# 3.0 AGING MANAGEMENT REVIEW RESULTS

For those structures and components that are identified as being subject to an aging management review, 10 CFR 54.21(a)(3) requires demonstration that the effects of aging will be adequately managed so that their intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation. The information provided in this chapter provides essential input to the required aging management review as it identifies and discusses the aging effects requiring management.

This chapter describes the results of the aging management reviews of the components and structures, identified in Chapter 2, "Structures and Components Subject to Aging Management Review." This chapter:

- provides references to the descriptions of common aging management programs
- identifies the components and structural components subject to aging management review, and their intended functions
- discusses the materials and internal and external environments
- describes or references the processes used to identify aging effects
- describes industry and plant-specific operating experiences with respect to the aging effects
- identifies the aging effects requiring management
- lists the aging management programs for aging effects requiring management.

Common aging management programs are contained in Section 3.1. For those structures and components identified as being subject to an aging management review, the results are contained in Section 3.2 for Reactor Coolant Systems, Section 3.3 for Engineered Safety Features Systems, Section 3.4 for Auxiliary Systems, Section 3.5 for Steam And Power Conversion Systems, Section 3.6 for structures and structural components (Subsection 3.6.1 for Containment and Subsection 3.6.2 for other structures), and Section 3.7 for electrical and instrumentation and controls. Aging management program descriptions are contained in Appendix B.

Tables 3.0-1 and 3.0-2 contain descriptions of the internal and external service environments at Turkey Point, which will be used in subsequent sections of this chapter. The environments used in the aging management reviews are listed in the "Environment" column in Tables 3.0-1 and 3.0-2. Within this Application, some of the internal environments have been subdivided into groups based on the fluid chemistry. The subgroups are identified in the "Description" column in Table 3.0-1.

# TABLE 3.0-1
# INTERNAL SERVICE ENVIRONMENTS

| Environment | Description |
|---|---|
| Air/Gas | Includes atmospheric air, dry/filtered instrument air, nitrogen, hydrogen, carbon dioxide, and Halon |
| Treated water | Base water for all clean systems. Demineralized water that can be deaerated, or include corrosion inhibitors, biocides, and boric acid, or any combination of these treatments<br>Within this Application, treated water has been subdivided into groups based on the chemistry of the water:<br>Treated water – primary – Normal operating Reactor Coolant System chemistry<br>Treated water – secondary – Normal operating secondary chemistry, including Main Steam, Feedwater, and Blowdown Systems<br>Treated water – borated – Systems that contain borated water except those included in treated water – primary, including Chemical and Volume Control, Spent Fuel Cooling, and Emergency Core Cooling Systems<br>Treated water – All other treated water systems, including Component Cooling Water, Emergency Diesel Generator Cooling, and Chilled Water Systems |
| Raw water | Water that enters the plant from the cooling water canals, ocean, bay, or city water source that has not been demineralized. In general, the water has been rough filtered to remove large particles and may contain a biocide for control of micro-organisms and macro-organisms. Although city water is purified for drinking purposes, it is conservatively classified as raw water for the purposes of aging management review.<br>Within this Application, raw water has been subdivided into groups based on the chemistry of the water:<br>Raw water – cooling canals – Salt water used as the ultimate heat sink<br>Raw water – city water – Potable water supplied to the water treatment plant and the Fire Protection System<br>Raw water – floor drainage – Fluids collected in building drains. The fluids can be treated water (primary, secondary, borated, or other), raw water (cooling water canals or city water), fuel oil, or lubricating oil |
| Fuel oil | Emergency diesel generator, diesel fire pump, and standby steam generator feedwater pump fuel oil |
| Lubricating oil | Lubricating oil for emergency diesel generators, pumps, and other components |
| Ohmic heating | Thermal stress on power cable materials can be due to ohmic heating resulting from electrical current |

# TABLE 3.0-2
# EXTERNAL SERVICE ENVIRONMENTS

| Environment [1] | Description |
|---|---|
| Outdoor [2] | Moist, salt-laden atmospheric air, temperature 30°F-95°F, humidity 5%-95%, exposed to weather, including precipitation and wind |
| Indoor – not air conditioned[2] | Atmospheric air, temperature 104°F (40°C) maximum, humidity 5%-95°F%, not exposed to weather |
| Indoor – air conditioned[2] | Atmospheric air, specific temperature/humidity range dependent on building/room. Typically, temperature 70°F-79°F, humidity 60%-80%, not exposed to weather |
| Containment air [2] | Atmospheric air, temperature 120°F maximum, humidity 5%-95%, total integrated dose rate – 1 rad/hour (excluding equipment located inside the reactor cavity), not exposed to weather<br>Note: Safety-related equipment in the containment has been analyzed to 122°F (50°C) continuous and 125°F for 2 weeks/year |
| Borated water leaks | Exposed to leakage from borated water systems |
| Buried | Above groundwater elevation, exposed to soil/fill. Below groundwater elevation, exposed to soil/fill and groundwater. Groundwater contains aggressive chemicals that can attack susceptible materials |
| Embedded/Encased | Reinforcing or embedded steel or piping in concrete |

NOTES: 1. For certain components and structural components that are submerged, the applicable environment in Table 3.0-1 is specified.
2. Where wetted conditions exist (e.g., condensation), the item is annotated with the applicable external environment in Chapter 3 system and structures tables.

# 3.1 COMMON AGING MANAGEMENT PROGRAMS

The Turkey Point programs described in Appendix B are credited for managing the effects of aging. This section does not describe the aging management programs nor discuss how the programs will manage the identified aging effects. Appendix B describes these programs and provides the information necessary to demonstrate that the identified aging effects will be adequately managed, to provide reasonable assurance that the systems, structures, and 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.

## 3.1.1 CHEMISTRY CONTROL PROGRAM

This information is contained in Appendix B, Subsection 3.2.4.

## 3.1.2 FPL QUALITY ASSURANCE PROGRAM

This information is contained in Appendix B, Section 2.0.

## 3.1.3 SYSTEMS AND STRUCTURES MONITORING PROGRAM

This information is contained in Appendix B, Subsection 3.2.15.

# 3.2 REACTOR COOLANT SYSTEMS

Reactor Coolant Systems components within the scope of license renewal that require aging management review are identified in Subsection 2.3.1. The following reactor coolant mechanical and structural components are included in this section:

- Reactor coolant piping
- Regenerative and excess letdown heat exchangers
- Pressurizers
- Reactor vessels
- Reactor vessel internals
- Reactor coolant pumps
- Steam generators

Determination of the aging effects related to Reactor Coolant Systems components begins with identification of aging effects defined in industry literature. From this set of aging effects, the materials, operating environments, and operating stresses define the aging effects requiring management for each component that is subject to an aging management review. Aging effects requiring management are then validated by a review of industry and Turkey Point Units 3 and 4 operating experience to provide assurance that all aging effects requiring management are identified.

The determination of aging effects requiring management considers the materials, environments, and stresses of Turkey Point Units 3 and 4 components. The aging effects requiring management for the Reactor Coolant Systems components are discussed in the following subsections.

The only areas inaccessible for inspection for the Reactor Coolant Systems are a limited number of locations internal to certain components (i.e., pressurizers, reactor vessel internals, and steam generators). Aging effects associated with these areas are addressed in the aging management review discussed in Subsections 3.2.3, 3.2.5, and 3.2.7 respectively.

## 3.2.1 REACTOR COOLANT PIPING

Reactor coolant piping consists of Class 1 and non-Class 1 components. The aging management review results for reactor coolant Class 1 piping components are discussed in Subsection 3.2.1.1, and reactor coolant non-Class 1 piping components are discussed in Subsection 3.2.1.2.

### 3.2.1.1 CLASS 1 PIPING

Reactor coolant Class 1 piping components are within the scope of license renewal as discussed in Subsection 2.3.1.2. Reactor coolant Class 1 piping components that are subject to an aging management review are listed in Table 3.2-1.

As stated previously in Subsection 2.3.1.2, WCAP-14575, "License Renewal Evaluation: Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components" [References 3.2-1 through 3.2-3], is not incorporated by reference in this Application. However, the Turkey Point aging management review was compared to WCAP-14575 with the results presented below.

The design and operation of the reactor coolant piping were reviewed using the process described in Subsection 2.3.1.1.1. This review confirmed that the Turkey Point Units 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. 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, Turkey Point has identified an additional function for the flow restricting orifices and reducers. 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.

Several open items and applicant action items were identified and documented in the NRC draft safety evaluation of WCAP-14575 [Reference 3.2-4]. The Turkey Point-specific responses to those open items and applicant action items relevant to the identification of reactor coolant piping components subject to aging management review are provided in Tables 2.3-2 and 2.3-3.

WCAP-14575 identified loss of material due to wear of reactor coolant pump and Class 1 valve mechanical closures. Turkey Point has concluded that loss of material due to wear does not require aging management for reactor coolant Class 1 piping components. Turkey Point has determined that cracking due to stress corrosion and loss of mechanical closure integrity due to aggressive chemical attack and stress relaxation are additional aging effects, not included in WCAP-14575, that require management in the license renewal term.

The aging management programs described in WCAP-14575 include six attributes and are established on an aging mechanism basis. The Turkey Point aging management programs referred to in this aging management review and described in Appendix B contain ten attributes, and are established on a program basis.

#### 3.2.1.1.1 MATERIALS AND ENVIRONMENTS

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 (see Tables 3.0-1 and 3.0-2).

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

#### 3.2.1.1.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Table 3.2-1 and are summarized in the following paragraphs.

The following internal and external aging effects require management during the period of extended operation:

- Cracking
- Reduction in fracture toughness
- Loss of mechanical closure integrity

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 is identified as a Time-Limited Aging Analysis (TLAA) and is addressed in Subsections 4.3.1 and 4.3.4.

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 reactor coolant Class 1 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. In order to confirm that cracking is not occurring in small bore (<4 inches in diameter) reactor coolant Class 1 piping, a one-time inspection to complement present ASME Section XI examinations will be performed. Continued performance of the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program, supplemented by the one-time Small Bore Class 1 Piping Inspection, provides assurance that flaw growth is managed and that the intended function of reactor coolant Class 1 piping components is maintained consistent with the current licensing basis for the period of extended operation.

Stress corrosion cracking is a localized, nonductile 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 reactor coolant Class 1 piping components. In addition, to reduce the susceptibility of reactor coolant Class 1 piping component materials to stress corrosion cracking, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment. The Chemistry Control Program provides assurance that stress corrosion cracking is managed and that the intended function of reactor coolant Class 1 piping components is maintained consistent with the current licensing basis for the period of extended operation.

REDUCTION IN FRACTURE TOUGHNESS

Reduction in fracture toughness due to thermal embrittlement is an aging effect requiring management for the period of extended operation. Thermal embrittlement refers to gradual and progressive changes in the microstructure and properties of a

material due to exposure to elevated temperatures for an extended period. The only reactor coolant Class 1 piping components subject to reduction in fracture toughness due to thermal embrittlement are austenitic stainless steel castings. Cast austenitic stainless steel (CASS) reactor coolant Class 1 piping components at Turkey Point consist of 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 Subsection 3.2.6.

Since the primary loop elbows are cast austenitic stainless steel, the reactor coolant primary loop Leak-Before-Break (LBB) analysis considers the effects of thermal embrittlement. The LBB analysis has been identified as a TLAA and has been reevaluated for the extended period of operation in accordance with 10 CFR 54.21(c)(1)(ii) (see Subsection 4.7.3). Consistent with the conclusions drawn in the NRC draft safety evaluation for WCAP-14575, Turkey Point has chosen the evaluation method to disposition reduction in fracture toughness due to thermal embrittlement of the primary loop elbows. Therefore, an aging management program to manage this effect for the reactor coolant primary loop CASS elbows is not required.

Consistent with the conclusions drawn in the NRC draft safety evaluation for WCAP-14575, screening of 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 ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection 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 current licensing basis for 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 in-service inspections and leakage testing. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection 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 current licensing basis for 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 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 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 current licensing basis for the period of extended operation.

#### 3.2.1.1.3 OPERATING EXPERIENCE

INDUSTRY 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. The industry correspondence that was reviewed for operating experience related to reactor coolant Class 1 and non-Class 1 piping components includes the following:

- NRC Bulletin 79-17, "Pipe Cracks in Stagnant Borated Water Systems at PWR Plants"
- NRC Bulletin 88-08, "Thermal Stresses in Piping Connected to Reactor Coolant Systems"
- NRC Bulletin 88-11, "Pressurizer Surge Line Thermal Stratification"
- 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 82-14, "TMI-1 Steam Generator/Reactor Coolant System Chemistry/Corrosion Problem"
- NRC Information Notice 82-30, "Loss of Thermal Sleeves in Reactor Coolant System Piping at Certain Westinghouse PWR Power Plants"

- NRC Information Notice 86-108, "Degradation of Reactor Coolant System Pressure Boundary Resulting From Boric Acid Corrosion"
- NRC Information Notice 87-46, "Undetected Loss of Reactor Coolant"
- NRC Information Notice 88-30, "Target Rock Two-Stage Safety-Relief Valve Setpoint Drift Update"
- NRC Information Notice 88-80, "Unexpected Piping Movement Attributed to Thermal Stratification"
- NRC Information Notice 89-07, "Failures of Small Diameter Tubing in Control Air, Fuel Oil, and Lube Oil Systems Render Emergency Diesels Inoperable"
- NRC Information Notice 91-74, "Changes in Pressurizer Safety Valve Setpoints Before Installation"
- NRC Information Notice 91-87, "Hydrogen Embrittlement of Raychem Craft Couplings"
- NRC Information Notice 92-15, "Failure of Primary System Compression Fittings"
- NRC Information Notice 92-36, "Intersystem Loss-of-Coolant Accident Outside Containment"
- NRC Information Notice 92-86, "Unexpected Restriction to Thermal Growth of Reactor Coolant Piping"
- NRC Information Notice 93-02, "Malfunction of a Pressurizer Code Safety Valve"
- NRC Information Notice 93-66, "Switchover to Hot-Leg Injection Following a Loss-of-Coolant Accident in Pressurized Water Reactors"
- NRC Information Notice 93-90, "Unisolatable Reactor Coolant System Leak Following Repeated Application of Leak Sealant"
- NRC Information Notice 94-55, "Problems with Copes-Vulcan Pressurizer Power-Operated Relief Valves"
- SOER 25-87, "Pressurizer Surge Line Thermal Stratification"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.2.1.1.2. Note that a summary of industry experience associated with reactor coolant Class 1 piping components is also provided in WCAP-14575.

PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 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 reactor coolant Class 1 piping component aging, in addition to interviews with responsible engineering personnel. No aging effects requiring management were identified from this review beyond those identified in Subsection 3.2.1.1.2.

3.2.1.1.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.2.1.1.2. Table 3.2-1 contains the results of the aging management review for reactor coolant Class 1 piping components and summarizes the aging effects requiring management.

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

- ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program
- Boric Acid Wastage Surveillance Program
- Chemistry Control Program
- Small Bore Class 1 Piping Inspection

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of reactor coolant Class 1 piping components listed in Table 3.2-1 are maintained consistent with the current licensing basis for the period of extended operation.

### 3.2.1.2 NON-CLASS 1 PIPING

Reactor coolant non-Class 1 piping components are within the scope of license renewal, as discussed in Subsection 2.3.1.2. Reactor coolant non-Class 1 piping components that are subject to an aging management review are listed in Table 3.2-1.

#### 3.2.1.2.1 MATERIALS AND ENVIRONMENTS

Reactor coolant non-Class 1 piping components are exposed to internal environments of air/gas, treated water, treated water – primary, and lubricating oil; and external environments of containment air and potential borated water leaks (see Tables 3.0-1 and 3.0-2).

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

#### 3.2.1.2.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Table 3.2-1 and are summarized in the following paragraphs.

The following internal and external aging effects require management during the period of extended operation:

- Cracking
- Loss of material
- Loss of mechanical closure integrity

CRACKING

Cracking due to stress corrosion is an aging effect requiring management for the period of extended operation. At Turkey Point, cracking due to fatigue is identified as a Time-Limited Aging Analysis and is addressed in Subsection 4.3.4.

Stress corrosion cracking is a localized, nonductile 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 reactor coolant non-Class 1 piping components. In addition, to reduce the susceptibility of reactor coolant non-Class 1 piping component materials to stress corrosion cracking, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment. The Chemistry Control Program provides assurance that stress corrosion cracking is managed and that the intended function of the reactor coolant non-Class 1 piping

components is maintained consistent with the current licensing basis for the period of extended operation.

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 reactor coolant non-Class 1 piping components are general corrosion, crevice corrosion, pitting corrosion, microbiologically influenced corrosion, selective leaching, galvanic corrosion, and aggressive chemical attack.

General corrosion, crevice corrosion, pitting corrosion, microbiologically influenced corrosion, and selective leaching have been identified as aging mechanisms for internal surfaces of reactor coolant non-Class 1 piping components. The Chemistry Control Program provides an effective means of controlling these corrosion mechanisms and provides assurance that the intended function of reactor coolant non-Class 1 piping components is maintained consistent with the current licensing basis for the period of extended operation.

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 supply piping (carbon steel); and between the reactor coolant pump upper bearing heat exchanger tubes (brass) and the carbon steel heat exchanger tube sheet. Although galvanic action is considered as a corrosion mechanism, no adverse effect of galvanic corrosion has been identified for these material combinations and environments at Turkey Point. The Galvanic Corrosion Susceptibility Inspection Program provides assurance that galvanic corrosion is managed and that the intended function of reactor coolant non-Class 1 piping components is maintained consistent with the current licensing basis for the period of extended operation.

General corrosion and pitting corrosion have been identified as aging mechanisms for external surfaces of carbon steel components. Although existing protective coatings applied to these surfaces have effectively protected them from corrosion effects, the Systems and Structures Monitoring Program provides assurance that general corrosion and pitting corrosion are managed and that the intended function of reactor coolant non-Class 1 piping components is maintained consistent with the current licensing basis for the period of extended operation.

Aggressive chemical attack was identified as an aging mechanism for external surfaces of carbon steel components exposed to potential borated water leaks. The Boric Acid Wastage Surveillance Program provides assurance that the aging mechanism of loss of material 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 current licensing basis for the period of extended operation.

LOSS OF MECHANICAL CLOSURE INTEGRITY

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. 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 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 current licensing basis for the period of extended operation.

### 3.2.1.2.3 OPERATING EXPERIENCE

INDUSTRY 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. The industry correspondence that was reviewed for operating experience related to reactor coolant non-Class 1 piping components is included in the listing provided in Subsection 3.2.1.1.3.

No aging effects requiring management were identified from the documents listed in Subsection 3.2.1.1.3 beyond those already identified in Subsection 3.2.1.2.2.

PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 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 reactor coolant non-Class 1 piping component aging, in addition to interviews with responsible engineering personnel. No aging effects requiring management were identified from this review beyond those identified in Subsection 3.2.1.2.2.

#### 3.2.1.2.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.2.1.2.2. Table 3.2-1 contains the results of the aging management review for reactor coolant non-Class 1 piping components and summarizes the aging effects requiring management.

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

- Boric Acid Wastage Surveillance Program
- Chemistry Control Program
- Galvanic Corrosion Susceptibility Inspection Program
- Systems and Structures Monitoring Program

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of reactor coolant non-Class 1 piping components listed in Table 3.2-1 are maintained consistent with the current licensing basis for the period of extended operation.

## 3.2.2 REGENERATIVE AND EXCESS LETDOWN HEAT EXCHANGERS

The regenerative and excess letdown heat exchangers are within the scope of license renewal, as discussed in Subsection 2.3.1.3. Regenerative and excess letdown heat exchanger components that are subject to an aging management review are listed in Table 3.2-1.

### 3.2.2.1 MATERIALS AND ENVIRONMENTS

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).

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

### 3.2.2.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Table 3.2-1 and are summarized in the following paragraphs.

The following internal and external aging effects require management during the period of extended operation:

- Cracking
- Loss of material
- Loss of mechanical closure integrity
- Fouling

#### 3.2.2.2.1 CRACKING

Cracking due to stress corrosion is an aging effect requiring management for the period of extended operation.

Stress corrosion cracking 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 regenerative and excess letdown heat exchangers. In addition, to reduce the susceptibility of regenerative and excess letdown heat exchangers materials to stress corrosion cracking, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment. The Chemistry Control Program provides assurance that stress corrosion cracking is managed and that the intended function of regenerative and excess letdown heat exchangers is maintained consistent with the current licensing basis for the period of extended operation.

3.2.2.2.2 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 the excess letdown heat exchangers are general corrosion, crevice corrosion, pitting corrosion, galvanic corrosion, microbiologically influenced corrosion, and aggressive chemical attack. Note that the regenerative heat exchangers are of all welded, stainless steel construction and not subject to loss of material.

General corrosion has been identified as an aging mechanism for internal carbon steel surfaces of the excess letdown heat exchangers. Microbiologically influenced corrosion 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 component cooling water that contains dissolved oxygen. The addition of corrosion inhibitors to the component cooling water, in accordance with the Chemistry Control Program, provides an effective means of controlling general and microbiologically influenced corrosion in the shell sides of the excess letdown heat exchangers and provides assurance that the intended function of the excess letdown heat exchangers is maintained consistent with the current licensing basis for the period of extended operation.

Galvanic corrosion has been identified 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 as a corrosion mechanism, no adverse effect of galvanic corrosion has been identified for these material combinations and environments at Turkey Point. The Galvanic Corrosion Susceptibility Inspection Program provides assurance that galvanic corrosion is managed and that the intended function of the excess letdown heat exchangers is maintained consistent with the current licensing basis for the period of extended operation.

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 microbiologically influenced corrosion have been identified as aging mechanisms for external carbon steel surfaces of the excess letdown heat exchangers. Although existing protective coatings applied to these surfaces have effectively protected them from corrosion effects, the Systems and Structures Monitoring Program provides assurance that general corrosion, crevice corrosion, pitting corrosion, and microbiologically influenced corrosion are managed and that the intended function of the excess letdown heat exchangers is maintained consistent with the current licensing basis for the period of extended operation.

Aggressive chemical attack was identified as an aging mechanism for the excess letdown heat exchanger external surfaces exposed to potential borated water leaks. The Boric Acid Wastage Surveillance Program provides assurance that the aging mechanism of loss of material due to aggressive chemical attack is managed and that the intended function of the excess letdown heat exchangers is maintained consistent with the current licensing basis for the period of extended operation.

#### 3.2.2.2.3 LOSS OF MECHANICAL CLOSURE INTEGRITY

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. 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. 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 the excess letdown heat exchangers is maintained consistent with the current licensing basis for the period of extended operation. Note that there are no bolted mechanical closures associated with the regenerative heat exchangers.

#### 3.2.2.2.4 FOULING

Aging mechanisms that can result in fouling of the heat exchanger heat transfer surfaces include biological fouling and particulate fouling.

Biological fouling has been identified as an aging mechanism affecting the excess letdown heat exchanger tubing exposed to component cooling water. The addition of biocides, in accordance with the Chemistry Control Program, provides assurance that the intended function of the excess letdown heat exchangers is maintained consistent with the current licensing basis for the period of extended operation.

Particulate fouling has been identified as an aging mechanism for the regenerative and excess letdown heat exchanger tubing. The Chemistry Control Program provides assurance that particulate fouling is managed and that the intended function of the regenerative and excess letdown heat exchangers is maintained consistent with the current licensing basis for the period of extended operation.

### 3.2.2.3 OPERATING EXPERIENCE

#### 3.2.2.3.1 INDUSTRY 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. The industry correspondence that was reviewed for operating experience related to the regenerative and excess letdown heat exchangers 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”
- 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 Subsection 3.2.2.2.

#### 3.2.2.3.2 PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 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 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 Subsection 3.2.2.2.

### 3.2.2.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.2.2.2. Table 3.2-1 contains the results of the aging management review for the regenerative and excess letdown heat exchangers and summarizes the aging effects requiring management.

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

- Boric Acid Wastage Surveillance Program
- Chemistry Control Program
- Galvanic Corrosion Susceptibility Inspection Program
- Systems and Structures Monitoring Program

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of the regenerative and excess letdown heat exchanger components listed in Table 3.2-1 are maintained consistent with the current licensing basis for the period of extended operation.

