 18 months, inspections of borated water systems outside containment are performed.

The staff finds these frequencies acceptable and appropriate given the description of the applicant’s operating history and industry practice of inspecting systems inside containment every refueling outage.

[Acceptance Criteria] The applicant states that all cases of boric acid leakage are either corrected or evaluated. The staff requested the applicant to provide details regarding the evaluation of a boric acid leakage discovery including specific evaluation criteria and the bases for such criteria. In response to the staff's request, the applicant stated that this AMP implements commitments made through the applicant's response to GL 88-05 including guidelines for locating small leaks, conducting examinations and performing evaluations. In addition, leakage evaluations are performed under the applicant's corrective actions program and consider the location and characteristics of the leak, the component's function, other systems affected by the leak, operability requirements, technical specifications, and the UFSAR. On the basis of the information provided, the staff finds that appropriate and adequate acceptance criteria for detecting and correcting boric acid leaks are implemented through this AMP.

[Operating Experience] The applicant states that this program was originally implemented as a result of boric acid leaks experienced at Turkey Point and NRC GL 88-05. The program addresses the generic letter requirements including: (1) detection of principal location where coolant leaks are smaller than allowable TS limits, (2) methods for conducting examinations which are integrated into ASME Code VT-2 inspections; and (3) corrective actions to prevent recurrences of this type of leakage. Since establishing the program, the applicant asserts that there have been no instances of boric acid corrosion that have impacted license renewal system intended functions.

The staff finds that the applicant has demonstrated the boric acid wastage surveillance program has been effective in preventing damage to components due to exposure to concentrated boric acid.

3.9.3.3 FSAR Supplement

In Section 3.9.3.3 of the SER with open items, the staff requested that the applicant update the UFSAR Supplement with a summary description of the Boric Acid Waste Surveillance program. By letter dated November 1, 2001, the applicant provide the requested information in Section 16.2.3 of Appendix A to the LRA. The staff finds the summary description acceptable, and therefore confirmatory item 3.9.2-1 is closed.

3.9.3.4 Conclusions

The staff has reviewed the boric acid wastage surveillance program described in Section 3.2.3, “Boric Acid Wastage Surveillance Program,” of Appendix B and various sections of the LRA and responses to the staff's RAIs. On the basis of this review, the staff concludes that the applicant has demonstrated that there is reasonable assurance that the boric acid wastage surveillance program will adequately manage the aging effects of various components susceptible to the corrosive element of boric acid in accordance with the CLB during the period of extended operation.

3.9.4 Chemistry Control Program

This program is covered in Section 3.1.1 of this safety evaluation report.

3.9.5 Containment Spray System Piping Inspection Program

3.9.5.1 Summary of Technical Information in the Application

Containment spray is designed to remove sufficient heat to maintain the containment below its design pressure and temperature during a loss-of-coolant accident or main steam line break. Containment spray is composed of two motor-driven horizontal centrifugal pumps, each discharging to two spray lateral headers located near the top of the containment structure. The system also utilizes the residual heat removal pumps and heat exchangers for the long-term recirculating phase of containment spray, as described in section 2.3.2.5 of the LRA. Additionally, containment spray provides a source of water for the emergency containment filtration spray (see Subsection 2.2.2.6 of the LRA). Components associated with this function are included in the scope of emergency containment filtration. Containment spray is described in UFSAR Section 6.4

The flow diagrams listed in Table 2.3-4 of the LRA show the evaluation boundaries for the portions of containment spray that are within the scope of license renewal.

Containment spray is within the scope of license renewal because it contains structures and components that are safety-related and are relied upon to remain functional during and following design-basis events and structures and components that are a part of the environmental qualification program.

Containment spray components subject to an aging management review include the pumps and valves (pressure boundary only), heat exchangers, cyclone separators, piping, tubing, fittings, orifices, and spray nozzles. The intended functions for containment spray components subject to an aging management review include pressure boundary integrity, spray, throttling, filtration, and heat transfer. A complete list of containment spray components requiring an aging management review and the component intended functions is provided in Table 3.3-2 of Section 3.3 of the LRA. The aging management review for containment spray is discussed in Section 3.3 of the LRA.

3.9.5.2 Staff Evaluation

As identified in Table 3.3-2, of the LRA, the containment spray system piping inspection program is credited for aging management of selected valves, piping and fittings in containment spray. The applicant has identified loss of material to be the aging effect requiring management for the stainless steel pressure boundary components in a treated water environment.

The staff evaluation of the containment spray system piping inspection program focused on how the program manages the aging effect through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The corrective actions, confirmation process and administrative controls for license renewal are in accordance with the site controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to an aging management review. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[Program Scope] The applicant stated that the containment spray system piping inspection program manages the aging effect of loss of material due to general, crevice, and pitting corrosion on the internal surfaces of carbon steel piping/fittings and valves wetted by boric acid in the containment spray headers. In RAI 3.9.5-4, the staff requested the applicant to discuss the differences in design, construction or operation of this system at Turkey Point that explain why the scope of their program is limited to loss of material for carbon steel components.

In its response the applicant stated that for austenitic stainless steels in treated water, the relevant conditions required for stress corrosion cracking (SCC) are the presence of halogens in excess of 150 ppb or sulfates in excess of 100 ppb, and elevated temperature. For Turkey Point treated water environments, a temperature criterion of greater than 140 °F is utilized for susceptibility of austenitic stainless steels to SCC. Containment spray (CS) operates at a temperature less than 140 °F. Therefore, cracking due to SCC is not an aging effect requiring management for CS components. This conclusion is supported by plant operating and maintenance experience.

NRC Bulletin 79-17, "Pipe Cracks in Stagnant Borated Water Systems at PWR Plants," Information Notice 79-19, "Pipe Cracks in Stagnant Water Systems at PWR Plants," and IE Circular 76-06, "Stress Corrosion Cracks in Stagnant, Low-Pressure Stainless Piping Containing Boric Acid Solution at PWRs," describe several instances of throughwall cracking in stainless steel piping in stagnant borated water systems. NRC Bulletin 79-17 required licensees to review safety-related systems that contain stagnant, oxygenated, borated water. For these identified systems, licensees were requested to review preservice NDE, inservice NDE results, and chemistry controls. Also, ultrasonic and visual examinations of representative samples of circumferential welds were performed. The results of these reviews and inspections for Turkey Point, which included the containment spray system, identified no anomalies in chemistry or indications of SCC at welds. All of the instances of SCC in the nuclear industry have identified the presence of halogens, such as chlorides in the failed component. These occurrences most likely resulted from the inadvertent introduction of contaminants into the system. SCC can occur in stainless steel at ambient temperature if exposed to a harsh environment (i.e., with significant contamination). However, these conditions are considered to be event-driven, resulting from a breakdown of quality controls for water chemistry. Based on the above discussion, cracking due to SCC was determined not to be an aging effect requiring management for containment spray. The staff concurs with the applicant and considers the RAI issue resolved. The staff finds the overall scope of the program acceptable.

[Preventive Actions] The applicant states that as a preventive action, the surveillance procedures require the closure of a second isolation valve in the containment spray headers when the pumps are started for testing. In RAI 3.9.5-1 the staff requested the applicant to clarify the effectiveness of the preventive action. In its response the applicant stated that the

containment spray pumps surveillance testing procedures require closure of the second isolation valve in the containment spray headers. This preventive measure minimizes the possibility of water entering the spray headers, however, it is not credited for managing any aging effect. The aging management review assumed that the isolation valves leak and that the containment spray header is exposed to a borated water environment. The staff is satisfied with this response because the applicant's action is based on a conservative assumption and the RAI issue is considered resolved. Therefore, the staff finds the applicant's prevention actions adequate and acceptable.

[Parameters Monitored or Inspected] The applicant stated that the program monitors the wall thickness of selected piping/fittings in the spray headers within the containments. The staff finds the parameters identified for monitoring will permit timely detection of aging effects and are therefore acceptable.

[Detection of Aging Effects] The applicant stated that ultrasonic thickness measurement is utilized for this examination. The aging effect of concern, loss of material would be evident by the reduced wall thickness in the piping/fittings being examined. The staff concurs with the applicant's determination that the ultrasonic thickness measurements are effective in detecting the aging effects and, therefore, finds the detection method acceptable.

[Monitoring and Trending] The applicant stated that the examination is initially performed each refueling outage. The piping/fittings thickness measurements permit calculation of a corrosion rate. Inspection frequency may be adjusted based on corrosion rate to ensure that minimum wall thickness requirements for the pipe are maintained. If evaluation of the inspection results indicates that loss of material due to corrosion is not occurring, the containment spray system piping inspection program may be discontinued. Also, in RAI 3.9.5-3 the staff requested that the applicant describe the methods for monitoring and evaluating the aging effects for piping/fitting joints that may be inaccessible. In its response, the applicant stated that all piping/fittings required to be examined are accessible to perform ultrasonic thickness measurements. The RAI issue is, therefore, considered resolved. The staff finds the applicant's methodology will be effective in monitoring and trending the aging effects and is therefore acceptable.

[Acceptance Criteria] The applicant stated that the wall thickness measurements greater than minimum wall thickness values for the component design of record are acceptable. Wall thickness measurements less than the minimum required values are entered into the corrective action program. The staff finds this acceptable.

In RAI 3.9.5-2, the staff requested the applicant to indicate whether or not the required minimum wall thickness of the piping/fittings and valves has been evaluated to withstand damage due to fatigue resulting from flow-induced vibrations. In its response, the applicant stated that flow-induced vibration is not a design consideration for the containment spray system because the fluid flowing through the system is water (single phase) and there is no flow geometry (e.g., cross flow through tubes, etc.) that would induce flow vibrations. The minimum wall thickness is based on design pressure, dead weight, thermal, and seismic loads in accordance with the requirements of ANSI B31.1. The staff finds the response reasonable and acceptable. The RAI issue is, therefore, considered resolved. The staff finds the acceptance criteria for evaluating component damage will be able to determine the progress of damage due to aging effects and specify the time when appropriate corrective action needs to be taken and are therefore acceptable.

[Operating Experience and Demonstration] Ultrasonic thickness measurements have been performed for several years. The technique has proven to be successful at determining the wall thickness of piping/fittings and other components.

This is an existing program at Turkey Point that uses a technique with demonstrated capability and a proven industry record to measure wall thickness. This examination is performed utilizing approved procedures and qualified personnel. The ultrasonic thickness measurement technique has been previously used to measure the wall thickness in the containment spray system spray headers and other plant systems. The results of these examinations have detected some areas of localized corrosion in the headers, and the results are documented.

Based on the operating experience at Turkey Point, the staff considers the continued implementation of the containment spray system piping inspection program provides reasonable assurance that loss of material will be managed such that components from the containment spray system piping and therefore is acceptable.

3.9.5.3 FSAR Supplements

The staff has reviewed the UFSAR Section 16.2.5 and has confirmed that it contains the appropriate elements of the program.

3.9.5.4 Conclusion

In conclusion, based on the information discussed above, the staff finds the implementation of the containment spray system piping inspection program will provide reasonable assurance that loss of material will be managed such that the components within the scope of license renewal will continue to perform their intended functions consistent with the CLB throughout the period of extended operation.

3.9.6 Environmental Qualification Program

3.9.6.1 Summary of Technical Information in the Application

The environmental qualification program is created for ensuring the qualified life of electrical and I&C components within the scope of 10 CFR 50.49. The thermal, radiation, and wear cycle aging analyses of plant electrical and I&C components required to meet 10 CFR 50.49 have been identified as time-limited aging analyses for Turkey Point, Units 3 and 4.

3.9.6.2 Staff Evaluation

The staff reviewed the EQ program to determine whether it will ensure that the electrical and I&C components covered under this program will continue to perform their intended function consistent with the current licensing basis for the period of extended operation. The staff's evaluation of the component qualification focused on how the program manages the aging effect through effective incorporation of the following 10 elements: program scope, preventive action, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The LRA indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site controlled corrective actions program pursuant to Appendix B to 10 CFR Part 50, and cover all components that are subject to AMR. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[Program Scope] The scope of the program includes the environmentally qualified devices that are within the scope of 10 CFR 50.49 including the following categories of electrical equipment located in a harsh environment:

- safety-related equipment
- non-safety-related equipment whose failure could adversely affect safety-related equipment
- the necessary post-accident monitoring equipment

The staff considers the scope of the program acceptable.