## 3.2.3 PRESSURIZERS

The pressurizers are within the scope of license renewal, as discussed in Subsection 2.3.1.4. Pressurizer components that are subject to an aging management review are listed in Table 3.2-1.

As stated previously in Subsection 2.3.1.4, WCAP-14574, "License Renewal Evaluation: Aging Management Evaluation for Pressurizers" [References 3.2-3, 3.2-5, and 3.2-6], is not incorporated by reference in this Application. However, the Turkey Point aging management review was compared to WCAP-14574 with the results presented below.

The design and operation of the Turkey Point Units 3 and 4 pressurizers were reviewed using the process described in Subsection 2.3.1.1.1. This review confirmed that the Turkey Point pressurizers are bounded by the description of the pressurizer in WCAP-14574 with regard to design criteria and features, modes of operation, intended functions, and environments/exposures. The materials of the Turkey Point pressurizers correspond to those in WCAP-14574 with the exception of the shells. The Turkey Point pressurizer shells are made of ASTM A-302 Grade B rather than SA 533 Grade A Class 2, as specified in WCAP-14574. This does not constitute a significant deviation because these materials are essentially the same. The fabrication techniques and installed configuration are the same as those specified in WCAP-14574 with the exception of the earthquake lugs and valve support brackets. The Turkey Point pressurizers do not include these items.

WCAP-14574 identifies ASME Section XI inspections as the program to manage stress corrosion cracking of the pressurizer nozzle safe ends. Stress corrosion cracking of stainless steel materials in the primary coolant environment is effectively managed by the Turkey Point Chemistry Control Program. Turkey Point has determined that cracking due to flaw growth is an additional aging effect that requires management at Turkey Point. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program is credited to manage the aging effects of cracking due to flaw growth.

The aging management programs described in WCAP-14574 include six attributes and are established on an aging mechanism basis. The Turkey Point aging management programs referred to in this aging management review and described in Appendix B contain ten attributes, and are established on a program basis.

### 3.2.3.1 MATERIALS AND ENVIRONMENTS

The pressurizers are exposed to an internal environment of treated water - primary and external environments of containment air and potential borated water leaks (see Tables 3.0-1 and 3.0-2).

Pressurizer components are constructed of stainless steel, alloy steel, and carbon steel. Note there are no Alloy 600 penetrations associated with the pressurizers. The pressurizer components, their intended functions, the materials, and environments are summarized in Table 3.2-1.

### 3.2.3.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Table 3.2-1 and are summarized in the following paragraphs.

The following internal and external aging effects require management during the period of extended operation:

- Cracking
- Loss of material
- Loss of mechanical closure integrity

#### 3.2.3.2.1 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 is identified as a Time-Limited Aging Analysis and is analytically addressed in Subsection 4.3.1.

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 pressurizer 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. Continued performance of the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides assurance that flaw growth is managed and that the intended function of

the pressurizers is maintained consistent with the current licensing basis for the period of extended operation.

Stress corrosion cracking is a localized, nonductile 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 pressurizers. In addition, to reduce the susceptibility of pressurizer materials to stress corrosion cracking, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment. The Chemistry Control Program provides assurance that stress corrosion cracking is managed and that the intended function of the pressurizers is maintained consistent with the current licensing basis for the period of extended operation.

3.2.3.2.2 LOSS OF MATERIAL

Loss of material due to aggressive chemical attack was identified as an aging mechanism requiring management for external surfaces of carbon and low alloy steel pressurizer components exposed to borated water leaks. The Boric Acid Wastage Surveillance Program provides assurance that the aging mechanism of loss of material due to aggressive chemical attack is managed and that the intended function of the pressurizer is maintained consistent with the current licensing basis for the period of extended operation.

3.2.3.2.3 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 in-service inspections and leakage testing. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides assurance that loss of mechanical closure integrity due to stress relaxation is managed and that the intended function of the pressurizers is maintained consistent with the current licensing basis for 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 pressurizers 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 is managed and that the intended function of the pressurizers is maintained consistent with the current licensing basis for the period of extended operation.

### 3.2.3.3 OPERATING EXPERIENCE

#### 3.2.3.3.1 INDUSTRY 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. The industry correspondence that was reviewed for pressurizer operating experience includes the following:

- NRC Bulletin 82-02, "Degradation of Threaded Fasteners in the Reactor Coolant Pressure Boundary of PWR Plants"
- NRC Bulletin 88-08, "Thermal Stresses in Piping Connected to Reactor Coolant Systems"
- NRC Bulletin 88-11, "Pressurizer Surge Line Thermal Stratification"
- NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants"
- NRC Information Notice 82-30, "Loss of Thermal Sleeves in Reactor Coolant System Piping at Certain Westinghouse PWR Power Plants"
- NRC Information Notice 86-108, "Degradation of Reactor Coolant System Pressure Boundary Resulting From Boric Acid Corrosion"
- NRC Information Notice 88-30, "Target Rock Two-Stage Safety-Relief Valve Setpoint Drift Update"
- NRC Information Notice 88-80, "Unexpected Piping Movement Attributed to Thermal Stratification"
- NRC Information Notice 90-10, "Primary Water Stress Corrosion Cracking of Inconel 600"
- NRC Information Notice 91-74, "Changes in Pressurizer Safety Valve Setpoints Before Installation"

- NRC Information Notice 93-02, "Malfunction of a Pressurizer Code Safety Valve"
- NRC Information Notice 94-55, "Problems with Copes-Vulcan Pressurizer Power-Operated Relief Valves"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.2.3.2. Note that a summary of industry experience associated with pressurizers is also provided in WCAP-14574.

3.2.3.3.2 PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 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 pressurizer component aging, in addition to interviews with responsible engineering personnel. No aging effects requiring management were identified from this review beyond those identified in Subsection 3.2.3.2.

### 3.2.3.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.2.3.2. Table 3.2-1 contains the results of the aging management review for the pressurizers and summarizes the aging effects requiring management.

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

- ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program
- Boric Acid Wastage Surveillance Program
- Chemistry Control Program

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of the pressurizer components listed in Table 3.2-1 are maintained consistent with the current licensing basis for the period of extended operation.

## 3.2.4 REACTOR VESSELS

The reactor vessels are within the scope of license renewal, as discussed in Subsection 2.3.1.5. Reactor vessel components that are subject to an aging management review are listed in Table 3.2-1. Note that Turkey Point has included bottom mounted instrumentation tubing, thimble tubes, and the seal tables within the scope of this subsection.

### 3.2.4.1 MATERIALS AND ENVIRONMENTS

Reactor vessel components are exposed to internal environments of treated water - primary and air/gas, and external environments of containment air, treated water – primary (per note 1 on Table 3.0-2 for thimble tubes), and potential borated water leaks (see Tables 3.0-1 and 3.0-2).

Reactor vessel components are constructed of stainless steel, low alloy steel, carbon steel, and Alloy 600. Reactor vessel components, their intended functions, the materials, and environments are summarized in Table 3.2-1.

### 3.2.4.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Table 3.2-1 and are summarized in the following paragraphs.

The following internal and external aging effects require management during the period of extended operation:

- Cracking
- Reduction in fracture toughness
- Loss of material
- Loss of mechanical closure integrity

#### 3.2.4.2.1 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 reactor vessel underclad cracking) is identified as a Time-Limited Aging Analysis (TLAA) and is analytically addressed in Subsections 4.3.1 and 4.3.2.

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 reactor vessel 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. Continued performance of the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides assurance that flaw growth is managed and that the intended function of the reactor vessels is maintained consistent with the current licensing basis for the period of extended operation.

Stress corrosion cracking is a localized, nonductile 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 reactor vessels. In addition, to reduce the susceptibility of reactor vessel materials to stress corrosion cracking, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment. The Chemistry Control Program provides assurance that stress corrosion cracking is managed and that the intended function of the reactor vessels is maintained consistent with the current licensing basis for the period of extended operation.

Primary water stress corrosion cracking of the control rod drive mechanism housing tubes is a recognized industry issue. The Reactor Vessel Head Alloy 600 Penetration Inspection Program has been specifically designed to address primary water stress corrosion cracking of control rod drive mechanism housing tubes. The Reactor Vessel Head Alloy 600 Penetration Inspection Program, in conjunction with the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program and the Chemistry Control Program, provide assurance that the intended function of the control rod drive mechanism housing tubes is maintained consistent with the current licensing basis for the period of extended operation. Note that the reactor vessels are the only Reactor Coolant System components with Alloy 600 penetrations at Turkey Point.

Stress corrosion cracking is an aging mechanism for reactor vessel closure studs and nuts. Visual, surface, and volumetric inspections performed as part of the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program have been proven to be effective for managing the aging effects of stress corrosion

cracking and provide assurance that the intended function of the reactor vessel closure studs and nuts is maintained consistent with the current licensing basis for the period of extended operation.

Stress corrosion cracking of the external surfaces of the bottom mounted instrumentation guide tubes has been previously experienced at Turkey Point. Although corrective actions have been implemented which have virtually eliminated future stress corrosion cracking of these components, this aging effect requires management based on Turkey Point plant-specific experience (see Subsection 3.2.4.3.2 below). The Boric Acid Wastage Surveillance Program provides assurance that the intended function of the bottom mounted instrumentation guide tubes is maintained consistent with the current licensing basis for the period of extended operation.

#### 3.2.4.2.2 REDUCTION IN FRACTURE TOUGHNESS

Fracture toughness is defined as the capability of a material to resist sudden failure caused by crack propagation. Fracture toughness of reactor vessel materials is reduced primarily by irradiation in the beltline region of the reactor vessel. Reduction in fracture toughness of reactor vessel beltline materials is an aging effect that requires management in the license renewal period. Several TLAAs associated with reduction in fracture toughness are addressed in Section 4.2. These TLAAs include pressurized thermal shock, upper-shelf energy, and pressure-temperature limit curves for heatup and cooldown. The Reactor Vessel Integrity Program ensures that the time-dependent parameters used in the TLAA evaluations remain valid for the license renewal period.

#### 3.2.4.2.3 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 reactor vessels are general corrosion, mechanical wear, fretting wear, and aggressive chemical attack.

General corrosion has caused leakage of control rod drive mechanism canopy seal welds. Turkey Point Units 3 and 4 reactor vessels have experienced canopy seal weld leaks in the past. Canopy seal weld leaks are generally small (pin hole) in nature and 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 Inservice Inspection Program, and the Boric Acid

Wastage Surveillance Program. These programs provide assurance that the intended function of the canopy seal welds is maintained consistent with the current licensing basis for 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 Inservice Inspection Program provide assurance that the intended function of these reactor vessel components is maintained consistent with the current licensing basis for 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 is discussed further in Subsection 4.7.1. Based on that evaluation, thimble tube N-05 requires aging management in accordance with 10 CFR 54.21(c)(1)(iii). The Thimble Tubes Inspection Program provides assurance that the intended function of the reactor vessel bottom mounted instrumentation thimble tubes is maintained consistent with the current licensing basis for the period of extended operation.

Loss of material due to aggressive chemical attack was identified as an aging mechanism requiring management for external surfaces of carbon and low alloy steel reactor vessel components exposed to borated water leaks. The Boric Acid Wastage Surveillance Program provides assurance that the aging mechanism of loss of material due to aggressive chemical attack is managed and that the intended function of the reactor vessels is maintained consistent with the current licensing basis for the period of extended operation.

#### 3.2.4.2.4 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 inservice inspections and leakage testing. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides assurance that loss of mechanical closure integrity due to stress relaxation is managed and that the intended function of the reactor vessels is maintained consistent with the current licensing basis for 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 reactor vessels 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 is managed and that the intended function of the reactor vessels is maintained consistent with the current licensing basis for the period of extended operation.

### 3.2.4.3 OPERATING EXPERIENCE

#### 3.2.4.3.1 INDUSTRY 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. The industry correspondence that was reviewed for reactor vessel operating experience includes the following:

- NRC Bulletin No. 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 Subsection 3.2.4.2.

#### 3.2.4.3.2 PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 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 reactor vessel component aging, in addition to interviews with responsible engineering personnel. Turkey Point has experienced outside diameter initiated stress corrosion cracking of bottom mounted instrumentation guide tubes and loss of material due to general corrosion of canopy seal welds. Accordingly, aging management programs are identified to manage these effects. These aging effects are included with those identified in Subsection 3.2.4.2.

### 3.2.4.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.2.4.2. Table 3.2-1 contains the results of the aging management review for reactor vessel components and summarizes the aging effects requiring management.

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

- ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program
- Boric Acid Wastage Surveillance Program
- Chemistry Control Program
- Reactor Vessel Head Alloy 600 Penetration Inspection Program
- Reactor Vessel Integrity Program
- Thimble Tube Inspection Program

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of the reactor vessel components listed in Table 3.2-1 are maintained consistent with the current licensing basis for the period of extended operation.

## 3.2.5 REACTOR VESSEL INTERNALS

The reactor vessel internals are within the scope of license renewal, as discussed in Subsection 2.3.1.6. Reactor vessel internals components that are subject to an aging management review are listed in Table 3.2-1.

As stated previously in Subsection 2.3.1.6, WCAP-14577, "License Renewal Evaluation: Aging Management for Reactor Internals" [References 3.2-7 and 3.2-8], is not incorporated by reference in this Application. However, the Turkey Point aging management review was compared to WCAP-14577 with the results presented below.

The design and operation of the reactor vessel internals were reviewed using the process described in Subsection 2.3.1.1.1. This review confirmed that the Turkey Point Units 3 and 4 reactor vessel internals are bounded by the description of the reactor vessel internals in WCAP-14577 with regard to design criteria and features, modes of operation, intended functions, and environments/exposures. The materials of the Turkey Point Units 3 and 4 reactor vessel internals correspond to those in WCAP-14577. The fabrication techniques and installed configuration are the same as those specified in WCAP-14577.

WCAP-14577 was intended to bound all Westinghouse plants. However older plants, such as Turkey Point, have shorter fuel elements and the internals components with fluences greater than $10^{21}$ n/cm$^2$ do not include the lower support castings and the clevis bolts.

The discussion and evaluation of Time-Limited Aging Analyses in the reactor vessel internals in WCAP-14577 is general in nature and is not intended to satisfy plant-specific identification and disposition of reactor vessel internals TLAAs. WCAP-14577 identifies fatigue as the only TLAA generically applicable to Westinghouse reactor vessel internals, and then provides a discussion on options for dispositioning and management of fatigue. Turkey Point's TLAA identification effort also identified fatigue as the only TLAA applicable to the reactor vessel internals. Fatigue of the reactor vessel internals is addressed in Subsection 4.3.1.

The aging management programs described in WCAP-14577 include six attributes and are established on an aging mechanism basis. The Turkey Point aging management programs referred to in this aging management review and described in Appendix B contain ten attributes, and are established on a program basis.

### 3.2.5.1 MATERIALS AND ENVIRONMENTS

The reactor vessel internals are exposed to an environment of treated water - primary (see Table 3.0-1).

The reactor vessel internals components are constructed of stainless steel, Alloy 600, and Alloy X-750. The reactor vessel internals components, their intended functions, the materials, and environments are summarized in Table 3.2-1.

### 3.2.5.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Table 3.2-1 and are summarized in the following paragraphs.

The following internal and external aging effects require management during the period of extended operation:

- Cracking
- Reduction in fracture toughness
- Loss of material
- Loss of mechanical closure integrity
- Loss of preload
- Dimensional change

#### 3.2.5.2.1 CRACKING

Cracking due to stress corrosion and irradiation assisted stress corrosion is an aging effect requiring management for the period of extended operation. At Turkey Point, cracking due to fatigue is identified as a Time-Limited Aging Analysis and is addressed in Subsection 4.3.1.

Stress corrosion cracking (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 reactor vessel internals components. In addition, to reduce the susceptibility of reactor vessel internals materials to stress corrosion cracking, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment. The Chemistry Control Program provides

assurance that stress corrosion cracking is managed and that the intended function of the reactor vessel internals is maintained consistent with the current licensing basis for the period of extended operation.

Premature failure by intergranular environmental cracking of materials exposed to ionizing radiation has been termed irradiation assisted stress corrosion cracking (IASCC). Experience in pressurized water reactors (PWRs) in the United States, France, and Belgium indicates that IASCC is a plausible aging mechanism for PWR internals components. As with SCC, IASCC requires stress, environment, and a susceptible material. However, in the case of IASCC, a normally nonsusceptible material is rendered susceptible by exposure to neutron irradiation. Susceptibility has been observed at fluences as low as $1 \times 10^{21}$ n/cm$^2$ (E > 0.1 MeV) in laboratory studies on Type 304 stainless steel in PWR environments. Type 316 stainless steel is less susceptible and field information suggests that greater exposures are required for the development of susceptibility. Therefore, reactor vessel internals components exposed to fluences greater than $1 \times 10^{21}$ n/cm$^2$ (see Subsection 3.2.5.2.2) are potentially susceptible to irradiated assisted stress corrosion cracking. The Reactor Vessel Internals Inspection Program in conjunction with the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provide assurance that IASCC is managed and that the intended function of the reactor vessel internals is maintained consistent with the current licensing basis for the period of extended operation.

### 3.2.5.2.2 REDUCTION IN FRACTURE TOUGHNESS

Reduction in fracture toughness due to thermal embrittlement and irradiation embrittlement is an aging effect requiring management for the period of extended operation. Thermal embrittlement refers to gradual and progressive changes in the microstructure and properties of a material due to exposure to elevated temperatures for an extended period. Reactor vessel internals components made from cast austenitic stainless steel (CASS) are potentially subject to reduction in fracture toughness due to thermal embrittlement. The only CASS components in the reactor vessel internals are the lower support castings. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program and the Reactor Vessel Internals Inspection Program provide assurance that any reduction in fracture toughness due to thermal aging is managed and that the intended function of the reactor vessel internals is maintained consistent with the current licensing basis for the period of extended operation.

Reduction in fracture toughness due to irradiation embrittlement is an aging effect requiring management for the period of extended operation. Exposure to high-energy neutrons can cause changes in the properties of stainless steel and nickel-based alloys used in reactor internals. Neutron irradiation can produce changes in mechanical properties by increasing yield and ultimate strength, and correspondingly decreasing ductility and fracture toughness of internals component materials. Studies show that embrittlement of stainless steel can occur at fluences as low as $1x10^{21}$ n/cm$^2$ (E> 0.1 MeV).

For Turkey Point Units 3 and 4, the following reactor vessel internals parts will be exposed to fluences greater than $1x10^{21}$ n/cm$^2$ (E > 0.1 MeV) during the period of extended operation and are potentially susceptible to irradiation embrittlement:

- lower core barrels
- baffle/former assemblies
- baffle/former bolts
- barrel/former bolts
- lower core plates, fuel pins
- lower support columns, bolts
- thermal shields

Therefore, reduction in fracture toughness due to irradiation embrittlement is an aging effect requiring management for the listed reactor vessel internals components. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program in conjunction with the Reactor Vessel Internals Inspection Program provide assurance that any reduction in fracture toughness due to irradiation embrittlement is managed and that the intended function of the reactor vessel internals is maintained consistent with the current licensing basis for the period of extended operation.

### 3.2.5.2.3 LOSS OF MATERIAL

Loss of material due to mechanical wear is an aging effect requiring management for the period of extended operation. Loss of material due to wear can occur on the lower core plate fuel pins, core barrel flanges, guide tubes and guide pins, upper core plate alignment pins, and radial keys and clevis inserts. Inspections performed as part of the existing ASME Section XI, Subsections IWB, IWC, and IWD Inservice

Inspection Program provides assurance that the intended function of the reactor vessel internals is maintained consistent with the current licensing basis for the period of extended operation.

3.2.5.2.4 LOSS OF MECHANICAL CLOSURE INTEGRITY

Loss of mechanical closure integrity of upper support columns, guide tubes, and clevis insert bolts can occur due to cracking (SCC) and stress relaxation. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program in conjunction with the Chemistry Control Program provide assurance that loss of mechanical closure integrity is managed and that the intended function of the reactor vessel internals is maintained consistent with the current licensing basis for the period of extended operation.

Loss of mechanical closure integrity associated with the lower support column, baffle/former bolts, and barrel/former bolts can occur due to cracking (IASCC), reduction in fracture toughness (irradiation embrittlement), irradiation creep, and stress relaxation. Significant data, information, and industry experience relative to the aging of this bolting is provided in WCAP-14577 [Reference 3.2-7] and, as such, not duplicated here. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program in conjunction with the Reactor Vessel Internals Inspection Program and Chemistry Control Program provide assurance that loss of mechanical closure integrity is managed and that the intended function of the reactor vessel internals is maintained consistent with the current licensing basis for the period of extended operation.

3.2.5.2.5 LOSS OF PRELOAD

Loss of preload due to stress relaxation of the reactor vessel internals holddown springs is an aging effect requiring management for the period of extended operation. Inspections performed as part of the existing ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provide assurance that the loss of preload of the holddown springs is managed such that the intended function of the reactor vessel internals is maintained consistent with the current licensing basis for the period of extended operation.

3.2.5.2.6 DIMENSIONAL CHANGE

Dimensional changes due to void swelling are a potential aging effect requiring management. Swelling, frequently referred to as cavity swelling or void swelling, is

defined as a gradual increase in size (dimensions) of a given reactor vessel internals part due to irradiation conditions. Void swelling has been postulated from laboratory testing for liquid metal fast breeder reactors (LMFBRs).

During the past 30 years, swelling of PWR internals components was not considered a significant age-related degradation mechanism. However, Garner, et al. [Reference 3.2-9], concluded that, based on LMFBR data, end-of-life exposures of some PWR internals will lead to significant levels (≥ 10%) of swelling. Foster, et al. [Reference 3.2-10], concluded that at the approximate reactor internals end-of-life dose of 100 displacements per atom, swelling would be less than 2% at irradiation temperatures between 572°F and 752°F. To date, field service experience in PWR plants has not shown any evidence of swelling.

With respect to swelling, industry data are currently being evaluated as part of Westinghouse Owners Group and Electric Power Research Institute (EPRI) Material Reliability Project programs. At present there have been no indications from the different reactor vessel internals bolt removal programs, or from any of the other inspection and functional evaluations (e.g., refueling), that there are any discernible effects attributable to swelling. An industry initiative to consider the accumulated data, engineering evaluations of the ramifications of swelling, and the field observations is presently scheduled to be complete in 2001.

In summary, it is known that void swelling can occur under certain conditions. The extent to which it degrades intended functions cannot be quantified but, at this point, some minor degradation in the form of dimensional changes is assumed. The Reactor Vessel Internals Inspection Program includes an evaluation of dimensional changes due to void swelling. If determined to be significant, program inspections will be performed. Therefore, the Reactor Vessel Internals Inspection Program provides assurance that the aging effect of dimensional change due to swelling is managed and that the intended function of the reactor vessel internals is maintained consistent with the current licensing basis for the period of extended operation.

### 3.2.5.3 OPERATING EXPERIENCE

#### 3.2.5.3.1 INDUSTRY 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. The

industry correspondence that was reviewed for reactor vessel internals operating experience includes the following:

- NRC Bulletin 88-09, "Thimble Tube Thinning in Westinghouse Reactors"
- NRC Information Notice 87-19, "Perforation and Cracking of Rod Control Cluster Assemblies"
- NRC Information Notice 98-11, "Cracking of Reactor Vessel Internal Baffle Former Bolts in Foreign Plants"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.2.5.2. Note that a summary of industry experience associated with reactor vessel internals is also provided in WCAP-14577.

3.2.5.3.2 PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 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 reactor vessel internals component aging, in addition to interviews with responsible engineering personnel. No aging effects requiring management were identified from this review beyond those identified in Subsection 3.2.5.2.

### 3.2.5.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.2.5.2. Table 3.2-1 contains the results of the aging management review for the reactor vessel internals components and summarizes the aging effects requiring management.

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

- ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program
- Chemistry Control Program
- Reactor Vessel Internals Inspection Program

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of the reactor vessel internals components listed in Table 3.2-1 are maintained consistent with the current licensing basis for the period of extended operation.

## 3.2.6 REACTOR COOLANT PUMPS

The reactor coolant pumps and integral thermal barrier heat exchangers are within the scope of license renewal, as discussed in Subsection 2.3.1.7. Reactor coolant pump components that are subject to an aging management review are listed in Table 3.2-1.

The reactor coolant pump is included in WCAP-14575, "License Renewal Evaluation: Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components" [References 3.2-1 through 3.2-3]. As stated previously in Subsection 2.3.1.7, WCAP-14575 is not incorporated by reference in this Application. However, the Turkey Point aging management review was compared to WCAP-14575 with the results presented below.

The design and operation of the reactor coolant pumps were reviewed using the process described in Subsection 2.3.1.1.1. This review confirmed that the Turkey Point Units 3 and 4 reactor coolant pumps 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 reactor coolant pumps are consistent with the intended functions identified in WCAP-14575.

Several open items and applicant action items were identified and documented in the NRC draft safety evaluation of WCAP-14575 [Reference 3.2-4]. The Turkey Point specific responses to those open items and applicant action items relevant to the identification of reactor coolant pump components subject to aging management review are provided in Tables 2.3-2 and 2.3-3.

WCAP-14575 identified loss of material due to wear of reactor coolant pump and Class 1 valve mechanical closures. Turkey Point has concluded that loss of material due to wear of mechanical closures does not require aging management for the reactor coolant pump. Turkey Point 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 in the license renewal term.

The aging management programs described in WCAP-14575 include six attributes and are established on an aging mechanism basis. The Turkey Point aging

management programs referred to in this aging management review and described in Appendix B contain ten attributes, and are established on a program basis.

### 3.2.6.1 MATERIALS AND ENVIRONMENTS

Reactor coolant pumps 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).

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

### 3.2.6.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Table 3.2-1 and are summarized in the following paragraphs.

The following internal and external aging effects require management during the period of extended operation:

- Cracking
- Reduction in fracture toughness
- Loss of material
- Loss of mechanical closure integrity
- Fouling

#### 3.2.6.2.1 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 is identified as a Time-Limited Aging Analysis and is analytically addressed in Subsections 4.3.1 and 4.3.4.

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 reactor coolant pump 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. Continued performance of the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides assurance that flaw growth is managed and that the intended function of the reactor coolant pumps is maintained consistent with the current licensing basis for the period of extended operation.

Stress corrosion cracking is a localized, nonductile 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 reactor coolant pumps. In addition, to reduce the susceptibility of reactor coolant pump materials to stress corrosion cracking, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment. The Chemistry Control Program provides assurance that stress corrosion cracking is managed and that the intended function of the reactor coolant pumps is maintained consistent with the current licensing basis for the period of extended operation.

#### 3.2.6.2.2 REDUCTION IN FRACTURE TOUGHNESS

Reduction in fracture toughness due to thermal embrittlement is an aging effect requiring management for the period of extended operation. Thermal embrittlement refers to gradual and progressive changes in the microstructure and properties of a material due to exposure to elevated temperatures for an extended period. The only reactor coolant pump components subject to reduction in fracture toughness due to thermal embrittlement are austenitic stainless steel castings. Cast austenitic stainless steel (CASS) Class 1 components at Turkey Point consist of the reactor coolant 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 CASS primary loop elbows and valves is discussed in Subsection 3.2.1.

Consistent with the conclusions drawn in the NRC draft safety evaluation for WCAP-14575, the CASS reactor coolant pump casings and closure flanges do not require

an aging management program to manage thermal embrittlement beyond the examinations programmatically required by ASME Section XI as modified by Code Case N-481. Accordingly, the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides assurance that any reduction in fracture toughness due to thermal aging is managed and that the intended function of the reactor coolant pumps is maintained consistent with the current licensing basis for the period of extended operation.

#### 3.2.6.2.3 LOSS OF MATERIAL

Loss of material is an aging effect requiring management for the period of extended operation. The aging mechanism that can cause loss of material for the reactor coolant pump integral thermal barrier heat exchanger is microbiologically influenced corrosion.

The internal surface of the reactor coolant pump integral thermal barrier heat exchanger tubing is exposed to a treated water environment. Loss of material due to microbiologically influenced corrosion has been identified as an aging effect for the internal surface of the reactor coolant pump integral thermal barrier heat exchanger tubing. The Chemistry Control Program provides assurance that the aging effect of loss of material due to microbiologically influenced corrosion is managed and that the intended function of the reactor coolant pump integral thermal barrier heat exchanger is maintained consistent with the current licensing basis for the period of extended operation.

#### 3.2.6.2.4 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 inservice inspections and leakage testing. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides assurance that loss of mechanical closure integrity due to stress relaxation is managed and that the intended function of the reactor coolant pumps is maintained consistent with the current licensing basis for 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 reactor coolant pump components is made of low alloy steel bolting material and is subject to aggressive chemical attack. The Boric Acid Wastage Surveillance Program provides assurance that the aging effect of loss of mechanical closure integrity due to aggressive chemical attack is managed and that the intended function of the reactor coolant pumps is maintained consistent with the current licensing basis for the period of extended operation.

3.2.6.2.5 FOULING

Aging mechanisms that can result in fouling of the reactor coolant pump 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 component cooling water. The addition of biocides, in accordance with the Chemistry Control Program, manages this aging effect and provides assurance that the intended function of reactor coolant pump integral thermal barrier heat exchangers is maintained consistent with the current licensing basis for the period of extended operation.

Particulate fouling has been identified as an aging effect for heat transfer surfaces of the reactor coolant pump integral thermal barrier heat exchangers. The Chemistry Control Program provides assurance that particulate fouling is managed and that the intended function of the reactor coolant pump integral thermal barrier heat exchangers is maintained consistent with the current licensing basis for the period of extended operation.

### 3.2.6.3 OPERATING EXPERIENCE

3.2.6.3.1 INDUSTRY 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. The industry correspondence that was reviewed for reactor coolant pumps 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 Subsection 3.2.6.2. Note that a summary of industry experience associated with reactor coolant pumps is provided in WCAP-14575.

#### 3.2.6.3.2 PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 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 reactor coolant pump component aging, in addition to interviews with responsible engineering personnel. No aging effects requiring management were identified from this review beyond those identified in Subsection 3.2.6.2.

### 3.2.6.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.2.6.2. Table 3.2-1 contains the results of the aging management review for the reactor coolant pumps and summarizes the aging effects requiring management.

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

- ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program
- Boric Acid Wastage Surveillance Program
- Chemistry Control Program

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of the reactor coolant pump components listed in Table 3.2-1 are maintained consistent with the current licensing basis for the period of extended operation.

## 3.2.7 STEAM GENERATORS

The steam generators are within the scope of license renewal, as discussed in Subsection 2.3.1.8. Steam generator components that are subject to an aging management review are listed in Table 3.2-1.

### 3.2.7.1 MATERIALS AND ENVIRONMENTS

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 (see Tables 3.0-1 and 3.0-2).

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.

### 3.2.7.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Table 3.2-1 and are summarized in the following paragraphs.

The following internal and external aging effects require management during the period of extended operation:

- Cracking
- Loss of material
- Loss of mechanical closure integrity

#### 3.2.7.2.1 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 is identified as a Time-Limited Aging Analysis and is analytically addressed in Subsection 4.3.1. Based on industry and Turkey Point experience with fatigue cracking of transition cone girth welds and feedwater nozzles, additional discussion is provided below.

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 steam generator 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. Continued performance of the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides assurance that flaw growth is managed and that the intended function of the steam generators is maintained consistent with the current licensing basis for the period of extended operation.

Stress corrosion cracking is a localized, nonductile 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 steam generator components. In addition, to reduce the susceptibility of steam generator materials to stress corrosion cracking, Turkey Point prevents sensitized stainless steels from coming in contact with an aggressive environment. The Chemistry Control Program provides assurance that stress corrosion cracking is managed and that the intended function of the steam generators is maintained consistent with the current licensing basis for the period of extended operation.

Industry operating experience has shown transition cone girth welds to be susceptible to cracking due to fatigue. Plant-specific and industry operating experiences have shown the steam generator feedwater nozzles to be susceptible to cracking due to fatigue. Since these particular failure mechanisms have been experienced, aging management of fatigue cracking of the steam generator transition cone girth weld and feedwater nozzle is required for the period of extended operation. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides assurance that cracking due to fatigue is managed and that the intended function of the steam generators is maintained consistent with the current licensing basis for the period of extended operation.

Industry experience has shown that steam generator tubing is susceptible to primary water stress corrosion cracking (PWSCC) and secondary side intergranular attack (IGA) and intergranular stress corrosion cracking (IGSCC). The existing steam generator tube material, Alloy 600 TT (thermally treated), has an increased resistance to all forms of corrosion as compared to the tubing supplied with the original Turkey Point Units 3 and 4 steam generators. However, Alloy 600 TT tubing in the steam generators remains susceptible to IGA/IGSCC and PWSCC. The aging

effects of IGA/IGSCC and PWSCC can be managed by the continuation of the current steam generator tube inservice inspection program. The Chemistry Control Program and steam generator tube inspections performed in accordance with the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program and the Steam Generator Integrity Program provide assurance that IGA/IGSCC and PWSCC are managed and that the intended function of the steam generators is maintained consistent with the current licensing basis for the period of extended operation.

Industry experience has also shown steam generator tube plugs to be susceptible to PWSCC. The root cause of the PWSCC has been attributed to tube plugs fabricated from improperly heat-treated Alloy 600 material. Alloy 600 mechanical tube plugs installed on Turkey Point Units 3 and 4 have been removed and replaced with properly heat-treated Alloy 690 TT tube plugs. These replacement tube plugs have a high resistance to PWSCC. However, since the industry has experienced PWSCC of steam generator tubes, PWSCC has been determined to be an aging effect requiring management. The Steam Generator Integrity Program and the Chemistry Control Program provide assurance that PWSCC is managed and that the intended function of the steam generator tube plugs is maintained consistent with the current licensing basis for the period of extended operation.

#### 3.2.7.2.2 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 the steam generators are general corrosion, crevice corrosion, pitting corrosion, mechanical wear, and aggressive chemical attack.

General corrosion, pitting corrosion, and crevice corrosion have been identified as aging mechanisms for internal surfaces of carbon steel and low alloy steel components on the steam generator secondary side. General corrosion, pitting corrosion, and crevice corrosion of the secondary side steam generator internal surfaces is mitigated by maintaining adequate secondary side chemistry controls. The Chemistry Control Program provides assurance that general corrosion, pitting corrosion, and crevice corrosion are managed and that the intended function of the steam generators is maintained consistent with the current licensing basis for the period of extended operation.

Pitting of the secondary side of the steam generator tubing has occurred at a number of older plants. The location of the pitting is generally in the sludge pile region on the secondary face of the tube sheet. Pitting is not expected to be a significant aging mechanism for the Turkey Point Units 3 and 4 steam generators due to the low amount of copper in the secondary system, careful control of the oxidizing in the secondary water, and the routine removal of tube sheet sludge via lancing. The Chemistry Control Program and Steam Generator Integrity Program provide assurance that pitting corrosion is managed and that the intended function of the steam generators is maintained consistent with the current licensing basis for the period of extended operation.

Steam generator tubes in the U-bend region of the tube bundles have shown minor wear at the intersection with the anti-vibration bars. Wear of the steam generator U-tubes is an aging mechanism that requires management. Eddy current examinations, performed in accordance with the ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program and the Steam Generator Integrity Program, provide assurance that tube wear is managed and that the intended function of the steam generators is maintained consistent with the current licensing basis for the period of extended operation.

Loss of material due to aggressive chemical attack has been identified as an aging mechanism requiring management for external surfaces of carbon steel components exposed to borated water leaks. The Boric Acid Wastage Surveillance Program provides assurance that the aging mechanism of loss of material due to aggressive chemical attack is managed and that the intended function of the steam generators is maintained consistent with the current licensing basis for the period of extended operation.

#### 3.2.7.2.3 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 following the current periodic inservice inspection and leakage testing program. The ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program provides assurance that loss of mechanical closure integrity due to stress relaxation is

managed and that the intended function of the steam generators is maintained consistent with the current licensing basis for 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. Low alloy steel mechanical closure bolting associated with the steam generators and exposed to potential borated water leaks is subject to aggressive chemical attack. 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 the steam generators is maintained consistent with the current licensing basis for the period of extended operation.

### 3.2.7.3 OPERATING EXPERIENCE

#### 3.2.7.3.1 INDUSTRY 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. The industry correspondence that was reviewed for steam generator operating experience includes the following:

- NRC Bulletin 79-13, "Cracking in Feedwater System Piping"
- NRC Bulletin 88-02, "Rapidly Propagating Cracks in Steam Generator Tubes"
- NRC Bulletin 89-01, "Failure of Westinghouse Steam Generator Tube Mechanical Plugs"
- NRC Generic Letter 82-32, "Potential Steam Generator Related Generic Requirements"
- NRC Generic Letter 85-02, "Staff Recommended Actions Stemming from NRC Integrated Program for the Resolution of Unresolved Safety Issues Regarding Steam Generator Tube Integrity"
- NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants"
- NRC Generic Letter 95-03, "Circumferential Cracking of Steam Generator Tubes"

- NRC Generic Letter 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking"
- NRC Generic Letter 97-06, "Degradation of Steam Generator Internals"
- NRC Information Notice 79-27, "Steam Generator Tube Ruptures at Two Plants"
- NRC Information Notice 82-06, "Failure of Steam Generator Primary Side Manway Closure Studs"
- NRC Information Notice 82-14, "TMI-1 Steam Generator/Reactor Coolant System Chemistry/Corrosion Problem"
- NRC Information Notice 82-37, "Cracking in the Upper Shell to Transition Cone Girth Weld of a Steam Generator at an Operating Pressurized Water Reactor"
- NRC Information Notice 83-24, "Loose Parts in the Secondary Side of Steam Generators at Pressurized Water Reactors"
- NRC Information Notice 84-18, "Stress Corrosion Cracking in Pressurized Water Reactor Systems"
- NRC Information Notice 84-49, "Intergranular Stress Corrosion Cracking Leading to Steam Generator Tube Failure"
- NRC Information Notice 85-37, "Chemical Cleaning of Steam Generators at Millstone 2"
- NRC Information Notice 85-65, "Crack Growth in Steam Generator Girth Welds"
- NRC Information Notice 88-06, "Foreign Objects in Steam Generators"
- NRC Information Notice 88-31, "Steam Generator Tube Rupture Analysis Deficiency"
- NRC Information Notice 88-99, "Detection and Monitoring of Sudden and/or Rapidly Increasing Primary-to-Secondary Leakage"
- NRC Information Notice 89-33, "Potential Failure of Westinghouse Steam Generator Tube Mechanical Plugs"
- NRC Information Notice 89-65, "Potential for Stress Corrosion Cracking in Steam Generator Tube Plugs Supplied by Babcock and Wilcox"

- NRC Information Notice 90-04, "Cracking of the Upper Shell-to-Transition Cone Welds in Steam Generators"
- NRC Information Notice 90-49, "Stress Corrosion Cracking in PWR Steam Generator Tubes"
- NRC Information Notice 91-43, "Recent Incidents Involving Rapid Increases in Primary-to-Secondary Leak Rate"
- NRC Information Notice 91-67, "Problems With the Reliable Detection of Intergranular Attack (IGA) of Steam Generator Tubing"
- NRC Information Notice 92-80, "Operation With Steam Generator Tubes Seriously Degraded"
- NRC Information Notice 93-20, "Thermal Fatigue Cracking of Feedwater Piping to Steam Generators"
- NRC Information Notice 93-52, Draft NUREG-1477, "Voltage-Based Interim Plugging Criteria for Steam Generator Tubes"
- NRC Information Notice 93-56, "Weaknesses in Emergency Operating Procedures Found as a Result of Steam Generator Tube Rupture"
- NRC Information Notice 94-05, "Potential Failure of Steam Generator Tubes Sleeved with Kinetically Welded Sleeves"
- NRC Information Notice 94-43, "Determination of Primary-to-Secondary Steam Generator Leak Rate"
- NRC Information Notice 94-62, "Operational Experience on Steam Generator Tube Leaks and Tube Ruptures"
- NRC Information Notice 94-88, "Inservice Inspection Deficiencies Result in Severely Degraded Steam Generator Tubes"
- NRC Information Notice 95-40, "Supplemental Information to Generic Letter 95-03, Circumferential Cracking of Steam Generator Tubes"
- NRC Information Notice 96-09, "Damage in Foreign Steam Generator Internals"
- NRC Information Notice 96-09, Supplement 1, "Damage in Foreign Steam Generator Internals"
- NRC Information Notice 96-38, "Results of Steam Generator Tube Examinations"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.2.7.2.

3.2.7.3.2 PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 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 Units 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. As previously discussed, cracking of feedwater nozzles due to fatigue has been experienced at Turkey Point. No additional aging effects requiring management were identified from this review beyond those identified in Subsection 3.2.7.2.

### 3.2.7.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.2.7.2. Table 3.2-1 contains the results of the aging management review for the steam generators and summarizes the aging effects requiring management.

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

- ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program
- Boric Acid Wastage Surveillance Program
- Chemistry Control Program
- Steam Generator Integrity Program

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of the steam generator components listed in Table 3.2-1 are maintained consistent with the current licensing basis for the period of extended operation.

## 3.2.8 REFERENCES

3.2-1 WCAP-14575, "License Renewal Evaluation: Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components," Revision 1, August 1996.

3.2-2 R. A. Newton (WOG) letter to U. S. Nuclear Regulatory Commission, "Response to NRC Request (dated April 18, 1997) for Additional Information on WOG Generic Technical Report WCAP-14575, License Renewal Evaluation: Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components," June 13, 1997.

3.2-3 R. A. Newton (WOG) letter to U. S. Nuclear Regulatory Commission, "Response to NRC Request (dated June 4, 1999) for Additional Information on WOG Generic Technical Reports WCAP-14574, Aging Management Evaluation for Pressurizers, and WCAP-14575, Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components," July 19, 1999.

3.2-4 C. I. Grimes (NRC) letter to R. A. Newton (WOG), "Draft Safety Evaluation Concerning Westinghouse Owners Group License Renewal Evaluation: Aging Management Evaluation for Class 1 Piping and Associated Pressure Boundary Components, WCAP-14575, Revision 1, August 1996," February 10, 2000.

3.2-5 WCAP-14574, "License Renewal Evaluation: Aging Management Evaluation for Pressurizers," Revision 0, July 1996.

3.2-6 R. A. Newton (WOG) letter to U. S. Nuclear Regulatory Commission, "Response to NRC Request (dated May 6, 1997) for Additional Information on WOG Generic Technical Report WCAP-14574 - License Renewal Evaluation: Aging Management for Pressurizers," May 30, 1997.

3.2-7 WCAP-14577, "License Renewal Evaluation: Aging Management for Reactor Internals," Revision 0, June 1997.

3.2-8 R. A. Newton (WOG) to letter U. S. Nuclear Regulatory Commission, "Response to NRC Request (dated June 14, 1999) for Additional Information on WOG Generic Technical Report: WCAP-14577, License Renewal Evaluation: Aging Management for Reactor Vessel Internals," November 24, 1999.

3.2-9 Garner, F.A., L.R. Greenwood, and D. L. Harrod, "Potential High Fluence Response of Pressure Vessel Internals Constructed from Austenitic Stainless Steels," Sixth International Symposium on Environmental Degradation of Materials in Nuclear Power Systems, August 1993.

3.2-10 Foster, J. P. and A. Boltax, "Correlation of Irradiation Creep Data Obtained in Fast and Thermal Neutron Spectra with Displacement Cross Sections," Journal of Nuclear Materials, No. 89 (1980).

# TABLE 3.2-1
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Coolant Piping – Class 1 Components** | | | | | |
| **Internal Environment** | | | | | |
| Valves ≥ 4 inches | Pressure boundary | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-M-1<br>• Examination Category B-M-2<br>• Examination Category B-P |
| Valves < 4 inches | Pressure boundary | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-M-1<br>• Examination Category B-P |
| Piping/fittings ≥ 4 inches | Pressure boundary | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-J<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Coolant Piping – Class 1 Components (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Piping/fittings < 4 inches | Pressure boundary | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-J<br>• Examination Category B-P<br>Small Bore Class 1 Piping Inspection |
| Orifices<br>Reducers | Pressure boundary<br>Throttling | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program |
| Primary loop elbows | Pressure boundary | Stainless steel - cast | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-J<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Coolant Piping – Class 1 Components (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Valves<br>≥ 4 inches | Pressure boundary | Stainless steel - cast | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-M-1<br>• Examination Category B-M-2<br>• Examination Category B-P |
| | | | | Reduction in fracture toughness | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-M-1<br>• Examination Category B-M-2<br>• Examination Category B-P |
| Valves<br>< 4 inches | Pressure boundary | Stainless steel - cast | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-M-1<br>• Examination Category B-P |
| | | | | Reduction in fracture toughness | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-M-1<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Coolant Piping – Class 1 Components (continued)** | | | | | |
| **External Environment** | | | | | |
| Valves<br>Piping/fittings | Pressure boundary | Stainless steel | Containment air | None | None required |
| Orifices<br>Reducers | Pressure boundary<br>Throttling | Stainless steel | Containment air | None | None required |
| Primary loop elbows<br>Valves | Pressure boundary | Stainless steel - cast | Containment air | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Low alloy steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-G-1<br>• Examination Category B-G-2<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Coolant Piping – Non-Class 1 Components** | | | | | |
| **Internal Environment** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Flexible hoses<br>Filters<br>Vessels | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Reactor coolant pump motor upper bearing oil heat exchanger channels and covers | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Reactor coolant pump motor upper bearing oil heat exchanger tube sheets | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| | | | Lubricating oil | None | None required |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Coolant Piping – Non-Class 1 Components (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Reactor coolant pump motor upper bearing oil heat exchanger tubing and lower bearing oil cooling coils | Pressure boundary [1] | Admiralty brass<br>90/10 CuNi | Treated water (inside diameter) | Loss of material | Chemistry Control Program |
| | | | Lubricating oil (outside diameter) | None | None required |
| Piping/fittings associated with reactor coolant pump oil coolers | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |

NOTE: 1. Heat transfer is not a license renewal intended function for these components. These items are within the scope of license renewal to ensure the integrity of the Component Cooling Water System pressure boundary.

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Coolant Piping – Non-Class 1 Components (continued)** | | | | | |
| **External Environment** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Flexible hoses<br>Filters<br>Vessels | Pressure boundary | Stainless steel | Containment air | None | None required |
| Reactor coolant pump motor upper bearing oil heat exchanger channels and covers | Pressure boundary | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Piping/fittings associated with reactor coolant pump oil coolers | Pressure boundary | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Bolting (mechanical closures) | Pressure boundary | Low alloy steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Regenerative and Excess Letdown Heat Exchangers** | | | | | |
| **Internal Environment** | | | | | |
| Excess letdown heat exchanger shells, shell heads, shell nozzles, and shell flanges | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Excess letdown heat exchanger channels and heads, nozzles, divider plates | Pressure boundary | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program |
| Excess letdown heat exchanger tubes | Pressure boundary<br>Heat transfer | Stainless steel | Treated water – primary (inside diameter) | Cracking<br>Fouling | Chemistry Control Program |
| | | | Treated water (outside diameter) | Loss of material<br>Fouling | Chemistry Control Program |
| Excess letdown heat exchanger tube sheets | Pressure boundary | Stainless steel | Treated water – primary (tube side) | Cracking | Chemistry Control Program |
| | | | Treated water (shell side) | Loss of material | Chemistry Control Program |
| Regenerative heat exchangers | Pressure boundary<br>Heat transfer | Stainless steel | Treated water – primary (shell and tube sides) | Fouling<br>Cracking | Chemistry Control Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Regenerative and Excess Letdown Heat Exchangers (continued)** | | | | | |
| **External Environment** | | | | | |
| Excess letdown heat exchanger shells, shell heads, shell nozzles, and shell flanges | Pressure boundary | Carbon steel | Containment air (wetted with condensation) | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Excess letdown heat exchanger channels, channel heads, and nozzles | Pressure boundary | Stainless steel | Containment air | None | None required |
| Regenerative heat exchangers | Pressure boundary | Stainless steel | Containment air | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Low alloy steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Pressurizers** | | | | | |
| **Internal Environment** | | | | | |
| Upper heads<br>Lower heads | Pressure boundary | Carbon steel w/ stainless steel cladding | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-B<br>• Examination Category B-P |
| Surge nozzles<br>Spray nozzles<br>Safety nozzles<br>Relief nozzles | Pressure boundary | Carbon steel w/ stainless steel cladding | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-D<br>• Examination Category B-P |
| Surge nozzle safe ends<br>Spray nozzle safe ends<br>Safety nozzle safe ends<br>Relief nozzle safe ends | Pressure boundary | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-F<br>• Examination Category B-P |
| Surge nozzle thermal sleeves<br>Spray nozzle thermal sleeves | Pressure boundary[1] | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program |

NOTE: 1. The thermal sleeves are not part of the pressure boundary, but do provide thermal shielding to minimize nozzle low cycle thermal fatigue.