[Preventive Actions] The program includes preventive actions required to maintain the qualification time period for the environmentally qualified devices.

[Parameter Monitored or Inspected] The program establishes an aging limit (qualified life) for each installed device. The installed life of each device is monitored, and appropriate actions (replacement, refurbishment, or requalified) are taken before the aging limit is exceeded. The staff considers this monitoring appropriate because the program objective is to ensure the qualified life of devices established is not exceeded.

[Detection of Aging Effects] The program does not require the detection of aging effects for equipment while in service since effects are maintained within established acceptable limits by the EQ program actions. When the qualified life is less than the plant license period, the program requires replacement, refurbishment, or requalification of the component prior to the end of its qualified life. When unexpected adverse effects are identified during operation or maintenance activities, they are evaluated to determine the root cause and significance in accordance with the approved procedures. The staff considers the applicant's program to replace, refurbish, or requalify the component prior to the end of its qualified life acceptable.

[Monitoring and Trending] The installed life of each environmentally qualified device is monitored, and appropriate actions (replacement, refurbishment, or requalified) are taken before the aging limit is exceeded. The program does not require monitoring or trending of condition or performance parameters of equipment while in service to manage the effects of aging. The staff considers this is acceptable since 10 CFR 50.49 does not require monitoring and trending of component condition or performance parameters of inservice components to manage the effects of aging.

[Acceptance Criteria] The program requires replacement, refurbishment, or requalification before exceeding the life limit (qualified life) of each installed device. The staff considers this is acceptable since it is consistent with 10 CFR 50.49 requirements of refurbishment, replacement, or requalification before exceeding the qualified life of each installed device.

[Operating Experience] The EQ program is an ongoing program at Turkey Point that considers the best practices of industry organizations, vendors, and utilities. The program provides assurance that the environments to which installed devices are exposed will not exceed the qualified lives associated with the devices. This is accomplished through effective monitoring of key parameters (temperature, radiation) at established frequencies with well-defined acceptance criteria. The EQ program is governed by the quality control program to ensure accurate results.

The overall effectiveness of the EQ program is supported by the excellent operating experience for systems, structures, and components that are influenced by the program. No environmental qualification related degradation has resulted in loss of component intended functions on any systems. The program has been subject to periodic internal and external assessment activities that help to maintain highly effective control and facilitate continuous improvement. The staff finds that the applicant has adequately addressed operating experience.

3.9.6.3 FSAR Supplement

The summary description of the EQ program provided in Section 16.2.6 of Appendix A to the LRA is sufficient.

3.9.6.4 Conclusion

The applicant stated that its EQ program is an effective program for managing the effects of aging to ensure that the components within the scope of license renewal will continue to perform their intended function consistent with the current licensing basis for the period of extended operation. The staff considers the applicant’s program which monitors key parameters (temperature and radiation) at established frequencies with well-defined acceptance criteria, provides assurance that the environments to which installed devices are exposed will not exceed the qualified lives associated the devices. Thus, the equipment will continue to perform its intended function consistent with the CLB throughout the period of extended operation.

The staff concludes that the EQ program will adequately manage the qualified life of components for the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.7 Fatigue Monitoring Program

3.9.7.1 Summary of Technical Information in the Application

In Section 3.2.7 of Appendix B to the LRA, the applicant describes an existing aging management program, the FMP, that is designed to track cyclic and transient occurrences to ensure that reactor coolant pressure boundary components remain within ASME Code Section III fatigue limits. The applicant refers to the FMP as a confirmatory program (rather than an actual aging management program) because the program only monitors the number of significant plant transients to ensure that number of transients assumed in the design fatigue analyses are not exceeded.

3.9.7.2 Staff Evaluation

The staff reviewed the FMP to determine whether it will ensure that the fatigue design limits are not exceeded during the period of extended operation. The staff's evaluation of the component cyclic and transient limit program focused on how the program manages the aging effect through effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The LRA indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled corrective actions program pursuant to Appendix B to 10 CFR Part 50, and cover all structures and components that are subject to aging management review. The staff evaluation of the applicant's corrective actions program is provided separately in Section 3.1.2 of this safety evaluation report. The corrective actions program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[Program Scope] The scope of the program includes the reactor vessels, reactor vessel internals, pressurizers, steam generators, reactor coolant pumps, and pressurizer surge lines. The program tracks the number of design cycles to ensure that these components remain within their design limits. The staff considers the scope of the program, which includes the RCS components qualified in accordance with ASME Code fatigue analyses acceptable.

[Preventive and Mitigative Actions] The applicant identified the cycle counting procedure as the preventative action for this program. The staff considers counting of design cycles to be an acceptable preventive action.

[Parameters Inspected or Monitored] The parameters monitored are the cycles of design transients used in the Class 1 design analyses. The staff considers this monitoring appropriate because the program objective is to ensure the number of cycles assumed in the design analyses are not exceeded.

[Detection of Aging Effects] The program monitors design transients used in the fatigue analysis of components and the information is used to ensure that the fatigue design limits are not exceeded. This provides assurance that the fatigue analyses of record remain valid during the period of extended operation. The staff considers this monitoring appropriate.

[Monitoring and Trending] The applicant uses administrative procedures for logging design cycles. As stated previously, the program monitors the design transients used in the fatigue analysis of the components to ensure that the fatigue analyses of record remain valid during the period of extended operation. The staff finds this program element acceptable.

[*Acceptance Criteria]* The applicant specifies the maximum number of design cycles in the plant administrative procedures. The applicant indicated that the plant procedures require administrative action should the actual cycle count reach 80% of any design cycle limit. The staff considers this criterion acceptable.

[Operating Experience] The applicant's program involves tracking transients used in the design of these components. The applicant indicates that an independent assessment of the program was performed. According to the applicant the assessment concluded that the administrative procedure accurately identifies and classifies plant design cycles. The staff finds that the applicant has adequately addressed operating experience.

3.9.7.3 FSAR Supplement

The summary description of the FMP provided in Section 16.2.7 of Appendix A to the LRA is sufficient.

3.9.7.4 Conclusion

The applicant references the FMP in its discussion of the fatigue TLAAs as a confirmatory program to ensure that design fatigue limits are not exceeded during the period of extended operation. The staff considers the applicant's program, which monitors the number of plant transients that were assumed in the fatigue design an acceptable method to manage the fatigue usage of the RCS components within the scope of the program.

The staff concludes that the FMP will adequately manage thermal fatigue of RCS components for the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.8 Fire Protection Program

3.9.8.1 Summary of the Technical Information in the Application

The fire protection program is designed to protect plant equipment in the event of a fire, to ensure safe plant shutdown, and minimize the risk of a radioactive release to the environment. The program relies on fire water supply including sprinklers, Halon suppression, fire dampers, RCP oil collection, alternate shutdown, safe shutdown, and fire detection and protection. Individual components that constitute alternate shutdown and safe shutdown were screened with their respective systems. The screening for fire detection and protection electrical and

Instrumentation and Controls is discussed in Section 2.5 of the LRA. Fire protection is described in UFSAR Appendix 9.6A. The majority of fire protection is common to Units 3 and 4.

The flow diagrams listed in Table 2.3-5 of the LRA show the evaluation boundaries for the portions of fire protection that are within the scope of license renewal.

Fire protection is in the scope of license renewal because it contains structures and components that are safety-related and are relied upon to remain functional during and following design-basis events, structures and components that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions, and structures and components that are relied on during postulated fires.

Fire protection components that are subject to an aging management review include the raw water tanks, pumps and valves (pressure boundary only), tanks, heat exchangers, hose stations, flame arrestors, sprinklers, strainers, orifices, piping, tubing, and fittings. The intended functions for Fire protection components that are subject to an aging management review are pressure boundary integrity, heat transfer, filtration, throttling, fire spread prevention, and spray. A complete list of the fire protection components that require aging management review and the component intended functions, appears in Tables 3.4-14 and 3.6-12 of the Application. The aging management reviews for fire protection are discussed in Sections 3.4 and 3.6.2 of the LRA. Fire extinguishers, fire hoses, and air packs are not subject to an aging management review because they are replaced based on conditions in accordance with National Fire Protection Association (NFPA) standards and plant surveillance procedures for fire protection equipment. This position is consistent with the NRC staff's guidance on consumables provided in the NRC's letter to the applicant dated March 10, 2000.

The Fire Protection Program manages the aging effects of loss of material, cracking, and fouling for the components/piping of the fire Protection System and Fire Rated Assemblies. Additionally, this program manages the aging effects of loss of material, loss of seal, cracking, and erosion for structures and structural components associated with fire protection. Appendix 9.6A contains a detailed discussion of the Fire Protection Program.

As stated earlier, the scope of the Fire Protection Program will be enhanced to include inspection of additional components prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4.

3.9.8.2 Staff Evaluation

As identified in Table 3.4-14 of the LRA, the fire protection program is credited for aging management of specific component/commodity groups associated with the fire protection and fire rated assemblies.

The following specific component/commodity groups are identified:

- carbon steel raw water tanks in air/gas, outdoor, and raw water environments with an aging effect requiring management of loss of material

- cast iron electric and diesel fire pumps and heat exchanger shell in treated water, indoor-not air-conditioned, and outdoor environments with aging effects requiring management of loss of material and fouling

- copper alloy diesel fire pump heat exchanger tubes and cover in a raw water environment with aging effects requiring management of loss of material and fouling

- cast iron basket strainers in raw water and outdoor environments with an aging effect requiring management of loss of material

- carbon steel, stainless steel, cast iron, and copper alloy valves, piping, tubing, fittings, sprinklers, flexible hoses, flame arrestors, and flow restriction orifices in air/gas, raw water, and outdoor environments with an aging effect requiring management of loss of material

- rubber expansion joints in an indoor-not air-conditioned environment with an aging effect requiring management of cracking

The staff's evaluation of the fire protection program focused on how the program manages the aging effect through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored of inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components that are subject to an aging management review. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this safety evaluation. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[*Program Scope]* The fire protection program manages the aging effects of loss of material, cracking, and fouling for the components/piping of the Fire Protection System and Fire Rated Assemblies. Additionally, this program manages the aging effects of loss of material, loss of seal, cracking, and erosion for structures and structural components associated with fire protection.

The applicant states that the scope of the fire protection program will be enhanced to include inspection of additional components. Commitment dates associated with the enhancement of this program are contained in Appendix A to the LRA.

In RAI 3.9.8-1, the staff requested the applicant to provide the basis and guidelines which are to be used for the selection of the additional components in the enhanced program. In its response, the applicant stated that cracking of rubber, neoprene, or coated canvas materials due to embrittlement is an aging effect evaluated in the aging management review process. The aging management review of fire protection components identified rubber expansion joints on the suction and discharge of the diesel fire pump. As a result, the fire protection program, described in Section 3.2.8 of Appendix B to the LRA will be enhanced to include inspection of the rubber expansion joints on the suction and discharge of the diesel fire pump engine piping for evidence of cracking or drying. All other components subjected to aging effects requiring management under the fire protection program are currently included within the scope of this program. The staff finds the applicant's response reasonable and acceptable. The RAI issue is, therefore, considered resolved. With the resolution of the staff's concerns as discussed above, the staff finds the scope of the fire protection program adequate and acceptable.

[Preventive Actions] The applicant states that many fire protection components are provided with a protective coating to minimize the potential for external corrosion. Coating minimizes corrosion by limiting exposure to the environment. However, coatings are not credited in the determination of the aging effects requiring management. This is acceptable to the staff because coatings provide an added measure of protection.

[Parameters Monitored or Inspected] The applicant states that surface conditions are monitored visually to determine the extent of external material degradation. Visual examination will detect loss of material due to general, crevice, and pitting corrosion, as well as loss of seal or cracking due to embrittlement. Internal conditions are monitored via leakage, flow, and pressure testing. Internal loss of material (due to general, crevice, and pitting corrosion; microbiologically influenced corrosion; and selective leaching) and blockage due to fouling can be detected by changes in flow or pressure, leakage, or evidence of excessive corrosion products during flushing of the system. The staff finds that the parameters monitored will permit timely detection of the aging effects and are therefore acceptable.