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Pressurizers (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Heater wells<br>Heater sheaths | Pressure boundary | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-E<br>• Examination Category B-P |
| Shells | Pressure boundary | Alloy steel w/ stainless steel cladding | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-B<br>• Examination Category B-P |
| Instrument nozzles<br>Thermowells | Pressure boundary | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-P |
| Manway covers | Pressure boundary | Carbon steel w/ stainless steel disc insert | Treated water - primary | Cracking | Chemistry Control Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Pressurizers (continued)** | | | | | |
| **External Environment** | | | | | |
| Upper heads<br>Lower heads | Pressure boundary | Carbon steel | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Surge nozzles<br>Spray nozzles<br>Safety nozzles<br>Relief nozzles | Pressure boundary | Carbon steel | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Surge nozzle safe ends<br>Spray nozzle safe ends<br>Safety nozzle safe ends<br>Relief nozzle safe ends | Pressure boundary | Stainless steel | Containment air | None | None required |
| Heater wells<br>Heater sheaths | Pressure boundary | Stainless steel | Containment air | None | None required |
| Support skirts and flanges | Structural support | Carbon steel | Containment air | Cracking | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-H |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Pressurizers (continued)** | | | | | |
| **External Environment (continued)** | | | | | |
| Shells | Pressure boundary | Alloy steel | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Instrument nozzles Thermowells | Pressure boundary | Stainless steel | Containment air | None | None required |
| Manway covers | Pressure boundary | Carbon steel | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Manway cover bolts | Pressure boundary | Low alloy steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-G-2<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessels** | | | | | |
| **Internal Environment** | | | | | |
| Closure head domes<br>Closure head flanges | Pressure boundary | Low alloy steel w/ stainless steel cladding | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-A<br>• Examination Category B-P |
| Upper shell flanges | Pressure boundary<br>Support reactor vessel internals | Low alloy steel w/ stainless steel cladding | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-A<br>• Examination Category B-P |
| Upper shells | Pressure boundary | Low alloy steel w/ stainless steel cladding | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-A<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessels (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Primary inlet nozzles<br>Primary outlet nozzles | Pressure boundary | Low alloy steel w/ stainless steel cladding | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-D<br>• Examination Category B-P |
| Primary nozzle safe ends | Pressure boundary | Stainless steel weld butter | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-F<br>• Examination Category B-P |
| Intermediate shells<br>Lower shells<br>Circumferential welds | Pressure boundary | Low alloy steel w/ stainless steel cladding | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-A<br>• Examination Category B-P |
| | | | | Reduction in fracture toughness | Reactor Vessel Integrity Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessels (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Bottom head toruses<br>Bottom head domes | Pressure boundary<br>Support reactor vessel internals | Low alloy steel w/ stainless steel cladding | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-A<br>• Examination Category B-P |
| Control rod drive mechanism rod travel housings<br>Control rod drive mechanism latch housings<br>Control rod drive mechanism housing flanges | Pressure boundary | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program |
| | | | | Loss of material | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-P<br>Boric Acid Wastage Surveillance Program |
| Control rod drive mechanism housing tubes (head adapters) | Pressure boundary | Alloy 600 | Treated water - primary | Cracking | Chemistry Control Program<br>Reactor Vessel Head Alloy 600 Penetration Inspection Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-E<br>• Examination Category B-O<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessels (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Head vent pipes | Pressure boundary | Alloy 600<br>Stainless steel | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-E<br>• Examination Category B-P |
| O-ring leak monitor tubes | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Core support lugs | Support reactor vessel internals | Alloy 600 | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-2 |
| | | | | Loss of material | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-2 |
| Instrumentation tubes<br>Instrumentation tube safe ends | Pressure boundary<br>Support thimble tubes | Alloy 600<br>Stainless steel | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-E<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessels (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Bottom mounted instrumentation guide tubes | Pressure boundary<br>Support thimble tubes | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-P |
| Seal table fittings | Pressure boundary<br>Support thimble tubes | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessels (continued)** | | | | | |
| **External Environment** | | | | | |
| Closure head domes (includes lifting lugs)<br>Closure head flanges<br>Upper shells<br>Primary inlet nozzles<br>Primary outlet nozzles<br>Intermediate shells<br>Lower shells | Pressure boundary | Low alloy steel | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Upper shell flanges | Pressure boundary<br>Support reactor vessel internals | Low alloy steel | Containment air | Loss of material | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-G-1<br>• Examination Category B-P |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Refueling seal ledges | Structural support [1] | Carbon steel | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Primary nozzle safe ends | Pressure boundary | Stainless steel weld butter | Containment air | None | None required |
| Nozzle support pads | Structural support | Low alloy steel weld build-up | Containment air | None | None required |

NOTE: 1. Provides structural support for refueling cavity seal ring.

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessels (continued)** | | | | | |
| **External Environment (continued)** | | | | | |
| Bottom head toruses<br>Bottom head domes | Pressure boundary<br>Support reactor vessel internals | Low alloy steel | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Control rod drive mechanism rod travel housings<br>Control rod drive mechanism latch housings<br>Control rod drive mechanism housing flanges | Pressure boundary | Stainless steel | Containment air | None | None required |
| Control rod drive mechanism housing tubes (head adapters) | Pressure boundary | Alloy 600 | Containment air | None | None required |
| Control rod drive mechanism ventilation shroud support rings | Structural support [1] | Carbon steel | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Head vent pipes | Pressure boundary | Alloy 600<br>Stainless steel | Containment air | None | None required |

NOTE: 1. Provides structural support to control rod drive mechanism cooling credited for station blackout

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessels (continued)** | | | | | |
| **External Environment (continued)** | | | | | |
| O-ring leak monitor tubes | Pressure boundary | Stainless steel | Containment air | None | None required |
| Instrumentation tubes<br>Instrumentation tube safe ends | Pressure boundary<br>Support thimble tubes | Alloy 600<br>Stainless steel | Containment air | None | None required |
| Bottom mounted instrumentation guide tubes | Pressure boundary<br>Support thimble tubes | Stainless steel | Containment air | Cracking | Boric Acid Wastage Surveillance Program |
| Bottom mounted instrumentation flux thimble tubes[1] | Pressure boundary<br>Support thimble tubes | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program |
| | | | | Loss of material | Thimble Tube Inspection Program |
| Seal tables | Support thimble tubes | Stainless steel | Containment air | None | None required |
| Seal table fittings | Pressure boundary<br>Support thimble tubes | Stainless steel | Containment air | None | None required |

NOTE: 1. Fretting wear of thimble tubes was identified as a TLAA (Subsection 4.7.1). Option iii of 10 CFR 54.21(c)(1) was selected to address this aging effect.

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessels (continued)** | | | | | |
| **External Environment (continued)** | | | | | |
| Closure studs, nuts, and washers | Pressure boundary | Low alloy steel | Containment air | Loss of material<br>Loss of mechanical closure integrity | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-G-1<br>• Examination Category B-P |
| | | | Borated water leaks | Loss of mechanical closure integrity<br>Cracking | Boric Acid Wastage Surveillance Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-G-1<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management[1] | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessel Internals** | | | | | |
| Lower core plates and fuel pins<br>Core barrels and flanges | Core support<br>Flow distribution | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program |
| | | | | Cracking<br>Reduction in fracture toughness | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3<br>Reactor Vessel Internals Inspection Program |
| | | | | Loss of material (fuel pins and flanges only) | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3 |
| Lower support columns | Core support | Stainless steel | Treated water - primary | Cracking | Chemistry Control Program |
| | | | | Cracking<br>Reduction in fracture toughness | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3<br>Reactor Vessel Internals Inspection Program |
| Radial keys and clevis inserts | Core support | Stainless steel (radial keys)<br>Alloy 600 (clevis inserts) | Treated water - primary | Cracking | Chemistry Control Program |
| | | | | Loss of material | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3 |

NOTE: 1. The reactor vessel internals parts requiring management for dimensional changes due to void swelling (if any) have yet to be determined.

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessel Internals (continued)** | | | | | |
| Upper core plate alignment pins | Guide and support rod control cluster assemblies (RCCAs) | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program |
| | | | | Loss of material | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3 |
| Baffle and former assemblies | Core support<br>Flow distribution | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program |
| | | | | Cracking<br>Reduction in fracture toughness | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3<br>Reactor Vessel Internals Inspection Program |
| Core barrel outlet nozzles<br>Diffusers | Flow distribution | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program |
| Upper support plates<br>Upper support columns | Guide and support RCCAs | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program |
| Secondary core support<br>Upper core plate | Core support<br>Flow distribution | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program |
| Head/vessel alignment pins | Core support | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program |
| Guide tubes and guide pins | Guide and support RCCAs | Stainless steel<br>Alloy X-750 (pins) | Treated water – primary | Loss of material | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3 |
| | | | | Cracking | Chemistry Control Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessel Internals (continued)** | | | | | |
| Internals holddown springs | Core support | Stainless steel | Treated water – primary | Loss of preload | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3 |
| | | | | Cracking | Chemistry Control Program |
| Thermal shields | Shield vessel | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program |
| | | | | Cracking<br>Reduction in fracture toughness | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3<br>Reactor Vessel Internals Inspection Program |
| Bottom mounted instrumentation columns<br>Upper instrumentation columns | Guide and support instrumentation | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program |
| Head cooling spray nozzles | Flow distribution | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program |
| Lower support castings | Core support<br>Flow distribution | Stainless steel – cast | Treated water – primary | Cracking | Chemistry Control Program |
| | | | | Reduction in fracture toughness | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3<br>Reactor Vessel Internals Inspection Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Vessel Internals (continued)** | | | | | |
| Bolting (upper support column, guide tube, clevis insert) | Core support | Stainless steel<br>Alloy X-750 (clevis insert bolts) | Treated water – primary | Loss of mechanical closure integrity | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3 |
| Bolting (lower support column, baffle/former, barrel/former) | Core support | Stainless steel | Treated water – primary | Loss of mechanical closure integrity | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-N-3<br>Reactor Vessel Internals Inspection Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Coolant Pumps** | | | | | |
| **Internal Environment** | | | | | |
| Reactor coolant pumps | Pressure boundary (casing and main flange) | Stainless steel – cast | Treated water – primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-L-1 as modified by Code Case N-481<br>• Examination Category B-L-2<br>• Examination Category B-P |
| | | | | Reduction in fracture toughness | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-L-1 as modified by Code Case N-481<br>• Examination Category B-L-2 |
| | Pressure boundary (thermal barrier flanges) | Stainless steel | Treated water – primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Coolant Pumps (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Thermal barrier heat exchanger tubes | Pressure boundary<br>Heat transfer | Stainless steel | Treated water – primary (outside diameter) | Fouling<br>Cracking | Chemistry Control Program |
| | | | Treated water (inside diameter) | Fouling<br>Loss of material | |
| Thermal barrier heat exchanger nozzles | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Reactor Coolant Pumps (continued)** | | | | | |
| **External Environment** | | | | | |
| Reactor coolant pumps<br>Thermal barrier heat exchanger nozzles | Pressure boundary | Stainless steel – cast<br>Stainless steel | Containment air | None | None required |
| Reactor coolant pump lugs | Structural support | Stainless steel | Containment air | Cracking | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-K and Code Case N-509 |
| Bolting (mechanical closures) | Pressure boundary | Low alloy steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-G-1<br>• Examination Category B-G-2<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Steam Generators** | | | | | |
| **Internal Environment** | | | | | |
| Channel heads | Pressure boundary | Carbon steel w/ stainless steel cladding | Treated water – primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-B<br>• Examination Category B-P |
| Primary inlet and outlet nozzles | Pressure boundary | Carbon steel w/ stainless steel cladding | Treated water – primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-D<br>• Examination Category B-P |
| Primary inlet and outlet nozzle safe ends | Pressure boundary | Stainless steel weld butter | Treated water – primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-F<br>• Examination Category B-P |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Steam Generators (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Tube sheets | Pressure boundary | Alloy steel w/ Alloy 600 cladding (primary side) | Treated water – primary | Cracking | Chemistry Control Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-B<br>• Examination Category B-P |
| | | Alloy steel (secondary side) | Treated water – secondary | Cracking | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category C-A<br>• Examination Category C-H |
| | | | | Loss of material | Chemistry Control Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Steam Generators (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| U-tubes | Pressure boundary<br>Heat transfer | Alloy 600 TT | Treated water – primary (inside diameter) | Cracking | Chemistry Control Program<br>Steam Generator Integrity Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-Q<br>• Examination Category B-P |
| | | | Treated water – secondary (outside diameter) | Cracking<br>Loss of material | Chemistry Control Program<br>Steam Generator Integrity Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-Q<br>• Examination Category B-P |
| Divider plates | Flow distribution | Alloy 600 | Treated water - primary | Cracking | Chemistry Control Program |
| Steam generator tube plugs | Pressure boundary | Alloy 690 TT | Treated water - primary | Cracking | Chemistry Control Program<br>Steam Generator Integrity Program |
| Primary manways | Pressure boundary | Carbon steel with stainless steel disc inserts | Treated water - primary | Cracking | Chemistry Control Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Steam Generators (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Upper and lower shells<br>Elliptical heads<br>Transition cones | Pressure boundary | Alloy steel | Treated water - secondary | Cracking | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category C-A<br>• Examination Category C-H |
| | | | | Loss of material | Chemistry Control Program |
| Feedwater nozzles<br>Steam outlet nozzles | Pressure boundary | Alloy steel | Treated water - secondary | Cracking | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category C-B<br>• Examination Category C-H |
| | | | | Loss of material | Chemistry Control Program |
| Steam flow limiters | Throttling | Alloy steel | Treated water - secondary | Loss of material | Chemistry Control Program |
| Blowdown nozzles and secondary side shell penetrations | Pressure boundary | Alloy steel | Treated water - secondary | Cracking | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category C-H |
| | | | | Loss of material | Chemistry Control Program |
| Secondary closure covers | Pressure boundary | Carbon steel | Treated water - secondary | Loss of material | Chemistry Control Program |
| Tube bundle wrappers<br>Wrapper support systems | Structural support | Carbon steel | Treated water - secondary | Loss of material | Chemistry Control Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Steam Generators (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Tube support plates | Structural support | Stainless steel | Treated water - secondary | Cracking | Chemistry Control Program |
| Anti-vibration bars | Structural support | Chrome-plated Alloy 600 | Treated water - secondary | Cracking | Chemistry Control Program |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Steam Generators (continued)** | | | | | |
| **External Environment** | | | | | |
| Channel heads<br>Primary manways<br>Primary inlet and outlet nozzles | Pressure boundary | Carbon steel | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Primary inlet and outlet nozzle safe ends | Pressure boundary | Stainless steel weld butter | Containment air | None | None required |
| Upper and lower shells<br>Elliptical heads<br>Transition cones<br>Feedwater nozzles<br>Steam outlet nozzles | Pressure boundary | Alloy steel | Containment air | None | None required |
| Secondary closure covers | Pressure boundary | Carbon steel | Containment air | None | None required |
| Blowdown piping nozzles and secondary side shell penetrations | Pressure boundary | Alloy steel | Containment air | None | None required |

# TABLE 3.2-1 (continued)
# REACTOR COOLANT SYSTEMS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Steam Generators (continued)** | | | | | |
| **External Environment (continued)** | | | | | |
| Support pads | Structural support | Carbon steel | Containment air | Cracking | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-H |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Seismic lugs | Structural support | Alloy steel | Containment air | Cracking | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category C-C |
| Bolting (mechanical closures – primary) | Pressure boundary | Low alloy steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program<br>ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category B-G-2<br>• Examination Category B-P |
| Bolting (mechanical closures – secondary) | Pressure boundary | Low alloy steel | Containment air | Loss of mechanical closure integrity | ASME Section XI, Subsections IWB, IWC, and IWD Inservice Inspection Program<br>• Examination Category C-H |

# 3.3 ENGINEERED SAFETY FEATURES SYSTEMS

The following systems are included in this section:

- Emergency Containment Cooling
- Containment Spray
- Containment Isolation
- Safety Injection
- Residual Heat Removal
- Emergency Containment Filtration
- Containment Post Accident Monitoring and Control

Subsection 2.3.2 provides a description of these systems and identifies the components requiring an aging management review for license renewal. For the Engineered Safety Features Systems, the specific materials and environments, the resulting aging effects, and the specific programs to manage these aging effects are listed in Tables 3.3-1 through 3.3-7. Appendix C contains the process that identified the aging effects requiring management for non-Class 1 components.

## 3.3.1 MATERIALS AND ENVIRONMENTS

The Engineered Safety Features Systems are exposed to internal environments of treated water - borated, treated water, lubricating oil, and air/gas; and external environments of outdoor, indoor - not air-conditioned, containment air, embedded/encased, and potential borated water leaks (see Tables 3.0-1 and 3.0-2).

The only parts of systems or components considered to be inaccessible for inspection are those that are buried or encased in concrete. These environments are addressed as part of the aging management review process; see Table 3.0-2, "External Service Environments." Potential aging effects associated with these environments are reviewed and those aging effects requiring management are identified along with the credited aging management program(s). All other parts of systems and components can be accessed, if required. The only Engineered Safety Features System containing inaccessible parts is Residual Heat Removal. This system contains some stainless steel piping that is embedded/encased in concrete.

The tanks, pumps, heat exchangers, piping, tubing, and associated components and commodity groups for these systems are constructed of stainless and carbon steels, cast iron, Inconel, brass, bronze, copper, and aluminum. The components and commodity groups, their intended functions, the materials, and environments for the Engineered Safety Features Systems are summarized in Tables 3.3-1 through 3.3-7.

## 3.3.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Tables 3.3-1 through 3.3-7. The aging effects requiring management for each system are summarized in the following paragraphs.

Emergency Containment Cooling - The aging effects requiring management are loss of material for carbon steel components and loss of material and fouling for admiralty brass heat exchanger tubing. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Containment Spray - The aging effects requiring management are loss of material for carbon steel, stainless steel, cast iron, and brass components; and loss of material and fouling for stainless steel heat exchanger tubing. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Containment Isolation - The aging effect requiring management is loss of material for carbon steel components. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Safety Injection - The aging effects requiring management are loss of material for carbon steel, stainless steel, brass, and cast iron components; cracking for certain stainless steel components; and loss of material and fouling for Inconel heat exchanger tubing and gray cast iron thrust bearing coolers. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Residual Heat Removal - The aging effects requiring management are loss of material for carbon steel and stainless steel components; cracking for certain stainless steel components; and loss of material, cracking, and fouling for stainless steel heat exchanger tubing. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Emergency Containment Filtration - The aging effect requiring management is loss of material for carbon steel and stainless steel components. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Containment Post Accident Monitoring and Control - The aging effect requiring management is loss of material for carbon steel and stainless steel components. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

## 3.3.3 OPERATING EXPERIENCE

### 3.3.3.1 INDUSTRY 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. The industry correspondence that was reviewed for operating experience related to Engineered Safety Features Systems includes the following:

- NRC Bulletin 79-03, "Longitudinal Weld Defects in ASME SA-312 Type 304 Stainless Steel Pipe"
- NRC Bulletin 79-17, "Pipe Cracks in Stagnant Borated Water Systems at PWR Plants"
- NRC Bulletin 80-24, "Prevention of Damage Due to Water Leakage Inside Containment"
- NRC Bulletin 82-02, "Degradation of Threaded Fasteners in the Reactor Coolant Pressure Boundary of PWR Plants"
- NRC Bulletin 88-08, "Thermal Stresses in Piping Connected to Reactor Coolant Systems"
- NRC Bulletin 89-02, "Stress Corrosion Cracking of High-Hardness Type 410 Stainless Steel Internal Preloaded Bolting in Anchor Darling Model S350W Swing Check Valves or Valves of Similar Design"
- NRC Bulletin 93-02, "Debris Plugging of Emergency Core Cooling Suction Strainers"
- NRC IE 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 Generic Letter 91-17, "Generic Safety Issue 29, Bolting Degradation or Failure in Nuclear Power Plants"
- NRC Generic Letter 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System after a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment"

- NRC Information Notice 79-19, "Pipe Cracks in Stagnant Borated Water Systems at PWR Plants"
- NRC Information Notice 80-05, "Chloride Contamination of Safety Related Piping and Components"
- NRC Information Notice 80-15, "Axial (Longitudinal) Oriented Cracking in Piping"
- NRC Information Notice 80-40, "Excessive Nitrogen Supply Pressure Actuates Safety-Relief Valve Operation to Cause Reactor Depressurization"
- NRC Information Notice 83-46, "Common-Mode Valve Failures Degrade Surry's Recirculation Spray Subsystem"
- NRC Information Notice 84-18, "Stress Corrosion Cracking in Pressurized Water Reactor Systems"
- NRC Information Notice 84-89, "Stress Corrosion Cracking in Non-Sensitized 316 Stainless Steel"
- NRC Information Notice 85-34, "Heat Tracing Contributes to Corrosion Failure of Stainless Steel Piping"
- NRC Information Notice 85-59, "Valve Stem Corrosion Failures"
- NRC Information Notice 88-37, Flow Blockage of Cooling Water to Safety System Components"
- NRC Information Notice 89-30, "High Temperature Environments at Nuclear Power Plants"
- NRC Information Notice 89-77, "Debris in Containment Emergency Sumps and Incorrect Screen Configuration"
- NRC Information Notice 89-80, "Potential for Water Hammer, Thermal Stratification, and Steam Binding in High Pressure Coolant Injection Piping"
- NRC Information Notice 90-10, "Primary Water Stress Corrosion Cracking (PWSCC) of Inconel 600"
- NRC Information Notice 90-65, "Recent Orifice Plate Problems"
- NRC Information Notice 91-05, "Intergranular Stress Corrosion Cracking in Pressurized Water Reactor Safety Injection Accumulator Nozzles"

- NRC Information Notice 94-63, " Boric Acid Corrosion of Charging Pump Casing Caused by Cladding Cracks"
- NRC Information Notice 95-26, "Defect in Safety-Related Pump Parts due to Inadequate Heat Treatment"
- NRC Information Notice 96-10, "Potential Blockage by Debris of Safety System Piping Which Is Not Used During Normal Operation or Tested During Surveillance"
- NRC Information Notice 96-27, "Potential Clogging of High Pressure Safety Injection Throttle Valves During Recirculation"
- NRC Information Notice 97-13, "Deficient Conditions Associated with Protective Coatings at Nuclear Power Plants"
- NRC Information Notice 97-46, "Unisolable Crack in High Pressure Injection Piping (Oconee)"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.3.2.

### 3.3.3.2 PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 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 Engineered Safety Features Systems component aging, in addition to interviews with responsible engineering personnel. No aging effects requiring management were identified from this review beyond those identified in Subsection 3.3.2.

## 3.3.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.3.2. Tables 3.3-1 through 3.3-7 contain the results of the aging management review for the Engineered Safety Features Systems and summarize the aging effects requiring management.

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

- Boric Acid Wastage Surveillance Program
- Chemistry Control Program
- Containment Spray System Piping Inspection Program
- Emergency Containment Cooler Inspection
- Field Erected Tanks Internal Inspection
- Galvanic Corrosion Susceptibility Inspection Program
- Periodic Surveillance and Preventive Maintenance Program
- Systems and Structures Monitoring Program

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of the Engineered Safety Features Systems components listed in Tables 3.3-1 through 3.3-7 are maintained consistent with the current licensing basis for the period of extended operation.

# TABLE 3.3-1
# EMERGENCY CONTAINMENT COOLING

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Emergency containment cooler headers | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Emergency containment cooler tubes (inside diameter) | Pressure boundary<br>Heat transfer | Admiralty brass | Treated water | Loss of material[1] | Chemistry Control Program<br>Emergency Containment Cooler Inspection |
| | | | | Fouling | Chemistry Control Program |
| Emergency containment cooler housings | Pressure boundary | Carbon steel | Air/Gas | Loss of material | Systems and Structures Monitoring Program |

NOTE: 1. Emergency containment cooler tube wear was identified as a TLAA (see Subsection 4.7.2). Option (iii) of 10 CFR 54.21(c)(1) was selected to address this aging effect.

# TABLE 3.3-1 (continued)
# EMERGENCY CONTAINMENT COOLING

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Emergency containment cooler headers | Pressure boundary | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Emergency containment cooler tubes (outside diameter) | Pressure boundary | Admiralty brass | Containment air | None | None required |
| Emergency containment cooler housings | Pressure boundary | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.3-2
# CONTAINMENT SPRAY

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Containment spray pumps | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |
| Containment spray pump seal water heat exchanger shells and covers | Pressure boundary | Cast iron | Treated water - borated | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Containment spray pump seal water heat exchanger tube shields | Pump seal cooling | Brass | Treated water - borated | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Containment spray pump seal water heat exchanger tubes (outside diameter), tube coil bands and clips. | Pressure boundary<br>Heat transfer | Stainless steel | Treated water | Loss of material<br>Fouling | Chemistry Control Program |
| Containment spray pump seal water heat exchanger tubes (inside diameter) | Pressure boundary<br>Heat transfer | Stainless steel | Treated water - borated | Loss of material<br>Fouling | Chemistry Control Program |

# TABLE 3.3-2 (continued)
# CONTAINMENT SPRAY

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Containment spray pump seal water cyclone separators | Pressure boundary<br>Filtering | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |
| Valves<br>Piping/ fittings<br>Tubing/ fittings<br>(upstream of MOV-3/4-880A and -880B) | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |
| Valves<br>Piping/ fittings<br>Tubing/ fittings<br>(downstream of MOV-3/4-880A and -880B to containment penetrations) | Pressure boundary | Stainless steel | Air/Gas<br>Treated water - borated | Loss of material | Chemistry Control Program |
| Valves<br>Piping/fittings<br>(downstream of containment penetrations to Containment elevation 65') | Pressure boundary | Carbon steel | Air/Gas<br>Treated water - borated | Loss of material | Containment Spray System Piping Inspection Program<br>Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |

# TABLE 3.3-2 (continued)
# CONTAINMENT SPRAY

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>(above Containment elevation 65') | Pressure boundary | Carbon steel | Air/Gas | None | None required |
| Spray nozzles | Pressure boundary<br>Spray | Bronze | Air/Gas | None | None required |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |

# TABLE 3.3-2 (continued)
# CONTAINMENT SPRAY

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Containment spray pumps | Pressure boundary | Stainless steel | Indoor - not air-conditioned | None | None required |
| Containment spray pump seal water heat exchanger shells and covers | Pressure boundary | Cast iron | Indoor – not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Containment spray pump seal water heat exchanger flex fittings | Pressure boundary | Brass | Indoor – not air-conditioned | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Filters | Pressure boundary | Stainless steel | Indoor – not air-conditioned | None | None required |
| Spray nozzles | Pressure boundary<br>Spray | Bronze | Containment air | None | None required |

# TABLE 3.3-2 (continued)
# CONTAINMENT SPRAY

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Containment air | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.3-3
# CONTAINMENT ISOLATION

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Containment Purge Systems** | | | | | |
| **Internal Environment** | | | | | |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Air/Gas | None | None required |
| Tubing/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Debris screen gratings | Filtration | Carbon steel - galvanized | Air/Gas | None | None required |
| Debris screen banding | Filtration | Stainless steel | Air/Gas | None | None required |
| **External Environment** | | | | | |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Tubing/fittings | Pressure boundary | Stainless steel | Outdoor<br>Containment air | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.3-3 (continued)
# CONTAINMENT ISOLATION

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Breathing Air Systems** | | | | | |
| **Internal Environment** | | | | | |
| Valves<br>Piping/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| **External Environment** | | | | | |
| Valves<br>Piping/fittings | Pressure boundary | Stainless steel | Containment air<br>Indoor - not air-conditioned, | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.3-3 (continued)
# CONTAINMENT ISOLATION

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Nitrogen and Hydrogen Systems** | | | | | |
| **Internal Environment** | | | | | |
| Valves<br>Tubing/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Air/Gas | None | None required |
| **External Environment** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Containment air<br>Indoor - not air-conditioned | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Containment air<br>Indoor - not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.3-4
# SAFETY INJECTION

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Refueling water storage tanks | Pressure boundary | Carbon steel | Air/Gas | Loss of material | Field Erected Tanks Internal Inspection |
| | | | Treated water - borated | Loss of material | Chemistry Control Program<br>Field Erected Tanks Internal Inspection |
| Accumulators | Pressure boundary | Stainless steel (cladding) | Treated water - borated | Loss of material | Chemistry Control Program |
| | | | Air/Gas | None | None required |
| Safety injection pumps | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |
| Safety injection pump thrust bearing coolers | Pressure boundary<br>Heat transfer | Gray cast iron | Treated water - borated | Loss of material<br>Fouling | Chemistry Control Program |
| | | | Lubricating oil | None | None required |
| Safety injection pump shaft seal heat exchanger tubes (inside diameter) | Pressure boundary<br>Heat transfer | Inconel | Treated water - borated | Loss of material<br>Fouling | Chemistry Control Program |
| Safety injection pump shaft seal heat exchanger tubes (outside diameter) | Pressure boundary<br>Heat transfer | Inconel | Treated water | Loss of material<br>Fouling | Chemistry Control Program |

# TABLE 3.3-4 (continued)
# SAFETY INJECTION

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Safety injection pump shaft seal heat exchanger tube shields | Pressure boundary | Brass | Treated water - borated | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection |
| Safety injection pump shaft seal heat exchanger shells and covers | Pressure boundary | Cast iron | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |
| Flow elements<br>Orifices | Pressure boundary<br>Throttling | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |

# TABLE 3.3-4 (continued)
# SAFETY INJECTION

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Refueling water storage tanks | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Accumulators | Pressure boundary | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Safety injection pumps | Pressure boundary | Stainless steel | Indoor - not air-conditioned | None | None required |
| Safety injection pump thrust bearing coolers | Pressure boundary | Gray cast iron | Indoor – not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Safety injection pump shaft seal heat exchanger shells and covers | Pressure boundary | Cast iron | Indoor – not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |

# TABLE 3.3-4 (continued)
# SAFETY INJECTION

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Indoor – not air-conditioned<br>Containment air | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Outdoor | None | None required |
| Piping/fittings (large bore, thin wall outdoors, and outdoors in trenches) | Pressure boundary | Stainless steel | Outdoor | Cracking [1] | Systems and Structures Monitoring Program |
| Flow elements<br>Orifices | Pressure boundary<br>Throttling | Stainless steel | Indoor – not air-conditioned<br>Containment air | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

NOTE: 1. Plant experience has identified the potential for cracking in non-stress relieved heat affected zones of weld joints for this piping.

# TABLE 3.3-5
# RESIDUAL HEAT REMOVAL

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Residual heat removal pumps | Pressure boundary | Stainless steel | Treated water - borated | Loss of material<br>Cracking[1] | Chemistry Control Program |
| Residual heat removal heat exchanger shells and baffles | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Residual heat removal heat exchanger tubes | Pressure boundary<br>Heat transfer | Stainless steel | Treated water – borated (inside diameter) | Loss of material<br>Cracking[1]<br>Fouling | Chemistry Control Program |
| | | | Treated water (outside diameter) | Loss of material<br>Fouling | Chemistry Control Program |
| Residual heat removal heat exchanger tube sheets | Pressure boundary | Stainless steel | Treated water – borated (tubes side) | Loss of material<br>Cracking[1] | Chemistry Control Program |
| | | | Treated water (shell side) | Loss of material | Chemistry Control Program |
| Residual heat removal pump seal water heat exchanger shells, covers, and baffles | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |

NOTE: 1. Stress corrosion cracking is an aging effect requiring management for stainless steel at temperatures >140°F.

# TABLE 3.3-5 (continued)
# RESIDUAL HEAT REMOVAL

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Residual heat removal pump seal water heat exchanger tubes (outside diameter) | Pressure boundary<br>Heat transfer | Stainless steel | Treated water | Loss of material<br>Fouling | Chemistry Control Program |
| Residual heat removal pump seal water heat exchanger tubes (inside diameter) | Pressure boundary<br>Heat transfer | Stainless steel | Treated water - borated | Loss of material<br>Cracking[1]<br>Fouling | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Thermowells | Pressure boundary | Stainless steel | Treated water - borated | Loss of material<br>Cracking[1] | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Check valve 3-753A | Pressure boundary | Stainless steel | Treated water - borated | Loss of material<br>Cracking[1] | Chemistry Control Program |
| | | | | Cracking[2] | Periodic Surveillance and Preventive Maintenance Program |
| Flow elements<br>Orifices | Pressure boundary<br>Throttling | Stainless steel | Treated water - borated | Loss of material<br>Cracking[1] | Chemistry Control Program |

NOTES: 1. Stress corrosion cracking is an aging effect requiring management for stainless steel at temperatures >140°F.
2. Monitoring of existing flaw is required.

# TABLE 3.3-5 (continued)
# RESIDUAL HEAT REMOVAL

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Residual heat removal pumps | Pressure boundary | Stainless steel | Indoor – not air-conditioned | None | None required |
| Residual heat removal heat exchanger shells | Pressure boundary | Carbon steel | Indoor – not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Residual heat removal pump seal water heat exchanger shells and covers | Pressure boundary | Carbon steel | Indoor – not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Thermowells | Pressure boundary | Stainless steel | Indoor – not air-conditioned | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Containment air | None | None required |
| Piping/fittings | Pressure boundary | Stainless steel | Embedded/Encased | None | None required |
| Flow elements<br>Orifices | Pressure boundary<br>Throttling | Stainless steel | Indoor – not air-conditioned | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.3-6
# EMERGENCY CONTAINMENT FILTRATION

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Emergency containment filter housings | Pressure boundary | Carbon steel | Air/Gas | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Emergency containment filter floodjet spray nozzles | Pressure boundary<br>Spray | Brass | Air/Gas | None | None required |
| Piping/fittings | Pressure boundary | Copper | Air/Gas | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |

# TABLE 3.3-6 (continued)
# EMERGENCY CONTAINMENT FILTRATION

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Emergency containment filter housings | Pressure boundary | Carbon steel | Containment air | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Emergency containment filter floodjet spray nozzles | Pressure boundary<br>Spray | Brass | Containment air | None | None required |
| Piping/fittings | Pressure boundary | Copper | Containment air | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Containment air | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.3-7
# CONTAINMENT POST ACCIDENT MONITORING AND CONTROL

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Hydrogen monitor pumps | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Containment air radiation monitor sample pump casings | Pressure boundary | Aluminum | Air/Gas | None | None required |
| Containment ventilation high-efficiency particulate air (HEPA) and charcoal filter housings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Post Accident Sampling System cooler shells, covers, and tube coils [1] | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Carbon steel | Air/Gas | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Valves<br>Piping/fittings, | Pressure boundary | Brass | Air/Gas | None | None required |

NOTE: 1. Heat transfer is not a license renewal intended function for these components.

# TABLE 3.3-7
# CONTAINMENT POST ACCIDENT MONITORING AND CONTROL

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Tubing/fittings | Pressure boundary | Copper | Air/Gas | None | None required |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Air/Gas | None | None required |

# TABLE 3.3-7 (continued)
# CONTAINMENT POST ACCIDENT MONITORING AND CONTROL

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Hydrogen monitor pumps | Pressure boundary | Stainless steel | Indoor - not air-conditioned | None | None required |
| Containment air radiation monitor sample pump casings | Pressure boundary | Aluminum | Indoor - not air-conditioned | None | None required |
| Containment ventilation HEPA and charcoal filter housings | Pressure boundary | Stainless steel | Indoor - not air-conditioned | None | None required |
| Post Accident Sampling System cooler shells, covers, and tube coils | Pressure boundary | Stainless steel | Indoor - not air-conditioned | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Carbon steel | Indoor - not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |

# TABLE 3.3-7 (continued)
# CONTAINMENT POST ACCIDENT MONITORING AND CONTROL

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effect Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Indoor - not air-conditioned | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Stainless steel | Containment air | None | None required |
| Valves<br>Piping/fittings<br>Filters | Pressure boundary | Brass | Indoor - not air-conditioned | None | None required |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Indoor - not air-conditioned | None | None required |
| Tubing/fittings | Pressure boundary | Copper | Indoor - not air-conditioned | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# 3.4 AUXILIARY SYSTEMS

The following systems are included in this section:

- Intake Cooling Water
- Component Cooling Water
- 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 and Electrical Equipment Room Ventilation
- Control Building Ventilation
- Emergency Diesel Generator Building Ventilation
- Turbine Building Ventilation
- Fire Protection
- Emergency Diesel Generators and Support Systems

Subsection 2.3.3 provides a description of these systems and identifies the components requiring an aging management review for license renewal. Appendix C contains the process that identified the aging effects requiring management for non-Class 1 components.

## 3.4.1 MATERIALS AND ENVIRONMENT

The Auxiliary Systems are exposed to internal environments of air/gas, raw water – cooling canals, raw water – city water, raw water – floor drainage, treated water – primary, treated water – borated, treated water – secondary, treated water, lubricating oil, and fuel oil; and external environments of outdoor, indoor – not air conditioned, indoor - air conditioned, containment air, embedded/encased, buried, and potential borated water leaks. (See Tables 3.0-1 and 3.0-2).

The only parts of systems or components considered to be inaccessible for inspection are those that are buried or embedded/encased in concrete. These environments are addressed as part of the aging management review process; see Table 3.0-2, "External Service Environments." Potential aging effects associated with these environments are reviewed and those aging effects requiring management are identified along with the credited aging management program(s). All other parts of systems and components can be accessed, if required. The only Auxiliary Systems containing inaccessible parts are Intake Cooling Water and Fire Protection, which contain buried cast iron and carbon steel piping and valves, and Waste Disposal and Spent Fuel Pool Cooling, which contain stainless steel piping embedded/encased in concrete.

The tanks, pumps, heat exchangers, piping, tubing, valves, and associated components and commodity groups for these systems are constructed of carbon steel, stainless steel, cast iron, monel, aluminum, aluminum-bronze, bronze, copper nickel, brass, aluminum brass, red brass, Worthite (nickel based alloy), copper, canvas, neoprene, and rubber. The components, their intended functions, materials, and environments for the Auxiliary Systems are summarized in Tables 3.4-1 through 3.4-15.

## 3.4.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Tables 3.4-1 through 3.4-15. The aging effects requiring management for each system are summarized in the following paragraphs.

Intake Cooling Water – The aging effects requiring management are loss of material for carbon steel, stainless steel, cast iron, monel, bronze, aluminum–bronze, and copper nickel components; and cracking for rubber expansion joints. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Component Cooling Water – The aging effects requiring management are loss of material for carbon steel, stainless steel, cast iron, brass, and copper nickel components; and loss of material and fouling for aluminum-brass heat exchanger tubing. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Spent Fuel Pool Cooling – The aging effects requiring management are loss of material for carbon steel, stainless steel, and worthite (nickel based alloy) components; and loss of material and fouling for stainless steel heat exchanger tubing. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Chemical and Volume Control – The aging effects requiring management are loss of material for carbon steel, stainless steel, and cast iron components; loss of material and fouling for copper 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.

Primary Water Makeup – The aging effect requiring management is loss of material for stainless steel components. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Sample Systems – The aging effects requiring management 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.

Waste Disposal – The aging effects requiring management 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.

Instrument Air – The aging effects requiring management are loss of material for carbon steel, stainless steel, and copper alloy components; and fouling for aluminum heat exchanger fins. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Normal Containment and Control Rod Drive Mechanism Cooling – The aging effects requiring management 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.

Auxiliary Building and Electrical Equipment Room Ventilation – The aging effects requiring management 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.

Control Building Ventilation – The aging effects requiring management are loss of material for carbon steel, stainless steel, copper, and aluminum components; and cracking for coated canvas flexible connectors.

Emergency Diesel Generator Building Ventilation – No aging effects requiring management were identified.

Turbine Building Ventilation – The aging effects requiring management are loss of material for carbon steel, stainless steel, and aluminum components; loss of material and fouling for copper components; and cracking for coated canvas flexible connectors.

Fire Protection – The aging effects requiring management are loss of material for carbon steel, stainless steel, cast iron, and copper alloy components; loss of material and fouling for copper alloy heat exchanger tubing; and cracking for rubber

expansion joints and flexible connectors. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Emergency Diesel Generators and Support Systems – The aging effects requiring management are loss of material for carbon steel, cast iron, stainless steel, copper, and copper alloy components; cracking for stainless steel and rubber expansion joints and flexible couplings; and loss of material and fouling for red brass and copper alloy heat exchanger tubing.

## 3.4.3 OPERATING EXPERIENCE

### 3.4.3.1 INDUSTRY 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. The industry correspondence that was reviewed for operating experience related to Auxiliary Systems includes the following:

- NRC Bulletin 79-03, "Longitudinal Weld Defects in ASME SA-312 Type 304 Stainless Steel Pipe"
- NRC Bulletin 79-17, "Pipe Cracks in Stagnant Borated Water Systems at PWR Plants"
- NRC Bulletin 80-24, "Prevention of Damage Due to Water Leakage Inside Containment"
- NRC Bulletin 81-03, "Flow Blockage of Cooling Water to Safety System Components by Corbicula sp. (Asiatic clam) and Mytilus sp. (mussel)"
- NRC Bulletin 82-02, "Degradation of Threaded Fasteners in the Reactor Coolant Pressure Boundary of PWR Plants"
- NRC Bulletin 87-01, "Thinning of Pipe Walls in Nuclear Power Plants"
- NRC Bulletin 88-08, "Thermal Stresses in Piping Connected to Reactor Coolant Systems"
- NRC Bulletin 89-02, "Stress Corrosion Cracking Of High-Hardness Type 410 Stainless Steel Internal Preloaded Bolting In Anchor Darling Model S350W Swing Check Valves Or Valves Of Similar Design"
- NRC Circular 76-06, "Stress Corrosion Cracks in Stagnant, Low Pressure Stainless Piping Containing Boric Acid Solution at PWRs"
- NRC Circular 80-11, "Emergency Diesel Generator Lube Oil Cooler Failures"
- NRC Generic Letter 83-26, "Clarification of Surveillance Requirements for Diesel Fuel Oil Impurity Level Tests"
- NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants"

- NRC Generic Letter 88-14, "Instrument Air Supply System Problems Affecting Safety Related Equipment"
- NRC Generic Letter 89-08, "Erosion/Corrosion Induced Pipe Wall Thinning"
- NRC Generic Letter 89-13, "Service Water System Problems Affecting Safety Related Equipment"
- NRC Generic Letter 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Class 1, 2 and 3 Piping"
- NRC Generic Letter 91-17, "Generic Safety Issue 29, Bolting Degradation or Failure in Nuclear Power Plants"
- NRC Information Notice 79-19, "Pipe Cracks in Stagnant Borated Water Systems at PWR Plants"
- NRC Information Notice 79-23, "Emergency Diesel Generator Lube Oil Coolers"
- NRC Information Notice 80-05, "Chloride Contamination of Safety Related Piping and Components"
- NRC Information Notice 80-15, "Axial (Longitudinal) Oriented Cracking in Piping"
- NRC Information Notice 80-40, "Excessive Nitrogen Supply Pressure Actuates Safety-Relief Valve Operation to Cause Reactor Depressurization"
- NRC Information Notice 81-38, "Potentially Significant Equipment Failures Resulting from Contamination of Air-Operated Systems"
- NRC Information Notice 83-46, "Common-Mode Valve Failures Degrade Surry's Recirculation Spray Subsystem"
- NRC Information Notice 84-18, "Stress Corrosion Cracking in Pressurized Water Reactor Systems"
- NRC Information Notice 84-71, "Graphitic Corrosion of Cast Iron in Salt Water"
- NRC Information Notice 85-24, "Failures of Protective Coatings in Pipes and Heat Exchangers"
- NRC Information Notice 86-96, "Heat Exchanger Fouling Can Cause Inadequate Operability of Service Water Systems"

- NRC Information Notice 87-28, "Air Systems Problems at U.S. Light Water Reactors"
- NRC Information Notice 88-17, "Summary of Responses to NRC Bulletin 87-01, Thinning of Pipe Walls in Nuclear Power Plants"
- NRC Information Notice 88-37, "Flow Blockage of Cooling Water to Safety System Components"
- NRC Information Notice 89-01, "Valve Body Erosion"
- NRC Information Notice 89-07, "Failures of Small Diameter Tubing in Control Air, Fuel Oil, and Lube Oil Systems Render Emergency Diesel Generators Inoperable"
- NRC Information Notice 89-30, "High Temperature Environments at Nuclear Power Plants"
- NRC Information Notice 89-76, "Biofouling Agent: Zebra Mussel"
- NRC Information Notice 90-39, "Recent Problems with Service Water Systems"
- NRC Information Notice 90-65, "Recent Orifice Plate Problems"
- NRC Information Notice 91-05, "Intergranular Stress Corrosion Cracking in Pressurized Water Reactor Safety Injection Accumulator Nozzles"
- NRC Information Notice 91-46, "Degradation of Emergency Diesel Generator Fuel Oil Delivery Systems"
- NRC Information Notice 93-12, "Summary of Observations Compiled During Engineering Audits or Inspections of Licensee Erosion/Corrosion Programs"
- NRC Information Notice 94-58, "Reactor Coolant Pump Lube Oil Fire"
- NRC Information Notice 94-59, "Accelerated Dealloying of Cast Aluminum-Bronze Valves Caused by Microbiologically Induced Corrosion"
- NRC Information Notice 94-79, "Microbiologically Influenced Corrosion of Emergency Diesel Generator Service Water Piping"
- NRC Information Notice 97-13, "Deficient Conditions Associated with Protective Coatings at Nuclear Power Plants"
- NRC Information Notice 98-43, "Leaks in Emergency Diesel Generator Lubricating Oil and Jacket Cooling Water Piping"

- NRC Information Notice 99-07, "Failed Fire Protection Deluge Valves and Potential Testing Deficiencies in Preaction Sprinkler Systems"

No aging effects requiring management were identified from the above documents beyond those identified in Subsection 3.4.2.

### 3.4.3.2 PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 3 and 4 operating experience was also reviewed to validate the identified aging effects requiring management. The review included a survey of Turkey Point non-conformance reports, licensee event reports, and condition reports for any documented instances of auxiliary systems component aging, in addition to interviews with responsible engineering personnel. No aging effects requiring management were identified from this review beyond those identified in Subsection 3.4.2.

## 3.4.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.4.2. Tables 3.4-1 through 3.4-15 contain the results of the aging management review for the Auxiliary Systems and summarize the aging effects requiring management.

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

- Boric Acid Wastage Surveillance Program
- Chemistry Control Program
- Fire Protection Program
- Galvanic Corrosion Susceptibility Inspection Program
- Intake Cooling Water System Inspection Program
- Periodic Surveillance and Preventive Maintenance Program
- Systems and Structures Monitoring Program

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of the auxiliary systems components listed in Tables 3.4-1 through 3.4-15 are maintained consistent with the current licensing basis for the period of extended operation.