[Detection of Aging Effects] The applicant stated that detection of degradation on external surfaces is determined by visual examination. Surfaces of components and structures are examined for damage, deterioration, leakage, or other forms of corrosion.

Functional testing and flushing of the system clears away internal scale, debris, and other foreign material that could lead to blockage/obstruction of the system. Flow and pressure tests verify system integrity. Visual examination of breached portions of the system also verifies unobstructed flow and integrity of the piping/components.

In RAI 3.9.8-2, the staff requested the applicant to identify the specific programs which are credited for monitoring external and internal material degradation of the fire protection system components and piping. In its response, the applicant identified the programs relevant to the fire protection system. Based on its review, the staff finds that the applicant's response is satisfactory, and the issue is considered resolved. In addition, the staff requested the applicant at a meeting held on April 12, 2001, to provide clarification regarding the inspection and testing of sprinkler systems. In its response the applicant stated that per UFSAR Appendix 9.6A, Turkey Point's current licensing basis does not include National Fire Protection Association (NFPA) 25 for testing and inspection of sprinkler heads. However, Turkey Point generally conforms to NFPA guidelines, and many tests and inspections are performed in accordance with NFPA.

Turkey Point uses potable city water (potable) as its water source for fire protection. This water was conservatively classified as "raw water" for the purpose of performing aging management reviews even though it is clean and free of contaminants compared to lake or river water used in fire protection systems at other plants. The quality of the water minimizes loss of material, as evidenced by Turkey Point's operating and maintenance experience. As identified in the above list of fire protection procedures, a fire protection system annual flush is credited for ensuring the system is clear of scale, debris and foreign material.

For closed head sprinkler systems, inspections and testing are performed on an 18-month interval, in accordance with the “Spray Sprinkler System Inspection.” This procedure verifies the systems are in a state of readiness by ensuring proper operation of clapper/inlet valves, all nozzles are unobstructed, and water and supervisory air pressure are within specifications.

Testing of open head sprinkler systems is done by the “Open Head Spray/Sprinkler 3-Year Air Flow Test.” This procedure requires connection of service air to the dry pipe and verification of flow path by the discharge of air at the opening of each sprinkler head/spray nozzle to ensure system functionality. Additionally, each spray nozzle is also visually inspected for obstruction.

Based on feedback from the NRC staff during a meeting on April 12, 2001, the applicant proposed to perform testing of wet pipe sprinkler heads following the guidance of NFPA commencing in the year 2022 (50 years from the issuance of the original operating license on Unit 3). This enhancement will be included with the fire protection program enhancements described in Appendix A, Section 16.2.8 (page A-37), and Appendix B, Section 3.2.8 (page B-56). The staff finds that these inspections and tests will provide a satisfactory means for detecting the aging effects in fire protection system components. Therefore, the staff finds the applicant’s detection methods acceptable.

[Monitoring and Trending] The degradation found as a result of inspection/testing of the systems/components is addressed by the fire protection program procedures. The evaluation of the inspection/testing results may result in additional testing, monitoring, and trending. The staff finds this methodology will provide effective monitoring are trending of the aging effects and is therefore acceptable.

[Acceptance Criteria] The results of the inspection/testing will be evaluated in accordance with the acceptance criteria in the appropriate fire protection procedure(s). Parameters required to be monitored and controlled are listed in the applicable documents.

In RAI 3.9.8-3, the staff requested the applicant to identify the specific fire protection procedures which specify the acceptance criteria for evaluating the inspection and test results of the components/piping. Also, the applicant was requested to identify the applicable documents which list the parameters required to be monitored and controlled. In its response, the applicant identified the relevant procedures which, contain the parameter required to be monitored or controlled. The staff finds the applicant’s response satisfactory and acceptable. The RAI issue is therefore closed. With the resolution of the staff’s concerns, the staff finds the acceptance criteria adequate and acceptable.

[Operating Experience and Demonstration] The Fire Protection Program has been an ongoing program at Turkey Point. The program was enhanced by implementation of 10 CFR Part 50, Appendix R, and has evolved over many years of plant operation. The program incorporates the best practices recommended by NFPA and Nuclear Electric Insurance Limited (NEIL) and is approved by the NRC.

The overall effectiveness of the program is demonstrated by the excellent operating experience of systems, structures, and components that are included in the Fire Protection Program. The applicant states that the program has been subjected to periodic internal assessment activities. These activities, as well as other external assessments, help to maintain highly effective fire protection control and facilitate continuous improvement through monitoring industry initiatives and trends in the area of aging control. The staff finds that, based on the operating experience, the applicant will effectively maintain a Fire Protection Program during the extended period of operation.

3.9.8.3 FSAR Supplements

The staff has reviewed the UFSAR Section 16.2.8 of Appendix A to the LRA and has confirmed that it contains the appropriate elements of the program.

3.9.8.4 Conclusion

On the basis of its review as discussed above, the staff concludes that the continued implementation of the fire protection program by the applicant provides reasonable assurance that the aging effects (loss of seal, loss of material, cracking, and fouling) will be managed such that components/commodity groups within the scope of license renewal will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

3.9.9 Flow-Accelerated Corrosion Program

The applicant described its flow-accelerated corrosion (FAC) program in Section 3.2.9, "Flow-Accelerated Corrosion Program," of Appendix B to the LRA. The LRA also included relevant material from Section 3.5 of the LRA. These sections address aging effects of the components in the feedwater and blowdown system and the main steam and turbine generators system. The objective of the FAC program is to manage the aging effects caused by FAC. It is accomplished by controlling the environment to which the affected components are exposed, predicting the degradation of these components by FAC and taking corrective actions once degradation has been identified.

The staff reviewed the applicant's description of the program in Section 3.2.9 of Appendix B of the LRA and relevant material in the other referenced section of the LRA to determine whether the applicant has demonstrated that the program will adequately manage the effects of aging caused by FAC in the plant during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.9.1 Summary of Technical Information in the Application

In the LRA the applicant has identified the following systems which contain the components that are subjected to FAC:

- main steam and turbine generator
- feedwater and blowdown

The applicant has identified loss of material by FAC as an aging effect for carbon steel components exposed to secondary water (treated water-secondary). These components, when exposed to the environment of moving single or two-phase water with low pH, low oxygen content and relatively high temperature, corrode at higher rates than if they were in contact with a stagnant fluid. The resulting loss of material produces thinning of walls in the affected components. In order to prevent their failure, the aging effect due to FAC has to be managed. The staff finds that there is reasonable assurance that this mode of degradation is the only plausible aging effect for aging management considerations.

The applicant developed a methodology for addressing the FAC issue. The applicant's methodology was based on EPRI recommendations specified in report NSAC-202L-R2, "Recommendations for Effective Flow-Accelerated Corrosion Program." The licensee concluded that it will ensure proper management of aging effects in the components subjected to FAC and will allow them to perform their intended functions consistent with the CLB, during the period of extended operation.

3.9.9.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information in the LRA regarding the applicant's demonstration that the FAC program will ensure that the effects of aging due to FAC will be adequately managed so that intended functions will be maintained consistent with CLB throughout the period of extended operation for all affected components in the systems included in the LRA. After completing the initial review, by letter dated February 1, 2001, the staff issued several requests for additional information (RAIs). By letter dated April 19, 2001, the applicant responded to the staff's RAIs.

The staff's evaluation of the applicant's AMPs related to FAC focused on program elements rather than detailed plant-specific procedures. To determine whether these program elements adequately mitigate the effects of aging to maintain the intended functions consistent with the CLB throughout the period of extended operation, the staff evaluated seven elements applicable to these programs. The corrective actions, confirmation process and administrative controls for license renewal were not discussed in this section because the applicant indicated that they are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff's evaluation of the quality assurance program is provided separately in Section 3.1.2 of this SER. The remaining seven elements are evaluated below.

[Program Scope] The applicant stated in Section 3.2.9 of Appendix B of the LRA that the scope of this program includes managing the aging effects caused by a loss of material by FAC from the components in the systems specified in Section 3.5 of the LRA. The program predicts, detects, monitors and mitigates FAC in high energy carbon steel piping associated with the main steam and turbine generator and feedwater and blowdown systems. It includes determination of the extent of wall thinning in these components and their repair or replacement when wall thickness reaches predetermined minimum thickness. In the future, the program will be enhanced to address loss of material from steam trap lines. The staff finds this scope adequate because it will detect and manage the aging effects in the components subjected to FAC.

[Preventive or Mitigative Actions] The magnitude of FAC depends on the geometry, hydrodynamic characteristics, and water chemistry of the system. The first two attributes cannot be controlled, but water chemistry can be controlled by the chemistry control program. High pH and oxidizing environment will minimize FAC. However, an oxidizing environment may

be undesirable for controlling other corrosion mechanisms. This method of controlling FAC has, therefore, limited application. Another effective preventive action against component failures by FAC is early detection and timely repair or replacement of the damaged components. The staff finds that predicting and measuring wall thickness, repairing and replacing damaged components, and, to some extent, controlling water chemistry, will effectively mitigate aging effects due to FAC.

[Parameters Monitored or Inspected] The program monitors the effects caused by FAC by measuring wall thickness of the components subjected to FAC. The EPRI-developed analytical model, CHECWORKS, is used to predict FAC in piping systems on the basis of plant-specific data, including material of construction, chemistry, hydrodynamics, and operating conditions. Subsequently, the components suspected to be damaged by FAC are examined by the NDE methods and their wall thickness determined. The staff finds that the parameters monitored will permit timely detection of aging effects in the components exposed to FAC.

[*Detection of Aging Effects*] Wall thickness is measured by UT examination and by radiography, as specified in EPRI NSAC-202L, which are standard, well-developed, NDE techniques that produce reliable results. The staff finds that determination of wall thickness by these techniques will provide satisfactory means for detecting aging effects in the components exposed to FAC.

[Monitoring and Trending] Using the predictive and inspection methods, the applicant will be able to detect, monitor and trend the magnitude of component wall thinning by FAC. If degradation is detected such that the wall thickness is less than the minimum allowed by the acceptance criteria, the component will be repaired or replaced and additional examinations will be performed of the components in adjacent areas to bound the damaged component. The staff finds this methodology will provide effective monitoring and trending of aging effects caused by FAC. The program will also include monitoring and trending of material loss by general corrosion of external surfaces of the components in the steam traps. This monitoring will be performed simultaneously with the monitoring of FAC in these components.

[Acceptance Criteria] The criterion for component replacement is based on the allowable minimum wall thickness for a given component specified in the ANSI B31.1 code. Inspections and analytical methods monitor and trend wall thickness. If it is predicted that the component will reach its minimum allowable wall thickness before the next inspection interval, the component is repaired, replaced, or acceptability to perform its function reevaluated. The staff finds that the criteria used for evaluating component damage will be able to determine the progress of FAC damage and specify the time when the appropriate corrective actions have to be taken.

[Operating Experience] The applicant has implemented the FAC program in response to NRC GL 89-08, “Erosion/Corrosion-Induced Pipe Wall Thinning.” The program applies to components subjected to FAC in the main steam and turbine generator system and the feedwater and blowdown system, containing single and two-phase fluids. These components were periodically examined by NDE methods and those which did not continue to meet the design criteria were either repaired or replaced by the components made from the same materials or from material more resistant to FAC. In the past, there has been a small number of components replaced due to FAC damage in the portions of main steam and turbine generator and feedwater and blowdown systems in the scope of the LRA. They included the

nozzle, elbow, and expander at the discharge from the feedwater pumps, the expanders/reducers associated with the feedwater regulating valves, and the pipe segment in the feedwater line in containment. The applicant stated that all damaged components were repaired or replaced in time and there were no cases of component inservice failure. The program was, therefore, successful in managing loss of material by the components exposed to FAC. The staff finds this approach acceptable.

3.9.9.3 FSAR Supplement

The summary description of the FAC program provided in Section 16.2.9 of Appendix A to the LRA is sufficient.

3.9.9.4 Conclusions

The staff has reviewed the information in Section 3.2.9 of Appendix B of the LRA. On the basis of this review, the staff concludes that the applicant has demonstrated there is reasonable assurance that the FAC program will adequately manage aging effects caused by FAC in accordance with the CLB throughout the period of extended operation.

3.9.10 Intake Cooling Water System Inspection Program

3.9.10.1 Summary of the Technical Information in the Application

The Intake cooling water removes heat from component cooling water and turbine plant cooling water. The intake cooling water pumps supply salt water from the plant's intake area through two redundant piping headers to the tube side of the component cooling water and turbine plant cooling water heat exchangers. Flow is routed from the heat exchangers to the plant discharge canal. Intake cooling water is described in UFSAR Section 9.6.2.

The flow diagrams listed in Table 2.3-5 show the evaluation boundaries for the portions of intake cooling water that are within the scope of license renewal. The component cooling water heat exchangers were considered to be part of component cooling Water and were screened with that system.

Intake cooling water is in the scope of license renewal because it contains structures and components that are safety-related, and are relied upon to remain functional during and following design-basis events. The scope also includes structures and components that are non-safety-related whose failure could prevent satisfactory accomplishment of the safety-related functions, and structures and components that are relied on during postulated fires and station blackout events.

Intake cooling water components that are subject to an aging management review include pumps and valves (pressure boundary only), strainers, orifices, piping, tubing, and fittings. The intended functions for intake cooling water components that are subject to an aging management review are pressure boundary integrity, filtration, structural integrity, structural support, and throttling. A complete list of intake cooling water components that require aging management review and the component intended functions appears in Table 3.4-1 of the LRA. The aging management review for intake cooling water is discussed in Section 3.4 of the LRA.

The Intake Cooling Water System Inspection Program manages the aging effects of loss of material due to various corrosion mechanisms, stress corrosion cracking, and biological fouling for Intake Cooling Water System components. The program includes inspections, performance testing, evaluations, and corrective actions that are performed as the result of the applicant commitments to NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment."

This program will be enhanced to improve documentation of scope and frequency of the intake cooling water piping crawl-through inspections and component cooling water heat exchanger tube integrity inspections prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4.

3.9.10.2 Staff Evaluation

As identified in Table 3.4-1, Chapter 3 of the Application, the Intake Cooling Water System Inspection Program is credited for aging management of specific component commodity groups in the Component Cooling Water and Intake Cooling Water systems. The specific component/commodity groups identified are the following:

- carbon steel basket strainers (shell) in a raw water environment with an aging effect requiring management of loss of material

- stainless steel basket strainers (screens) in a raw water environment with an aging effect requiring management of loss of material

- cast iron valves, piping/fittings in the main lines upstream of the strainers in a raw water environment with an aging effect requiring management of loss of material

- bronze valves (CCW heat exchange vents and drains) welded to the CCW heat exchanger channels in a raw water environment with an aging effect requiring management of loss of material

- copper-nickel piping/fittings (vents and drains) welded to the CCW heat exchanger channels in a raw water environment with an aging effect requiring management of loss of material

- copper-nickel CCW heat exchanger tube sheets in a raw water environment with an aging effect requiring management of loss of material

- aluminum-brass CCW heat exchanger tubes in a raw water environment with aging effects requiring management of loss of material and fouling

The staff evaluation of the intake cooling water system inspection program focused on how the program manages the aging effect through the effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

The corrective actions, confirmation process and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to an aging management review. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this safety evaluation. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[*Program Scope]* NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment," recommended the implementation of an ongoing program of surveillance and control techniques to significantly reduce flow blockage caused by biofouling, corrosion, erosion, protective coating failures, stress corrosion cracking, and silting problems in systems and components supplied by the intake cooling water system. The intake cooling water system inspection program was developed in response to this generic letter and addresses the aging effects of loss of material due to various corrosion mechanisms, stress corrosion cracking, and fouling due to macro-organisms for those components subject to raw water (i.e., salt water) conditions. The program utilizes performance testing and evaluations, systematic inspections, leakage evaluations, and corrective actions to ensure that loss of material, cracking, or biological fouling do not lead to loss of component intended functions.

The staff finds the program scope in conformance with Generic Letter 89-13, and is therefore acceptable.

[Preventive Actions] The applicant stated that the intake cooling water system inspection program is preventive in nature, since it provides for the periodic inspection and maintenance of internal linings protecting the intake cooling water heat exchanger, performance monitoring, testing, and periodic tube inspections. Maintenance of the internal piping/component linings minimizes the potential loss of material due to corrosion that could impact the pressure boundary intended function. Performance monitoring and testing; channel head, tube sheet, and anode inspections; and tube examinations of component cooling water heat exchangers provide for early identification of internal fouling and tube degradation that could impact heat transfer and pressure boundary intended functions. External coatings are applied to portions of the intake cooling water system to minimize corrosion. Coatings minimize corrosion by limiting exposure to the environment. However, coatings are not credited in the determination of the aging effects requiring management. This is acceptable to the staff because coatings provide additional protection beyond the other preventive actions stated above. The staff therefore finds the applicant's preventive actions acceptable.

[*Parameters Monitored or Inspected]* The applicant stated that during inspections of the internal piping component, surface conditions of piping/components and their internal linings are visually inspected for degradation. Wall thickness measurements are taken when deemed necessary.

During performance monitoring, testing, and tube inspections of component cooling water heat exchangers, the applicant indicated that pressures, temperatures, and flows are measured as part of periodic performance testing of the component cooling water heat exchangers to verify heat transfer capability. This testing is supplemented by routine monitoring of differential temperatures across the heat exchanger during operation. Tube integrity of the component cooling water heat exchangers is monitored by periodic nondestructive examination (e.g., eddy current testing) to ensure detection of aging effects. This is acceptable to the staff because the parameters proposed to be monitored are considered adequate to manage the aging effects.

[Detection of Aging Effects] The applicant stated that during inspections of internal piping component, visual examination of the piping/components and their internal linings is performed. Additional nondestructive testing may be utilized to measure surface condition, and the extent of wall thinning based on the evaluation of the examination results is documented in accordance with the corrective action program. The staff finds this acceptable because these methods have been proven to be effective in detecting aging effects.

[Monitoring and Trending] The applicant states that inspections of the internal piping/components and frequencies are in accordance with commitments under Generic Letter 89-13. Internal piping/component inspections are performed periodically during refueling outages. Inspection frequencies are adjusted based upon experience and ensure the timely detection of aging effects.

During the performance monitoring, testing, and tube inspections of component cooling water heat exchangers, online monitoring of system parameters is used to provide an indication of flow blockage. Heat transfer testing results are documented and reviewed in plant procedures. The heat transfer capability is trended to ensure that the component cooling water heat exchangers satisfy safety analysis requirements. Component cooling water heat exchanger tube condition is determined by eddy current testing and documented accordingly. Heat exchanger tube cleaning, tube replacements, or other corrective actions are implemented as required.

The staff finds that the proposed methodologies will provide effective monitoring and trending of aging effects and are therefore acceptable.

[Acceptance Criteria] Biological fouling is considered undesirable and is removed or reduced during the inspection process of the internal piping/components. When required by procedure, wall thickness values are determined and evaluated.

During the performance monitoring, testing, and tube inspections of component cooling water heat exchangers, acceptance criteria are provided to ensure that the design-basis heat transfer capability is maintained and to determine when component cooling water heat exchanger cleaning and inspection are required. Differential pressure criteria guidelines are provided to ensure that the intake cooling water design-basis flow rate is maintained and to identify when back flushing or cleaning of the intake cooling water basket strainers is required.

In RAI 3.9.10-2 the staff requested the applicant to identify the specific plant procedures and applicable documents which contain detailed guidance related to the performance monitoring, testing and tube examinations of the component cooling water system piping and heating exchangers. Also, the applicant was requested to provide the acceptance criteria and bases for the evaluation of the inspection results. In its response, the applicant identified the applicable procedures related to the monitoring, testing and inspection of the heat exchangers. In addition, acceptance criteria are provided to ensure that design-basis and Technical Specification requirements for heat transfer capability are maintained. Guidelines are provided for cleaning, inspecting, and testing the heat exchangers. The applicant’s response is considered reasonable and acceptable to close the issue of this RAI. With the resolution of the staff's concerns as discussed above, the staff finds the acceptance criteria acceptable.

[Operating Experience and Demonstration] The applicant states that the existing intake cooling water system inspection program has been an ongoing formalized inspection program at Turkey Point. The program was formally implemented as a result of Generic Letter 89-13, which recommended monitoring of service water systems to ensure that they would perform their safety-related function and based on experiences of biological fouling and corrosion throughout the industry. The conservative philosophy established within the program has been successful in managing the loss of material due to corrosion and fouling of the component cooling water heat exchanger. This program has been effective in maintaining acceptable component cooling water heat exchanger performance and addressing biological fouling of strainers and heat exchangers. Various sections of the intake cooling water piping, basket strainers, and heat exchangers are periodically examined using nondestructive examination to determine the effects of corrosion and biological fouling. Results are evaluated and components are either repaired or replaced as required.

The program has been reviewed by the NRC during several inspections with no significant deviations or violations identified. FPL Quality Assurance surveillance and reviews have been performed with no significant deficiencies identified. Procedures and practices were enhanced as a result of the recommendations provided from these inspections.

Metallurgical analysis of component cooling water heat exchanger tubes removed in 1991 and 1994 indicated that stress corrosion cracking was a potential root cause and, as a result, zinc anodes were installed and are inspected during tube cleaning. Analysis in 1996 of additional component cooling water heat exchanger tubes indicated that inside pitting was a potential failure mechanism and, as a result, a less abrasive cleaning tool was recommended. Both of these corrective actions have proven to be effective in minimizing repetitive failures.

A review of the Maintenance Rule database by the applicant and staff for the Intake Cooling Water and the Component Cooling Water Systems shows that the current aging management programs have supported system availability above the required performance criteria for the period from May 1996 through March 2000. No components have failed during that period. Therefore, based on operating experience the staff finds the program acceptable.

3.9.10.3 FSAR Supplements

The staff has reviewed UFSAR Section 16.2.10 of Appendix A to the LRA and has confirmed that it contains the essential elements of the program.

3.9.10.4 Conclusion

On the basis of its review as discussed above, the staff finds that the continued implementation of the intake cooling water system inspection program provides reasonable assurance that the aging effects of corrosion and biological fouling will be managed, such that the components within the scope of license renewal will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

3.9.11 Periodic Surveillance and Preventive Maintenance Program

The applicant described its periodic surveillance and preventive maintenance program in Section 3.2.11 of Appendix B of the LRA. The staff reviewed this section of the application to determine whether the applicant has demonstrated that the aging effects on those program-specific systems and structures will be adequately managed by this program during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.11.1 Summary of Technical Information in Application

The applicant specified that the periodic surveillance and preventive maintenance program applies to component/commodity groups in certain designated systems and structures. The program is intended for managing the aging effects of loss of material, cracking, fouling, loss of seal, and embrittlement of systems and structures. Activities of the program consist of periodic visual inspection of selected surfaces of specific components and structural components, or alternatively their replacement/refurbishment during the performance of periodic surveillance and preventive maintenance activities. The program also includes leak inspections of limited portions of the chemical and volume control systems.

The applicant indicated that the periodic surveillance and preventive maintenance program is an established program and its effectiveness has been demonstrated by early detection of component surface defects for timely actions to ensure structural integrity, and concludes that the program is consistent with the CLB, and will remain effective during the period of extended operation.

3.9.11.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information in the LRA regarding the applicant's demonstration that the effects of aging will be adequately managed so that intended function will be maintained consistent with the CLB throughout the period of extended operation for systems and structures included in the program.

The periodic surveillance and preventive maintenance program is for managing the aging effects of loss of material, cracking, fouling, loss of seal, and embrittlement of component/commodity groups in certain specified systems and structures. The program activities include periodic visual inspections for evidence of surface defects, followed by replacement or refurbishment as needed by the results of the inspection activities and by industry experience. It is an established program and has been effective in the past. The staff concurs that its continued implementation will serve its intended purpose.

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven programs are evaluated below.

[Program Scope] As indicated in the LRA, the program applies to component/commodity groups in the following systems and structures: chemical and volume control, control building ventilation, emergency containment filtration, emergency diesel generators and support systems, fire protection, instrument air, intake cooling water, residual heat removal, turbine building ventilation, and waste disposal. The structures consist of auxiliary building, emergency diesel generator buildings, turbine building, and yard structures. The staff finds that relevant systems and structures are included in the scope of the program, and therefore, the scope is adequate.