# TABLE 3.4-1
# INTAKE COOLING WATER[1]

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Intake cooling water pumps | Pressure boundary | Stainless steel<br>Carbon steel<br>Cast iron | Raw water – cooling canals | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Intake cooling water pump expansion joints | Pressure boundary | Rubber | Raw water – cooling canals | Cracking | Periodic Surveillance and Preventive Maintenance Program |
| Basket strainers (shell) | Pressure boundary | Carbon steel | Raw water – cooling canals | Loss of material | Intake Cooling Water System Inspection Program |
| Basket strainers (internal screens) | Filtration | Stainless steel | Raw water – cooling canals | Loss of material | Intake Cooling Water System Inspection Program |
| Valves<br>Piping/fittings<br>(main lines upstream of basket strainers) | Pressure boundary | Cast iron | Raw water – cooling canals | Loss of material | Intake Cooling Water System Inspection Program |

NOTE: 1. The component cooling water heat exchangers are included with the Component Cooling Water System (see Table 3.4-2).

# TABLE 3.4-1 (continued)
# INTAKE COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>(main lines between basket strainers and component cooling water heat exchangers) | Pressure boundary | Cast iron | Raw water – cooling canals | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>Piping/fittings<br>(main lines downstream of component cooling water heat exchangers above ground) | Structural support [1] | Cast iron | Raw water – cooling canals | Loss of material | Systems and Structures Monitoring Program |
| Piping/fittings<br>(main lines downstream of component cooling water heat exchangers buried) | Structural integrity [2] | Cast iron | Raw water – cooling canals | None | None required |
| Piping/fittings | Pressure boundary | Stainless steel | Raw water – cooling canals | Loss of material | Systems and Structures Monitoring Program |

NOTES: 1. Pressure boundary not required because heat transfer has been accomplished. Structural support required to maintain seismic integrity function of the system.
2. Pressure boundary not required because heat transfer has been accomplished. Structural integrity required to prevent flow restriction.

# TABLE 3.4-1 (continued)
# INTAKE COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>(vents on the outlet channels of the component cooling water heat exchangers) | Pressure boundary | Carbon steel | Raw water – cooling canals | Loss of material | Systems and Structures Monitoring Program |
| Piping/fittings (instrumentation) | Pressure boundary | Bronze | Raw water – cooling canals | Loss of material | Systems and Structures Monitoring Program |
| Piping/fittings (vents and drains welded to the component cooling water heat exchanger channels) | Pressure boundary | Copper nickel | Raw water – cooling canals | Loss of material | Intake Cooling Water System Inspection Program |
| Valves<br>Piping/fittings<br>Chemical injection nozzles (Unit 3 only) | Pressure boundary | Monel | Raw water – cooling canals | Loss of material | Systems and Structures Monitoring Program |
| Tubing/fittings | Pressure boundary | Stainless steel | Raw water – cooling canals | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>(pump discharges) | Pressure boundary | Aluminum – bronze | Raw water – cooling canals | Loss of material | Periodic Surveillance and Preventive Maintenance Program |

# TABLE 3.4-1 (continued)
# INTAKE COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves (instrumentation) | Pressure boundary | Stainless steel<br>Bronze | Raw water – cooling canals | Loss of material | Systems and Structures Monitoring Program |
| Valves (component cooling water heat exchanger vent and drain valves) | Pressure boundary | Bronze | Raw water – cooling canals | Loss of material | Intake Cooling Water System Inspection Program |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Raw water – cooling canals | Loss of material | Systems and Structures Monitoring Program |
| Thermowells | Pressure boundary | Stainless steel | Raw water – cooling canals | Loss of material | Systems and Structures Monitoring Program |

# TABLE 3.4-1 (continued)
# INTAKE COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Intake cooling water pumps | Pressure boundary | Stainless steel<br>Carbon steel<br>Cast iron | Outdoor | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Intake cooling water pump expansion joints | Pressure boundary | Rubber | Outdoor | Cracking | Periodic Surveillance and Preventive Maintenance Program |
| Basket strainers (shell) | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Piping/fittings (upstream of the component cooling water heat exchangers buried) | Pressure boundary | Cast iron | Buried [1] | None | None required |
| Valves Piping/fittings (intake structure and turbine building above ground) | Pressure boundary | Cast iron | Outdoor | Loss of material | Systems and Structures Monitoring Program |

NOTE: 1. Based on volumetric inspections and analysis, the corrosion rate due to loss of material aging mechanisms will not impact component intended functions.

# TABLE 3.4-1 (continued)
# INTAKE COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Valves Piping/fitting (component cooling water heat exchanger rooms upstream of the heat exchangers above ground) | Pressure boundary | Cast iron | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves Piping/fittings (downstream of component cooling water heat exchangers above ground) | Structural support [1] | Cast iron | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Piping/fittings (downstream of component cooling water heat exchangers buried) | Structural integrity [2] | Cast iron | Buried | None | None required |

NOTES: 1. Pressure boundary not required because heat transfer has been accomplished. Structural support required to maintain seismic integrity function of the system.
2. Pressure boundary not required because heat transfer has been accomplished. Structural integrity required to prevent flow restriction.

# TABLE 3.4-1 (continued)
# INTAKE COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Piping/fittings | Pressure boundary | Stainless steel<br>Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | Carbon steel | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| | | Bronze | Outdoor | None | None required |
| Piping/fittings (welded to component cooling water heat exchanger channels) | Pressure boundary | Copper nickel | Outdoor | None | None required |
| Piping/fittings<br>Valves<br>Chemical injection nozzles<br>(Unit 3 only) | Pressure boundary | Monel | Outdoor | None | None required |
| Tubing/fittings | Pressure boundary | Stainless steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |

# TABLE 3.4-1 (continued)
# INTAKE COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Valves | Pressure boundary | Aluminum – bronze<br>Bronze | Outdoor | None | None required |
| | | Stainless steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | Carbon steel | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| | | | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Thermowells | Pressure boundary | Stainless steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Bolting (mechanical closures in component cooling water heat exchanger rooms) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-2
# COMPONENT COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Component cooling water head tanks | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| | | | Treated water | Loss of material | Chemistry Control Program |
| Component cooling water surge tanks | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Pressure vessels (air reservoirs) | Pressure boundary | Carbon steel | Air/Gas | None | None required |
| Component cooling water pumps | Pressure boundary | Cast iron | Treated water | Loss of material | Chemistry Control Program |
| Component cooling water heat exchanger shells, baffle plates, connecting rods, spacers, and nuts | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| Component cooling water heat exchanger tube sheets | Pressure boundary | Copper nickel | Raw water – cooling canals (tube side) | Loss of material | Intake Cooling Water System Inspection Program |
| | | | Treated water (shell side) | Loss of material | Chemistry Control Program |

# TABLE 3.4-2 (continued)
# COMPONENT COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Component cooling water heat exchanger tubes | Pressure boundary<br>Heat transfer | Aluminum-brass | Raw water – cooling canals (inside diameter) | Loss of material<br>Fouling | Intake Cooling Water System Inspection Program |
| | | | Treated water (outside diameter) | Loss of material | Chemistry Control Program |
| Component cooling water heat exchanger channels, and channel door overlay | Pressure boundary | Copper nickel | Raw water – cooling canals | Loss of material | Intake Cooling Water System Inspection Program |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Thermowells | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Filters | Pressure boundary | Stainless steel<br>Carbon steel<br>Brass | Air/Gas | None | None required |

# TABLE 3.4-2 (continued)
# COMPONENT COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves | Pressure boundary | Brass | Treated water | Loss of material | Chemistry Control Program |
| Rotometers | Pressure boundary<br>Throttling | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| | | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| | | Stainless steel | Air/Gas | None | None required |

# TABLE 3.4-2 (continued)
# COMPONENT COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Component cooling water head tanks | Pressure boundary | Stainless steel | Outdoor | None | None required |
| Component cooling water surge tanks [1] | Pressure boundary | Carbon steel | Indoor - not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| Pressure vessels (air reservoirs) | Pressure boundary | Carbon steel | Indoor - not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Component cooling water pumps | Pressure boundary | Cast iron | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Component cooling water heat exchanger shells, flanges, and doors | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Component cooling water heat exchanger channels | Pressure boundary | Copper nickel | Outdoor | None | None required |

NOTE: 1. The component cooling water surge tanks are not located near borated water sources.

# TABLE 3.4-2 (continued)
# COMPONENT COOLING WATER

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Containment air<br>Indoor - not air-conditioned<br>Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Filters<br>Thermowells | Pressure boundary | Stainless steel | Containment air<br>Indoor - not air-conditioned<br>Outdoor | None | None required |
| Orifices<br>Rotometers | Pressure boundary<br>Throttling | Stainless steel | Indoor – not air conditioned<br>Containment air<br>Outdoor | None | None required |
| Rotometers | Pressure boundary<br>Throttling | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves | Pressure boundary | Brass | Outdoor<br>Indoor – not air conditioned | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-3
# SPENT FUEL POOL COOLING

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Spent fuel pool cooling pumps<br>Refueling water purification pumps | Pressure boundary | Stainless steel | Treated water – borated | Loss of material | Chemistry Control Program |
| Emergency spent fuel pool cooling pumps | Pressure boundary | Worthite (nickel based alloy) | Treated water – borated | Loss of material | Chemistry Control Program |
| Spent fuel pool cooling heat exchanger tubes | Pressure boundary<br>Heat transfer | Stainless steel | Treated water – borated (inside diameter) | Loss of material<br>Fouling | Chemistry Control Program |
| | | | Treated water (outside diameter) | Loss of material<br>Fouling | Chemistry Control Program |
| Spent fuel pool cooling heat exchanger tube sheets | Pressure boundary | Stainless steel | Treated water – borated (tube side) | Loss of material | Chemistry Control Program |
| | | | Treated water (shell side) | Loss of material | Chemistry Control Program |
| Spent fuel pool cooling heat exchanger channels | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |

# TABLE 3.4-3 (continued)
# SPENT FUEL POOL COOLING

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Spent fuel pool cooling heat exchanger shells, covers and baffles | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Filters<br>Demineralizers | Pressure boundary | Stainless steel | Treated water – borated | Loss of material | Chemistry Control Program |
| Flow elements<br>Orifices | Pressure boundary<br>Throttling | Stainless steel | Treated water – borated | Loss of material | Chemistry Control Program |

# TABLE 3.4-3 (continued)
# SPENT FUEL POOL COOLING

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Spent fuel pool cooling pumps | Pressure boundary | Stainless steel | Indoor – not air conditioned | None | None required |
| Refueling water purification pumps | Pressure boundary | Stainless steel | Outdoor | None | None required |
| Emergency spent fuel pool cooling pumps | Pressure boundary | Worthite (nickel based alloy) | Indoor – not air conditioned | None | None required |
| Spent fuel pool cooling heat exchanger shells and covers | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Filters<br>Demineralizers | Pressure boundary | Stainless steel | Indoor – not air conditioned<br>Outdoor | None | None required |
| Piping/fittings | Pressure boundary | Stainless steel | Encased/Embedded (concrete) | None | None required |
| | | | Treated water – borated (submerged) | Loss of material | Chemistry Control Program |

# TABLE 3.4-3 (continued)
# SPENT FUEL POOL COOLING

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Flow elements Orifices | Pressure boundary<br>Throttling | Stainless steel | Indoor – not air conditioned | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-4
# CHEMICAL AND VOLUME CONTROL

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Boric acid storage tanks<br>Boric acid batching tank | Pressure boundary | Stainless steel | Treated water - borated | Loss of material<br>Cracking [1] | Chemistry Control Program |
| | | | Air/Gas | None | None required |
| Volume control tanks<br>Holdup tanks | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |
| | | | Air/Gas | None | None required |
| Boric acid storage tank pumps | Pressure boundary | Stainless steel | Treated water - borated | Loss of material<br>Cracking [1] | Chemistry Control Program |
| Charging pumps | Pressure boundary | Stainless steel | Treated water - borated | Cracking | Periodic Surveillance and Preventive Maintenance Program |
| | | | | Loss of material | Chemistry Control Program |
| Charging pump suction stabilizers and pulsation dampeners | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |
| Charging pump oil cooler bonnets | Pressure boundary | Cast iron | Treated water | Loss of material | Galvanic Corrosion Susceptibility Inspection Program |

NOTE: 1. Plant experience has identified the potential for cracking of previously heat traced components.

# TABLE 3.4-4 (continued)
# CHEMICAL AND VOLUME CONTROL

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Charging pump oil cooler tubes | Pressure boundary<br>Heat transfer | Copper | Treated water (inside diameter) | Loss of material<br>Fouling | Chemistry Control Program |
| | | | Lubricating oil (outside diameter) | None | None required |
| Non-regenerative heat exchanger shells and tube supports | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Non-regenerative heat exchanger tubes | Pressure boundary<br>Heat transfer | Stainless steel | Treated water – borated (inside diameter) | Loss of material<br>Cracking [1] | Chemistry Control Program |
| | | | Treated water (outside diameter) | Loss of material | Chemistry Control Program |
| Non-regenerative heat exchanger tube sheets | Pressure boundary | Stainless steel | Treated water – borated (tube side) | Loss of material<br>Cracking [1] | Chemistry Control Program |
| | | | Treated water (shell side) | Loss of material | Chemistry Control Program |

NOTE: 1. Portions of the system >140°F are potentially susceptible to stress corrosion cracking.

# TABLE 3.4-4 (continued)
# CHEMICAL AND VOLUME CONTROL

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Non-regenerative heat exchanger channels | Pressure boundary | Stainless steel | Treated water – borated | Loss of material<br>Cracking [1] | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Thermowells<br>(upstream of non-regenerative heat exchanger and downstream of regenerative heat exchanger) | Pressure boundary | Stainless steel | Treated water – borated | Loss of material<br>Cracking [1] | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Thermowells<br>Tubing/fittings<br>Demineralizers<br>Filters<br>(main charging and letdown loops) | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |

NOTE: 1. Portions of the system >140°F are potentially susceptible to stress corrosion cracking.

# TABLE 3.4-4 (continued)
# CHEMICAL AND VOLUME CONTROL

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>Thermowells<br>Tubing/fittings<br>Filters<br>(boric acid supply to charging pump suction headers) | Pressure boundary | Stainless steel | Treated water - borated | Loss of material<br>Cracking [1] | Chemistry Control Program |
| Valves<br>Tubing/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Valves | Pressure boundary | Brass | Air/Gas | None | None required |
| Orifices<br>(main charging and letdown loops) | Pressure boundary<br>Throttling | Stainless steel | Treated water – borated | Loss of material | Chemistry Control Program |
| Orifices<br>Flow meters<br>(boric acid supply to charging pump suction headers) | Pressure boundary<br>Throttling | Stainless steel | Treated water – borated | Loss of material<br>Cracking [1] | Chemistry Control Program |

NOTE: 1. Plant experience has identified the potential for cracking of previously heat-traced components.

# TABLE 3.4-4 (continued)
# CHEMICAL AND VOLUME CONTROL

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Boric acid storage tanks<br>Boric acid batching tank | Pressure boundary | Stainless steel | Indoor - not air-conditioned | Cracking [1] | Periodic Surveillance and Preventive Maintenance Program |
| Volume control tanks<br>Holdup tanks | Pressure boundary | Stainless steel | Indoor - not air-conditioned | None | None required |
| Boric acid storage tank pumps | Pressure boundary | Stainless steel | Indoor - not air-conditioned | Cracking [1] | Periodic Surveillance and Preventive Maintenance Program |
| Charging pumps | Pressure boundary | Stainless steel | Indoor - not air-conditioned | None | None required |
| Charging pump suction stabilizers and discharge dampeners | Pressure boundary | Stainless steel | Indoor - not air-conditioned | None | None required |
| Charging pump oil cooler shells | Pressure boundary | Brass | Indoor - not air-conditioned | None | None required |
| Charging pump oil cooler bonnets | Pressure boundary | Cast iron | Indoor - not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |

NOTE: 1. Plant experience has identified the potential for cracking of previously heat-traced components.

# TABLE 3.4-4 (continued)
# CHEMICAL AND VOLUME CONTROL

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Non-regenerative heat exchanger shells | Pressure boundary | Carbon steel | Indoor - not air-conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves<br>Piping/fittings<br>Thermowells<br>Tubing/fittings<br>Demineralizers<br>Filters<br>(main charging and letdown loops) | Pressure boundary | Stainless steel | Containment air<br>Indoor – not air conditioned | None | None required |
| Valves<br>Piping/fittings<br>Thermowells<br>Tubing/fittings<br>Filters<br>(boric acid supply to charging pump suction headers) | Pressure boundary | Stainless steel | Indoor – not air conditioned | Cracking[1] | Periodic Surveillance and Preventive Maintenance Program |
| Instrument solenoid valves | Pressure boundary | Brass | Containment air<br>Indoor – not air conditioned | None | None required |

NOTE: 1. Plant experience has identified the potential for cracking of previously heat-traced components.

# TABLE 3.4-4 (continued)
# CHEMICAL AND VOLUME CONTROL

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Containment air<br>Indoor – not air conditioned | None | None required |
| Orifices<br>Flow meters | Pressure boundary<br>Throttling | Stainless steel | Indoor – not air conditioned | Cracking[1] | Periodic Surveillance and Preventive Maintenance Program |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

NOTE: 1. Plant experience has identified the potential for cracking of previously heat-traced components.

# TABLE 3.4-5
# PRIMARY WATER MAKEUP

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Valves<br>Piping/fittings | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| **External Environment** | | | | | |
| Valves<br>Piping/fittings | Pressure boundary | Stainless steel | Indoor – not air conditioned<br>Containment air | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure Integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-6
# SAMPLE SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **NSSS Sample System** | | | | | |
| **Internal Environment** | | | | | |
| Sample heat exchanger shells and covers[1] | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings (pressurizer, reactor coolant system hot legs sample lines) | Pressure boundary | Stainless steel | Treated water - primary | Loss of material<br>Cracking[2] | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings (safety injection system sample lines) | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |

NOTES: 1. Heat transfer is not a license renewal intended function for the sample heat exchangers. Additionally, the tube side of these heat exchangers is normally isolated so the tubes do not perform a pressure boundary function.
2. Stainless steel materials exposed to temperature >140°F are susceptible to stress corrosion cracking (see Appendix C).

# TABLE 3.4-6 (continued)
# SAMPLE SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **NSSS Sample System (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>(other sample lines) | Pressure boundary | Stainless steel | Treated water - borated | Loss of material<br>Cracking | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>(volume control tank cover gas sample lines) | Pressure boundary | Stainless steel | Air/Gas | None | None required |

# TABLE 3.4-6 (continued)
# SAMPLE SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **NSSS Sample System (continued)** | | | | | |
| **External Environment** | | | | | |
| Sample cooler shells and covers | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Indoor – not air conditioned<br>Containment air | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-6 (continued)
# SAMPLE SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Secondary Sample System** | | | | | |
| **Internal Environment** | | | | | |
| Sample heat exchanger shells and covers | Structural support [1] | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| Sample heat exchanger tubes [2] (inside diameter) | Pressure boundary<br>Throttling | Stainless steel | Treated water - secondary | Loss of material<br>Cracking | Chemistry Control Program |
| Sample heat exchanger tubes (outside diameter) | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| Valves Piping/fittings | Pressure boundary | Carbon steel | Treated water - secondary | Loss of material | Chemistry Control Program |
| Valves Tubing/fittings | Pressure boundary<br>Throttling | Stainless steel | Treated water - secondary | Loss of material<br>Cracking | Chemistry Control Program |

NOTES: 1. Pressure boundary not required. Provides structural support for the cooling coils.
2. Required for Main Steam System pressure boundary. Heat transfer is not a license renewal intended function for the sample heat exchangers.

# TABLE 3.4-6 (continued)
# SAMPLE SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Secondary Sample System (continued)** | | | | | |
| **External Environment** | | | | | |
| Sample heat exchanger shells and covers | Structural support | Stainless steel | Outdoor | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Indoor – not air conditioned<br>Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves<br>Tubing/fittings | Pressure boundary<br>Throttling | Stainless steel | Outdoor | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-7
# WASTE DISPOSAL

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Residual heat removal pit sump pumps | Pressure boundary | Stainless steel | Raw water – floor drainage | Loss of material | Systems and Structures Monitoring Program |
| Waste gas compressor heat exchanger channels, covers, and tube sheets | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Waste gas compressor heat exchanger tubes[1] | Pressure boundary | Admiralty brass | Treated water (inside diameter) | Loss of material | Chemistry Control Program |
| | | | Treated water (outside diameter) | Loss of material | Chemistry Control Program |
| Valves Piping/fittings | Pressure boundary | Stainless steel | Raw water – floor drainage | Loss of material | Systems and Structures Monitoring Program |
| | | | | Fouling (clogging of drain piping) | Periodic Surveillance and Preventive Maintenance Program |

NOTE: 1. Required for Component Cooling Water System pressure boundary; heat transfer is not a license renewal intended function for the waste gas compressor heat exchangers.

# TABLE 3.4-7 (continued)
# WASTE DISPOSAL

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Stainless steel | Treated water - borated | Loss of material | Chemistry Control Program |
| | | Carbon steel | Air/Gas | None | None required |

# TABLE 3.4-7 (continued)
# WASTE DISPOSAL

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Residual heat removal pit sump pumps | Pressure boundary | Stainless steel | Raw water – floor drainage | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Waste gas compressor heat exchanger channels and covers | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Containment air<br>Indoor – not air conditioned | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Piping | Pressure boundary | Stainless steel | Embedded/Encased | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-8
# INSTRUMENT AIR

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Instrument air receiver tanks | Pressure boundary | Carbon steel | Air/Gas (wetted) | Loss of material | Periodic Surveillance and Preventive Maintenance Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Instrument air oil/water separators | Pressure boundary | Stainless steel | Air/Gas (wetted) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Instrument air aftercooler heat exchanger tube sheets, channels, header covers, shells | Pressure boundary | Carbon steel | Air/Gas (wetted) | Loss of material | Periodic Surveillance and Preventive Maintenance Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Instrument air aftercooler heat exchanger tubes | Pressure boundary<br>Heat transfer | Copper alloy | Air/Gas (wetted) | Loss of material | Galvanic Corrosion Susceptibility Inspection Program |
| Instrument air filters | Pressure boundary | Carbon steel | Air/Gas | None | None required |
| Instrument air dryers | Pressure boundary | Carbon steel | Air/Gas | None | None required |
| Instrument air flasks | Pressure boundary | Carbon steel | Air/Gas | None | None required |

# TABLE 3.4-8 (continued)
# INSTRUMENT AIR

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Instrument air strainers | Pressure boundary<br>Filtration | Carbon steel | Air/Gas (wetted) | Loss of material | Periodic Surveillance and Preventive Maintenance Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Valves Piping/fittings (upstream of air dryers) | Pressure boundary | Carbon steel | Air/Gas (wetted) | Loss of material | Periodic Surveillance and Preventive Maintenance Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Piping/fittings (upstream of air dryers) | Pressure boundary | Carbon steel – galvanized | Air/Gas (wetted) | Loss of material | Periodic Surveillance and Preventive Maintenance Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Valves Tubing/fittings (upstream of air dryers) | Pressure boundary | Stainless steel | Air/Gas (wetted) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |

# TABLE 3.4-8 (continued)
# INSTRUMENT AIR

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves<br>Tubing/fittings (upstream of air dryers) | Pressure boundary | Copper alloy | Air/Gas (wetted) | Loss of material | Galvanic Corrosion Susceptibility Inspection Program |
| Valves<br>Piping/fittings (downstream of air dryers) | Pressure boundary | Carbon steel | Air/Gas | None | None required |
| Piping/fittings (downstream of air dryers) | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings (downstream of air dryers) | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Valves<br>Tubing/fittings (downstream of air dryers) | Pressure boundary | Copper alloy | Air/Gas | None | None required |
| Orifices<br>Flow elements | Pressure boundary<br>Throttling | Stainless steel | Air/Gas | None | None required |

# TABLE 3.4-8 (continued)
# INSTRUMENT AIR

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Instrument air receiver tanks | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Instrument air oil/water separators | Pressure boundary | Stainless steel | Indoor – not air conditioned | None | None required |
| Instrument air aftercooler heat exchanger covers and shells | Pressure boundary<br>Heat transfer | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Instrument air heat exchanger fins | Heat transfer | Aluminum | Outdoor | Fouling | Systems and Structures Monitoring Program |
| Instrument air strainers | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Instrument air filters | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Instrument air dryers | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Instrument air flasks | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |

# TABLE 3.4-8 (continued)
# INSTRUMENT AIR

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Valves<br>Tubing/fittings | Pressure boundary | Copper alloy | Containment air<br>Indoor – not air conditioned<br>Outdoor | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Containment air<br>Indoor – not air conditioned<br>Outdoor | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Containment air<br>Indoor – not air conditioned<br>Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Piping/fittings | Pressure boundary | Carbon steel – galvanized | Containment air<br>Indoor – not air conditioned<br>Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-8 (continued)
# INSTRUMENT AIR

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Containment air<br>Indoor – not air conditioned | None | None required |
| Orifices<br>Flow elements | Pressure boundary<br>Throttling | Stainless steel | Containment air<br>Indoor – not air conditioned | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-9
# NORMAL CONTAINMENT AND CONTROL ROD DRIVE MECHANISM COOLING

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Normal containment cooler housings | Pressure boundary<br>Structural support [1] | Carbon steel | Containment air | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Control rod drive mechanism cooler housings | Pressure boundary<br>Structural support [1] | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| Normal containment cooler headers | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Control rod drive mechanism cooler headers | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Normal containment cooler tubes | Pressure boundary<br>Heat transfer | Admiralty brass | Treated water (inside diameter) | Loss of material<br>Fouling | Chemistry Control Program |
| Control rod drive mechanism cooler tubes (Unit 3) | Pressure boundary<br>Heat transfer | Stainless steel | Treated water (inside diameter) | Loss of material<br>Fouling | Chemistry Control Program |

NOTE: 1. Housings provide structural support to ensure integrity of the safety-related Component Cooling Water System pressure boundary.

# TABLE 3.4-9 (continued)
# NORMAL CONTAINMENT AND CONTROL ROD DRIVE MECHANISM COOLING

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Control rod drive mechanism cooler tubes (Unit 4) | Pressure boundary<br>Heat transfer | Admiralty brass | Treated water (inside diameter) | Loss of material<br>Fouling | Chemistry Control Program |
| Ductwork | Pressure boundary | Carbon steel – galvanized | Containment air | None | None required |
| Ductwork (wetted sections of ductwork near normal containment cooler housings) | Pressure boundary | Carbon steel – galvanized | Containment air | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Control rod drive mechanism ductwork shrouds | Pressure boundary | Carbon steel – galvanized | Containment air | None | None required |
| Normal containment cooling ductwork flexible connectors | Pressure boundary | Neoprene<br>Coated canvas | Containment air | Cracking | Periodic Surveillance and Preventive Maintenance Program |
| Control rod drive mechanism cooling ductwork flexible connectors | Pressure boundary | Neoprene | Containment air | Cracking | Systems and Structures Monitoring Program |

# TABLE 3.4-9 (continued)
# NORMAL CONTAINMENT AND CONTROL ROD DRIVE MECHANISM COOLING

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Normal containment cooler housings | Pressure boundary<br>Structural support [1] | Carbon steel | Containment air | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Control rod drive mechanism cooler housings | Pressure boundary<br>Structural support [1] | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Normal containment cooler headers | Pressure boundary | Carbon steel | Containment air | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Control rod drive mechanism cooler header | Pressure boundary | Carbon steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |

NOTE: 1. Housings provide structural support to ensure integrity of the safety-related Component Cooling Water System pressure boundary.

# TABLE 3.4-9 (continued)
# NORMAL CONTAINMENT AND CONTROL ROD DRIVE MECHANISM COOLING

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Normal containment cooler tubes | Pressure boundary<br>Heat transfer | Admiralty brass | Containment air | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Normal containment cooler tube fins | Heat transfer | Aluminum | Containment air | Loss of material<br>Fouling | Periodic Surveillance and Preventive Maintenance Program |
| Control rod drive mechanism cooler tubes (Unit 3) | Pressure boundary<br>Heat transfer | Stainless steel | Containment air | Loss of material | Systems and Structures Monitoring Program |
| Control rod drive mechanism cooler tubes (Unit 4) | Pressure boundary<br>Heat transfer | Admiralty brass | Containment air | Loss of material | Systems and Structures Monitoring Program |
| Control rod drive mechanism cooler fins | Heat transfer | Aluminum | Containment air | Loss of material | Galvanic Corrosion Susceptibility Inspection Program |
| | | | | Fouling | Systems and Structures Monitoring Program |
| Ductwork | Pressure boundary | Carbon steel – galvanized | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-9 (continued)
# NORMAL CONTAINMENT AND CONTROL ROD DRIVE MECHANISM COOLING

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Ductwork (wetted) (section of ductwork near normal containment cooler housings) | Pressure boundary | Carbon steel – galvanized | Containment air | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Control rod drive mechanism ductwork and shrouds | Pressure boundary | Carbon steel – galvanized | Containment air | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Normal containment cooling ductwork flexible connectors | Pressure boundary | Neoprene<br>Coated canvas | Containment air | Cracking | Periodic Surveillance and Preventive Maintenance Program |
| Control rod drive mechanism ductwork flexible connectors | Pressure boundary | Neoprene | Containment air | Cracking | Systems and Structures Monitoring Program |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-10
# AUXILIARY BUILDING AND ELECTRICAL EQUIPMENT ROOM VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Auxiliary building ventilation air handler housings | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| Auxiliary building ventilation pre and roughing filter housings | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| Ductwork | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| | | Carbon steel | Air/Gas | Loss of material | Systems and Structures Monitoring Program |
| Pressure test point plugs | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| Tubing/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Flexible connectors | Pressure boundary | Coated canvas | Air/Gas | Cracking | Systems and Structures Monitoring Program |

# TABLE 3.4-10 (continued)
# AUXILIARY BUILDING AND ELECTRICAL EQUIPMENT ROOM VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Auxiliary building ventilation air handler housings | Pressure boundary | Carbon steel – galvanized | Indoor –not air conditioned | None | None required |
| Auxiliary building ventilation pre and roughing filter housings | Pressure boundary | Carbon steel – galvanized | Indoor – not air conditioned | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Ductwork | Pressure boundary | Carbon steel – galvanized | Indoor – not air conditioned | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| | | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Pressure test point plugs | Pressure boundary | Carbon steel – galvanized | Indoor – not air conditioned | None | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Tubing/fittings | Pressure boundary | Stainless steel | Indoor – not air conditioned | None | None required |

# TABLE 3.4-10 (continued)
# AUXILIARY BUILDING AND ELECTRICAL EQUIPMENT ROOM VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Flexible connectors | Pressure boundary | Coated canvas | Indoor – not air conditioned | Cracking | Systems and Structures Monitoring Program |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-11
# CONTROL BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Cable spreading room and computer room chilled water surge tanks | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| | | | Air/Gas | Loss of material | Systems and Structures Monitoring Program |
| Cable spreading room and computer room chilled water pumps | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| Cable spreading room and computer room chiller water boxes | Pressure boundary<br>Heat transfer | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Wye strainers<br>Thermowells | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Level gauges | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| | | | Air/Gas | Loss of material | Systems and Structures Monitoring Program |
| Flow elements | Pressure boundary<br>Throttling | Carbon steel | Treated water | Loss of material | Chemistry Control Program |

# TABLE 3.4-11 (continued)
# CONTROL BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Flow elements | Pressure boundary<br>Throttling | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| Air separators<br>Valves<br>Tubing/fittings | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| | | | Air/Gas | None | None required |
| Control room ventilation air handling unit housings | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| Control room ventilation recirculation filter housing | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| Inverter room and battery room air handling unit housing | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| Cable spreading room and computer room air handling unit housings | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Cable spreading room and computer room air handling unit headers | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |

# TABLE 3.4-11 (continued)
# CONTROL BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Cable spreading room and computer room air handling unit tubes | Pressure boundary<br>Heat transfer | Copper | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Cable spreading room and computer room air handling unit air boxes in air handlers | Pressure boundary | Carbon steel | Air/Gas (wetted with condensation) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Ductwork | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| Ductwork flexible connectors | Pressure boundary | Coated canvas | Air/Gas | Cracking | Systems and Structures Monitoring Program |

# TABLE 3.4-11 (continued)
# CONTROL BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Cable spreading room and computer room chilled water surge tanks | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Cable spreading room and computer room chilled water pumps | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Cable spreading room and computer room chiller water boxes | Pressure boundary<br>Heat transfer | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Wye strainer<br>Valves<br>Piping/fittings<br>Level gauges<br>Thermowells | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>Piping/fittings<br>Thermowells | Pressure boundary | Carbon steel | Indoor – air conditioned | None | None required |

# TABLE 3.4-11 (continued)
# CONTROL BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Flow elements | Pressure boundary<br>Throttling | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Indoor – air conditioned | None | None required |
| Valves<br>Tubing/fittings | Pressure boundary | Stainless steel | Indoor – air conditioned | None | None required |
| Air separators<br>Valves<br>Tubing/fittings | Pressure boundary | Stainless steel | Outdoor | None | None required |
| Flow elements | Pressure boundary<br>Throttling | Stainless steel | Outdoor<br>Indoor – air conditioned | None | None required |
| Control room ventilation air handling unit housings | Pressure boundary | Carbon steel – galvanized | Indoor – air conditioned | None | None required |
| Control room ventilation recirculation filter housing | Pressure boundary | Carbon steel – galvanized | Indoor – air conditioned | None | None required |
| Inverter room and battery room air handling unit housing | Pressure boundary | Carbon steel – galvanized | Indoor – air conditioned | None | None required |

# TABLE 3.4-11 (continued)
# CONTROL BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Cable spreading room and computer room air handling unit housings | Pressure boundary | Stainless steel | Indoor – air conditioned | None | None required |
| Cable spreading room and computer room air handling unit headers | Pressure boundary | Stainless steel | Indoor – air conditioned (wetted with condensation) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Cable spreading room and computer room air handling unit tubes | Pressure boundary<br>Heat transfer | Copper | Indoor – air conditioned (wetted with condensation) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Cable spreading room and computer room air handling unit air boxes in air handlers | Pressure boundary | Carbon steel | Indoor – air conditioned (wetted with condensation) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Cable spreading room and computer room air handling unit tube fins | Heat transfer | Aluminum | Indoor – air conditioned (wetted with condensation) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Ductwork | Pressure boundary | Carbon steel – galvanized | Indoor – air conditioned | None | None required |
| Ductwork flexible connectors | Pressure boundary | Coated canvas | Indoor – air conditioned | Cracking | Systems and Structures Monitoring Program |

# TABLE 3.4-11 (continued)
# CONTROL BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Outdoor<br>Indoor – air conditioned | None | None required |

# TABLE 3.4-12
# EMERGENCY DIESEL GENERATOR BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Ductwork | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| Filter housings | Pressure boundary | Carbon steel – galvanized | Air/Gas | None | None required |
| **External Environment** | | | | | |
| Ductwork | Pressure boundary | Carbon steel – galvanized | Indoor – not air conditioned<br>Indoor – air conditioned | None | None required |
| Filter housings | Pressure boundary | Carbon steel – galvanized | Indoor – not air conditioned<br>Indoor – air conditioned | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Indoor – not air conditioned<br>Indoor – air conditioned | None | None required |

# TABLE 3.4-13
# TURBINE BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Chilled water surge tanks | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| | | | Air/Gas | Loss of material | Systems and Structures Monitoring Program |
| Chilled water air separators | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| | | | Air/Gas | Loss of material | Systems and Structures Monitoring Program |
| Chilled water pumps | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| Chiller water boxes | Pressure boundary<br>Heat transfer | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Valves Piping/fittings | Pressure boundary | Carbon steel | Air/Gas | Loss of material | Systems and Structures Monitoring Program |
| | | | Treated water | Loss of material | Chemistry Control Program |

# TABLE 3.4-13 (continued)
# TURBINE BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves<br>Tubing/fittings<br>Level gauges | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| | | | Air/Gas | None | None required |
| Flexible hoses | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| Wye strainers<br>Thermowells<br>Test wells | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| Flow elements | Pressure boundary<br>Throttling | Stainless steel<br>Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| Air handling unit housings | Pressure boundary | Carbon steel | Air/Gas | Loss of material | Systems and Structures Monitoring Program |
| Air handling unit headers | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Air handling unit heat exchanger tubes | Pressure boundary<br>Heat transfer | Copper | Treated water | Loss of material<br>Fouling | Chemistry Control Program |
| Air handling unit air boxes in air handlers | Pressure boundary | Carbon steel | Air/Gas (wetted with condensation) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |

# TABLE 3.4-13 (continued)
# TURBINE BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Chilled water surge tanks | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Chilled water air separator | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Chilled water pumps | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Chiller water boxes | Pressure boundary<br>Heat transfer | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Valves<br>Piping/fittings<br>Wye strainers<br>Thermowells<br>Test wells | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>Piping/fittings<br>Test wells | Pressure boundary | Carbon steel | Indoor – air conditioned | None | None required |

# TABLE 3.4-13 (continued)
# TURBINE BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Valves<br>Tubing/fittings<br>Flexible hoses<br>Level gauges | Pressure boundary | Stainless steel | Outdoor | None | None required |
| Valves<br>Tubing/fittings<br>Flexible hoses | Pressure boundary | Stainless steel | Indoor – air conditioned | None | None required |
| Flow elements | Pressure boundary<br>Throttling | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | | Indoor – air conditioned | None | None required |
| | | Stainless steel | Outdoor | None | None required |
| Air handling unit housings | Pressure boundary | Carbon steel – galvanized<br>Stainless steel | Indoor – air conditioned | None | None required |
| Air handling unit headers | Pressure boundary | Carbon steel | Indoor – air conditioned (wetted with condensation) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Air handling unit heat exchanger tubes | Pressure boundary<br>Heat transfer | Copper | Indoor – air conditioned (wetted with condensation) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |

# TABLE 3.4-13 (continued)
# TURBINE BUILDING VENTILATION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Air handling unit air boxes | Pressure boundary | Carbon steel | Indoor – air conditioned (wetted with condensation) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Air handling unit heat exchanger fins | Heat transfer | Aluminum | Indoor – air conditioned (wetted with condensation) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Outdoor<br>Indoor – air conditioned | None | None required |

# TABLE 3.4-14
# FIRE PROTECTION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Raw water tanks | Pressure boundary | Carbon steel | Air/Gas<br>Raw water – city water | Loss of material | Fire Protection Program |
| Diesel driven fire pump fuel oil tank | Pressure boundary | Carbon steel | Fuel oil | None | None required |
| | | | Air/Gas | None | None required |
| Reactor coolant pump oil collection tanks | Pressure boundary | Carbon steel | Lubricating oil<br>Air/Gas | None | None required |
| Reactor coolant pump oil collection enclosures and drip pans | Pressure boundary | Stainless steel | Lubricating oil<br>Air/Gas | None | None required |
| Electric fire pump<br>Diesel fire pump | Pressure boundary | Cast iron | Raw water – city water | Loss of material | Fire Protection Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Diesel fire pump heat exchanger (radiator) shell | Pressure boundary | Cast iron | Treated water | Loss of material | Fire Protection Program |
| Diesel fire pump heat exchanger (radiator) tubes and cover | Pressure boundary<br>Heat transfer | Copper alloy | Raw water – city water | Loss of material<br>Fouling | Fire Protection Program |

# TABLE 3.4-14 (continued)
# FIRE PROTECTION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Basket strainers (body) | Pressure boundary | Cast iron | Raw water – city water | Loss of material | Fire Protection Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Basket strainers (elements) | Filtration | Stainless steel | Raw water – city water | Loss of material | Fire Protection Program |
| Valves Piping/fittings | Pressure boundary | Carbon steel | Raw water – city water | Loss of material | Fire Protection Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| | | | Air/Gas (associated with oil tanks) [1] | None | None required |
| | | | Air/Gas | Loss of material | Fire Protection Program |

NOTE: 1. Internal surfaces of oil tanks are exposed to a combination of oil and air/gas. The components have an oily film coating the surface.

# TABLE 3.4-14 (continued)
# FIRE PROTECTION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Piping/fittings | Pressure boundary | Carbon steel – galvanized | Raw water – city water | Loss of material | Fire Protection Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| | | | Air/Gas | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Cast iron | Raw water – city water | Loss of material | Fire Protection Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Valves | Pressure boundary | Cast iron | Air/Gas | Loss of material | Fire Protection Program |
| Valves<br>Tubing/fittings | Pressure boundary | Copper alloy | Raw water – city water | Loss of material | Fire Protection Program |
| | | | Air/Gas | None | None required |
| Sprinkler heads | Pressure boundary<br>Spray | Copper alloy | Air/Gas | None | None required |
| | | | Raw water – city water | Loss of material | Fire Protection Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Flexible hoses | Pressure boundary | Stainless steel | Raw water – city water | Loss of material | Fire Protection Program |

# TABLE 3.4-14 (continued)
# FIRE PROTECTION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Piping/fittings<br>Tubing/fittings<br>Flexible hoses | Pressure boundary | Stainless steel | Lubricating oil | None | None required |
| Flow restriction orifices | Pressure boundary<br>Throttling | Stainless steel | Raw water – city water | Loss of material | Fire Protection Program |
| Flame arrestors | Fire spread prevention | Carbon steel | Air/Gas | None | None required |

# TABLE 3.4-14 (continued)
# FIRE PROTECTION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Raw water tanks | Pressure boundary | Carbon steel | Outdoor | Loss of material | Fire Protection Program |
| Diesel driven fire pump fuel oil tank | Pressure boundary | Carbon steel | Outdoor | Loss of material | Fire Protection Program |
| Reactor coolant pump oil collection tank<br>Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Containment air | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Reactor coolant pump oil collection enclosures and drip pans | Pressure boundary | Stainless steel | Containment air | None | None required |
| Electric fire pump | Pressure boundary | Carbon steel<br>Cast iron | Outdoor | Loss of material | Fire Protection Program |
| Diesel fire pump | Pressure boundary | Carbon steel<br>Cast iron | Indoor – not air conditioned | Loss of material | Fire Protection Program |
| Diesel fire pump heat exchanger (radiator) shell | Pressure boundary | Cast iron | Indoor – not air conditioned | Loss of material | Fire Protection Program |
| Diesel fire pump heat exchanger (radiator) cover | Pressure boundary | Copper alloy | Indoor – not air conditioned | None | None required |

# TABLE 3.4-14 (continued)
# FIRE PROTECTION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Basket strainers (body) | Pressure boundary | Cast iron | Outdoor | Loss of material | Fire Protection Program |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Outdoor | Loss of material | Fire Protection Program |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Fire Protection Program |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Piping/fittings | Pressure boundary | Carbon steel – galvanized | Outdoor<br>Indoor – not air conditioned | None | None required |
| Valves<br>Piping/fittings | Pressure boundary | Cast iron | Outdoor | Loss of material | Fire Protection Program |
| Valves<br>Piping/fittings | Pressure boundary | Cast iron<br>Carbon steel | Buried | Loss of material | Fire Protection Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Flexible hoses | Pressure boundary | Stainless steel | Containment air<br>Indoor – not air conditioned<br>Outdoor | None | None required |
| Valves<br>Tubing/fittings | Pressure boundary | Copper alloy | Outdoor | None | None required |
| Sprinkler heads | Pressure boundary<br>Spray | Copper alloy | Outdoor | None | None required |

# TABLE 3.4-14 (continued)
# FIRE PROTECTION

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Flow restriction orifices | Pressure boundary<br>Throttling | Stainless steel | Outdoor | None | None required |
| Flame arrestors | Prevent spread of fire to fuel tank | Carbon steel | Outdoor | Loss of material | Fire Protection Program |
| Expansion joints | Pressure boundary | Rubber | Indoor – not air conditioned | Cracking | Fire Protection Program |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.4-15
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Air Intake and Exhaust System** | | | | | |
| **Internal Environment** | | | | | |
| Exhaust piping/ fittings<br>Silencers | Pressure boundary | Carbon steel | Air/Gas | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Air filter assemblies | Pressure boundary<br>Filtration | Carbon steel | Air/Gas | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Expansion joints | Pressure boundary | Stainless steel | Air/Gas | Cracking | Periodic Surveillance and Preventive Maintenance Program |
| Flexible couplings | Pressure boundary | Rubber | Air/Gas | Cracking | Periodic Surveillance and Preventive Maintenance Program |
| Tubing/fittings | Pressure boundary | Stainless steel | Air/Gas | None | None required |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Air Intake and Exhaust System (continued)** | | | | | |
| **External Environment** | | | | | |
| Exhaust piping/ fittings<br>Silencers | Pressure boundary | Carbon steel | Outdoor (Unit 3)<br>Indoor – not air conditioned (Units 3 and 4) | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Air filter assemblies | Pressure boundary<br>Filtration | Carbon steel | Indoor – not air conditioned | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Expansion joints | Pressure boundary | Stainless steel | Indoor – not air conditioned | Cracking | Periodic Surveillance and Preventive Maintenance Program |
| Flexible couplings | Pressure boundary | Rubber | Indoor – not air conditioned | Cracking | Periodic Surveillance and Preventive Maintenance Program |
| Tubing/fittings | Pressure boundary | Stainless steel | Indoor – not air conditioned | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Outdoor<br>Indoor – not air conditioned | None | None required |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Air Start System** | | | | | |
| **Internal Environment** | | | | | |
| Air start accumulators | Pressure boundary | Carbon steel<br>Stainless steel | Air/Gas | None | None required |
| Air start motors | Pressure boundary | Aluminum alloy | Air/Gas | None | None required |
| Air start system lubricators | Pressure boundary | Carbon steel | Air/Gas | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Governor bypasses | Pressure boundary | Carbon steel – galvanized<br>Carbon steel<br>Stainless steel<br>Copper alloy<br>Cast iron | Air/Gas | None | None required |
| Filters | Pressure boundary<br>Filtration | Stainless steel | Air/Gas | None | None required |
| Flexible hose | Pressure boundary | Rubber braided | Air/Gas | Cracking | Periodic Surveillance and Preventive Maintenance Program |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Air Start System (continued)** | | | | | |
| **External Environment** | | | | | |
| Air start accumulators | Pressure boundary | Carbon steel (Unit 3) | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | Stainless steel (Unit 4) | Indoor – not air conditioned | None | None required |
| Air start motors | Pressure boundary | Aluminum alloy | Indoor – not air conditioned | None | None required |
| Air start system lubricators | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Governor bypasses | Pressure boundary | Carbon steel<br>Cast iron | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | Carbon steel (galvanized)<br>Stainless steel<br>Copper alloy | Indoor – not air conditioned | None | None required |
| Filters | Pressure boundary<br>Filtration | Stainless steel | Indoor – not air conditioned | None | None required |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Air Start System (continued)** | | | | | |
| **External Environment (continued)** | | | | | |
| Flexible hoses | Pressure boundary | Rubber braided | Indoor – not air conditioned | Cracking | Periodic Surveillance and Preventive Maintenance Program |
| | | Stainless steel | Indoor – not air conditioned | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Indoor – not air conditioned | None | None required |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Fuel Oil System** | | | | | |
| **Internal Environment** | | | | | |
| Unit 3 Diesel Oil Storage Tank | Pressure boundary | Carbon steel | Fuel oil | Loss of material | Chemistry Control Program<br>Periodic Surveillance and Preventive Maintenance Program |
| | | | Air/Gas | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Unit 4 Diesel Oil Storage Tank (liner) | Pressure boundary | Carbon steel | Fuel oil | Loss of material | Chemistry Control Program<br>Periodic Surveillance and Preventive Maintenance Program |
| | | | Air/Gas | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Emergency diesel generator fuel oil pumps | Pressure boundary | Carbon steel<br>Cast iron | Fuel oil | Loss of material | Chemistry Control Program |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Fuel Oil System (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Diesel oil day tanks | Pressure boundary | Carbon steel | Fuel oil | Loss of material | Chemistry Control Program |
| | | | Air/Gas | None | None required |
| Diesel oil skid tanks | Pressure boundary | Carbon steel | Fuel oil | Loss of material | Chemistry Control Program |
| | | | Air/Gas | None | None required |
| Valves<br>Piping/fittings<br>Sight glasses | Pressure boundary | Carbon steel | Fuel oil | Loss of material | Chemistry Control Program |
| | | | Air/Gas | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Flex hoses<br>Filters<br>Sight glasses | Pressure boundary | Stainless steel | Fuel oil | Loss of material | Chemistry Control Program |
| | | | Air/Gas | None | None required |
| Tubing/fittings | Pressure boundary | Copper | Fuel oil | Loss of material | Chemistry Control Program |
| Filters | Pressure boundary<br>Filtration | Carbon steel<br>Cast iron<br>Stainless steel | Fuel oil | Loss of material | Chemistry Control Program |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Fuel Oil System (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Flame arrestors | Pressure boundary<br>Fire spread prevention | Carbon steel | Air/Gas | None | None required |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Fuel Oil System (continued)** | | | | | |
| **External Environment** | | | | | |
| Unit 3 Diesel Oil Storage Tank | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Unit 4 Diesel Oil Storage Tank (liner) | Pressure boundary | Carbon steel | Embedded/Encased | None | None required |
| Diesel oil day tanks | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Diesel oil skid tanks | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Emergency diesel generator fuel oil pumps | Pressure boundary | Carbon steel<br>Cast iron | Outdoor (Unit 3)<br>Indoor – not air conditioned (Unit 4) | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Carbon steel<br>Stainless steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>Piping/fittings<br>Sight glasses | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Fuel Oil System (continued)** | | | | | |
| **External Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Flex hoses<br>Filters<br>Sight glasses | Pressure boundary | Stainless steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Tubing/fittings | Pressure boundary | Copper | Indoor – not air conditioned | None | None required |
| Filters | Pressure boundary<br>Filtration | Carbon steel<br>Cast iron<br>Stainless steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Flame arrestors | Pressure boundary<br>Fire spread prevention | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Outdoor<br>Indoor – not air conditioned | None | None required |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Cooling Water System** | | | | | |
| **Internal Environment** | | | | | |
| Diesel generator cooling water expansion tanks | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| Diesel generator cooling water pumps | Pressure boundary | Cast iron | Treated water | Loss of material | Chemistry Control Program |
| Diesel generator cooling water immersion heaters | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |
| Radiator water boxes (Units 3 and 4) | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Unit 3 – Periodic Surveillance and Preventive Maintenance Program<br>Unit 4 – Galvanic Corrosion Susceptibility Inspection Program |
| Radiator tubes (Units 3 and 4) | Pressure boundary<br>Heat transfer | Copper alloy | Treated water | Loss of material<br>Fouling | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Cooling Water System (continued)** | | | | | |
| **Internal Environment (continued)** | | | | | |
| Tubing/fittings<br>Flexible hoses | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| Valves<br>Sight glasses | Pressure boundary | Copper alloy | Treated water | Loss of material | Chemistry Control Program |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Cooling Water System (continued)** | | | | | |
| **External Environment** | | | | | |
| Diesel generator cooling water expansion tanks | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Diesel generator cooling water pumps | Pressure boundary | Cast iron | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Diesel generator cooling water immersion heaters | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Radiator water boxes (Units 3 and 4) | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Radiator tubes (Unit 3) | Pressure boundary<br>Heat transfer | Copper alloy | Indoor – not air conditioned | Loss of material | Periodic Surveillance and Preventive Maintenance Program |
| Radiator tubes (Unit 4) | Pressure boundary<br>Heat transfer | Copper alloy | Indoor – not air conditioned | None [1] | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |

NOTE: 1. Precluded by design, Unit 4 radiators are substantially different from Unit 3 radiators.