The staff finds that in Appendix B, subsection 3.2.11, page B-67 of the LRA, yard structures are listed as one category of structures for which aging effects are managed by the periodic surveillance and preventive maintenance program. However, this program was not included in the last column of Table 3.6-20 which identifies specific programs and activities for aging management of yard structures. Per RAI 3.9.22-2, the staff requested the licensee to clarify this discrepancy, or make appropriate modifications either to Table 3.6-20 or in the scope of the periodic surveillance and preventive maintenance program. The licensee indicated in their response (dated April 19, 2001) that yard structures were inadvertently listed in page B-7 of the LRA, and the list of structures will be revised to remove yard structures from the scope of the periodic surveillance and preventive maintenance program. The staff finds this acceptable because the aging effects associated with the yard structures are managed by the systems and structures monitoring program, boric acid wastage surveillance program, and the ASME Section XI, IWF ISI program.

[*Preventive or Mitigative Actions]* There are no preventive or mitigative actions applicable to the aging effects being managed by this program. However, this program in its entirety satisfies this program element.

[Detection of Aging Effects] The aging effects concerning loss of material, cracking, fouling, loss of seal, and embrittlement, will be detected by visual inspection of external surfaces for evidence of corrosion, cracking, leakage, or coating damage. For some equipment, aging effects are addressed by periodic replacement in lieu of visual inspection and refurbishment. The staff finds that the techniques used to detect aging effects are consistent with accepted engineering practice.

As indicated in the scope description, the periodic surveillance and preventive maintenance program is credited for managing several aging effects including embrittlement of structures, systems, and components. However, the embrittlement effect to be managed by this program is not shown in tables related to Section 3.3, 3.4, and 3.6. In addition, given that aging effects are detected by visual inspections, acceptance criteria on how embrittlement effects are managed and detected should be provided. The licensee indicated in their response that cracking is the aging effect resulting from embrittlement and requiring management for coated canvas and rubber in environments such as treated water, raw water, air/gas, etc., and for components/commodity groups such as intake cooling water pumps expansion joints, containment cooling ductwork flexible connectors, emergency diesel generator (EDG) air intake and exhaust system flexible couplings, and EDG air start system flexible hose. The periodic surveillance and preventive maintenance program will conduct periodic visual inspection for replacement of items found cracked. The response also identified sections in the LRA where more descriptions on the subject are provided. On the basis of the visual inspection to be performed periodically on the specified structures, to detect cracks, the applicant's response is acceptable.

[Parameters Monitored or Inspected] Surface conditions of systems, structures, and components are monitored, through visual inspections, for corrosion, fouling or in some cases, leakage, during the performance of periodic maintenance. On the basis of inspection results, refurbishment is performed as required. For some equipment, periodic replacement is performed on a specified frequency. The staff finds that the process is logical and reasonable.

The applicant indicated that this program will be enhanced with regard to the scope of specific inspections and their documentation. As indicated in Section 16.2.11 of the UFSAR supplement in Appendix A to the LRA, specific enhancements to the scope and documentation of some inspections performed under this program will be implemented prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4. The staff had requested the licensee to provide a description of the program enhancements. In response, a list of enhancements to the periodic surveillance and preventive maintenance program was provided, which includes descriptions on several enhanced maintenance procedures and activities for additional inspection on various components and attributes. On the basis of the enhancements to identify potential degradation under the specified program enhancements, the staff finds that the descriptions are adequate and acceptable.

[Monitoring and Trending] System, structure, and component inspections are performed periodically during preventive maintenance or surveillance activities. Alternatively, some components are replaced on a specified frequency. Inspection and replacement frequencies are adjusted as necessary based on the results of these activities and industry experience. The staff finds that the process is reasonable. However, since this is an existing program, the applicant was requested to provide a brief description regarding how frequently the inspections were conducted, and components were replaced. In its response, the applicant indicated that the periodic surveillance and preventive maintenance program currently includes inspection frequencies ranging from two months to ten years depending upon the specific component and aging effect being managed and plant operating experience. Several examples of inspections that are part of this program and their current inspection frequencies were provided. Examples of some components that have 42 month replacement frequencies were also described. The applicant indicated that frequencies of replacement may be adjusted as necessary based on future plant-specific performance and/or industry experience. This is acceptable to the staff.

[Acceptance Criteria] Acceptance criteria and guidelines are provided in the applicant's implementing procedures for the inspections, refurbishments, and replacements, as applicable. The applicant was requested to provide a brief description of acceptance criteria and guidelines, and documentation on implementation procedures for the inspections, refurbishments, and replacements. In its response, the applicant indicated that acceptance criteria are tailored to each individual inspection considering the aging effect being managed. For example, inspections for loss of material provide guidance that requires evaluation under the corrective action program if there is evidence of loss of material beyond uniform light surface corrosion; visually detectable cracking requires evaluation under the corrective action program, and refurbishment and replacements are performed on a specified frequency based on plant experience and/or equipment supplier recommendations. In addition, inspection and surveillance procedures of the periodic surveillance and preventive maintenance program contain requirements for documenting the results of the inspections. On the basis of the

directions provided in plant procedures regarding the need for corrective action, the staff finds the applicant's response to be acceptable.

[Operating Experience] The applicant indicated that the periodic surveillance and preventive maintenance program is an established program at Turkey Point and has proven effective at maintaining the material condition of systems, structures, and components and detecting unsatisfactory conditions. The effectiveness of the program is supported by improved system, structure, and component material conditions and reliability, documented by internal and external industry assessments. The periodic surveillance and preventive maintenance program is subject to periodic assessments to ensure effectiveness and continuous improvement. The applicant was asked to demonstrate the effectiveness of the program in the operating experience and demonstration summary. In its response, the applicant indicated that the effectiveness of this program is demonstrated by the high level of system/equipment availability as documented via the plant's periodic assessments under the Maintenance Rule. For example, there have been no functional failures of intake cooling water system pumps, pump discharge check valves, or expansion joints since the inception of the replacement under the periodic surveillance and preventive maintenance program for these components. The staff finds that satisfactory operating experience provides evidence of the effectiveness of this program to manage the aging effects of the specified systems, structures and components.

3.9.11.3 FSAR Supplement

The LRA indicated that the periodic surveillance and preventive maintenance program will be enhanced to address the scope of specific inspections and their documentation. As indicated in Section 16.2.11 of the UFSAR Supplement in Appendix A, specific enhancements to the scope and documentation of some inspections performed under this program will be implemented prior to the end of the initial operating license terms for Turkey Point, Units 3 and 4.

3.9.11.4 Conclusion

The staff has reviewed the information in Section 3.2.11 of Appendix B to the LRA. On the basis of this review, the staff concludes that the continued implementation of the periodic surveillance and preventive maintenance program provides reasonable assurance that the aging effects of loss of material, cracking, fouling, loss of seal, and embrittlement will be managed, such that the components and structural components within the scope of license renewal will continue to perform their intended functions consistent with the CLB during the period of extended operation.

3.9.12 Reactor Vessel Head Alloy 600 Penetration Inspection Program

3.9.12.1 Summary of Technical Information in the Application

The applicant described its AMP of the reactor vessel head alloy 600 penetration in Section 3.2.12, "Reactor Vessel Head Alloy 600 Penetration Inspection Program," of Appendix B to the LRA. In Section 3.2.12 of the LRA, the applicant specified that the reactor vessel head Alloy 600 penetration inspection program (RVHPIP) is designed to manage the aging effect of cracking due to stress corrosion in the vessel head penetration (VHP) nozzles. The applicant qualified this statement by stating that the program would include a one-time volumetric examination of the VHPs to the Turkey Point, Unit 4 reactor vessel head, as well as visual examinations of the vessel head external surfaces at Turkey Point, Units 3 and 4, during scheduled outages consistent with the boric acid wastage surveillance program. The staff reviewed the subject AMP to determine whether the applicant has demonstrated that the effects of aging of the Alloy 600 VHPs will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.12.2 Staff Evaluation

The applicant credits the RVHPIP for managing aging effects in the Turkey Point Alloy 600 VHP nozzles. The current industry-wide program for monitoring cracking in Alloy 600 VHP nozzles is based on an integrated ranking and monitoring program for VHP nozzles developed by the Nuclear Energy Institute (NEI) in the late 1990s. This program is based on the industry's generic and plant-specific responses to Generic Letter 97-01 (GL 97-01), "Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations," which ranked the susceptibility of Alloy 600 VHPs to PWSCC based on probabilistic cracking models. Based on the susceptibility rankings for Turkey Point (Letter L-2001-65), the RVHPIP includes a volumetric examination of selected VHP nozzles of Unit 4 to be performed prior to 2007, whereas Unit 3 had a sufficiently low ranking to not require such examination throughout the license renewal period.

From November 2000 to April 2001, reactor coolant pressure boundary (RCPB) leakage from VHP nozzles was identified at four PWR plants. Supplemental examinations of the degraded nozzles indicated the presence of circumferential cracks in four of the CRDM nozzles. These findings are significant in that the cracking was reported to initiate from the OD side of the nozzle, either in the associated J-groove welds or heat-affected-zones, and not from the inside surface of the nozzles as was assumed in the industry responses to GL 97-01. In this recent experience, the degradation was severe enough to penetrate the RCPB, and the circumferential cracking is the first such finding in VHP nozzles in any PWR.

In response to the identified cracking, the NEI and the Materials Reliability Program (MRP) submitted Topical Report TP-1001491, Part 2, "PWR Materials Reliability Program Interim Alloy 600 Safety Assessments for US PWR Plant (MRP-44)." This report included a revised susceptibility ranking model for PWR plants. This revised model places Turkey Point Units 3 and 4 within 10 EFPY of the same conditions evident at the plant which identified three circumferential cracks in its CRDM nozzles, within the current license term for each unit.

To address the potential safety implication of these findings, the NRC issued NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles," on August 3, 2001. The bulletin (NRC ADAMS Accession Number ML012080284) emphasized the need to use effective examination techniques capable of detecting flaws in these nozzles, in an approach consistent with the relative susceptibility of the VHP nozzles.

Leakage of reactor coolant from the RCPB is not allowed by Turkey Point Technical Specifications, and therefore the overall approach of the RVHPIP described in the application (e.g., leakage detection) may not be consistent with current regulatory and industry efforts to resolve the potential issues of cracking in VHP nozzles. In accordance with the issues raised in NRC Bulletin 2001-001, aging management of PWSCC in the Turkey Point VHP nozzles is an emerging issue that needs to be resolved in coordination with ongoing industry efforts for the current license period. Since the RVHPIP is not consistent with the current status of the

NEI/MRP integrated program for monitoring and controlling PWSCC in VHP nozzles, and since the issues raised in NRC Bulletin 2001-001 are currently being resolved with licensees, the staff has not evaluated the RVHPIP against the AMP attributes listed in Section 2.0 of Appendix B to the application. The staff, therefore, could not complete its review of the acceptability of the RVHPIP for the license renewal term until this program is found acceptable for the current license period. The staff, therefore, considered the acceptability of the RVHPIP to be an open issue and issued Open Item 3.9.12-1 on the AMP.

As stated in Open Item 3.9.12-1, the applicant did not specify in Section 3.2.12 of Appendix B to the LAR whether it would continue to be a participant in the NEI program for managing primary water stress corrosion cracking (PWSCC) in Alloy 600 reactor vessel head penetrations (VHPs) of U.S. pressurized water reactors (PWRs), and whether the applicant would continue to use the reactor vessel head Alloy 600 penetration inspection program (RVHPIP) as a basis for evaluating the Alloy 600 VHPs in the Turkey Point nuclear units during the proposed extended operating terms for the units. The scope of the RVHPIP described in Section 3.2.12 of Appendix B to the LRA needs to be updated to reflect that the applicant will continue to implement program for monitoring and controlling cracking in U.S. VHP nozzles during the period of extended operating term. This includes updating the RVHPIP to reflect the information and relative rankings for the Turkey Point units in Topical Report MRP-44 to make it consistent with NEI's current integrated program for evaluating Alloy 600 VHPs in U.S. PWRs.

In FPL letter L-2001-236 responding to Open Item 3.9.12-1, the applicant stated that it will continue to be a participant in the industry programs for managing PWSCC in Alloy 600 reactor VHP nozzles of U.S. pressurized water reactors during the period of extended operation. The applicant informed the staff that, as documented in FPL's response to NRC Bulletin 2001-01 (refer to FPL Letter #L-2001-198 dated September 4, 2001), the work performed under the Electric Power Research Institute (EPRI) MRP and NEI is an integral part of the Turkey Point RVHPIP. The applicant stated that the bulletin response provides the Turkey Point Unit 3 and 4 rankings utilizing the latest industry PWSCC susceptibility model, in addition to updating reactor VHP inspection commitments, and that, as the industry gains experience, the ranking models will continue to be refined and thus, Turkey Point's RVHPIP will be updated to reflect the new information and relative rankings for Turkey Point Units 3 and 4 in the Topical Reports MRP-44 and 48, accordingly. The staff concludes that this approach will ensure that the RVHPIP will be modified as necessary based on the latest bases for monitoring for and controlling PWSCC in the Turkey Point VHP nozzles.

3.9.12.3 FSAR Supplement

The summary description provided in Appendix A, Chapter 16, Section 16.2.12 of the LRA is sufficient.

3.9.12.4 Conclusions

The staff has reviewed the information in Appendix B, Section 3.2.12 of the LRA and responses to the staff's RAIs and to Open Item 3.9.12. On the basis of this review, the staff has determined that the applicant has resolved the issue identified in Open Item 3.9.12-1 and has provided a sufficient basis for ensuring that the RVHPIP will be sufficient to monitor and control cracking in the Alloy 600 VHP nozzles and their associated J-groove welds and heat-affected-zones during the proposed operating terms for the Turkey Point units. This basis will ensure that the scope and attributes of RVHPIP will be consistent with the most recent scope and methods developed by the industry for monitoring and controlling PWSCC in U.S. VHP nozzles and their associated J-groove welds. The staff therefore concludes that Open Item 3.9.12-1 is resolved and the RVHPIP is acceptable to ensure that the applicant will monitor for and control PWSCC in the Turkey Point VHP nozzles during the extended periods of operation for the units.

3.9.13 Reactor Vessel Integrity Program

The applicant described its reactor vessel integrity program in Section 3.2.13 of Appendix B, to the LRA. For the reactor vessel, Section 3.2.4 and Table 3.2-1 of the LRA identify cracking, reduction in fracture toughness, loss of material, and loss of mechanical closure integrity as aging effects requiring management for the period of extended operation.

The Turkey Point Unit 3 and 4 reactor vessel integrity program is designed to manage reactor vessel irradiation embrittlement, and encompasses the following subprograms:

- reactor vessel surveillance capsule removal and evaluation
- fluence and uncertainty calculations
- monitoring effective full power years
- pressure/temperature limit curves

Through the reactor vessel integrity program, the applicant intends to comply with the requirements of 10 CFR 50.60, Appendices G and H, and 10 CFR 50.61.

The four subprograms are reviewed separately in the following paragraphs.

Criteria for the first 40 years are specified in 10 CFR Part 50, Appendix H, “Reactor Vessel Materials Surveillance Program,” for monitoring changes in the fracture toughness of ferritic materials in the reactor beltline region to neutron irradiation, and thermal environments. Appendix H requires that the surveillance program design and withdrawal schedule meet the requirements of American Society for Testing and Materials (ASTM) E-185, “Standard Practice for Conducting Surveillance Tests for Light Water Cooled Nuclear Power Vessels.”

Regulatory Guide (RG) 1.99, Revision 2, “Radiation Embrittlement of Reactor Vessel Materials,” describes general procedures acceptable to the NRC staff for calculating the effects of neutron irradiation embrittlement of the low alloy steels used for light water-cooled RVs. Surveillance data from the Appendix H program are used in RG 1.99, Revision 2 calculations, if applicable.

By letter dated February 8, 1985, the staff approved the combination of the Turkey Point Unit 3 and 4 material surveillance programs into a single integrated program. In a letter dated July 11, 1997, the staff approved BAW-1543, Revision 4, including Supplements 1 and 2, “Master Integrated Reactor Vessel Surveillance Program,” to demonstrate continuous management of aging effects for all plants included in BAW-1543, Revision 4, Supplement 2. Turkey Point, Units 3 and 4, were included in this report. Turkey Point, Units 3 and 4, were a special case, since each of the other Babcock & Wilcox and Westinghouse plant-specific reactor vessel surveillance programs were prepared in accordance with ASTM E 185-82. The Turkey Point Unit 3 and 4 reactor vessels were purchased to the Summer 1966 Addenda to the 1965 Edition of the ASME Code. ASTM E 185-66 was the surveillance capsule standard in effect at the time the Turkey Point Unit 3 and 4 reactor vessels were purchased. Since the Turkey Point Unit 3 and 4 capsule withdrawal schedules meet the ASTM E 185 Edition that was current at the time the reactor vessels were purchased, the withdrawal schedules meet the requirements of Appendix H to 10 CFR Part 50. Staff approval in the 1985 and 1997 letters were for a 40-year license term.

3.9.13.1 Reactor Vessel Surveillance Capsule Removal and Evaluation

3.9.13.1.1 Summary of Technical Information in the Application

The applicant described the reactor vessel surveillance capsule removal and evaluation in Appendix B, Section 3.2.13.1 of the LRA. The staff reviewed the program in Appendix B, Section 3.2.13.1 of the LRA to determine whether the applicant has demonstrated that the aging effects covered by the subject program will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.13.1.2 Staff Evaluation

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are discussed below.

[*Program Scope*] The reactor vessel surveillance capsule removal and evaluation program manages the aging effect of reduction in fracture toughness due to neutron irradiation on the reactor vessel beltline forgings and circumferential welds. The aging effect is managed by performing Charpy V-notch and tensile tests on specimens that are irradiated in the reactor vessel. Based on the above, the program scope is appropriate.

[*Preventive or Mitigative Actions*] There are no preventive or mitigative actions associated with the reactor vessel surveillance capsule removal and evaluation program, nor did the staff identify a need for such actions.

[*Parameters Monitored or Inspected*] The parameter to be monitored is the increase in temperature at the 30 ft-lb energy from unirradiated and irradiated specimens. The tests are in accordance with the applicable ASTM standards identified in Section 5.0 of BAW-1543A, Revision 2. In addition, accumulated neutron fluence is monitored utilizing surveillance capsule dosimetry.

In RAI 3.9.13-1 (letter dated February 1, 2001) the staff requested additional information regarding modifications to the reactor vessel surveillance program to accommodate a 60-year license. In a letter dated April 19, 2001, the applicant provided the response to the requested information. Specifically, the applicant stated that the 48 EFPY peak neutron fluence (inside wall) for the Turkey Point circumferential welds is projected to be less than 4.5 X 10^{19} n/cm^2 which is equivalent to approximately 2.8 X 10^{19} n/cm^2 at 1/4T location. The Turkey Point Unit 4 "X" capsule is currently projected to be removed in 2007 at a fluence of 3.85 x 10^{19} n/cm^2

which is greater than the 1/4T fluence at 48 EFPY.

The amount of radiation embrittlement of the circumferential beltline welds is based on the methodology in RG 1.99, Revision 2 (See staff evaluation in section 4.2.2). The data in the Turkey Point surveillance capsules, including Capsule X, are used to monitor radiation embrittlement of the reactor vessel circumferential beltline welds. To date, capsules that contain weld metal and have neutron fluences exceeding 4 x 10^{19} n/cm^2 have been withdrawn from Dresden 2 (Capsule 5), Maine Yankee (Capsule A-35), Prairie Island 1 (Capsules R and S), Prairie Island 2 (Capsule R) and Robinson (Capsule T). The measured increase in reference temperature for all these data, except for the Dresden 2 data, are within the RG predicted increase in reference temperature plus two standard deviation values, which indicates that the methodology in RG 1.99, Revision 2 is applicable for fluence exceeding 4 x 10^{19} n/cm^2. Therefore, although the neutron fluence for Capsule X will not exceed the 48 EFPY peak neutron fluence for the Turkey Point circumferential welds, its data may be extrapolated to the higher fluence using the methodology in RG 1.99, Revision 2.

The applicant also stated that there are nine remaining standby capsules in the Turkey Point vessels from which to gather data on fluence, spectrum, temperature, and neutron flux. The last capsule will not be withdrawn prior to the 55^{th} year as shown in LRA Appendix A, Table 4.4-2 (page A-10). The staff finds this response to be acceptable since the available surveillance capsule data are sufficient to monitor changes in the RV material due to neutron irradiation during the license extension period.

[*Detection of Aging Effects*] The aging of the affected components will be detected by quantifying the change in temperature at 30 ft-lb energy from unirradiated and irradiated specimens. The staff finds this approach to be acceptable since it will determine the increase in reference temperature due to irradiation.

[*Monitoring and Trending*] Empirical material fracture toughness and accumulated neutron fluence data are obtained from the vessel irradiated surveillance specimens. These data and the trend curves from RG 1.99, Revision 2, provide the basis for the value for reference temperature for nil-ductility transition (RT_{NDT}) and for determining reactor vessel heatup and cooldown limits. These data are monitored and trended to ensure continuing reactor vessel integrity. The surveillance capsule withdrawal schedule is specified in Chapter 4 of the UFSAR Supplement provided in Appendix A to the LRA. Turkey Point, Units 3 and 4, have sufficient surveillance capsules for the extended period of operation. Future decisions concerning the frequency of withdrawal of surveillance capsules will be based on changes in fuel type or fuel loading pattern. The staff finds this response to be acceptable since it will monitor operating changes and RV integrity.

[*Acceptance Criteria*] The acceptance criteria for fracture toughness are that the RT_{PTS} value for each reactor vessel material shall remain below the screening criteria of 270 ^{o}F for plates and axial welds, and below 300 ^{o}F for circumferential welds. The requirement also includes a Charpy upper-shelf energy (USE) greater than 50 ft-lb. For materials whose Charpy USE fall below 50 ft-lb, there are provisions in Appendix G to 10 CFR Part 50 which must be followed. Specifically, the applicant must demonstrate that, during the period of extended operation, the Charpy USE has a margin of safety against fracture equivalent to that specified in Section XI of the ASME Boiler and Pressure Vessel Code. The staff finds this approach to be acceptable since it complies with 10 CFR 50.61, the PTS rule.

[*Operating Experience*] The reactor vessel surveillance capsule removal and evaluation program meets the requirements of 10 CFR Part 50, Appendix H, and has been in effect since the initial plant startup. This program has been updated over the years and has provided experience in addressing reduction in fracture toughness. Turkey Point Unit 3 and 4 pressure-temperature (P-T) limit curves have been updated using results from the vessel surveillance capsule specimen evaluations. Turkey Point, Units 3 and 4, have been evaluated to have values for RT_{PTS} that are below the screening criteria in 10 CFR 50.61. The staff finds the applicant's description of operating experience acceptable.

3.9.13.1.3 FSAR Supplement

On the basis of the staff's evaluation described above, the summary description of the reactor vessel surveillance capsule removal and evaluation program described in Appendix A to the LRA is acceptable.

3.9.13.1.4 Conclusion

The staff has reviewed the information in Section 3.2.13.1 of Appendix B of the LRA. On the basis of this review, the staff finds that the reactor vessel surveillance capsule removal and evaluation program for Turkey Point, Units 3 and 4, is acceptable, and the single integrated surveillance program between the two units will directly measure the increase in 30 ft-lb transition temperature as a function of neutron irradiation. The data will be applied to the Turkey Point Unit 3 and 4 reactor vessels, and the applicant will ensure that the fracture toughness values meet the requirements of 10 CFR Part 50 or the applicable sections of the ASME Boiler and Pressure Vessel Code, as described above under "Acceptance Criteria." Therefore, the staff finds that the aging effects associated with this program will be adequately managed in accordance with the CLB during the period of extended operation.

3.9.13.2   Fluence and Uncertainty Calculations

3.9.13.2.1 Summary of Technical Information in the Application

The applicant described its fluence and uncertainty calculations in Section 3.2.13.2 of Appendix B of the LRA. The staff reviewed the program in Appendix B, Section 3.2.13.2 of the LRA to determine whether the applicant has demonstrated that the aging effects covered by the subject program will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.13.2.2 Staff Evaluation

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are evaluated below.

[*Program Scope*] The purpose and scope of the reactor vessel fluence and uncertainty calculations are to provide accurate predictions of the actual reactor vessel neutron fast fluence value for use in the development of the P-T limit curves and pressurized thermal shock calculations. The staff finds the applicant's definition of program scope acceptable.