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Cooling Water System (continued)** | | | | | |
| **External Environment (continued)** | | | | | |
| Tubing/fittings<br>Flexible hoses | Pressure boundary | Stainless steel | Indoor – not air conditioned | None | None required |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Indoor – not air conditioned | None | None required |
| Valves<br>Sight glasses | Pressure boundary | Copper alloy | Indoor – not air conditioned | None | None required |
| Flexible hoses | Pressure boundary | Rubber | Indoor – not air conditioned | Cracking | Systems and Structures Monitoring Program |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Indoor – not air conditioned | None | None required |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Lube Oil System** | | | | | |
| **Internal Environment** | | | | | |
| Diesel generator lube oil pumps | Pressure boundary | Carbon steel<br>Cast iron | Lubricating oil | None | None required |
| Heat exchanger shells | Pressure boundary | Carbon steel | Lubricating oil | None | None required |
| Heat exchanger tubing | Pressure boundary<br>Heat transfer | Red brass | Treated water (inside diameter) | Loss of material<br>Fouling | Chemistry Control Program |
| | | | Lubricating oil (outside diameter) | None | None Required |
| Heat exchanger channel heads | Pressure boundary | Cast iron | Treated water | Loss of material | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Flexible hoses<br>Sight glasses | Pressure boundary | Carbon steel<br>Cast iron | Lubricating oil | None | None required |
| Filters | Pressure boundary<br>Filtration | Carbon steel<br>Cast iron | Lubricating oil | None | None required |
| Tubing/fittings | Pressure boundary | Stainless steel | Lubricating oil | None | None required |
| Orifices | Pressure boundary<br>Throttling | Carbon steel<br>Stainless steel | Lubricating oil | None | None required |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Lube Oil System (continued)** | | | | | |
| **External Environment** | | | | | |
| Diesel generator lube oil pumps | Pressure boundary | Carbon steel<br>Cast iron | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Heat exchanger shells | Pressure boundary | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Heat exchanger channel heads | Pressure boundary | Cast iron | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Flexible hoses<br>Sight glasses | Pressure boundary | Carbon steel<br>Cast iron | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Filters | Pressure boundary<br>Filtration | Carbon steel<br>Cast iron | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| Tubing/fittings | Pressure boundary | Stainless steel | Indoor – not air conditioned | None | None required |
| Orifices | Pressure boundary<br>Throttling | Carbon steel | Indoor – not air conditioned | Loss of material | Systems and Structures Monitoring Program |
| | | Stainless steel | Indoor – not air conditioned | None | None required |

# TABLE 3.4-15 (continued)
# EMERGENCY DIESEL GENERATORS AND SUPPORT SYSTEMS

| Component/ Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Lube Oil System (continued)** | | | | | |
| **External Environment (continued)** | | | | | |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Indoor – not air conditioned | None | None required |

# 3.5 STEAM AND POWER CONVERSION SYSTEMS

The following systems are included in this section:

- Main Steam and Turbine Generators
- Feedwater and Blowdown
- Auxiliary Feedwater and Condensate Storage

Subsection 2.3.4 provides a description of these systems and identifies the components requiring an aging management review for license renewal. Appendix C contains the process that identified the aging effects requiring management for non-Class 1 components.

## 3.5.1 MATERIALS AND ENVIRONMENT

The Steam and Power Conversion Systems are exposed to internal environments of treated water - secondary, treated water, lubricating oil, and air/gas; and external environments of outdoor, containment air, buried, and potential borated water leaks (see Tables 3.0-1 and 3.0-2).

The only parts of systems or components considered to be inaccessible for inspection are those that are buried or embedded/encased in concrete. These environments are addressed as part of the aging management review process; see Table 3.0-2, "External Service Environments." Potential aging effects associated with these environments are reviewed and those aging effects requiring management are identified along with the credited aging management program(s). All other parts of systems and components can be accessed, if required. The only Steam and Power Conversion System containing inaccessible piping parts is the Standby Steam Generator Feedwater System, which contains sections of buried stainless steel piping.

The tanks, pumps, heat exchangers, piping, tubing, valves, and associated components and commodity groups for these systems are constructed of carbon steel, stainless steel, low alloy steel, cast iron, and brass. The components and commodity groups, their intended functions, the materials, and environments for the Steam and Power Conversion Systems are summarized in Tables 3.5-1 through 3.5-3.

## 3.5.2 AGING EFFECTS REQUIRING MANAGEMENT

The aging effects requiring management and the programs and activities that manage the aging effects for each applicable environment and material combination are provided in Tables 3.5-1 through 3.5-3. The aging effects requiring management for each system are summarized in the following paragraphs.

Main Steam and Turbine Generators - The aging effects requiring management are loss of material for carbon steel and stainless steel components, and cracking for certain stainless steel components and heat exchanger tubing. The aging effect requiring management for carbon steel mechanical closure bolting is loss of mechanical closure integrity.

Feedwater and Blowdown - The aging effects requiring management 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.

Auxiliary Feedwater and Condensate Storage - The aging effect requiring management is loss of material for cast iron, admiralty brass, carbon steel, low alloy steel, and stainless steel components.

## 3.5.3 OPERATING EXPERIENCE

### 3.5.3.1 INDUSTRY 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. The industry correspondence that was reviewed for operating experience related to Steam and Power Conversion Systems includes the following:

- NRC Bulletin 79-03, "Longitudinal Weld Defects in ASME SA-312 Type 304 Stainless Steel Pipe"
- NRC Bulletin 79-13, "Cracking in Feedwater System Piping"
- NRC Bulletin 82-02, "Degradation of Threaded Fasteners in the Reactor Coolant Pressure Boundary of PWR Plants"
- NRC Bulletin 87-01, "Thinning of Pipe Walls in Nuclear Power Plants"
- NRC Bulletin 89-02, "Stress Corrosion Cracking of High Hardness Type 410 Stainless Steel Internal Preloaded Bolting In Anchor Darling Model S530W Swing Check Valves or Valves of Similar Design"
- NRC Generic Letter 79-20, "Information Requested on PWR Feedwater Lines"
- NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants"
- NRC Generic Letter 88-14, "Instrument Air Supply System Problems Affecting Safety Related Equipment"
- NRC Generic Letter 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning"
- NRC Generic Letter 91-17, "Generic Safety Issue 29, Bolting Degradation or Failure in Nuclear Power Plants"
- NRC Information Notice 80-05, "Chloride Contamination of Safety Related Piping and Components"
- NRC Information Notice 80-29, "Broken Studs on Terry Turbine Steam Inlet Flanges"
- NRC Information Notice 81-04, "Cracking in Main Steam Lines"

- NRC Information Notice 84-32, "Auxiliary Feedwater Sparger and Pipe Hanger Damage"
- NRC Information Notice 84-87, "Piping Thermal Deflection Induced by Stratified Flow"
- NRC Information Notice 85-56, "Inadequate Environment Control for Components and Systems in Extended Storage"
- NRC Information Notice 86-106, "Feedwater Line Break"
- NRC Information Notice 87-28, "Air Systems Problems at U.S. Light Water Reactors"
- NRC Information Notice 87-36, "Significant Unexpected Erosion of Feedwater Lines"
- NRC Information Notice 88-17, "Summary of Responses to NRC Bulletin 87-01, Thinning of Pipe Walls in Nuclear Power Plants"
- NRC Information Notice 88-37, Flow Blockage of Cooling Water to Safety System Components"
- NRC Information Notice 89-01, "Valve Body Erosion"
- NRC Information Notice 89-53, "Rupture of Extraction Steam Line on High Pressure Turbine"
- NRC Information Notice 89-76, "Biofouling Agent: Zebra Mussel"
- NRC Information Notice 89-80, "Potential for Water Hammer, Thermal Stratification, and Steam Binding in High-Pressure Coolant Injection Piping"
- NRC Information Notice 90-65, "Recent Orifice Plate Problems"
- NRC Information Notice 91-18, "High-Energy Piping Failures Caused by Wall Thinning"
- NRC Information Notice 91-19, "Steam Generators Feedwater Distribution Piping Damage"
- NRC Information Notice 91-28, "Cracking in Feedwater System Piping"
- NRC Information Notice 91-38, "Thermal Stratification in Feedwater System Piping"
- NRC Information Notice 92-07, "Rapid Flow-Induced Erosion/Corrosion of Feedwater Piping"

- NRC Information Notice 93-20, "Thermal Fatigue Cracking of Feedwater Piping to Steam Generators"
- NRC Information Notice 93-21, "Summary of Observations Compiled During Engineering Audits or Inspections of Licensee Erosion/Corrosion Programs"
- NRC Information Notice 94-59, "Accelerated Dealloying of Cast Aluminum-Bronze Valves Caused by Microbiologically Induced Corrosion"
- NRC Information Notice 94-79, "Microbiologically Influenced Corrosion of Emergency Diesel Generator Service Water Piping"
- NRC Information Notice 95-11, "Failure of Condensate Piping Because of Erosion/Corrosion at a Flow-Straightening Device"
- NRC Information Notice 99-19, "Rupture of the Shell Side of a Feedwater Heater at the Point Beach Plant"

No aging effects requiring management were identified from the above documents beyond those already identified in Subsection 3.5.2.

### 3.5.3.2 PLANT-SPECIFIC EXPERIENCE

Turkey Point Units 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 and Power Conversion Systems component aging, in addition to interviews with responsible engineering personnel. No aging effects requiring management were identified from this review beyond those identified in Subsection 3.5.2.

## 3.5.4 CONCLUSION

The review of industry information, NRC generic communications, and Turkey Point Units 3 and 4 operating experience identified no additional aging effects beyond those discussed in Subsection 3.5.2. Tables 3.5-1 through 3.5-3 contain the results of the aging management review for the Steam and Power Conversion Systems and summarize the aging effects requiring management.

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

- 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

Based on the evaluations provided in Appendix B for the programs listed above, aging effects are adequately managed so that the intended functions of the Steam and Power Conversion Systems components listed in Tables 3.5-1 through 3.5-3 are maintained consistent with the current licensing basis for the period of extended operation.

# TABLE 3.5-1
# MAIN STEAM AND TURBINE GENERATORS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Unit 4 Main Steam Isolation Valve instrument air accumulator tanks | Pressure boundary | Carbon steel | Air/Gas | None | None required |
| Main process piping:<br>Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Treated water - secondary | Loss of material | Chemistry Control Program<br>Flow Accelerated Corrosion Program |
| Steam traps:<br>Valves<br>Piping/fittings<br>Steam traps | Pressure boundary | Carbon steel | Treated water - secondary | Loss of material | Chemistry Control Program<br>Flow Accelerated Corrosion Program |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Treated water - secondary | Loss of material<br>Cracking | Chemistry Control Program |
| Valves<br>Tubing/fittings<br>Filters<br>Flex hoses<br>Rupture disks | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Instrument air 3-way valves | Pressure boundary | Brass | Air/Gas | None | None required |
| Flow elements | Pressure boundary<br>Throttling | Carbon steel | Treated water - secondary | Loss of material | Chemistry Control Program |

# TABLE 3.5-1 (continued)
# MAIN STEAM AND TURBINE GENERATORS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Unit 4 Main Steam Isolation Valve instrument air accumulator tanks | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Main process piping:<br>Valves<br>Piping/fittings | Pressure boundary | Carbon steel | Containment air Outdoor | None[1] | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Steam traps:<br>Valves<br>Steam traps<br>Piping/fittings | Pressure boundary | Carbon steel | Outdoor | Loss of material | Flow Accelerated Corrosion Program[2] |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Containment air | None | None required |
| Valves<br>Tubing/fittings<br>Filters<br>Flex hoses<br>Rupture disks | Pressure boundary | Stainless steel | Outdoor | None | None required |
| Instrument air 3-way valves | Pressure boundary | Brass | Outdoor | None | None required |

NOTES: 1. Carbon steel components that normally operate at high temperatures are not susceptible to loss of material.
2. Flow Accelerated Corrosion Program addresses external general corrosion via use of radiographic examinations.

# TABLE 3.5-1 (continued)
# MAIN STEAM AND TURBINE GENERATORS

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Flow elements | Pressure boundary<br>Throttling | Carbon steel | Containment air Outdoor | None[1] | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

NOTE: 1. Carbon steel components that normally operate at high temperatures are not susceptible to loss of material.

# TABLE 3.5-2
# FEEDWATER AND BLOWDOWN

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Demineralized water storage tank | Pressure boundary | Carbon steel | Air/Gas | Loss of material | Field Erected Tanks Internal Inspection |
| | | | Treated water | Loss of material | Chemistry Control Program<br>Field Erected Tanks Internal Inspection |
| Standby steam generator feedwater pumps | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| #6 Feedwater heater shells, tube sheets, and covers | Pressure boundary | Carbon steel | Treated water - secondary | Loss of material | Chemistry Control Program<br>Flow Accelerated Corrosion Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| #6 Feedwater heater tubes[1] | Pressure boundary | Stainless steel | Treated water - secondary (inside and outside diameters) | Loss of material<br>Cracking | Chemistry Control Program |

NOTE: 1. Heat transfer is not a license renewal intended function for this component.

# TABLE 3.5-2 (continued)
# FEEDWATER AND BLOWDOWN

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>(main feedwater and blowdown) | Pressure boundary | Carbon steel | Treated water - secondary | Loss of material | Chemistry Control Program<br>Flow Accelerated Corrosion Program<br>Galvanic Corrosion Susceptibility Inspection Program |
| Tubing/fittings<br>Thermowells<br>(feedwater) | Pressure boundary | Stainless Steel | Treated water – secondary | Loss of material<br>Cracking | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Thermowells<br>(blowdown) | Pressure boundary | Stainless steel | Treated water - secondary | Loss of material<br>Cracking | Chemistry Control Program |
| Instrument air solenoid valves | Pressure boundary | Brass | Air/Gas | None | None required |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Treated water - secondary | Loss of material<br>Cracking | Chemistry Control Program |
| Strainers | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |

# TABLE 3.5-2 (continued)
# FEEDWATER AND BLOWDOWN

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>(standby steam generator feedwater pump suction) | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |
| Orifices | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |

# TABLE 3.5-2 (continued)
# FEEDWATER AND BLOWDOWN

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Demineralized water storage tank | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Standby steam generator feedwater pumps | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| #6 Feedwater heater shells and covers | Pressure boundary | Carbon steel | Outdoor | None[1] | None required |
| Valves Piping/fittings (main feedwater and blowdown) | Pressure boundary | Carbon steel | Containment air | None[1] | None required |
| | | | Borated water leaks | Loss of material | Boric Acid Wastage Surveillance Program |
| Tubing/fittings | Pressure boundary | Stainless steel | Containment air | None | None required |
| Valves Piping/fittings (from standby steam generator feedwater pumps to main feedwater piping) | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |

NOTE: 1. Carbon steel components that normally operate at high temperatures are not susceptible to loss of material.

# TABLE 3.5-2 (continued)
# FEEDWATER AND BLOWDOWN

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>(main feedwater and blowdown) | Pressure boundary | Carbon steel | Outdoor<br>Indoor – not air-conditioned | None[1] | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Thermowells<br>(blowdown) | Pressure boundary | Stainless steel | Outdoor<br>Indoor – not air-conditioned | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Strainers<br>(standby steam generator feedwater pump suction) | Pressure boundary | Stainless steel | Outdoor | Loss of material<br>Cracking[2] | Systems and Structures Monitoring Program |
| Piping<br>(standby steam generator feedwater pump suction) | Pressure boundary | Stainless steel | Buried | None | None required |

NOTES: 1. Carbon steel components that normally operate at high temperatures are not susceptible to loss of material.
2. Plant experience has identified the potential for cracking in non-stress relieved heat affected zones of weld joints for this piping.

# TABLE 3.5-2 (continued)
# FEEDWATER AND BLOWDOWN

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Instrument air solenoid valves | Pressure boundary | Brass | Outdoor | None | None required |
| Orifices | Pressure boundary<br>Throttling | Stainless steel | Outdoor | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Borated water leaks | Loss of mechanical closure integrity | Boric Acid Wastage Surveillance Program |

# TABLE 3.5-3
# AUXILIARY FEEDWATER AND CONDENSATE STORAGE

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment** | | | | | |
| Condensate storage tanks | Pressure boundary | Carbon steel | Air/Gas | Loss of material | Field Erected Tanks Internal Inspection |
| | | | Treated water | Loss of material | Chemistry Control Program<br>Field Erected Tanks Internal Inspection |
| Auxiliary feedwater pumps | Pressure boundary | Low alloy steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program[1] |
| Auxiliary feedwater pump turbine casings | Pressure boundary | Carbon steel | Treated water - secondary<br>Air/Gas | Loss of material | Auxiliary Feedwater Steam Piping Inspection Program |
| Auxiliary feedwater pump lube oil cooler and governor oil cooler tube sheets | Pressure boundary | Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program[1] |
| | | | Lubricating oil | None | None required |

NOTE: 1. Galvanic corrosion only at carbon steel contact points with stainless steel, brass, and low alloy steel for these components.

# TABLE 3.5-3 (continued)
# AUXILIARY FEEDWATER AND CONDENSATE STORAGE

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Auxiliary feedwater pump lube oil cooler and governor oil cooler channels and covers | Pressure boundary | Cast iron | Treated water | Loss of material | Chemistry Control Program<br>Auxiliary Feedwater Pump Oil Coolers Inspection |
| Auxiliary feedwater pump lube oil cooler and governor oil cooler shells<br>Lube oil pump casings<br>Lube oil reservoirs<br>Piping/fittings | Pressure boundary | Carbon steel | Lubricating oil | None | None required |
| Auxiliary feedwater pump lube oil cooler and governor oil cooler tube bundles | Pressure boundary<br>Heat transfer | Admiralty brass<br>Stainless steel | Treated water (inside diameter) | Loss of material | Chemistry Control Program |
| | | | Lubricating oil (outside diameter) | None | None required |
| Valves<br>Piping/fittings<br>Tubing/fittings | Pressure boundary | Stainless steel | Treated water | Loss of material | Chemistry Control Program |

# TABLE 3.5-3 (continued)
# AUXILIARY FEEDWATER AND CONDENSATE STORAGE

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **Internal Environment (continued)** | | | | | |
| Valves<br>Piping/fittings | Pressure boundary | Carbon steel<br>Low alloy steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program[1] |
| Valves<br>Piping/ fittings<br>Steam traps | Pressure boundary | Carbon steel | Treated water - secondary<br>Air/Gas | Loss of material | Auxiliary Feedwater Steam Piping Inspection Program |
| Valves<br>Piping/fittings (upstream of MOVs 3/4 1403, 1404, and 1405 | Pressure boundary | Carbon steel | Treated water - secondary | Loss of material | Chemistry Control Program |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Flex hoses<br>Rupture disks | Pressure boundary | Stainless steel | Air/Gas | None | None required |
| Orifices | Pressure boundary<br>Throttling | Stainless steel<br>Carbon steel | Treated water | Loss of material | Chemistry Control Program<br>Galvanic Corrosion Susceptibility Inspection Program[1] |

NOTE: 1. Galvanic corrosion only at carbon steel contact points with stainless steel, brass, and low alloy steel for these components.

# TABLE 3.5-3 (continued)
# AUXILIARY FEEDWATER AND CONDENSATE STORAGE

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment** | | | | | |
| Condensate storage tanks | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Auxiliary feedwater pumps | Pressure boundary | Low alloy steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Auxiliary feedwater pump turbine casings | Pressure boundary | Carbon steel | Outdoor | Loss of material | Auxiliary Feedwater Steam Piping Inspection Program |
| Auxiliary feedwater pump lube oil cooler and governor oil cooler shells and channels | Pressure boundary | Carbon steel<br>Cast iron | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>Piping/fittings<br>Steam traps<br>(non-insulated) | Pressure boundary | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| Valves<br>Piping/fittings<br>(insulated) | Pressure boundary | Carbon steel | Outdoor | Loss of material | Auxiliary Feedwater Steam Piping Inspection Program |

# TABLE 3.5-3 (continued)
# AUXILIARY FEEDWATER AND CONDENSATE STORAGE

| Component / Commodity Group | Intended Function | Material | Environment | Aging Effects Requiring Management | Program/Activity |
|---|---|---|---|---|---|
| **External Environment (continued)** | | | | | |
| Valves<br>Piping/fittings<br>Tubing/fittings<br>Orifices<br>Rupture disks<br>Flex hoses | Pressure boundary | Stainless steel | Outdoor | None | None required |
| Orifices | Pressure boundary<br>Throttling | Carbon steel | Outdoor | Loss of material | Systems and Structures Monitoring Program |
| | | Stainless steel | Outdoor | None | None required |
| Bolting (mechanical closures) | Pressure boundary | Carbon steel | Outdoor | None | None required |