[*Preventive or Mitigative Actions*] There are no preventive or mitigative actions associated with the fluence and uncertainty calculations, nor did the staff identify a need for such actions. The staff finds this response acceptable since no preventive or mitigative actions are associated with this subprogram.

[*Parameters Monitored or Inspected]* The monitored parameters are the reactor vessel neutron fast fluence values, which are predicted based on analytical models meeting the requirements of draft NRC DG-1053, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," and are benchmarked using dosimetry results that are available from the reactor vessel surveillance capsule removal and evaluation subprogram. Note that in the past, benchmarking has been supplemented by draft RG DG-1053 cavity (ex-vessel) dosimetry. In RAI 3.9.13.2-1 (letter dated February 1, 2001) the staff requested additional information regarding the reactor vessel fluence calculations. In a letter dated April 19, 2001, the applicant stated that the determination of the fluence is based on both calculations and measurements. The fluence prediction is made with calculations, and measurements are used to qualify the calculational methodology.

The applicant has implemented a pressure vessel radiation surveillance program at Turkey Point. The program is based on ASTM E185. Eight materials test capsules were placed in each unit (16 total). Additionally, external neutron dosimeters have been installed and analyzed. The program provides for the periodic removal of capsules and/or dosimeters for evaluation throughout the plant life. The present database at Turkey Point includes data evaluated from three Unit 3 capsules, two Unit 4 capsules, and cycle-specific cavity dosimetry measurements during Unit 3 Cycles 10 and 15. The results from these measurements, the Unit 3 and 4 operating histories, and calculated power distributions make up the database for the fluence calculations.

The most recent data calculations use discrete ordinates radiation transport (DORT) for the neutron transport calculation, a DORT post-processor code named DOTSOR for geometry conversion, and Bugle-96, an ENDF-B-VI-based cross-section library. The power distributions are based on the Westinghouse Advanced Nodal Code (ANC).

The fluence calculation methods include the following:

- The calculation uses detailed modeling of the capsules and cavity dosimeters that include significant structural and geometrical details necessary to define the neutron environment at points of interest.

- The transport calculation for the reactor model was carried out in the R,θ and R,Z coordinates using DORT and BUGLE-96. The R,θ model included 152 mesh points in the R direction covering the range from the center of the core to about 14 cm into the concrete shield to account for back scatter. In the azimuthal direction, 47 mesh points were used which models an octant of the reactor.

- The core power distribution used to determine the neutron source was calculated from ANC nodal calculations. The relative pin-by-pin distributions for each assembly location together with the cycle burnup for each assembly were used to determine the relative power output for each pin in the core, averaged over the cycle. The DOTSOR code was used to convert this power distribution from x,y to R,θ coordinates and to place the source in each mesh cell. The average assembly burnup was used to determine the source per group, the average neutrons per fission and the average energy per fission.

- Neutron dosimetry analysis of the passive sensors within the surveillance capsule, which included activation measurement and evaluation of their composition and location, are also considered in the development of fluence results.

- Calculation to measurement (C/M) comparisons indicated a C/M ratio greater than 1.0. The calculated values were used without modification, consistent with the recommendation of DG-1053.

- Fluence projections use power distributions which are representative of planned future fuel management using flux suppression inserts in the assemblies at the core flats. Core designs are controlled by limiting the power in the peripheral assemblies at these locations.

The staff finds this response to be acceptable since it is consistent with the recommendations in DG-1053.

[*Detection of Aging Effects*] Fluence values in excess of predicted values can result in lower fracture toughness values in reactor vessel materials due to irradiation embrittlement. The potential for these effects is determined using calculations of vessel fluence, empirical results from Charpy V-notch tests of irradiated specimens, and capsule dosimetry in accordance with the reactor vessel surveillance capsule removal and evaluation program. The staff finds this approach to be acceptable since the above-mentioned parameters are sufficient for determining predicted fluence valves.

[*Monitoring and Trending*] Neutron fluence and uncertainty calculations are performed to predict the neutron fast fluence. These calculations are verified using dosimetry results that are available from the reactor vessel surveillance capsule removal and evaluation program, as supplemented by the cavity (ex-vessel) dosimetry. The frequency of updating fluence and uncertainty calculations may change as additional data are obtained. Changes in fuel type or fuel loading pattern may also change the frequency of surveillance capsule withdrawal and the performance of neutron fluence and uncertainty calculations. The staff finds this approach acceptable since dosimetry results can be used to verify calculations to predict neutron fluence.

[*Acceptance Criteria*] Based on the calculations, the reactor vessel fluence uncertainty values are to be within the NRC-suggested ±20%. Calculated fluence values for fast neutrons (above 1.0 MeV) are compared with measured values. This methodology represents a continuous validation process to ensure that no biases have been introduced and that the uncertainties remain comparable to the reference benchmarks. The staff finds this approach to be acceptable since it is a continuous validation process.

[*Operating Experience*] The neutron fluence and uncertainty calculations for Turkey Point Units 3 and 4, have been performed in accordance with the guidelines of draft RG DG-1053 and validated using data obtained from the capsule dosimetry. The results of the fluence uncertainty values are to be within the NRC-suggested limit of ±20%. This has been validated by the comparison of the calculated fluence values with measured values. This methodology represents a continuous validation process to ensure that no biases have been introduced, and that the uncertainties remain comparable to the reference benchmarks. The staff finds the applicant's description of operating experience acceptable.

3.9.13.2.3 FSAR Supplement

On the basis of the staff's evaluation described above, the summary description of the fluence and uncertainty calculations program described in Appendix A to the LRA is acceptable.

3.9.13.2.4 Conclusion

The staff has reviewed the information in Section 3.2.13.2 of Appendix B to the LRA. On the basis of this review, the staff finds the calculations are consistent with requirements of 10 CFR Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements," and finds the program acceptable for the period of extended operation.

3.9.13.3 Monitoring Effective Full Power Years

3.9.13.3.1 Summary of Technical Information in the Application

The applicant described the monitoring of effective full power years (EFPY) in Section 3.2.13.3 of Appendix B to the LRA. The staff reviewed the program in Section 3.2.13.3 of Appendix B to the LRA to determine whether the applicant has demonstrated that the aging effects covered by the subject program will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.13.3.2 Staff Evaluation

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are evaluated below.

[*Program Scope*] The purpose and scope of this program are to accurately monitor and tabulate the accumulated operating time experienced by the reactor vessel. The EFPY data are used to ensure that the power history is within ±0.3 effective full-power days (EFPD) of the plant computer generated value and to determine the period of time for which the P-T limit curves are applicable. The staff finds the applicant's definition of program scope acceptable.

[*Preventive or Mitigative Actions*] There are no preventive or mitigative actions associated with the monitoring of the EFPY program, nor did the staff identify a need for such actions. The staff finds this response acceptable since no preventive or mitigative actions are associated with this program.

[*Parameters Monitored or Inspected*] The program monitors and tabulates the accumulated operating time experienced by the Turkey Point Unit 3 and 4 reactor vessels. The EFPYs of plant operation are based on reactor incore power calculations obtained from the plant's nuclear applications software program. Site reactor engineers determine EFPY values by comparing burnup estimated from incore instrumentation to the thermal power calculated burnup. The staff finds this approach to be acceptable since it uses plant parameters to calculate EFPY of operation.

[*Detection of Aging Effects*] EFPY calculations are utilized for the prediction of neutron fast fluence and the determination of the reduction in fracture toughness of reactor vessel critical materials. The staff finds this approach to be acceptable since it facilitates the calculation of neutron fluence and the determination reduction of fracture toughness in beltline materials.

[*Monitoring and Trending*] This program monitors the reactor vessel EFPYs to be used in predicting the neutron fast fluence. Each Turkey Point unit is monitored to determine the EFPY of operation. These data are used to validate the applicability of the P-T limit curves for the next operating cycle. The staff finds this approach to be acceptable since it is used to monitor applicability of the P-T limit curves.

[*Acceptance Criteria*] Calculated effective full power years shall not exceed the Technical Specification limit for the validity of the pressure-temperature limit curves. The staff finds this approach acceptable because it is consistent with the requirements of 10 CFR 50.60.

[*Operating Experience*] The EFPY values are determined by comparing the fuel burnup to the thermal power calculated burnup. The fuel burnup comparisons have been found to be within the expected accuracy. The staff finds the applicant's description of operating experience acceptable.

3.9.13.3.3 FSAR Supplement

On the basis of the staff's evaluation described above, the summary description for the monitoring effective full power years program described in LRA Appendix A is acceptable.

3.9.13.3.4 Conclusion

The staff has reviewed the information in Appendix B, Section 3.2.13.3 of the LRA. On the basis of this review, the staff finds this procedure meets the requirements of 10 CFR Part 50, Appendix G, and finds it acceptable for the period of extended operation.

3.9.13.4 Pressure-Temperature Limit Curves

3.9.13.4.1 Summary of Technical Information in the Application

The applicant described the pressure-temperature limit curves in Appendix B, Section 3.2.13.4 of the LRA. The staff reviewed the program in Appendix B, Section 3.2.13.4 of the LRA to determine whether the applicant has demonstrated that the aging effects covered by the subject program will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.13.4.2 Staff Evaluation

The application indicated that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and cover all structures and components subject to AMR. The staff's evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this SER. This program satisfies the elements of corrective actions, confirmation process, and administrative controls. The remaining seven elements are evaluated below.

[*Program Scope*] The purpose and scope of this program are to establish P-T limit curves for the normal operating, inservice leak test, and hydrostatic test limits for the RCS, as applicable to the Turkey Point Unit 3 and 4 pressure vessels. The curves are used to limit operations based on the material properties of the vessel caused by neutron irradiation. The staff finds the applicant's definition of program scope acceptable.

[*Preventive or Mitigative Actions]* Pressure-temperature limit curves are provided to specify the maximum allowable pressure as a function of reactor coolant temperature in order to prevent or minimize the effects of reduced fracture toughness caused by neutron irradiation. The staff finds these actions acceptable since they will ensure that the plant is operating within the allowable pressure and temperature ranges.

[*Parameters Monitored or Inspected*] Pressure-temperature limit curves are generated assuming that a 1/4T surface flaw exists, and using the fracture mechanics methodology in ASME Section XI, Appendix G. The P-T curves are determined by using bounding input heatup and cooldown transients. The staff finds this approach to be acceptable since the P-T limits curves are generated to meet the requirements in Appendix G to Section XI of the ASME Code and Appendix G to 10 CFR Part 50.

[*Detection of Aging Effects]* The P-T limit curves are not provided for the detection of aging effects but rather to prevent or minimize the effects of reduced fracture toughness caused by neutron irradiation. The staff finds this response acceptable since it clarifies the purpose of the P-T limit curves.

[*Monitoring and Trending]* The P-T limit curves are valid for a period expressed in EFPYs. These curves are updated prior to exceeding the EFPYs for which they are valid. The time period for updating P-T limit curves may change if conditions such as changes in fuel type or fuel loading pattern occur. The staff finds this approach acceptable since P-T limits curves will be updated prior to exceeding the applicable EFPYs.

[*Acceptance Criteria*] The P-T limit curves are valid for a specified number of EFPYs. The curves must be updated before this time period is exceeded. The staff finds this approach acceptable since the validity of the curves is monitored and the P-T limit curves are updated prior to exceeding the applicable EFPY.

[*Operating Experience]* Turkey Point, Units 3 and 4, operate in accordance with P-T limit curves that have been updated using the results of data obtained from surveillance capsule specimens. The P-T limit curves provide sufficient operating margin while preventing or minimizing the effects of reduced fracture toughness caused by neutron irradiation. The staff finds the applicant's description of operating experience acceptable.

3.9.13.4.3 FSAR Supplement

On the basis of the staff's evaluation described above, the summary description for the pressure temperature limit curves program described in LRA, Appendix A is acceptable. The staff's evaluation of the calculational methodology for the curves, and the extension to 48 EFPYs is described in the pressure-temperature limits TLAA section of this SER.

3.9.13.4.4 Conclusion

The staff has reviewed the information in Section 3.2.13.4 of Appendix B of the LRA. On the basis of this review, the staff finds this procedure meets the requirements of 10 CFR Part 50, Appendix G. Therefore, the staff finds it acceptable for the period of extended operation.

3.9.14 Steam Generator Integrity Program

The applicant described its AMP, steam generator integrity program, in Section 3.2.14 of Appendix B, of the LRA. The program is aimed at verifying the integrity of various steam generator components. The staff reviewed this section of the application to determine whether the applicant has demonstrated that the effects of aging will be adequately managed during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.14.1 Summary of Technical Information in the Application

As identified in Chapter 3, the steam generator integrity program is credited for aging management of the steam generators. The program manages the aging effects of cracking and loss of material and includes the following essential elements: inspection of steam generator tubing and tube plugs; steam generator secondary-side integrity inspections; tube integrity assessment; assessment of degradation mechanisms; primary-to-secondary leakage monitoring; primary and secondary chemistry control; sludge lancing; maintenance and repairs; and foreign material exclusion. Inspections and other aging management activities are performed in accordance with the Turkey Point Unit 3 and 4 Technical Specifications, and the program is structured to meet NEI 97-06, "Steam Generator Program Guidelines."

3.9.14.2 Staff Evaluation

The staff evaluation of the AMP focused on the program elements rather than details of specific plant procedures. To determine whether the AMPs are adequate to manage the effects of aging so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation, the staff evaluated the following 10 elements: (1) program scope, (2) preventive or mitigative actions, (3) parameters monitored or inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria, (7) corrective actions, (8) confirmation process, (9) administrative controls, and (10) operating experience.

The application indicates that the corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and apply to AMPs credited for license renewal and are performed, or in the case of new programs to be performed, in accordance with the applicant's quality assurance program. The staff's evaluation of the quality assurance program is provided separately in Section 3.1.2 of the SER. The remaining seven element are evaluated below.

[*Program Scope*] The steam generator integrity program ensures that steam generator integrity is maintained under normal operating, transient, and postulated accident conditions. The program is structured to meet the NEI 97-06, "Steam Generator Program Guidelines," which references several EPRI guidelines. These EPRI guidelines include steam generator examination, tube integrity assessments, both primary and secondary water chemistry, primary-to-secondary leakage, in situ pressure testing, and tube plug assessment. The program provides for comprehensive examinations of steam generator tubes and plugs to identify and repair degraded conditions before the degradation exceeds allowable limits. The staff finds that the scope of the steam generator integrity program is adequate.

[*Preventive or Mitigative Actions*] Preventive measures include primary and secondary chemistry control. As clarified in response to RAI 3.9.4-1, the applicant stated that the chemistry control program currently complies with the following industry guidelines:

- EPRI, TR-105714, Rev. 4, "PWR Primary Water Chemistry Guidelines," Vols. 1 and 2
- EPRI, TR-102134, Rev. 5, "PWR Secondary Water Chemistry Guidelines"

On the basis of the staff's review of the applicant's chemistry control program in Section 3.1.1 of this SER, the staff finds the preventive actions acceptable.

[*Parameters Monitored or Inspected*] The applicant applies volumetric inspection techniques, primarily eddy current testing, to detect degradation of the steam generator tubes and plugs. Inspection activities also monitor for leakage from tube plugs. In response to RAI 3.9.14-3, the applicant states that the scope of eddy current and visual inspections incorporate the guidance contained in NEI 97-06 and WCAP 15093, "Evaluation of EDF Steam Generator Internals Degradation – Impact of Causal Factors on the Westinghouse Models F, 44F, D and E2 Steam Generators" for detection of potential tube and plug degradation, and degradation of internal component's and the presence of loose parts. Examination personnel are qualified in accordance with the standards and criteria provided in NEI 97-06, examination techniques are qualified and validated for site-specific use in accordance with the standards and criteria contained in NEI 97-06, and steam generator tube integrity is assessed in accordance with performance criteria in NEI 97-06. Primary-to-secondary leakage is monitored during operation. The staff finds the parameters inspected under this program are acceptable because they will be effective in managing the specified aging effects.

[*Detection of Aging Effects*] The applicant stated that the extent and schedule of the inspections prescribed by the steam generator integrity program are designed to ensure that flaws do not exceed established performance criteria. The extent and schedule of the inspections are designed to ensure timely detection and replacement of leaking plugs. Lastly, detection of primary-to-secondary leakage during plant operation will assist in identifying potentially unacceptable tube degradation caused by the aging mechanisms. The staff agrees that these are acceptable methods for identifying steam generator degradation.

[*Monitoring and Trending*] The applicant's inspection intervals are based on technical specification requirements as well as the guidance contained in NEI 97-06. The inspections are expected to provide timely detection of cracking, pitting, and wear. In addition, the frequency and extent of plug inspections are expected to provide for timely detection of tube plug leakage. Lastly, daily monitoring of primary-to-secondary leakage will identify degradation of steam generator tubing. The staff finds the monitoring and trending activities acceptable.

[*Acceptance Criteria*] The program requires that steam generator tubes are removed from service in accordance with the requirements of the technical specifications and the steam generator integrity program. Any tube plug leakage detected requires tube plug replacement. Identified primary-to-secondary leakage is compared with the limits allowed by the technical specifications. In response to RAI 3.9.14-4, the applicant stated that Turkey Point power plant procedures for off-normal conditions associated with primary-to-secondary steam generator tube leakage incorporate the operational leakage performance criteria provided in NEI 97-06. These criteria are more restrictive and, thus, bound the technical specification primary-to-secondary leakage limits. The staff finds the acceptance criteria acceptable.

[*Operating Experience*] The current steam generator inspection activities have been evaluated against industry recommendations provided by EPRI and Westinghouse. The steam generator integrity program is not a new program, and has been effective at Turkey Point in ensuring the timely detection and correction of the aging effects of cracking and loss of material in steam generator tubes. The steam generator integrity program considers the guidance provided in NEI 97-06 which is all-inclusive in managing steam generator tube bundle and internals degradation. The staff agrees with the applicant's assessment of operating experience.

3.9.14.3 FSAR Supplement

The staff has confirmed that the steam generator integrity program as described in the FSAR Supplement contains the appropriate essential elements.

3.9.14.4 Conclusion

The staff has reviewed the information provided in Appendix B, Section 3.2.14 of the LRA. On the basis of this review, as set forth above, the staff concludes that the applicant has demonstrated that the steam generator integrity program will adequately manage aging effects for steam generators in accordance with the CLB throughout the period of extended operation.

3.9.15 Systems and Structures Monitoring Program

This program is covered in Section 3.1.3 of this safety evaluation report.

3.9.16 Thimble Tube Inspection Program

The applicant described its thimble tube inspection program in Section 3.2.16 of Appendix B of the LRA. The staff reviewed this section of the application to determine whether the applicant has demonstrated that the aging effects of the incore instrumentation thimble tubes will be adequately managed by this program during the period of extended operation as required by 10 CFR 54.21(a)(3).

3.9.16.1 Summary of Technical Information in the Application

The applicant specified that the thimble tube inspection program is for aging management of thimble tubes in Turkey Point, Units 3 and 4, by conducting inspection of a single thimble tube N-05 in Unit 3. The program utilizes eddy current test (ECT) to determine thimble tube wall thickness and predict wear rates for early identification of the need for corrective action before the potential thimble tube failure.

The applicant indicated that the thimble tube inspection program was created and implemented in both Units 3 and 4 in response to NRC Bulletin 88-09, "Thimble Tube Thinning in Westinghouse Reactors." The selection of a single tube N-05 for aging management during the extended operation is based on assessment of previous inspections and the Time-Limited Aging Analysis (TLAA) results.

3.9.16.2 Staff Evaluation

In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information in the LRA regarding the applicant's demonstration that the effects of aging will be adequately managed so that intended function will be maintained consistent with the CLB throughout the period of extended operation for the incore instrumentation thimble tubes. The staff evaluation of the thimble tube inspection program focused on effective incorporation of the following 10 elements: program scope, preventive or mitigative actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience.

It is noted that corrective actions, confirmation process, and administrative controls for license renewal are in accordance with the site-controlled quality assurance program pursuant to 10 CFR Part 50, Appendix B, and covers all structures and components subject to an aging management review. The staff evaluation of the applicant's quality assurance program is provided separately in Section 3.1.2 of this safety evaluation report. This program satisfies the elements of corrective actions, confirmation process and administrative controls. Because of the limited scope of the program, further elaboration on the remaining seven elements is not required.

The existing thimble tube inspection program for Turkey Point, Units 3 and 4, in response to NRC Bulletin 88-09, was started in early 1990s. The program required eddy current testing (ECT) of thimble tubes. The ECT inspections established the tube wall wear rates in both units. It was based on these wear rates and the TLAA results, the applicant determined that only a single tube (N-05 in Unit 3) requires inspection for the extended operation. Based on above discussion, the staff finds that to inspect only thimble N-05 in the licensee's thimble tube inspection program is acceptable.

Due to potential uncertainties in wear locations and wear rates, the staff feels that TLAA based on previous inspection results obtained in the early 1990s may not be realistic without verification, and the applicant may need to inspect all thimble tubes, or at least a sample of tubes, in both Units 3 and 4 during the one-time inspection for determining the status of wear in thimble tubes. In addition, if more inspections are needed as a result of the one-time inspection, further staff review and updating of the FSAR supplement is needed. Thus the applicant was requested to identify documentation and provide a description of the plant procedures related in a letter dated February 1, 2001, to thimble tube inspection, to provide justification regarding adequacy of inspecting a single tube in the program, and to provide criteria that will be used to determine the scope of additional tests, if necessary.

In its response dated April 19, 2001, the applicant indicated that the procedures for performance of thimble tube ECT inspection were created and used satisfactorily for the determination of thimble tube wall thinning in response to NRC Bulletin 88-09. These procedures consisted of a plant procedure and NDE department procedure. The plant procedure specifies all plant associated requirements, precautions and limitations for performing the thimble tube ECT, including acceptance criteria and corrective action program requirements. The NDE procedure, which is specific for the thimble tubes, provides all technical requirements for performing the thimble tube ECT, including the level of qualification of examination personnel and of others involved in the selection and calibrations of equipment to be used. On the basis of the conservative calculations performed, the Unit 3 thimble tube at location N-05 was determined to be the worst case concerning wall thinning rate. The calculated remaining life for thimble N-05 was determined to be approximately half the life of the thimble tube with the next highest wall thinning rate. On the basis of the considerable margin on the calculated remaining life of all the other thimble tubes tested when compared with the calculated remaining life of thimble N-05, it is reasonable to conclude that the results of ECT on thimble N-05 can be used to justify the acceptance of the other thimble tubes. The applicant indicated that the criteria for determining the scope of additional tests have not yet been established. However, for determining the need for additional ECT on other thimble tubes, consideration will be given to a major reduction on the predicted life of the thimble N-05 when using the test results to recalculate the remaining life of this thimble tube. On the basis of the results of the ECT on the thimble N-05, ECT may be performed on other thimble tubes that were previously tested and identified with high wall thinning rates. The selection of these tubes will depend on the recalculated remaining life of these tubes. The staff finds this acceptable.

Since a thimble tube failure will result in leakage of reactor coolant, it is prudent for the staff to know whether a leaking thimble tube can be isolated. Thus the applicant was requested to describe the corrective actions mentioned in page B-88 of the LRA if a tube leak does occur. In its response, the applicant indicated that manually operated isolation valves are provided for isolating thimble tubes. These valves may be closed after removal of the detector cable assembly. If a thimble tube leak does occur, the affected unit would be shut down in accordance with technical specification requirements. Repairs and subsequent testing would then be performed in accordance with the plant's corrective action program. Based on the above discussion, the staff finds that this is acceptable because the leaked thimble tube is isolable.

3.9.16.3 FSAR Supplement

In section 16.2.16 of appendix of LRA, the applicant states that this inspection will be performed prior to the end of initial operating license term. The staff finds this acceptable.

3.9.16.4 Conclusion

The staff has reviewed the information in Section 3.2.16 of Appendix B to the LRA. On the basis of this review, the staff concludes that the continued implementation of the thimble tube inspection program provides reasonable assurance that the aging effects of thimble tubes in Turkey Point, Units 3 and 4, will be managed, such that early detection of potential thimble tube wear will ensure timely corrective measures to mitigate thimble tube failure in accordance with the CLB during the period of extended operation.